VR-Forces

Scenario Management Guide

VT MÄK
A company of VT Systems

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Preface

This manual is written for persons who will use the VR-Forces application. The manual assumes that you are familiar with your operating system and that you know how to work in your computer's graphical window environment.

Please see release documentation for information about changes and updates to VR-Forces since this manual went to press.

How This Manual is Organized

The chapters are organized as follows:

Chapter 1, *Creating and Running Scenarios*, explains how to create and run scenarios, how to create batch scenarios and how to checkpoint scenarios.

Chapter 2, *Creating and Placing Objects*, explains describes the common procedures for creating entities, tactical graphics, and props.

Chapter 3, *Creating and Managing Entities*, explainsthe fine points of creating entities. It also covers embarkation and collision avoidance.

Chapter 4, *Working with Aggregate Entities*, explains how to create and edit aggregate entities.

Chapter 5, *Overlays and Tactical Graphics* describes the creation and use of overlays, how to create tactical graphics other than points, lines, and areas, and how to edit tactical graphics.

Chapter 6, *Assigning Tasks*, provides general information about assigning tasks and creating behavior sets..

Chapter 7, *Task Procedures*, describes the tasks provided with VR-Forces.

Chapter 8, *Setting Entity State*, describes how to assign set data requests to entities.

Chapter 9, *Writing Plans* explains how to write plans for entities and how to write global plans.

Chapter 10, *Target Detection and Combat Features*, describes spot reports, laser targeting, entity hostility, and how entities take damage.

Chapter 11, *Managing Indirect Fire and Missiles*, explains how to configure and call in indirect fire.

Chapter 12, *Environment Conditions*, describes how to manipulate the time of day and weather conditions.

Chapter 13, *Creating Scripted Tasks*, introduces scripted tasks and explains how to create them. It does not cover how to write scripts for scripted tasks.

Chapter 14, *Writing Scripts for Scripted Tasks*, introduces the Lua script API for VR-Forces and explains how to write scripts for scripted tasks.

Appendix A, *Example Scenarios* walks you through the process of creating two of the sample scenarios provided with VR-Forces.

Appendix B, *Merging Scenarios* explains how to use the Scenario Merge tool to merge scenarios.

Appendix C, *Systems and System Usage* lists all the systems provided with VR-Forces and provides information about them, including which entities use them..

VR-Forces Documentation

VR-Forces documentation is provided as manuals in PDF format, online help, and HTML class documentation. The PDF files are in the *./doc* directory. The VR-Forces documentation set is as follows:

- *VR-Forces Documentation Center* is your central starting point for accessing the VR-Forces manual set. It has a documentation roadmap, tables of contents for all manuals, and a master index, including the TDB Tool, to help you find references to subjects that are covered in two or more manuals or locate the manual in which a particular topic is discussed. All table of contents entries and index entries are live links to the manuals.
- *VR-Forces Getting Started Guide* is a quick introduction to VR-Forces. It covers the basics of installing VR-Forces, running a scenario, and creating a scenario. It focuses on helping new users avoid common mistakes.
- *VR-Forces Users Guide* describes how to install VR-Forces and configure license management. It explains how to use the VR-Forces graphical user interface to view simulations and how to manage aspects of VR-Forces that are not directly related to creating and running scenarios.
- *VR-Forces Scenario Management Guide* explains how to create and run scenarios.
- *VR-Forces Configuration Guide* explains advanced features for configuring performance and how to edit VR-Forces configuration files. It includes documentation of the Entity Editor, OPD Editor, and Scenario Merge tools. It also explains how to compose terrains and configure 3D models.
- *VR-Forces Migration Guide* collates API migration information for recent releases.
- Online help. The VR-Forces front-end, the OPD Editor, the Entity Editor, and the TDB Tool have online help accessible from the Help menu.
- VR-Forces Developers Guide and API documentation. Class documentation and developers guides in linked HTML pages.
- *VR-Forces Release Notes*.
- VR-Forces First Experience Guide. A brief introduction to the most basic features of VR-Forces. Provides less detail than *VR-Forces Getting Started Guide*.
- VR-Forces *Entity Model Catalog*. A catalog of all of the entities configured in the Entity Editor with basic parameter details and a screen capture of the model.

MÄK Products

VR-Forces is a member of the VT MÄK line of software products designed to streamline the process of developing and using networked simulated environments. The VT MÄK product line includes the following:

- VR-Link® Network Toolkit. VR-Link is an object-oriented library of C++ functions and definitions that implement the High Level Architecture (HLA) and the Distributed Interactive Simulation (DIS) protocol. VR-Link has built-in support for the RPR FOM and allows you to map to other FOMs. This library minimizes the time and effort required to build and maintain new HLA or DIS-compliant applications, and to integrate such compliance into existing applications.

  VR-Link includes a set of sample debugging applications and their source code. The source code serves as an example of how to use the VR-Link Toolkit to write applications. The executables provide valuable debugging services such as generating a predictable stream of HLA or DIS messages, and displaying the contents of messages transmitted on the network.

- MÄK RTI. An RTI (Run-Time Infrastructure) is required to run applications using the High Level Architecture (HLA). The MÄK RTI is optimized for high performance. It has an API, RTIspy®, that allows you to extend the RTI using plug-in modules. It also has a graphical user interface (the RTI Assistant) that helps users with configuration tasks and managing federates and federations.
- VR-Forces®. VR-Forces is a computer generated forces application and toolkit. It provides an application with a GUI, that gives you a 2D and 3D views of a simulated environment.

  You can create and view local entities, aggregate them into hierarchical units, assign tasks, set state parameters, and create plans that have tasks, set statements, and conditional statements. VR-Forces also functions as a plan view display for viewing remote entities taking part in an exercise. Using the toolkit, you can extend the VR-Forces application or create your own application for use with another user interface.

- VR-Vantage™. VR-Vantage is a line of products designed to meet your simulation visualization needs. It includes three end-user applications (VR-Vantage Stealth, VR-Vantage PVD, and VR-Vantage IG) and the VR-Vantage Toolkit.
  - VR-Vantage Stealth displays a realistic, 3D view of your virtual world, a 2D plan view, and an exaggerated reality (XR) view. Together these views provide both situational awareness and the big picture of the simulated world. You can move your viewpoint to any location in the 3D world and can attach it to entities so that it moves as they do.
  - VR-Vantage IG is a configurable desktop image generator (IG) for out the window (OTW) scenes and remote camera views. It has most of the features of the Stealth, but is optimized for its IG function.
  - VR-Vantage PVD provides a 2D plan view display. It gives you the big picture of the simulated world.

  - The VR-Vantage Toolkit is a 3D visual application development toolkit. Use it to customize or extend MÄK's VR-Vantage applications, or to integrate VR-Vantage capabilities into your custom applications. VR-Vantage is built on top of OpenSceneGraph (OSG). The toolkit includes the OSG version used to build VR-Vantage.

- MÄK Data Logger. The Data Logger, also called the Logger, can record HLA and DIS exercises and play them back for after-action review. You can play a recorded file at speeds above or below normal and can quickly jump to areas of interest. The Logger has a GUI and a text interface. The Logger API allows you to extend the Logger using plug-in modules or embed the Logger into your own application. The Logger editing features let you merge, trim, and offset Logger recordings.
- VR-Exchange™. VR-Exchange allows simulations that use incompatible communications protocols to interoperate. For example, within the HLA world, using VR-Exchange, federations using the HLA RPR FOM 1.0 can interoperate with simulations using RPR FOM 2.0, or federations using different RTIs can interoperate. VR-Exchange supports HLA, TENA, and DIS translation.
- VR-TheWorld™ Server. VR-TheWorld Server is a simple, yet powerful, web-based streaming terrain server, developed in conjunction with Pelican Mapping. Delivered with a global base map, you can also easily populate it with your own custom source data through a web-based interface. The server can be deployed on private, classified networks to provide streaming terrain data to a variety of simulation and visualization applications behind your firewall.
- VR-inTerra. VR-inTerra is a C++ API for adding terrain agility to applications. It can load, page, or stream terrain from a wide variety of formats or sources into a single, consistent run-time representation, consisting of a collision graph and vector network.

How to Contact Us

For VR-Forces technical support, information about upgrades, and information about other MÄK products, you can contact us in the following ways:

Telephone

Call or fax us at:	Voice:	617-876-8085 (extension 3 for support)
	Fax:	617-876-9208

E-mail

Sales and upgrade information:	info@mak.com
Technical support:	support@mak.com
VR-Vantage support:	vrv-support@mak.com

Internet

MÄK web site home page:	www.mak.com
License key requests:	www.mak.com/support/get-licenses.html
Product version and platform information:	www.mak.com/support/product-versions.html
For the free, unlicensed MÄK RTI:	www.mak.com/resources/bonus-material/cat_view/16-bonus-materials/24-mak-high-performance-rti.html
MÄK Community Forum:	www.mak.com/community-forum/1-forum.html

Post

Send postal correspondence to:	VT MÄK 150 Cambridge Park Drive, 3rd Floor Cambridge, MA, USA 02140

When requesting support, please tell us the product you are using, the version, and the platform on which you are running.

Document Conventions

This manual uses the following typographic conventions:

`Monospaced`	Indicates commands or values you enter.
`Monospaced Bold`	Indicates a key on the keyboard.
`Monospaced Italic`	Indicates command variables that you replace with appropriate values.
Blue text	A hypertext link to another location in this manual or another manual in the documentation set.
`{ }`	Indicates required arguments.
`[ ]`	Indicates optional arguments.
|	Separates options in a command where only one option may be chosen at a time.
`( | )`	In command syntax, indicates equivalent alternatives for a command-line option, for example, `(-h | --help)`.
/	Indicates a directory. Since MÄK products run on both Linux and Windows PC platforms, we use the / (slash) for generic discussions of pathnames. If you are running on a PC, substitute a \ (backslash) when you type pathnames.
Italic	Indicates a file name, pathname, or a class name.
sans Serif	Indicates a parameter or argument.
➤	Indicates a one-step procedure.
Menu → Option	Indicates a menu choice. For example, an instruction to select the Save option from the File menu appears as: Choose **File → Save**.
	Click the icon to run a tutorial video in the default browser.
	Indicates supplemental or clarifying information.
	Indicates additional information that you must observe to ensure the success of a procedure or other task.

Directory names are preceded with dot and slash characters that show their position with respect to the VR-Forces home directory. For example, the directory *vrforces4.2/doc* appears in the text as *./doc*.

Mouse Button Naming Conventions

An instruction to click the mouse button, refers to clicking the primary mouse button, usually the left button for right-handed mice and the right button for left-handed mice. The context-sensitive menu, also called a popup menu or right-click menu, refers to the menu displayed when you click the secondary mouse button, usually the right button on right-handed mice and the left button on left-handed mice.

Third Party Licenses

MÄK software products may use code from third parties. This section contains the license documentation required by these third parties.

Boost License

VR-Link, and all MÄK software that uses VR-Link uses some code that is distributed under the Boost License. All header files that contain Boost code are properly attributed. The Boost web site is: www.boost.org.

Boost Software License - Version 1.0 - August 17th, 2003

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The copyright notices in the Software and this entire statement, including the above license grant, this restriction and the following disclaimer, must be included in all copies of the Software, in whole or in part, and all derivative works of the Software, unless such copies or derivative works are solely in the form of machine-executable object code generated by a source language processor.

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libXML and libICONV

VR-Link and all MÄK software that uses VR-Link, links in libXML and libICONV. On some platforms the compiled libraries and header files are distributed with MÄK Products. MÄK has made no modifications to these libraries. For more information about these libraries please see the following web sites:

- The LGPL license is available at: http://www.gnu.org/licenses/lgpl.html
- Information about IconV is at: http://www.gnu.org/software/libiconv/
- Information about LibXML is at: http://xmlsoft.org/

Lua

VR-Forces uses the Lua programming language (www.lua.org). Its license is as follows:

Freefont OpenType Font Set

VR-Vantage applications and VR-Forces use the Freefont OpenType font set from the Free Software Foundation. It is covered by the General Public License (GPL). For details, please see: http://www.gnu.org/licenses/gpl.html

Third-Party Licenses for VR-Vantage Applications

VR-Vantage applications use a variety of third-party libraries. Developers who want to use these libraries may be required to purchase developer's licenses. Please see section 1.2 in *VR-Forces Front-End Developers Guide* for details.

1

Creating and Running Scenarios

This chapter explains how to create, load, run, and save scenarios.

1.1. Creating a Scenario

To use VR-Forces to simulate entities, you must load a scenario or create a new one. When you first start VR-Forces, the Startup Screen asks you if you want to create or load a scenario (unless you have disabled this feature). Thereafter, to create a scenario, use the procedure in this section. (For details about the Startup Screen, please see Section 5.1.1, "Starting VR-Forces from the VR-Forces Launcher," in *VR-Forces Users Guide*.)

If you are using multiple front-ends in the same session, when one of them creates a scenario, the terrains in all other front-ends are closed (unless the terrain is the same as that for the new scenario) and the terrain for the new scenario is loaded.

To create a scenario:

1. Choose **File** → **New Scenario**, or click the New Scenario button () on the File toolbar. The Choose Simulation Terrain dialog box opens (Figure 1-1). By default, it opens in *./userData/terrains*, the directory that contains the terrain files shipped with VR-Forces. (For a brief description of the databases supplied with VR-Forces, please see Section 18.8, "Terrain Databases Provided with VR-Forces," in *VR-Forces Users Guide*. For details about terrain files, please see Section 3.11, "Terrain Databases," in *VR-Forces Users Guide*.)

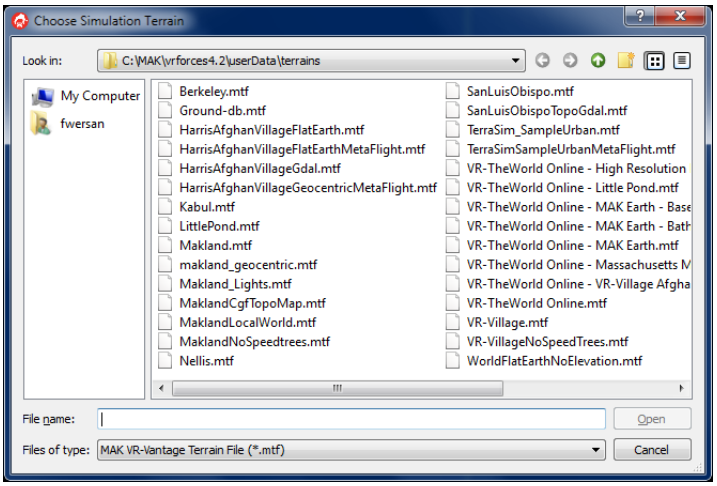
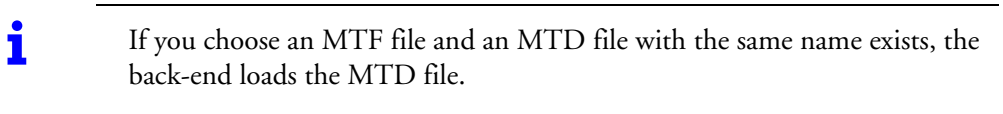


Figure 1-1. Select Simulation Database dialog box

2. In the file list, select a terrain database. (MTF is the preferred file type.) A database must be a flat earth, geocentric, UTM, or Lambert Conformal Conic database. By default, this terrain is used for both the front-end and back-end.



If you choose an MTF file and an MTD file with the same name exists, the back-end loads the MTD file.

3. Click Open. The New Scenario dialog box opens (Figure 1-2).

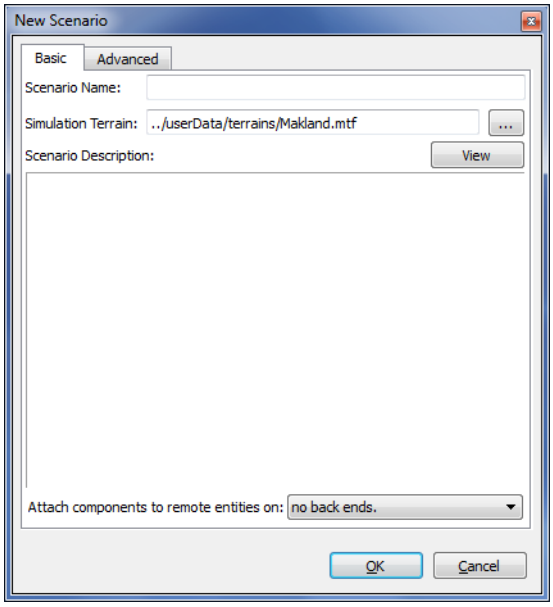


Figure 1-2. New Scenario dialog box

4. Optionally, set basic scenario parameters. Table 1-2 describes the basic parameters.

Table 1-1: Basic scenario parameters

Parameter	Description
Scenario Name	Specifies the name of the scenario. This is the name used to identify the scenario when you join a session. If you do not specify a name, the scenario file name is used.
Simulation Terrain	Specifies the terrain to be used by the back-end. By default, this is the terrain you selected in the Choose Simulation Terrain dialog box. However, you can change it if you want to.
Scenario Description	The scenario description lets you provide a descripion of the scenario. This may be useful to remind you or other VR-Forces users of its purpose or special details. You can enter the description as plain text or as HTML. If you use HTML, when the description is displayed in the Scenario Information dialog box, it is displayed using the HTML formatting.
Attach Components to Remote Entities On	Specifies whether or not to attach components to remote entities, and if so, the back-ends on which to manage the components that are being attached to remote entities. Unlike other scenario parameters, you can change this value when you load a scenario. For details about configuring components for attachment to remote entities, please see Section 7.12, "Configuring VR-Forces Components on Remote Entities," in *VR-Forces Configuration Guide*. ! This value is not saved in the scenario file. To attach components in future runs of the scenario, you must specify the appropriate setting each time you load the scenario.

For more information about these parameters, please see Section 3.2.1, "Scenario Parameters," in *VR-Forces Configuration Guide*.

5. Optionally, select the Advanced tab (Figure 1-3) and set advanced scenario parameters (overriding the default settings).

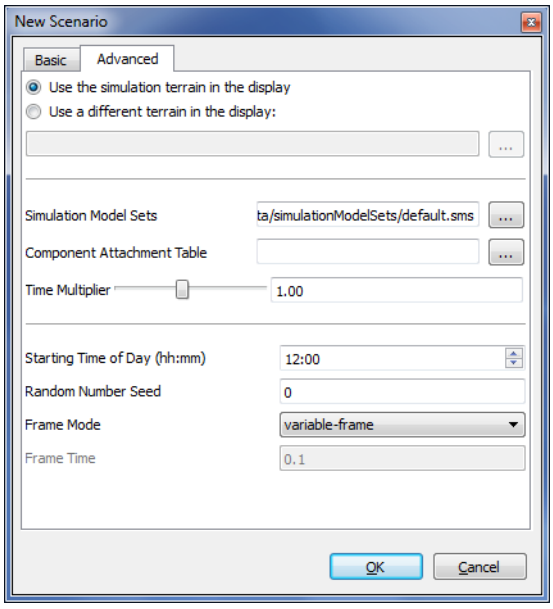


Figure 1-3. New Scenario dialog box, Advanced tab

Table 1-2 describes the parameters you can set.

Table 1-2: Advanced scenario parameters

Parameter	Description
Use the Simulation Terrain in the Display	If selected (the default), the scenario uses the same terrain for the front-end and back-end.
Use a Different Terrain for the Display	If selected, lets you specify the terrain to be used by the front-end.
Simulation Model Sets	Specify one or more simulation model sets. A scenario must specify at least one simulation model set. For more information, please see "Specifying Multiple Simulation Model Sets," on page 1-8. Default: *default.sms*.
Component Attachment Table	If you plan to attach components to remote entities, specify the component attachment table that you want to use. For details about configuring components for attachment to remote entities, please see Section 7.12, "Configuring VR-Forces Components on Remote Entities," in *VR-Forces Configuration Guide*.
Time Multiplier	Specify a time multiplier for the scenario. For HLA time-managed federations, this parameter is ignored. Default: 1.0 (real-time).
Starting Time of Day	Specify the time of day at which the simulation should start. As time advances, the Time of Day toolbar will change coloration. In 3D, the sky coloration also changes as time advances.

Table 1-2: Advanced scenario parameters

Parameter	Description
Random Number Seed	Specify a random number seed as an integer > = 0.
Frame Mode	Select a frame mode from the list.
Frame Time	Specifies the length of a frame, in seconds. This parameter is not enabled if Frame Mode is variable-frame.

For more information about these parameters, please see:

- Section 3.13.1, "Simulation Time," in *VR-Forces Users Guide*.
- Section 3.13.3, "Exercise Clock Modes," in *VR-Forces Users Guide*.
- Section 3.2.1, "Scenario Parameters," in *VR-Forces Configuration Guide*.

6. Click OK. The scenario information is displayed and the terrain is displayed in the 2D view.
7. Add the entities and graphical objects that you need for your simulation. For information about adding entities and tactical graphics, please see Chapter 2, *Creating and Placing Objects*.
8. Save the scenario. For details about saving scenarios, please see "Saving a Scenario," on page 1-18.

1.1.1. Specifying Multiple Simulation Model Sets

You can specify more than one simulation model set for a scenario. One strategy for extending VR-Forces is to use the default SMS for the majority of objects and to create a separate SMS for customized entities. As you upgrade to newer versions of VR-Forces, you can more easily migrate your customized SMS to the new version because your changes have not been integrated into the default SMS.

To specify multiple simulation model sets for a scenario:

1. In the New Scenario dialog box, click the Browse button on the Simulation Model Set line. The Simulation Model Set Files dialog box opens. It lists the SMS files to be loaded for this scenario.

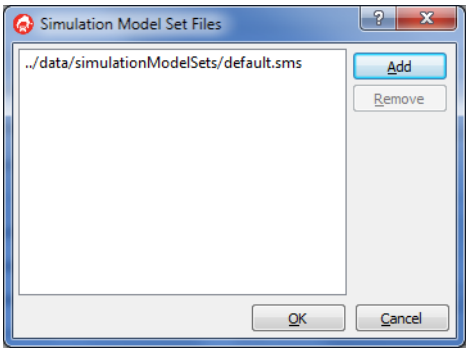


Figure 1-4. Simulation Model Set Files dialog box

2. In the The Simulation Model Set Files dialog box, click Add. A blank line is added to the window (Figure 1-5).

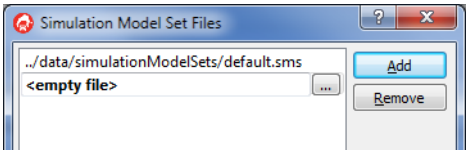


Figure 1-5. Add simulation model set

3. Click the Browse button next to the blank line. The Choose File dialog box opens.
4. Select a simulation model set and click Open. The SMS is added to the text box.
5. Click OK.
6. Complete the New Scenario dialog box.

1.1.2. Merging Scenarios

VR-Forces users often assign scenario development to multiple persons or teams. Then they merge the separately-developed scenarios into a master scenario. Merging scenarios by hand can be a difficult task due to the requirement to reconcile entity and object names, plans, and other scenario elements that could be duplicated, particularly if objects are named using the default conventions. VR-Forces includes an offline tool, Scenario Merge, for merging scenarios. For details, please see Appendix B, *Merging Scenarios*.

1.1.3. Importing and Exporting MSDL

Military Scenario Definition Language (MSDL) is a SISO standard for describing military scenarios using an XML format. It allows for interchange of scenario descriptions between simulation applications and systems that use different internal formats. You can import MSDL files into a VR-Forces scenario.

VR-Forces does not import all of the information that can be in an MSDL file. It imports and exports:

- Entities and entity locations. Locations are always exported in geocentric coordinates.
- Force relationships and hostility relationships.
- Aggregate formations.
- Tactical graphics.

To import MSDL:

1. Create or load a scenario.
2. Choose **File** → **Import Scenario Laydown**. The Import Scenario File dialog box opens.
3. Select the MSDL file that you want to import.
4. Click Open.

Exporting MSDL

To export a scenario to MSDL:

1. Create or load a scenario.
2. Choose **File** → **Export Scenario Laydown**. The Export Scenario dialog box opens.
3. Type a name for the file.
4. Click Save. If VR-Forces is not sure how to export an entity type to MSDL, the Export MSDL Scenario dialog opens (Figure 1-6).

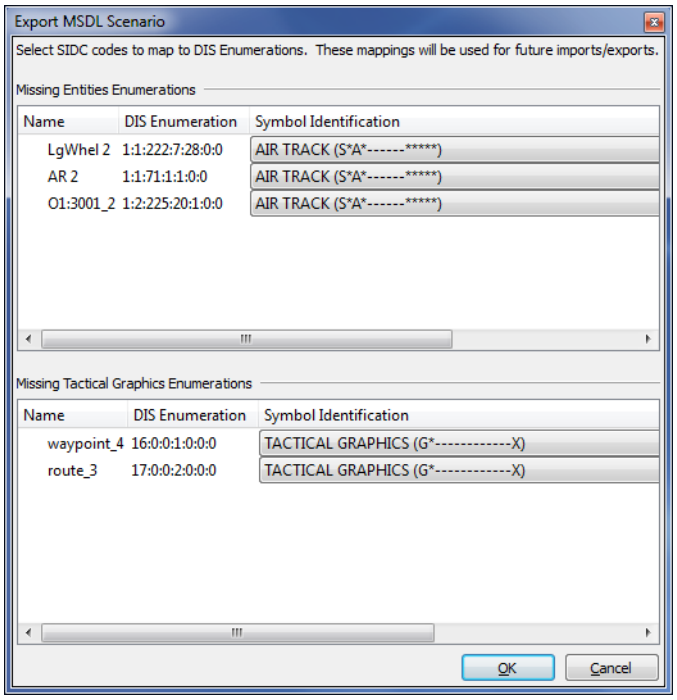


Figure 1-6. Export MSDL Scenario dialog box

5. For each entity type listed in the Export MSDL Scenario dialog box:
   a. In the Symbol Identification column, click the value. A list of possible identification codes is displayed. (These codes are from the MSDL specification. You will need to familiarize yourself with the specification to fully understand them.)
   b. Select the proper identification.
6. Click OK.

1.2. Loading a Scenario

After you have created and saved a scenario, you can load it and run it on any platform supported by the version of VR-Forces in which you created it. Most scenarios are forward compatible. Please see *VR-Forces Release Notes* for compatibility issues.

- If you are running multiple front-ends in the same session, when you load a scenario, any terrains that are open on other front-ends are closed and the terrain for the newly loaded scenario is opened.
- When you load a scenario that uses multiple back-ends, if any of the required back-ends are not running, VR-Forces prompts you to remap the objects in the scenario. The Remap Missing Back-ends dialog box lists the unavailable back-ends and the available back-ends. You can specify which back-ends to map objects to or you can select "map all to" and map all objects to one back-end. For more information about remapping back-ends, please see *Remapping Back-ends*, under Section 3.2.5, "Working with Multiple Back-ends," in *VR-Forces Users Guide*.

To load a scenario:

1. Choose **File** → **Load Scenario** or click the Open Scenario button ( ) on the File toolbar. The Load Scenario dialog box opens (Figure 1-7).

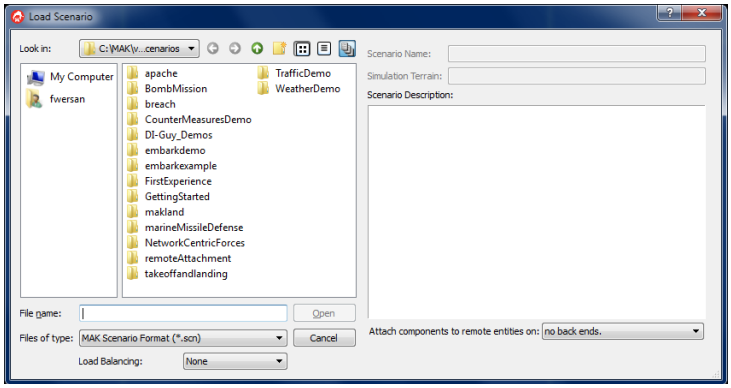


Figure 1-7. Load Scenario dialog box

2. Select a scenario to load. Basic information about the scenario is displayed (Figure 1-8). Scenarios are files with the suffix *.scn*. Sample scenarios are located in the *./userData/scenarios* directory. (Batch scenarios, described in "Running VR-Forces in Batch Mode," on page 1-24, have the suffix *.bsn*.)

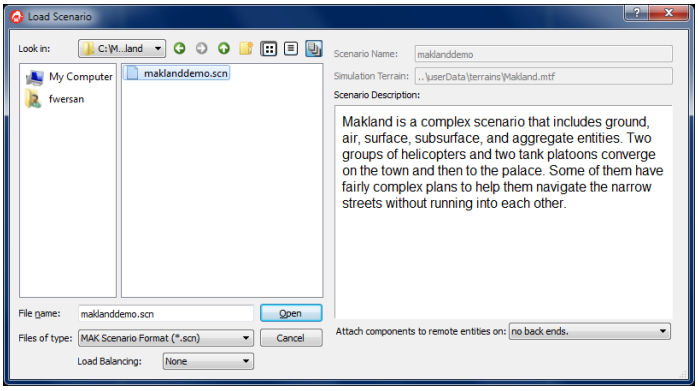


Figure 1-8. Load Scenario dialog box

3. Optionally, specify whether or not to allow management of components on remote entities by selecting an option in the Attach Components to Remote Entities On list. For details about configuring components on remote entities, please see Section 7.12, "Configuring VR-Forces Components on Remote Entities," in *VR-Forces Configuration Guide*.
4. Optionally select a load balancing option.
5. Click Open.

1.2.1. Loading a Recently Loaded Scenario

VR-Forces keeps a list of the scenarios you open. You can quickly open a scenario from the list.

➤ To open a recently used scenario, choose **File** → **Recent Scenarios** → *scenario_name*.

1.2.2. Loading a Scenario from the Command Line

If you start VR-Forces from the command line, you can specify a scenario to load. You can specify the scenario in the back-end or front-end. The other executable will load it as soon as it starts up.

To load a scenario when you start the back-end, use the `-L` command-line option, for example:

```
vrfSimDIS -s 1 -a 3001 -L "../userData/scenarios/mySce-
  nario.scn"
```

To load a scenario when you start the front-end, use the `--scenarioFile` command-line option, for example:

```
vrfGui --scenarioFile "../userData/scenarios/mySce-
  nario.scn" --dis -s 1 -a 3000
```

1.2.3. Load Balancing a Scenario

After you create a scenario, you may decide that you want to spread simulation of objects across more back-ends than you used to create it. You would typically increase the number of back-ends to improve performance. The process of spreading the simulation work across multiple simulation engines is called load balancing. VR-Forces supports even distribution (done automatically by VR-Forces) and manual load balancing.

! If you are using interest management to support large entity counts, do not enable load balancing. It will negate the assignment of entities to specific back-ends that is part of designing a scenario for interest management.

To load-balance a scenario:

1. Choose **File** → **Load Scenario**. The Load Scenario dialog box opens.
2. In the Load Scenario dialog box, select an option from the Load Balancing list (Figure 1-9).

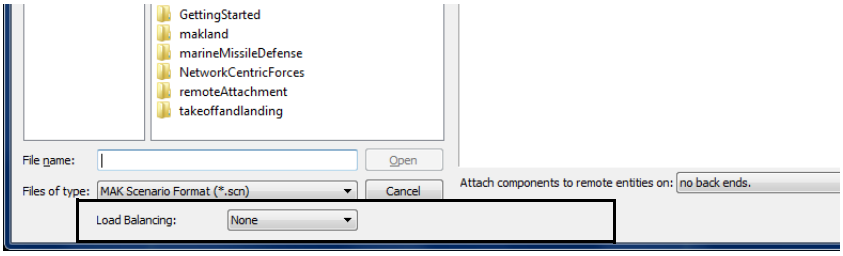


Figure 1-9. Load Balancing list

If you select Even Distribution, VR-Forces automatically distributes objects across the available back-ends. If you choose Manual load balancing, the Object Mapping dialog box opens (Figure 1-10).

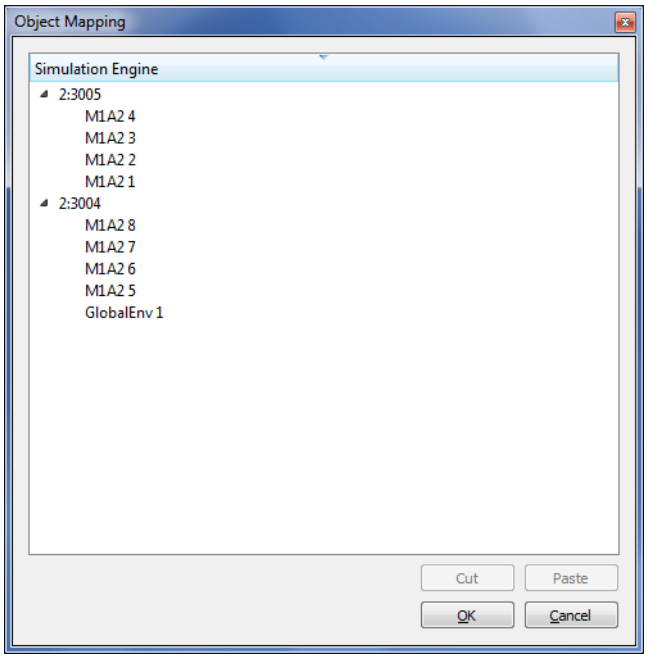


Figure 1-10. Object Mapping dialog box

3. In the Object Mapping dialog box, expand the list for the back-end from which you want to distribute objects.
4. Redistribute objects by dragging them from a source back-end to a target back-end, or by cutting them from the source back-end and pasting them onto the target back-end. You can view the new distribution of objects by expanding the list for the target back-end.
5. Click OK. The scenario loads. If you open the information dialog box for an object, the title bar displays the back-end on which it is simulated.
6. To preserve the new object mappings, save the scenario. When you save the scenario, you are prompted to save the original mappings. Click No to save the new load balanced mappings.

1.2.4. Displaying Scenario Information

When you create a scenario, you specify a variety of parameters (or accept default values) and, optionally, specify a name and description for the scenario. If a scenario has a description, when you load the scenario, the Scenario Information dialog box opens automatically. (You can disable this behavior.)

You can display scenario information at any time while a scenario is loaded. You can edit the scenario description. Other values are read only. (You can edit them directly in the scenario file. For details, please see Section 3.2, "The Scenario File," in *VR-Forces Configuration Guide*.)

To display scenario information:

1. Choose **File** → **Scenario Information**. The Scenario Information dialog box opens (Figure 1-11).

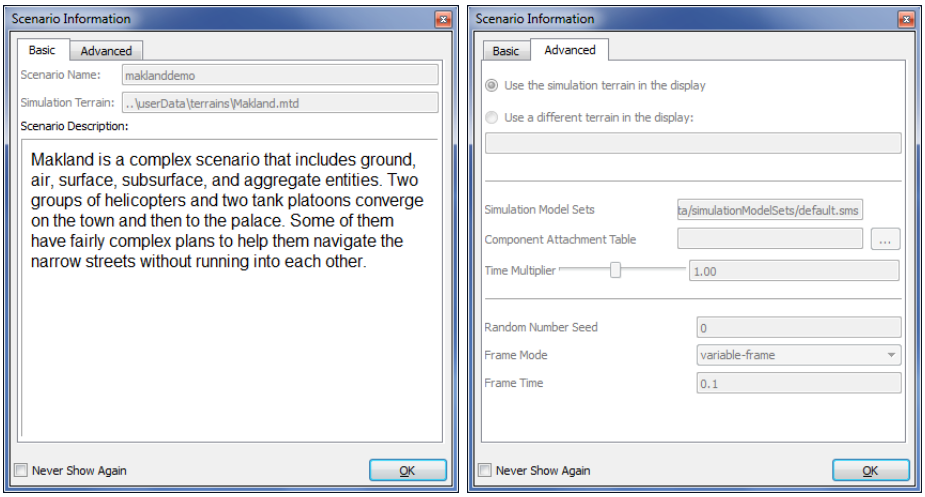


Figure 1-11. Scenario Information dialog box

2. To view advanced parameters, select the Advanced tab.

Enabling and Disabling Display of the Scenario Description

By default, the scenario description gets displayed when you open a scenario. You can turn it off in the Scenario Information window and you can enable and disable its display in the Application Settings dialog box.

To disable display of scenario information when a scenario is loaded, use one of the following methods:

- When the Scenario Information window opens, select the Never Show Again check box.
- On the Application Settings dialog box, Session Options page, clear the Show Scenario Information Dialog check box.

➤ To enable the Scenario Information dialog box, on the Application Settings dialog box, Session Options page, select the Show Scenario Information Dialog check box.

1.2.5. Editing the Scenario Description

You can edit a scenario's description in the Scenario Information dialog box.

To edit a scenario's description:

1. Choose **File** → **Scenario Information**. The Scenario Information dialog box opens (Figure 1-12).

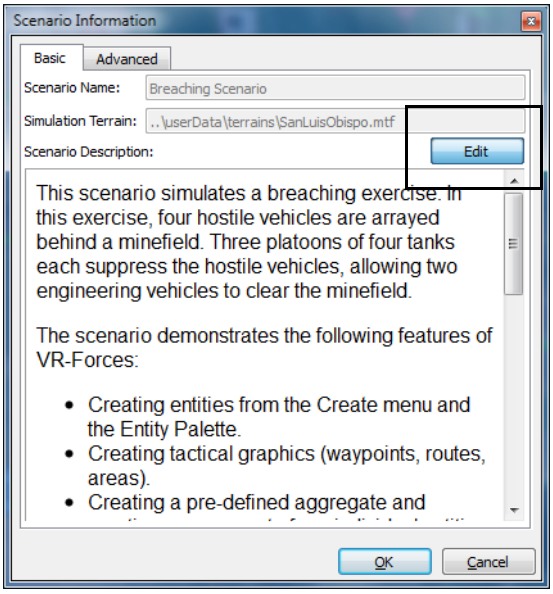


Figure 1-12. Scenario Information (editable)

2. Click Edit. The description window changes to edit mode and the button text changes to View.
3. Edit the text.
4. To see how the text will be displayed, click View.
5. Click OK.

1.2.6. Sample Scenarios

VR-Forces includes several sample scenarios. Appendix A, *Example Scenarios* has the step-by-step process for creating the breaching scenario and the embarkexample scenario.

1.3. Saving a Scenario

The first time you save a scenario, VR-Forces saves the path of the terrain database and other scenario configuration data to a scenario file (extension *.scn*). (Paths are saved relative to the *./bin* directory.) This information usually does not change between runs of a scenario. Every time you save a scenario, VR-Forces saves the order of battle, the plans, and object mapping information to individual files that have the same name as the scenario, but with file extensions that identify the information in the file (*.oob*, *.pln*, *.gpl*, *.xtr*, *.omp*, and so on).

- If you want to keep the initial state of a scenario (simulation time = 0 and no simulation has taken place), so that you can repeatedly run a simulation from the beginning, save the scenario when you have finished creating it, but before you run it. Then, do not save the scenario again under the same name (unless you specifically want to change the original state of the scenario).
- If you load an alternate terrain in a front-end when it joins a session, the alternate terrain is not saved as part of the scenario.

When you save a scenario, whether during the course of setting it up or during a simulation, all object state information gets saved. Essentially, every save is a checkpoint. Therefore, when you run a saved simulation, all entities will resume whatever they were doing when the scenario was saved.

If entities are executing scripted tasks, some information regarding the tasks is not saved. For details, please see "Limitations for Checkpointing Scripted Tasks," on page 14-9.

If you save a scenario after it has started (whether it is paused or running), it is not saved to the original scenario file. It is saved to a checkpoint that is named using the convention *scenario_name*_at_time_*time*.scn. This ensures that you cannot inadvertently overwrite the original scenario file. To overwrite the original scenario, you must use Save Scenario As. For more information about checkpoints, please see "Saving Checkpoints," on page 1-20.

To save a new scenario:

1. Choose **File** → **Save Scenario** or click the Save button () on the File toolbar. The Save Scenario dialog box opens.
2. Select the directory in which you want to save the scenario.
3. Give the scenario a name.
4. Click Save. All scenario files are saved with the new name.

If you save a remapped scenario, you are prompted to save the scenario with the original mappings or with the remappings.

1.3.1. Saving an Existing Scenario

In most computer applications, when you save an existing file, the current version of the file simply overwrites the previously saved version. However, when VR-Forces saves a scenario, the save action depends on the status of the scenario. VR-Forces tracks the simulation time of the scenario. When you save a scenario:

- If a version of the scenario exists with the current simulation time, VR-Forces displays a message indicating that a version of the scenario at that simulation time exists and asks if you want to overwrite it.
- If there is no version with the current simulation time, VR-Forces creates a new checkpoint at the current simulation time, using the checkpoint naming convention.

This behavior ensures that if you change a scenario after you have started a simulation, you will never inadvertently overwrite the original version or another checkpoint.

➤ To save a previously saved scenario, choose **File** → **Save Scenario**.

1.3.2. Saving a Scenario to a New Name

To save a scenario to a new name:

1. Choose **File** → **Save Scenario As**. The Save Scenario dialog box opens.
2. Select the directory in which you want to save the scenario.
3. Give the scenario a name.
4. Click Save. The scenario is saved to the new name.

1.3.3. Saving Checkpoints

You may want to save snapshots of a simulation at various points in its life for after-action-review or to use as the starting point of a new exercise. You might also want to stop an exercise and resume it at some later point, with all entities remembering their tasks and state information. You can do this by saving a checkpoint.

If entities are executing scripted tasks, some information regarding the tasks is not saved. For details, please see "Limitations for Checkpointing Scripted Tasks," on page 14-9.

You can save a checkpoint at any time by saving the scenario. Checkpoints are saved to the same directory. You can also configure VR-Forces to save checkpoints at regular intervals. If periodic checkpointing is enabled, the Status bar displays the time until the next checkpoint.

When you run a checkpointed scenario, entities resume the tasks that they were executing at the time the checkpoint was saved. If detonations were scheduled or if missiles were in flight, they resume their former state.

Saving an Individual Checkpoint

Whenever you save a scenario, it creates a checkpoint.

➤ To save an individual checkpoint, choose **File** → **Save Scenario**.

Scheduling Periodic Checkpoints

You can configure VR-Forces to save checkpoints at regular intervals. You can specify that the intervals be calculated in real time or simulation time. Saving checkpoints in simulation time may be useful if you are running a scenario at a rate greater or lesser than real time.

To schedule checkpoints:

1. Choose **File** → **Schedule Periodic Checkpointing.** The Periodic Checkpointing dialog box opens (Figure 1-13).

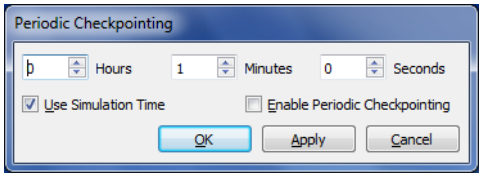


Figure 1-13. Periodic Checkpointing dialog box

2. Enter the time interval between checkpoints, in hours, minutes, and seconds.
3. Select the Enable Periodic Checkpointing check box.
4. To save checkpoints based on simulation time, check the Use Simulation Time check box. To use real time intervals, clear the check box.
5. Click OK.

Disabling Periodic Checkpointing

To disable periodic checkpointing:

1. Choose **File** → **Schedule Periodic Checkpointing**. The Periodic Checkpointing dialog box opens.
2. Clear the Enable Periodic Checkpointing check box.
3. Click OK.

1.3.4. Deleting Checkpoints

You can delete checkpoints manually in a file browser, like you can delete any other files on your computer. You can also easily delete them from the front-end.

To delete checkpoints:

1. Choose **File** → **Delete Scenario Checkpoints**. The Delete Checkpoints dialog box opens (Figure 1-14).

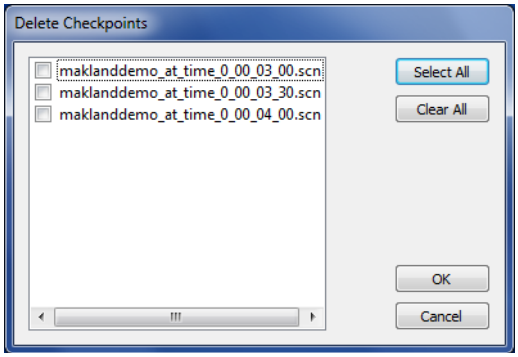


Figure 1-14. Delete Checkpoints dialog box

2. Select the checkpoints that you want to delete.
3. Click OK.

1.4. Starting a Simulation

If you want to use VR-Forces to simply observe a remote simulation, you can start it, open a terrain database, and wait for it to pick up messages from the network. However, you will probably use VR-Forces to run simulations that have locally simulated entities.

1.4.1. Starting or Resuming a Paused Scenario

When you load a scenario, it opens in the paused state unless you start with the `-L` and `-r` back-end command line options.

➤ To begin or resume execution of a paused scenario, choose **Simulation** → **Run Scenario**, or click the Run button on the Simulation Control toolbar (Figure 1-15).

! Always save a new scenario before you run it for the first time. If you do not save it, you will not be able to return to the starting point. Rewinding a scenario that has not been saved deletes all unsaved objects.

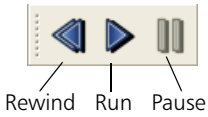


Figure 1-15. Simulation Control toolbar

1.4.2. Changing the Simulation Speed

You can vary the speed of a simulation so that it runs at speeds faster or slower than real-time.

If you are running VR-Forces with time management, the Simulation Time Scale toolbar has no effect on simulation speed.

! If you increase the speed at which a scenario runs, the frame rate is reduced and performance of models may degrade.

➤ To change the speed of a simulation, drag the indicator on the Simulation Time Scale toolbar (Figure 1-16), or type a value in the text box.

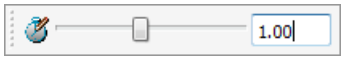


Figure 1-16. Simulation Time Scale toolbar

1.4.3. Pausing a Scenario

When you pause a simulation, local entities stop executing plans and tasks. Display of remote entity activity continues as it is received over the network.

➤ To pause a simulation, choose **Simulation** → **Pause Scenario**, or click the Pause button on the Simulation Control toolbar (Figure 1-15).

1.4.4. Rewinding a Scenario

If you are running a scenario or have completed a scenario and want to start it over again, you can rewind it. Rewinding a scenario returns it to its last saved state.

If you are working on a new scenario and have not saved it, rewind deletes all your work and returns the scenario to its original, blank state.

If you save checkpoints while a scenario is running, when you rewind, the scenario rewinds to the most recent checkpoint, not to the original scenario. To return to a version of the scenario other than the most recent checkpoint, you must load that version.

➤ To rewind a scenario, choose **Simulation** → **Rewind Scenario**, or click the Rewind button on the Simulation Control toolbar (Figure 1-15).

If you do not pause a scenario before you rewind it, it starts playing again immediately.

1.4.5. Closing a Scenario

➤ To close a scenario, choose **File** → **Close Scenario**, or click the Close Scenario button () on the File toolbar.

1.5. Running VR-Forces in Batch Mode

Batch mode allows you to run one or more scenarios multiple times, without direct action through the graphical user interface. A scenario run in batch mode runs with the parameters in the scenario file, except that you can override the random number seed.

Batch mode is “read only.” You cannot save a scenario, create entities or objects, pause the scenario, or otherwise change it, while a batch is running. However, you can view the Objects List Panel, Plan windows, and open informational dialog boxes. You can close a scenario that is running in batch mode and resume control of VR-Forces.

1.5.1. The Batch File

A batch mode file contains the information that VR-Forces needs to run scenarios in batch mode. Batch mode offers the following options:

- Run a particular scenario multiple times.
- Run a series of different scenarios (batches), each of which can be run multiple times.
- Run from the command line using one back-end. If a scenario was created using multiple back-ends, you cannot run it in batch mode using this method.
- Run from the VR-Forces front-end using one or more back-ends.
- Generate Logger Control messages to have the MÄK Logger record each simulation.

For each batch (one scenario run one or more times) within the batch file, you can:

- Specify the length of time the simulation is to run (in real time or simulation time).
- Specify the object parameter database to use.
- Specify that the random number seed used be the value specified in the scenario file, a value specified in the batch file, or be computer generated.

A batch file has the file extension *.bsn*.

1.5.2. Creating a Batch File

To run VR-Forces in batch mode, you create a batch file (*.bsn*). VR-Forces supplies a sample batch file. Use it as a model for creating your own batch files.

To create a batch file:

1. Create scenarios as you would any scenario. (For details, please see "Creating a Scenario," on page 1-3.)
2. In a text editor, open the sample batch file provided with VR-Forces.
3. Save the batch file under a new name, with the file extension *.bsn*.
4. Replace the sample values with your own, as described in "Editing a Batch File," on page 1-26.
5. Save the new batch file.

1.5.3. Editing a Batch File

A batch file is written in MÄK Technologies Lisp format (MTL). (For information about the MTL format, please see Section 2.5, "MÄK Technologies Lisp (MTL) Files," in *VR-Forces Configuration Guide*.) A batch file starts with parameters that affect the entire batch. Then it has a batch list, which contains one or more batches. Each batch specifies a scenario, the number of times it is to be run, and other parameters. Table 1-3 describes the parameters.

The following is an example of a batch file:

```
(scenario-batch
  (use-logger-control True)
  (logger-files-path "..\logger_tapes") ;; path is relative to Logger
  executable.
  (batch-list
    (batch
      (number-of-runs  2)
      (random-number-seed 4)
      (scenario-filename  "..\data\scenarios\breach\breaching.scn")
      (parameter-filename
        "..\data\simulationModelSets\default\vrfSim.opd")
      (simulation-run-duration 0 : 0 : 0 : 30.000000) ;; simulation time
    )
    (batch
      (number-of-runs  3)
      (scenario-filename
        "..\data\scenarios\apache\apache_groundDB.scn")
      (parameter-filename
        "..\data\simulationModelSets\default\vrfSim.opd")
      (run-duration 0 : 0 : 0 : 20.000000) ;; real time
    )
  )
)
```

Table 1-3: Batch file parameters (Sheet 1 of 2)

Parameter	Description
Scenario-batch parameters	
use-logger-control	Specifies whether or not to generate Logger Control messages. Options: ◆ False – Do not generate messages. ◆ True – Generate messages to create Logger files for each run of each batch.
logger-files-path	If user-logger-control is True, specifies the directory in which to store Logger files. The path can be absolute or relative to the Logger executable.

Table 1-3: Batch file parameters (Sheet 2 of 2)

Parameter	Description
Batch-list parameters	
number-of-runs	Specifies how many times to run the scenario in this batch run entry.
random-number-seed	This parameter is optional. If it is specified, it overrides the random number seed in the scenario file. It specifies a random number seed as follows: ◆ -1 – use a value generated by the computer. Values are different for each run of this batch. ◆ Any non-negative integer – use the number specified for each run of the batch.
scenario-filename	Specifies the scenario to be run in this batch run entry. The scenario can be specified as an absolute path or a path relative to the directory in which the executable is located.
parameter-filename	This parameter is optional. If it is specified, it overrides the object parameter database specified by the scenario and specifies the object parameter database file to use.
simulation-run-duration	Specifies the duration in simulation time that the simulation will run. It is mutually exclusive with run-duration. If both are specified, VR-Forces uses simulation-run-duration. ! Specify hours, minutes, and days as integers, for example 15. Specify seconds as real numbers, for example, 15.0.
run-duration	Specifies the duration in real time that the simulation will run. For example, if a scenario has a time scale set to 2 (twice real time), and a run-duration of 10 minutes, 20 minutes of simulation time will elapse before the batch stops running this scenario. It is mutually exclusive with simulation-run-duration. ! Specify hours, minutes, and days as integers, for example 15. Specify seconds as real numbers, for example, 15.0.

1.5.4. Running VR-Forces in Batch Mode

To run VR-Forces in batch mode:

1. Start VR-Forces. If any of the scenarios you plan to run in batch mode require multiple back-ends, start the back-ends with the required site and application IDs.
2. If you are going to generate Logger control messages, start the MÄK Logger.
3. Choose **File** → **Load Batch File**, or click the Load Batch File button () on the File toolbar. The Load Batch File dialog box opens.
4. Select the batch file you want to run.
5. Click Open.

VR-Forces begins running the first scenario in the batch file. When VR-Forces finishes running the batch file, it closes the final scenario.

- When VR-Forces runs a batch file, if it cannot load a scenario specified in the file, it skips the scenario and goes to the next batch entry in the file.
- Automatic remapping is always enabled for batch mode.

Running in Batch Mode from the Command Line

If your scenarios only need one back-end, you can run a batch file from the command line.

➤ To run a batch from the command line, use the `-B` parameter, with the back-end in separate mode, for example:

```
vrfSimDIS -s 1 -a 3001
   -B "../userData/scenarios/batchfile.bsn"
```

The scenario begins to run automatically.

1.5.5. Recording Batch Scenarios

You can generate Logger Control messages and save scenario output to a Logger file. You must start the Logger before you run the batch scenario.

If you generate Logger Control messages, each simulation is saved individually by the Logger, with a filename in the format:

```
<batch_scenario_name>_<scenario_run_number>_<random_number_seed>.lgr
```

You can specify the directory in which you want the Logger file to be saved.

The MÄK Logger does not record batch file runs if a previous recording exists. By default, the Logger does not allow you to overwrite existing files using the remote control API. So, once you record a batch run, you cannot record a subsequent run of the same batch. You can work around this problem by editing the *lgrConfig.xml* file to permit overwriting of Logger files. Make the following edits in the configuration file for each protocol for which you want to record batch runs:

Add the following lines to the <defaults> section:

```
<var name="processRemoteControl" type="bool" value="true"/>
<var name="recordRemoteControl" type="bool" value="true"/>
<var name="allowDeleteRemoteControl" type="bool" value="true"/>
```

Add the following lines to the <commands name="startup"> section:

```
<command domain="Simulation" protocol="DIS"
  command="SetRemoteControlSettings">
  <param name="process" var="processRemoteControl"></param>
  <param name="record" var="recordRemoteControl"></param>
  <param name="allowDelete" var="allowDeleteRemoteControl"></param>
</command>
```

Use the appropriate value for the protocol attribute.

1.6. Recording VR-Forces Simulations with the MÄK Logger

You can use the MÄK Logger to record VR-Forces simulations and then play them back for review. If you want to view a Logger file in VR-Forces (as opposed to some other MÄK viewer, such as the VR-Vantage Stealth), note the following considerations:

- When you view the Logger file, you must run VR-Forces with an application number that is different from the one you used when you recorded the simulation. If you use the same application number, VR-Forces may crash.
- Do not load the original scenario in VR-Forces while you view the recording. Just load the terrain database that the simulation requires.
- If you are using HLA 1516, do not record a simulation and then immediately play it back. Exit the applications and start a new federation. Trying to play back the file in the federation from which it was recorded can result in name reservation conflicts and applications may crash.

2

Creating and Placing Objects

This chapter describes generic procedures for creating and placing entities and tactical graphics. The later chapters assume that you are familiar with these procedures.

2.1. Creating Objects

VR-Forces lets you create entities, cultural features, tactical graphics, and props. You can create entities, cultural features, and tactical graphics from the Create menu or the Entity Palette. You create props from the Prop Palette. The procedure for creating an object is essentially the same regardless of the type of object:

1. Select the object that you want to create.
2. Specify the location and properties of the object.

However, there are several ways to select the object you want to create and several ways to specify an object's location and properties. This chapter describes the different generic ways to create objects. Additional procedures specific to the object type are described in later chapters.

When you create an object, VR-Forces adds a tab to the right side of the window, below the object palettes. The tab is labeled Create *object*, where *object* is whatever object you selected to create. If you click that tab, it opens a dialog box that lets you specify the properties of the object you are creating. Table 2-1 lists the properties that you can set for each object type. You can also edit these same properties after you create an object.

Table 2-1: Editable object properties

	Entity	Cultural Feature	Tactical Graphic	Prop
Force	X	X	X	
Heading	X	X		
Label	X	X		
Location	X	X	X	X
Name	X	X	X	
Overlay	X (Edit only)	X (Edit only)	X	
Style			X	

2.2. Selecting the Object to Create

You can select the object to create on the Create menu or on an object palette (Entity Palette, Tactical Graphics Palette, or Prop Palette). Once you have selected the object, placing the object is the same regardless of how you started the process. For details, please see "Placing Objects," on page 2-9.

The Create menu does not contain the full list of objects configured in VR-Forces. It only lists the entities and tactical graphics that you have marked as "Favorites". It gives you quick access to your most frequently used objects. For details, please see "Adding an Object to the Favorites List," on page 2-21.

2.2.1. Selecting the Object to Create on the Create Menu

If you have marked an object as a Favorite, it is available on the Create menu.

To select the object to create on the Create menu:

1. If you are using multiple simulation engines, in the Selected Simulation Engine toolbar select the simulation engine on which you want to simulate the object.
2. To create an object or graphic, choose **Create** → *category* → *object_type*, where:
   - *category* is a category of entity, such as Ground or Human, a category of cultural feature (Building or Cultural Feature), or a category of tactical graphic (Tactical Graphic or Control Object).
   - *object_type* is a specific type within the category, such as M1A2 or T80.

   The cursor changes to draw mode and a Create Object tab is added to the window. For details about draw mode, please see "Draw Mode," on page 2-8.
3. Create the object, as described in "Placing Objects," on page 2-9.

2.2.2. Selecting the Object to Create on an Object Palette

VR-Forces has the following object palettes that let you quickly choose the object that you want ot create:

- Entity Palette. Create entities, cultural features, and buildings.
- Tactical Graphics Palette. Create tactical graphics, such as control objects, lines, circles, points, and text.
- Prop Palette. Create props that can be saved as part of the terrain.

Figure 2-1 shows the location of the palettes.

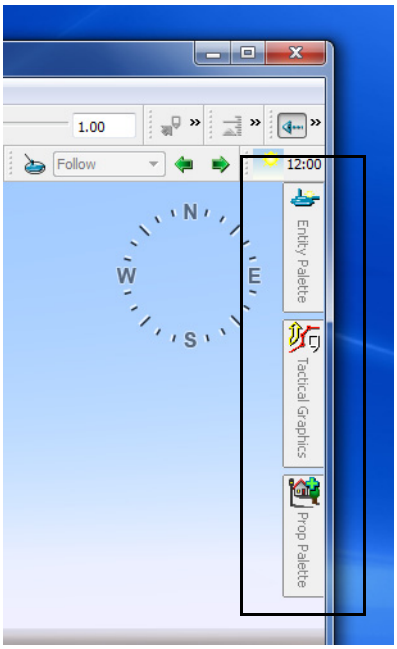


Figure 2-1. Object creation palette tabs

To select the object to create on an object palette:

1. If you are using multiple simulation engines, in the Selected Simulation Engine toolbar select the simulation engine on which you want to simulate the object.
2. Click the tab for the palette you want to open. The palette is displayed (Figure 2-2).

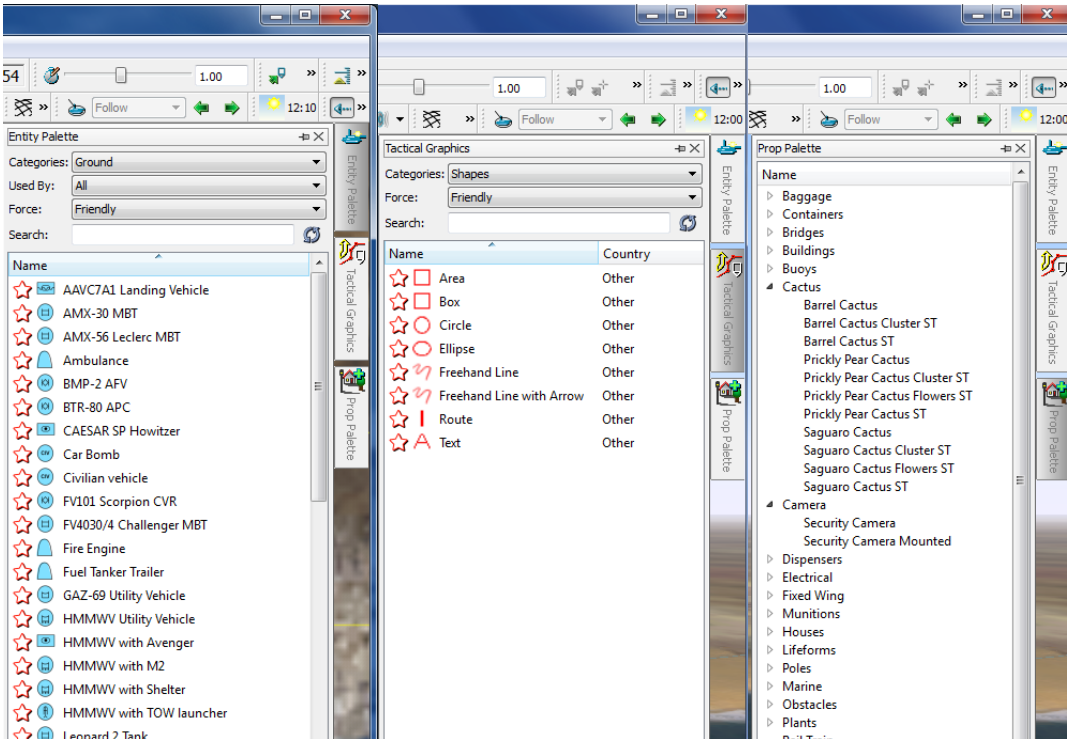


Figure 2-2. Object palettes

By default, the palettes list all objects that can be created. You can filter the Entity Palette list by category, force, and country of use. You can filter the Tactical Graphics Palette by category and force. The Prop Palette organizes props by category in a tree list.

3. Optionally, in the Categories list, select the category for the object you want to create, such as ground or fixed-wing for entities, or control objects for tactical graphics.

4. Optionally, filter the Entity Palette by selecting a country in the Used By list.

The Used By filter lists entities of the selected Category that are used by the specified country. VR-Forces does not provide an exhaustive list of countries or the platforms that they use. You can add additional countries and categorize entities in the Entity Editor. For details, please see Section 5.5.3, "Editing an Entity's Used By Countries List," in *VR-Forces Configuration Guide*.

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5. In the Force list, select the force for which you want to create this entity. All entity types for a given platform are listed. There is no preconceived force for any of them.

6. In the list of objects, click the object that you want to create. The cursor changes to draw mode and a Create Object tab is added to the window. For details about draw mode, please see "Draw Mode," on page 2-8.
7. Create the object, as described in "Placing Objects," on page 2-9.

2.2.3. Pinning an Object Palette to the Window

Ordinarily, after you select an object to create, the palette closes. However, you can pin the palette to keep it open so that you can select additional objects to create without needing to click the palette's tab to reopen it. If you pin a palette, it becomes dockable and undockable and you can drag it off the window like the other panels. (For details about undocking panels, please see Section A.1, "Dockable Panels and Toolbars," in *VR-Forces Users Guide*.)

➤ To pin a palette so that it stays open after you select an object, click the pin button (⊣) in the title bar (Figure 2-3).

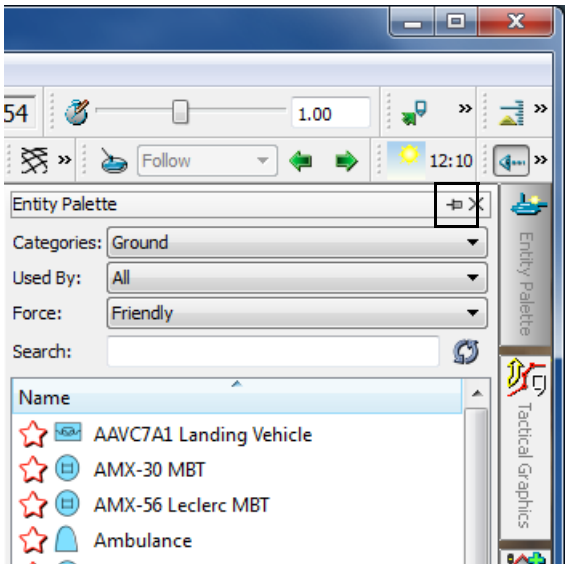


Figure 2-3. Palette pin

2.2.4. Draw Mode

When you are creating an object, the cursor changes to draw mode. If you are creating an entity or a cultural feature in the 2D view, the cursor changes to a 2D icon that represents the chosen entity (Figure 2-4).

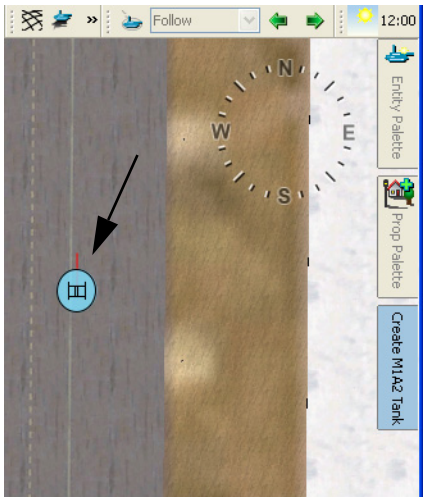
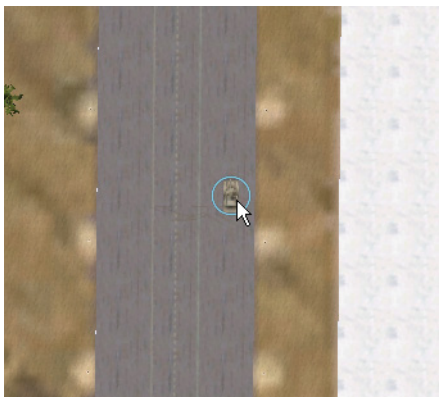


Figure 2-4. 2D entity creation and Create *Object* tab

In the 3D view, the cursor changes to the 3D model for the chosen entity (Figure 2-5). If you are zoomed out, 3D models may be hard to see.



Top-down view as in Figure 2-1

Ground-level view

Figure 2-5. 3D entity creation

If you are creating a tactical graphic, the cursor displays the waypoint symbol when you create a point and a vertex symbol when you create any type of line or area. Figure 2-6 illustrates draw mode cursors.

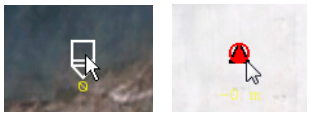


Figure 2-6. Cursors in draw mode

If you are creating a prop, the cursor changes to show the model for the prop. In the 2D view, the model is a top down view and is proportional to the terrain, so it may be difficult to see if you are zoomed out.

2.3. Placing Objects

After you select the object that you want to create, the Create Object tab is added to the right side of the window below the Prop Palette.

There are two basic methods for placing entities, as follows:

- Click to Create. Each mouse click creates an instance of the selected object. For multi-vertex tactical graphics, each click specifies a vertex. Click to Create is best for rapidly creating objects using the default values for the object's properties.

  The create object graphic is attached to the mouse cursor. Although you can use the Create Object dialog box to specify an object's name or other properties, as you move the cursor into the dialog box, the creation location (as represented by the object graphic) moves with it, which can be disconcerting. You can set heading and altitude dynamically, so there is no need to use the Create Object dialog box for these properties.

- Click to Locate. Mouse clicks specify the coordinates, but do not cause the entity to be created. The create object graphic is placed at the specified coordinates, but is not attached to the mouse cursor.

  If you want to explicitly set the object's location, and particularly if you want to set the altitude relative to sea level, you must use this method. This method may also be more comfortable for persons who want to take a deliberative approach to specifying an object's properties before creating it.

2.3.1. Placing an Object Using Default Values (Click to Create)

Although you can specify an object's properties using the Click to Create method, it is best suited for quickly creating objects using default properties. Objects are placed on the default overlay.

To place an object with each mouse click:

1. Select the object that you want to create as described in "Selecting the Object to Create," on page 2-3.
2. For entities and waypoints, click on the terrain for each object you want to place. You can create multiple single point objects without exiting create mode. For details about disabling this create mode, please see "Locking the Mouse to the Object Being Created," on page 2-15.

   For multi-vertex tactical graphics, click on the terrain to place each vertex. Right click to place the last vertex in a route or area. (Do not try to close areas by clicking on the starting point. Doing so only creates another vertex near the first one.)

   To draw a circles, ellipses, boxes, or text, please see the sections in Chapter 5, *Overlays and Tactical Graphics*.

- If new objects or vertices do not get displayed as you click, it is possible that Attach Object to Mouse is disabled. To restore Click to Create mode:
  1. Click the Create Object tab. The Create Object dialog box opens.
  2. Select the Attach Object to Mouse check box.
- If tactical graphics are not displayed after you create them, check to see if the display of tactical graphics has been disabled. For details, please see Section 6.4, "Displaying Tactical Graphics," in *VR-Forces Users Guide*.

3. Optionally, you can set the altitude of an object as you create it. For details, please see "Setting Altitude Dynamically," on page 2-13.
4. Optionally, you can set the heading of an object as you create it. For details, please see "Specifying an Object's Heading Dynamically," on page 2-15.

If you want to specify any of the object's properties in the Create Object dialog box while using Click to Create, you can do so. However, be aware that as you move the cursor into the dialog box, the object graphic will move also. Once you specify the desired properties, click on the terrain to create an object with those properties. The properties will be applied to any additional objects you create until you change them or close the dialog box.

5. Right-click to exit create mode.

2.3.2. Specifying an Object's Properties Before You Create It (Click to Locate)

In the Click to Locate method, clicking on the terrain sets the coordinates of the object, but does not create it. You can specify all of the object's properties in the Create Object dialog box before creating it. Table 2-1 lists the properties that you can set for the different types of objects.

VR-Forces remembers how you use the Create Object dialog box on a per-object basis. For example, if you create a waypoint and open the Create Waypoint dialog box to specify its properties, the next time you create a waypoint, the Create Waypoint dialog box opens automatically. If the dialog box opens and you do not want it open for this object creation or for future creations of the current object type, click the Create Object tab. The dialog box will close and VR-Forces will still be in object creation mode. The next time you create this object type, the dialog box will not open automatically.

To specify the properties of an object when you create it:

1. Select the object that you want to create as described in "Selecting the Object to Create," on page 2-3. A Create Object tab is added to the window below the Prop Palette (Figure 2-4).
2. Click the Create Object tab. A Create Object dialog box that is appropriate for the object opens (Figure 2-9).

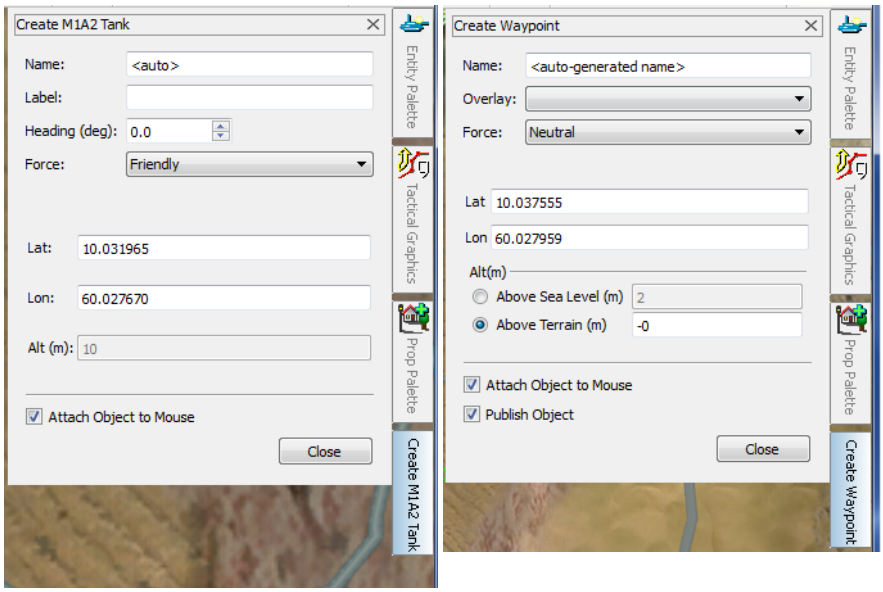


Figure 2-7. Create Object dialog boxes

3. Clear the Attach Object to Mouse check box. For details about this option, please see "Locking the Mouse to the Object Being Created," on page 2-15.

4. To specify the object's name, type a name in the Name box. For details about how entities are named, please see Section 3.5.1, "How Entities are Identified," in *VR-Forces Users Guide*.
5. If you are creating an entity, specify a label (optional).
6. To specify the object's heading, type or select a value, in degrees, in the Heading box.
7. To specify the overlay on which to place an object, select an overlay from the Overlay list.
8. To specify an entity or point object's coordinates, click on the terrain or type coordinate values in the dialog box. To specify the altitude, follow the procedure in "Specifying an Object's Altitude," on page 2-12.

   To specify the vertices of a route or area:

   a. Click on the terrain to place the first vertex, or type the coordinates in the dialog box.
   b. Click the Add button () to add a vertex.
   c. Click to locate the vertex or type the coordinates.
   d. Continue adding vertices until you are finished specifying the route or area. You can insert vertices anyplace in the object by selecting an existing vertex and clicking the Add button.

   To draw circles, ellipses, boxes, or text, please see Chapter 5, *Overlays and Tactical Graphics*.
9. Click Create. The object is created. You can continue to create additional objects of this type.
10. For tactical graphics, specify whether or not to publish the object.
11. To close the dialog box, click Close.

2.4. Specifying an Object's Altitude

You can specify an altitude for air platforms, sub-surface entities, the vertices of waypoints and routes, and props when you create them or edit their properties. (You can also set altitude for entities using the Location set data request, Fly Alitutde tasks, and the Move to Location task. You can set altitude dynamically or in the various dialog boxes for setting object properties or actions.)

2.4.1. Setting Altitude Dynamically

You can set altitude dynamically for entities that support an altitude, for waypoints, for individual vertices of a route, and for props that have not been saved into a terrain. When you set altitude dynamically, it is set relative to the terrain.

To set altitude dynamically:

- If you are creating the object, press **Alt** and scroll the mouse wheel, or press **Alt**+left mouse button and drag the mouse.
- If you are editing an entity or vertex:
  a. Double-click the object to make it editable.
  b. Press **Alt** and scroll the mouse wheel, or press **Alt**+left mouse button and drag the mouse.
  c. Click to set the new altitude.

2.4.2. Setting Altitude in the Create Object or Edit Object Dialog Box

When you set altitude in a dialog box, you have the following options:

- Above Sea Level. The distance above sea level. If the terrain is higher than the altitude entered, the entity will be below the surface of the ground.
- Above Terrain. The distance above the terrain at this location.

If you are creating or editing a route, you can adjust the altitude of all of the vertices at the same time and in the same way. For details, please see "Specifying the Altitude for All of the Vertices in a Route," on page 2-14.

To set altitude in a dialog box:

1. If you are creating or editing an object:
   a. Click the Create Object (or Edit Object) tab. A dialog box opens.
   b. Clear the Attach Object to Mouse check box. The Location group box becomes enabled. (Although the entity will change its location as you move the cursor into the dialog box, it snaps back to its original location as soon as you clear the check box.)
2. In the Altitude group box, select one of the options.
3. Type an altitude in the box.

2.4.3. Specifying the Altitude for All of the Vertices in a Route

When you create a route or edit its vertices, you may want to change the altitude of all of its vertices in a similar way. VR-Forces lets you:

- Adjust all vertices by the same amount.
- Set all vertices to the same height above sea level.
- Set all vertices to the same height above the terrain.

To change the altitude for all of the vertices in a route:

1. If you are creating a route, open the Create Route dialog box. If you are editing a route:
   a. Select the route.
   b. Choose **Entities** → **Edit**. The Edit Route dialog box opens.
2. Click the Adjust Points button ( ). The Adjust All Points dialog box opens (Figure 2-8).

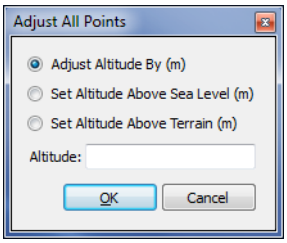


Figure 2-8. Adjust All Points dialog box

3. Select the adjustment action as follows:
   – Adjust Altitude By. Changes the altitude of each vertex by the amount specified in the Altitude box.
   – Set Altitude Above Sea Level. Sets the altitude of each vertex to the amount above sea level specified in the Altitude box. This could result in some vertices being below ground.
   – Set Altitude Above Terrain. Sets the altitude of each vertex the amount above the terrain specified in the Altitude box.
4. Type the desired altitude adjustment value in the Altitude box.
5. Click OK.

2.5. Specifying an Object's Heading Dynamically

When you create an entity, cultural feature, or prop, you can set its heading in the Create Object dialog box, or dynamically. Afterwards, you can edit an entity or cultural feature's heading directly or use the Heading set data request. (For more information, please see "Heading," on page 8-15.)

➤ To set an object's heading dynamically as part of the creation process, hold down the **`Shift`** key and the left mouse button, and drag the mouse.

In the 2D view, as you change the heading for an entity you can see the heading indicator change heading. However cultural features do not have heading indicators, so if you want to set the heading dynamically, you may want to switch to 3D view so that you can see the model rotate.

2.6. Locking the Mouse to the Object Being Created

By default, when you create entities or waypoints, you can create multiple objects by continuously left-clicking without exiting create mode. This is a very convenient feature if you want to create objects using default naming conventions and do not need to specify specific location coordinates or overlay assignments during the creation process. (You can always edit an object's properties after you create it.)

However, if you want to use the Create Object dialog box to specify location or other properties for each object as you create it, this feature can be inconvenient because as you move the mouse to the Create Object dialog box, the placement location changes with the mouse movement. Disabling this feature can give you greater control over the creation process, because clicking to set the location of the object or a vertex does not create it – it sets the coordinates, but lets you make further changes in the Create Object dialog box before you create the object.

If you disable an object's attachment to the mouse when you are creating objects, you create them by clicking Create in the dialog box rather than clicking on the terrain.

➤ To enable or disable the mouse's attachment to the creation location, in the Create Object or Edit Object dialog box, select or clear the Attach Object to Mouse check box (Figure 2-9). When you select the check box, a Create button gets added to the dialog box. The setting gets carried over to future object creations.

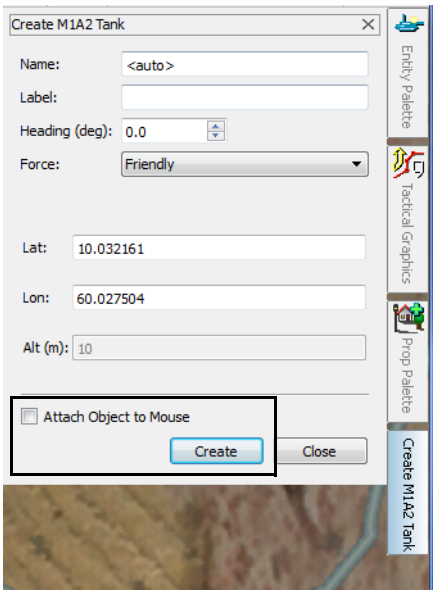


Figure 2-9. Create Object dialog box

2.7. Moving Objects

You can move an object by dragging it, changing its location in the Edit Object dialog box, or for entities only, sending a Location request.

For information about setting the location of an entity, please see "Location," on page 8-18.

> You can only move objects simulated by VR-Forces.

2.7.1. Dragging an Object to a New Location

To drag an object from one point on the terrain to another:

1. Double-click the object, or select the object and choose **Entities** → **Move**.
2. Move the mouse to change the location of the object.
3. Left-click the mouse.

> - You can drag multiple objects and they can be of different types.
> - To drag multiple objects, you must select the objects and choose **Entities** → **Move**.

Canceling a Drag-and-Drop Move

➤ To cancel a move made by dragging an object, press **Escape** before you click the left mouse button.

2.8. Copying and Pasting Objects

You can copy objects and paste the copies elsewhere in a scenario or even in another scenario. The Paste Special option allows you to specify which entity characteristics you paste.

VR-Forces copies the following data about an object:

- Environmental objects:
  - Original name
  - Label
  - Force
  - Color.
- Entities:
  - Original name
  - Label
  - Force
  - Heading
  - Appearance (lights, landing gear, and so on)
  - Rules of engagement
  - Plan.
- Aggregate entities copy the same information as individual entities plus the list of subordinates.

VR-Forces does not copy:

- The current task.
- State information, except as noted previously.
- Load balancing status. All objects get pasted into the currently selected back-end.
- Embarkation structures. If, for example, you copy an aircraft carrier that has planes embarked, only the carrier is copied, not the embarked entities.

! The copy/paste process is resource intensive. It is primarily for use during scenario development. Use during a simulation could affect performance.

2.8.1. Copying Objects

To copy objects:

1. Select the objects you want to copy.
2. Choose **Entities** → **Copy**.

2.8.2. Pasting Objects

A simple paste pastes all of the attributes of an object that get copied. It pastes objects as follows:

- Tactical graphics are placed on the currently selected overlay. If you copied objects that were on different overlays, that differentiation is not preserved.
- Copied objects maintain the state at the time that they were copied. Therefore, if you paste objects some time after they were initially copied, the copies do not reflect any changes that may have taken place to the original entities. For example, if an entity was copied and then deleted, the copied version of the entity is still pasted.
- Embarkation structures are not copied, only the parent entity.

Pasting entity plans may have unexpected consequences, because their object references do not change when you copy them. For example, suppose the plan for Entity A refers to Waypoint 1. You copy Entity A and Waypoint 1 and paste them as Entity B and Waypoint 2. If you copy the plan, Entity B's plan will still refer to Waypoint 1. If you expected it to refer to Waypoint 2, you will not see the behavior you expected. You can choose not to paste plans. For details, please see "Pasting Specific Entity Characteristics," on page 2-19.

To paste objects:

1. Choose **Entities** → **Paste**. The objects in the paste buffer are displayed on screen. They float as you move the cursor to show you where they will be placed when you paste them.
2. Click on the terrain where you want the objects to be pasted. They are pasted in the relative positions in which they were copied. If an object has an altitude, it is pasted using the same altitude above the terrain as the original object.
3. Optionally, continue pasting additional copies if desired.
4. Right-click to exit paste mode.

2.8.3. Pasting Specific Entity Characteristics

When you paste entities, you can specify which of the following entity characteristics you want to paste with the entity:

- Plans.
- Appearance.
- Heading.
- Rules of engagement.
- Entity name. (If you are pasting an entity in its original scenario, you must paste with a new name. However if you are copying it to another scenario, you might want to keep the same name.)
- Altitude. You can specify that the previous altitude be applied as above terrain or as above sea level.

To paste particular entity characteristics:

1. Choose **Entities** → **Paste Special**. The Paste Special dialog box opens.

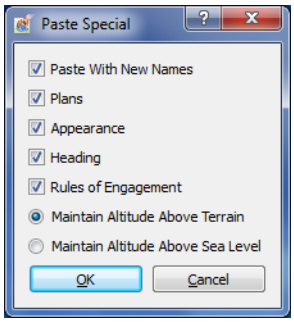


Figure 2-10. Paste Special dialog box

2. By default, all check boxes are selected. Clear the check boxes for the options you do not want to paste. If you are pasting entities into the scenario from which they were copied, you must paste with new names. Clearing that option will cause the paste to fail.
3. Choose the altitude option that you want to use.
4. Click OK. The objects in the paste buffer are displayed on screen. They float as you move the cursor to show you where they will be placed when you paste them.
5. Click on the terrain where you want the objects to be pasted. They are pasted in the relative positions in which they were copied.
6. Optionally, continue pasting additional copies if desired.
7. Right-click to exit paste mode.

Pasting Altitude

When you paste objects, if the pasted object can have an altitude value, such as a fixed-wing entity, a waypoint, or the vertices of a route, the default behavior is to replicate the original altitude above the terrain. If you use the Paste Special operation, you can choose to apply the original altitude as being above sea level. Figure 2-11 illustrates these alternatives. A waypoint is placed on the terrain. It is 0 meters above the terrain. However, the terrain itself is 200m above sea level. If the waypoint is copied and pasted at point A and the altitude above the terrain is maintained, the point is placed at 0m above the terrain. If the point is pasted at point B and altitude above sea level is maintained, it is placed 200m above sea level.

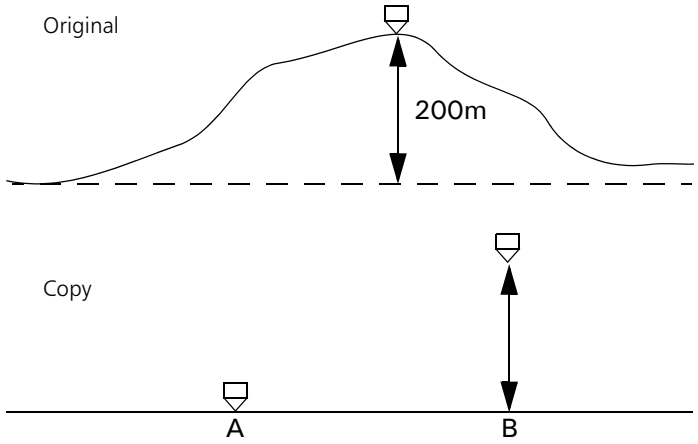


Figure 2-11. Pasting altitude

2.9. Creating Cultural Features

Cultural features are objects that you can add to a scenario to simulate human artifacts such as buildings, bridges, and so on. They are in the Building and Cultural Feature categories on the Create menu and the Entity Palette. You add them to a scenario the same way you would add an entity. Cultural features are listed in the Objects List Panel. You can apply some set data requests to them, such as Location and Heading.

! Some of the choices on the cultural feature lists are the same as those available on the Prop Palette. However, cultural features are not the same things as props. Props are terrain objects and can be saved as part of a terrain. Cultural features are not part of the terrain, they are a type of entity and are saved in the order of battle file.

2.10. Creating Props

Props are terrain objects that you can select independently of the terrain. Section 10.12.1, "Extracting Props from a Terrain Patch," in *VR-Forces Configuration Guide* explains how to create them by extracting them from a terrain or a feature layer. However, you can also create them from the Props Palette, similarly to how you create entities. This is a valuable feature if your terrains do not have any features that you can extract as props. However note the following important details:

- Props are not saved in a scenario. If you want to save a prop, you must save the terrain. You can save the terrain to a different name or overwrite the existing terrain. The next time you open the terrain, the prop will be part of it.
- When you create a prop, the back-end does not know anything about it, because it is a terrain object. To have the back-end take the prop into account, you must save the terrain (as mentioned in the previous paragraph) and start a new scenario that uses the terrain.
- You can also create cultural features that look exactly like the props that you can create. However cultural features are not the same things as props. Cultural features are treated like entities. They are listed with entities and tactical graphics and get saved as part of the scenario.

The list of props that you can create from the Prop Palette is based on the model definitions defined on the Model Definitions tab of the Visual Model Editors dialog box. Therefore, you can add new props to the Prop Palette by adding new model definitions. For details, please see Section 12.7, "Adding Object Models as Props," in *VR-Forces Configuration Guide*.

2.11. Adding an Object to the Favorites List

As mentioned in "Selecting the Object to Create," on page 2-3, the Create menu does not include all of the objects that you can create. It just lists the objects that you have designated as "Favorites". When you specify that an entity or tactical graphic be a favorite, it is automatically added to the Create menu.

The favorites list is specific to a simulation model set. It is saved to *./data/simulationModelSets/<model_set>/gui/favorites.mst*. You can copy the file to other instances of VR-Forces or future releases and your favorites list will be enabled.

To add or remove an object from the Favorites list:

1. Open the Entity Palette or Tactical Graphics Palette.
2. Select the category for the object you want to add to the Favorites list.
3. Click the star to the left of the object's name.

3

Creating and Managing Entities

This chapter explains how to create and manipulate entities. For information about working with aggregate entities, please see Chapter 4, *Working with Aggregate Entities*. For information about managing entity information, please see Chapter 7, *Viewing Entities and Entity Information*, in *VR-Forces Users Guide*. For information about entity hostility relationships, target detection, and target acquisition, please see Chapter 10, *Target Detection and Combat Features*. For information about assigning tasks and set data requests to entities, please see Chapter 6, *Assigning Tasks* and Chapter 8, *Setting Entity State*.

3.1. Creating Entities

The basic procedure for creating an entity is fairly simple:

1. On the Create menu or Entity Palette, select the entity that you want to create.
2. Click on the terrain to place the entity.
3. Optionally, specify the properties of the entity, such as name, altitude, and heading.

The generic procedures for choosing the entity to create, placing it on the terrain, and setting properties are described in Chapter 2, *Creating and Placing Objects*. This section provides additional details about entity creation and placement.

You can also create entities by copying existing entities. For details, please see "Copying and Pasting Objects," on page 2-17.

You can create pre-configured aggregates the same way you create individual entities. You can also create aggregates by aggregating existing entities. To learn how to create an aggregate, please see "Creating Aggregates," on page 4-5.

When you create entities, if spot reports are enabled and a particular force is hidden, if you create an entity of the hidden force, you will not be able to see it. It is recommended that you disable spot reports or set the viewpoint to show all forces when you are creating scenarios. For details about spot reports, please see "Displaying Entities Based on Spot Reports," on page 10-2.

The force ID of the entity is set to the type specified in the simulation model set.

3.1.1. Default Placement of New Entities

By default, ground, lifeform, rotary-wing, and fixed-wing entities get placed on the ground. Surface and subsurface entities are created at sea level.

Ground-based entities are placed at the highest possible terrain intersection at the location. If a terrain supports buildings with multiple levels, the entity is placed at the highest level. Once the entity begins moving, if the next calculated location resides in-between two levels of terrain, and if the entity is configured to respect terrain intersections when moving, and there is no terrain blocking its movement, the entity places itself at the closest elevation to the desired location.

3.1.2. Placing Entities Inside Buildings

One of the benefits of creating entities in a 3D observer mode is the ease of placing entities in the precise location and orientation that you want them to be in, particularly inside buildings. However, placing entities inside small enclosed spaces can be hindered by the location of walls relative to the observer. You can work around this problem by:

- Adjusting the near clipping plane to remove the display of walls and floors until you see the location where you want to place entities. For details about changing the clipping plane, please see Section 9.4.1, "Setting the Clipping Planes," in *VR-Forces Configuration Guide*.
- Adjusting the transparency of a building so that you can see inside of it. For details about changing transparency, please see Section 10.12.5, "Setting the Opacity of Props," in *VR-Forces Configuration Guide*.

If you enable view constraints, it may restrict your ability to move the observer into buildings. You can disable view constraints by pressing **x**.

3.1.3. Placing Entities on Other Entities

If you want to place an entity on or in another entity, such as an aircraft on an aircraft carrier or a dismounted infantry entity in a truck, then you must embark the entity. Creating an entity on top of another entity will not provide the results you want. For example, if you create a fixed-wing entity and manipulate its location and altitude so that it looks like it is on the deck of an aircraft carrier, as soon as you start the simulation, the jet will start flying at that altitude, because it is not attached to the carrier. It is just created at a particular location. For complete details about embarking entities, please see "Embarking and Disembarking Entities," on page 3-5.

3.1.4. Entity Resources

When you create an entity, it has a full complement of resources, as defined in the object parameter database. You do not have to assign resources to an entity when you create it. However, if you want an entity to start a simulation with less than a full set of resources, you could use Resource set data requests to set its resources at some amount less than 100%.

3.1.5. Deleting Entities

To delete an entity:

1. Select the entity you want to delete.
2. Choose **Entities** → **Delete** or press the **`Delete`** key.

- If you delete an aggregate entity, all its subordinates also get deleted.
- If you delete an entity that has an intervisibility object pinned to it, the intervisibility object also gets deleted. For details, please see Section 14.10, "Deleting Intervisibility Objects," in *VR-Forces Users Guide*.

3.2. Editing Entities

You can edit the following entity properties:

- Name
- Location
- Heading
- Altitude
- Overlay.

To edit an entity:

1. Select the entity.
2. Choose **Entities** → **Edit**. The Edit Entity dialog box opens (Figure 3-1).

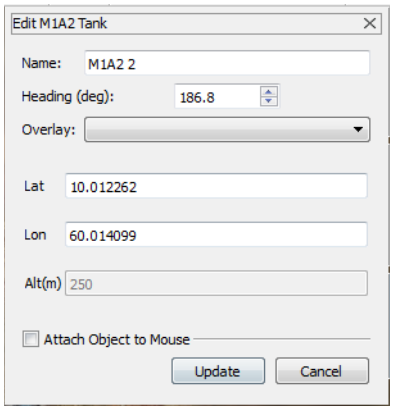


Figure 3-1. Edit Entity dialog box

3. Change the properties as desired.
4. Click OK.

You can also change the location, altitude, and heading dynamically, through a variety of movement tasks, or with set data requests. For details, please see:

- "Setting Altitude Dynamically," on page 2-13.
- "Specifying an Object's Heading Dynamically," on page 2-15.
- "Moving Objects," on page 2-16.
- Chapter 7, *Task Procedures*.
- Chapter 8, *Setting Entity State*.

3.3. Embarking and Disembarking Entities

Embarkation places entities into or onto other entities, for example, dismounted infantry in a truck, trucks on an LCAC, or aircraft on an aircraft carrier. While embarked, the entities travel with the entity on which they are embarked. Embarked entities are not visible in the 2D view. They are always visible in the 3D view.

If you are using HLA and want to use the embarkation feature, you must use RPR FOM 2, draft 17. VR-Forces includes configurations in the Simulation Connections Configuration dialog box that start VR-Forces using the correct FED file and FOM Mapper for RPR FOM 1.0 and RPR FOM 2, draft 17.

You can attach control objects to entities so that embarked entities can use them to move about on the parent entity. For example, an aircraft could taxi towards a waypoint on the flight deck of an aircraft carrier.

Attached objects are shown in the Embarkation View on the Objects List Panel.

The embarkation status of entities is displayed in the Embarkation View of the Objects List Panel (Figure 3-2).

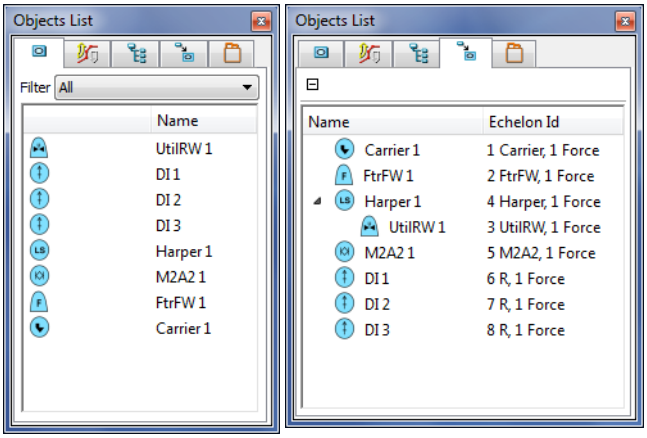


Figure 3-2. Echelon View and Embarkation View

You can embark and disembark entities instantly (described in this section), or you can have them simulate embarkation and disembarkation using the Embark and Disembark tasks, described in Chapter 7, *Task Procedures*.

When you embark an entity using the Embark task, the entity can embark only on entities that are configured to accept that type of entity. For example, LCACs are configured to accept several types of ground vehicles. You cannot give a DI an Embark task to embark on an LCAC. However, when you use the immediate embark method to embark an entity, you can use preconfigured slots (spaces) for entities or specify an override. When you specify an override you can embark an entity on any other entity at the coordinates you enter. However, it is your responsibility to know what the proper coordinates are.

3.3.1. Embarking and Disembarking Entities Instantly

You can embark and disembark entities instantly using commands on the Entities menu, using set data requests, or in the Embarkation View. Using set data requests lets you embed immediate embarkation in plans. This may be particularly useful in a global plan, in which you may want to quickly create and embark entities without paying attention to the realism of the action. For details about using set data requests for embarkation, please see "Embarked," on page 8-11 and "Disembarked," on page 8-10.

Embarking Entities Instantly Using the Embark On Command

The Embark On command lets you embark entities using preconfigured embarkation spaces or using specific coordinates. If the embarkation spaces on the parent entity are full, VR-Forces sends a message to the back-end console and the entity is not embarked. To embark entities instantly from a plan, use the Embarked set data request.

To embark an entity instantly using the Embark On command:

1. Select the entity that you want to embark.
2. Choose **Entities** → **Embark On**. The Embark On dialog box opens.

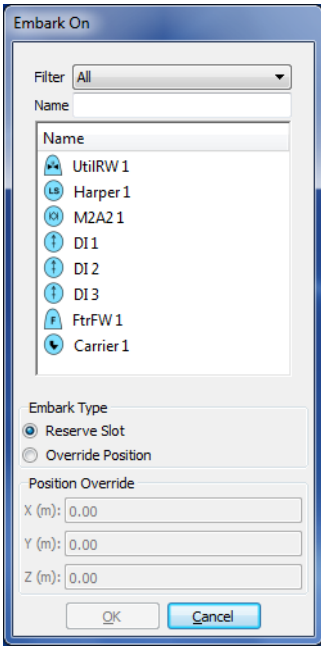


Figure 3-3. Embark On dialog box

3. Optionally, filter the list of potential parent entities.
4. Select the parent entity.
5. To embark in a configured space, select the Reserve Slot option. To specify an embarkation point, select Override Position.
6. If you chose the Override Position option, specify the coordinates on the parent, in body coordinates, for the embarkation point.
7. Click OK.

Embarking Entities in the Embarkation View

To embark an object in the Embarkation View:

1. On the Objects List Panel, select the Embarkation view.
2. Drag the entity you want to embark onto the parent entity. The Embarked dialog box opens.
3. Click OK to embark using the Reserve Slot option.
4. To specify an embarkation location, select Override Position and specify the location.
5. Click OK.

3.3.2. Disembarking Entities Using the Disembark Command

Like the Embark On command, the Disembark command is typically used as part of scenario development. To simulate disembarkation, you would use the Disembark task. To provide instant disembarkation in a plan, you would use the Disembarked set data request.

To disembark an entity instantly:

1. Select the entity that you want to disembark.
2. Choose **Entities** → **Disembark**. If the entity was embarked using the default embarkation point, it is disembarked next to the former parent entity. If the entity was embarked using a position override, it is disembarked in the same location as the former parent.

To disembark an entity in the Embarkation View:

1. Open the Embarkation View.
2. Drag the entity you want to disembark off of the parent entity to the force level.

Disembarking All Entities

When you disembark all entities from a parent, the placement of the entities depends on how they were embarked. If the entities were embarked with the Embark On command or the Embark task, they are disembarked to separate locations near the parent. If they were embarked with the Embarked set data request, they are all disembarked in the same location in the center of the parent entity. Since this behavior is usually not desirable, you should understand how you embarked the entities before you use this command.

To disembark all entities from a parent entity:

1. Select the parent entity.
2. Choose **Entities** → **Disembark All**.

3.4. Collision, Obstacle, and Feature Avoidance

By default, entities avoid other entities, features, and obstacle control objects. If, while carrying out a task, a ground, lifeform, or rotary-wing entity detects that it is on course to collide with another entity, a feature, or an obstacle, it alters its route to avoid the collision. Then it returns to its task.

When an entity avoids an obstacle, it does not necessarily follow the outline of the obstacle, it avoids the obstacle's bounding volume, which is conceptually the smallest rectangle that bounds all of the points in the obstacle.

Ground entities avoid features, such as buildings and plants. By default, entities avoid other entities (some cultural features are created as entities), buildings, water, and vegetation. (LCACs do not avoid vegetation by default.)

Collision avoidance has the following qualifications:

- To specify that ground entities should not move through the terrain (for example, through a wall or through a hill), set the **check-terrain-collisions** parameter in the automotive actuator component (powertrain) to True. For performance reasons, it defaults to False, so that entities that do not care about terrain collisions do not perform the check.
- If an entity is tasked to move to a point that is inside an obstruction, or very close to one, it might never reach the point, but it will continue to try to reach the point as long as the task is in effect. This behavior also applies to entities following routes that have vertices inside an obstruction.
- If a terrain has geometric features as well as point vector features, the feature avoidance may not work because the points are placed on the terrain on "top" of the existing geometry, which means they are on top of the geometric feature.
- Do not place entities inside obstacles. Their behavior will be unpredictable.
- Although you can assign a force to an obstacle when you create it, it has no effect on entity behavior. Entities avoid all obstacles.

You can configure the objects that an entity will avoid by editing its entry in the object parameter database. For details about configuring obstacle avoidance, please see Section 7.10, "Configuring Obstruction Avoidance," in *VR-Forces Configuration Guide*.

The B-HAVE Module for VR-Forces, an extra-cost plug-in for VR-Forces provides improved collision avoidance using advanced AI techniques.

3.5. Entity Movement and Soil Type

In VR-Forces, the movement of entities is affected by the surfaces on which they are moving. The speed of movement over a given surface (as a percentage of ordered speed) is configured in the **soil-list** block in an entity's object parameter database entry.

Table 3-1 lists the soil types supported for terrain databases and how they map to the roughness types that can configured in the **soil-list** block for VR-Forces entities.

Table 3-1: Soil type/roughness type mappings

Soil type	Roughness type
ocean	deep-water
deepLake	deep-water
shallowLake	shallow-water
deepRiver	deep-water
shallowRiver	shallow-water
shallowPond	shallow-water
shallowStream	shallow-water
dryGround	hard-packed
pavedRoad	paved-road
gravelRoad	gravel
dirtRoad	gravel
asphalt	hard-packed
USRailroad	hard-packed
softSoil	sand
swamp	muck
mud	muck
forest	hard-packed
grass	hard-packed
cultivatedFields	hard-packed
orchards	hard-packed
rock	rocks
boulder	rocks
sand	sand
building	hard-packed
tree	hard-packed

3.6. Using a Joystick to Control Entities

VR-Forces supports use of joysticks to control ground, fixed-wing, and rotary-wing entities. The default joystick parameters are specified in the file *./appData/settings/vrfSim/joyParam.dat*. (For details, please see Section 7.9, "Configuring Joysticks," in *VR-Forces Configuration Guide*.) You can override the default values for specific entities by editing parameters for the joystick controller in the system definition file for an entity's movement system.

- The joystick must be connected to the computer on which the entity is being simulated.
- You cannot enable or disable joystick support for all entities at once. You can only enable joysticks for individual entities.

To enable or disable joystick use:

1. Select the entity for which you want to enable or disable joysticks.
2. Choose **Entities** → **Enable Joystick** or **Disable Joystick**.

4

Working with Aggregate Entities

This chapter explains how to create and manage aggregate entities.

4.1. Introduction to Aggregates

It is important to understand the differences between an aggregate entity that is in the aggregated state and one that is in the disaggregated state. The types of aggregates are introduced in Section 3.6, "Aggregate Entities," in *VR-Forces Users Guide*. This section provides additional details about how aggregates function in the two different aggregation states.

4.1.1. How an Aggregate's State is Shown

Aggregates publish their current aggregate state using the DIS/RPR FOM aggregate state enumeration. The current value for this parameter is displayed on the Aggregate Information page in an aggregate's information dialog box (Figure 4-1). It can be accessed in the aggregate's *DtVrfAggregateStateRepository* member.

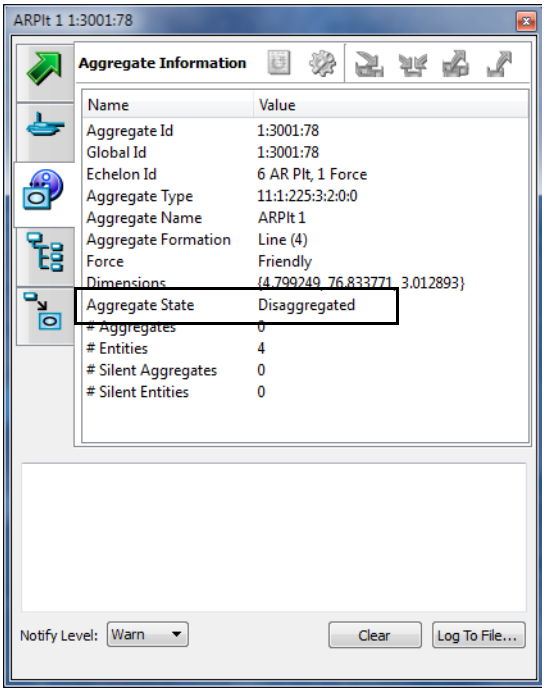


Figure 4-1. Aggregate Information page

Aggregated State

When an aggregate is in the aggregated state, its subordinates do not exist as distinct entities. It does not have any subordinates shown in the Echelon View or on the Subordinates tab of its information dialog box. It does not display ghosted icons for subordinates. You cannot expand or collapse it.

Disaggregated State

When an aggregate is in the disaggregated state, its subordinates are simulated as distinct entities. (However, it is possible to have a disaggregated aggregate with no subordinates.) Subordinates are displayed under the aggregate in the Echelon View and are listed on the Subordinates tab of its information dialog box. You can expand or collapse the aggregate view.

4.1.2. Changing the Aggregation State at Runtime

Aggregates can change their aggregation state at runtime. All state information maintained by the aggregate (for example, the current task it is executing, plan state, current resource levels) is maintained across the transition between aggregated and disaggregated states. This section describes how aggregates handle transitions for the most important activities.

Movement

All movement tasks can be executed in either aggregated or disaggregated state. Aggregates can transition between states at any time, without interrupting movement tasks. For example, suppose an aggregate in the disaggregated state, is executing a move-to-location task. While it is executing the task, you issue a Aggregate State set data request, indicating it should switch to the aggregated state. The aggregate transitions into the aggregated state (subordinates are deleted, and the state associated with them is mapped and stored internally in the aggregate), and continues moving toward its destination. Similarly, making a transition in the opposite direction while executing a movement task, does not interrupt the execution of that task.

Aggregates preserve their formation across aggregate state transitions.

Combat

Only disaggregated aggregates can engage in combat. However, an aggregate remembers any loss of resources or subordinates while it is aggregated. If a subordinate is destroyed while the aggregate is disaggregated, it will not be created again if the aggregate aggregates and then disaggregates again.

Resources

Resources are tracked and restored across state transitions. However, if a subordinate is destroyed while in the disaggregated state, then all of its resources are lost. They are not redistributed to other subordinates.

When you restore an aggregate that is in the aggregated state (using Restore), the original configuration of the aggregate is recreated. If you restore an aggregate that is in the disaggregated state, then only those subordinates still present in the simulation are restored. Any destroyed subordinates that were previously removed from the simulation as result of a disaggregate-->aggregate--> disaggregate transition are not restored. To fully recover all subordinates, restore the aggregate while in the aggregated state.

4.1.3. Triggering Aggregate State Transitions

Aggregate state transitions can be initiated manually or automatically, as follows:

- Manually: You can send a Aggregate State set data request or use Aggregate and Disaggregate commands on the Entities menu. This immediately forces the aggregate to change state. As a set data request, state changes can be included in plans.
- Automatically: On the Aggregate Display Settings page of the Display Settings dialog box you can configure automatic aggregation and disaggregation. In automatic mode, aggregates automatically aggregate or disaggregate according to the following rules:
  - If the aggregate is within “disaggregation range” of a hostile entity or aggregate, the aggregate is in the disaggregated state. Disaggregation range is the range around an entity or aggregate in which you want to force any nearby aggregated entities to disaggregate so you can detect or engage them. This range is configurable for every type of entity and aggregate in the Entity Editor. (You must show advanced parameters to set this parameter.)
  - If the aggregate’s formation footprint (projection of its bounding extent in a topographic plane) overlaps a disaggregation area, the aggregate is in the disaggregated state. (A disaggregation area is a specific type of control object.)
  - If neither of the above conditions is in effect, the aggregate is in the aggregated state.

4.2. Creating Aggregates

You can create an aggregate by selecting existing entities (which can be individual entities or aggregate entities) and combining them to form an aggregate entity, or by placing a preconfigured aggregate from the Entity Palette.

When you create an aggregate, it is created as a subordinate to the force level. You cannot create aggregates that are subordinates of an existing aggregate. Once you create an aggregate, you can subordinate it to another aggregate. (For details, please see "Adding Entities to an Aggregate," on page 4-9).

By default, aggregates are created in a disaggregated state. However, you can change this behavior. For details, please see "Configuring the Aggregate Creation State," on page 4-8.

4.2.1. Creating an Aggregate by Combining Existing Entities

When you create an aggregate by combining entities, you can specify the order of subordinates in the aggregate. This determines which subordinate is considered the aggregate leader and affects the assignment of echelon IDs. You cannot change the subordinate order after you create the aggregate.

When you create an aggregate entity, the members of the aggregate get new echelon IDs to reflect the new entity hierarchy.

To create an aggregate by combining existing entities:

1. Select the entities that you want to become part of an aggregate.
2. Choose **Entities** → **Aggregate As**. The Aggregate As dialog box opens (Figure 4-3).

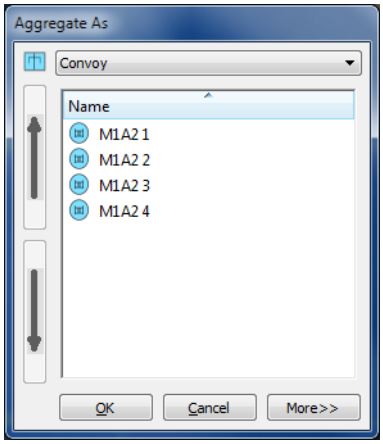


Figure 4-2. Aggregate As dialog box

3. Select an aggregate type from the list.

The Convoy aggregate can only be assigned convoy tasks. Its only purpose is to allow you to quickly aggregate miscellaneous ground vehicles into a convoy. You cannot aggregate or disaggregate a convoy aggregate.

4. Optionally, customize the entity type enumeration for the aggregate, as follows:
   a. Click More. The dialog box expands to show the entity type enumeration for the aggregate type selected.

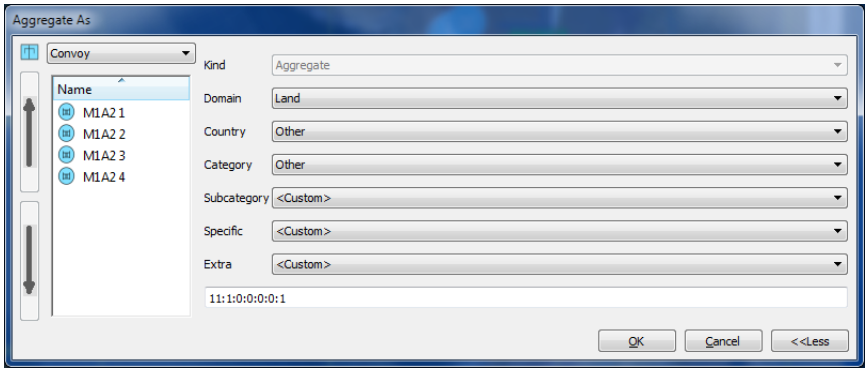


Figure 4-3. Aggregate As dialog box

   b. Edit the enumeration by typing values in the boxes in the left column, or selecting values from the lists in the right column.

If an edit to the enumeration results in an entity type that does not match the aggregate type selected in the list, the list entry does not change. However, the aggregate will be created with the entity type specified by the custom enumeration.

5. Optionally, change the order of subordinates, as follows:
   a. Select the subordinate whose order you want to change.
   b. Click the up or down arrow to move it to a new position in the list of subordinates.
6. Click OK.

By default, the aggregate is created in a disaggregated, collapsed format. The icons for individual members are hidden. You can change the default aggregation state. For details, please see "Configuring the Aggregate Creation State," on page 4-8.

4.2.2. Creating a Preconfigured Aggregate

VR-Forces includes preconfigured aggregates at several hierarchical levels. You can configure these entities and add additional aggregates in the Entity Editor. (For details, please see Section 5.7, "Editing Aggregate Composition and Formations," in *VR-Forces Configuration Guide*.)

You can create preconfigured aggregates by selecting them on the Entity Palette and follow the standard procedures for creating entities. The abbreviations in the aggregate names have the following meanings:

- ADA. Air defense artillery.
- COLT. Combat observation lasing team.
- CSS. Combat service support.
- FA. Field artillery.
- MI. Mechanized infantry.

You can add additional preconfigured aggregates to the Entity Palette by creating them in the Entity Editor.

4.2.3. Configuring the Aggregate Creation State

To configure the aggregation state used when aggregates are created:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Aggregate Display Settings page (Figure 4-4).

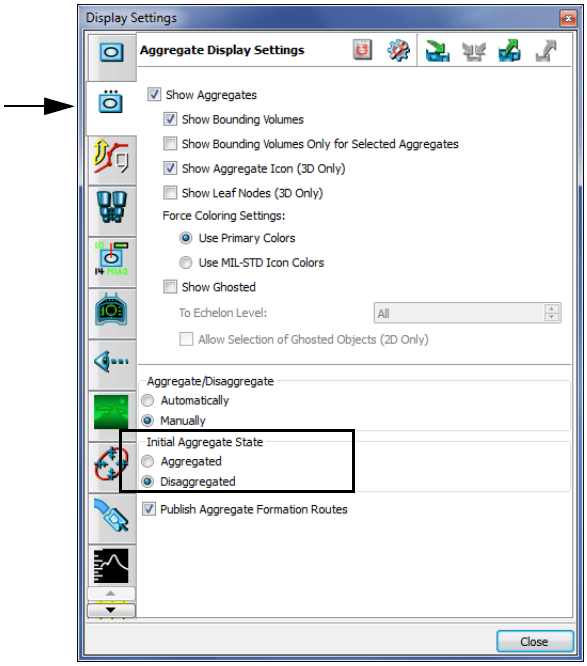


Figure 4-4. Aggregate Display Settings page

3. In the Initial Aggregate State group box, select the creation option that you want.
4. Click OK.

4.3. Selecting an Aggregate

➤ To select an aggregate, select its icon on the terrain, or select it in one of the views on the Objects List Panel.

4.4. Adding Entities to an Aggregate

➤ To add an entity to an aggregate, in the Echelon View, select the entity you want to add and drag it onto the aggregate as illustrated in Figure 4-5. Notice that the name of the aggregate stays the same, but its echelon ID changes.

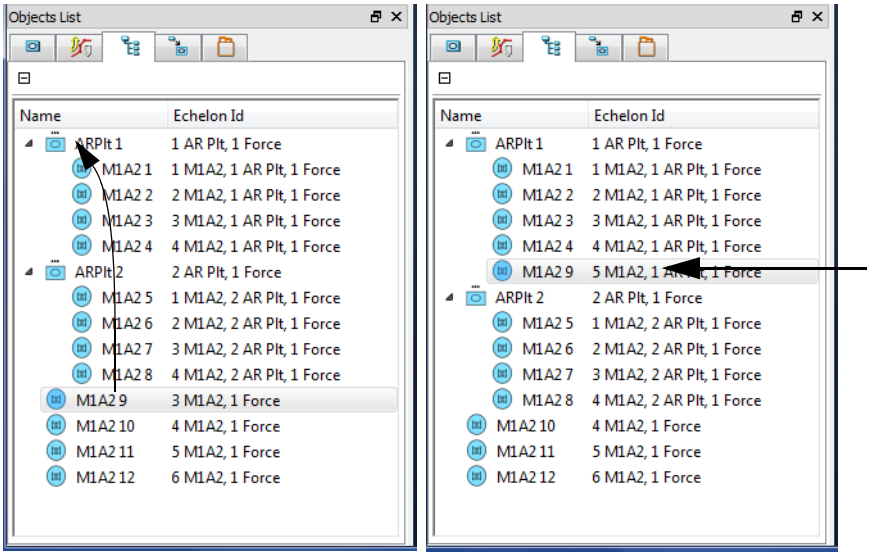


Figure 4-5. Adding an entity to an aggregate

4.5. Removing an Entity from an Aggregate

➤ To remove an entity from an aggregate, in the Echelon View, drag the entity from the aggregate to the force level in the window, as illustrated in Figure 4-6, or into another aggregate. Notice that the name of the aggregate stays the same, but its echelon ID changes.

You can remove entities from an aggregate only if it is in the disaggregated state.

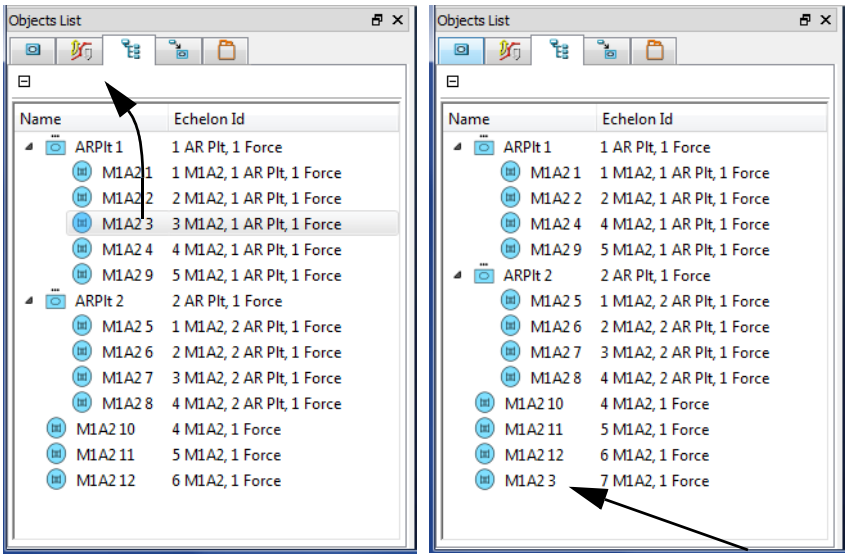


Figure 4-6. Removing an entity from an aggregate

4.6. Changing the Aggregation State of an Aggregate Entity

You can aggregate and disaggregate aggregates manually and automatically.

> The Convoy aggregate does not support aggregation and disaggregation.

4.6.1. Aggregating and Disaggregating Entities Manually

To aggregate a disaggregated entity:

1. Select the aggregate.
2. Choose **Entities** → **Aggregate**.

> You can also change an aggregate's state with the Aggregate State set data request (which also means that you can change state from within a plan).

To disaggregate an aggregated entity:

1. Select the aggregate.
2. Choose **Entities** → **Disaggregate**.

4.6.2. Configuring Automatic Aggregation and Disaggregation

When automatic aggregation and disaggregation is enabled, aggregated entities automatically disaggregate when they enter a disaggregation area or when they encounter opposing forces.

To configure automatic aggregation and disaggregation:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Aggregate Display Settings page (Figure 4-4).
3. In the Aggregate/Disaggregate group box, select Automatically or Manually.
4. Click OK.

4.6.3. Using Disaggregation Areas

When an aggregated entity that has automatic aggregation and disaggregation enabled enters a disaggregation area, it disaggregates. When it leaves the area, it aggregates again. A disaggregation area is a control object. You create one just like any other area, as described in Chapter 2, *Creating and Placing Objects*.

4.7. Writing Plans for Aggregates

➤ To write a plan for an aggregate, follow the procedures for writing a plan for an entity in Chapter 9, *Writing Plans*.

4.8. Deleting an Aggregate

! If you delete an aggregate, all its member entities get deleted.

To delete an aggregate:

1. Select the aggregate.
2. Choose **Entities** → **Delete**.

5

Overlays and Tactical Graphics

This chapter explains how to create and edit overlays and tactical graphics.

5.1. Introduction

Tactical graphics are graphical objects, such as lines, points, and areas, that you can draw on the terrain, or which are drawn by VR-Forces or remote applications. Control objects are a special kind of tactical graphic. Entities are aware of control objects and most lines and points and can interact with them. For example, an entity can follow a route, move to a point, or avoid an obstacle. VR-Forces can test to determine if an entity is in an area or to either side of a phase line.

All tactical graphics and entities are placed on overlays. By default, they are placed on the Default overlay. You can create additional overlays and assign objects to them.

For conceptual information about tactical graphics, please see Section 3.7, "Tactical Graphics," in *VR-Forces Users Guide*.

5.1.1. Naming Tactical Graphics

The names you assign to graphics must be unique among all objects. Names are case sensitive, for example you can create three points called Waypoint Alpha, waypoint alpha, and Waypoint alpha, but you cannot create an area called Area 1 and a disaggregation area called Area 1. Object names can be up to 255 characters long.

Some character sets require multiple ASCII characters to represent a displayed character. If you use one of the these character sets, the maximum length of object names in visible characters may vary.

5.2. Creating and Editing Overlays

Overlays allow you to add graphic objects to the VR-Forces window as if you were adding clear plastic overlays to a physical map and drawing on them. They provide a convenient way to organize and manage the tactical graphics in a simulation. You can add any number of overlays. You can rename them. You can enable or disable editing of the objects they contain.

When you create a tactical graphic, entity, or cultural feature, if you do not explicitly assign it to an overlay, it gets placed on the Default overlay. If the Default overlay does not exist, it gets created.

5.2.1. Creating an Overlay

To create an overlay:

1. On the Objects List Panel, select the Overlays tab (Figure 5-1).

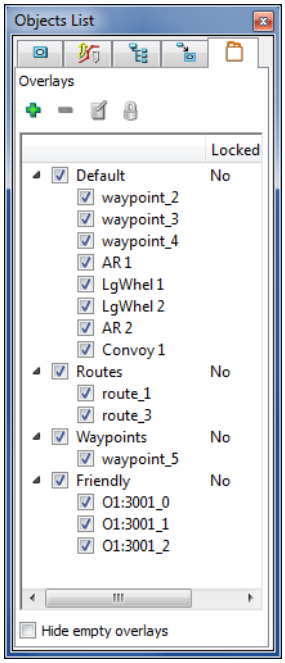


Figure 5-1. Overlays tab

2. Click the Add button (✚). An overlay is added to the list with a default name.
3. Optionally, change the name as described in "Changing an Overlay's Name," on page 5-5.

5.2.2. Selecting Overlays

➤ To select an overlay, click its name on the Overlays tab.

5.2.3. Locking an Overlay

When an overlay is locked, you cannot edit the objects on it. You can still add and delete objects.

To lock or unlock an overlay:

1. On the Objects List Panel, select the Overlays tab.
2. Select the overlay you want to lock or unlock.
3. Click the Lock/Unlock button (🔒), or double-click the entry in the Locked column. It will toggle between Yes and No.

5.2.4. Changing an Overlay's Name

To change an overlay's name:

1. On the Objects List Panel, select the Overlays tab.
2. Select the overlay that you want to rename and click the Rename button (), or double-click the overlay whose name you want to change. The name becomes editable.
3. Type a new name.
4. Press **Enter**.

5.2.5. Deleting an Overlay

To delete an overlay:

1. On the Objects List Panel, select the Overlays tab.
2. Select the overlay you want to delete.

! When you delete an overlay, all of the tactical graphics on it are also deleted.

---

3. Click the Delete button ().

5.3. Creating Tactical Graphics

The generic procedures for creating tactical graphics are described in Chapter 2, *Creating and Placing Objects*. This section provides additional details about tactical graphic creation and placement.

5.3.1. Creating Freehand Lines

A freehand line is essenitally many short line segments. After you create a freehand line you can change the sampling rate used to determine how many segments it has. The fewer the segments, the less fluid the line is.

Unlike other lines, the individual vertices of a freehand line do not have vertex markers. You cannot select them individually on the map. However, you can edit them in the Edit Freehand Line dialog box.

The Freehand Line With Arrow automatically puts an arrow at the end of the line. However, you can also add an arrow to a freehand line that is created without one.

If you reduce the sampling rate, resulting in fewer segments and a less fluid line, once you save the line you cannot automatically increase the number of segments to increase the fluidity of the line. You would have to add vertices by hand.

To create a freehand line:

1. Open the Tactical Graphics Palette.
2. Select the Shapes category.
3. Select Freehand line or Freehand Line with Arrow.
4. Click where you want the line to start, and while holding down the left mouse button, draw a line on the screen.
5. Release the mouse button. The Create Freehand dialog box opens.
6. Edit the properties as desired.

5.3.2. Drawing Circles and Ellipses

Entities do not interact with circle and ellipses. They are strictly for use as graphics.

To draw a circle:

1. Open the Tactical Graphics Palette.
2. Select the Shapes category.
3. Select Circle. The cursor changes to draw mode and shows a vertex icon.
4. Click to place the center of the circle. A center point is placed on the terrain and a circle is drawn. There is now a vertex icon on the circumference of the circle.
5. Drag the mouse to set the radius of the circle.
6. Click to complete the circle.

To draw an ellipse:

1. Open the Tactical Graphics Palette.
2. Select the Shapes category.
3. Select Ellipse. The cursor changes to draw mode and shows a vertex icon.
4. Click to set the center of the ellipse. A center point is set and a small circle is displayed with a vertex indicator at the bottom of the circle.
5. Drag the mouse up or down and click to set the height of the ellipse. A vertex indicator is added to the left side of the circle.
6. Drag the mouse left and right and click to set the width of the ellipse.

5.3.3. Drawing Boxes

Boxes are constrained to be parallelograms. Entities do not interact with boxes. (In other words, they are not areas.)

To draw a box:

1. Open the Tactical Graphics Palette.
2. Select the Shapes category.
3. Select Box. A box is attached to the cursor
4. Click to place the box in the approximate location that you want.
5. Double-click any vertex. The vertex changes to show it is editable.
6. Drag the vertex to reshape the box.

5.3.4. Adding Text to an Overlay

You can add text to an overlay. The maximum width of the text object is fixed.

To add text to an overlay:

1. Open the Tactical Graphics Palette.
2. Select the Shapes category. (Text is also in the Logistics, Intel, and Symbols categories.)
3. Select Text. The text “Text” is attached to the cursor.
4. Click to set the bottom center of the text. The Create Text dialog box opens.
5. Type the text you want in the Text box.
6. Edit any other properties as desired.
7. Click Create.

5.3.5. Assigning Tactical Graphics to an Overlay

By default, when you create a tactical graphic, it gets assigned to whichever overlay is selected on the Overlay tab. If no overlay exists, the Default overlay is created and the graphic is assigned to it. You can assign a tactical graphic to a different overlay when you create it or edit it. To assign a tactical graphic to an overlay when you create it, set this property as described in "Specifying an Object's Properties Before You Create It (Click to Locate)," on page 2-11. To move a tactical graphic to a different overlay, follow the procedure in "Moving a Tactical Graphic to a Different Overlay," on page 5-8.

Moving a Tactical Graphic to a Different Overlay

To move a tactical graphic to a different overlay:

1. Select the object you want to move.
2. Choose **Entities** → **Edit**. The Edit Object dialog box opens.
3. If Attach Object to Mouse is selected, clear the check box.
4. In the Overlay list, select the overlay that you want the object to move to.
5. Click Update.

You can also move a tactical graphic to a different overlay by dragging it to the new overlay on the Overlays tab of the Objects List panel.

5.3.6. Displaying a Terrain Profile When You Create a Line

You can display a terrain profile window while you create a line. You can configure terrain profiles to automatically display a terrain profile when a line is created (Section 13.1.2, "Configuring Terrain Profiles," in *VR-Forces Users Guide*), or you can display the window manually.

To open a terrain profile window while you are creating a line:

1. Select the object that you want to create as described in "Selecting the Object to Create," on page 2-3. A Create Object tab is added to the window below the Prop Palette (Figure 2-4).
2. Click the Create Object tab. A Create Object dialog box that is appropriate for the object opens (Figure 5-2).

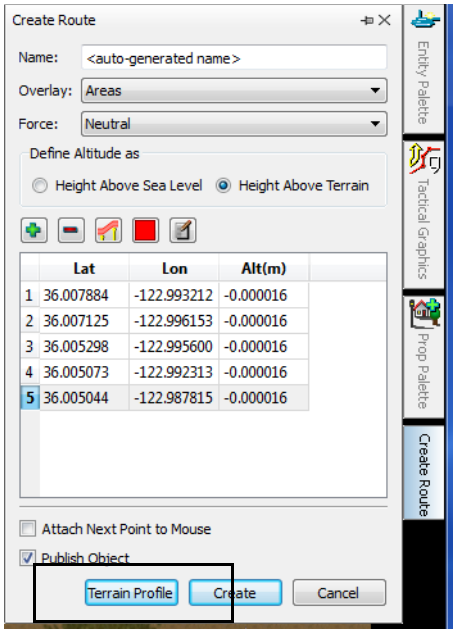


Figure 5-2. Terrain Profile button

3. Click to place the first vertex. The Terrain Profile button is activated.
4. Click Terrain Profile.

5.3.7. Publishing Tactical Graphics

By default, all tactical graphics are published. That is, they are sent out over the network and are visible to other participants in an exercise. You can choose to not publish a tactical graphic. In that case, it is visible only in the front-end on which it was created.

Published tactical graphics get saved to the order of battle file. Unpublished tactical graphics get saved to the overlays file that gets created as part of the scenario. You can also manually save tactical graphics to an overlay file separate from the one stored with the scenario.

To publish or unpublish a tactical graphic:

1. Select the graphic you want to edit.
2. Choose **Entities** → **Edit**. The Edit Object dialog box opens.
3. To publish the object, select the Publish Object check box. To unpublish it, clear the check box.

5.3.8. Creating Routes for Aircraft

When you create a route for a fixed-wing entity, remember that as an aircraft flies between the vertices of a route, it starts at the altitude of the first vertex and immediately rises or falls to the altitude of the next vertex as shown in the trajectory in (Figure 5-3). (It does not change altitude smoothly between the vertices.) If a terrain feature in-between the two vertices is higher than the trajectory followed by the aircraft, the aircraft will fly into the terrain, even though a line between the two vertices would not pass through the terrain. There is no terrain following built into the route following process for fixed-wing entities.

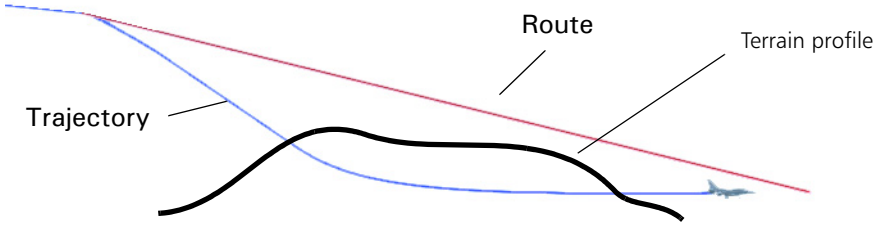


Figure 5-3. Fixed-wing trajectory between vertices

This caution applies to rotary-wing entities if there are abrupt changes in elevation in the terrain. Rotary-wing entities can follow the terrain, but they only look down, not ahead, so abrupt changes in terrain could cause a crash.

5.4. Deleting Tactical Graphics

To delete a graphical object:

1. Select the object you want to delete.
2. Choose **Entities** → **Delete**, or press the **`Delete`** key.

5.5. Editing Tactical Graphics

You can edit a tactical graphic's properties. The properties that you can edit vary depending on the type of graphic and can include some or all of the following:

- Add, delete, and edit vertices ("Editing Vertices," on page 5-12).
- Change its name.
- Change the altitude reference ("Setting Altitude in the Create Object or Edit Object Dialog Box," on page 2-13, "Specifying the Altitude for All of the Vertices in a Route," on page 2-14.
- Change the direction of a line ("Changing the Direction of a Line," on page 5-15).
- Edit linear and areal styles:
  - Change the pen style and width.
  - Change the line style.
  - Add or remove arrows.
  - Change the fill of an area.

  ("Changing Linear and Areal Style Properties," on page 5-15.)
- Move it to a different location ("Dragging an Object to a New Location," on page 2-16).
- Move it to a different overlay ("Moving a Tactical Graphic to a Different Overlay," on page 5-8).
- Change the color ("Changing the Color of a Tactical Graphic," on page 5-15).
- Resize boxes and text objects ("Resizing Boxes and Text Objects," on page 5-14).
- Rotate an ellipse ("Rotating an Ellipse," on page 5-14).

To edit a tactical graphic, its overlay must be unlocked.

5.5.1. Editing Vertices

You can edit the vertices of routes and areas. You can edit them dynamically or in the Edit Object dialog box.

Adding a Vertex

You can add vertices to a route or area directly on the terrain or in the Edit Object dialog box.

To add a vertex to an object dynamically:

1. Right-click the vertex next to which you want to add a new vertex. A menu is displayed.
2. Choose **Add Point After** or **Add Point Before**. A point is added midway between the selected vertex and the next or previous vertex, based on the command you chose.
3. Optionally, edit the new point as described in "Editing a Vertex," on page 5-13.

To add a vertex in the Edit Object dialog box:

1. Select the object you want to edit.
2. Choose **Entities** → **Edit**. The Edit Object dialog box opens (Figure 5-4).

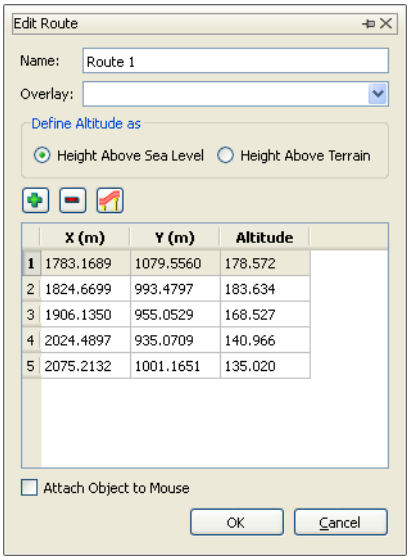


Figure 5-4. Edit Route dialog box

3. If Attach Object to Mouse is selected, clear the check box.
4. In the list of vertices, select the vertex after which you want to add the new vertex.
5. Click the Add button (+). A vertex is added midway between the selected vertex and the next vertex. If you selected the last vertex, a new vertex is added to the end of the route.

6. Optionally, edit the new point as described in "Editing a Vertex," on page 5-13.
7. Click Update.

Editing a Vertex

You can edit a vertex dynamically or in the Edit Object dialog box.

To edit a vertex dynamically:

1. Double-click the vertex.
2. Move the mouse to change the vertex's location.
3. Use **Alt**+mouse wheel or **Alt**+left mouse button+drag to change the altitude.
4. Click to place the vertex.

To edit a vertex in the Edit Object dialog box:

1. Select the object you want to edit.
2. Choose **Entities** → **Edit**. The Edit Object dialog box opens.
3. If Attach Object to Mouse is selected, clear the check box.
4. If you are editing a waypoint, click on the terrain to specify a new location or edit the coordinates and altitude in the Edit Waypoint dialog box.

   If you are editing a phase line, route, or area, you can:

   a. Double-click the coordinate value you want to change to make it editable.

   b. Type a new value and press Enter or click someplace outside of the value.

   Alternatively, you can click on the map to change the coordinates of the selected vertex. To set the altitude, you must edit the value by hand.
5. Click Update.

Deleting a Vertex

You can delete vertices directly or in the Edit Object dialog box.

To delete a vertex directly:

1. Right-click the vertex you want to delete. A menu is displayed.
2. Choose **Delete Point**. The point is deleted. (There is no confirmation prompt.)

To delete a vertex in the Edit Object dialog box:

1. Select the object you want to edit.
2. Choose **Entities** → **Edit**. The Edit Object dialog box opens.
3. If Attach Object to Mouse is selected, clear the check box.
4. In the list of vertices, select the vertex you want to delete.
5. Click the Delete button (−).
6. Click Update.

5.5.2. Resizing Boxes and Text Objects

You cannot edit the individual vertices of a box or a text object, you can only resize them.

➤ To resize a box or text object, grab one of its vertices and drag it to create the new object size.

5.5.3. Rotating an Ellipse

In addition to changing the width and height of an ellipse, you can rotate it around its center point. You can undo and redo ellipse rotation.

To rotate an ellipse:

1. Select the ellipse.
2. Choose **Entities** → **Edit**. The Edit *object* dialog box opens.
3. Select the Free Rotate check box.
4. Click OK.
5. Grab one of the points on the ellipse and drag it in a circular direction.

5.5.4. Changing the Direction of a Line

All lines have a direction. The direction affects how an entity moves along it and the direction that arrows face, if present. If you draw a line and then decide you want to reverse its direction, you can do so.

To change the direction of a line:

1. Select the line.
2. Choose **Entities** → **Edit**. The Edit *object* dialog box opens.
3. Click the Reverse Direction button ( ).
4. Click OK.

5.5.5. Changing the Color of a Tactical Graphic

You can change the color of a tactical graphic.

To change the color of an tactical graphic:

1. Select the graphic whose color you want to change.
2. Choose **Entities** → **Edit**. The Edit *object* dialog box opens.
3. Click the Color button ( ). A color picker dialog box opens.
4. Click a color button or click the Custom Color button to choose a new color from the Color Picker.
5. Click OK.

5.5.6. Changing Linear and Areal Style Properties

Lines and areas have a variety of properties that can be set in the Edit Style dialog box. The procedure is essentially the same for all of these properties. The properties you might be able to change are as follows:

- Line width. The width of the lines that make up a tactical graphic, either the actual line or the boundary of an area.
- Pen style. How the line or outline is drawn – solid line, no line, or as dashed and dotted lines. This property does not apply to lines that use a texture, such as Line of Contact.
- Fill style. The fill style for areal objects. Fill styles include degrees of solid fill and various types of line and grid fills.
- Line style. The different types of special lines, such as Main Axis.
- Arrow. You can add arrows to the end of a line or at the end of each segment of the line.

To change a style property:

1. Select the graphic you want to edit.
2. Choose **Entities** → **Edit**. The Edit object dialog box opens.
3. Click the Edit Style button (). The Edit Style dialog box opens (Figure 5-5).

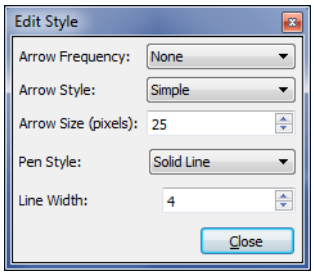


Figure 5-5. Edit Style dialog box

4. Change the properties by selecting options from the appropriate list or typing new values.
5. Click OK.

5.6. Saving and Loading Tactical Graphics and Overlays

If you publish a tactical graphic, it is automatically saved to the order of battle file (*.oob*). If you do not publish a tactical graphic, it is automatically saved to the overlay file (*.ovl*). There may be cases where you want to create a set of overlays for use in multiple scenarios. You can save them to an overlay file independently of the scenario, or even save the overlays and not save the scenario at all.

When you save overlay objects, only unpublished tactical graphics get saved.

To save overlays and tactical graphics:

1. Choose **File** → **Save Overlay**. The Save Overlay dialog box opens.
2. Type a name for the overlay file.
3. Click Save.

5.6.1. Loading Tactical Graphics and Overlays

You can load overlays that you have saved from a previous session.

To load overlays:

1. Choose **File** → **Load Overlay**. The Load Overlay dialog box opens.
2. Select the overlay file you want to load.
3. Click Open.

When you load overlay objects, you must use the same terrain database you created them on, or a terrain database that includes the area they were created in.

6

Assigning Tasks

This chapter provides general details about how to assign tasks to entities. For descriptions of specific tasks and how to assign them, please see Chapter 7, *Task Procedures*.

6.1. Assigning Tasks to Entities

You can assign tasks to an entity as part of its plan, as part of a global plan, and independently of any plan. For conceptual information about tasks, please see Section 3.8, "Tasks," in *VR-Forces Users Guide*. For information about how to add a task to a plan, please see "Adding an Entity Task or Set Data Request to a Plan," on page 9-18. For the procedures for assigning tasks, please see "Task Procedures," on page 7-4.

You cannot assign tasks to non-VR-Forces entities. However, you can use a remote entity as a parameter in a task, for example, following a remote entity, or targeting a remote entity. For more information, please see "Using Non-VR-Forces Entities in Plans," on page 9-35.

6.1.1. C++ Tasks and Scripted Tasks

The VR-Forces application includes a basic set of entity tasks for movement, weapons fire and other actions, that were developed using the VR-Forces Toolkit and the C++ API. System integrators often add additional tasks before delivering VR-Forces to their customers. These tasks are called C++ tasks to distinguish them from another type of task – the scripted task. Scripted tasks, written in the Lua programming language, use the lower-level C++ tasks and the VR-Forces Lua API to build higher-order tasks for entities.

To the VR-Forces end user, these tasks, all of which are listed on the Task menu, are indistinguishable. However, you can write new scripted tasks and edit existing tasks. Therefore, where necessary, when discussing a task, this manual will indicate which type of task it is discussing. For information about scripted tasks, please see Chapter 13, *Creating Scripted Tasks*.

VR-Forces also supports a special category of scripted tasks called reactive tasks. These tasks are not on the Task menu. They execute when a condition becomes true. For details, please see "Reactive Tasks," on page 6-10.

6.1.2. Concurrent Task Execution

Some tasks can execute at the same time. Some are mutually exclusive. If you assign an entity a task that is mutually exclusive with its current task, the current task is abandoned. If you assign a task that is not mutually exclusive with the current task, an entity executes the new task while continuing to execute the previous task.

When you assign a mutually exclusive independent task, VR-Forces displays a prompt that asks you to confirm interruption of the current task. You can disable this prompt if you always want a new task to interrupt the current task.

Tasks are organized into the following groups:

- Weapon
- Movement
- Radio
- Depth control.

All tasks within a group are mutually exclusive among themselves. For example, all movement tasks are mutually exclusive. Entities that are moving can usually execute a task from one of the other groups at the same time. For example, entities can execute the various Send tasks while they are executing movement tasks. When you create a scripted task, you can specify which groups it conflicts with. For information about how to configure mutually exclusive tasks, please see Section 7.8, "Configuring Task Execution Rules," in *VR-Forces Configuration Guide*. For information about scripted tasks, please see Chapter 13, *Creating Scripted Tasks*.

6.1.3. How do I Know which Entity can Execute a Task?

Some VR-Forces tasks apply to almost all entities, such as Radio tasks and some movement tasks. Others are valid only for particular platforms or even particular entity types. Sometimes it is obvious which entity types can execute a task. For example, you would expect that Fixed-Wing Land only applies to fixed-wing entities. Similarly, Raise Periscope applies to submarines. However, for other tasks, it is not always evident which entity can execute a task.

Entities can execute tasks for which they have an appropriate controller. Since most task controllers are embodied in systems, this means that entities can execute the tasks supported by their various movement, weapons, sensors, and other systems. For example, to deploy naval mines, an entity needs a Naval Mine Deployment system.

To see which systems an entity has, and thereby infer which tasks it can execute, you can examine the entity's systems in the Entity Editor. You can also refer to *VRFEntityCatalog.pdf*, which lists the systems for each entity configured in the Entity Editor.

Appendix C, *Systems and System Usage* lists each system provided with VR-Forces, the types of entities it supports, and its description. It also lists each system and the entities that are configured to use it.

6.1.4. Escaping the Task Assignment Process

You can escape the task assignment process at any point before you complete it.

➤ To escape the task assignment process, in the task dialog box, click Cancel.

6.1.5. Specifying Parameters for Tasks

VR-Forces lets you specify task parameters in dialog boxes or by selecting them on the terrain. Many tasks require you to select an object or entity.

If you select the appropriate object, the selection is reflected in the task dialog box.

If you prefer, you can specify all parameters in the task dialog box. Depending on the zoom level of the terrain and the number of entities and tactical graphics you have created, it may be easier to select an object from a list than to select it from a densely packed group of icons.

Selecting Objects in Multiple List Dialog Boxes

Some task dialog boxes, such as Patrol Between, require you to select multiple objects, each of which is selected from a different list.

You can select the objects in the list window or in the display window. At any given moment, one of the lists is the active list and a selection in the display window is reflected in that list. The active list is indicated by the button next to the Filter list (Figure 6-1).

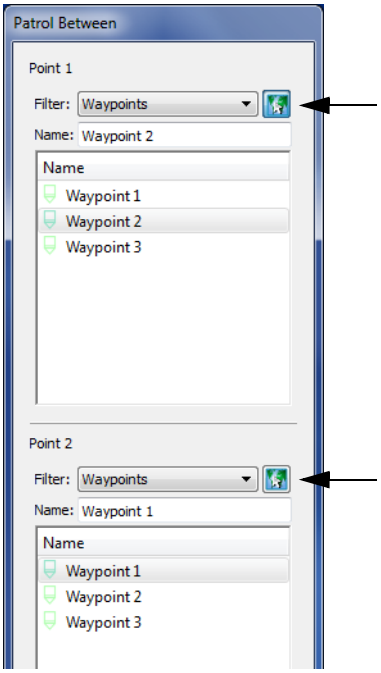


Figure 6-1. Multiple list dialog box

The active list is determined as follows:

- When you first open the dialog box, the first list window is automatically active. If you select an object in the display, it is selected in the first list window. Then the second list window automatically becomes active and the next object you select in the display is selected in the second list window. This sequence continues until all list windows have a selection. Then the last window stays as the active list.
- Selecting an object in a list window makes it active.
- Clicking the Filter button ( ) next to the Filter list makes that list window active. It will stay active until you click the button to inactivate it or click in another list window.
- If all lists are inactive (by clicking the Filter button to put it into the unselected state), you can click objects in the display without affecting the selections in the list windows.

6.1.6. Viewing Task Status

The Entity Information dialog box for an entity lists its current task on the Task Status page. It also lists the state of the reactive tasks that are enabled for the entity. If an entity is executing a task as part of its plan, you can also see which task it is executing by opening its Plan window (Figure 6-2).

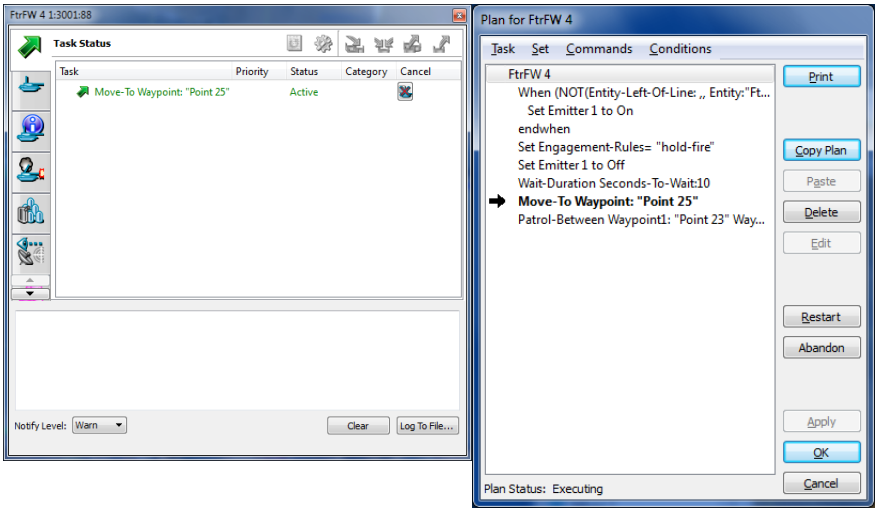


Figure 6-2. Display of entity task status

6.1.7. Filtering the Object Selection Lists

If a task requires you to select objects, you can filter the object selection list to make it easier to find the particular objects you need to select (Figure 6-3). If you are selecting entities, for example in a Follow Entity task, you can display all entities, individual entities only, or aggregate entities only. Within the latter two groups, you can display friendly or opposing entities. In a Move To task, you can filter for waypoints, friendly entities, or opposing entities.

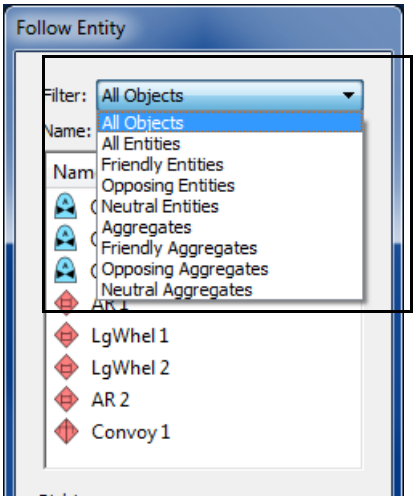


Figure 6-3. Entity filter list

➤ To filter an entity list, in a task or set data request dialog box, choose the filter type from the list.

6.1.8. Skipping (Stopping) a Task

You can instruct an entity to stop executing its current task. If the entity is executing a plan, it moves to the next task in its plan. If there are no further tasks, the entity waits for further orders.

➤ To order an entity to skip a task, choose **Entities** → **Skip Task**.

- Skip Task does not apply to members of an aggregate that are executing tasks assigned to them by the aggregate leader.
- You can also stop tasks from the Task Status page of the Entity Information dialog box. For details, please see "Cancelling a Reactive Task," on page 6-15.

6.2. Assigning Tasks to Aggregates

➤ To assign a task to an aggregate, select the aggregate, then assign it a task as you would any individual entity.

6.2.1. Convoy Tasks

VR-Forces has two tasks for moving in convoys – Convoy Along and Convoy To. These tasks can only be assigned to aggregate entities made up of ground vehicles. When an aggregate receives a convoy task, it organizes itself into a column based on the echelon IDs. Then it executes the task.

Once the task begins, the members of the aggregate try to maintain a consistent distance apart from each other. You can configure this distance by editing the Ground Convoy Movement system in the OPD Editor. The distance is specified by the **separation-distance** parameter. You can also specify an amount by which the separation distance can vary using the **separation-tolerance** parameter.

If VR-Forces can determine that a convoy task is not appropriate for a given aggregate, for example a rotary wing aggregate, the convoy tasks will not be available on the Task menu. However, in other cases, such as mixed aggregates or if you aggregate disparate entities as Ground Aggregate, it is up to you to know whether or not an aggregate consists only of ground vehicles or contains platforms that do not support convoy tasks.

6.2.2. Independently Tasking Aggregate Members

Members of a disaggregated aggregate can have individual plans or be assigned tasks independently of the aggregate. If a member of an aggregate unit is independently tasked, when it completes its task it automatically becomes tasked by its superior. You do not need to give it a Tasked by Superior set data request. You can override this behavior by setting an object's **tasked-by-superior-upon-task-complete** parameter in the object parameter database to False.

If a Skip Task command is given to an independently tasked subordinate, it remains in the independently tasked state until it either completes a task or it is given a Set Tasked by Superior set data request.

When an entity becomes tasked by its superior, it does not execute the task that the aggregate is currently executing. It receives the next task that is sent out by the aggregate.

When a disaggregated aggregate changes to the aggregated state, the individual subordinates cease to exist. Therefore, if a subordinate is executing an independent task, when the aggregate changes state, the task activity ends immediately.

6.3. Reactive Tasks

Reactive tasks are a special category of scripted tasks. Unlike other tasks (whether scripted or built-in), reactive tasks do not begin to execute as soon as they are assigned. They monitor events in a simulation and execute in response to conditions specified in the script. In this way they are similar to collision avoidance, which takes over entity movement in response to an imminent collision, or `When` statements in plans, which get triggered when a condition becomes true.

Because reactive tasks are scripted tasks, you are not restricted to the few conditions available in plans. You have the full VR-Forces Lua API available to script the conditions and the resulting behaviors. Like other scripted tasks, reactive tasks are either scenario-specific or system reactive tasks.

Reactive tasks have the following behaviors and characteristics:

- Reactive tasks can be automatically enabled for a category of entity. They can also be individually enabled and disabled.
- When a reactive task is activated, the current task is suspended. When the reactive task concludes, the entity resumes the previous task, if possible. There may be cases where the previous task is no longer valid. For example, if an entity was executing a Move to Waypoint (Use Roads) task and the result of the reactive task was that the entity is no longer near the road network, it will not be able to resume the Move to Waypoint (Use Roads) task.
- Reactive tasks support task concurrency.
- Reactive tasks can be interrupted by other reactive tasks. Precedence among reactive tasks is based on a task's priority. If a reactive task is executing and a reactive task with a higher priority gets triggered, it suspends the current reactive task. When the higher priority task completes, the lower priority task resumes. When it completes, the original task resumes. Multiple nesting of tasks in this way is permitted. Reactive tasks with the same or lower priority do not interrupt the active task.
- Reactive tasks can have parameters, just like any other task. If a reactive task is enabled and the parameters are not set, it may not work as expected. A well-written reactive task should have default values for parameters, but VR-Forces does not enforce this.
- Users can change the priority of a reactive task while a scenario is running. This affects the next activation of the task.
- If a reactive task is interrupted by an nonconcurrent independent task assignment, from the Task menu or a global plan, the reactive task and all suspended tasks are cancelled and the new task is executed. However, it is still possible that the new task could be interrupted by the same or a different reactive task.
- Active reactive tasks can be cancelled by a VR-Forces user.
- After a reactive task is complete, it enters the enabled state and can become triggered again.
- The status of reactive tasks is displayed on the Task Status page of the Entity Information dialog box, along with the status of the current or suspended task.

The following sections describe how to manage reactive tasks in a scenario. For information about how to write and configure reactive tasks, please see Chapter 14, *Writing Scripts for Scripted Tasks*.

6.3.1. Enabling Reactive Tasks

Like other scripted tasks, when a reactive task is written, it is specified as being valid for one or more entity types. It can also be configured to be enabled by default. If a reactive task is not enabled by default, you can enable it for individual entities.

This procedure applies to the currently selected entity. If you have multiple Entity Information windows open, selecting a reactive task on the Task Status page of an entity does not select the entity and does not make it the task affected by this procedure.

To enable a reactive task:

1. Select the entity for which you want to enable the task.
2. Choose **Set** → **Reactive Tasks** → **Enable**. The Enable Reactive Task dialog box opens (Figure 6-4). If there are no reactive tasks available, the dialog box states this. This condition occurs if all appropriate reactive tasks are already enabled or there are no reactive tasks for this entity type.
3. In the Reactive Tasks list, select the task you want to enable. If the task requires parameters, the dialog box redisplays and lists the parameters.
4. If necessary, specify the parameters.
5. Click OK.

You can also enable reactive tasks in the Reactive Task Status dialog box. For details, please see "Managing Reactive Tasks," on page 6-14.

6.3.2. Disabling Reactive Tasks

You can disable reactive tasks on a per-entity basis. When you disable a reactive task, any active tasks continue to execute. However, no new instances of the disabled task will be activated.

This procedure applies to the currently selected entity. If you have multiple Entity Information windows open, selecting a reactive task on the Task Status page of an entity does not select the entity and does not make it the task affected by this procedure.

To disable a reactive task for an entity:

1. Select the entity for which you want to disable a reactive task.
2. Choose **Set** → **Reactive Tasks** → **Disable**. The Disable Reactive Task dialog box opens. If there are no reactive tasks available, the dialog box states this. This condition occurs if all appropriate reactive tasks are already disabled or there are no reactive tasks for this entity type.
3. In the Reactive Tasks list, select the task you want to disable.
4. Click OK.

You can also disable reactive tasks in the Reactive Task Status dialog box. For details, please see "Managing Reactive Tasks," on page 6-14.

6.3.3. Setting the Priority of a Reactive Task

When a reactive task is created, it is assigned a priority. The priority determines which reactive tasks it can override or be overridden by. Priorities are expressed as integers, with 1 being the highest priority. You can change the priority of a reactive task on a per-entity basis.

This procedure applies to the currently selected entity. If you have multiple Entity Information windows open, selecting a reactive task on the Task Status page of an entity does not select the entity and does not make it the task affected by this procedure.

To change the priority of a reactive task:

1. Select the entity for which you want to change a reactive task's priority.
2. Choose **Set** → **Reactive Tasks** → **Priority**. The Reactive Task Priority dialog box opens. If there are no reactive tasks available, the dialog box states this.
3. In the Reactive Tasks list, select the task whose priority you want to change.
4. Select a priority in the box. The lower the number, the higher its priority.
5. Click OK.

You can also change priority in the Reactive Task Status dialog box. For details, please see "Managing Reactive Tasks," on page 6-14.

6.3.4. Managing Reactive Tasks

You can enable, disable, and change priority for all the reactive tasks that apply to an entity from the Reactive Task Status dialog box.

To manage multiple reactive tasks for an entity:

1. Select the entity for which you want to manage reactive tasks.
2. Choose **Set** → **Reactive Tasks** → **Manage** or choose **Entities** → **Manage Reactive Tasks**. The Manage Reactive Task dialog box opens (Figure 6-4). It lists each reactive task configured for this entity type, its status, and its priority. If a task requires parameters, you can set them.

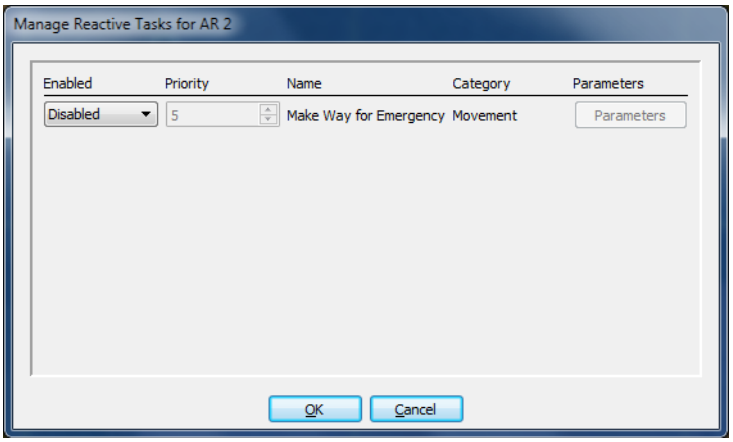


Figure 6-4. Manage Reactive Task dialog box

3. For each task, to enable or disable, select an option from the list in the Enabled column.
4. For each task, change the priority by selecting an option in the box in the Priority column.
5. For each task that has parameters, click Parameters and set its parameters.
6. Click OK.

6.3.5. Cancelling a Reactive Task

You can cancel a reactive task while it is executing. When you cancel a reactive task, the entity resumes the suspended task. However, if the condition that caused the reactive task to activate is still true, when you cancel a reactive task, it will usually immediately activate again.

You can also use this procedure to cancel (skip) a regular task.

To cancel a reactive task:

1. Select the entity whose task you want to cancel.
2. Choose **Entities** → **Information**, or press **`i`**. The Entity Information dialog box opens.
3. Select the Task Status page. If a reactive task is active, it has a button in the Cancel column.
4. Right-click the active task and choose **Cancel Reactive Task**, or click the button in the Cancel column.

6.4. Using Behavior Sets to Manage Scripted Tasks

Behavior Sets let you organize scripted tasks so that a set of related tasks can be enabled or disabled at the force level.

If a scripted task is not assigned to a Behavior Set, its availability to an entity is determined by the following settings:

- The Valid for Entity Types list for the task.
- For tasks specific to systems, configuration of that system on an entity.
- For reactive tasks, the Enable/Disable setting in the Manage Reactive Tasks dialog box for the entity.

If a scripted task is assigned to a Behavior Set, then in addition to the requirements in the previous list, it is available to entities only if the Behavior Set is assigned to a force and only to entities of that force. (You can assign a Behavior Set to more than one force.)

As an example of how you might use Behavior Sets, suppose that dismounted infantry react differently to an attack depending on whether they are operating in rural terrain or in urban terrain. You have a set of scripted tasks that you have written for reacting to attack in each of these two situations. If you are not using Behavior Sets, then at a minimum, to manage which tasks would get used when the entitities are under attack, you would have to tell users not to use the innapropriate tasks. Or, you could enable and disable the correct set of tasks in the Scripted Tasks dialog box before the start of the scenario. Or, you would have to enable and disable the tasks on a per entity basis in the Manage Reactive Tasks dialog box. Shifting back and forth between simulations in different terrains might become a management problem.

Using Behavior Sets, you could create a Behavior Set for rural terrain operations and one for urban operations. You would assign the relevant scripted tasks to each Behavior Set. Then before you ran a scenario, you would assign the Behavior Set you want to use to the force. The tasks in the Behavior Set would be enabled and those in the unused Behavior Set would be disabled. There would be no further configuration required.

6.4.1. Creating Behavior Sets

To create a Behavior Set:

1. Choose **Simulation** → **Behavior Sets**. The Edit Behavior Sets dialog box opens (Figure 6-5).

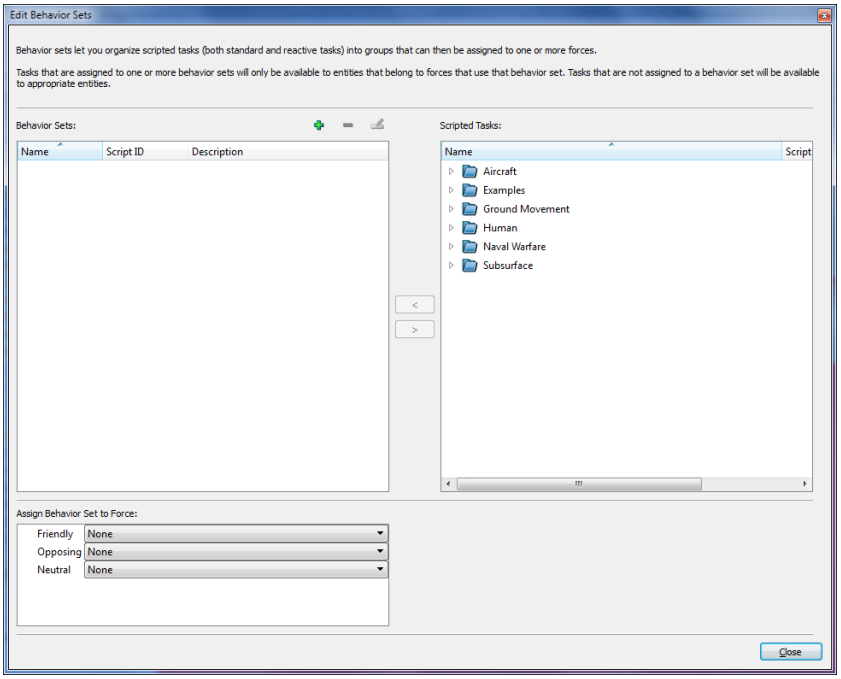


Figure 6-5. Edit Behavior Sets dialog box

2. Click the Add button (✚). The New Behavior Set Name dialog box opens.
3. Type a name for the Behavior Set.
4. Click OK.
5. In the Scripted Tasks list, select the scripted tasks that you want to assign to this Behavior Set. Click the left-facing arrow. The scripted tasks are added to the Behavior Set. If you select a folder, all tasks in the folder get added to the Behavior Set. (You can also assign tasks to Behavior Sets in the Edit Scripted Task dialog box. For details, please see "Creating a New Scripted Task," on page 13-5.)
6. Optionally, assign the Behavior Set to a force.

6.4.2. Editing Behavior Sets

You can edit Behavior Sets, rename them, and delete them.

To edit Behavior Sets:

1. Choose **Simulation** → **Behavior Sets**. The Edit Behavior Sets dialog box opens (Figure 6-5).
2. Expand the Behavior Set that you want to edit.
3. Add and remove scripted tasks by selecting them and clicking the appropriate arrow button.

➤ To rename a Behavior Set, select it in the Behavior Sets list, click the Rename button (), and type a new name.

➤ To delete a Behavior Set, select it in the Behavior Sets list and click the Delete button ().

6.4.3. Assigning a Behavior Set to a Force

You can only assign one Behavior Set to a force at any given time.

To assign a Behavior Set to a force:

1. Choose **Simulation** → **Behavior Sets**. The Edit Behavior Sets dialog box opens (Figure 6-5).
2. In the Assign Behavior Set to Force window, click the list for the force to which you want to assign a Behavior Set.
3. Select the Behavior Set that you want to assign. If you do not want any Behavior Sets assigned, select the blank line in the list.

6.5. Entity Movement On Roads and Off Roads

Some terrains have vector road networks. Ground vehicle entities can use these networks to move precisely through the terrain. The tasks for moving on roads are distinct from the tasks for moving without respect to road networks. (For a description of how entities move when they use road driving, please see "Road Driving Behavior," on page 6-20.) If you want entities to move both on and off roads, you need to understand how these tasks interact.

The road driving tasks are Move to Waypoint (On Roads) and Move To Location (On Roads). The generic movement tasks are Move to Location (Direct) and Move to Waypoint (Direct).

Road driving tasks are valid only for ground vehicles. If you give a road driving task (including Move To (On Roads), Treat Route as Road, and Use Roads in B-HAVE default plans) to any other type of entity, it will fail.

When you give an entity a generic Move To (Direct) task, it moves directly towards its destination. It will avoid obstacles. It will not pay attention to the terrain except to the extent that it cannot move on certain soil types or terrains that are too steep.

When you give an entity a Move (On Roads) task, it must be within 10 meters of the edge of the road (this is configurable) or the task fails. It will move along the road network to the point nearest the destination and then will stop. If the destination is not on the road, the entity does not leave the road to move to it.

Given these behaviors, if you want an entity to move from an off-road location to another location, but use roads if it can, you will have to give it three tasks:

1. Move to Waypoint (Direct) or Move to Location (Direct), where the waypoint or location is on the road network.
2. Move to Waypoint (On Roads) or Move To Location (On Roads), where the waypoint or location is the final destination or some point on the road network where you want the entity to leave the network.
3. Move to Waypoint (Direct) or Move to Location (Direct), where the waypoint or location is the final off road destination.

VR-Forces has a pair of tasks that combine direct movement and road driving – Move to Waypoint (Plan Path) and Move To Location (Plan Path). If you give an entity one of these tasks, it moves directly to the nearest point on the nearest road, drives along the road to the nearest point to the destination, then drives directly to the destination.

Using one of these tasks saves you from assigning three tasks as in the sequence in the previous paragraphs. However, using a path planning task may not result in the most efficient plan. For example, consider the entity and waypoint in Figure 6-6. The quickest way to get to the waypoint is to drive directly to it across the terrain. Alternatively, it could drive to the road, drive a short distance, and then exit the road. Figure 6-7 shows the path (bold red) that VR-Forces plans when given the Move To Waypoint (Plan Path) task. As you can see, it uses the road network, but not in the most direct way.

Figure 6-6. Entity and waypoint

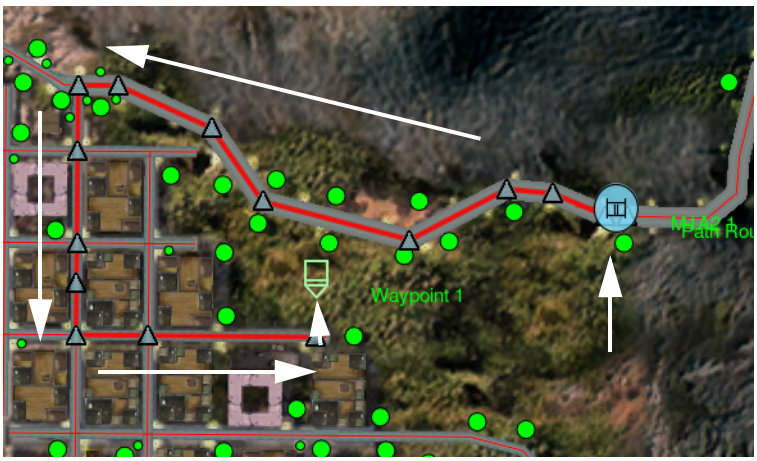


Figure 6-7. Result of Move To Waypoint (Plan Path)

6.5.1. Road Driving Behavior

The Move (On Roads) tasks use road driving behaviors intended to provide realistic behavior of multiple cars on a road network. When an entity is given one of these tasks:

- It clamps to the road and does not deviate from it.
- It goes around corners accurately.
- It ignores any obstacles that are near to the road and which would ordinarily trigger obstacle avoidance. The vehicle only responds to obstacles that block the road.
- If a vehicle is blocking its progress and there is an adjacent lane in the road that is clear, the entity passes the blocking vehicle.

In the Move Along Route task, you can specify that VR-Forces treat the route as a road. The entity would then use the road driving system to follow the route.

6.6. Fixed-Wing Entity Tasks and Behaviors

This section describes the behaviors of fixed-wing entities supplied with VR-Forces and the issues you should keep in mind when assigning tasks and set data requests.

6.6.1. Placement of Newly Created Fixed-Wing Entities

When you create a fixed-wing entity, it is placed on the ground. If you want a fixed-wing entity to start a scenario in the air, you must set its altitude at the beginning of the scenario. It will loiter at the specified altitude.

6.6.2. Fly Task Behavior is Different from Move Task Behavior

Fixed-wing entities can move in response to Fly tasks (Fly Altitude, Fly Heading, and so on) and Move tasks (Move to Waypoint (Direct), Move Along Route, and so on). There are important differences between how fixed-wing entities respond to the different classes of movement tasks. Fixed-wing entities can move on the ground (taxi), in which case they move like ground vehicles.

For Move and Patrol tasks, if a fixed-wing entity is in the air:

- When a fixed-wing entity moves to a point or between the vertices in a route, it immediately ascends or descends to the altitude of the target point. This is illustrated in "Fixed-Wing Movement Between Vertices," on page 6-24.
- When an entity arrives at a point or the end point of a route, it loiters.

Fly tasks are only for entities that are in the air. You cannot use them to cause an entity to take off or land. For Fly tasks:

- Entities move to a new altitude at the specified heading, at the specified climb or descent rate.
- When they reach the new altitude, they continue flying at their current heading.

Given these differences, if you want to change heading, altitude, or both for an entity that is in the air and not executing a Move or Patrol task, use a Fly task. These tasks are not designed to have an entity move to a particular location or along a route. To have an entity move to a particular location or along a route, use a Move or Patrol task. In most cases, Fly Altitude will be preferable to Move to Altitude.

6.6.3. Specifying and Maintaining Altitude for Fixed-Wing Entities

You can explicitly change a fixed-wing entity's altitude in the following ways:

- The Altitude set data request moves an entity immediately to the specified altitude.
- The Move to Altitude task causes an entity to spiral to the specified altitude at the same coordinates that it had when it received the task.
- The Fly Altitude and Fly Heading and Altitude tasks cause the entity to move smoothly to the new altitude while continuing to fly at its current or newly specified heading.

An entity's altitude changes implicitly if it is given a Move or Patrol task in which the altitude of the target point or vertex is different from the entity's current altitude. In this case the entity immediately moves to the new altitude and then proceeds to the target point.

When you assign a task that includes a location and you specify the location by clicking on the terrain, the default altitude is zero. If you do not specify a non-zero altitude in the task dialog box, VR-Forces uses the altitude of the entity at the time the task is assigned. This prevents you from inadvertently specifying a location that would cause the entity to crash.

6.6.4. Fixed-Wing Entity Movement on the Ground and in the Air

Fixed-wing aircraft support takeoff and landing. Since they can move on the ground and in the air, you need to understand their behavior in these different environments. Table 6-1 and Table 6-2 describe how fixed-wing entities respond to Move To, Move Along Route, and Patrol Route tasks depending on their current location. The rest of this section provides additional details about take-off and landing.

Table 6-1: Fixed-wing entity Move To behavior

If entity is on/in the:	and waypoint is on/in the:	the entity:
Ground	Ground	taxis to point.
Ground	Air	takes off towards the point.
Air	Air	flies to point.
Air	Ground	crashes.

Table 6-2: Fixed-wing entity route-following behavior

If entity is on/in the:	and next vertex is on/in the:	the entity:
Ground	Ground	taxis to vertex.
Ground	Air	takes off toward the vertex.

Table 6-2: Fixed-wing entity route-following behavior

If entity is on/in the:	and next vertex is on/in the:	the entity:
Air	Air	flies to the vertex.
Air	Ground	tries to land at the vertex.

Fixed-wing entities do not support terrain-following. Therefore, when you task a fixed-wing entity to move to a point or follow a route, you must be certain that there are no points in the terrain that are higher than the altitude of the entity's flight path, or the entity will crash. For example, if you assign a fixed-wing entity to follow a route whose vertices are set at 3000 meters above sea level, if the terrain rises above 3000 meters at some point in between two vertices of the route, the entity will crash into the terrain at that point (Figure 6-8). You can view the terrain profile of the route to check for intersections with the terrain. (For details, please see Section 13.1.1, "Displaying a Line's Terrain Profile," in *VR-Forces Users Guide*.)

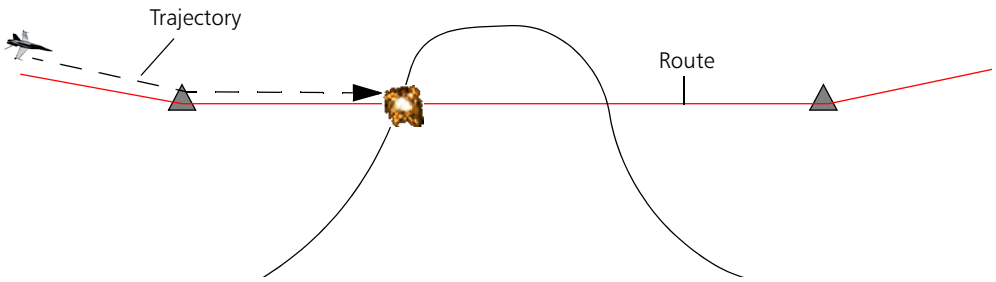


Figure 6-8. Fixed-wing route following

Fixed-Wing Movement Between Vertices

If two vertices in a route are not at the same altitude, a fixed-wing entity does not fly from the first vertex to the second in a smooth gradient. As soon as it passes the first vertex, it immediately descends to the altitude of the next vertex and then continues to fly towards it at that altitude. Therefore, it is possible that you could create a route that does not intersect the terrain, but an entity flying along that route could crash because a location in the terrain exceeds the altitude of a destination point, as illustrated in (Figure 6-9).

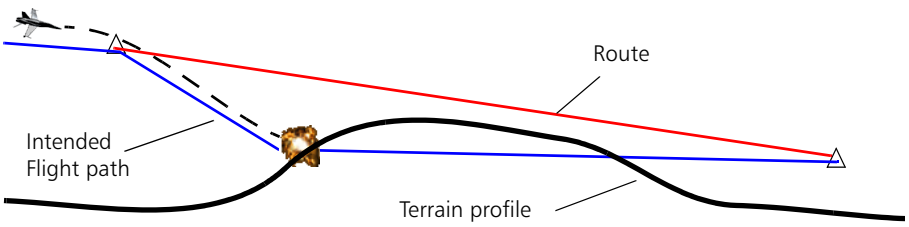


Figure 6-9. Fixed-wing trajectory between vertices

If you want a plane to change altitude using a smooth gradient, use one of the Fly Altitude tasks. However, these tasks do not let you follow a route.

6.6.5. How Fixed-Wing Entities Take Off

You can have fixed-wing aircraft take off using the Fixed Wing Takeoff task (for details, please see "Fixed Wing Takeoff," on page 7-22) or by using innate behavior. This section describes take-off using innate behavior.

Fixed-wing entities take off by moving to a waypoint that is above ground level or by following a route that has a vertex above ground level.

When you task a fixed-wing entity to move to a waypoint that is above ground level, the entity orients itself directly towards that point and accelerates in the direction of the point. When it reaches its minimum lift speed, it takes off and rises to the altitude of the point it is moving to. You can control the distance required to take off by setting the **max-thrust parameter**.

When a fixed-wing entity takes off, it does not take into account the soil type or terrain, except that if the slope of the terrain along which the entity must move to take off is greater than the **max-slope** parameter, the entity halts.

Fixed-wing entities do not know anything about runways that may be part of a terrain database. When you create a waypoint towards which an entity will take off, or create a route along which an entity will take off, you are responsible for ensuring that the entity is properly oriented towards the runway.

If an entity takes off as part of route following, you can define a runway with two points on the ground. If an entity detects that the point in the route after the one it is moving towards is in the air, it uses the current point as the take-off direction, but takes off as soon as possible and flies to the point in the air. Figure 6-10 illustrates this behavior.

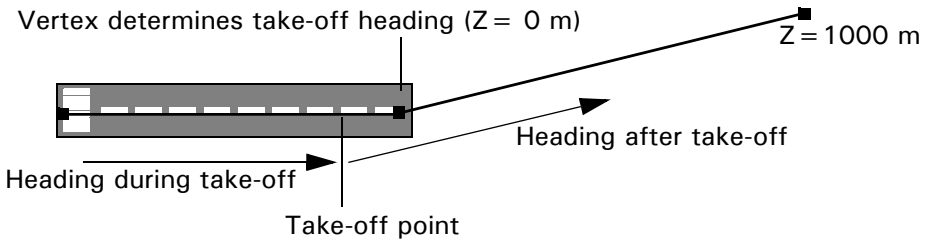


Figure 6-10. Defining a runway for take-off

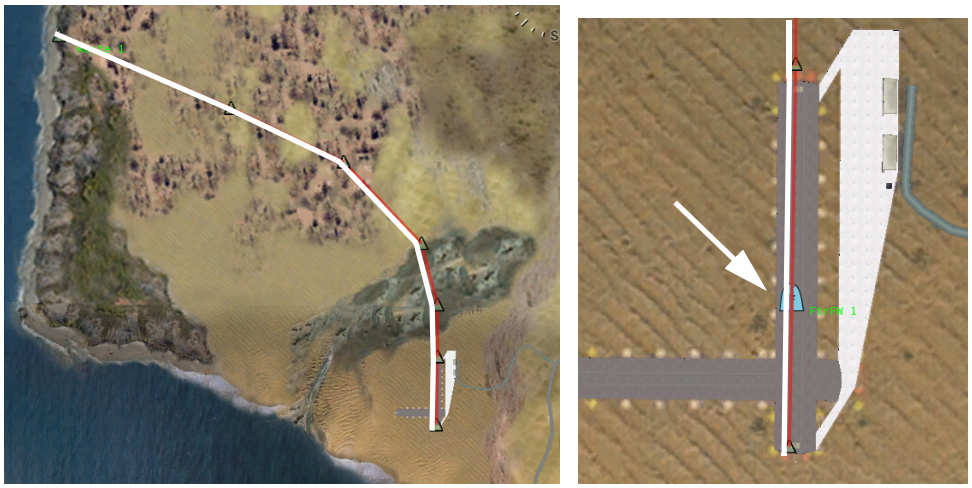
6.6.6. How Fixed-Wing Entities Land

You can have aircraft land using the Fixed Wing Land task (please see "Fixed-Wing Land," on page 7-21), or as described in this section. The underlying behavior of the Fixed Wing Land task is the same as in this section. Using the Fixed Wing Land task automates the process of setting up the approach route.

A fixed-wing entity can land only in the context of following or patrolling a route. When a fixed-wing entity follows a route and determines that the next vertex in the route is on the ground, it decelerates as it reduces altitude towards that vertex. If it does not have enough distance from the previous vertex to decelerate sufficiently, it may crash. To ensure adequate deceleration, you may want to create a trigger that sets the entity's speed when it approaches the runway.

Any time an entity is within 10 meters of the terrain and it is moving within 10 percent of its minimum lift speed, it will try to land.

To orient an entity for landing, you may have to create several vertices prior to the runway to get the entity properly lined up. Figure 6-10 shows two different routes ending at an airport (the routes have been edited to improve visibility). The first route has vertices that line up the entity with the runway. The second route curves in towards the runway, so the entity does not approach the runway in a straight line. Therefore, as it reaches the landing point, it is not lined up with the runway and it lands on the taxiway.



Entity lands on runway

Entity lands to left of runway

Figure 6-11. Landing fixed-wing entities

6.7. Rotary-Wing Entity Tasks and Behaviors

This section describes the behaviors of rotary-wing entities supplied with VR-Forces and the issues you should keep in mind when assigning tasks and set data requests.

Rotary-wing entities get created on the ground unless you specify an altitude at creation. (For details about specifying an altitude when you create an air platform, please see "Specifying an Object's Altitude," on page 2-12.)

If a rotary-wing entity is airborne and it is not assigned a task, it hovers at the specified location and altitude. When it completes a task, it hovers in the location where it completed the task.

The **terrain-check** parameter determines how a rotary-wing entity interacts with the terrain. If **terrain-check** is False, a rotary-wing entity ignores the terrain. It could appear to fly below ground. However, when **terrain-check** is set to False, VR-Forces does not have to check ground points, so performance may improve.

When **terrain-check** is True, rotary-wing entities interact with the terrain. If a rotary-wing entity approaches a ground point at three meters per second or less, it lands. If it approaches the ground at a greater speed, it crashes.

When you assign a task that includes a location and you specify the location by clicking on the terrain, the default altitude is zero. If you do not specify a non-zero altitude in the task dialog box, VR-Forces uses the altitude of the entity at the time the task is assigned. This prevents you from inadvertently specifying a location that would cause the entity to crash.

Helicopters have a basic terrain avoidance algorithm that helps prevent crashing if they are sent to waypoints or follow routes that do not have an altitude. The terrain avoidance logic maintains a distance above the ground; it does not look ahead. So, a helicopter could crash if the terrain rises suddenly (Figure 6-12). You can view the terrain profile of the route to check for intersections with the terrain. (For details, please see Section 13.1.1, "Displaying a Line's Terrain Profile," in *VR-Forces Users Guide*.)

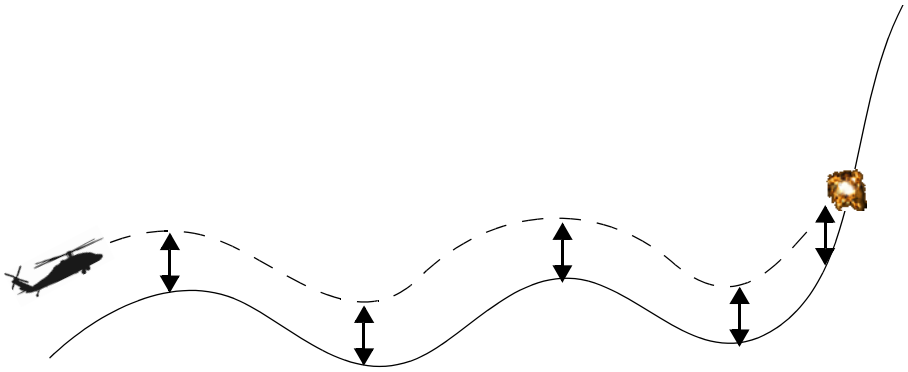


Figure 6-12. Helicopter terrain avoidance

6.7.1. Controlling Rotary-Wing Orientation

A rotary-wing entity can move laterally (sideways) without changing its orientation. In other words, it does not have to face in the direction it is moving. Rotary-wing entity movement controllers have two parameters that configure the speed at which a rotary-wing entity can move laterally. Rotary-wing entities rotate to try to align themselves with their velocity vector under the following circumstances:

- If the current speed is greater than the speed specified by **vel-to-align-actual**.
- If the speed of the entity is not greater than **vel-to-align-actual**, but the desired speed of the entity (the velocity it is attempting to achieve as a result of position or velocity commands) is greater than **vel-to-align-desired**.

If you do not want a rotary-wing entity to align itself with its direction of travel, set **vel-to-align-actual** and **vel-to-align-desired** to speeds that are greater than the speed at which you expect the entity to travel. You can set these parameters in the OPD Editor.

7

Task Procedures

This chapter describes the tasks supplied with VR-Forces.

7.1. Task Procedures

This chapter describes the procedures for the tasks supplied with VR-Forces. If your installation uses the VR-Forces API to add additional tasks, consult with your software engineers for local procedural information. Please see "Fixed-Wing Entity Tasks and Behaviors," on page 6-21 and "Rotary-Wing Entity Tasks and Behaviors," on page 6-27, for additional information about assigning tasks to these entity types.

The instructions for creating tasks direct you to use options on the Task menu. However, all the options available on the main menu are also available on context-sensitive menus. A limited number of tasks are available on the Tasks Toolbar.

7.2. Animated Movement

The Animated Movement task lets you assign a scripted behavior to an entity. This task is a generalized version of firing ballistic missiles, which is described in "Ballistic Missiles," on page 11-8. To use this task, you must first create a file that describes the movements that you want an entity to make. Animated movement files can be in comma-separated vlaues (CSV) format or 3DS ASCII Export (ASE) format. You configure animated movement tasks in the Entity Editor. For details, please see Section 5.9.2, "Configuring Animated Movement," in *VR-Forces Configuration Guide*.

To assign an animated movement task:

1. Select the entity to task.
2. Choose **Task** → **Movement** → **Animated Movement**. The Animated Movement dialog box opens (Figure 7-1).

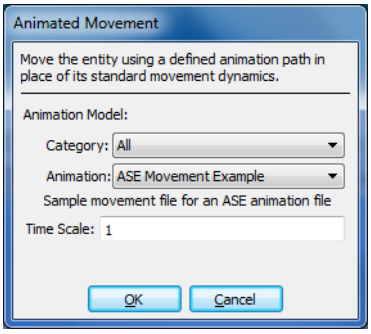


Figure 7-1. Animated Movement dialog box

3. Optionally, filter the animation list by selecting a category in the Category list.
4. Select an animation in the Animation list. You are responsible for knowing that the animation is appropriate to the entity you selected.
5. Optionally, specify a time scale. By changing the time scale you can make the animation run faster or slower than specified in the animation file.

7.3. Arm Mine at Depth

If a naval mine has been deployed, Arm Mine at Depth lets you change the mine's parameters.

Arm Mine at Depth is a system scripted task. It is disabled by default.

To arm a mine:

1. Select the mine.
2. Choose **Task** → **Arm Mine at Depth**. The Arm Mine at Depth dialog box opens.
3. Specify the depth at which to arm the mine.
4. Specify the radius within which target entities will detonate the mine.
5. Optionally, specify a time when the mine will be armed, in days and hours:minutes:seconds.
6. In the Targets list, add the types of entities that can trigger the mine, as follows:
   a. Click the Add button (). The Entity Type dialog box opens.
   b. Build an entity type by selecting options from the lists for each enumeration component or type an enumeration.
   c. Click OK.
7. To specify that only hostile entities will set off the mine, select Hostile Only. If this setting is cleared, any entity will set off the mine.
8. Click OK.

7.4. Come to Stop

The Come to Stop task stops a surface entity using a normal stop, an emergency stop, or a slow drift.

To assign a Come to Stop task:

1. Select the entity.
2. Choose **Task** → **Movement** → **Come to Stop**. The Come to Stop dialog box opens.
3. Select an option for how to stop.
4. Click OK.

7.5. Convoy Along

The Convoy Along task commands an aggregate to move along a route in a convoy. When the task starts, the lead entity moves far enough along the route for the rest of the aggregate to create a column that ends approximately at the beginning of the route. Then the aggregate begins moving along the route.

The Convoy Along task is valid only for ground-vehicle aggregates.

For more details about convoys, please see "Convoy Tasks," on page 6-9.

To assign a Convoy Along task:

1. Select the aggregate that you want to send in a convoy.
2. Choose **Task** → **Movement** → **Convoy Along**. The Convoy Along dialog box opens.
3. Specify the route to convoy along.
4. Click OK.

7.6. Convoy To

The Convoy To task commands an aggregate to move to a waypoint in a convoy. If you specify use of roads, VR-Forces uses the information in the road network to plan the convoy's movement. If you do not specify use of roads, the convoy moves directly across the terrain as an individual entity would move in a Move To task.

The Convoy To task is valid only for ground-vehicle aggregates.

For more details about convoys, please see "Convoy Tasks," on page 6-9.

To assign a Convoy To task:

1. Select the aggregate that you want to send in a convoy.
2. Choose **Task** → **Movement** → **Convoy To**. The Convoy To dialog box opens.
3. Specify the waypoint to convoy to.

When you specify use of roads, VR-Forces looks for roads over a fairly wide area and if one is found, will try to use them even if this results in an indirect approach to the waypoint. If there are no roads close to the route you would expect the aggregate to take to reach the waypoint, do not select his option.

4. Click OK.

7.7. Deploy Sonobuoy

The Deploy Sonobuoy task lets an aircraft deploy a sonobuoy for taking sonar readings. A sonobuoy is deployed as an entity. This task is available to entities that have a Sonobuoy Deployer system configured. Deploy Sonobuoy is a system scripted task.

RPR FOM 1.0 does not support active sonar. You will not be able to create sonobuoys if they have an active sonar system.

To deploy a sonobuoy:

1. Select the entity.
2. Choose **Task** → **Deploy Sonobuoy**. The Deploy Sonobuoy dialog box opens.
3. Select the type of sonar to use – Active or Passive.
4. Specify the depth at which to deploy the sonobuoy.
5. Click OK.

7.8. Deploy Sonobuoys Along Route

The Deploy Sonobuoys Along Route task lets an aircraft deploy sonobuoys for taking sonar readings. A sonobuoy is deployed as an entity. This task is available to entities that have a Sonobuoy Deployer system configured. Deploy Sonobuoys Along Route is a system scripted task.

RPR FOM 1.0 does not support active sonar. You will not be able to create sonobuoys if they have an active sonar system.

To deploy sonobuoys along a route:

1. Select the entity.
2. Choose **Task** → **Deploy Sonobuoys Along Route**. The Deploy Sonobuoys Along Route dialog box opens.
3. Select the route to use.
4. Specify the distance between each sonobuoy.
5. Select the type of sonar to use – Active or Passive.
6. Specify the depth at which to deploy the sonobuoys.
7. Click OK.

7.9. Disembark

The Disembark task causes an entity to move to the parent entity's egress (exit) point and disembark. If the selected entity is an aggregate (disaggregated), the disembark task is given to all embarked subordinates. The task is considered complete when all subordinates are disembarked. To disembark entities immediately, that is, without using a task, please see "Embarking and Disembarking Entities," on page 3-5.

- When an entity disembarks, it simply goes to the disembarkation location. If you plan to disembark several entities from the same parent by giving them disembark tasks, you are responsible for making sure that each entity moves from the disembarkation point before the next entity disembarks.
- Aggregate entities in the aggregated state cannot embark or disembark. If a disaggregated entity is embarked, you cannot aggregate it either manually, or as a result of automated aggregation conditions.

To disembark an entity:

1. Select the entity you want to disembark.
2. Choose **Task** → **Embarkation** → **Disembark**, or click the Disembark button ( ) on the Tasks toolbar.

7.10. Disembark All

The Disembark All task is given to a parent entity. It gives a Disembark task to all embarked entities except aggregates. When you issue a Disembark All task, VR-Forces tries to disembark the entities sequentially and have them move to sufficiently dispersed locations to avoid collision problems.

To disembark all entities from a parent entity:

1. Select the parent entity.
2. Choose **Task** → **Embarkation** → **Disembark All**.

7.11. DI-Guy Animation

VR-Forces can specify the movements and appearance of DI-Guy models used in the Stealth observer mode and in 3D visualization programs such as VR-Vantage Stealth. The DI-Guy Animation task directs the 3D model to engage in a one-time or repeated series of motions. VR-Forces does not simulate the actions that the 3D model performs; it just adjusts the location and orientation of the VR-Forces entity to synchronize it with the 3D model's animated behavior. To change a 3D model's appearance, use the DI-Guy Appearance set data request. For details, please see "DI-Guy Appearance," on page 8-10.

The DI-Guy Animation task applies only to lifeform entities.

To specify a DI-Guy animation:

1. Select the lifeform entity whose behavior you want to animate.
2. Choose **Task** → **DI-Guy** → **DI-Guy Animation**. The DI-Guy Animation dialog box opens (Figure 7-2).

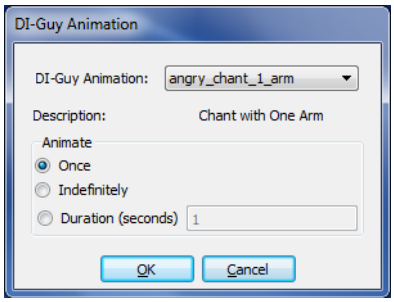


Figure 7-2. DI-Guy Task Animation dialog box

3. In the Animation list, select an animation. The names of animation options do not always clearly describe the animation. The Description is a friendlier description of what the animation is.

You can edit the animation description. Descriptions are in *./appData/settings/vrfSim/character_animations_table.mtl*.

4. In the Animate group box, specify the duration of the animation.
5. Click OK.

7.12. Drop Naval Depth Charge

The Drop Naval Depth Charge task drops a depth charge at the current location of the entity. To execute this task, an entity must have a Naval Depth Charge Deployment weapons system. Drop Naval Depth Charge is a system scripted task.

To drop a naval depth charge:

1. Select the entity.
2. Choose **Task** → **Engagement** → **Drop Naval Depth Charge**. The Drop Naval Depth Charge dialog box opens.
3. In the Naval Depth Charge list, select the type of depth charge to drop.
4. Specify the depth at which you want the depth charge to explode.
5. Click OK.

7.13. Drop Naval Depth Charge at Location

The Drop Naval Depth Charge at Location task drops a depth charge at a specified location. To execute this task, an entity must have a Naval Depth Charge Deployment weapons system. Drop Naval Depth Charge at Location is a system scripted task.

In this task, the location is the location of the entity when it drops the depth charge. Since the entity is flying, the location must include a reasonable altitude.

To drop a naval depth charge at a location:

1. Select the entity.
2. Choose **Task** → **Engagement** → **Drop Naval Depth Charge at Location**. The Drop Naval Depth Charge At Location dialog box opens.
3. In the Naval Depth Charge list, select the type of depth charge to drop.
4. Specify the depth at which you want the depth charge to explode.
5. Specify the location where you want to drop the depth charge.

   By default, this task uses the altitude of the entity at the time the task is assigned as the altitude for the drop location. (Use Current Altitude check box.) If you specify an altitude and the check box is selected, VR-Forces ignores the altitude you entered and uses the current entity altitude. If you want to specify the altitude, clear the check box and make sure that you specify the altitude in the Altitude group box. If you click on the terrain to specify the X, Y location, the altitude gets set to 0, so be sure to enter the altitude you want after clicking on the terrain.
6. Click OK.

7.14. Drop Naval Mine

The Drop Naval Mine task allows entities with a Naval Mine Deployment system to drop naval (underwater) mines at their current location. Drop Naval Mine is a system scripted task.

To drop a naval mine:

1. Select the entity.
2. Choose **Task** → **Engagement** → **Drop Naval Mine**. The Drop Naval Mine dialog box opens.
3. In the Naval Mine list, select the type of mine to drop.
4. In the Mine Depth field, set the depth to drop the mine. Positive numbers are below sea level.
5. In the Arming Delay fields, set the time to elapse before the mine becomes armed. The first field is days. The second field is Hours:Minutes:Seconds.
6. In the Detonate Proximity field, set the distance from the mine within which a target entity will detonate the mine.
7. In the Trigger Entity Types list, add the types of entities that can trigger the mine, as follows:
   a. Click the Add button (). The Entity Type dialog box opens.
   b. Build an entity type by selecting options from the lists for each enumeration component or type an enumeration.
   c. Click OK.
8. To specify that only hostile entities will set of the mine, select Hostile Only. If this setting is cleared, any entity will set off the mine.
9. Click OK.

7.15. Drop Naval Mines Along Route

The Drop Naval Mines Along Route task allows entities with a Naval Mine Deployment system to drop naval (underwater) mines while they travel along a route. Drop Naval Mines Along Route is a system scripted task.

To drop naval mines along a route:

1. Select the entity.
2. Choose **Task** → **Engagement** → **Drop Naval Mine**. The Drop Naval Mines Along Route dialog box opens.
3. Select the route to follow.
4. In the Mine Spacing field, specify the distance between each mine.
5. In the Naval Mine list, select the type of mine to drop.
6. In the Mine Depth field, set the depth to drop the mine. Positive numbers are below sea level.
7. In the Arming Delay fields, set the time to elapse before the mine becomes armed. The first field is days. The second field is Hours:Minutes:Seconds.
8. In the Detonate Proximity field, set the distance from the mine within which a target entity will detonate the mine.
9. In the Trigger Entity Types list, add the types of entities that can trigger the mine, as follows:
   a. Click the Add button (). The Entity Type dialog box opens.
   b. Build an entity type by selecting options from the lists for each enumeration component or type an enumeration.
   c. Click OK.
10. To specify that only hostile entities will set of the mine, select Hostile Only. If this setting is cleared, any entity will set off the mine.
11. Click OK.

7.16. Embark

The Embark task causes an entity to move to the ingress (entry) point of the parent entity and embark on it. If the embarking entity is an aggregate, each available taskable subordinate is given an embark task. When all subordinates have embarked, the aggregate task is considered complete.

Aggregate entities in the aggregated state cannot embark or disembark.

The Embark task is valid only if the specified parent entity is configured to accept the entity that wants to embark on it. If you task an entity to embark on an entity that is not configured to receive it, for example, you task a DI to embark on an M1A2, the entity will not respond to the task. If you want to embark an entity on an entity that is not configured to receive it, you can use the immediate embarkation process. For details, please see "Embarking and Disembarking Entities," on page 3-5.

Table 7-1 lists the entities that support embarkation and the number and type of embarked entities they can hold. High fidelity entities (HF column) have polygonal models of the entity and embarkation slots defined in such a way that the embarking entities can smoothly embark on the host entity when viewed in the 3D view or VR-Vantage.

Table 7-1: Embarkation support

Entity	Can Carry	HF
M2A2 Bradley IFV	6 DI	
M113 Armored Utility Vehicle	11 DI	
M-939A2 5-Ton Truck	14 DI	x
MT-LB Multipurpose Armored Vehicle	11 DI	
BTR-80 Armored Personnel Carrier	11 DI	
BMP-2 AVF	7 DI	
C-130 Hercules	92 DI or 3 ground vehicles	
CH-46E Sea Knight	11 DI	
CH-53E Super Stallion	55 DI	
UH-60 Blackhawk	11 DI	
OH-58 Kiowa	6 DI	
Mi-2 Hoplite	11 DI	
LCAC Landing Craft Air Cushion	12 HMMWVs or 4 trucks or 1 M1A2 or 1 generic ground vehicle	x
LSD-49 Harpers Ferry	2 LCACs and 2 helicopters	x

Table 7-1: Embarkation support

Entity	Can Carry	HF
Guided Missile Destroyer	2 helicopters	
Aircraft Carrier	12 fighters or 9 fighters and 2 cargo planes. Three helicopters. 70 planes below deck.	x

The aircraft carrier can carry both fixed-wing and rotary-wing aircraft. After the deck positions are used, additional entities embarked are stored below deck, as in a low-fidelity model.

- If you are using HLA and want to use the embarkation feature, you must use RPR FOM 2, draft 17. VR-Forces includes entries on the Simulation Connections Configuration dialog box that start VR-Forces using the correct FED file and FOM Mapper for RPR FOM 1.0, and RPR FOM 2, draft 17.
- If the embarkation spaces on the parent entity are full, VR-Forces sends a message to the back-end console and the entity does not try to embark.
- If you give multiple entities embark tasks for the same parent, you are responsible for spreading the tasks over time so that the entities do not all converge on the parent at the same time, which would result in problems due to collision avoidance.

To embark an entity:

1. Select the entity.
2. Choose **Task** → **Embarkation** → **Embark**, or click the Embark button () on the Tasks toolbar. The Embark On dialog box opens.

Unlike the Embark On dialog box that opens when you choose **Entities** → **Embark**, the Embark On dialog box for the Embark task does not allow you to choose the embarkation point.

3. Select the parent entity (the entity to embark on) or type its name in the Name box.
4. Click OK.

7.17. Execute Close Air Support

The Execute Close Air Support task assigns a fixed-wing fighter or bomber a close air support (CAS) task based on a 9-Line Briefing. The entity being tasked must be in the air to execute this task. This is a system scripted task.

A 9-Line Briefing is a format used by U.S. armed forces to call in CAS. The Execute Close Air Support dialog box explicitly or implicitly requests all of the information in a 9-Line Briefing. However, the scripted task does not use all of this information to simulate CAS. (The procedure notes which fields are not used.) The task has parameters for all 9 lines to provide simulation authenticity. Since this is a scripted task, you could modify it to use all of the parameters.

To execute close air support:

1. Select the entity you want to fire.
2. Choose **Task** → **Engagement** → **Execute Close Air Support**. The Execute Close Air Support dialog box opens (Figure 7-3).
3. In the Initial Point section, specify the location from which the aircraft should line up with the target by entering location values or clicking on the terrain.
4. In the Heading box, specify the approach heading. Optionally, specify an offset if you want the entity to favor a particular side of the line of approach.
5. In the Distance box, specify the distance from the initial point to the target. This information is not used by the task.
6. Select the target. Target selection satisfies lines 4, 5, and 6 of a 9-Line briefing, because it provides the location, altitude, and name of the target.
7. In the Mark Type box, specify how the target is marked. This information is not used by the task.

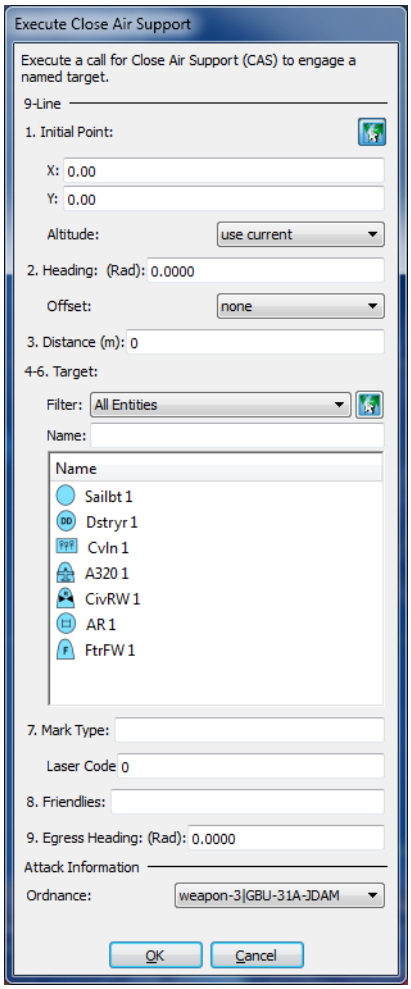


Figure 7-3. Execute Close Air Support dialog box

8. If you are using a laser designator to mark the target, enter the laser code. (If you specify a laser code, an entity in the simulation must be lasing the target for the CAS to work.)
9. In the Friendlies box, specify the distance and direction of friendly forces from the target. This information is not used by the task.
10. In the Egress Heading box, specify the heading by which the attacking entity should leave after parting the target. It will continue on this heading until it is given another task.
11. In the Ordnance list, select the type of bomb to drop.
12. Click OK.

7.18. Explode Charge at Depth

The Explode Charge at Depth task explodes a depth charge at the specified depth. You can use this task to explode a depth charge that has been deployed, but has not yet exploded.

Explode Charge at Depth is a system scripted task. It is disabled by default.

To explode a depth charge:

1. Select the depth charge.
2. Choose **Task** → **Explode Charge at Depth**. The Explode Charge at Depth dialog box opens.
3. Specify the depth.
4. Click OK.

7.19. Fire at Target

The Fire at Target task commands an entity to fire at a specific target. You can specify which weapon system to use and how many rounds to fire.

To order an entity to fire at a target:

1. Select the entity you want to fire.
2. Choose **Task** → **Engagement** → **Fire at Target**. The Fire at Target dialog box opens.
3. Select the target entity.
4. In the Weapon Selection group box, select an option as follows:
   - To let VR-Forces choose the weapon, select Automatic.
   - To choose the weapon yourself, select Manual and select a weapon from the list.
5. In the Maximum Rounds to Fire box, enter the number of rounds you want the entity to fire. (The entity will stop firing when the target is destroyed or when the maximum number of rounds has been fired, whichever comes first.)

7.20. Fire Cruise Missile

A cruise missile can fly directly to a target or follow a route.

To fire a cruise missile:

1. Select an entity that has cruise missile resources.
2. Choose **Task** → **Engagement** → **Fire Cruise Missile**. The Fire Cruise Missile dialog box opens (Figure 7-4).

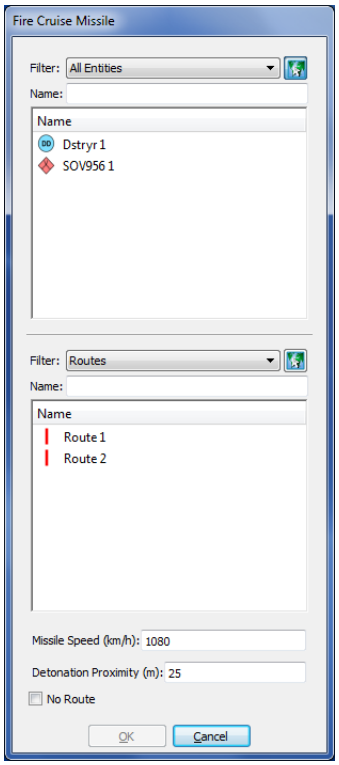


Figure 7-4. Fire Cruise Missile dialog box

3. Select the target from the list or on the terrain, or type its name in the Name box. Targets can be entities or points.
4. Select a route for the missile to follow or select the No Route check box. If no route is selected, the missile flies directly to the target.
5. Specify the ordered speed for the missile.
6. Specify the detonation proximity for the warhead. It will detonate within this range of the selected target.
7. Click OK.

7.21. Fire for Effect Tasks

You can task artillery entities and surface vessels that have naval guns to fire for effect. The three options are:

- Fire-for-Effect on Entity.
- Fire-for-Effect on Location, where location is a point on the terrain.
- Fire-for-Effect on Target, where a target is a waypoint.

If an entity has more than one weapon, you can select multiple weapons to fire. However, they will all fire on the same target. You cannot target them independently.

To assign a Fire-for-Effect task:

1. Select the entity to which you want to assign the task. (It must be an artillery entity.)
2. Choose **Task** → **Engagement** → **Fire-for-Effect on Entity** (or Location or Target). The appropriate dialog box opens.
3. Identify the target as follows:
   - For FFE Entity, select the target entity in the list, select it on the terrain, or type its name in the Name box.
   - For FFE Location, click a location on the terrain, or enter the coordinates.
   - For FFE Target, select a point from the list, or select it on the terrain.

For FFE Entity and FFE Target, you can filter the target list.

5. In the Select Weapons list, select the weapons that you want to fire.
6. Specify the number of rounds.
7. Optionally, specify the height above the terrain at which rounds should detonate.
8. Click OK.

- The Fire-for-Effect tasks are only meaningful when assigned to artillery entities or surface vessels that have naval guns.
- When you choose Fire-for-Effect on Entity, VR-Forces notes the location of the entity and fires at that spot. If the targeted entity moves, the artillery does not change the location at which it is firing.
- Artillery entities have maximum and minimum ranges. To see these ranges, enable range rings for the entity. (For details, please see Section 7.8, "Displaying Entity Range (Threat) Rings," in *VR-Forces Users Guide*.) The back-end console window prints messages when you select targets that are outside of the entity's range.

7.21.1. Firing Naval Guns

Ordinarily, naval guns fire their munitions in a parabola, similar to artillery. However, they can also fire directly at a target if the following conditions are true:

- The target's range is greater than the weapon's minimum range, but less than the first value in its range list.
- The **capable-of-direct-alignment** parameter for the weapon system's naval-gun-controller is set to True.
- The firing entity has line-of-sight to the target.

7.22. Fixed-Wing Land

"How Fixed-Wing Entities Take Off," on page 6-25, describes how fixed-wing entities land and the steps to design a landing approach. The Fixed Wing Land task automates the process of landing a fixed-wing aircraft. However, you must still specify a route to serve as the runway. Fixed-Wing Land is a system scripted task.

When the task is invoked, VR-Forces defines an approach route for the plane to move along. The length of this route is either the plane's altitude or the length needed to slow the plane down to landing speed, whichever is greater. The route is created and the plane moves along the route, coming to landing speed. At the end of the approach route, the plane is tasked to move along the runway.

! Although it is possible to land an entity on another entity, such as an aircraft carrier, if you want to embark an entity, you must use the Embark task, not a landing task.

To land a fixed-wing aircraft:

1. Select the entity.
2. Choose **Task** → **Movement** → **Fixed Wing Land**. The Fixed Wing Land dialog box opens.
3. In the Name box, type the name of the route you want it to land on, or select the route in the list or on the terrain.
4. Click OK.

7.23. Fixed Wing Takeoff

You can explicitly task a fixed-wing entity to take off. (For details about implicit take-off, please see "How Fixed-Wing Entities Take Off," on page 6-25.) In a Fixed Wing Takeoff task, the entity moves along the specified route, reaches takeoff speed (30% of minimum lift), and then moves to a point defined by the controller some distance up and away from the end of the route. Fixed-Wing Takeoff is a system scripted task.

To assign a Fixed Wing Takeoff task:

1. Select the entity.
2. Choose **Task** → **Movement** → **Fixed Wing Takeoff**. The Fixed Wing Takeoff dialog box opens.
3. Select the route to take off on or type its name in the Name box.
4. Click OK.

7.24. Fly Altitude

The Fly Altitude task commands a fixed-wing or rotary-wing entity to fly to the specified altitude at a specified ascent or descent rate, using its current heading and ordered speed. When it reaches the altitude it continues to fly at that altitude at the current heading until it receives other commands. The entity will not exceed the limits for altitude or ascent/descent rate set in the OPD for the entity type.

You cannot use a Fly Altitude task to cause a fixed-wing entity to take off. A fixed-wing entity that is on the ground ignores this task.

If a rotary-wing entity is on the ground and is given this task, it rises to the specified altitude as it moves forward at its current heading. If a rotary-wing entity is in the air and is given this task with an altitude of zero, it descends to approximately 33 M and continues flying at that altitude at its current heading.

To assign a Fly Altitude task:

1. Select a fixed-wing or rotary-wing entity.
2. Choose **Task** → **Movement** → **Fly Altitude**. The Fly Altitude dialog box opens.
3. In the Altitude box, specify the altitude above sea level to fly to.
4. In the Climb/Descent Rate box, specify the rate.
5. Click OK.

7.25. Fly Heading

The Fly Heading task commands a fixed-wing or rotary-wing entity to turn to the specified heading at the specified turn rate. It maintains its current altitude and speed. When it is finished turning to the new heading, it continues to fly at this heading until it receives other commands. The entity will not exceed the turn rate specified in the OPD.

A fixed-wing entity that is on the ground ignores this task.

If a rotary-wing entity is on the ground and is given this task, it rises to approximately 60 M and then drops down to approximately 33 M while simultaneously moving forward and turning to the specified heading. After turning to the new heading, it continues moving forward. Its altitude varies somewhat as it follows the terrain.

To assign a Fly Heading task:

1. Select a fixed-wing or rotary-wing entity.
2. Choose **Task** → **Movement** → **Fly Heading**. The Fly Heading dialog box opens.
3. In the Heading box, specify the heading to fly to.
4. In the Turn Rate box, specify the rate.
5. Click OK.

7.26. Fly Heading and Altitude

The Fly Heading and Altitude task commands a fixed-wing or rotary-wing entity to fly to a specified altitude, at a specified ascent or descent rate, while turning to a specified heading at a specified turn rate. If you do not specify a heading or altitude, the entity continues to use the current value for that parameter.

While executing this task, the entity maintains its current speed. When it completes the command, it continues to fly at the new altitude and heading until given other commands. The entity will not exceed the limits on altitude, turn rate, and ascent/descent rate set in the OPD.

You cannot use a Fly Heading and Altitude task to cause a fixed-wing entity to take off. A fixed-wing entity that is on the ground ignores this task.

If a rotary-wing entity is on the ground and is given this task, it takes off and moves forward while it rises to the specified altitude and turns to the specified heading. If a rotary-wing entity is in the air and is given this task with an altitude of zero, it moves forward and turns to the new heading while it descends to approximately 33 M and continues flying at that altitude on the new heading.

To assign a Fly Heading task:

1. Select a fixed-wing or rotary-wing entity.
2. Choose **Task** → **Movement** → **Fly Heading and Altitude**. The Fly Heading and Altitude dialog box opens.
3. In the Heading box, specify the heading to fly to.
4. In the Altitude box, specify the altitude above sea level to fly to.
5. In the Turn Rate box, specify the rate.
6. In the Climb/Descent Rate box, specify the rate.
7. Click OK.

7.27. Follow Entity

You can order an entity to follow another entity. You can specify a distance and offset between the entities. If you tell two or more entities to follow the same entity, make sure that you do not give them the same offset (please see "Following Entities," on page 9-34).

An entity continues to follow its target entity until:

- The task is overridden.
- The followed entity is destroyed.

If entity A is assigned to follow entity B, but it cannot find entity B, entity A continues to look for entity B until entity B becomes available, or until entity A is assigned another task.

The following entity tries to match the speed of the followed entity unless it has to hold back or catch up to accommodate changes in direction or terrain effects.

To order an entity to follow another entity:

1. Select the entity.
2. Choose **Task** → **Movement** → **Follow Entity**. The Follow Entity dialog box opens.
3. Optionally, filter the entity list.
4. In the Name box, type the name of the entity to follow, or select it from the list or on the terrain.
5. Optionally, type an offset in the Behind, Right, and Above text boxes. If you want an entity to follow in front, to the left, or below, put a minus sign (-) in front of the value.
6. Click OK.

7.27.1. How Fixed-Wing Entities Follow Entities

A fixed-wing entity can follow an entity that is on the ground, or might be on the ground, for example if it is following a fixed-wing entity that lands. To ensure that the follower does not crash, make sure that it is following above the followed entity and that the distance above is high enough to account for changes in the terrain.

7.28. Intercept and Destroy

The Intercept and Destroy task tells an entity to move towards the target entity and engage it in any way that is appropriate.

Intercept and Destroy turns off collision avoidance for the tasked entity. Its primary purpose is to allow entities such as car bombs and suicide bombers to approach a target entity and detonate its munition. If you give this task to an entity that does not have any offensive capability, such as a truck, it will ram the target. However, since VR-Forces does not model the effects of two entities colliding, there will be no damage to either entity and the tasked entity may end up circling the target. Therefore, you should be careful about which entities you assign this task to or the results may not be what you expect.

To assign the Intercept and Destroy task:

1. Select the entity to which you want to assign the task.
2. Choose **Task** → **Engagement** → **Intercept and Destroy**. The Intercept and Destroy dialog box opens.
3. Select the entity that is to be the target of the assault.
4. Optionally, specify a standoff distance. The entity will not go closer to the target than this distance.
5. Click OK.

7.29. Lase Target

The Lase Target task simulates aiming a laser beam at a target to guide a laser guided weapon. By default, entities with laser capability lase autonomously. Use this task if you want to lase a specific target. An entity can lase a target while it is executing a movement task.

To lase a target, an entity must have a Laser Designator system. By default, rotary-wing entities based on the generic attack helicopter platform and the DI Lasing entity can lase targets.

To lase a target:

1. Select the entity that will aim the laser.
2. Choose **Task** → **Engagement** → **Lase Target**. The Lase Target dialog box opens.
3. Select the entity that you want to lase.
4. Click OK.

7.30. Launch Anti-Submarine Missile (Vertical)

The Launch Anti-Submarine Missile (Vertical) task lets a surface entity launch a missile that flies to the vicinity of the target and then drops a homing torpedo. To execute this task, an entity needs an Anti-Submarine Missile (Vertically Launched) weapon system. This is a system scripted task.

To launch an anti-submarine missile:

1. Select the surface entity.
2. Choose **Task** → **Engagement** → **Launch Anti-Submarine Missile (Vertical)**. The Launch Anti-Submarine Missile (Vertical) dialog box opens.
3. Select the target entity.
4. Specify the location at which to drop the homing torpedo.
5. Click OK.

7.31. Launch Counter Measures

Fixed-wing and rotary-wing entities can launch counter measures, such as chaff and flares. Launch Counter Measures is not an exclusive task. It does not interrupt an entity's current task. (For more information, please see "Launching Counter Measures (Chaff and Flare)," on page 10-17.)

To launch counter measures:

1. Select the entity that you want to launch counter measures.
2. Choose **Task** → **Engagement** → **Launch Counter Measures**. The Launch Counter Measures dialog box opens.
3. In the Counter Measure Types list, select the type of counter measures you want to launch.
4. In the Number To Fire box, specify the number of counter measures to launch.
5. In the Time Between Fires box, specify the amount of time, in seconds, between each counter measure launch.
6. Click OK.

7.32. Launch Smoke

The Launch Smoke task causes an entity to create a smoke cloud. The cloud is created as an environmental object. It grows over time.

An entity can launch a smoke cloud towards a threat or in a specific direction. Smoke clouds affect sensors. They do not affect entity movement.

Tactical smoke is delivered by the M250 smoke grenade launcher. An entity must have this system to execute this task.

To launch a smoke cloud:

1. Select the entity that you want to launch smoke.
2. Choose **Task** → **Engagement** → **Launch Smoke**. The Launch Smoke dialog box opens.
3. Select At Nearest Threat or Toward Compass Heading.
4. If you selected Toward Compass Heading, specify a compass heading, in degrees.
5. Click OK.

7.33. LaunchTorpedo

Subsurface entities can launch two types of anti-ship torpedoes. One moves at a fixed depth; one homes in on the center of the target. In both cases, the torpedo travels at an initial bearing for a fixed distance before it homes in on the target. The Launch Torpedo tasks are system scripted tasks.

7.33.1. Anti-ship (Fixed Depth)

To launch a torpedo that moves at a fixed depth:

1. Select a subsurface entity.
2. Choose **Task** → **Engagment** → **Launch Torpedo** → **Anti-ship (Fixed Depth)**. The Anti-ship (Fixed Depth) dialog box opens.
3. Optionally, filter the entity list.
4. Select the target entity.
5. In the Homing Start Delay box, enter the amount of time that the torpedo should travel on its initial bearing.
6. In the Cruise Depth box, specify the depth the torpedo should travel at. It will remain at this depth.
7. In the Initial Bearing box, specify the bearing the torpedo should travel at until it begins homing in on the target.
8. In the Proximity Trigger Distance box, set the distance from a target at which the torpedo will detonate.
9. Click OK.

7.33.2. Anti-Submarine

The anti-submarine torpedo homes in on the center of the target.

To launch an anti-submarine torpedo:

1. Select a subsurface entity.
2. Choose **Task** → **Engagment** → **Launch Torpedo** → **Anti-submarine**. The Anti-Submarine dialog box opens.
3. Optionally, filter the entity list.
4. Select the target entity.
5. In the Homing Start Delay box, enter the amount of time that the torpedo should travel on its initial bearing.
6. In the Initial Bearing box, specify the bearing the torpedo should travel at until it begins homing in on the target.
7. In the Proximity Trigger Distance box, set the distance from a target at which the torpedo will detonate.
8. Click OK.

7.34. Lower Periscope

The Lower Periscope task lowers the periscope of a subsurface entity. The periscope is an articulated part that is visible in the Stealth view. Lower Periscope is a system scripted task.

To lower a submarine's periscope:

1. Select the entity.
2. Choose **Task** → **Other** → **Lower Periscope**.

7.35. Move Along Route

By default, an entity moves along a route from its nearest vertex to its end point.

- If you edit a route while an entity is moving to the starting point of that route as part of a Move Along Route task, the entity will move to the nearest vertex, whether it is the starting point, or not.
- If you want an entity to repeatedly move along the same route from beginning to end (for example, to follow a circular route), be sure to clear the Start at Closest Vertex check box. If you do not, after the first time the entity moves along the route, it will keep going to the end vertex, because that will be the closest vertex to where it is starting the new Move Along Route task.
- When you task an air platform entity to follow a route, be sure to take into account the altitude of the route's vertices and the terrain the entity has to pass over to complete the task. (For more information, please see "Fixed-Wing Movement Between Vertices," on page 6-24 and "Rotary-Wing Entity Tasks and Behaviors," on page 6-27.)
- Aggregates do not generate subordinate routes until they reach the beginning of the route.
- An aggregate starts moving along a route when the leading edge of its formation is at the first point of the route. It is considered finished when the leading edge reaches the last point of the route.

To direct an entity to move along a route:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move Along Route**, or click the Move Along Route button () on the Tasks toolbar. The Move Along Route dialog box opens.
3. In the Name box, type the name of the route you want the entity to follow, or select a route in the list or on the terrain.
4. To have the entity move from the end of the route to the beginning, select Reverse Direction.

5. To have the entity use the road driving movement strategy, select the Treat Route as Road check box. The route is treated as a two-lane bidirectional road.

! If you select Treat Route as Road, the entity must be within 10 meters of the route or the task will fail. The task is treated just like a Move To Waypoint/Location (On Roads) task.

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6. To have the entity start the route at the beginning, clear the Start at Closest Vertex check box.
7. Click OK.

7.36. Move Into Formation

You can order a disaggregated aggregate to move to a formation at a specified location. Moving to a formation is not the same as setting formation. Setting formation changes the formation instantly. Moving to a formation causes the members of the aggregate to simulate traveling through the terrain into the new formation.

For aggregated aggregates, Move Into Formation has the same effect as a Formation set data request.

To direct an aggregate to move to a formation:

1. Select the aggregate.
2. Choose **Task** → **Movement** → **Move Into Formation**. The Move Into Formation dialog box opens.
3. Select the desired formation from the list.
4. Specify the location at which the aggregate is to move into formation by entering coordinates, or by clicking on the terrain.
5. If you specify the location by clicking and the task is for an air platform that is in the air, change the altitude to a height that will prevent the entity from crashing.
6. Specify the heading the aggregate is to assume at the target location.
7. Click OK.

7.37. Move To Altitude

You can order an air or subsurface entity to move to an altitude. When you assign this task, the entity moves to the new altitude at the same coordinates. Fixed-wing aircraft spiral to the new coordinates. Rotary-wing and subsurface entities rise or fall. Moving to an altitude is not the same as setting altitude. Setting altitude moves an entity instantaneously. It is also not the same thing as Fly Altitude. At the conclusion of Move to Altitude, an aircraft circles or hovers at the new altitude. At the conclusion of Fly Altitude, an aircraft continues moving at its current heading.

Fixed-wing entities that are on the ground cannot respond to a Move to Altitude task. If they are given this task, a message is printed to the object console and the task is ignored.

To send an entity to an altitude:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move to Altitude**, or click the Move to Altitude button () on the Tasks toolbar. The Move To Altitude dialog box opens.
3. Type the altitude that you want the entity to move to.
4. Click OK.

7.38. Move To Depth

The Move To Depth task lets you specify the depth for subsurface entities. When an entity moves to a depth, it continues any horizontal movement that was in effect prior to starting the task.

To assign a move to depth task:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move to Depth**. The Move To Depth dialog box opens.
3. Select an option for the depth. If you choose a specific depth, type a depth in the Target Depth box.
4. Specify the ascent/descent rate.
5. Click OK.

7.39. Move To Location (Direct)

You can order an entity to move to a location on the terrain. If you add Move to Location (Direct) tasks to a plan, you have more options than when you give an independent task.

Moving to a location is not the same as setting location. Setting location moves an entity instantaneously. Moving to a location causes an entity to simulate traveling through the terrain.

If you want an entity to use the road network to move to a location, use the Move To Location (On Roads) task. If you want to move both on and off road, use Move To Location (Plan Path). For details about road movement, please see "Entity Movement On Roads and Off Roads," on page 6-18.

To direct an entity to move to a location as an independent task:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move to Location (Direct)**, or click the Move to Location (Direct) button ( ) on the Tasks toolbar. The Move to Location (Direct) dialog box opens.

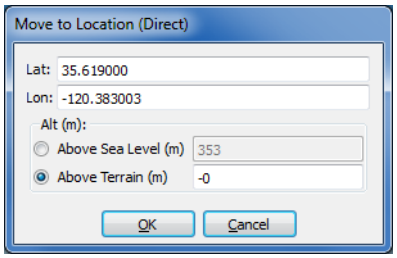


Figure 7-5. Move to Location (Direct) dialog box for an independent task

3. Click on the terrain where you want the entity to move, or enter the coordinates of the location in the Move to Location (Direct) dialog box.
4. Optionally, set the altitude, as described in "Specifying an Object's Altitude," on page 2-12.

> If you specify the location by clicking and the task is for an air platform that is in the air, be sure to change the altitude to a height that will prevent the entity from crashing.

5. Click OK.

7.39.1. Adding Multiple Move To Location (Direct) Tasks to a Plan

When you add a Move to Location (Direct) task to a plan, you can add multiple locations without clicking OK and selecting the task again from the menu. Also, since in this method you cannot specify the altitude for each location, you can specify a height above the terrain for the altitude of the succeeding points.

To add multiple Move to Location (Direct) tasks to a plan:

1. In the Plan Editor for an entity, choose **Task** → **Movement** → **Move to Location (Direct)**. The Move to Location (Direct) dialog box opens.
2. Select Each Click Generates A Task.
3. If you want to specify an altitude for the locations, specify an altitude, as described in "Specifying an Object's Altitude," on page 2-12.
4. Click a point on the terrain for each location that you want the entity to move to. A Move To Location (Direct) task is added to the plan for each location.
5. Click OK.

7.40. Move To Location (On Roads)

The Move To Location (On Roads) task causes an entity to move along the road network to the nearest point on the road to the specified location. If the location is not on the road, the entity does not leave the road to move to the location.

The entity must be within 10 meters of the edge of the road at the start of the task or it will fail. (The distance is configurable in the **allowable-distance** parameter in the **rail-path-movement** controller in the entity's movement system definition file.)

If you want an entity to move directly to a location without using the road network, use the Move To Location (Direct) task. If you want to move both on and off road, use Move To Location (Plan Path). For details about road movement, please see "Entity Movement On Roads and Off Roads," on page 6-18.

Move To Location (On Roads) is valid only for ground vehicles. If you give it to any other type of entity, it fails.

To direct an entity to move to a location along roads:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move To Location (On Roads)**. The Move To Location (On Roads) dialog box opens.
3. Click on the terrain where you want the entity to move, or enter the coordinates of the location in the dialog box.
4. Click OK.

7.41. Move to Location (Plan Path)

VR-Forces has two versions of the Move to Location (Plan Path) task. One is for ground vehicles; one is for surface and subsurface entities.

7.41.1. Move to Location (Plan Path) for Ground Vehicles

The Move to Location (Plan Path) task combines the Move to Location (Direct) and Move to Location (On Roads) tasks to let you send an entity to a location without the need to create multiple individual Move to Location (Direct) and Move to Location (On Roads) tasks. Move to Location (Plan Path) is a system scripted task.

When an entity receives this task, it determines if there is a road network near by. If there is, it moves directly to the nearest point on the road network. Then it moves along the roads using road driving behavior until it gets to the point on the road that is closest to the destination. Then the entity moves off the road directly to the destination.

For more information about road driving and how the path planning tasks work, please see "Entity Movement On Roads and Off Roads," on page 6-18.

To move a ground vehicle to a location with path planning:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move To Location (Plan Path)**. The Move To Location (Plan Path) dialog box opens.
3. Click on the terrain where you want the entity to move, or enter the coordinates of the location in the dialog box.
4. Click OK.

7.41.2. Move to Location (Plan Path) for Ships

The Move to Location (Plan Path) task plots a route to the destinaion location based on the depth of water between the starting point and ending point. You specify the minimum depth required for the ship to maneuver. You can specify that the depth be based on the ship's draft or you can enter a specific depth value. The ship's draft is determined based by calculating the distance its bounding box extends below its origin, as set in the Entity Editor.

The formula for calculating the draft is:

draft = height/2 - offset (Up)

where height and offset are set in the Size group box in the Entity Editor.

If you give this task to a submarine, VR-Forces assumes that it is moving on the surface.

This task is a system scripted task.

To move a surface or subsurface vehicle to a location with path planning:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move To Location (Plan Path)**. The Move To Location (Plan Path) dialog box opens.
3. Click on the terrain where you want the entity to move, or enter the coordinates of the location in the dialog box.
4. Specify how you want VR-Forces to determine the minimum depth of water for the route.
5. If you want to see the path displayed, select Display Route.
6. Click OK.

7.42. Move To Waypoint (Direct)

You can order an entity to move to a point or another entity. Moving to an object is not the same as setting location. Setting location moves an entity instantaneously. Moving to an object simulates an entity traveling through the terrain.

If you want an entity to use the road network to move to a waypoint, use the Move To Waypoint (On Roads) task. If you want to move both on and off road, use Move To Waypoint (Plan Path). For details about road movement, please see "Entity Movement On Roads and Off Roads," on page 6-18.

To send an entity to an object:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move to Waypoint (Direct)**, or click the Move to Waypoint (Direct) button ( ) on the Tasks toolbar. The Move To Waypoint (Direct) dialog box opens.
3. Optionally, filter the object selection list.
4. In the Name box, type the name of the object to move to, or select the object in the list or on the terrain.
5. Click OK.

When you task an air platform entity to move to an object, be sure to take into account the altitude setting for the object and the terrain the entity has to pass over to complete the task.

7.43. Move To Waypoint (On Roads)

The Move To Waypoint (On Roads) task causes an entity to move along the road network to the nearest point on the road to the specified waypoint. If the waypoint is not on the road, the entity does not leave the road to move to it.

The entity must be within 10 meters of the edge of the road at the start of the task or it will fail. (The distance is configurable in the **allowable-distance** parameter in the **rail-path-movement** controller in the entity's movement system definition file.)

If you want an entity to move directly to a waypoint without using the road network, use the Move To Waypoint (Direct) task. If you want to move both on and off road, use Move To Waypoint (Plan Path). For details about road movement, please see "Entity Movement On Roads and Off Roads," on page 6-18.

Move To Waypoint (On Roads) is valid only for ground vehicles. If you give it to any other type of entity, it will fail.

To direct an entity to move along roads to a waypoint:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move To Waypoint (On Roads)**. The Move To Waypoint (On Roads) dialog box opens.
3. Select the waypoint.
4. Click OK.

7.44. Move to Waypoint (Plan Path)

Move to Waypoint (Plan Path) has two versions, one for ground vehicles and one for surface and subsurface entities.

7.44.1. Move to Waypoint (Plan Path) for Ground Vehicles

The Move to Waypoint (Plan Path) task combines the Move to Waypoint (Direct) and Move to Waypoint (On Roads) behaviors to let you send an entity to a waypoint without the need to create multiple individual Move to Waypoint (Direct) and Move to Waypoint (On Roads) tasks. Move to Waypoint (Plan Path) is a system scripted task.

When an entity receives this task, it determines if there is a road network near by. If there is, it moves directly to the nearest point on the road network. Then it moves along the roads using road driving behavior until it gets to the point on the road that is closest to the destination. Then the entity moves off the road directly to the destination.

For more information about road driving and how the path planning tasks work, please see "Entity Movement On Roads and Off Roads," on page 6-18.

To direct an entity to move to a waypoint with path planning:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move To Waypoint (Plan Path)**. The Move To Waypoint (Plan Path) dialog box opens.
3. Select the waypoint.
4. Click OK.

7.44.2. Move to Waypoint (Plan Path) for Ships

The Move to Waypoint (Plan Path) task plots a route to the waypoint based on the depth of water between the starting point and ending point. You specify the minimum depth required for the ship to maneuver. You can specify that the depth be based on the ship's draft or you can enter a specific depth value. The ship's draft is determined based by calculating the distance its bounding box extends below its origin, as set in the Entity Editor.

The formula for calculating the draft is:

draft = height/2 - offset (Up)

where height and offset are set in the Size group box in the Entity Editor.

If you give this task to a submarine, VR-Forces assumes that it is moving on the surface.

This task is a system scripted task.

To move a surface or subsurface vehicle to a waypoint with path planning:

1. Select the entity.
2. Choose **Task** → **Movement** → **Move To Waypoint (Plan Path)**. The Move To Waypoint (Plan Path) dialog box opens.
3. Select the waypoint to move to.
4. Specify how you want VR-Forces to determine the minimum depth of water for the route.
5. If you want to see the path displayed, select Display Route.
6. Click OK.

7.45. Orbit

The Orbit task allows a fixed-wing aircraft to circle around a point without needing to create a route for it to follow.

To specify an orbit task:

1. Select the entity that you want to orbit.
2. Choose **Task** → **Movement** → **Orbit**. The Orbit dialog box opens.
3. Specify the coordinates of a point on the terrain around which the entity should orbit. You can click on the terrain to specify the points.
4. Specify the altitude at which to fly.
5. Specify the radius of the circle.
6. Select or clear the Clockwise option to specify the direction of travel.
7. Click OK.

7.46. Patrol Along Route

When an entity patrols along a route, it moves to the nearest vertex of the route, to the end point, back to the beginning of the route, and then continues going back and forth along the route until given another command.

To order an entity to patrol along a route:

1. Select the entity.
2. Choose **Task** → **Movement** → **Patrol Along Route**, or click the Patrol Along Route button () on the Tasks toolbar. The Patrol Along Route dialog box opens.
3. In the Name box, type the name of the route to patrol along, or select the route in the list or on the terrain.
4. Click OK.

When you task an air platform entity to follow a route, be sure to take into account the altitude of the vertices and the terrain the entity has to pass over to complete the task.

7.47. Patrol Between

An entity can patrol between two point objects, entity objects, or both. When an entity patrols between two objects, it goes to the starting object, then moves back and forth between the two objects.

To order an entity to patrol between two objects:

1. Select the entity.
2. Choose **Task** → **Movement** → **Patrol Between**, or click the Patrol Between Points button () on the Tasks toolbar. The Patrol Between dialog box opens.
3. In the Name box for Point 1, type the name of the first object to patrol between, or select an object in the list or on the terrain.
4. In the Name box for Point 2, type the name of the second object to patrol between, or select an object in the list or on the terrain.
5. Click OK.

When you task an air platform entity to patrol between objects, be sure to take into account the altitude of the objects and the terrain the entity has to pass over to complete the task.

7.48. Pattern Hold (Location)

The Pattern Hold (Location) task assigns a fixed-wing or rotary-wing entity to execute a standard hold pattern at the specified location. This is a system scripted task.

To assign a pattern hold (location) task:

1. Select a fixed-wing or rotary-wing entity.
2. Choose **Task** → **Movement** → **Pattern Hold (Location)**. The Pattern Hold (Location) dialog box opens.
3. Enter the location or select it on the terrain.
4. Specify the heading, speed, and altitude for the hold pattern.
5. Specify the turn direction for the hold pattern.
6. Click OK.

7.49. Pattern Hold (Waypoint)

The Pattern Hold (Waypoint) task assigns a fixed-wing or rotary-wing entity to execute a standard hold pattern at the specified waypoint. This is a system scripted task.

To assign a pattern hold (waypoint) task:

1. Select a fixed-wing or rotary-wing entity.
2. Choose **Task** → **Movement** → **Pattern Hold (Waypoint)**. The Pattern Hold (Waypoint) dialog box opens.
3. Select the waypoint.
4. Specify the heading, speed, and altitude for the hold pattern.
5. Specify the turn direction for the hold pattern.
6. Click OK.

7.50. Place IED

The Place IED task lets a human entity place an improvised explosive device (IED) at a particular location and move to a post-placement location. This task also sets the parameters for how the IED will be armed. Place IED is a system scripted task.

To assign a place IED task to a human entity:

1. Select the entity.
2. Choose **Task** → **Engagement** → **Place IED**. The Place IED dialog box opens (Figure 7-6).

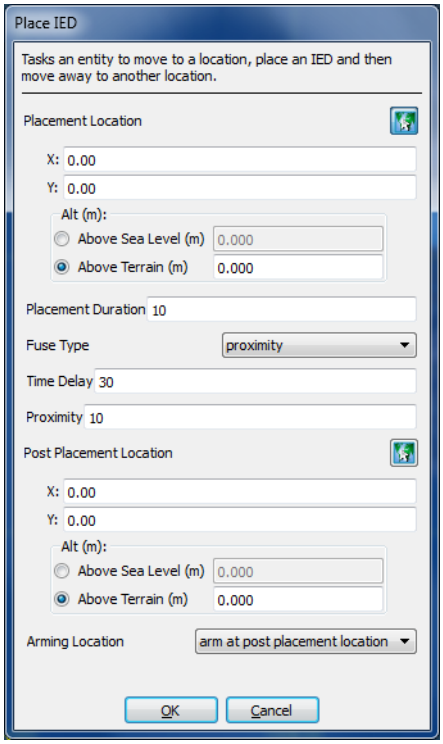


Figure 7-6. Place IED dialog box

3. Enter the location where the IED should be placed, or click on the terrain to specify the location.
4. Select a fuse type from the Fuse Type list.
5. For a timed delay fuse, specify the time to delay in the Time Delay box.
6. For a proximity fuse, specify the distance from the IED within which another entity will trigger the IED.
7. Enter the location where the entity should move to after it places the IED, or click on the terrain to specify the location.
8. In the Arming Location list select Arm at Placement Location to arm the IED as soon as it is placed, or Arm at Post Placement Location to arm it when the entity reaches the post-placement location.
9. Click OK.

7.51. Raise Periscope

The Raise Periscope task raises the periscope of a subsurface entity. The periscope is an articulated part that is visible in the Stealth observer mode. Raise Periscope is a system scripted task.

To raise a submarine's periscope:

1. Select the entity.
2. Choose **Task** → **Other** → **Raise Periscope**.

7.52. Release Bomb Tasks

Fixed-wing entities can release bombs targeted to a laser spot, a location, or an entity. The Release Bomb on Laser Spot task requires that another entity lase the target. You must synchronize the laser code for the bomber with the laser code for the lasing entity. Use of lasers is described in:

- "Lasing Targets," on page 10-13.
- "Lase Target," on page 7-26.
- "Laser Code," on page 8-17.
- "Synchronize Laser Code," on page 8-27.

To assign a release bomb task:

1. Select the entity that will release the bomb.
2. Choose **Task** → **Engagement** → *task*, where *task* is Release Bomb on Laser Spot, Release Bomb on Location, or Release Bomb on Target. The appropriate dialog box opens.
3. In the Bomb Types list, select the type of bomb you want to drop.
4. In the Detonation Proximity box, enter the distance from the target at which the bomb should detonate.
5. For Release Bomb on Location, specify the location.

   For Release Bomb on Target, select the target.
6. Click OK.

7.53. Rotary-Wing Land

The Rotary Wing Land task automates the process of landing a rotary-wing aircraft. Rotary-wing aircraft can land on points.

! Although it is possible to land an entity on another entity, such as an aircraft carrier, if you want to embark an entity, you must use the Embark task, not a landing task.

To land a rotary-wing aircraft:

1. Select the entity.
2. Choose **Task** → **Movement** → **Rotary Wing Land**. The Rotary Wing Land dialog box opens.
3. In the Name box, type the name of the waypoint on which you want the entity to land, or select the waypoint in the list or on the terrain.
4. Click OK.

7.54. Sail Heading

The Sail Heading task causes a surface entity to sail towards the specified heading. After turning to the heading, the entity moves at its ordered speed indefinitely.

To assign a sail heading task:

1. Select the entity.
2. Choose **Task** → **Movement** → **Sail Heading**. The Sail Heading dialog box opens.
3. Specify a heading in the indicated units (radians or degrees).
4. Specify the diameter of the turn.
5. Specify the direction of the turn, as follows:
   - Toward Heading. Chooses the most direct turn.
   - Port. Turns to port until it reaches the heading.
   - Starboard. Turns to starboard until it reaches the heading.
6. Click OK.

7.55. Send Radio Set

The Send Radio Set task lets you send a set data request to an entity using a VR-Forces radio message. The receiving entity executes the set data request as if you had issued it directly to the entity from the Set menu or a set data request in a plan.

To send a set data request radio message:

1. Select the entity that will send the message.
2. Choose **Task** → **Radio**→ **Send Radio Set** → *category* → *set_data_request*, where *category* is one of the categories of set data requests and *set_data_request* is one of the set data requests for that category. A dialog box for the set data request opens.
3. In the Name text box, type the name of the entity that will receive the set data request message, or select the entity in the list or on the terrain.
4. If the selected set data request requires input, complete the dialog box as described in Chapter 8, *Setting Entity State*.
5. To send the message to all entities configured to receive messages from this entity's radio, select the Broadcast check box. (For details about configuring the radio model, please see Section 2.4, "Configuring Communication Models," in *VR-Forces Configuration Guide*.)
6. Click OK.

7.56. Send Radio Task

The Send Radio Task task lets you send a task to an entity using a VR-Forces radio message. The receiving entity executes the task as an independent task.

To send a task radio message:

1. Select the entity that will send the message.
2. Choose **Task** → **Radio**→ **Send Radio Task** → *category* → *task*, where *category* is one of the categories of tasks and *task* is one of the tasks in that category. A dialog box for the task opens.
3. In the Name text box, type the name of the entity that will receive the task message, or select the entity in the list or on the terrain.
4. If the selected task requires input, complete the dialog box as described in "Specifying Parameters for Tasks," on page 6-5.
5. To send the message to all entities configured to receive messages from this entity's radio, select the Broadcast check box. (For details about configuring the radio model, please see Section 2.4, "Configuring Communication Models," in *VR-Forces Configuration Guide*.)
6. Click OK.

7.57. Send Text Message

The Send Text Message task lets you send a text message to an entity using a VR-Forces simulated radio message. The receiving entity must be on the same network as the sending entity. Usually this means the same aggregate or same force. The receiving entity can test for receipt of the message in a conditional statement in its plan. (For details, please see "The Receive Text Message Condition," on page 9-13.)

To send a text message:

1. Select the entity that will send the message.
2. Choose **Task** → **Radio** → **Send Text Message**. The Send Text dialog box opens.
3. In the Name text box, type the name of the entity that will receive the text message, or select the entity in the list or on the terrain.
4. In the Message Text box, type the message.
5. To send the message to all entities configured to receive messages from this entity's radio, select the Broadcast check box. (For details about configuring the radio model, please see Section 2.4, "Configuring Communication Models," in *VR-Forces Configuration Guide*.)
6. Click OK.

7.58. Sonar Dip

Rotary-wing entities that have sonar can dip the sonar into water at a specified depth. Dipped sonar is not visualized in the Stealth view. The sonar is just simulated at the specified depth. Entities cannot dip sonar if they are moving faster than a set speed. Sonar Dip is a system scripted task.

To dip sonar:

1. Select the entity.
2. Choose **Task** → **Sonar Dip**. The Sonar Dip dialog box opens.
3. Specify the location at which to dip the sonar.
4. Specify how long the sonar should stay dipped.
5. Select the type of sonar to dip – Active or Passive.

RPR FOM 1.0 does not support active sonar.

6. Specify the depth for the sonar.
7. Click OK.

7.59. Sweep Naval Mines

The Sweep Naval Mines task causes an entity to look for and disable naval mines along a route. It looks within a specified distance from the route. The error rate specifies a percentage of the time that the entity will detect a mine, but not disable it. The Sweep Naval Mines task is available to surface entities that have a Naval Mine Sweep system. Sweep Naval Mines is a system scripted task.

To assign the Sweep Naval Mines task:

1. Select the entity.
2. Choose **Task** → **Movement** → **Sweep Naval Mines**. The Sweep Naval Mines dialog box opens.
3. Select the route to follow.
4. Specify the sensing range. The default is 300 meters.
5. Optionally, specify an error rate as a percentage of the mines found that are not disabled.
6. Click OK.

7.60. Turn To Heading

The Turn to Heading task provides a realistic way for ground vehicles to turn to a new heading. Rather than turning instantly, as happens with the Heading request, a vehicle pivots or makes a K-turn to the new heading. The turning behavior for an entity is controlled by its **can-pivot** parameter in the object parameter database.

To order an entity to turn to a heading:

1. Select the entity.
2. Choose **Task** → **Movement** → **Turn to Heading**. The Turn to Heading dialog box opens.
3. Type a heading.
4. Click OK.

7.61. User Task

User tasks are tasks that have been added to VR-Forces using the VR-Forces toolkit. To assign a user task, you must know the name of the task and the required values for up to four parameters.

The User Task command is not available on the Task menu unless a developer adds a controller that accepts a user task.

To assign a user task:

1. Select the entity that you want to execute the task.
2. Choose **Task** → **Other** → **User Task**. The User Task dialog box opens.
3. Type the name of the task.
4. Type any required parameters.

7.62. Wait Tasks

You can order an entity to wait indefinitely, for a specified period of time, or until a specified elapsed simulation time.

The Wait task is not equivalent to an immediate stop task. If an entity is moving and you give it a Wait task, it might not stop immediately, particularly if a controller such as the collision avoidance controller is controlling its movement.

7.62.1. Wait

To order an entity to wait indefinitely:

1. Select the entity.
2. Choose **Task** → **Wait** → **Wait**.

If you put an indefinite wait in a plan, the entity does not progress through its plan until it receives another command.

7.62.2. Wait Duration

To order an entity to wait a specific amount of time:

1. Select the entity.
2. Choose **Task** → **Wait** → **Wait Duration**. The Wait Duration dialog box opens.
3. Specify the duration of the wait in hours, minutes, and seconds.
4. Click OK.

7.62.3. Wait Elapsed

To order an entity to wait until a specific elapsed simulation time:

1. Select the entity.
2. Choose **Task** → **Wait** → **Wait Elapsed**. The Wait Elapsed dialog box opens.
3. Specify the elapsed time from the start of the simulation, in hours, minutes, and seconds.
4. Click OK.

For information about simulation time and simulated exercise time, please see Section 3.13.1, "Simulation Time," in *VR-Forces Users Guide*.

8

Setting Entity State

This chapter explains how to set entity state, such as speed, force, and target.

8.1. Setting Entity State and Attributes

You can set the following entity state values for VR-Forces entities. The Set menu is context sensitive. It only shows the options that apply to the selected entity.

- Active Sonar Mode
- Aggregate State
- Altitude
- Appearance
- Armed
- Capabilities
- Collision avoidance types
- Concealed
- Counter Measures Auto Launch
- Destroyed
- Detonation Fuse Type
- DI-Guy Appearance
- Disembarked
- Embarked
- Emitter
- Force
- Formation
- Heading
- IFF
- Lase Autonomous
- Laser Code
- Location
- Notify Level
- Ordered Speed
- Posture
- Radar Mode
- Reorganize
- Resources
- Restore
- Rules of Engagement
- Sector of Responsibility
- Sonar Depth
- Spot Reports
- Surrendered
- Synchronize Laser Code
- Target
- Tasked by Superior
- Weapon State.

- The graphical user interface does not necessarily know about the state of an entity. When you open a dialog box for a Set command, any data in the dialog box represents either default values or the most recently used value, except for the Altitude, Location, and Heading dialog boxes, which show the current values for the selected entity.
- You can filter entity selection lists. For details, please see "Filtering the Object Selection Lists," on page 6-8.

8.2. Active Sonar Mode

If an entity has an active sonar system, you can set the sonar mode.

RPR FOM 1.0 does not support active sonar.

To set the active sonar mode:

1. Select the entity.
2. Choose **Set** → **Sensors** → **Active Sonar Mode**. The Active Sonar Mode dialog box opens.
3. In the System ID list, select the sonar system that you are setting. The entities provided with VR-Forces just have one active sonar system.
4. In the Mode list, select a sonar mode or select Off to disable active sonar.
5. Click OK.

8.3. Aggregate State

The Aggregate State request lets you change an aggregate from the aggregated state to the disaggregated state and vice versa.

To set an aggregate's aggregation state:

1. Select the aggregate.
2. Choose **Set** → **Aggregate** → **Aggregate State**. The Aggregate State dialog box opens.
3. Select the desired state from the list.
4. Click OK.

8.4. Altitude

The Altitude request changes the altitude of entities immediately. If you want a fixed-wing or rotary-wing entity to move to an altitude, use the Move to Altitude or Fly Altitude task. You can set the altitude manually or place an entity at a specific level in a multi-level terrain features, such as a building.

To set an entity's altitude:

1. Select the entity.
2. Choose **Set** → **Position** → **Altitude**, or click the Altitude button () on the Sets toolbar. The Altitude dialog box opens. It displays the entity's current altitude.
3. Type the new altitude.
4. Click OK.

8.5. Appearance

You can set appearance attributes for entities. The appearance attributes that are available for an entity are determined by its entry in *./appData/settings/vrfGui/appearance.mtl*. The default list of appearance attributes is based on the DIS standard.

The Lifeform State field of the Appearance dialog box sets the posture for an entity. If VR-Forces does not support a selected posture, it simulates the entity using the closest similar posture. If a posture involves walking or running, VR-Forces chooses the posture to use based on the entity's speed. For more information about setting posture, please see "Posture," on page 8-20.

To set appearance values:

1. Select the entity.
2. Choose **Set** → **Appearance** → **Appearance**. The Appearance dialog box opens. The settings displayed are the current settings for the entity.
3. Change appearance settings as desired.
4. Click OK.

8.6. Armed

IEDs, car bombs, and suicide bombers must be armed to detonate. They are all armed by default. You can disarm them and re-arm them.

IEDs, car bombs, and suicide bombers have radios. Therefore, you can arm and disarm them using the Send Radio Set task.

To arm or disarm an explosive device:

1. Select the IED.
2. Choose **Set** → **Engagement** → **Armed**. The Armed dialog box opens.
3. Select an option from the list.
4. Click OK.

8.7. Capabilities

You can set capabilities for entities. The capabilities that are available for an entity are determined by its entry in *./appData/settings/vrfGui/capabilities.mtl*. The default list of capabilities is based on the DIS standard.

To set entity capabilities:

1. Select the entity.
2. Choose **Set** → **Disposition** → **Capabilities**. The Capabilities dialog box opens. It displays the current settings for the entity.
3. Change the settings you want to change.
4. Click OK.

8.8. Collision Avoidance Types

Sometimes entities exhibit undesired collision avoidance behavior because they try to avoid objects that are close to their line of travel, but not necessarily blocking it. You can enable and disable avoidance of entities, buildings, and trees on a per-entity basis. This option overrides the collision avoidance settings in the object parameter database entry for the entity.

- Collision avoidance settings are saved in an entity's process state repository. However, there is no indication in the GUI what these settings are. Therefore, we recommend that you not change collision avoidance settings through the GUI indiscriminately because you may lose track of which entities are avoiding which types of objects. To permanently set collision avoidance for an entity, edit its components in the object parameter database.
- When the Collision Avoidance Types dialog box opens, it does not reflect the settings for the selected entities. It only provides a default setting. Make sure that you review all the settings in the dialog box to be sure you do not inadvertently enable or disable a setting that you do not want to change.
- The Collision Avoidance Types set data request lets you specify collision avoidance only for broad categories of objects. You can set collision avoidance more specifically in the object parameter database.

To change collision avoidance for specific object types:

1. Select the entity.
2. Choose **Set** → **Action** → **Collision Avoidance Types**. The Collision Avoidance Types dialog box opens.
3. Select the check boxes for object types to avoid and clear the check boxes for the object types that the entity should not try to avoid.
4. Click OK.

8.9. Concealed

The Concealed request sets an entity's concealment attribute to True or False. This only affects the DIS or RPR FOM data sent over the network. It does not affect the simulation.

To set the concealment attribute for an entity:

1. Select the entity.
2. Choose **Set** → **Disposition** → **Concealed**. The Concealed dialog box opens.
3. Select an option from the list.
4. Click OK.

8.10. Counter Measures Auto Launch

The Counter Measures Auto Launch set data request lets you enable and disable automatic launching of counter measures. If you disable automatic counter measures, you can still launch them manually using the Launch Counter Measures task.

To enable or disable automatic launch of counter measures:

1. Select the entity.
2. Choose **Set** → **Engagement** → **Counter Measures Auto Launch**. The Auto Launch dialog box opens.
3. Select an option from the list.
4. Click OK.

8.11. Destroyed

You can set an entity's state to be destroyed. This can be helpful when you want an entity to be destroyed without having to first simulate its destruction by another entity.

To set an entity's state to destroyed:

1. Select the entity.
2. Choose **Set** → **Appearance** → **Destroyed**. The entity is immediately destroyed.

8.12. Detonation Fuse Type

The Detonation Fuse Type set data request lets you configure detonation of improvised explosive devices (IEDs), suicide bombers, and car bombs. You can set them to detonate immediately, at a certain time delay, or based on the proximity of a target entity. If you specify proximity detonation, you can set the radius of the proximate area. If you specify time, you must set the time in seconds until detonation. Detonation Fuse Type implicitly arms the device. (For details about arming devices, please see "Armed," on page 8-6.)

IEDs, car bombs, and suicide bombers have radios. Therefore, you can detonate them using the Send Radio Set task.

To configure detonation of an IED or car bomb:

1. Select the IED that you want to configure.
2. Choose **Set** → **Engagement** → **Detonation Fuse Type**. The Detonation Fuse Type dialog box opens.
3. In the Fuse Type list, select the fuse type (Timed, Immediate, or Proximity).
4. If you selected a Timed fuse, in the Time box, specify the elapsed time, in seconds, at which the IED should detonate.

   If you selected a Proximity fuse, in the Proximity box, specify the radius of the area in which an entity will trigger the detonation.
5. Click OK.

8.13. DI-Guy Appearance

The DI-Guy Appearance set data request determines the clothing and physical characteristics of a lifeform when it is displayed in a 3D simulation that uses DI-Guy characters.

The DI-Guy Appearance set data request applies only to lifeform entities.

To set an entity's DI-Guy appearance:

1. Select the entity.
2. Choose **Set** → **Appearance** → **DI-Guy Appearance**, or click the DI-Guy Appearance button () on the Sets toolbar. The DI-Guy Appearance dialog box opens.
3. Select an appearance from the list.
4. Optionally, in the 3D view only, select the Apply Selected Appearance Immediately check box. This displays the selected entity with the new appearance so that you can see what the appearance looks like before you apply the change.
5. Click OK.

8.14. Disembarked

The Disembarked set data request immediately disembarks an entity (as opposed to simulating disembarkation, as done by the Disembark task). It is the equivalent of the **Entities** → **Disembark** command. However, Disembarked allows you to include immediate disembarkation in a plan.

To set an entity to be disembarked:

1. Select the entity. (If you are using the 2D icon model set embarked entities are not displayed, so you have to select it in the Objects List Panel.)
2. Choose **Set** → **Embarkation** → **Disembarked**.

8.15. Embarked

The Embarked set data request immediately embarks an entity (as opposed to simulating embarkation, as done by the Embark task). It is the equivalent of the **Entities** → **Embark On** command. However, Embarked allows you to include immediate embarkation in a plan.

- If you are using HLA and want to use the embarkation feature, you must use RPR FOM 2, draft 17.

To set an entity to be embarked:

1. Select the entity to be embarked.
2. Choose **Set** → **Embarkation** → **Embarked**. The Embarked dialog box opens.
3. Select the entity to embark on.
4. Optionally, specify a embarkation offset. The default, 0,0,0, puts the entity at the center of the parent entity.
5. Click OK.

8.16. Emitter

The radar sensor has an emitter component that models basic electromagnetic emissions. An entity can have multiple emitter components. Each emitter component can have a list of modes and each mode can have multiple beams.

Emission properties (azimuth, elevation, effective radiated power, and so on) for each beam are specified in the emitter component descriptor in the object parameter database. Emission properties are published by the emitter component.

An emitter component can publish itself as a standard beam type or a tracking beam type. The type is determined by the setting for the **targeting-capable** parameter in the object parameter database. It applies to all beams emitted by the specific component. If **targeting-capable** is False, the beam is a standard beam. If **targeting-capable** is True, it is a tracking beam.

If an emitter component has **targeting-capable** set to True, it registers for set-target messages. If you set a target for the entity on which the emitter is mounted, it publishes the target entity as its tracking target for all of the components beams.

- Setting a target does not cause the beam to actually track the target. The beam's behavior is determined by the parameters in its description in the object parameter database.
- The emitter will continue to publish the targeted entity as its tracking target until you set another target, regardless of the status of that entity in the exercise. There is no way to set the target to "none".
- Please see Section 7.5, "Configuring Emitters," in *VR-Forces Configuration Guide*, for an explanation of how to configure individual and multiple emitters in the object parameter database.
- Please see the online help for the OPD Editor for a description of emitter parameters.

Each emitter has an ID that is assigned automatically, starting with 0. Unless you change the system definition files, all default fixed-wing aircraft have one emitter with ID 0.

To turn on electromagnetic emissions:

1. Select the entity.
2. Choose **Set** → **Sensors** → **Emitter**. The Emitter dialog box opens (Figure 8-1).

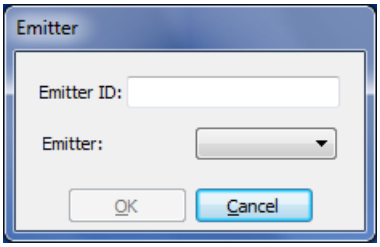


Figure 8-1. Emitter dialog box

3. Type the emitter ID. If the entity only has one emitter, its ID is 0. If it has more than one emitter, IDs get incremented by 1 for each additional emitter. There is no way to identify the emitter ID for a particular emitter, so you will have to use a trial-and-error approach to identify the correct emitter ID to use.
4. In the Emitter list, select On.

8.17. Force

You can change an entity's force during runtime. This might be useful in a simulation in which neutral forces begin assisting one force or another, or in which opposing forces capture friendly force weaponry and begin using it.

When you change an entity's force, its:

- Echelon ID changes to reflect the new force.
- Icon changes to the appropriate force color and type.
- Force ID changes.

Its entity enumeration does not change. So, for example, if you change the force of an M1A2, which has the country code 225 (United States), it still has the same country code, even though it might now be functioning as part of a force that is opposing United States forces.

To set the force of an entity:

1. Choose **Set** → **Disposition** → **Force**. The Force dialog box opens.
2. Select a force from the list.
3. Click OK.

8.18. Formation

VR-Forces supports the following formations:

- Column (default)
- Line
- Wedge
- Vee
- User-defined formations.

Formations are defined in formation files in the directory *./data/simulationModel-Sets/<model_set>/vrfSim/formation*. Formation files have the extension *.frm*. In addition to the named formations provided by MÄK, VR-Forces supports user-defined formations. If you create a new formation in the Entity Editor, it automatically gets added to the formation list for the aggregate types that support it.

The vee and wedge formations provided with VR-Forces place the aggregate leader at the end of one of the arms of the formation. If an aggregate has fewer than seven or eight members, it will not be symmetrical.

When you set the formation for a disaggregated aggregate, the entities that make up the aggregate snap to formation immediately. If you want entities to simulate moving into formation, rather than snapping to formation, use the Move Into Formation task.

If you set the formation for an aggregated aggregate, the aggregate remembers the formation and uses it the next time it disaggregates.

To set an aggregate's formation:

1. Select the aggregate whose formation you want to set.
2. Choose **Set** → **Aggregate** → **Formation**. The Formation dialog box opens.
3. In the Formation list, select the formation that you want the aggregate to use.
4. Click OK.

For information about configuring formations and about how to create user-defined formations, please see Section 7.4, "Configuring Formations," in *VR-Forces Configuration Guide*.

8.19. Heading

The Heading request instantly sets an entity's heading. If you want an entity to move to a new heading by pivoting or executing a K-turn, use the Turn To Heading task.

To set an entity's heading:

1. Select the entity.
2. Choose **Set** → **Position** → **Heading**, or click the Heading button (⦶) on the Sets toolbar. The Heading dialog box opens. It displays the entity's current heading.
3. In the Heading text box, type a heading, in degrees.
4. Click OK.

8.19.1. Setting an Entity's Heading Manually

You can set an entity's heading by directly manipulating the entity.

To set an entity's heading manually:

1. Double-click the entity.
2. **`Shift`**+left mouse button+drag the mouse to change the heading. In the 3D view, you can see the entity rotate to the new heading. In the 2D view, the heading indicator rotates.
3. Release the **`Shift`** key.
4. Release the mouse button. If you have enabled rotation of icons to the heading, the entity icon rotates. For information about rotating icons to a heading, please see Section 7.2.2, "Rotating 2D Icons to an Entity's Heading," in *VR-Forces Users Guide*.

8.20. IFF

Friendly fixed-wing entities can model a NATO Identification Friend from Foe (IFF) transponder.

- Mode 5 and mode C are equivalent.
- The dialog box does not force you to enter valid codes. It truncates invalid entries to the correct length (but not necessarily valid data).
- When you open the dialog box, it reflects the current IFF settings for the entity, if any.
- You can view an entity's IFF settings on the IFF tab of its Information dialog box.

To set the IFF transponder for a fixed-wing entity that is configured with an IFF controller:

1. Select the entity.
2. Choose **Set** → **Sensors** → **IFF**. The IFF dialog box opens (Figure 8-2).

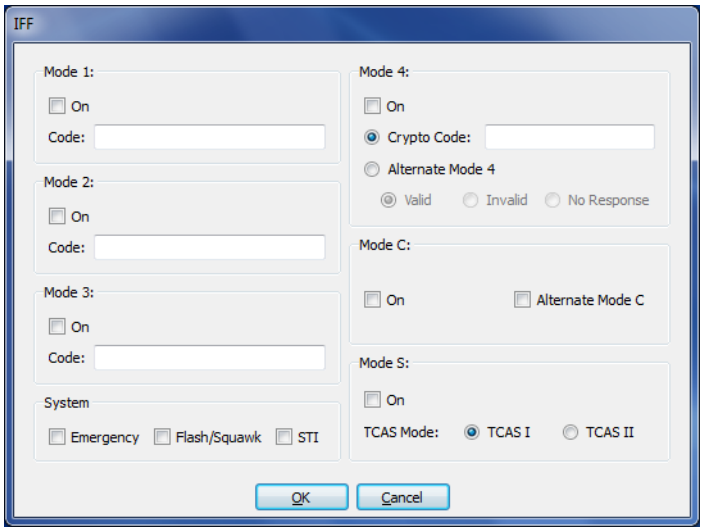


Figure 8-2. IFF dialog box

3. Complete the IFF dialog box.

8.21. Lase Autonomous

By default, entities with laser capability lase targets autonomously as part of the built-in target acquisition and firing process. You can specifically enable and disable autonomous lasing.

To enable or disable autonomous lasing:

1. Select the entity.
2. Choose **Set** → **Laser Designator** → **Lase Autonomous**. The Lase Autonomous dialog box opens.

The Lase Autonomous dialog box does not show the current lasing state of the entity.

3. Select an option from the list (Off or On).
4. Click OK.

8.22. Laser Code

The Laser Code set data request sets the code for laser beams sent by an entity and the code that the entity's missiles seek when they fire. By default, VR-Forces calculates a laser code for each laser-capable entity when it is created. You can change the laser code to a code of your choice. For information about the consequences of setting laser codes, please see "Lasing Targets," on page 10-13.

To specify an entity's laser code:

1. Select the entity.
2. Choose **Set** → **Laser Designator** → **Laser Code**. The Laser Code dialog box opens.
3. Type a number between 111 and 8888, using only the digits 1-8.
4. Click OK.

8.23. Location

To move an entity instantly from one place to another, you can set its location or you can drag it to a new location. For information about dragging entities, please see "Dragging an Object to a New Location," on page 2-16. For ground entities, specifying an altitude lets you place an entity at different levels (floors) in building features.

To set the location for an entity:

1. Select the entity.
2. Choose **Set** → **Position** → **Location**. The Location dialog box opens. It displays the entity's current location. The cursor changes to input mode.
3. Click on the terrain where you want to move the entity, or enter the coordinates of the location in the Location dialog box.
4. Optionally, set the altitude, as described in "Specifying an Object's Altitude," on page 2-12.
5. Click OK.

8.24. Notify Level

You can set the notification level for entity console messages without opening the Entity Information dialog box.

To set the notification level:

1. Choose **Set** → **Other** → **Notify Level**. The Notify Level dialog box opens.
2. Select a notification level in the list.
3. Click OK.

8.25. Ordered Speed

When you set an entity's speed, you are setting its ordered speed, the speed at which you want it to move. It may not move at that actual speed due to soil type, slope, and so on. If you set the speed while an entity is moving, it accelerates or decelerates from the current speed to the new ordered speed.

- Regardless of the speed that you enter, an entity's speed cannot exceed the value set by the **max-speed** parameter in the object parameter database.
- The Speed request sets the ordered speed of a fixed-wing entity in its current context – air or ground. The entity will not exceed the maximum speed for that context. However, if the maximum allowable ground speed is greater than the lift speed of the entity, and you assign an ordered speed greater than the lift speed, when the entity reaches that speed, it will take off.

To set the ordered speed of an entity:

1. Select the entity.
2. Choose **Set** → **Action** → **Ordered Speed**. The Ordered Speed dialog box opens.
3. In the Ordered Speed text box, set the speed.
4. Click OK.

8.26. Posture

A human entity (civilian or dismounted infantry) has a posture that determines its position when it is not moving and its type of movement when it is moving. Table 8-1 lists the position and movement relationships for each posture.

Table 8-1: Posture relationships

Posture	When it is not moving, it is:	When it is moving, it is:
standing	standing	walking or running
kneeling	kneeling	crawling
prone	prone	crawling
running	standing	walking or running
walking	standing	walking or running
crawling	prone	crawling
parachuting	standing	walking or running
jumping	standing	walking or running
sitting	standing	walking
squatting	prone	crawling
crouching	prone	crawling
wading	standing	walking or running

- For those postures listed as "walking or running", VR-Forces sets the movement posture based on the entity's speed.
- If an entity does not support a particular posture, it is set to the closest supported posture.
- Setting posture in the Lifeform State field of the Appearance dialog box has the same effect as setting the posture using the Posture set data request.

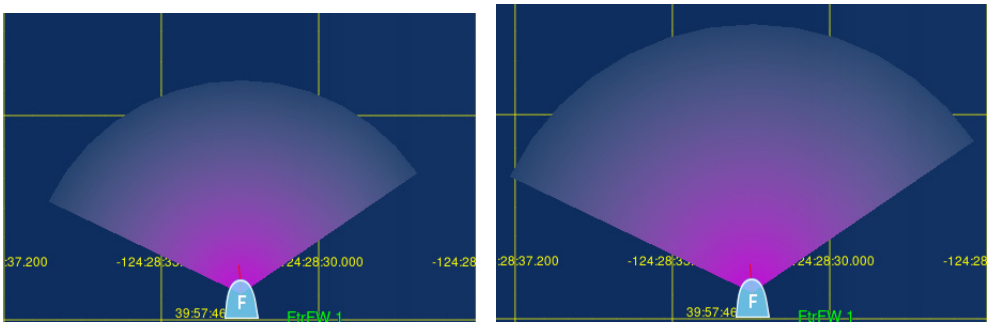
To set a lifeform's posture:

1. Select the lifeform.
2. Choose **Set** → **Appearance** → **Posture**. The Posture dialog box opens.
3. Select a posture from the list.
4. Click OK.

8.27. Radar Mode

The Radar Mode set data request lets you change the type of beam that an entity emitter publishes. By default, each fixed-wing aircraft has one emitter that has two beam types, search and track. For more information about emitter beams, please see "Emitter," on page 8-12 and Section 7.5, "Configuring Emitters," in *VR-Forces Configuration Guide*.

Figure 8-3 illustrates the difference in appearance between the beams for the two radar modes, in the 2D view. (The beams are not displayed unless you set emitters to be on.)



Search Track

Figure 8-3. Radar mode beams

To set an entity's radar mode:

1. Select the entity whose radar mode you want to set.
2. Choose **Set** → **Sensors** → **Radar Mode**. The Radar Mode dialog box opens.
3. If the entity has more than one emitter, select the emitter ID you want to set in the Emitter ID list.
4. Select the mode in the Mode list.

8.28. Reorganize

If automatic reorganization is not enabled, you can reorganize an aggregate by issuing the Reorganize set data request.

To reorganize an aggregate:

1. Select the aggregate that you want to reorganize.
2. Choose **Set** → **Aggregate** → **Reorganize**.

The change takes place immediately. For more information about reorganization, please see *Reorganizing Aggregates*, under Section 3.6.1, "How Aggregates Are Organized," in *VR-Forces Users Guide*.

8.29. Resources

You can specify the value to assign to a resource. The resources provided with VR-Forces that you can set are fuel and ammunition. The object parameter database lists the ammunition types available for each type of entity.

To specify a resource value:

1. Select the entity.
2. Choose **Set** → **Disposition** → **Resources**. The Resources dialog box opens.
3. Select a resource from the Resource list.
4. Specify a value for the resource. The dialog box displays the maximum amount of the resource allowed, as configured in the object parameter database.
5. Click OK.

8.30. Restore

Restoring an entity returns its resources to the values specified in the object parameter database. If the entity is destroyed, it returns it to life.

When you restore an aggregate that is in the aggregated state (using Restore), the original configuration of the aggregate is recreated. If you restore an aggregate that is in the disaggregated state, then only those subordinates still present in the simulation are restored. Any destroyed subordinates that were previously removed from the simulation as result of a disaggregate-->aggregate-->disaggregate transition are not restored. To fully recover all subordinates, restore the aggregate while in the aggregated state.

To restore an entity:

1. Select the entity.
2. Choose **Set** → **Disposition** → **Restore**.

The change takes place immediately.

8.31. Rules of Engagement

Rules of engagement specify the conditions under which an entity will fire at the enemy.

The rules of engagement for a fixed-wing entity are in effect whether it is on the ground or in the air. If you do not want fixed-wing entities to fire missiles while they are on the ground, you must change the rules of engagement.

To specify the rules of engagement for an entity:

1. Select the entity.
2. Choose **Set** → **Engagement** → **Rules of Engagement**, or click the Rules of Engagement button () on the Sets toolbar. The Rules of Engagement dialog box opens.
3. In the Rules of Engagement list, select the rule you want to apply.
4. Click OK.

8.31.1. How Fire-When-Fired-Upon Works

An entity considers itself under fire if either of the following is true:

- An "Entity Impact" detonation interaction that targeted this entity has recently (within **underFireTime** seconds (default 120)) been received.
- Any detonation has happened within **underFireDistance** (default 1000 meters) of this entity.

There is no attempt to return fire specifically at the attacking entity. If an entity thinks that it is under fire, it will fire at any enemies that it can target.

The **underFireTime** and **underFireDistance** parameters are part of the under-fire-determination-sensor component in an entity's platform (OPE) file.

8.32. Sector of Responsibility

An entity's sector of responsibility is used with detection tables to determine the priority of targets. Normally, the priority of targets that are outside an entity's sector of responsibility is lower than the priority of targets in its sector of responsibility. For information about the target detection tables, please see Section 7.2, "Detection Tables," in *VR-Forces Configuration Guide*.

You must specify a sector center and a sector size. Sector center is the center of the area you wish to designate, and sector size is the size of the area, both in degrees. Degrees are measured as 0 to the front (based on the heading), increasing clockwise. If the Turret Scan Controller is mounted on an entity with an articulating turret, then the turret scans the sector of responsibility specified. Sector center is the midpoint of the area. Figure 8-4 illustrates these parameters. The sector size is approximately 140 degrees, a bit less than half the circle. The sector center is at 0 degrees.

The default sector of responsibility is 90 degrees, centered at zero degrees.

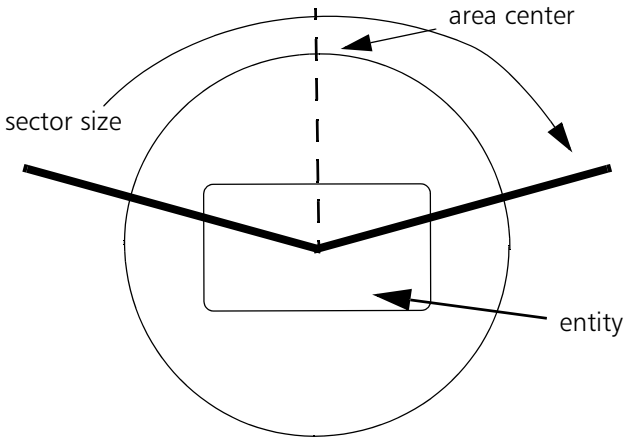


Figure 8-4. Sector of responsibility parameters

To set an entity's sector of responsibility:

1. Select the entity.
2. Choose **Set** → **Engagement** → **Sector of Responsibility**. The Sector of Responsibility dialog box opens.
3. In the Size text box, set the size of the area to be scanned, in degrees.
4. In the Center text box, set the center of the scan area, in degrees.
5. Click OK.

8.33. Sonar Depth

The Sonar Depth set data request lets you set the depth at which an entity's sonar operates. This allows you to simulate a helicopter dipping a sonar sensor into the water or a vessel dipping a sensor to a lower depth. Since sonar only works when the sensor is in the water, setting the sonar depth is the only way for helicopter-born sonar to work.

The sonar stays at this depth regardless of the altitude or depth of the entity. If you set the depth to be the depth of the entity with the Use Entity Depth option, it has the effect of retracting the sonar. If you simply set the sonar to the depth of the entity and the entity changes depth, the sonar will stay at the assigned depth.

To set sonar depth:

1. Select the entity.
2. Choose **Set** → **Sensors** → **Sonar Depth**. The Sonar Depth dialog box opens.
3. Specify the depth.
4. Optionally, select Use Entity Depth to set a dipped sonar to the depth of the entity.
5. Click OK.

8.34. Spot Reports

You can set spot reports on or off for all entities (global setting) from the Spot Reports page of the Application Settings dialog box. You can also set them for individual entities. When you set spot reports on, it means that the entity sends them. Visualization of spot reports is enabled or disabled for the GUI as a whole on the Spot Reports page. For more information about spot reports, including setting them globally, please see "Displaying Entities Based on Spot Reports," on page 10-2.

You cannot set an aggregate entity to send spot reports; you can only set spot reports for individual entities. However, you can select multiple individual entities and set spot reports for all of them at the same time.

To set spot reports on or off for an entity:

1. Select the entity.
2. Choose **Set** → **Sensors** → **Spot Reports**. The Spot Reports dialog box opens. If you are turning spot reports off, skip to step 5.
3. Select Broadcast to send spot reports to all entities. Select Send to Specific Entities to send to specific entities.
4. If you selected Send to Specific Entities, the entity list is enabled. Select the entities to which you want this entity to send sport reports.
5. Select an option from the Spot Reports Enabled list. If you choose On or Off, the setting persists regardless of the global spot report setting. If you want the entity to use the global spot report setting, choose Use Global Setting.
6. Click OK.

8.35. Surrendered

The Surrendered set data request only applies to lifeforms. When a lifeform is in the surrendered state, it does not fire at other entities and other entities do not fire at it.

To set an entity to be surrendered:

1. Select the entity.
2. Choose **Set** → **Disposition** → **Surrendered**. The Surrendered dialog box opens.
3. Select an option from the list.
4. Click OK.

8.36. Synchronize Laser Code

The Synchronize Laser Code set data request lets an entity with laser-guided weapons easily synchronize its laser code with the laser code of the lasing entity. The alternative to this command would be to use Laser Code to set the code for the lasing entity and the firing entity.

To synchronize laser codes:

1. Select the entity that has a laser-guide weapon.
2. Choose **Set** → **Laser Designator** → **Synchronize Laser Code**. The Synchronize Laser Code dialog box opens.
3. Select the lasing entity that you want this entity to synchronize with.
4. Click OK. The laser code for the selected entity is changed to match that of the lasing entity.

8.37. Target

You can command an entity to specifically target another entity. For this set data request to be effective, the target must be visible to the targeting entity. When you set a target, you override the priorities set by the target selection controller. If the specified target is in the list of candidate targets, it gets the highest priority as a target. However, if the specified target is not visible as a target to the targeting entity, the entity fires at the other available targets. It does not keep looking for the specified target. (You could achieve this behavior by putting a Target statement inside a While statement.)

To set an entity's target:

1. Select the entity.
2. Choose **Set** → **Engagement** → **Target**. The Target dialog box opens.
3. Optionally, filter the entity selection list.
4. In the Target list, or on the terrain, select the entity to target.
5. Click OK.

8.38. Tasked by Superior

You can order an entity that is part of an aggregate, and which is executing its own plan or is conducting an independent task, to stop executing those tasks and take commands from its aggregate. When you order an entity to be tasked by its superior, it stops conducting independent tasks and waits for the next order from the aggregate. (It does not execute the aggregate's current task, if any.) For more information about being tasked by superior, please see "Independently Tasking Aggregate Members," on page 6-10.

To order an entity to be tasked by its superior:

1. Select the entity.
2. Choose **Set** → **Other** → **Tasked by Superior**.

The change takes place immediately.

8.39. Weapon State

You can set the weapon state for dismounted infantry entities. The options are stowed, deployed, and in-fire-position.

> If an entity has an appearance for a weapon state, it uses it in the 3D view. However, some weapon states are not supported for some entities.

To set the weapon state:

1. Select the entity.
2. Choose **Set** → **Disposition** → **Weapon State**. The Weapon State dialog box opens.
3. Choose a weapon state from the list.
4. Click OK.

9

Writing Plans

This chapter explains how to combine tasks, set data requests, global commands, and conditions into plans.

9.1. Introduction to Entity Plans and Global Plans

A plan contains one or more statements that get executed by VR-Forces without human intervention. You build these statements in dialog boxes. VR-Forces writes the statement to the plan, so you do not have to worry about syntax errors in your statements when you first create them. However, you must understand the meaning of individual commands and parameters and the implications of how you order them, to make sure that a plan does what you want it to do.

VR-Forces supports two types of plans – entity plans and global plans. They have the following characteristics:

- Entity plans apply to a specific entity. They contain tasks and set data requests that are specific to the entity and which get executed sequentially. The sequence of task execution can be interrupted by receipt of a task from an external actor (a global plan command or independent task). The task sequence can also be interrupted if a trigger (a form of conditional statement) or a reactive task is activated.

Entity plans can include global commands (which are described later in this section). However, you must be careful not to target global commands, tasks, or sets to an entity in its own plan when you really want entity-specific tasks or sets. Entity tasks are executed sequentially. Sending an entity a global command, even from within its own plan, terminates its plan.

- Global plans are independent of any entity. The statements in a global plan affect the scenario as a whole (create and delete object commands) or a specific entity (task and set commands). Tasks sent to an entity from a global plan have the same effect on the entity as independent tasks assigned by a human player. They interrupt any task that the entity is engaged in and terminate its plan. Furthermore, if a global plan has a series of tasks for the same entity, they get sent in order without regard to completion of the previous task (as if you issued a series of commands from the Task menu, one immediately after another). In such a case, only the last command sent is likely to be completed.

  For an example of how to write a "good" global plan, please see Global Plans, in Chapter 6, *Writing Plans*, in *VR-Forces Getting Started Guide*.

In Figure 9-1, note that the entity plan window (on the right) is tied to a particular entity (shown in the title bar). It has the same menus as the global plan, plus additional Task and Set menus. The commands on the Task and Set menus in the entity plan apply implicitly to the entity for which you are writing the plan.

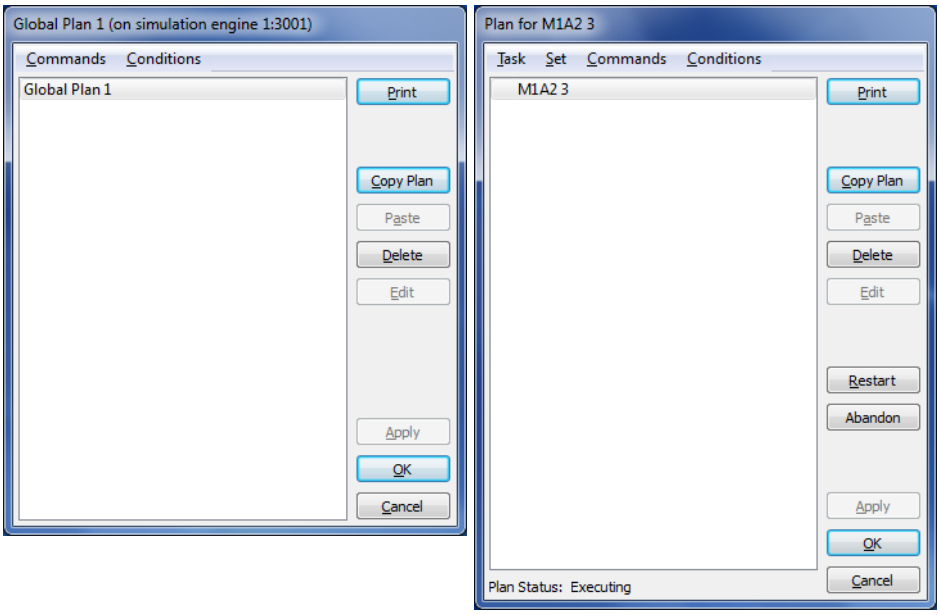


Figure 9-1. Global plan and entity plan

The commands menu, which is common to both types of plans, contains global commands. These commands allow you to:

- Create and delete objects.
- Assign tasks and set data requests to entities.
- Send console messages.
- Change hostility.
- Issue plans to entities.
- Abandon and restart plans.
- Change time of day and weather settings.

Global commands must explicitly state the entity to which they apply.

9.2. Conditional Statements

Many of the statements used in plans set a parameter or direct an entity to perform a specific task unconditionally. However, the plan language also includes the conditional statements, `If`, `When`, and `While`. A conditional statement specifies a condition and a block of plan statements.

- An `If` statement is evaluated once, when the plan arrives at the statement. If the condition is true at that point, VR-Forces executes the statements in the `If` block.
- A `When` statement is also called a trigger. It specifies a condition that is evaluated periodically by VR-Forces. If the condition becomes true, VR-Forces executes the statements in the trigger block. A trigger statement lets you plan for a condition without knowing in advance when the condition will occur.
- A `While` statement executes a block of statements repeatedly while the condition remains true. VR-Forces evaluates the condition when the plan first arrives at the `While` statement. If the condition is true, it executes the statements in the block. When it completes the statements, it evaluates the condition again. If it is still true, VR-Forces executes the statements again. It continues to do so as long as the `While` condition is true.

The conditions supported by VR-Forces are:

- Is an entity in a given area? (Entity In Area)
- Is an entity to the left of a phase line? (Entity Left of Line)
- Is an entity destroyed? (Entity Destroyed)
- Is an entity under fire? (Entity Under Fire)
- Has an entity located a target? (Entity Has Target)
- Has an entity's embarkation state changed? (Entity Embarked)
- Is an entity above or below a specified altitude? (Entity Altitude)
- Has an entity detected another entity? (Entity Detected)
- Has an entity received a radio message? (Receive Text Message)
- Has a lifeform surrendered? (Lifeform Surrendered)
- Does a lifeform have a particular DI-Guy animation? (Entity Di-Guy Animation Check)
- Does a lifeform have a particular DI-Guy appearance? (Entity Di-Guy Appearance Check)
- Is a random probability true? (Random)
- Is an entity resource at a certain level? (Resource)
- Is the simulation time greater than or less than a specific elapsed time? (Sim Time)

Conditional statements can include the boolean operators True and False, and the logical operators AND, OR, and NOT.

9.2.1. Specifying Names or Patterns in Conditional Statements

When you add a conditional statement to a plan, you must specify the entity or entities for which the condition will be tested. You can specify:

- A specific named entity, for example, When entity M1A2 1 is in Area 1.
- That the condition applies to "Self", for example, When "I" am in Area 1. Specifying a condition for one's self makes it easy to copy and paste plans or plan statements to the plans of other entities without doing any editing.
- An entity enumeration, for example, any entity with enumeration 1:1:225:1:1:3:0 (any M1A2).
- The inverse of the selection, for example, any entity but myself, or any entity except an M1A2.
- That for aggregates, the entire aggregate must satisfy the condition (the default), or that any subordinate member of an aggregate satisfies the condition. For example, the default behavior when Entity Is Destroyed is applied to an aggregate is that all members of the aggregate must be destroyed for the condition to be true. The alternative is that the condition is true if any member of the aggregate is destroyed.

The Name and Pattern specifications are mutually exclusive. You cannot specify a name and a pattern. The tab in the Condition dialog box that is visible when you click OK is the specification that gets applied.

Specifying a Name in a Conditional Statement

To specify a named entity in a condition statement:

1. In a conditional statement dialog box, select the Name tab (Figure 9-2).

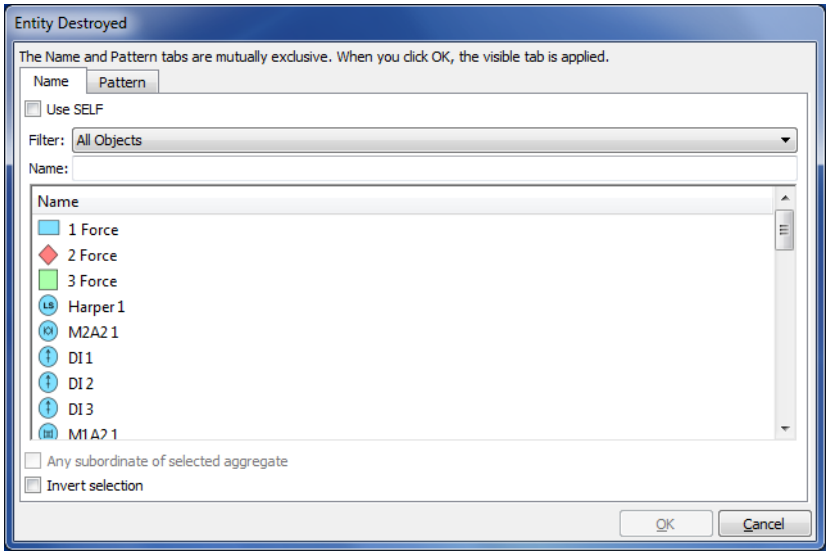


Figure 9-2. Name tab in condition dialog box

2. Do one of the following:
   - To specify the entity whose plan this is as the entity in the condition, select the Use SELF check box.
   - To specify an entity by name, select the entity in the list or type its name in the Name text box.
3. If you select an aggregate entity in the list, the Any Subordinate of Selected Aggregate check box is enabled. If you want the condition to be satisfied when any entity in the aggregate meets the condition, select the check box.
4. To specify the inverse of the name, that is, any entity except the selected one, select the Invert Selection check box.
5. Click OK.

Specifying an Entity Pattern in a Conditional Statement

The enumerations used in the lists on the Pattern tab are loaded from the file *./appData/settings/vrfGui/condition-entity-types.csv*. They represent a subset of the enumerations typically used for entities in simulations. However, you can enter any numeric value you want in the enumeration value boxes.

If you expect that you will consistently need to specify enumeration values that are not part of *condition-entity-types.csv*, such as a particular country code, you can edit it to add the patterns you need.

To specify an entity pattern in a condition statement:

1. In a conditional statement dialog box, select the Pattern tab (Figure 9-3).

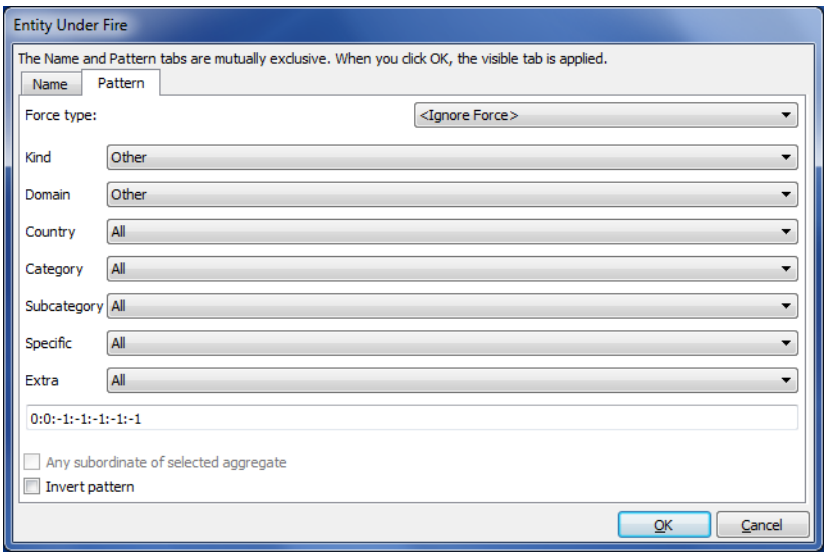


Figure 9-3. Pattern tab in condition dialog box

2. Optionally, specify a force to test for.
3. For each element of the enumeration, select an option from the list, or type an enumeration in the text box.
4. If the enumeration you enter is for an aggregate entity, the Any Subordinate Of Selected Aggregate check box is enabled. If you want the condition to be satisfied when any entity in the aggregate meets the condition, select the check box.
5. To specify the inverse of the name, that is, any entity except the selected one, select the Invert Pattern check box.
6. Click OK.

9.2.2. The If/else Statement

An `If/else` statement tests a condition. It only tests the condition once.

Do not use an `If` statement to test for receipt of a message or some other circumstance that does not represent an entity's state. VR-Forces does not keep a record of events and such a test will almost always evaluate to false. Use a `When` statement to test for conditions that do not evaluate entity state.

An `If/else` statement consists of:

- The word `If`.
- A condition to be evaluated.
- A block of statements.
- An `else` statement.
- Optionally, statements for the `else` condition.

If the condition is true at the moment the `If` statement is evaluated, control passes to the first statement of the `If` block. If the condition is false, control passes to the first statement in the `else` block, if you have one, or to the first statement after the complete `If/else` block if you do not have an `else` block. You can nest `If/else` statements within `If/else` statements. The syntax is as follows:

```
If (condition) then
   zero_one_or_more_statements
else
   zero_one_or_more_statements
endif
```

When VR-Forces reaches the end of the block of `If` or `else` statements, control passes to the first statement after the `If/else` statement.

The Add Conditional Expression dialog box ensures that you have the correct syntax. It does not ensure that your `If/else` block makes logical sense.

9.2.3. When Statements (Triggers)

A trigger consists of a `When` statement followed by a block of statements that are executed only if the condition in the `When` statement is true.

When VR-Forces reads a `When` statement, it registers the trigger and checks the condition. If the condition is true, control passes to the first statement in the `When` block. Task execution proceeds as follows:

- If the `When` block contains any tasks that are mutually exclusive with the currently executing task, the current task is discarded and the statements in the `When` block are executed.
- If the tasks in the `When` block are not mutually exclusive with the current task, or if the `When` block only has set data request statements, the `When` statements are executed and the current task continues. For more information about this case, please see "Using Triggers That Do Not Have Mutually Exclusive Tasks," on page 9-33.
- After the tasks in the `When` statement block are completed, control returns to the next statement in the entity's plan.

The location of a `When` statement in a plan has an important affect on its functioning. For a discussion about where to place triggers, please see "Deciding Where to Put Trigger Statements," on page 9-33.)

If the condition is false, VR-Forces continues to the next statement in the plan. It continues to check the trigger condition periodically. If at any point, the condition evaluates as true, control passes to the block of statements associated with the trigger. Task execution proceeds as described in the previous paragraph.

Figure 9-4 illustrates the process when a trigger has a task that is mutually exclusive with the current task. After the tasks in the `When` statement block are completed, control returns to the next statement in the entity's plan. If the entity was in a `While` loop when the trigger fired, it returns to the next statement in the `While` block.

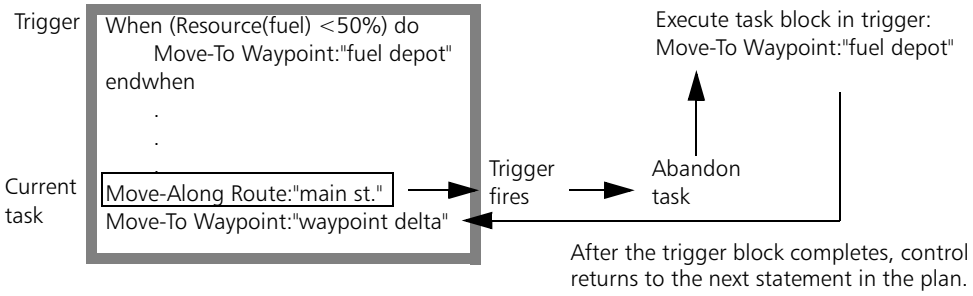


Figure 9-4. Flow of control for triggers

After a trigger fires, it is removed from the list of registered triggers. If you want to continue to test for the same condition, you need to execute another `When` statement for that condition.

Unregistering Triggers

You cannot unregister triggers while a scenario is running. If you do not want a trigger to be executed, you have the following options:

- Before you start the scenario, remove the trigger from the plan.
- During a simulation, abandon the plan.
- During the simulation, remove the trigger from the plan and save the plan. The new plan will erase the old one. However, the plan will begin executing at the first statement, which may not be the behavior you want.

9.2.4. While Statements

A `While` statement consists of:

- The word `While`.
- A condition to be evaluated.
- A block of statements.

If the condition is true at the moment the `While` statement is reached, control passes to the first statement of the `While` block. If the condition is false, control passes to the first statement after the complete `While` block. You can nest `While` statements within `If`, `When`, and `While` statements.

When VR-Forces reaches the end of the `While` block, it evaluates the condition again. If the condition is still true, VR-Forces executes the statements again. If it is false, control passes to the first statement after the `While` block.

- VR-Forces re-evaluates a `While` condition only after it has executed all of the statements in the block. If the condition becomes false while VR-Forces is executing statements in the block, VR-Forces continues to execute all statements because it does not re-evaluate the condition until it completes the `While` block.
- If you put a continuous task such as Wait or a Patrol Between in a `While` block, it is possible that the condition will never be re-evaluated, because the tasks in the block will never be completed.

9.2.5. Conditional Tests

This section describes each of the conditions that VR-Forces can test. When you set up conditions, keep in mind the following:

- If there is no entity with the specified name, the result is always false.
- If the specified entity is destroyed, the condition might never be satisfied. Your plan should take this possibility into account.

The Entity Has Target Condition

Entity Has Target returns true if the entity specified in the condition identifies a target. For example, consider the entities in Figure 9-5. The condition in M1A2 1's plan is true when BMP 1 has a target, not when M1A2 1 targets BMP 1.

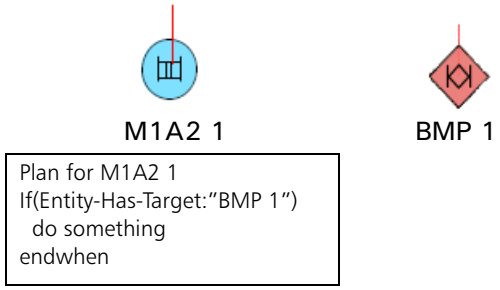


Figure 9-5. Entity Has Target condition

If an entity's rules of engagement prevent it from firing, this condition does not return true when the entity identifies a target.

The Entity In Area Condition

Entity In Area returns true if the entity (or member of an aggregate) reports that it is in the named area. You can use the `NOT` boolean operator, to test whether an entity is outside the area.

The Entity Left of Line Condition

Entity Left of Line returns true if the entity (or member of an aggregate) reports that it is to the left of the specified phase line.

An entity is considered to be to the left of a phase line if it is on the left side of an infinite extension of the phase line as viewed from a point on the line facing in the direction of the line. For a description of phase line direction, please see Section 3.7.2, "Phase Lines," in *VR-Forces Users Guide*.

The Entity Destroyed Condition

Entity Destroyed returns true if the specified entity or aggregate is destroyed.

The definition of destruction for an aggregate is implementation specific. The aggregates supplied by MÄK for VR-Forces report that they are destroyed if every member of the aggregate is destroyed. An aggregated aggregate is destroyed if the aggregateIf you have implemented aggregates locally using the VR-Forces Toolkit, they could have a different definition of destroyed.

The Entity Embarked Condition

Entity Embarked returns true if the named entity is embarked.

The Detect Entity Condition

The Detect Entity condition tests to see if an entity has been detected at a particular identification level. The identification levels are Detected, Classified, Identified, Full Knowledge. Identification levels are determined by the detection probability configuration files, based on the distance between the detecting entity and the target and for how long the entity has been detected. For details about the detection probability files, please see Section 7.2, "Detection Tables," in *VR-Forces Configuration Guide*.

The Entity Under Fire Condition

Entity Under Fire returns true if the entity (or member of an aggregate) is under fire.

The Altitude Condition

Altitude returns true if the entity (or member of an aggregate) is at a higher or lower altitude than the one specified.

The Receive Text Message Condition

The Receive Text Message condition tests to see if an entity has received a text message (sent by the Send Text Message task) that contains the text specified in the Receive Text Message dialog box.

The Entity Di-Guy Animation Check Condition

The Entity Di-Guy Animation Check condition tests the current DI-Guy animation for a lifeform. This condition may be useful if you are scripting a series of animations. For example, if a particular entity is using a threatening or hostile animation, you might want to have other entities respond a certain way.

The Entity Di-Guy Appearance Condition

The Entity Di-Guy Appearance Check condition tests the current DI-Guy appearance for a lifeform. This condition may be useful if you are scripting a lifeform's interaction with another lifeform based on ethnicity or how they are dressed.

The Lifeform Surrendered Condition

The Lifeform Surrendered condition tests to see if a lifeform entity has surrendered (using the Surrendered set data request).

The Sim Time Condition

The Sim Time condition returns true if the elapsed simulation time is greater than (Sim Time >) or less than (Sim Time <) the time specified in the statement. Sim Time is the elapsed simulation time in days, hours, minutes, and seconds.

The Resource Condition

The Resource condition tests the amount of a specified resource using comparison operators.

The Random Condition

You can use the Random condition to randomly decide an entity's behavior at run time.

Percentage – A floating point probability percentage value between 0% (zero) and 100%. Random returns true if a random number between zero and 100 is less than or equal to the specified value.

If you use the Random condition, consider the following issues:

- Random is not very useful in triggers, since triggers may evaluate their condition expressions as often as once per tick. This means that a trigger expression of "Random Probability:50%" is likely to fire within the first couple of times it is evaluated. Therefore, we recommend that you not create triggers that are based on a random condition.
- If you use a random condition in a cascading sequence of `If/else` statements, and you want to ensure the correct probability distribution, be careful how you specify the percentage value. For example, randomly selecting one of three paths with equal probability would be done like this:

```
If (Random Probability:33.33%) then
  Move-Along Route:"1"
Else
  If (Random Probability:50%) then
    Move-Along Route:"2"
  Else
    Move-Along Route:"3"
  Endif
Endif
```

- As with all other random numbers used in VR-Forces, if the scenario initializes a random number seed value (for details. please see "Scenario Parameters," on page 3-4 in *VR-Forces Configuration Guide*), then the results of the Random condition can be made repeatable. (For details about repeatability, please see Section 3.13.3, "Exercise Clock Modes," in *VR-Forces Users Guide*.)

Boolean and Logical Operators

You can use the following boolean and logical operators in conditional expressions:

- `True`.
- `False`.
- `AND (`*`expression, expression`*`)` – evaluates as true if both conditional expressions are true.
- `OR (`*`expression, expression`*`)` – evaluates as true if either of the expressions are true.
- `NOT (`*`expression`*`)` - evaluates as true if the conditional expression is false.

You can nest and combine conditional expressions.

9.3. Viewing Plans

You can view an entity's plan and observe its progress through the plan. You can view the plans for as many entities at a time as you want. In addition to viewing plan status in the Plan window, you can view the current task on the State page of the Entity Information dialog box.

To view an entity's plan:

1. Select the entity whose plan you want to view.
2. Choose **Entities** → **Plan**, or press **p**. The Plan window opens.

The task that an entity is executing is highlighted in the Plan window. When the entity completes its plan, a message is displayed in the status area at the bottom of the Plan window.

9.4. Writing Entity Plans

This section explains how to write entity plans. For conceptual information about plans, please see Section 3.9, "Plans," in *VR-Forces Users Guide*, and the previous sections in this chapter.

When you write a plan, keep the following considerations in mind:

- If you edit a plan during a simulation, when you apply the changes, the entity whose plan has been changed begins executing it from the beginning. This might mean its activities are no longer synchronized with those of the other entities, unless the updated plan only includes statements that you want to execute starting at the current point of the simulation. Therefore, we recommend that you edit plans when you first load a scenario, before you start running the simulation.
- If you have two or more Plan windows open at the same time, and you open a dialog box, such as Move To, but do not complete the command, you cannot open that same dialog box from another Plan window until you complete the one that is open.

To edit an entity's plan:

1. Select an entity.
2. Choose **Entities** → **Plan**, or press **p**. The Plan window opens. The entity's plan is displayed.

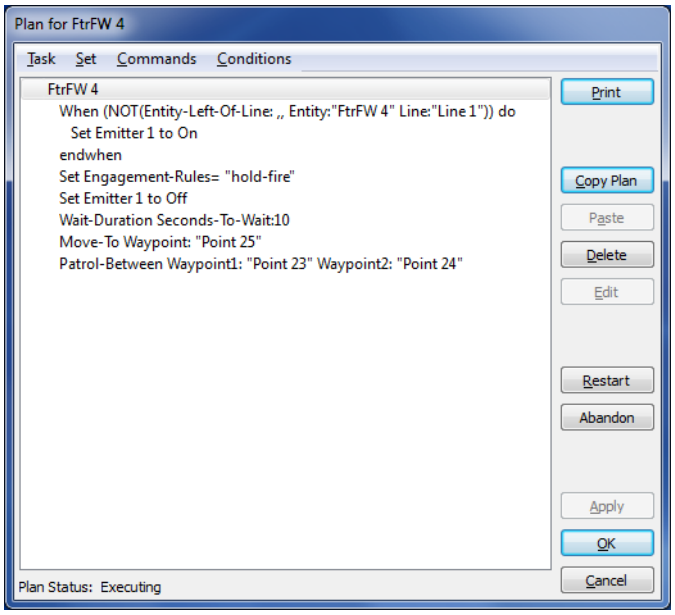


Figure 9-6. Plan window

3. Add new statements, edit statements, or delete statements as described in the following sections.

9.4.1. Adding an Entity Task or Set Data Request to a Plan

When you add statements to an entity plan, you add them after the currently selected statement. (For details about adding tasks to a global plan, please see"Adding Global Commands to a Plan," on page 9-24.)

To add a task to a plan:

1. Open the Plan window for an entity.
2. In the Plan window, select the statement immediately above where you want to insert a new statement. If the plan does not have any statements yet, the plan root – "*Entity_name*" is already selected.
3. Choose **Task** → *category* → *Task*, where *category* is one of the categories on the Task menu and *Task* is a task listed for the selected category. A dialog box appropriate to the task opens. The procedures for filling out each type of task dialog box are described in Chapter 6, *Assigning Tasks*.
4. Complete the required parameter information.
5. Click OK in the task dialog box to add the statement. You can click Cancel at any time to exit a task dialog box.

➤ To add a set data request to a plan, follow the same procedure as for adding a task, except choose **Set** → *category* → *Set Data Request*.

The procedures for filling out Set statement dialog boxes are in Chapter 8, *Setting Entity State*.

Some task and set statements, such as Wait, or Reorganize, do not require you to specify any values. They are added immediately to the plan without any intermediate dialog boxes.

9.4.2. Adding a Conditional Statement to a Plan

To add a conditional statement to a plan:

1. Open the Plan window for an entity.
2. In the Plan window, select the statement immediately above where you want to insert a new statement. If the plan does not have any statements yet, the plan root – *Entity_name* is already selected.
3. Choose **Conditions** → *condition*. The conditional expression dialog box opens.
4. Complete the conditional expression dialog box as described in "Building Statements in the Conditional Expression Dialog Box," on page 9-20.

Once you make a selection from a list, you cannot change it. If you make an error building a conditional expression, you will have to Cancel out of the dialog box and start over again.

5. Click OK. A conditional statement block is added to the plan, with the syntax (the condition plus an "end" statement) that defines the bounds of the block of tasks that are executed if the condition is true. You need to add the task statements that you want to have executed. To add the task statements, follow the procedure in "Adding an Entity Task or Set Data Request to a Plan," on page 9-18.

Building Statements in the Conditional Expression Dialog Box

The conditional expression dialog box is a dynamic dialog box that lets you build a conditional statement. It contains lists that have the permissible options for each step of a condition. As you select options, the dialog box redisplays, adding additional fields. You can build conditional statements using comparison operators, logical operators, and tests of entity status.

Using Prefix Notation to Establish Grouping and Precedence

To specify grouping, the Conditional Expression dialog box uses prefix notation, in which the operator comes first, followed by the operands. For example, a condition that you might verbalize as, "If entity 1 is in area A and entity 2 is in area B," is expressed in prefix notation as:

```
AND(entity 1 in area A, entity 2 in area B)
```

(For simplicity, this example does not use complete VR-Forces statement syntax.)

If you are not familiar with prefix notation, you might want to write out your conditional expressions before you begin entering them in the Conditional Expression dialog box.

Figure 9-7 illustrates how the Conditional Expression dialog box might redraw as you successively add the components of a condition statement. It creates the following conditional expression:

```
If(AND(Entity-In-Area Entity:"M1A2 2" Area:"base camp",
  resource(fuel)<25%))then
else
endif
```

The conditional expression dialog box resizes as you add conditions.

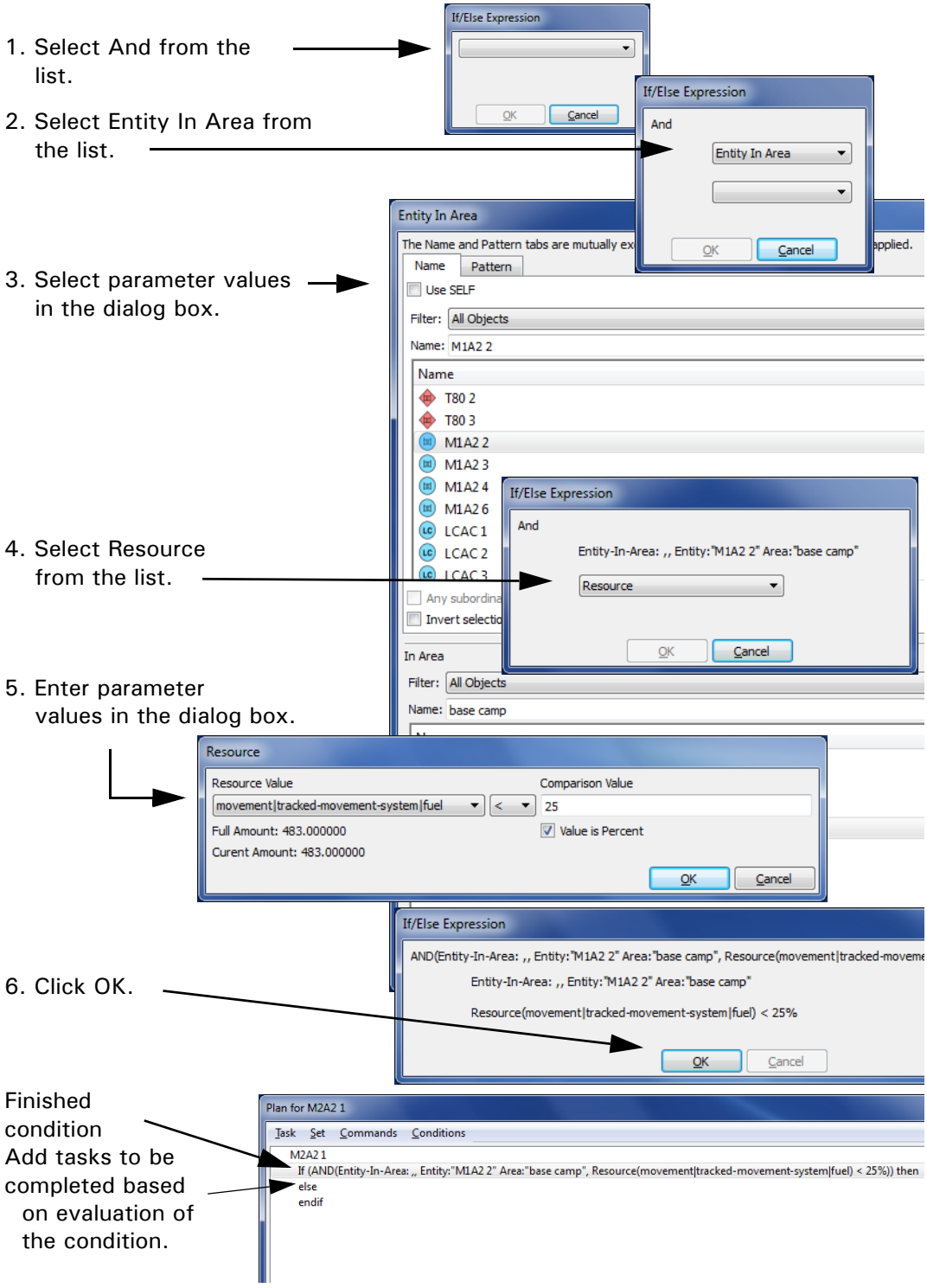


Figure 9-7. Example of building a conditional statement

9.4.3. Editing a Statement

You can edit simple statements in the Plan window. If you want to change a complex conditional statement, you must delete it and re-enter it.

To edit a plan statement:

1. Double-click the statement or select the statement and click Edit. An edit dialog box for the particular statement type opens.
2. Enter the changes you want to make.
3. Click OK in the edit dialog box.
4. Click OK or Apply in the Plan window.

9.4.4. Deleting Statements from a Plan

You can delete statements from a plan individually, or all at once.You can delete the individual statements in the statement block of a conditional statement. If you delete the conditional statement itself, all substatements are also deleted.

To delete a statement from a plan:

1. Select the statement you want to delete.
2. Click Delete or press **`Delete`**.

Deleting All Statements From a Plan

To delete all statements in a plan:

1. Select the top line in the plan.
2. Click Delete or press **`Delete`**.

9.4.5. Printing Plans

You can print plans. The printout lists the name of the scenario, the entity's name, and the plan statements.

To print a plan:

1. Open a global plan or the Plan window for the entity whose plan you want to print.
2. Click Print. A standard print dialog box for your operating system opens.
3. Complete the dialog box as you normally would.

9.4.6. Saving Changes to a Plan

You can save changes to a plan and continue editing, or save changes and exit the Plan window. The plan is saved to the scenario plan file. You do not specify a file to save it to.

➤ To save changes to a plan, in the Plan window click Apply or OK.

9.5. Creating Global Plans

Global plans are not tied to a specific entity. However, since they must be executed by a simulation engine, they are assigned to a specific back-end, just like objects are.

To create a global plan:

1. Choose **Simulation** → **Global Plans**. The Global Plans window opens (Figure 9-8). It lists each global plan and the simulation engine on which it is executed.

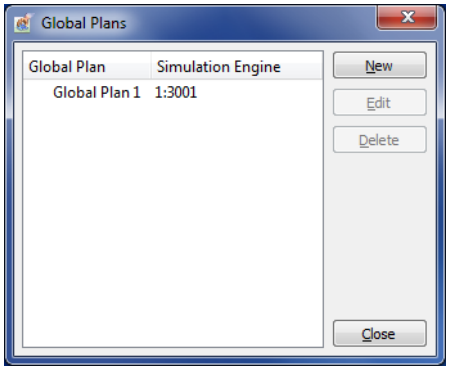


Figure 9-8. Global Plans window

2. Click New. The New Global Plan Information dialog box opens.
3. In the Plan Name box, type a name for the plan.
4. If your scenario has more than one back-end, select the back-end on which you want to run the global plan.
5. Click OK. The Global Plan window opens (Figure 9-9).

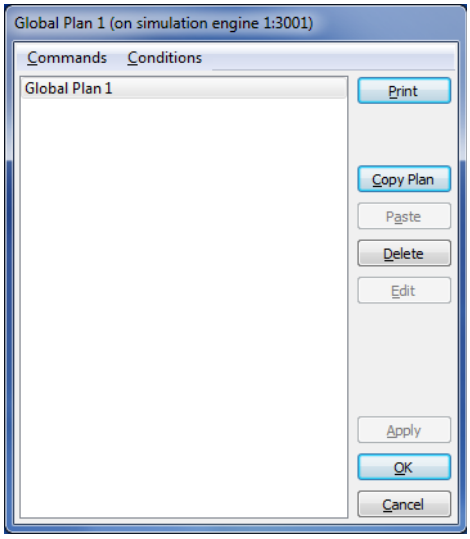


Figure 9-9. Edit Global Plan window

6. Add commands as described in "Adding Global Commands to a Plan," on page 9-24.

9.6. Adding Global Commands to a Plan

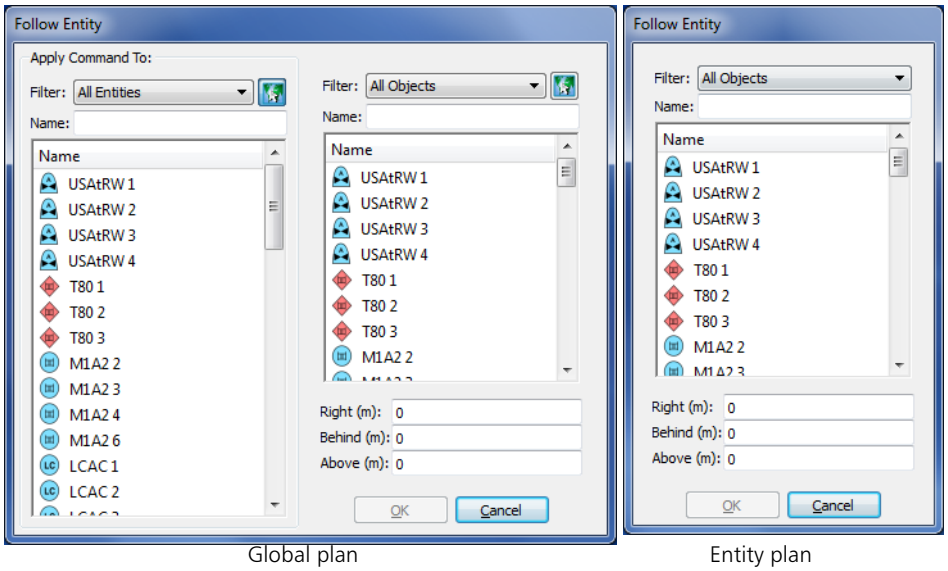
The global command submenus mimic the Task and Set menus on the VR-Forces menu bar and the options on the Entity Palette and Tactical Graphics Palette. There are also several global commands that are only available on the commands menu. Except as noted in this section, the procedures for adding global commands and conditional statements to a global plan are the same as the procedures for adding them to entity plans.

9.6.1. Adding a Global Task or Set to a Plan

The commands on the Task and Set menus in an entity plan apply implicitly to the entity for whom you are writing a plan. Global commands must be assigned explicitly to a target entity. Therefore, even though the list of tasks and sets on the commands menu look the same as those in an entity plan or the main VR-Forces menu bar, the dialog boxes they use are different.

Figure 9-10 shows the Follow Entity dialog box displayed if you choose **Commands** → **Task** → **Movement** → **Follow Entity** in a global plan, and the Follow Entity dialog box displayed if you choose **Task** → **Movement** → **Follow Entity** in an entity plan. The right pane in the global command requires the same information as the local command. The difference is that in the global command dialog box you must specify the entity to which the command will apply. You can specify an existing entity or you can specify the name of an entity that does not yet exist, but which you expect to be created during the lifetime of the scenario, perhaps as the result of a Create command in a global plan.

Other than the requirement to specify the target entity, adding a global task or set command to a plan uses the same procedure as adding any task or set to an entity plan.



Global plan Entity plan

Figure 9-10. Global command task dialog box and entity plan task dialog box

To assign a global command:

1. In a Plan window or Global Plan window, choose one of the commands on the commands menu or a submenu. The appropriate dialog box opens for the command.
2. If the dialog box requires you to specify the entity that will execute the command (in other words, if there is an Apply Command To panel in the dialog box), select an entity from the list or type its name in the Name box. The entity does not have to exist in the scenario at the time you add the command, but you should be sure that it will be created before the command is run.

Remember that a global task command affects an entity like an independent task. It interrupts the current task and causes the entity to abandon its plan. If you are adding a global task command to an entity plan, be sure that you are assigning it to some other entity and not the entity for whom you are writing the plan. (Unless you want the entity to abandon its plan.)

3. In the command-specific panel of the dialog box, complete the command parameters. Please see Chapter 6, *Assigning Tasks* and Chapter 8, *Setting Entity State* for the details of assigning specific tasks and sets.

9.6.2. Sending Console Messages

You can send messages to be displayed in the console on an object's information dialog box and to the back-end console. Messages sent by global plans go to the back-end console. Messages sent from an entity's plan go to the console in its Entity Information dialog box.

If the notification level for a console message is lower than the notification level configured for the back-end or the target entity, the message is not displayed. For example, if an entity's notification level is set to Info, it receives Error, Warn, and Info messages, but not messages set to Verbose or Debug.

To send a console message from a plan:

1. In an Entity Plan or Global Plan window, choose **Commands** → **Console Message**. The Console Message dialog box opens.
2. Select the notify level from the list.
3. Type the message you want to send.
4. Click OK.

9.6.3. Creating Objects from Within a Plan

You can create any of the objects on the Entity Palette from within a plan.

To create an object from a plan:

1. In an Entity Plan or Global Plan window, choose **Commands** → **Create** → *object*, where *object* is an object listed on one of the submenus.
2. Create the desired object as you would if you were creating it directly from the main Entity Palette. When you are finished creating the object, a create command is added to the plan and the object itself disappears. (The object disappears because you are not actually creating the object right now, you are just creating the command that will create it later when the plan executes.)

9.6.4. Deleting Objects from Within a Plan

You can delete any object in a scenario from a plan.

To delete an object from a plan:

1. In the Entity Plan or Global Plan window, choose **Commands** → **Delete Object**. The Delete Object dialog box opens.
2. Type the name of the object you want to delete or select the object in the list or on the terrain.
3. Click OK.

Deleting One's Self from the Scenario

The Delete Object global command lets you delete any specified object. If you just want to delete the entity whose plan you are editing, you can use the Delete Self command. Like the Use Self option in some conditions, Delete Self provides a non-entity-specific command that is useful for plans that you want to assign to multiple entities.

➤ To assign the Delete Self command, choose **Commands** → **Delete Self**.

9.6.5. Issuing a Plan

The Issue Plan global command lets you assign a plan to an entity. When you issue a plan, the new plan replaces whatever plan or task the entity is executing. Although you can issue a plan to any entity, this command is particularly useful for when you create an entity after a scenario has started.

When you create a scenario, you cannot create an entity plan for an entity that does not exist. Therefore, if you create an entity after the scenario starts (using the Create global command), it is difficult to send it a sequence of tasks because global commands are not executed in sequence (as discussed in "Introduction to Entity Plans and Global Plans," on page 9-3 and Chapter 6, *Writing Plans*, in *VR-Forces Getting Started Guide*). The Issue Plan command solves this problem.

Issue Plan is a concurrent task. Including it in an entity plan does not affect the current task that the entity is executing or the sequencing of tasks in its plan.

To issue a plan to an entity:

1. In a global plan or an entity plan, choose **Commands** → **Issue Plan**. The Issue Plan dialog box opens (Figure 9-11).

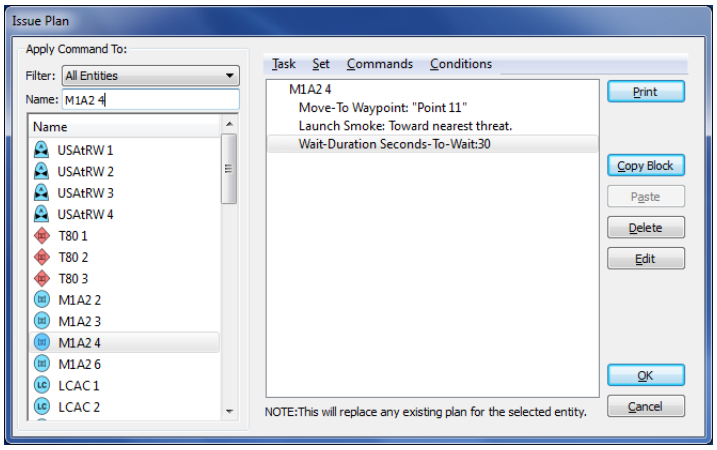


Figure 9-11. Issue Plan dialog box

2. In the Apply command To: group box, select the entity to which you want to assign this plan or type the name of the entity in the Name text box. If this is an entity that does not yet exist (because you plan to create it from a plan after the scenario starts), you must type the name and you are responsible for ensuring that the name you type matches the name of the entity that will be created.
3. Use the right side of the dialog box to write an entity plan. It has the exact same set of menus and commands as the Entity Plan dialog box. Follow the procedures described elsewhere in this chapter to write the plan.
4. Click OK.

9.7. Writing Plans for Aggregates

To write a plan for an aggregate:

1. Select the aggregate.
2. Follow the procedures for writing a plan for an individual entity.

Please see "Independently Tasking Aggregate Members," on page 6-10 for notes about how entities that are members of aggregates respond to individual plans and independent tasks.

9.8. Writing a Plan for Multiple Entities

You can write a plan and assign it to multiple entities at the same time. If any of the entities already has a plan, it is overwritten by the new plan. After you assign a plan using this procedure, you can individually edit the plans for any entity and the changes do not affect the other entities.

If you select several entities and they all have the exact same plan, the plan window displays that plan. If any of the entities have different plans, you are given the option to continue or cancel. If you continue, VR-Forces displays an empty Plan window and the new plan replaces the whatever plans the entities previously had.

To write a plan for multiple entities:

1. Select the entities to which you want to assign the same plan.
2. Choose **Entities** → **Plan**. The Plan window opens.
3. Add statements to the plan as you would if you were writing a plan for an individual entity.
4. Click OK. The plan is assigned to the selected entities.

9.9. Writing Plans for Remote Entities

If you attach components to remote entities, you can write plans for those entities. To assign plans, the entities must exist in the exercise, must have attached components, and must be present in the exercise when VR-Forces saves the scenario. The plans must be appropriate for the attached components. Movements tasks are not appropriate, because VR-Forces cannot control the location of a remote entity. Appropriate plan statements might be to enable spot reporting, or to send a radio message. For details about how to attach components to remote entities, please see Section 7.12, "Configuring VR-Forces Components on Remote Entities," in *VR-Forces Configuration Guide*.

9.10. Copying Plans and Plan Statements

You can copy plans and individual plan statements and paste them into another entity's plan.

To copy plan statements:

1. Open the Plan window for the plan that you want to copy.
2. To copy the entire plan, select the top line in the plan (*Entity_name*). To copy a statement, select the statement. If you select a conditional statement, the entire statement block is selected.
3. Click Copy. If you selected the top line, it reads Copy Plan. If you select a statement, it reads Copy Block.
4. Open the Plan window for the entity you want to copy the plan to.
5. Select the line just above where you want to insert the copied plan.
6. Click Paste.
7. Continue editing the plan as described in the previous sections.
8. Save the plan.

9.11. Restarting a Plan

There may be occasions when you want to restart an entity's plan without restarting a scenario. You can restart a plan interactively or by placing a Restart Plan command in a plan.

When you restart a plan, VR-Forces processes the statements in the plan, starting from the first statement. However, the entity executes tasks starting from its current location, not the location it had at the start of the scenario (unless it has not moved since the start of the scenario).

To restart a plan interactively:

1. Select the entity whose plan you want to restart.
2. Choose **Entities** → **Restart Plan**.

To restart a plan from within a plan:

1. Open an entity's plan or a global plan.
2. Choose **Commands** → **Restart Plan**. The Restart Plan dialog box opens.
3. Select the entity whose plan you want to restart.
4. Click OK.
5. Save the plan.

To restart a plan from the Plan window:

1. Open an entity's plan.
2. Click Restart.

9.12. Abandoning a Plan

You can order an entity to stop executing its plan. When you abandon a plan, the following things happen:

- The entity stops whatever task it is working on, even if it is an independent task.
- The plan is marked as complete.
- All registered triggers are deleted.
- The statement indicator skips to the end of the plan.
- The entity enters a wait state.

You can abandon a plan interactively or by sending an Abandon Plan command in an entity or global plan.

To abandon a plan interactively:

1. Select the entity whose plan you want to abandon.
2. Choose **Entities** → **Abandon Plan**.

To abandon a plan from within a plan:

1. Open an entity's plan or a global plan.
2. Choose **Commands** → **Abandon Plan**. The Abandon Plan dialog box opens.
3. Select the entity whose plan you want to abandon.
4. Click OK.
5. Save the plan.

To abandon a plan from the Plan window:

1. Open an entity's plan.
2. Click Abandon.

9.13. Considerations for Creating Plans

This section has tips for constructing plans including how to avoid problems that are hard to debug and how statements affect each other, with implications for how to organize the statements in a plan.

9.13.1. Name Changes Can Invalidate Plan Statements

Plan statements can reference named objects, such as tactical graphics and entities. For example, a Follow Entity task specifies the name of the entity to follow. If someone changes the name of an entity or tactical graphic after you create a plan, VR-Forces will not be able to find the object referenced in the plan statement. If this happens in a task statement, the plan skips the task and moves to the next task. If a renamed object is in a conditional statement, the condition may never become true.

9.13.2. Considerations for Using Triggers

Triggers are a versatile part of plans and you should have a good understanding of their intricacies before you use them.

Deciding Where to Put Trigger Statements

VR-Forces does not evaluate a trigger condition until it executes a `When` statement and registers the trigger. If you want to ensure that a `When` statement always gets read by VR-Forces, put it at the beginning of a plan before any non-trigger statements. If you put a trigger later in a plan, it is possible that it will never be registered. This could occur if a plan is abandoned. Of course, you might decide that you do not want a trigger to be registered unless a set of preceding tasks have been completed. In that case, placing it later in the plan may be exactly what you want to do.

You can also place a trigger inside a conditional block so that it gets registered only if a particular condition is true at a particular time.

For example, if you always want entity 1 to respond to entry of hostile forces into an area, put a trigger at the beginning of the plan. If you want entity 1 to respond to a hostile entity in an area only after the simulation has progressed for 15 minutes, nest the trigger inside another trigger that fires when Sim Time > 15 minutes.

Using Triggers That Do Not Have Mutually Exclusive Tasks

A trigger does not have to have any task statements in its statement block. It could just have Set statements. Or, it could have sets and concurrent tasks. If a trigger block just has Set statements, it does not interrupt the task that the entity is executing when the trigger gets executed. The Set statements get executed while the entity is performing its task. This has the same effect as if you manually set the entity's state while it was performing a task.

Using a trigger that just has Set statements can be useful if you want to change an entity's state under certain conditions, but do not know in advance when those conditions might exist.

Reregistering Triggers

A trigger can only fire once. It does not stay in effect for a reoccurrence of the triggering event. Under limited circumstances it is possible to work around this limitation. If an entity's plan only contains `When` statements, you could put a Restart Plan command at the end of each `When` block. In this way, after a trigger fires, it executes the commands in the trigger block and then it restarts the plan. This reregisters all of the `When` statements in the plan.

If a plan has commands outside of a trigger, then restarting the plan would also cause the entity to execute those commands, which might not be desirable. You might be able to work around this issue by putting these commands in a `When` block related to the simulation time.

As an alternative to using triggers, you can write reactive tasks, which work similarly to triggers or you can write a regular scripted task that is designed to repeatedly test a condition.

9.13.3. Moving In Formation

If you want an aggregate to move in a certain formation, add a Formation statement to the plan before the task that requires the aggregate to move. The default formation is a column.

9.13.4. Using the Tasked-By-Superior Request in a Plan

If you put the Tasked-By-Superior request in the body of a plan, it has no real effect. This is because, as soon as it is set, the plan goes to the next task and overrides the superior. The only way that the Tasked-By-Superior command gets implemented as part of a plan is if it is the last statement in a plan or the last statement in a trigger that happens to get executed after all the statements in an entity's plan have been executed.

9.13.5. Following Entities

If you tell two or more entities to follow another entity, do not give them the same offset values. If the followed entity stops, one follower will arrive at the specified offset position and stop, while the others will circle the location because they cannot all occupy the same space.

9.13.6. Planning Tasks for Aircraft

When you plan tasks for aircraft, the most important thing to remember is to pay attention to the terrain. Fixed-wing aircraft do not have terrain following capabilities. Rotary-wing aircraft have some terrain-following capacity, but it has some limitations. So if you assign aircraft an altitude that is lower than the terrain at some point along a route or the path they must follow to reach a waypoint, they will crash into the terrain. View the terrain profile for a route to see if it intersects the terrain.

You should also bear in mind that the turning radius and speed of fixed-wing aircraft affect how closely they can follow a route.

9.13.7. Using Non-VR-Forces Entities in Plans

You can use a non-VR-Forces entity as a parameter in a plan, for example, following a remote entity, or testing to see if a remote entity is in an area.

To identify non-VR-Forces entities, VR-Forces uses their marking text. If a non-VR-Forces entity does not have marking text, VR-Forces uses its entity identifier as its name.

VR-Forces does not recognize remote aggregates as aggregates, so it cannot check their children. Remote aggregates are ignored by the simulation engine.

- Referring to remote entities by their marking text may have unpredictable results if there is more than one remote entity with the same marking text.
- If you include a non-VR-Forces entity in a plan you must ensure that the remote simulator uses the same name for the entity in future runs.

10

Target Detection and Combat Features

The chapter describes VR-Forces features related to target detection and acquisition – spot reports, hostility relationships, lasing, and munition damage.

10.1. Displaying Entities Based on Spot Reports

A spot report is a report by an entity to members of its force that it has detected a member of another force.

By default, VR-Forces displays entities based on complete ground truth. That is, it shows all entities in their exact location. However in real-world combat and training situations, participants rarely know where all other entities are, including those in their own force. This is called the fog-of-war. VR-Forces can simulate a semblance of the fog-of-war by displaying entities based on spot reports, rather than ground truth.

When you display entities based on spot reports, you do not see all members of forces other than your own. You only see spot reports for other-force entities that have been detected by members of your force. Spot reports are represented by icons that are similar to entity icons, but they do not move as entity icons do. Furthermore, since spot reports lose value over time as entities move to different locations, VR-Forces maintains a certainty level for the location of other forces. If a detected entity is not detected again for a period of time, its certainty decreases and its icon becomes increasingly transparent to show that it is less certain that the entity is at the reported location.

- Generating spot reports can reduce the performance of the simulation engine.
- When spot reports are enabled, VR-Forces does not display icons for dead entities.
- When you rewind a scenario, the global spot report setting persists. Spot report settings for individual entities revert to the settings saved with the scenario.

You can view a video that demonstrates entity classification and spot reports at *./doc/vrforces_tutorialvideos.htm*.

10.1.1. Enabling or Disabling Spot Reports

You can enable or disable spot reports globally or per entity. To set spot reports for an entity, use the Spot Reports set data request, as described in "Spot Reports," on page 8-26.

Enabling or Disabling Spot Reports Globally

When you enable or disable spot reports globally, the setting is applied to all entities that have not explicitly set spot reports on or off with the Spot Reports set data request. The setting persists, which allows you to set an entity to use the global spot report setting.

To enable or disable spot reports for all entities:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Spot Report Options page.
3. Select the Enable/Disable Spot Reports tab (Figure 10-1).

Figure 10-1. Spot Report Options page, Enable/Disable Spot Reports tab

4. Click Turn on Spot Reports or Turn Off Spot Reports. The change takes effect immediately.

10.1.2. Configuring the Spot Reports Viewpoint

The spot report viewpoint determines which entities and objects are shown using ground truth and which are shown using only spot reports. You can select preconfigured viewpoints or create custom viewpoints.

- If you create an entity for a force that is not visible based on the viewpoint setting, after you create the entity, it will disappear. Therefore, it is recommended that you show ground truth for all forces when you are creating entities and tactical graphics.
- When you rewind a scenario, the viewpoint configuration stays the same as in the previous run of the scenario. The global spot report setting stays the same. Entity-specific spot report settings revert to the settings saved with the scenario.

Selecting a Preconfigured Spot Report Viewpoint

VR-Forces provides viewpoints for the friendly, opposing, and neutral forces. In each of these viewpoints, VR-Forces displays ground truth for the viewpoint force and spot reports for the other forces. For example, if you select the Friendly force viewpoint, all entities in Force 1 are displayed showing ground truth. All other entities are displayed only if they have been detected by a friendly entity that is configured to send spot reports.

When you select a preconfigured viewpoint, the check boxes in the windows in the Map View group box are automatically set to match the selected viewpoint.

To configure spot reports:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Spot Report Options page.
3. Select the Viewpoint tab (Figure 10-2).

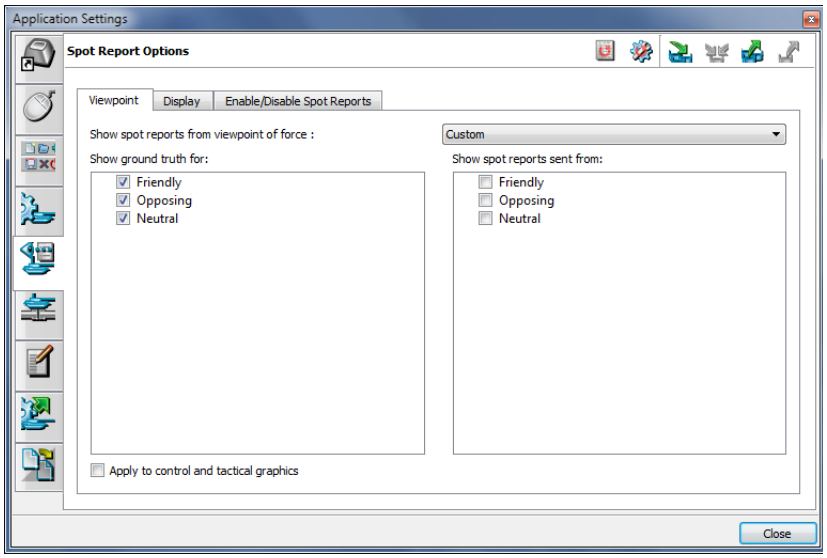


Figure 10-2. Spot Report Options page, Viewpoint tab

4. Select an option in the Show Spot Reports from Viewpoint of Force list.

Configuring Custom Spot Report Viewpoints

If you do not want to use a preconfigured viewpoint, you can create a custom viewpoint. This option allows you to see ground truth and spot reports from a mix of forces. When you create a custom viewpoint, the Show Spot Reports from Viewpoint of Force list displays the viewpoint that you have created (usually Custom).

It is possible to create a custom configuration in which no objects are displayed, so think carefully about your choices.

To configure a custom viewpoint:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Spot Report Options page.
3. Select the Viewpoint tab (Figure 10-2).
4. In the Show Ground Truth For window, select the forces for whom you want ground truth to be displayed. You would usually select the same forces as the ones selected in the Show Spot Reports Sent From window.
5. In the Show Spot Reports Sent From window, select the forces whose spot reports you want to display. In other words, if you are not showing ground truth for the opposing force and only want to see the opposing force entities that are detected by friendly and neutral entities, then select the Friendly and Neutral check boxes.

Configuring Same-Side Fog-of-War

There may be cases when you want to simulate same-side fog-of-war. That is, members of a force do not know where other members of their force are unless detected by an entity and reported using a spot report.

To simulate same-side fog-of-war, you must edit the *spot-report-generator.sysdef* file. You might want to create a customized file that you can assign only to the entities that you want to simulate same-side fog-of-war. (You can use the Entity Editor to change the spot report systems that entities use.) In the system definition file change the **send-spot-reports-on-own-force** parameter to True, as follows:

```
(spot-report-generator-system
  (controllers
    (spot-report-generator
      (component-descriptor-type
        "spot-report-generator-controller-descriptor")
      ...
      (object-types-to-spot-report
        (object-type  1 (1 -1 -1 -1 -1 -1 -1))
        (object-type  1 (3 -1 -1 -1 -1 -1 -1))
        (object-type  1 (5 -1 -1 -1 -1 -1 -1))
      )
      (send-spot-reports True)
      (send-spot-reports-on-own-force True)
      (send-spot-reports-on-hostile-forces True)
      (send-spot-reports-on-neutral-forces True)
    )
  )
  ...
)
```

You can edit the system definition file by hand or in the OPD Editor. For details about the OPD Editor and the Entity Editor, please see *VR-Forces Configuration Guide*.

10.1.3. Configuring the Spot Reports Certainty Level

It is assumed that as time passes the validity, or certainty, of a spot report declines. To simulate this decline in certainty, VR-Forces can display the icons that represent spot reports at increasing levels of transparency. You can configure the amount of time that VR-Forces displays icons for each certainty level.

To configure the amount of time, in seconds, that an icon is displayed at each certainty level:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Spot Report Options page.
3. Select the Display tab (Figure 10-3).
4. Double-click the value in the Time at Level column that you want to change. The value changes to edit mode.
5. Type a new value.
6. Click outside the list.

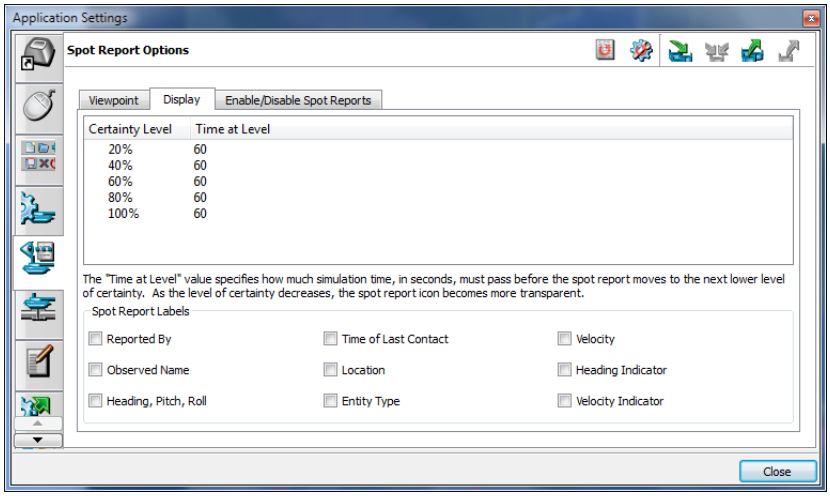


Figure 10-3. Spot Reports dialog box, Display tab

10.1.4. Applying Spot Reports to Tactical Graphics

You can display tactical graphics based on spot reports rather than ground truth. The same criteria are applied to their display as are applied to the display of entities. For information about how to assign objects to a force, please see "Creating Tactical Graphics," on page 5-5.

To apply spot reports to tactical graphics:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Spot Report Options page.
3. Select the Viewpoint tab (Figure 10-2).
4. Select the Apply to Control and Overlay Objects check box.

10.1.5. Displaying Labels for Spot Reports

You can display labels for spot reports with information similar to that for entity icons.

To display spot report labels:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Spot Report Options page.
3. Select the Display tab (Figure 10-3).
4. In the Spot Report Labels group box, select the labels that you want to display.

You can also enable labels for spot reports on the Display Settings dialog box, Symbol Decoration Settings page.

10.1.6. Using Spot Reports in Tasks

Spot reports are listed in the Objects List Panel and other entity lists. Although the spot report icon in the display window may not show information about a spot report if it has not been identified, the entry in the list includes the object name. You can filter the list to only show spot reports.

You can select a spot report as a parameter in tasks that require you to select an entity. If you use a spot report in a task, VR-Forces carries out the task based on the ground truth of the reported entity, not the location of the spot report. For example, if you specify a spot report in the Follow Entity task, and the target entity moves after the spot report was received, the following entity will follow the actual location of the reported entity, not its location when the spot report was made.

10.2. Managing Force Hostility Relationships

VR-Forces categorizes entities as members of a force, such as friendly, opposing, or neutral. By default, friendly forces and opposing forces are hostile to each other. Neither is hostile towards neutral forces. You can change force hostility relationships dynamically. This may be particularly useful if you are simulating an environment in which civilian populations become hostile to a particular force, or in which armed militias, for example, switch allegiances to other forces.

You can add new forces in the Entity Editor. For details, please see Section 5.16, "Managing the Forces List," in *VR-Forces Configuration Guide*. You can change a force's hostility in a global or entity plan. For details, please see "Changing a Force's Hostility in a Plan," on page 10-10.

You can change the default hostility relationships by editing the *forceHostilty.mtl* file for the simulation model set you are using (for example, *./data/simulationModelSets/default/forceHostilty.mtl*).

When you change force hostility at runtime, the changes are saved as part of the scenario. The hostility loaded with a scenario overrides the hostility loaded by the simulation model set's hostility file.

Hostility relationships are not reciprocal. For example if you set neutral force entities to be hostile to friendly force entities, that does not mean that friendly force entities are hostile to neutral force entities.

To change the force hostility matrix:

1. Choose **Simulation** → **Hostility Matrix**. The Hostility Matrix opens (Figure 10-4). Each row in the matrix lists the hostility relationships between that row's force and all of the other forces (represented by color-coded columns).

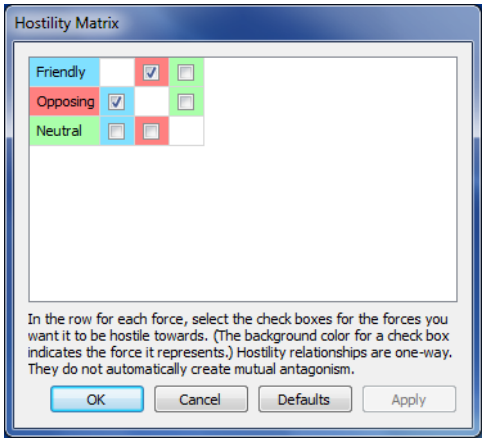


Figure 10-4. Hostility Matrix

2. For each row in the matrix, select the check boxes in the columns for the forces that you want this force to be hostile towards. Clear the check boxes for forces that you do not want it to be hostile towards.
3. Click OK.

10.2.1. Changing a Force's Hostility in a Plan

To change a force's hostility in a global or local plan:

1. Open a global plan or an entity's plan.
2. Choose **Commands** → **Change Hostility**. The Change Hostility dialog box opens (Figure 10-5).

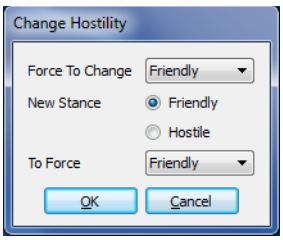


Figure 10-5. Change Hostility dialog box

3. In the Force to Change list, select the force whose hostility you want to change.
4. In the To Force list, select the force towards which you want to change hostility.
5. Select the new force relationship (New Stance), either Friendly or Hostile.
6. Click OK. The command is added to the plan.

10.3. Detecting Targets

Entities can have one or more sensors, for example, visual, sonar, or radar, for detecting and identifying other entities. When an entity detects another entity, it assigns it a combat identification (CID) level. If it continues to maintain contact with the entity, it upgrades the CID level as follows:

- CID Level 0 – not detected.
- CID Level 1 – Detected: the entity is detected, but only its platform is known, for example, ground.
- CID Level 2 – Classified: the entity's category is known, for example, tank.
- CID Level 3– Identified: the entity's category and subcategory are known, for example M1A2.
- CID Level 4 – Full Knowledge: all visible information about the entity is known.

CID levels are assigned based on the distance to the detected entity and the length of time that the entity has been in contact. You can configure these values in the detection tables (*./data/simulationModelSets/default/vrfSim/detection/*.csv*). For details about these configuration files, please see Section 7.2, "Detection Tables," in *VR-Forces Configuration Guide*.

By default, entities do not fire at a detected hostile entity until it achieves the Identified level. You can configure this behavior by changing the **detection-level-to-set-hostility** parameter in the entity's sensor system. For details about editing entity parameters, please see *VR-Forces Configuration Guide*.

Figure 10-6 shows a series of screen captures of an entity as its CID level is advanced from Detected through Identified. In this scenario, spot reports are enabled. Therefore, when an entity is detected, it is displayed with a yellow icon, rather than the normal color for the force. It is not given the correct force color until the detected entity is CID level Identified.

You can view videos that demonstrates entity classification and spot reports at *./doc/vrforces_tutorialvideos.htm*, or click the camera icons in previous paragraphs.

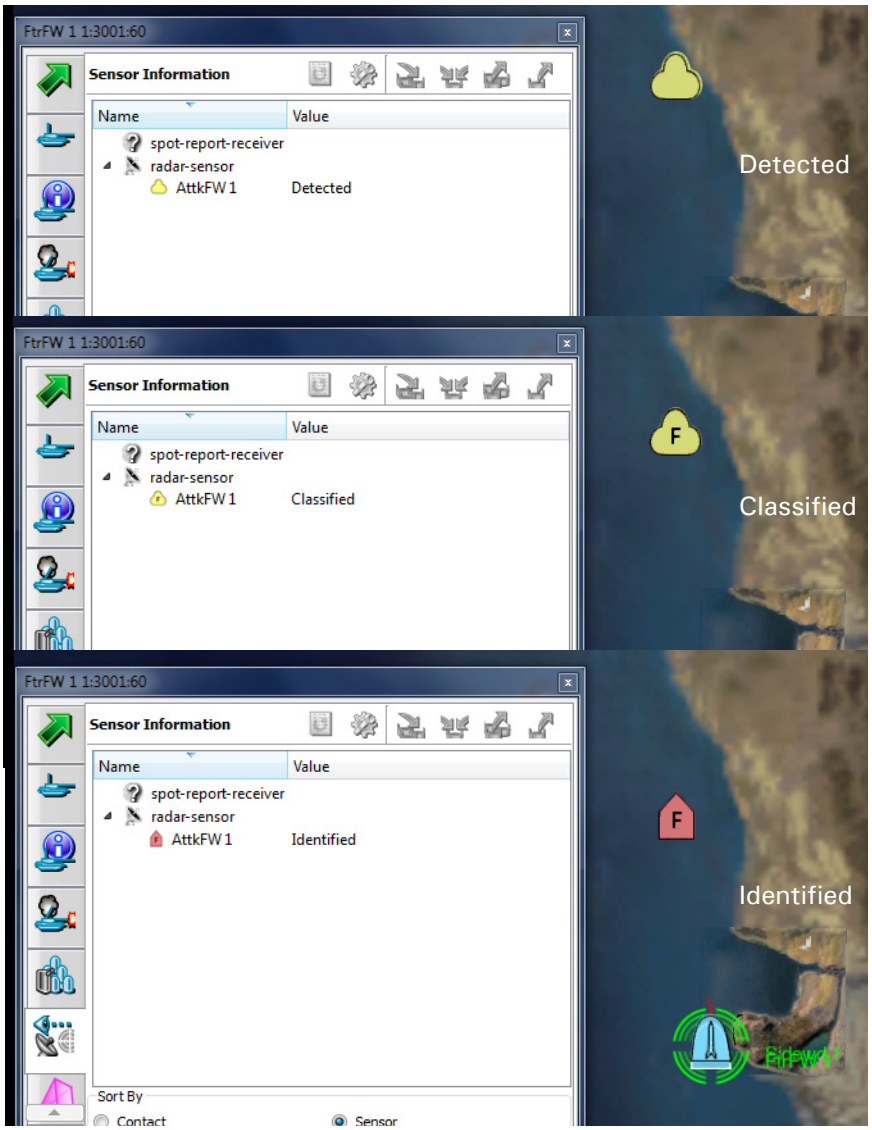


Figure 10-6. Entity classification and display when spot reports are enabled

10.3.1. Target Detection and Spot Reports

Entity detection and classification can be enhanced by enabling spot reports. Detected entities are assigned CID levels based on length of contact and distance from the detecting entity. In some cases, such as a fixed-wing aircraft flying quickly over a battlefield, or an entity that is at the extreme of its range from a target, contact might not be sufficient to advance to the Identified CID level. In such cases, even though the entity is technically capable of firing on the target, it might not do so because the CID level is not high enough.

If spot reports are enabled, the classification of entities in the spot reports that an entity receives is combined with the directly sensed information. Therefore, if an entity classifies a target at a low CID level, but it receives a spot report that classifies the target at a high CID level, it can fire on the target based on the CID level in the spot report. For example, as noted in the previous paragraph, a fixed-wing aircraft is unlikely to maintain contact with a ground-based entity long enough to elevate its CID level to Identified. However, if a member of its force on the ground identifies the target and sends out a spot report indicating CID level 3 or 4, when the fixed-wing aircraft receives the spot report, it can add the target to its target list.

10.3.2. Lasing Targets

Some entities, such as DI Lasing, have laser-targeting capability. Others, such as attack helicopters, have laser targeting capability and carry laser-guided missiles. Laser-guided missiles do not use the standard VR-Forces targeting mechanisms. They only fire on targets that are identified by laser beams that have the same laser code as the laser-guided missile launcher. The laser beam could be generated by a laser designator on the same entity (autonomous lasing), or could be generated by another entity.

Laser codes are numbers in the range of 111-8888, using only the digits 1-8. By default, VR-Forces calculates a unique laser code for each entity when it is created. When you assign a laser code to an entity, any laser beams sent by that entity use the assigned laser code and the missiles carried by that entity (if applicable) use the same code. Therefore, for example, the default behavior for attack helicopters would be to fire their laser-targeted missiles only at targets that they have lased.

A laser-guided missile launcher must be able to see a laser spot and an appropriate target before it fires. If the missile loses the laser spot before it hits the target, it tracks to the last known laser spot.

Autonomous Lasing

By default, entities that have laser-guided missiles are configured for autonomous lasing. This means that they can lase targets and fire at them without outside intervention (for example, using the Lase Target task). Entities with autonomous lasing enabled identify and fire at targets independently, just like entities that use conventional munitions.

Synchronizing Laser Codes

There are cases in which you will want more than one entity to use the same laser code. For example, you might want one entity to lase targets (the designator), and another one to fire on them (the shooter). In this case you would assign both entities the same laser code. The designator would be given the hold-fire rule of engagement or not have any missile resources. The shooter would be configured to not lase targets (Lase Autonomous would be set to Off). It would just fire on the targets identified by the designator's laser.

You can synchronize the laser codes of the lasing entity and the firing entity by setting them for each entity with the Laser Code set data request, or you can let VR-Forces synchronize the codes with the Synchronize Laser Code set data request. For details, please see "Laser Code," on page 8-17 and "Synchronize Laser Code," on page 8-27.

10.4. Using Sonar

VR-Forces simulates active and passive sonar. Entities can be configured with three types of sonar sensor systems: Active Sonar, Passive Sonar, and Sonar. The Sonar system includes both active and passive sonar. Both types of sonar use the VR-Forces sensor signature mechanism. The signatures are different, reflecting the different chances of detecting entities using the two types of sonar.

Passive sonar has the following characteristics:

- Sonar can be dipped at a depth other than that of the entity.
- If an entity is moving faster than a specified speed, passive sonar does not work.
- Sonar takes into account thermocline data. Thermoclines are layers of water that have different temperatures and, therefore, different density. Sound transmission varies as it passes through the thermocline. In VR-Forces sonar effectiveness is reduced as it passes through thermocline boundaries. For more information, please see "Setting the Thermocline," on page 12-13.
- Passive sonar ignores line-of-sight. It does not take into account underwater terrain or the presence of islands.
- If an entity is publishing propulsion noise, it can affect its detectability by passive sonar.

Active sonar has the following characteristics:

- Active sonar should acquire targets more quickly than passive sonar.
- If an entity has an active sonar system enabled, it is more easily detected by passive sonar systems.
- Entities with an active sonar that is enabled publish Underwater Acoustics PDUs.
- Entities can have multiple active sonar modes, similar to radar modes, using emitter beams. For details about configuring emitters, please see Section 7.5, "Configuring Emitters," in *VR-Forces Configuration Guide*.
- Active sonar detects targets within the range of its emitter beams, but without regard to the direction of the beams.
- Active sonar ignores propulsion noise and the presence of active sonar on the target.

RPR FOM 1.0 does not support active sonar. If you try to create an entity that has an active sonar system, the entity will not be created and a warning will be sent to the console. If you try to load a scenario that has such an entity, it will not be created.

Sonar only works in water. Therefore rotary-wing entities with sonar systems must set their depth in order to sense anything.

10.4.1. Propulsion Noise and Sonar

If an entity is generating propulsion noise, it is easier to detect using passive sonar. VR-Forces publishes propulsion noise for surface and subsurface entities. If the power plant for an entity is turned off, it does not publish propulsion noise. To turn propulsion noise on or off, change the power plant appearance (for details, please see "Appearance," on page 8-5) or set the **power-plant-active** parameter in the propulsion-noise-generator component of the entity's movement system in the OPD Editor.

VR-Forces publishes three propulsion noise values:

- Current Shaft RPM, calculated as `current speed * speed-to-rpm-factor`.
- Ordered Shaft RPM, calculated as `ordered speed * speed-to-rpm-factor`.
- Shaft RPM Rate of Change, calculated as `current acceleration * acceleration-to-rpm-factor`.

The values for current speed, ordered speed, and current acceleration are the current values for the entity. The values for speed-to-rpm-factor and acceleration-to-rpm-factor are taken from the **speed-to-rpm-factor** and **acceleration-to-rpm-factor** parameters in the propulsion-noise-generator component of the entity's movement system.

When a target is being detected by passive sonar, if it is publishing propulsion noise, its calculated RPM is compared to a nominal RPM (default 100) to generate a sensor signature modifier. For example, if an entity is publishing an RPM of 80, its signature is scaled by 0.8. If its RPM is 150, the signature is scaled by 1.5.

RPR FOM 1.0 does not support propulsion noise. If you try to create an entity that has propulsion noise enabled, the entity will not be created and a warning will be sent to the console. If you try to load a scenario that has such an entity, it will not be created.

10.5. Launching Counter Measures (Chaff and Flare)

Fixed-wing and rotary-wing entities can launch counter measures (chaff and flare) when they are targeted by air-to-air and ground-to-air missiles. By default, entities launch counter measures automatically based on settings in the *countermeasures.sysdef* file. When an aircraft detects a hostile missile within a specified range, it determines the type of missile and looks up the type of counter measures to use in the *USCounterMeasuresTable.asl* or *CISCounterMeasuresTable.asl* table.

Figure 10-7 shows a friendly force fighter launching counter measures against an aphid missile.

Figure 10-7. Counter measures (flare)

You can disable automatic counter-measures with the Counter Measures Auto Launch set data request. You can also launch counter-measures with the Launch Counter Measures task. The Launch Counter Measures task is not an exclusive task, so it does not interfere with the entity's current task. For details about the task and set data request, please see "Launch Counter Measures," on page 7-27 and "Counter Measures Auto Launch," on page 8-8.

You can configure the behavior of automatic counter measures in the *counter-measures-launcher.sysdef* and *cis-counter-measures-launcher.sysdef* files (in *./data/simulationModel-Sets/default/vrfSim/systems/other*). Table 10-1 describes the parameters that you might want to change.

Table 10-1: Counter measure launcher parameters

Parameter	Description
auto-launch-enabled True	Enables or disables automatic launching of counter measures.
auto-launch-range	The range within which an entity will detect missiles against which to launch counter measures.
auto-launch-reset-time	The amount of time, in seconds, an entity will wait before launching additional counter measures.
auto-launch-default-resource	The default counter measure to use.
auto-launch-number-of-resources	The numer of counter measures to launch for each launch sequence.
counter-measures-select-table-file	The counter measures selection table to use to determine which counter measures to fire for a particular missile.

10.6. Modeling Artillery Munitions

VR-Forces models artillery in two ways – direct fire and indirect fire. Artillery entities, such as howitzers use a direct fire model. The artillery entity is modeled and the munitions it fires are modeled. Indirect fire simply models artillery barrages within an area. For details about indirect fire, please see Chapter 11, *Managing Indirect Fire and Missiles*.

By default, when an artillery entity fires, VR-Forces models the munition. Munitions are not affected by wind speed or friction. VR-Forces can also model artillery without modeling the munition. In this case, it just publishes a fire event and detonation event. Modeling munitions requires more computer resources than not doing so. Therefore, in large simulations you may want to disable modeling of munitions.

To disable modeling munitions, in the indirect-fire-actuator, set the **simulate-munition** parameter to false. For example, in the OPD Editor:

1. Select the Systems List tab.
2. Select the M284 155mm Cannon.
3. Select the Components tab.
4. Expand the Actuators list.
5. Select M284-cannon.
6. Change the value for the **simulate-munition** parameter.

10.7. Taking Damage from Munitions

Entities can be damaged by munitions fired by other entities. They can be damaged by direct fire – a munition that hits the entity or within a configurable distance of the entity, and by indirect fire – a munition that explodes within a configurable distance of the entity. An entity can also suffer collateral damage. This can occur if an entity is hit by direct fire of sufficient power to damage nearby entities.

The types of munitions to which an entity is vulnerable are determined by its damage system. Each damage system has a damage actuator, which specifies damage files. These damage files specify how entities are damaged by direct and indirect fire from specific munitions. *VR-Forces Configuration Guide* describes damage systems and damage files. The important point to remember as a VR-Forces user is that an entity will not be harmed by a munition unless it has a damage system that knows about that munition. And, if you introduce a new munition type, it will not harm any entities unless their damage systems have a damage file for the new munition.

The default radar signature for ground vehicles is 500 meters. This is too short a distance for most fixed-wing aircraft to detect and fire on a ground vehicle. To make ground vehicles vulnerable to aircraft, increase the radar signature to a distance that is appropriate for the aircraft in your simulation.

11

Managing Indirect Fire and Missiles

This chapter explains how to create and edit indirect fire events and ballistic missiles.

11.1. Introduction to Indirect Fire

The indirect fire feature allows you to create, configure, and schedule indirect fire events. Indirect fire events are not associated with a particular entity. VR-Forces does not model the launcher or trajectory of the munitions. Indirect fire results in one or more salvos of one or more rounds in or near a designated area of the terrain. Entities do not take damage from indirect fire unless they are configured to do so. Figure 11-1 illustrates indirect fire fire within an indirect fire area.

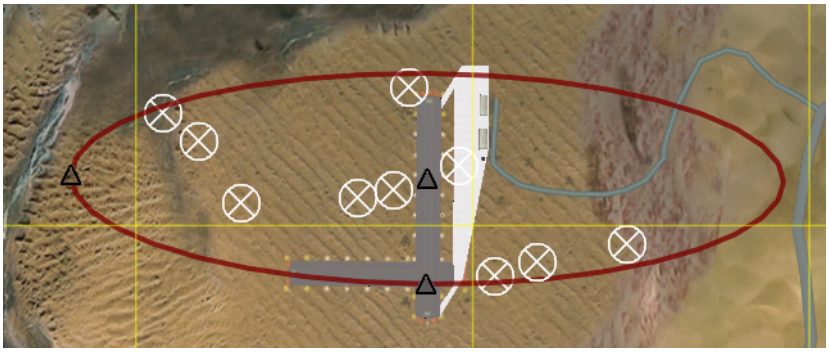


Figure 11-1. Indirect fire event

Indirect fire types are configured in *./data/simulationModelSets/default/indirectFire-Types.mtl*.

11.1.1. Creating an Indirect Fire Event

When you create an indirect fire event, you specify an area in which the event is to take place, the parameters of the event, and a starting time. The area in which an indirect fire event takes place is a tactical graphic and is listed on the Environmental tab of the Objects List Panel.

By default, indirect fire areas are placed on the Indirect Fire layer (which is created for the first indirect fire object). You can put other objects on this layer. You can put indirect fire objects on other layers by selecting a layer in the Create Indirect Fire dialog box or by dragging them on the Overlay tab of the Objects List Panel.

To create an indirect fire event:

1. Choose **Simulation** → **Munition Targets**. The Munition Target Settings dialog box opens (Figure 11-2).

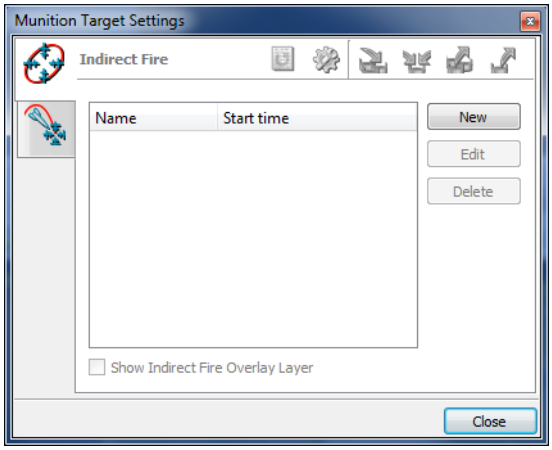


Figure 11-2. Munition Target Settings dialog box, Indirect Fire page

2. Select the Indirect Fire page.
3. Click New. The cursor changes to create mode and a tab for the Create Indirect Fire dialog box is added to the window.
4. Draw an ellipse on the map to specify the area of the fire event:
   a. Click to set the center of the ellipse. A center point is set and a small circle is displayed with a vertex indicator at the bottom of the circle.
   b. Drag the mouse up or down and click to set the height of the ellipse. A vertex indicator is added to the left side of the circle.
   c. Drag the mouse left and right and click to set the width of the ellipse (Figure 11-3).

   Optionally, you can specify the properties of the ellipse in the Create Indirect Fire dialog box.

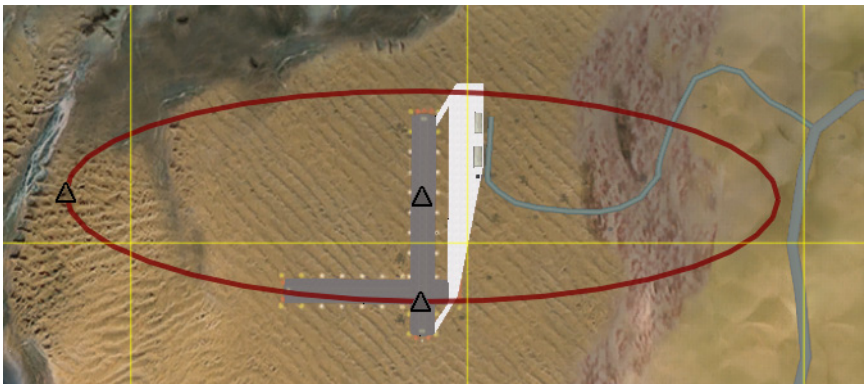


Figure 11-3. Indirect fire event area

5. Click the tab to display the Create Indirect Fire dialog box (Figure 11-4).

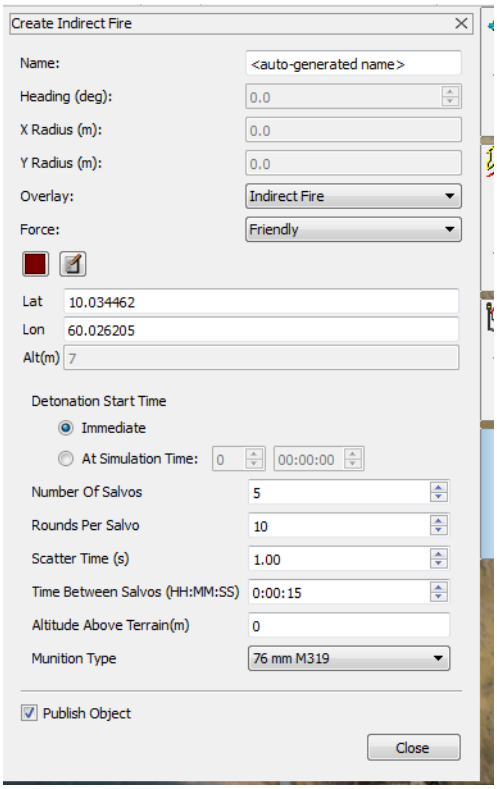


Figure 11-4. Create Indirect Fire dialog box

6. Type a name for the event in the Name text box, or accept the default name (Indirect Fire *n*).

7. Optionally, specify a layer for the event. (If there are no tactical graphics in the scenario, there might not be any layers to select. A layer will be created when you click Create to create this indirect fire event.)

8. Configure the parameters of the fire event, as follows:
   - Select the detonation start time. The options are Immediate or At Simulation Time. If you select At Simulation Time, enter the simulation time at which you want the munition to start firing.
   - In the Number of Salvos box, enter the number of salvos you want to fire.
   - In the Rounds Per Salvo box, enter the number of rounds you want to fire for each salvo.
   - In the Scatter Time box, enter the length of time for each salvo. The rounds in each salvo will be detonated at random times within this time period.
   - If you specified more than one salvo, in the Time Between Salvos box enter the amount of time you want to pass between each salvo.
   - Optionally, specify an altitude above the terrain that the rounds should detonate at.
   - Select the munition type in the Munition Type list.
9. Click Create. The Indirect Fire event is added to the list (Figure 11-5). The area is added as an object on the Indirect Fire layer on the Overlays tab of the Objects List Panel.

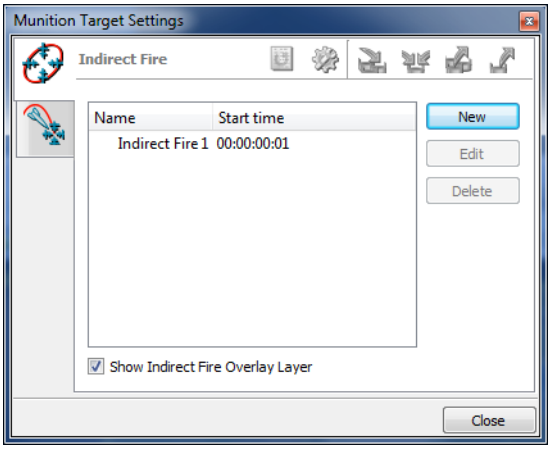


Figure 11-5. Indirect Fire page with indirect fire event

11.1.2. Editing Indirect Fire Events

You can edit the properties of an indirect fire event. You can also directly manipulate the area that specifies the event.

To edit an indirect fire event:

1. Choose **Simulation** → **Munition Targets**. The Munition Target Settings dialog box opens.
2. Select the Indirect Fire page (Figure 11-5).
3. Select the indirect fire event that you want to edit.
4. Click Edit. The Edit Indirect Fire dialog box opens.
5. Change the properties that you want to change.
6. Click OK.

11.1.3. Deleting Indirect Fire Events

To delete an indirect fire event:

1. Choose **Simulation** → **Munition Targets**. The Munition Target Settings dialog box opens (Figure 11-2).
2. Select the Indirect Fire page (Figure 11-5).
3. Select the indirect fire event that you want to delete.
4. Click Delete.
5. Click Close.

11.1.4. Configuring Indirect Fire Event Default Values

You can configure a set of default values that get applied to the Create Indirect Fire dialog box.

To configure default values for indirect fire events:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Indirect Fire Settings page (Figure 11-6).

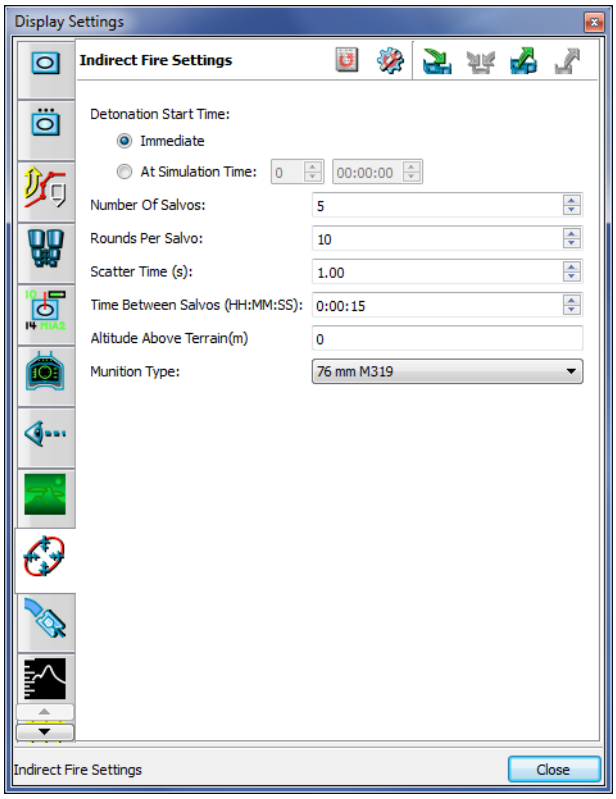


Figure 11-6. Indirect Fire Settings page

3. Set the parameters to the desired default values.
4. Click Close.

11.2. Ballistic Missiles

VR-Forces supports firing of ballistic missiles, including multistage missiles. The trajectory of a missile is determined by a series of coordinates in a comma-separated values (CSV) file. VR-Forces includes some sample CSV files. VR-Forces users are responsible for creating their own files if they want missiles to fly with different characteristics.

You fire a ballistic missile by specifying a target and choosing a missile type. The characteristics of the missile type are specified in the Entity Editor. A missile launches at the same altitude as the target point at a distance determined by the CSV file. Therefore, if a target point is placed at or near the ground, it is possible that due to variations in the terrain, the launch location could be underground. Once the missile launches, it follows the trajectory contained in the CSV that it is configured with. It detonates when it reaches the target point. For details about configuring missiles, please see Section 5.9.1, "Configuring Ballistic Missile Movement," in *VR-Forces Configuration Guide*.

11.2.1. Firing Ballistic Missiles

To fire a ballistic missile:

1. Choose **Simulation** → **Munition Targets**. The Munition Target Settings dialog box opens (Figure 11-2).
2. Select the Missile Target page (Figure 11-7).

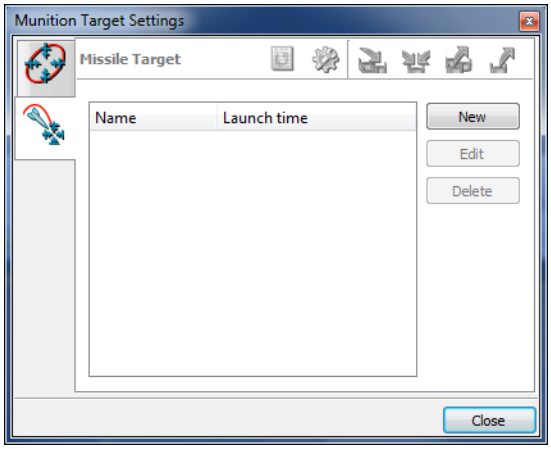


Figure 11-7. Munition Target Settings dialog box, Missile Target page

3. Click New. The cursor changes to a cross-hair.
4. Click the location where you want the missile to hit. The Create Missile Target dialog box opens (Figure 11-8).

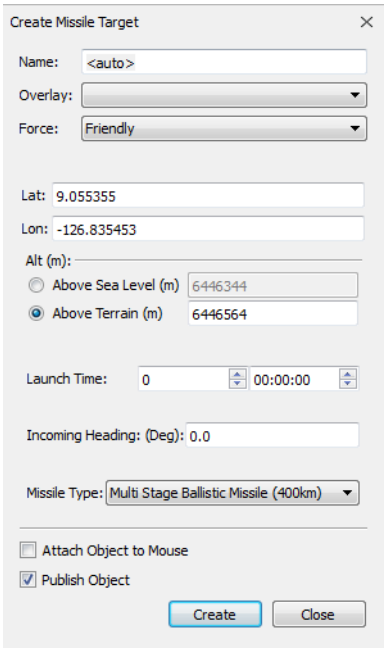


Figure 11-8. Create Missile Target dialog box

5. Optionally, specify the parameters for the target. In particular, set the following parameters:
   - Name. The name of the target point.
   - Launch Time. The simulation time at which the missile will be launched.
   - Incoming Heading. The heading, relative to the target, from which the missile will be launched.
   - Missile Type. An option from the list.
6. Click Create. The missile event is listed in the Missile Target window.

11.2.2. Editing Missile Target Events

You can edit the properties of a missile target event. You can also directly manipulate the target point.

To edit a missile target event:

1. Choose **Simulation** → **Munition Targets**. The Munition Target Settings dialog box opens (Figure 11-2).
2. Select the Missile Target page (Figure 11-7).
3. Select the missile fire event that you want to edit.
4. Click Edit. The Edit Missile Target dialog box opens.
5. Change the properties that you want to change.
6. Click Update.

11.2.3. Deleting Missile Target Events

To delete a missile target event:

1. Choose **Simulation** → **Munition Targets**. The Munition Target Settings dialog box opens (Figure 11-2).
2. Select the Missile Target page (Figure 11-7).
3. Select the missile fire event that you want to delete.
4. Click Delete.
5. Click Close.

You can also simply delete the target point from the terrain.

12

Environment Conditions

This chapter explains how to set the time of day and weather conditions.

12.1. Introduction to Environment Conditions

You can set the time of day, weather, and marine conditions from the front-end and in plans. The time of day and weather conditions are back-end settings, not merely front-end display effects. They affect entity sensors and line-of-sight. For example, if visibility is set to 4 kilometers, an entity will not see an entity that is 5 km away. If the time of day changes from daytime to nighttime, lighting conditions in the 3D view change accordingly.

The time of day advances as simulation time advances. However, they are not directly tied to each other. For example, if at the start of a simulation (simulation time 0:00:00:00), you set the time of day to 10:00 AM, after eight hours of simulation time passes, the time of day will be 6:00 PM. However, you could just as easily set the initial time of day to some other time or change it at will during the course of the simulation. These changes would not affect the elapsed simulation time in any way. They would just change the starting point for the advance of the time of day.

Time of Day and Global Weather are options on the commands menu in global plans and entity plans.

12.2. Setting the Time of Day

As time advances, the time displayed on the Environment Settings toolbar changes. The time of day setting is independent of simulation time.

To set the time of day:

1. Choose **Simulation** → **Environment Settings**, or click the Time of Day button ( ) on the Environment Settings toolbar. The Environment Settings dialog box opens.
2. Select the Time of Day page (Figure 12-1).

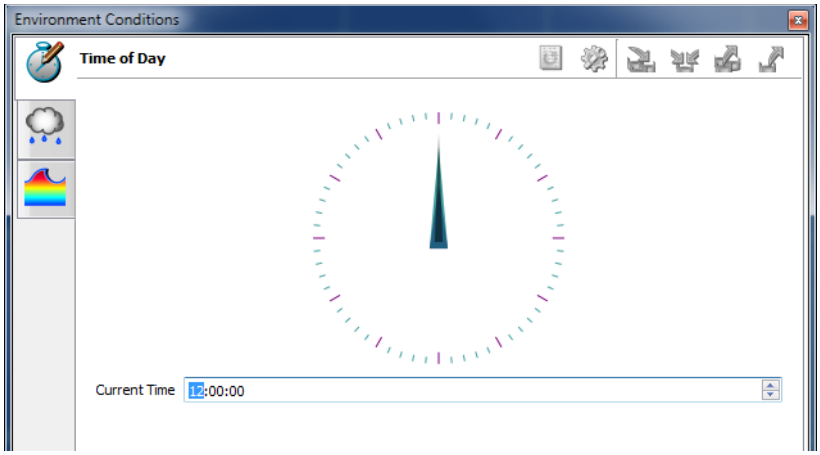


Figure 12-1. Time of Day page

3. Set the time of day by typing or selecting a value in the Current Time box.

12.3. Specifying the Environment Conditions

VR-Forces has a set of preconfigured environment conditions. Each environment condition has settings for:

- Weather:
  - Wind speed and direction.
  - Cloud cover.
  - Visibility.
  - Precipitation type and intensity.
  - Fog height and color.
- Marine:
  - Sea swell.
  - Sea state.
  - Surface transparency.
  - Underwater visibility.
  - Choppiness.
  - Surge depth.

Conditions range from clear to stormy and let you quickly set the weather without needing to adjust all the various weather parameters. However, if you want to, you can change any of the individual weather parameters. Changing a weather or marine setting does not affect the saved settings unless you specifically overwrite them.

You can save and import environment settings. When you save a scene, environment settings are saved as part of the scene. Environment settings support the standard VR-Forces settings behaviors, as described in "Managing VR-Vantage Settings," on page 3-20.

You can add your own environment conditions. You can also set an environment condition as the default condition to use when VR-Forces starts up. If you do not set a default condition, VR-Forces saves the settings that were in effect when you last closed it.

To specify a weather condition:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-2).

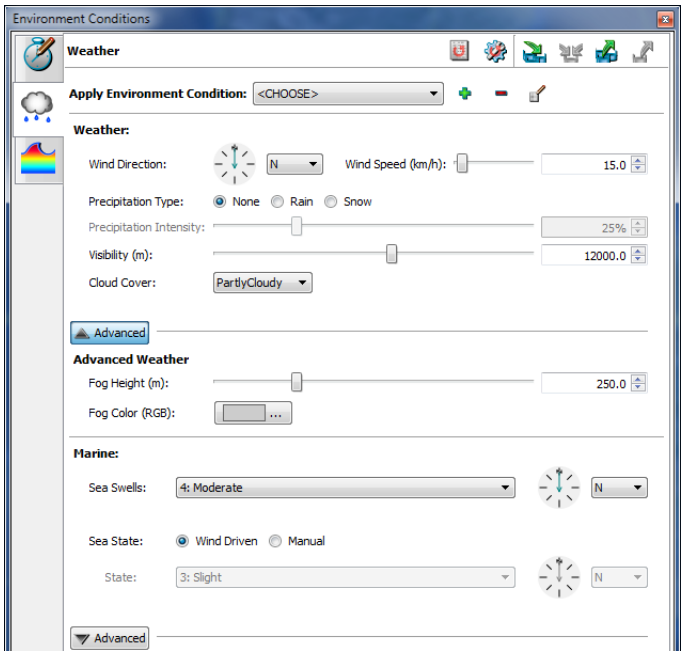


Figure 12-2. Weather page

3. In the Apply Environment Condition list, select the condition you want.

12.3.1. Adding an Environment Condition

If you add an environment condition, it gets added to the Apply Environment Condition list.

To add an environment condition:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-2).
3. Click the Add button (+). The Name an Environment Condition dialog box opens.
4. Type a name for the new condition.
5. Click OK.

12.3.2. Editing an Environment Condition

You can change the settings for an environment condition. Editing a condition essentially means overwriting a condition with the current set of weather and marine conditions.

To edit an environment condition:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-2).
3. Optionally, in the Apply Environment Condition list, select a condition you want to use as your starting point.
4. Change whatever conditions you want.
5. Click the Edit button ( ). The Select an Environment Condition dialog box opens.
6. In the Select Name list, select the condition you want to overwrite.
7. Click OK.

12.3.3. Deleting an Environment Condition

If you delete one of the built-in environment conditions, you can restore it from the factory settings.

To delete an environment condition:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-2).
3. Click the Delete button ( ). The Select an Environment Condition dialog box opens.
4. In the Select Name list, select the condition you want to delete.
5. Click OK.

12.4. Setting Weather Conditions

You can set the following weather conditions:

- Cloud cover
- Visibility
- Precipitation
- Wind speed and direction.

When you specify weather, the back-end sends out state updates with these conditions. Entities respond to them only if their model has the ability to do so.

12.4.1. Setting the Wind Speed and Direction

You can set the wind speed and direction. If you do not specify the sea state manually, it is set based on the wind conditions. The maximum wind speed that you can set is 360 km/h.) The wind direction affects the angle at which precipitation falls.

To set wind speed and direction:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-3).

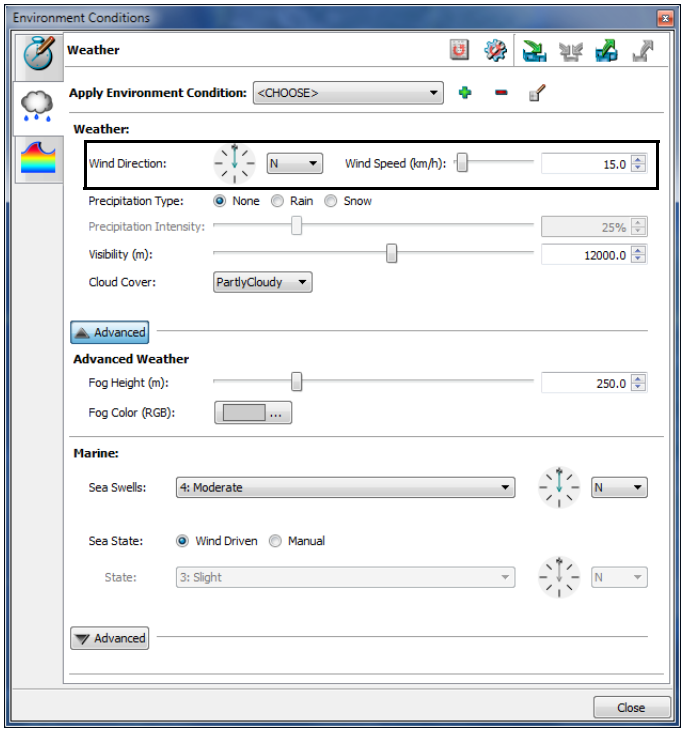


Figure 12-3. Weather page

3. Drag the Wind Direction indicator to the desired compass point or select an option from the list.
4. Drag the Wind Speed slider or enter a value in the box.

12.4.2. Setting Visibility (Fog)

The visibility setting determines the denseness of the fog effect, which determines how far you can see.

To set visibility:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-3).
3. Adjust the Visibility slider or enter a value in the box.

Configuring Fog

You can set the fog height and color. The fog height affects how much sky the observer can see when looking up from ground level. For example, if you set the fog height to 50m and look up, you will see some amount of sky above you, and to the sides it will be very gray. If you then set it to 10m and look up, you will see mostly blue sky above you, but still quite a bit of gray to the sides.

Fog settings are not modeled in the back-end. Therefore, they are not available when you set weather conditions in a plan.

To configure fog:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-3).
3. In the Weather section of the page, click Advanced. The dialog box expands to show options for fog.
4. To set the fog height, adjust the slider or enter a value in the box.
5. To set the fog color:
   a. Click the color swatch. A color picker dialog box opens.
   b. Select the color you want to apply to the fog. It is applied immediately, so you can easily see the effect of the new color and change it if you want to.
   c. Click OK.

12.4.3. Specifying Precipitation Type and Intensity

VR-Forces supports display of rain and snow. You can configure the intensity of precipitation.

To specify the precipitation type and intensity:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-3).
3. Select a Precipitation Type. If you select rain or snow, the Precipitation Intensity setting becomes editable.
4. Adjust the Precipitation Intensity slider or enter a value in the box. The range is 0% through 100%.

12.4.4. Specifying Cloud Cover

VR-Forces simulated varying amounts and types of cloud cover, from clear, to cloudy, to thunderstorm. When you choose an environment condition, it includes an appropriate degree of cloud cover. You can also change the cloud cover at any time.

To specify the cloud cover:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-3).
3. Select an option from the Cloud Cover list.

12.5. Configuring Marine Conditions

VR-Forces supports a variety of dynamic ocean effects (Figure 12-4), including:

- Douglas Sea State. This includes wind waves (wind sea), swell character, and the directions of each. VR-Forces allows each to be separately configured.
- Wave chop.
- Surface transparency. The ability to see through the water from above sea level.
- Underwater visibility. The ability to see underwater.
- Swell.
- Surge depth.

Figure 12-4. Fishing boat

Enabling dynamic ocean effects can affect performance.

12.5.1. Enabling Marine Effects

Marine effects can reduce performance. Therefore, they are disabled by default.

➤ To enable marine effects, choose **Observer** → **Dynamic Ocean**, or click the Dynamic Ocean button ( ) on the Observer Settings toolbar.

12.5.2. Configuring Marine Conditions

The preconfigured environment conditions available on the Scene Settings page of the Scene Settings dialog box include marine conditions. You can also customize the marine settings at any time.

To configure marine effects:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Weather page (Figure 12-3).

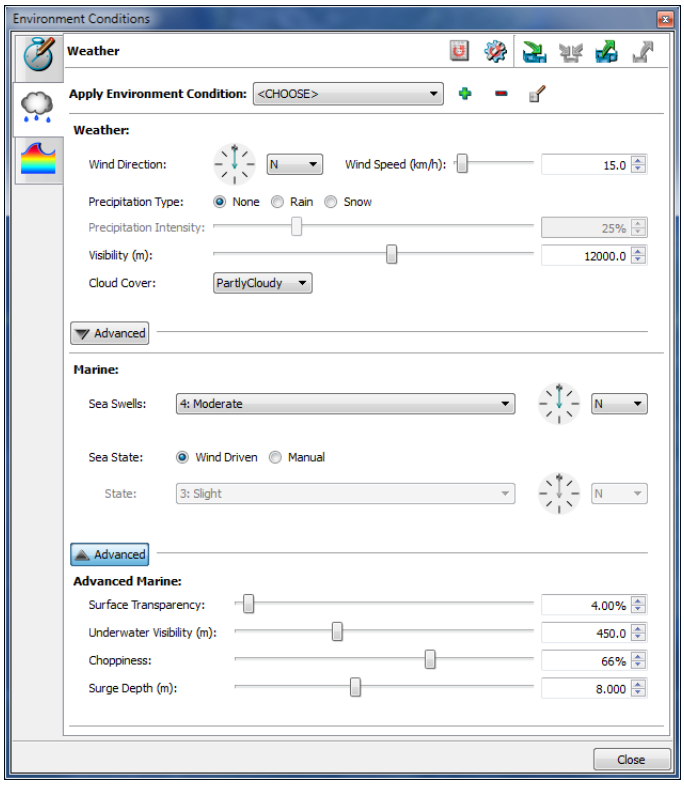


Figure 12-5. Weather page

3. Change settings as desired. The settings are described in Table 12-1.

Table 12-1: Advanced marine settings

Parameter	Description
Sea Swells	The amount of rise and fall of waves independent of wind. Choose from 10 fixed swell states. You can also set the compass direction from which swells originate.
Sea (wind) state	Determined by the wind direction and speed or set manually. If manual, one of the swell states for the Douglass sea state scale. You can also set the compass direction from which sea state originates.
Advanced Parameters	
Surface Transparency	The depth at which VR-Forces begins to apply transparency to the water surface if the terrain has bathymetry or underwater polygons. This setting helps reduce Z-fighting along the shoreline. It does not mean that you can see some distance into the water when the observer is over deep water. The maximum value represents transparency to 500 meters.
Underwater visibility	The distance you can see underwater if the observer is underwater
Choppiness	The percentage of turbulence on the water.
Surge depth	When bathymetry data is present, this is the depth of the water at which full storm effects take place. As the water gets shallower, it gets calmer.

12.6. Setting the Thermocline

Thermoclines are layers of water that have different temperatures and, therefore, different density. Sound transmission varies as it passes through the thermocline. In VR-Forces sonar effectiveness is reduced as it passes through thermocline boundaries. By default, VR-Forces does not set any thermoclines. You can specify the depth of up to five thermoclines.

To specify a thermocline:

1. Choose **Simulation** → **Environment Conditions**. The Environment Conditions dialog box opens.
2. Select the Thermoclines page (Figure 12-6).

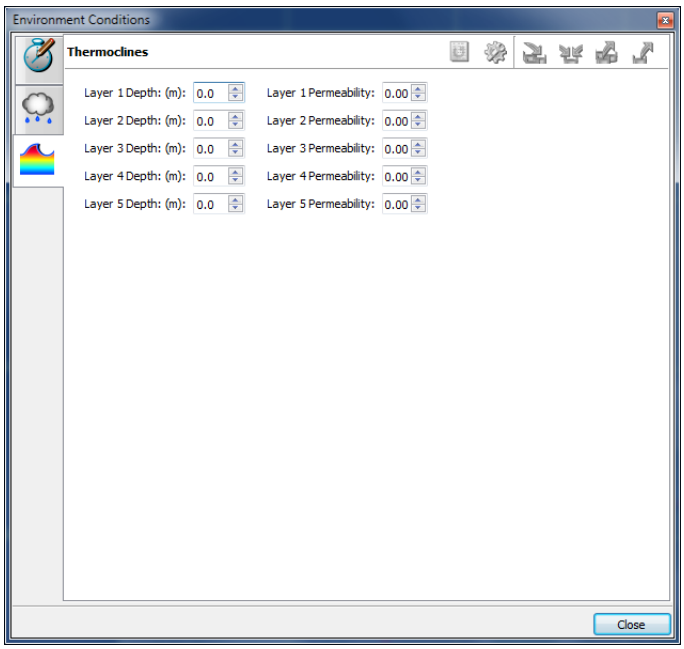


Figure 12-6. Thermoclines page

3. For each thermocline that you want to specify, type or select a value in the depth box and the permeability box.

12.7. Displaying Screen Splash Effects

When it is raining, VR-Forces can simulate raindrops hitting the oberver's camera lens. If the observer is close to the surface of the ocean (as if a periscope were being raised or lowered), VR-Forces can simulate the effect of waves and water droplets splashing on the observer's camera (Figure 12-7).

Figure 12-7. Rain effect

To enable or disable screen splash effects:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 12-8).

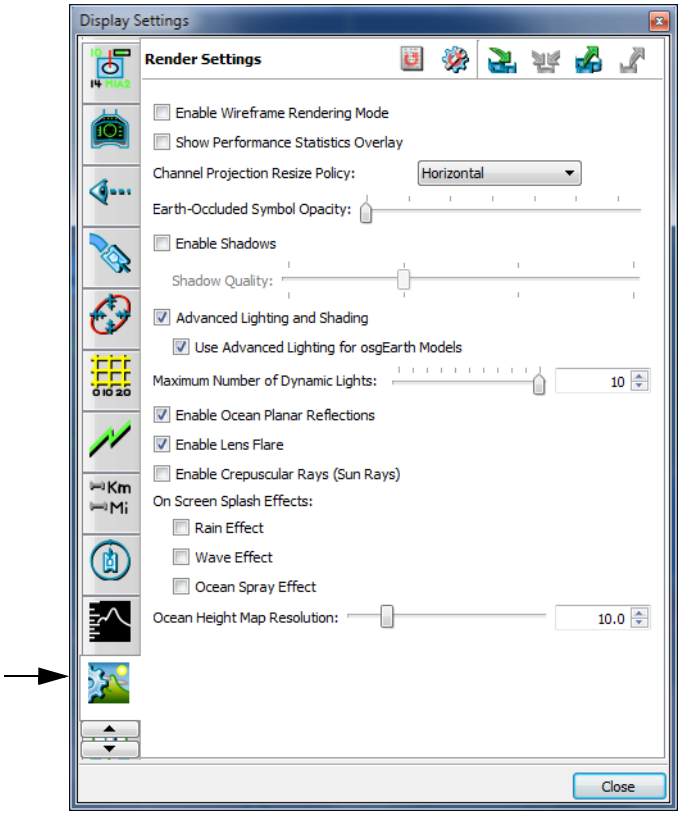


Figure 12-8. Render Settings page

3. Select or clear the Rain Effect, Wave Effect, or Ocean Spray effect check boxes.

13

Creating Scripted Tasks

VR-Forces lets you create new tasks by writing scripts. You do not need to know C++ or have a developers license to write these scripts.

13.1. Introduction to Scripted Tasks

The scripted task feature in VR-Forces allows you to create new tasks for entities without using the VR-Forces Toolkit and C++ API. Scripted tasks use the Lua programming language. The actions that entities can carry out are still limited to the basic C++ tasks provided by VR-Forces. However, since Lua is a full-featured scripting language, it is far more powerful than the plan language used to create entity plans and you can be much more creative in how you use the basic tasks. In addition to functions for tasks and sets, Lua scripts can make many types of calls to the simulation engine to get entity status or other simulation data. Scripts can also set some simulation data.

Scripted tasks get added to the Task menu and are treated just like the tasks that are built into VR-Forces. Scripted tasks are classified as system scripts or as scenario scripts. System scripted tasks are saved as part of the SMS and available to all scenarios that use that SMS. Scenario scripted tasks are available only in the scenario for which the script was created. However, you can save a scenario script as a system script if you want to and, just as with other data used by VR-Forces, there are ways of copying scripted tasks from one VR-Forces installation to another.

Reactive tasks are a special category of scripted tasks. Once enabled they monitor a simulation and get activated when the conditions set in the script become true. Reactive tasks are not added to the Task menu. In most respects the process for creating and writing reactive tasks is the same as creating and writing all scripted tasks. Assume that all details about scripted tasks apply to reactive tasks unless noted otherwise. For conceptual details about reactive tasks, please see "Reactive Tasks," on page 6-10.

When you create a scripted task, you can specify input parameters. When you assign the task to an entity, either from the Task menu or in a plan, VR-Forces builds a dialog box for the task that includes all of the parameters specified for the script.

Although creation of scripts requires that you have some programming skills, you do not need to know C++, use a compiler, or use the VR-Forces APIs to write these scripts.

From a Lua script you can:

- Create and delete simulation objects (entities, waypoints, and so on).
- Set weather and environment state.
- Get entity state, such as:
  - Aggregation
  - Location
  - Embarkation
  - Type
  - Force
  - Damage state
  - Velocity.
- Monitor and set entity resources.
- Get entity sensor contacts.
- Task other entities.
- Subtask self.
- Send Set Data Request messages.
- Test terrain:
  - Get terrain height.
  - Check line of sight.
  - Find feature data.

VR-Forces includes a text editor (SciTE) to use as the default script editor. You can configure VR-Forces to use a different editor if you want to. For details, please see "Specifying a Script Editor," on page 13-28.

13.1.1. Script Meta Data

A script has two major components, the script code, and the script meta data. The meta data provides all of the information that VR-Forces needs to store the script, add it to the Task menu, and generate the task dialog box.

13.1.2. The Lua Scripting Language

Lua is a lightweight scripting language used by VR-Forces to implement the scripted tasks feature. VR-Forces includes a set of Lua functions that map the built-in tasks and set data requests as well as the ability to obtain entity state information. You use these functions as the starting point for building new tasks. For details about the Lua language, please see the Lua website (www.Lua.org).

13.2. Creating a New Scripted Task

To create a new scripted task, you specify the meta data for the script and write the script code. A scripted task's meta data specifies the script's name, where it will be placed on the Task menu, and its parameters, if any. Specifying meta data may be an iterative process, particularly the parameters, which may change as you write the code for the script. However, the minimum first step in creating a scripted task is to specify a name for the script and add it to the list of scripted tasks. Once you do this, you can edit the meta data and the code as needed until you have completed the scripted task to your satisfaction.

All new scripted tasks are created as scenario tasks. If you want to create a new system scripted task, you save the scenario scripted task as a system scripted task. For details, please see "Creating a System Scripted Task," on page 13-26.

To create a new scripted task:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks dialog box opens (Figure 13-1).

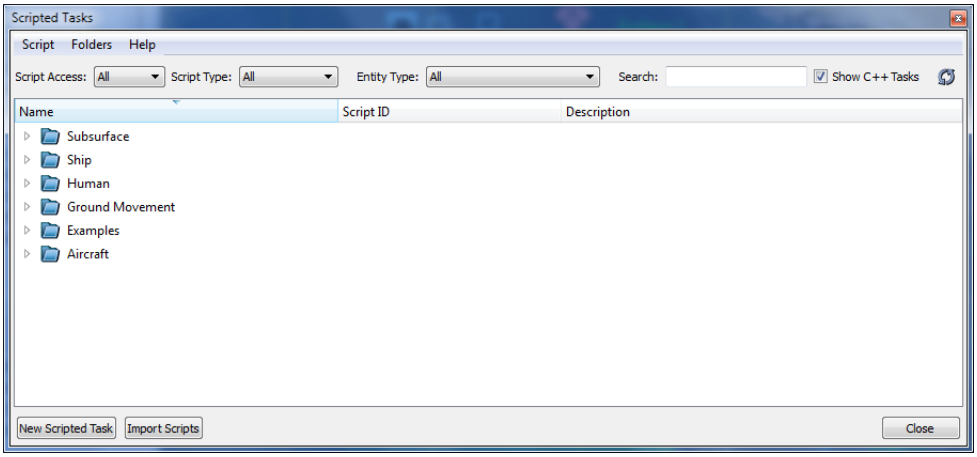


Figure 13-1. Scripted Tasks dialog box

2. If you have a folder hierarchy and want to create the script in a particular folder, select the folder. (For more information, please see "Organizing Scripted Tasks into Folders," on page 13-22.)
3. Choose **Script** → **New Scripted Task**. The New Scripted Task dialog box opens (Figure 13-2).

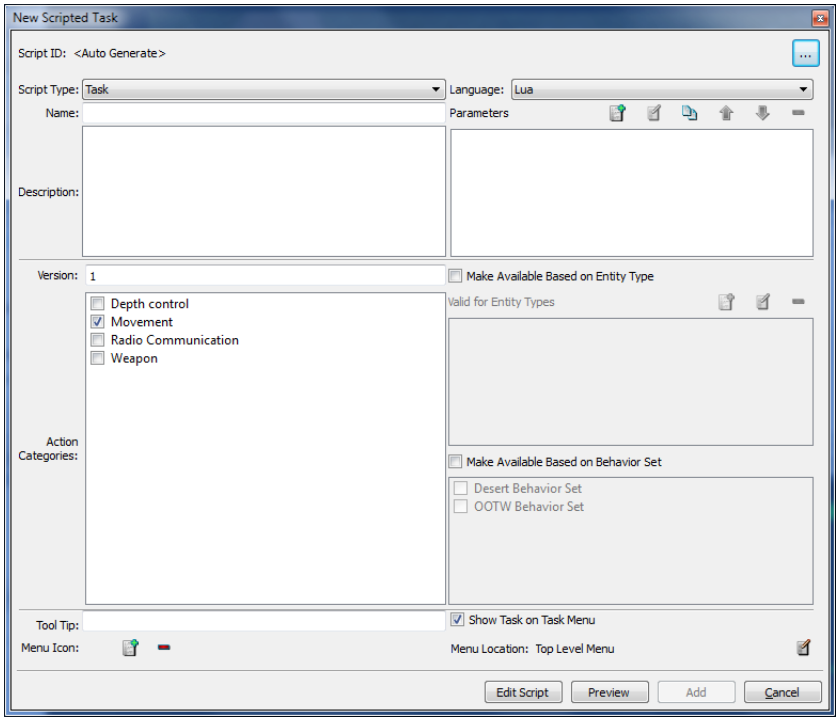


Figure 13-2. New Scripted Task dialog box

4. In the Script Type list, select the type of scripted task you are creating (Task or Reactive Task). The dialog box displays the correct set of meta data for the type of task you chose.

5. Complete the fields in the dialog box. They are described in Table 13-1 and in the following sections.

Table 13-1: Script meta data

Input Field	Description
Script ID	A unique name for the scripted task. VR-Forces generates a default name, but you will probably want to change it to something meaningful. It is your responsibility to make sure that it is unique. Please see "Specifying the Script ID," on page 13-9 for details.
Script Type	One of the following: ◆ Task. A scripted task that would typically be accessed through the Task menu. ◆ Reactive Task. A task that executes in response to specific conditions. The fields on the New Scripted Task dialog box vary based on which type of task is being created.

Table 13-1: Script meta data

Input Field	Description
Language	Specify Lua if you are writing a Lua script for this task. Specify C++ if you have written a new task controller and want to use the scripted task interface to create the GUI portion of the task. For more information, please see "Specifying the Programming Language for a Scripted Task," on page 13-18.
Name	The text that will be added to the Task menu for this script.
Description	The description of what the task does that is displayed on the task's dialog box. (Optional)
Tool Tip	Text for a tooltip when the task is selected on the Task menu. (Optional) (Does not apply to reactive tasks.)
Menu Icon	The icon to display next to the task name on the Task menu. Please see "Specifying the Task Menu Icon," on page 13-9 for details. (Optional) (Does not apply to reactive tasks.)
Version	Script version. Available as a parameter to a Lua script. For use by script writers who want to have different versions of a script.
Action Categories	Specifies the categories of tasks that this scripted task will interrupt. (In other words, action categories manage task concurrency. For details about concurrent tasks, please see "Concurrent Task Execution," on page 6-4.)
Behavior Sets	Select each Behavior Set that you want this script to be part of. You can also assign scripts to Behavior Sets in the Edit Behavior Sets dialog box. For details about Behavior Sets, please see "Using Behavior Sets to Manage Scripted Tasks," on page 6-16.
Parameters	The input parameters that the task requires. Please see "Specifying Task Parameters," on page 13-10 for details. (Optional)
Show Scripted Task on Task Menu	Select to show the scripted task on the Task menu. Clear to hide the task. (You might want to write a scripted task that will be used by other scripted tasks, but which you do not want a user to assign directly to an entity.) (Does not apply to reactive tasks.)
Menu Location	The location on the Task menu where this scripted task will be listed. Please see "Specifying the Task Menu Location," on page 13-13 for details. (Does not apply to reactive tasks.)

Table 13-1: Script meta data

Input Field	Description
Valid for Entity Types	The entity types that can use this task. This entry affects the context sensitivity of the Task menu. Please see "Specifying the Valid Entity Types for a Task," on page 13-16 for details.
Enabled by Default	Reactive tasks only. If selected, the reactive task is automatically enabled for all supported entity types.
Default Priority	Reactive tasks only. The priority for this task. For information about the effect of reactive task priority, please see "Reactive Tasks," on page 6-10.
View Like Priorities	Reactive tasks only. Displays a list of the reactive tasks that are valid for this task's entity types and action categories. This helps you decide what priority you want to give to the reactive task you are creating or editing.

6. Optionally, click Preview to see the dialog box that the scripted task will create.
7. Optionally, click Edit Script to begin writing the code for this scripted task.
8. Click Add. The script is added to the list in the Scripted Tasks window.

13.2.1. Specifying the Script ID

Each script must have a unique ID. VR-Forces generates a default ID, but it does not contain meaningful text. Therefore, you may want to change the ID.

! The script ID is used internally by VR-Forces to manage how a scripted task is executed. If a scripted task is used in a plan, it is referenced by its script ID. If you change the ID, you must ensure that it is unique. You cannot edit the ID of a system scripted task.

To specify the script ID:

1. In the New Scripted Task (or Edit Scripted Task) dialog box, click the button to the right of the Script ID. The New Script ID dialog box opens.
2. Type the ID you want to use.
3. Click OK.

13.2.2. Specifying the Task Menu Icon

If you want to put an icon on the Task menu next to the menu text, you can specify one. (Does not apply to reactive tasks.)

To specify a Task menu icon:

1. Click the Add button () next to the Menu Icon label. The Select Menu Icon dialog box opens.
2. Browse the directory structure and select the icon that you want to use.
3. Click Open.

➤ To remove the Task Menu icon for a script, click the Remove button () next to the Menu Icon label.

13.2.3. Specifying Task Parameters

Scripted tasks can take input parameters. When you specify parameters for a scripted task, VR-Forces automatically builds a dialog box that lets the user enter the parameter values. The parameter types that you can specify for a scripted task are as follows:

- Aggregate Formation. Provides a list of formations for aggregate entities.
- Altitude MSL. Altitude above mean sea level.
- Bomb Resource. Creates a list of bomb resources.
- Boolean. Creates a check box.
- Choice (List). Specifies choices presented in a drop-down list.
- Choice (Option Button). Specifies choices presented as a option (radio) buttons.
- DI-Guy Animation. Lets you select a DI-Guy animation.
- DI-Guy Appearance. Lets you select a DI-Guy appearance.
- Distance. Specifies a distance.
- Emitter. Entity emitter ID.
- Entity Type. Entity type enumeration.
- Force.
- Heading. Heading, in degrees.
- Integer. A whole number.
- Location (with altitude). Vector description of a location, in geocentric, including altitude.
- Location (without altitude). Vector description of a location, in geocentric, altitude not included.
- Munition Resource. Creates a list of munitions.
- Offset Location. Specifies an offset to the side, behind, and above, as in the Follow Entity task.
- Real. A floating point decimal number.
- Resource. Creates a list of available resources.
- Separator. Lets you put a separator in the generated dialog box. This is just for formatting purposes
- Simulation Object (Single). Lets you select one simulation object in a list window.
- Simulation Object (Multiple). Lets you select multiple simulation objects in a list window.
- Speed. Any kind of rate, such as speed, climb rate, and so on.
- String. An alphanumeric string.
- Time. Time in days:hours:minutes:seconds.
- Turn Rate. Turn rate in radians/second.

If a scripted task does not have any input parameters, it executes as soon as it is assigned to an entity, like the Wait command does.

To specify a parameter for a script:

1. Click the Add button () above the Parameters list. The Add Parameter dialog box opens (Figure 13-3).

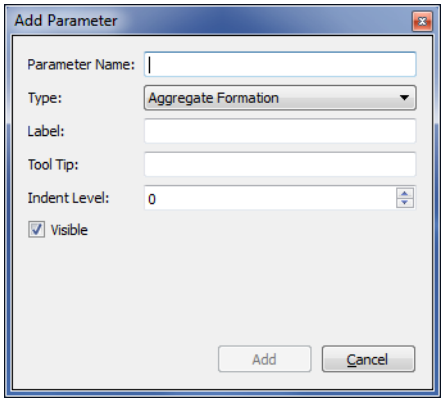


Figure 13-3. Add Parameter dialog box

2. Select the type of parameter from the Type list. If appropriate, the dialog box redisplays to request the details required for the variable type you selected.
3. Fill out the fields as follows:

   All of the parameters have the following fields:

   – Parameter Name. The name to be used by the Lua script for this parameter. For example, if you give a parameter the name **taskDestination**, in the Lua code for the scripted task, the parameter will be accessed as `taskParameters.taskDestination`.
   – Label. This is the text used on the dialog box that is generated for the task. If you leave this field blank, the parameter name is used.
   – Tool Tip. Optional text for a tool tip.
   – Indent Level. The number of pixels to indent the parameter on the task dialog box. This allows you to apply some formatting to the dialog box.
   – Visible check box. Specifies that the parameter be included on the scripted task dialog box. (You might want a parameter to be available in the code, but not have it set by a user when the scripted task is assigned.)

   Many parameters let you specify a default value or state.

   Some parameters let you specify a range for the acceptable values:

   – Range Bottom. The lowest acceptable value for this parameter.
   – Range Top. The highest acceptable value for this parameter.

The Boolean parameter type lets you create a check box. You can specify that the default be checked or unchecked.

For details about adding choices to a Choice parameter, please see "Specifying Choices for the Choice Parameters," on page 13-12. For details about adding categories to a filtered list, please see "Specifying Categories for a Simulation Object," on page 13-12.

Specifying Choices for the Choice Parameters

The Choice parameters require a list of choices, which get added to the dialog box as option buttons or as a list. You can add choices, edit them, and delete them.

To add a choice:

1. Click the Add Parameter button () on the Choice Box Values line. The New Choice dialog box opens.
2. Type the text for the choice.
3. Click OK.
4. Repeat this procedure for each choice that you want to have available. (The last choice added becomes the default choice.)

Specifying Categories for a Simulation Object

The Simulation Object parameter lets you build a list of categories on which to filter the display of entity types in a dialog box.

To add a category to the simulation object list:

1. Click the Add Parameter button () on the Filters line. The Choose Filter dialog box opens.
2. Select a filter from the Filters list.
3. Click OK.
4. Repeat the procedure to add as many filters as you want.

Editing the Category List for a Simulation Object Parameter

You can edit the list of filter categories for a Simulation Object parameter. The edit operation is essentially a replacement of the current category with a new one. You can achieve the same effect by deleting the current category and adding a new one.

To edit the list of filter categories in a Simulation Object parameter:

1. Select the parameter you want to edit in the Parameters list on the New Scripted Task dialog box.
2. Click the Edit button (). The Script Variable dialog box opens.
3. In the Filters list, select the filter that you want to edit.
4. Click the Edit button (). The Choose Filter dialog box opens.
5. Select the filter category that you want to use.
6. Click OK. The original category is removed and the new one is added.

To delete a category from a Simulation Object parameter:

1. Select the parameter you want to edit in the Parameters list on the New Scripted Task dialog box.
2. Click the Edit button (). The Script Variable dialog box opens.
3. In the Filters list, select the filter that you want to delete.
4. Click the Delete button (). The category is removed from the list.

13.2.4. Specifying the Task Menu Location

Scripted tasks get added to the Task menu, unless you specify that they not be shown (by clearing the Show Task on Task Menu check box). The default location is the top level of the menu. However, you will probably want to organize your tasks using the submenus provided by VR-Forces or in newly created submenus. The New Scripted Task dialog box displays the menu under which the scripted task is placed. It does not show the full path from the top level menu.

Reactive tasks do not get placed on the Task menu and do not have this option on the the New Scripted Task dialog box.

To specify a Task menu location for a scripted task:

1. Click the Edit button (). The Select Location on Task Menu dialog box opens (Figure 13-1).

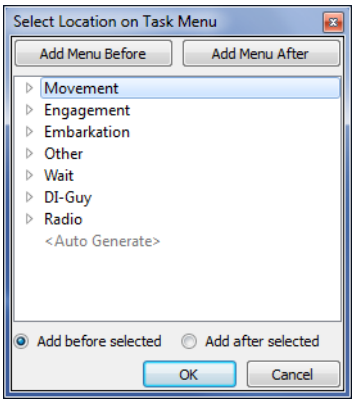


Figure 13-4. Select Location on Task Menu dialog box

2. To add the scripted task to an existing submenu:
   a. Expand the submenu on which you want to put the task.
   b. Select the task that you want the new task to be next to.
   c. To put the new task above the selected menu item, select the Add Item Before Selected option. To put the new task below the selected menu item, select the Add Item After Selected option.
   d. Click OK.
3. To create a new submenu for the scripted task:
   a. Select the submenu next to where you want to add the new submenu.
   b. To add the new menu before the selected submenu, click Add Menu Before. To add the new menu after the selected submenu, click Add Menu After. The New Menu Name dialog box opens.
   c. Type a name for the new submenu.
   d. Click OK.
   e. Add the scripted task to the new submenu using the procedure in step 2.

13.2.5. Specifying Action Categories

Some VR-Forces tasks can run at the same time as other tasks, while some are mutually exclusive. This is called task concurrency. (For details about concurrent tasks, please see "Concurrent Task Execution," on page 6-4.) The tasks provided with VR-Forces are organized in groups to help manage concurrency. In the New Scripted Task dialog box, these groups are represented as action categories.

When you create or edit a scripted task you can specify which groups of tasks the new task can run concurrently with and which it will interrupt. By default, the Movement category is selected, which means that if you do not change the setting, the new task will interrupt movement tasks.

➤ To specify which tasks a scripted task will interrupt, in the Action Categories list, select the categories to interrupt. For example, if the new task involves movement, you probably want it to interrupt other movement tasks, so you would select the Movement category check box. If it is a new type of message task, you probably want to let it run concurrently with movement tasks, so you would clear the Movement category check box.

13.2.6. Configuring a Script's Availability

Scripted tasks can be available to an entity based on the following criteria:

- The task implements a system. (For example, the Naval Mine Sweep task is available to entities with a Naval Mine Sweep system. This state is not shown in the Edit Scripted Task dialog box.)
- The task is available for certain entity types.
- The task is part of a Behavior Set.

Availability by entity type and by Behavior Set is configured in the New Scripted Task and Edit Scripted Task dialog boxes. Table 13-2 shows the interaction of these settings.

Table 13-2: Scripted task availability

Available by Entity Type	Available by Behavior Set	Availability
☑	☐	The script is available only to those entity types listed.
☐	☑	The script is available to all entities, but only if one of the selected Behavior Sets is applied to the entity's force.
☑	☑	The script is available to the specified entity types, but only if one of the selected Behavior Sets is applied to the entity's force.

Specifying the Valid Entity Types for a Task

You can restrict a scripted task to specific entity types. If you do this, the task will not appear on the Task menu when you select an entity for which it is not valid. Just as with built-in VR-Forces tasks, there are cases, such as for global plans, where VR-Forces cannot determine the entity context and the task will be available on the Task menu even though it is not appropriate to the entity that you are tasking. In those cases it is up to you to know that a task is valid.

To specify the valid entity types for a scripted task:

1. Select the Make Available Based on Entity Type check box.
2. Click the Add button () on the Valid for Entity Types line. The Entity Type dialog box opens (Figure 13-5). You can build an entity type enumeration by selecting options from the enumeration field lists or you can type in the enumeration directly.

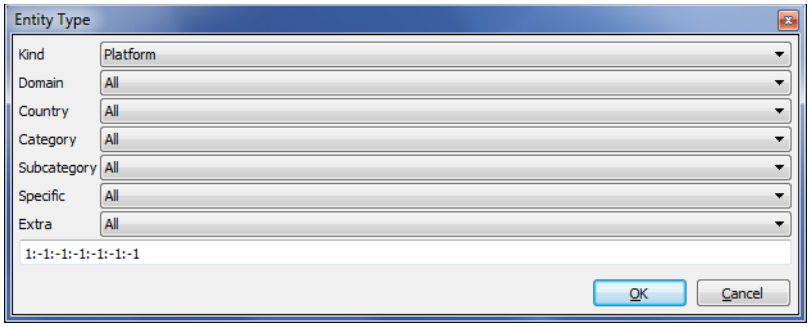


Figure 13-5. Entity Type dialog box

3. For each field of the entity type (Kind, Domain, Country, and so on), select an option from the list.

   The options are drawn from the DIS Enumerations document. As you select an option, the enumeration at the bottom of the dialog box changes to reflect your choice. You do not have to make a selection for each field. VR-Forces uses wild carding to match entities against the final enumeration.

4. If appropriate, add additional enumerations for each entity type that is valid for the scripted task.

Specifying Availability by Behavior Set

You can restrict a scripted task to specific Behavior Sets. If you do this, the task will not appear on the Task menu when you select an entity whose force does not have the Behavior Set assigned to it.

To specify that a scripted task is available by Behavior Set:

1. Select the Make Available Based on Behavior Set check box.
2. Select each Behavior Set for which you want this scripted task to be available.

You must create the Behavior Sets before you can assign scripts to them. All available Behavior Sets are automatically listed in the dialog box window.

13.2.7. Specifying the Programming Language for a Scripted Task

The Language list in the New Scripted Task dialog box has two options, Lua and C++. In most cases you will choose Lua and write a script to implement the scripted task. However, since the scripted task interface automatically generates task dialog boxes and updates the Task menu, it can be a convenient way to add the GUI component for new tasks that developers have written in C++ with the VR-Forces Toolkit. Developers who take this approach do not have to rebuild the VR-Forces front-end or write a plug-in to add their new task to the menu and code a task dialog box.

If a developer adds a new C++ task controller using this approach, it looks for the script ID of the scripted task. The Move (On Roads) tasks use the scripted task interface to create their dialog boxes. The addTask example in the VR-Forces Toolkit demonstrates this method of adding tasks. For more information, please see *VR-Forces Developers Guide*.

You can display C++ tasks in the Scripted Tasks dialog box by selecting the Show C++ Tasks check box (Figure 13-6).

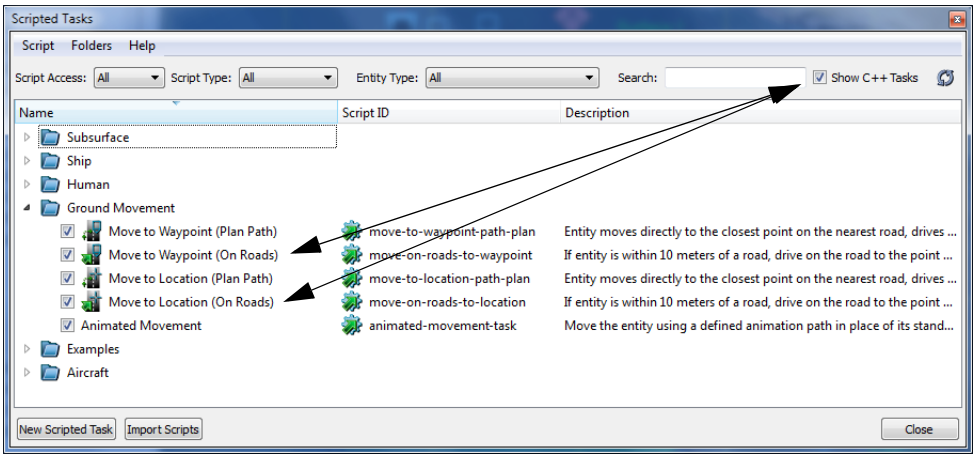


Figure 13-6. C++ tasks

13.2.8. Creating Reactive Tasks

The process for creating a reactive task is largely the same as for creating other scripted tasks. This procedure focuses on the differences.

To create a reactive task:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks dialog box opens (Figure 13-1).
2. If you have a folder hierarchy and want to create the script in a particular folder, select the folder. (For more information, please see "Organizing Scripted Tasks into Folders," on page 13-22.)
3. Choose **Script** → **New Scripted Task**. The New Scripted Task dialog box opens (Figure 13-2).
4. In Script Type list, select Reactive Task. The New Scripted Task dialog box redisplays to show the meta data fields for a reactive task (Figure 13-7).

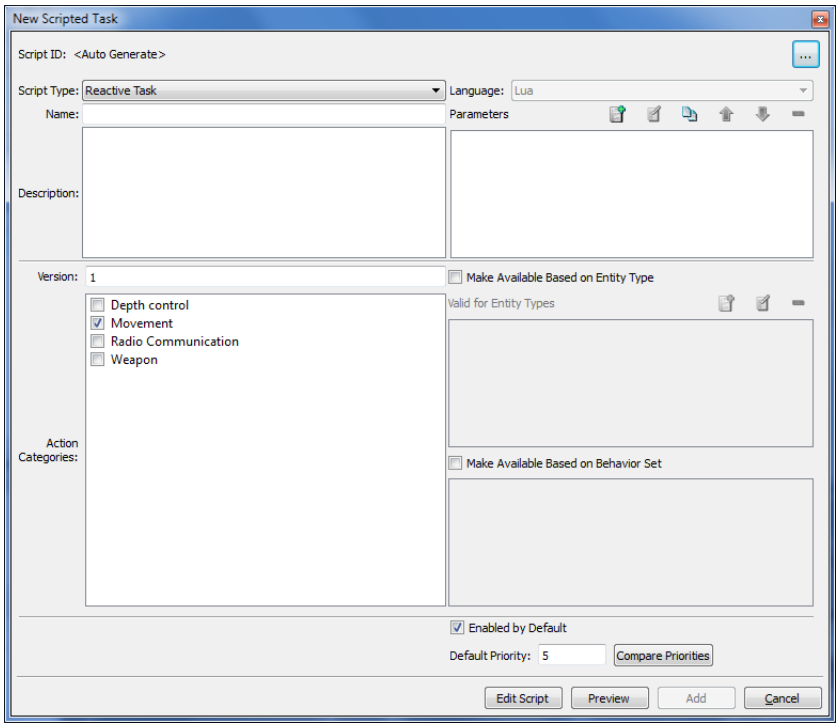


Figure 13-7. New Scripted Task dialog box, reactive task

5. Complete the fields in the dialog box. Fields that are common to all scripted tasks are described in Table 13-1.
6. To make this reactive task enabled by default, select the Enabled By Default check box.

7. In the Default Priority box, type the priority for this task. The lower the number, the higher the priority. To help you set the priority, you can view a list of all reactive tasks that are valid for the entity types of this task so that you can consider their relative importance and set an appropriate priority.
8. Optionally, click Compare Priorities to see a list of reactive tasks and their priorities.
9. Click Add.

13.3. Saving Scripted Tasks

When you create or edit a scripted task, its listing in the Scripted Tasks window is in italics, prefaced by an asterisk. When you save the scenario, or promote a scripted task to a system script, the scripted task gets saved and the italics and asterisk get removed.

It is likely that you will test scripted tasks by running a scenario and you will want to edit the scripted task as you find problems. If you create or edit a scripted task while a scenario is running and you decide to rewind the scenario without saving it (which would be normal behavior for rewinding a scenario), you are prompted to preserve the changes to the scripted task after the scenario rewinds. The scripted task is still not saved and you will, therefore, receive the standard "scenario modified" prompt when you start the scenario again. You do not have to save the scenario if the only thing that changed is the scripted task. You can continue to run the scenario and rewind while you are working on the scripted task. Eventually you will have to save the scenario if you want to save your changes to the scripted task.

13.4. Editing a Scripted Task

You can edit scripted tasks.

! If you edit a system scripted task, the changes will affect all scenarios that use the scripted task. You are responsible for ensuring that any changes have the intended results for all scenarios that are affected.

To edit the meta data for a scenario script:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Select the scripted task that you want to edit.

---

i In the Script ID column the icon indicates the type of scripted task, Task () or Reactive Task ().

---

3. Choose **Script** → **Scripted Task**, or double-click the script name. The Edit Scripted Task dialog box opens. (If you are editing a system scripted task, you are prompted to confirm that you want to edit it.)
4. Edit the meta data as desired.
5. Click Update.

13.5. Filtering the List of Scripted Tasks

You can filter the tasks listed in the Scripted Tasks dialog box by selecting options from the lists below the menu bar, as follows:

- Script Access: Show system scripts, scenario scripts, or all scripts.
- Script Type: Show scripted tasks, reactive tasks, or all scripted tasks.
- Entity Type: Show scripts that apply to the selected entity type.

---

i This filter is based on the Valid for Entity Types list for each scripted task. Some scripted tasks do not have any entity types listed. These tasks, such as Drop Naval Depth Charge, become available to entities based on the systems that they have configured. Therefore, this list may be somewhat misleading in terms of the overall applicability of scripted tasks to the different platforms.

- Show C++ Tasks: Toggles the display of tasks that are written in C++, but whose GUIs are created using the scripted task mechanism.

13.6. Organizing Scripted Tasks into Folders

You can create folders and organize scripted tasks by folder.

13.6.1. Adding a Folder

To add a folder:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Choose **Folders** → **Add Folder**. The Folder Name dialog box opens.
3. Type a name for the folder.
4. Click OK.

13.6.2. Renaming a Folder

To rename a folder:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Select the folder that you want to rename.
3. Choose **Folders** → **Rename Folder**. The Folder Name dialog box opens.
4. Type a new name for the folder.
5. Click OK.

13.6.3. Deleting a Folder

You cannot delete a folder that has scripts in it.

To delete a folder:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Select the folder that you want to delete.
3. Choose **Folders** → **Delete Folder**.

13.6.4. Adding Scripted Tasks to a Folder

➤ To add a scripted task to a folder, drag it onto the folder.

13.6.5. Removing a Scripted Task from a Folder

➤ To remove a scripted task from a folder, drag away from the folder.

13.7. Exporting and Importing Scripted Tasks

Scenario scripts are saved in a scenario's SPT file, not as individual scripts. If you want to make a scenario script available to other scenarios, but you do not want to save it as a system script, you can export the script from the scenario in which you created it and import it into any other scenario. You can export multiple scripts to one file as a script "package".

You cannot add or remove scripted tasks from a script package. To change the contents you would have to create a new package.

If scripted tasks are organized in folders, when you save them the folder structure is also saved.

To export scripted tasks:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Select the scripts that you want to export. (The window supports typical methods for selecting multiple entries in a list.)
3. Choose **Script** → **Export Script Package**. The Choose Script File dialog box opens. By default it opens in *./userData/taskScripts*.
4. Type a name for the scripts file.
5. Click Save. The scripts gets saved to a file with the extension *.spt*. The file contains the meta data and the script code.

13.7.1. Importing a Scripted Task Package

If you import a script package that has multiple scripted tasks, you can choose which scripted tasks to import. Scripts get imported with the folder hierarchy that they were saved in.

To import scenario scripted tasks:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Choose **Script** → **Import Script Package** or click Import Scripts. The Choose Script File dialog box opens.
3. Select the script file that you want to import.
4. Click Open. The Import dialog box opens (Figure 13-8). It lists the scripted tasks saved in the script file.

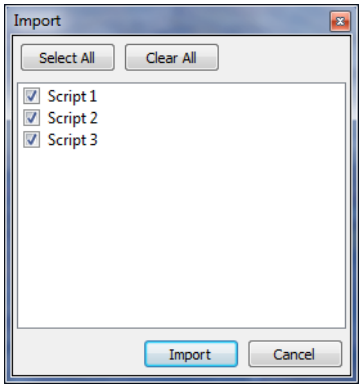


Figure 13-8. Import dialog box

5. Select the scripted tasks that you want to import.
6. Click Import.

13.8. Copying a Scripted Task

If you want to create a new script that is similar to an existing one, you can copy an existing script and then edit it for its new purpose.

To copy a scenario scripted task:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Select the scripted task that you want to copy.
3. Choose **Script** → **Duplicate**. The New Scripted Task dialog box opens. If you copied a scenario scripted task, the duplicate script is assigned a new script ID. If you copied a system script, the script ID is not changed. You will have to change the script ID manually.

If you do not change the script ID for a copied system scripted task, the system scripted task gets removed from the list of scripted tasks for this scenario and the new scripted task is added as a scenario scripted task. This lets you experiment with changes to a system scripted task without actually changing it. The original system scripted task will still be available to other scenarios.

4. Edit the script.
5. Click Duplicate. The script is added to the list.

13.9. Deleting a Scripted Task

If you delete a scripted task that is assigned to an entity in the scenario, the task assignment, whether as an independent task or as part of a plan, will fail. If the scripted task is used as a subtask in another scripted task, that scripted task will fail. VR-Forces does not warn you if either of these cases exist. It is your responsibility to consider the effects of deleting a scripted task.

To delete a scripted task:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Select the scripted task that you want to delete.
3. Choose **Script** → **Delete Scripted Task**.

13.10. Creating a System Scripted Task

To create a system scripted task, you create a scenario scripted task and then save it as a system scripted task. System scripted tasks are saved in *./data/simulationModelSet/<model_set>/scripts*. A system scripted task has two files. The meta data is saved in a file ending with the extension *.xml*. The code is saved in a file with the extension *.lua*.

To save a scenario scripted task as a system scripted task:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Select the scripted task that you want to save as a system scripted task.
3. Choose **Script** → **Promote to System Scripted Task**. You are prompted to confirm the change.
4. Click Yes.

13.10.1. Including System Scripted Tasks on the Task Menu

The system scripted tasks included with VR-Forces are all listed on the Task menu, except the scripted tasks in the Examples folder. However, you can specify that particular scripted tasks not be listed. You might want to do this to reduce clutter on the Task menu. Or you might want to limit the tasks available to players in a particular deployment of VR-Forces.

A system scripted task's inclusion on the Task menu is controlled by the following settings:

- The Show Scripted Task on Task Menu check box on the New Scripted Task and Edited Scripted Task dialog boxes.
- The check box next to the scripted tasks entry on the Scripted Tasks dialog box (Figure 13-9).
- Its membership in a behavior set. The effect of behavior sets on task availability is additive to the configuration discussed in this section. For details about using behavior sets, please see "Using Behavior Sets to Manage Scripted Tasks," on page 6-16.

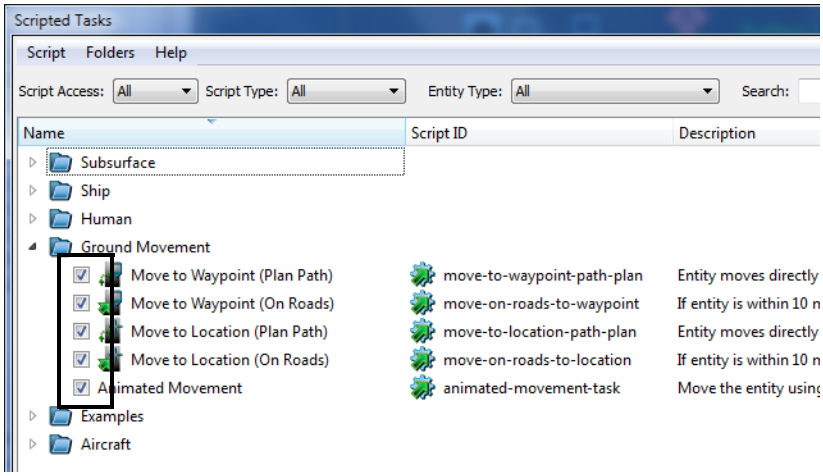


Figure 13-9. Show scripted task on Task menu check box

Table 13-3 shows when a scripted task is listed on the Task menu based on the configuration check boxes selected.

Table 13-3: System scripted task inclusion on Task menu

Show Scripted Task on Task Menu check box	System scripted task list check box	Task included on Task menu
☑	☑	Yes
☑	☐	No
☐	☑	Yes, for this scenario.
☐	☐	No

To specify the availability of a system scripted task on the Task menu:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. In the list of system scripted tasks, select the scripted task whose availability you want to change. Use Table 13-3 to determine which check box configuration you need for your desired Task menu status.
3. Choose **Script** → **Scripted Task**. The System Script Editing prompt opens. (If you have disabled this prompt, the Edit Scripted Task dialog box opens. Skip to step 5.)
4. In the System Script Editing prompt, click Yes. The Edit Scripted Task dialog box opens.
5. Select or clear the Show Scripted Task on Task Menu check box.
6. Click Update.

7. In the list of scripted tasks, select the check box next to the system scripted task you are editing to make it available. Clear the check box to make it unavailable.

13.11. Specifying a Script Editor

VR-Forces installs SciTE as the default script editor for scripted tasks. However, you can use any text editor that you want.

To specify the editor to use for scripts:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Scripted Task Options page (Figure 13-10).

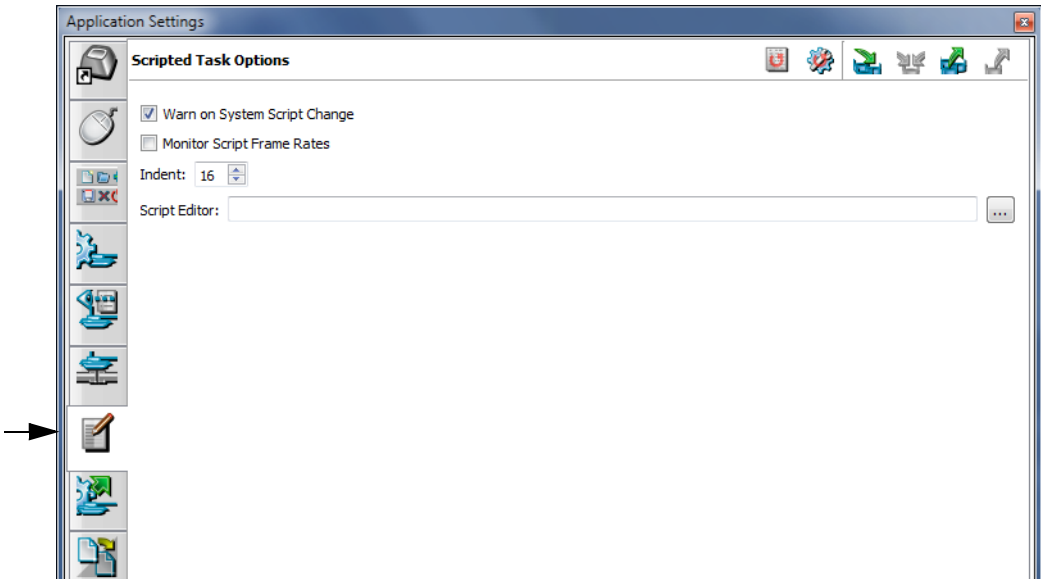


Figure 13-10. Scripted Task Option page

3. Click the Browse button (...) next to the Script Editor box. The Choose Script Editor dialog box opens.
4. Select the application that you want to use as the editor.
5. Click Open.

13.12. Editing Lua Files

To edit the scripts for scenario scripted tasks you need to work through the Scripted task GUI because the scripts are embedded in the scenario scripts file rather than being saved as individual Lua files. System scripts are saved as Lua files, but even in this case it is better to edit them in the context of the entire scripted task rather than by editing the Lua file. However, VR-Forces includes some libraries of Lua functions that are independent of any of the scripted tasks. They are available to be included in your scripted tasks. If you want to edit the functions in these libraries or add to them, you need to edit the individual Lua files. The function libraries are in *./userData/scripts*. You can open them in any editor, or access them through the Scripted Tasks dialog box.

To edit a Lua file from the Scripted Task dialog box:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks window opens (Figure 13-1).
2. Choose **Script** → **Edit External Script**. A file chooser dialog box opens.
3. Select the script that you want to edit. The file opens in a text editor.
4. Edit the file.
5. Save the file.

14

Writing Scripts for Scripted Tasks

This chapter explains how to write Lua scripts for scripted tasks.

14.1. The VR-Forces Lua Interface

The VR-Forces Lua interface provides a number of pre-defined elements that you can use to create scripts. These elements include object classes that represent the simulation, simulated objects, and geometric objects, plus Lua modules that provide tools for common tasks.

The classes and functions in the Lua interface are documented in the VR-Forces Lua API Documentation. This is a set of HTML files similar to the VR-Forces Toolkit documentation. It is accessible from the Windows Start menu or in *./doc/luadoc/index.html*.

14.1.1. Lua Classes

The Lua interface defines classes for common objects and functions. The classes in the interface are not fully featured classes as in the C++ language, but they do abstract the representation of information associated with an object and collect a set of methods related to the object. In Lua, to call a method `fn` on object `obj`, write:

```
obj:fn()
```

Several of the classes defined in the interface do not have constructors, because their objects are pre-defined or created only as return values to other functions. The classes and pre-defined objects in the interface are as follows:

- *vrf*. *vrf* is defined as a global object for all Lua scripts. It is an instance of a class that represents the Lua interface; other instances cannot be created in a script. The *vrf* object provides functions that control and access information in the VR-Forces simulation.
- *SimObject*. *SimObject* is a class that represents simulation objects in VR-Forces. There is no constructor for SimObjects in the interface, but there are *vrf* functions that create objects, that get objects by name, that get nearby objects, and so on. *SimObject* methods are provided for getting information about the object such as location, force type, and embarkation status.
- *this*. *this* is an object of class *SimObject* that is defined for all Lua scripts. It represents the entity running the script, also known as "ownship". It is not possible to construct a *this* object in a script. In addition to being able to use all of the *SimObject* methods, a Lua script can change the location and heading of *this*, manipulate its resources, and examine the contacts detected by the entity's sensors.
- *Location3D*, *Vector3D*, *VectorGeoc3D*, *VectorOffset3D*. These classes represent geometric objects. For more information, please see "Geometry," on page 14-15.
- *FeatureSet*. This class represents a set of features obtained from a query to the terrain database. A *FeatureSet* is created with a *vrf* query function. *FeatureSet* methods allow a script to examine the features to determine their attribute values, vertex locations, and so on.

In Lua, variables assigned to objects actually just hold a reference to an object, so that if one variable is assigned to another they will both hold a reference to the same object. In the following example, `firstObj` and `secondObj` refer to the same object.

```
firstObj = getObjectByName("APC 1")
secondObj = firstObj
```

In most cases this is what a Lua programmer wants. However, for the geometric objects, a Lua programmer may sometimes want to make a copy of an object. A simple assignment does not make a copy in Lua, so the geometric objects have makeCopy() methods to provide copies.

14.1.2. Lua Modules

The Lua interface includes Lua modules for use in Lua scripts. A module `stuff` can be accessed in a Lua script by writing

```
require "stuff"
```

The modules available in the interface are as follows:

- *vrfutil*. Technically, *vrfutil* is not a Lua module. (It is not defined with a module function.) It is just a set of global utility functions. The Lua script template that opens when a new script is created contains:

  ```
  require "vrfutil"
  ```

  so that these functions are available to the script by default.

- *fsm*. The *fsm* module defines a class that implements finite state machine logic. There is one function in this module, new(), which creates an *fsm* object.
- exectool. The *exectool* module is a package of functions that supports the use of a single Lua function to describe the control flow of a scripted task. To use this tool, the task logic is described in a function we call a scriptFunction. This function is written as if it will execute up to a subtask invocation, and then wait until that subtask is completed before continuing.

The *.lua* module files are located in *./userData/scripts*. You can add user-created modules to this directory and then import them into scripts with a `require` statement.

14.2. Script Loading and Execution

This section describes script entry point functions and the execution sequence for scripted tasks. It also describes how VR-Forces checkpoints scripted tasks and executes them when a checkpointed scenario is run.

14.2.1. Script Entry Points

The Lua API includes functions that we call "entry points" to a scripted task. When you create a new script, they are included in the default script template. Unlike the Lua functions that you might write as part of a script, you do not have to call entry point functions from within the script. They are called by the simulation engine. (However, if an entry point function is not defined in a script, it does not get called.)

- init(). Use init() to set up the initial state of your scripted task's environment. The init() function is the first function called when a scripted task is executed. It is called when a task is assigned to an entity, even if the scenario is paused. It is never called again for the life of the scripted task.
- tick(). The tick() function is the heart of every scripted task. It is called at every tick of the simulation engine once the entity has completed its initialization. Most of a scripted task's logic should be written into the tick() function as it is the only entry point function consistently called in the script.
- suspend(). The suspend() function gets executed when a reactive task is triggered for an entity and the reactive task cannot run concurrently with the current task. The typical behavior, as embodied in the scripted task template, is to stop all tasks and subtasks.
- resume(). The resume() function gets executed when a reactive task completes. The typical behavior is to reinitialize the suspended task.

As you can see from their descriptions, the suspend() and resume() functions do not exactly suspend and resume tasks as those terms are commonly understood. In most cases (this is task dependent), VR-Forces does not preserve the state of an entity's tasks when they are suspended, it stops the tasks. Nor does it resume the previous task from the point at which it was suspended, it restarts the task from the current state of the entity. However, VR-Forces always saves the lua state of scripted tasks, so when a scripted task resumes, its variables may need to be reset in init() or checkInit().

- saveState(). If a script is running, the saveState() function is called just before a scenario is about to be saved. VR-Forces automatically saves the state of script execution. (For details, please see "Limitations for Checkpointing Scripted Tasks," on page 14-9.) This function lets you do any additional processing to save the state of your scripted task. Most scripts do not use this function.
- loadState(). If a script was running when a scenario was saved, the loadState() function is called just after a scenario is loaded or rewound. VR-Forces automatically restores the state of a scripted task that was running when a scenario was saved. This function lets you do any additional processing required to restore the state of the script. If your script uses the saveState() function, you probably want to include complementary processing in loadState(). Most scripts do not use this function.

If your loadState() function assumes the presence of other entities, you must take into account that other entities might not have loaded yet when the function is called.

- shutdown(). The shutdown() function is called when the task is ending for any reason. You will not typically need to write any code in this function, however it is available if there is a case in which you want to do anything before the task ends.
- receiveTextMessage(). The receiveTextMessage() function is called when the entity executing this task receives a text message. The function provides some data to determine what the text message is and which entity the text message came from.

The following script entry points are only used in reactive tasks:

- check(). The check() function defines the condition under which the reactive task gets triggered. It keeps checking the condition until it becomes true, at which point it starts the reactive task.
- checkInit(). The checkInit() function initializes the reactive task when it is enabled. It sets the initial conditions for the check() function. checkInit() runs when a reactive task is first enabled and runs again after the reactive task completes so that it can begin checking the condition again.

14.2.2. The Scripted Task Execution Sequence

A Lua script has several distinct sections, including the entry points described in "Script Entry Points," on page 14-4 and the global commands in the script. When a scripted task is assigned to an entity, the following actions happen, even if the scenario is paused:

1. The script environment is initialized. This step defines the *vrf* and *this* objects and all of the class functions in the Lua API.
2. The script text is loaded. All Lua statements in the global scope are executed. Normally, the script defines (assigns initial values to) global variables here.
3. The init() function is called.

This sequence is followed whenever a scripted task is assigned, including the following situations:

- A scripted task is assigned while the scenario is running.
- An entity has a script assigned at the beginning of a scenario and the scenario is loaded or rewound.
- You modify the script or script metadata while the script is running.

If the simulation is running, after the init() function is called VR-Forces begins calling the tick() function at the period specified by the setTickPeriod() function (default: 0.5 seconds).

Suppose a script "test" contains the following code:

```
print("Global statements")
t = {}
function init()
  print("Init function")
  vrf:setTickPeriod(0.5)
  t[1] = 0
end
function tick()
  table.insert(t, vrf:getExerciseTime())
  print("Tick ", #t)
end
```

If script is assigned to an entity and then the scenario runs for a short time, the console output would be as follows:

```
Global statements
Init function
DtCgfDispatcher::controlScenario: run
Tick 2
Tick 3
Tick 4
DtCgfDispatcher::controlScenario: pause
```

Figure 14-1 illustrates the control flow for a scripted task.

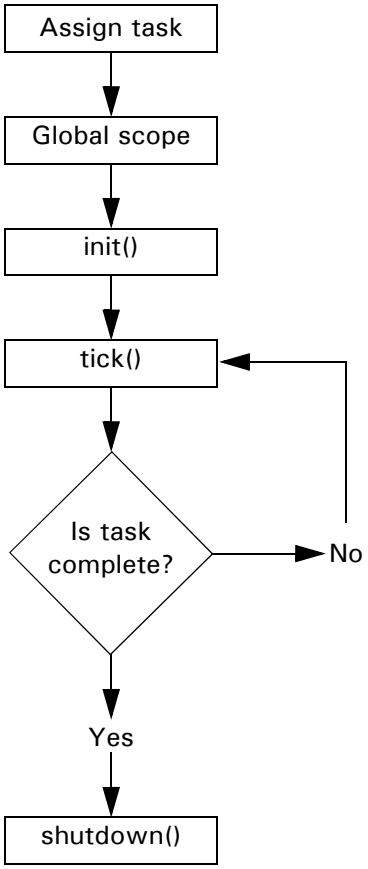


Figure 14-1. Scripted task control flow

The Script Execution Sequence for Reactive Tasks

Figure 14-2 illustrates the script execution sequence for reactive tasks. It is distinguished from that for scripted tasks by the addition of the checking process.

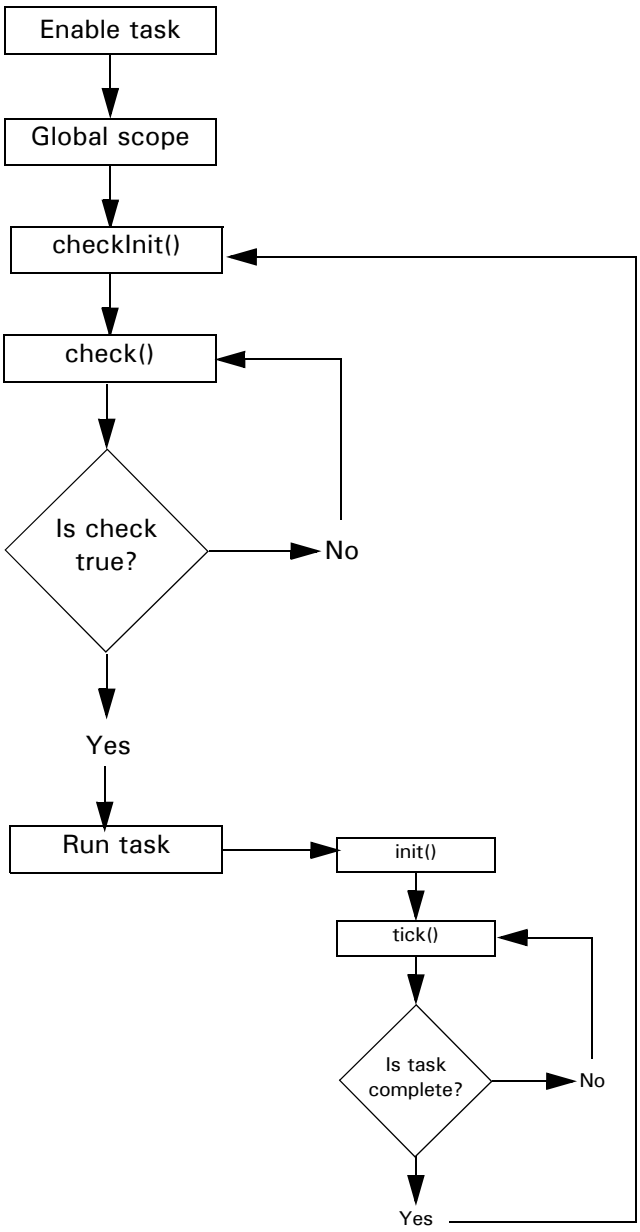


Figure 14-2. Reactive task control flow

The Script Execution Sequence for Saved Scenarios

When a scenario is saved (checkpointed), VR-Forces first runs saveState() and then saves the Lua state in the scenario file. (Checkpointing a scripted task has some limitations. For details, please see "Limitations for Checkpointing Scripted Tasks," on page 14-9. For general details about checkpointing, please see "Saving a Scenario," on page 1-18.) When a saved scenario is loaded, the following steps are taken to restore the scripted task:

1. The script environment is initialized. This step defines the *vrf* and *this* objects and all of the class functions in the Lua API.
2. The script text is loaded. All Lua statements in the global scope are executed. Global variables defined and initialized in this part of the script are re-initialized.
3. VR-Forces restores the values of global variables to the saved values. These values replace the initial values just assigned in step 2.
4. The loadState() function is called.

The init() function is not run when a scenario is reloaded.

Assume that the "test" scripted task described in the previous section is saved at the point shown in the sample code (t = 4). When the scenario is run from the checkpoint, the console output will be as follows:

```
DtCgfDispatcher::controlScenario: run
Tick 5
Tick 6
DtCgfDispatcher::controlScenario: pause
```

14.2.3. Limitations for Checkpointing Scripted Tasks

When VR-Forces saves (or checkpoints) a scenario, it saves the following aspects of the Lua state in the checkpoint:

- The values of global variables that contain strings, numbers, and objects (of the classes listed in "Lua Classes," on page 14-2).
- Tables, but only table values that contain strings, numbers, objects, and tables. Tables cannot contain values that refer to the same table, either directly or indirectly through another table.

The following aspects of the Lua state do not get saved in a checkpoint:

- Variables containing functions or threads.
- Variables declared in the global scope with the keyword `local` preceding the declaration.
- Table entries that do not use numbers or strings as keys.

Lua scripts that contain elements that do not get saved can still be restored after a checkpoint if the global statements in the script reset the elements. For example, a variable containing a function will not be saved in the scenario file, but if this variable is initialized in the global Lua statements, it will be reset when those statements are loaded. However, if the value of this variable was changed during script execution (in the init() or tick() functions), then its value will not be restored correctly.

Tables that reference themselves in the table do not get saved properly.

To demonstrate how scripted tasks get saved, assume the following script:

```
print("Global statements")
a = 0
t = {foo = 0, bar = 1}
f = function () print("hello") end
function init()
  print("Init function")
  vrf:setTickPeriod(0.5)
  a = 100  -- change a
  t.foo= 10 -- change t.foo
  t.bar = nil -- remove t.bar
  f = function () print("world") end -- change f
end
function tick()
  print ("Tick. a = ",a, "t.foo = ", t.foo, "t.bar = ", t.bar)
  f()
  print()
end
```

The output the first time the scripted task runs is as follows:

```
Global statements
Init function
DtCgfDispatcher::controlScenario: run
Tick. a = 100     t.foo = 10      t.bar = nil
world
```

When the scenario is saved and then reloaded, and the simulation is run again, the following is printed:

```
DtCgfDispatcher::controlScenario: run
Tick. a = 100     t.foo = 10      t.bar = 1
hello
```

A comparison of the outputs reveals that variable `a` and table entry `t.foo` were restored to the correct values. However, table entry `t.bar` and function `f` were re-initialized in the global statements, but were not restored to the values they had when the scenario was saved.

14.2.4. Editing Scripted Tasks While a Scenario is Running

You can add, remove, and edit scripted tasks during scenario creation or while a scenario is running. If a scripted task is not being used by any entities, editing or deleting it has no effect on the scenario. If you change a scripted task that is being executed by an entity, when you save the change the scripted task may be stopped, restarted, or continue to execute depending on what has changed.

Table 14-1 lists the effect on scripted tasks and scripted tasks running as subtasks if you edit the code or meta data:

Table 14-1: Side effects of editing scripted tasks

Change to scripted task	Result
Change code or any meta data except the script ID. Entity type is still supported.	The task restarts. Changes to the Action Category take effect when scenario restarts.
Entity types supported changes.	The task stops for entities that no longer support it.
Script ID changes.	The task continues to execute. Any other script that uses this scripted task (as a subtask) will fail until its code is updated to use the new script ID.

If you changed the entity types that can use the scripted task, then it will be added to or removed from the Task menu for the appropriate entity types. (This change takes place immediately.)

14.3. Tasks and Subtasks

The primary way that a scripted task carries out actions is through starting subtasks for the entity running it or sending tasks to other entities. All C++ tasks and other scripted tasks are available for sending as subtasks or tasks.

If a scripted task needs to give a task to the entity that is running it, it does so as a subtask. (The entity's current task is the scripted task itself, so any action that it needs to take is a subtask to the scripted task.) Subtasks are started using the vrf:startSubtask() function.

If a scripted task needs to give a task to an entity other than the one running it, it uses the vrf:sendTask() function.

A startSubtask() or sendTask() function specifies the task name and task parameters, if any. The name must be the name of one of the C++ tasks, as listed in the Task page of the Lua API Documentation, or the script ID of another scripted task.

The task parameters are passed as a Lua table, with parameter names as the indices and the parameter values as the values. The valid parameters for C++ tasks are also listed in the Task page. For scripted tasks, the parameter names are the parameter names defined for that task. You can view them by opening a scripted task in the Edit Scripted Task dialog box. Any parameters that are not specified when starting the task use their default values.

The following example subtask gives a Move To Waypoint task to the entity running the scripted task:

```
vrf:startSubtask("move-to", {destination = "Waypoint 1"})
```

If a task does not have any parameters, startSubtask() must represent the parameters as {}. For example:

```
vrf:startSubtask("wait", {})
```

The following example task sends a Patrol Between Waypoints task to the entity named “someEntity”:

```
vrf:sendTask(someEntity, "patrol-two-points",
  {first_control_point="Waypoint 1", second_control_point="Waypoint 2"})
```

If a task is started with an invalid name or invalid parameters, a runtime error will occur in the script.

Whenever a task or subtask is started, a task ID integer is returned. This task ID is used to monitor or stop the task.

If a task is started on an entity that cannot execute it, the task will enter the Complete (failed) state shortly after the start call is made. This may not happen until a subsequent tick of the scripted task.

14.3.1. Monitoring the Status of Tasks and Subtasks

Once a task is started, the scripted task that started it can monitor it using its task ID. A task can be in one of three states: Running, Complete, or Canceled, as follows:

- Running. The task was started, but has not completed or been canceled.
- Complete (success). The task has completed, and called endTask(true) to end itself.
- Complete (failure):
  - The task has ended itself by calling endTask(false).
  - The task failed to start because the entity was incapable of executing this task.
- Canceled:
  - The task was explicitly canceled using stopTask().
  - The task was replaced by a conflicting task.
  - The user issued a Skip Task.

The success or failure of task completion is defined by the task being executed, and may not be consistent between task types.

Subtasks are monitored with the functions:

- isSubtaskComplete(taskID)
- subtaskResult(taskID)
- isSubtaskRunning(taskID)
- isSubtaskCanceled(taskID).

Tasks are monitored with the functions:

- isTaskComplete(taskID)
- taskResult(taskID)
- isTaskRunning(taskID)
- isTaskCanceled(taskID).

14.3.2. Stopping Tasks

Any task or subtask that has been started from a scripted task can be stopped by that task before it has completed. This is done using stopTask(taskID) or stopSubtask(taskID).

14.3.3. Task Parameters

Task parameters are the parameters that are gathered from the user, or set by a parent task, when a task is started. They are passed into the new task when it starts.

For scripted tasks, the task parameters are available in a Lua table named taskParameters available in the global scope. The table contains items named using the parameter names specified in the parameters section of the Scripted Task dialog box when the task was created. The types of these parameters depend on the parameter types selected by the user in this dialog box. Table 14-2 lists the parameter types you can specify when you create a scripted task and the corresponding Lua types in the taskParameters table.

Table 14-2: Task parameters and Lua types

Parameter Type	Lua Type
Aggregate Formation	String
Altitude MSL	Number (meters)
Bomb Resource	String (resource name)
Boolean	Boolean
Choice (List)	Number (Index of the option chosen)
Choice (Option Button)	Number (Index of option chosen)
DI-Guy Animation	String
DI-Guy Appearance	String
Distance	Number (meters)
Emitter	Number (Index of the emitter system)
Entity Type	String (DIS type enumeration, colon separated)
Force	String
Heading	Number (radians)
Integer	Number
Location (with altitude)	Location3D
Location (without altitude)	Location3D
Munition Resource	String (resource name)
Offset Location	VectorOffset3D
Real	Number
Resource	String (resource name)
Simulation Object (Single)	SimObject
Simulation Objects (Multiple)	Table of SimObjects
Speed	Number (meters / second)
String	String
Time	Number (seconds)
Turn Rate	Number (radians / second)

14.4. Geometry

The Lua interface includes classes representing geometric objects. The classes represent locations and vectors in three dimensional space. Different classes are defined for vectors in different contexts so that functions that manipulate them know what their context is and can convert between contexts automatically. Therefore, a script does not have to, for example, create rotation matrices to perform coordinate transformations between vectors that are in an entity-body context and vectors that are in a world context.

14.4.1. *Location3D*

A *Location3D* represents a point in three-dimensional (3D) space. Scripts can access the three components of the location as latitude, longitude, and altitude. There is no other access to components in any other coordinate system. Methods are available to construct a *Location3D*, to create a vector from the difference between two locations, and to generate a new point by adding a vector to a location.

14.4.2. *Vector3D*

A *Vector3D* is a direction in a north-east-down coordinate system. Scripts can access these three components of a *Vector3D*, or access bearing-inclination-range (Figure 14-4). This is the type of vector that scripts will use most often to find directions between locations, to create new locations relative to other locations, and so on.

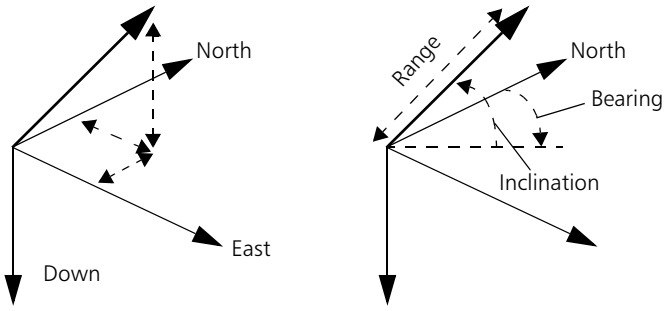


Figure 14-3. Vector3D: North-East-Down, or Bearing-Inclination-Range

When viewed from the perspective of a 3D Cartesian coordinate system that is fixed to the earth, there is no single north-east-down coordinate system. This is because “north” and “east” directions vary depending on where the observer is located on the earth. The *Vector3D* is therefore similar to a vector in topographic coordinates. At higher latitudes, “north” for two different entities may not be the same direction (for example, two planes near the north pole, but at different longitudes, that are both flying “north,” are not on parallel courses).

Figure 14-3 shows two north-east-down coordinate systems with origins at different locations on the earth. The coordinate systems have different orientations with respect to a coordinate system fixed to the earth.

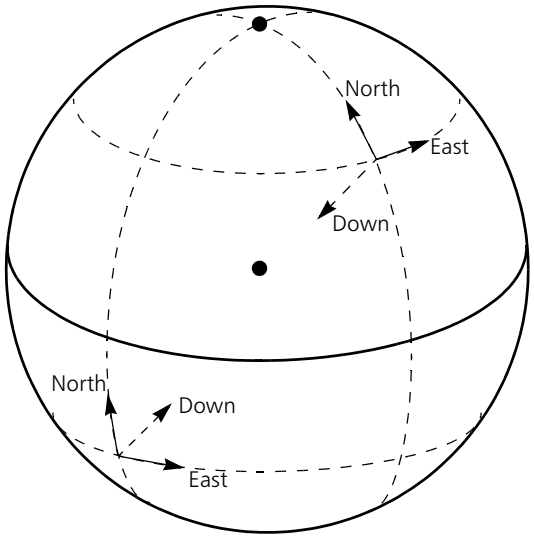


Figure 14-4. Coordinate systems with different origins

A *Vector3D* is not strictly a vector, in that it is not a straight line in a Cartesian coordinate system fixed to the earth. Just as the direction "east" changes (viewed in the Cartesian coordinate system) to follow the curvature of the earth, so does a *Vector3D*. This definition is different from topographic coordinates, which are Cartesian coordinates fixed to a point on the surface of the earth. Implications of this definition include the following:

- The heading of a *Vector3D* from one location to another is the heading of the shortest route around the earth (the great circle route) between the locations. The length is the great circle distance.
- The inclination of a *Vector3D* between two locations with the same altitude is 0.0, even when one location is over the horizon from the other.
- A *Vector3D* with length equal to the circumference of the earth, and inclination 0.0, when added to a location on the surface of the earth will produce a location coincident with the first location.

14.4.3. *VectorOffset3D*

A *VectorOffset3D* is a set of three values that define an offset from some reference direction defined by a *Vector3D*. The three values represent *right-forward-up*, where:

- *forward* is in the same direction as the reference.
- *right* is to the right in a horizontal plane. Horizontal means the plane defined by an inclination of zero; this definition implies that the "roll" component of the reference direction is assumed to be zero.
- *up* is perpendicular to *forward* and *right*, that is, *right* X *forward*.

A *VectorOffset3D* is appropriate to use, for example, to define the offsets of unit formation positions from a central location. Actual formation positions could be generated by transforming the offsets to *Vector3Ds* using the direction vector of the unit, and then adding the *Vector3Ds* to the unit location.

14.4.4. *VectorGeoc3D*

A *VectorGeoc3D* is a vector in a Cartesian coordinate system fixed to the earth (geocentric coordinates). The actual coordinate meanings and values are not accessible to the script, because they are considered to be abstract. A *VectorGeoc3D* can be generated only by taking the difference of two locations, or by transforming a *Vector3D* at a particular location.

A *VectorGeoc3D* between two locations is the line-of-sight vector between the locations. Therefore:

- A *VectorGeoc3D* between two points on opposite sides of the earth, at the same altitude, will go through the earth. (A *Vector3D*, by contrast, will go around the earth parallel to the surface.)
- The angle between two *VectorGeoc3D* vectors corresponding to north for two entities near the north pole will be the difference in their longitudes. (The angle between their *Vector3Ds* for north, by contrast, will be zero.)

The Lua interface does not have any simulation functions that require *VectorGeoc3Ds*. However, they may be manipulated to compute angles and so forth.

14.5. Reserved Words

Table 14-3 lists reserved words (in addition to those reserved by Lua), which should not be used except for their intended purpose.

Table 14-3: Reserved words

Name	Module	Function
vrf	vrf	Module singleton
this	SimObject	Ownship name
ScriptVrfObject	SimObject	Class name
Location3D	Location3D	Class name
Vector3D	Vector3D	Class name
VectorGeoc3D	VectorGeoc3D	Class name
VectorOffset3D	VectorOffset3D	Class name
ScriptFeatureSet	FeatureSet	Class name
vrfprint	vrfutil	Global function
printDebug	vrfutil	Global function
printVerbose	vrfutil	Global function
printInfo	vrfutil	Global function
printWarn	vrfutil	Global function
printError	vrfutil	Global function
EntityType	vrfutil	Global table of functions
bhaveLoaded	vrfutil	Global function
new	fsm	Function name

14.6. Error Detection

The VR-Forces Lua implementation can detect syntax errors and runtime errors.

When you save the script for a scripted task, it is checked for syntax errors. If an error is found, it is reported in an error message. In Figure 14-5, the `if` statement in line 7 is missing the `then` keyword.

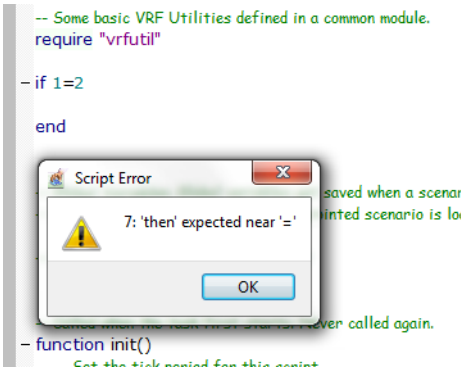


Figure 14-5. Lua syntax error

Detection of a syntax error does not prevent the script from being saved. If you do not fix the error and try to use the scripted task, the back-end will generate an error.

When you run a scripted task, the back-end can detect errors due to incorrect use of user functions and the Lua API functions, such as calling an object that does not exist, or trying to access feature data before it is paged in. When a runtime error is detected, the back-end generates an error message. When the back-end generates an error, the script that caused the error is displayed in bold, red type in the Scripted Tasks dialog box (Figure 14-6). Therefore, you may want to keep the dialog box open while you are testing new or edited scripts.

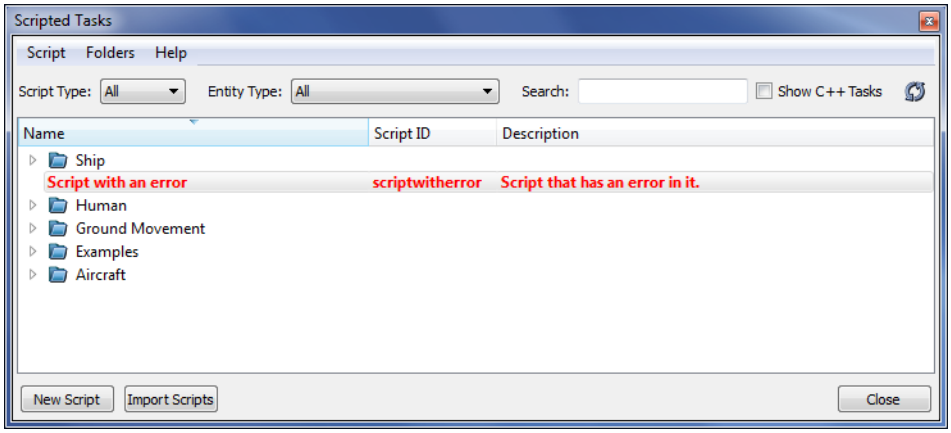


Figure 14-6. Lua error message

To view an error message:

1. In the Scripted Tasks dialog box, select the script that has generated an error.
2. Choose **Script** → **View Script Error**. An error message is displayed.

Script errors are also sent to the console in the Entity Information dialog box.

14.7. A Basic Scripted Task

VR-Forces includes many scripted tasks, all of which can serve as examples of how to write one. The Create and Move to Waypoint scripted task is intended is a basic example that shows you how to:

- Set up meta data.
- Include the VRF Utilities module.
- Initialize a subtask ID.
- Use the init() function.
- Create a waypoint using input from the task's dialog box.
- Send a set data request to an entity, using input from the task's dialog box.
- Use the tick() function.
- Send a subtask and get the subtask ID.
- Check for completion of the task.
- Stop the task.

The Lua code is comprehensively commented. This section supplements the comments.

14.7.1. Create and Move to Waypoint Meta Data

Figure 14-7 shows the meta data for the Create and Move to Waypoint scripted task.

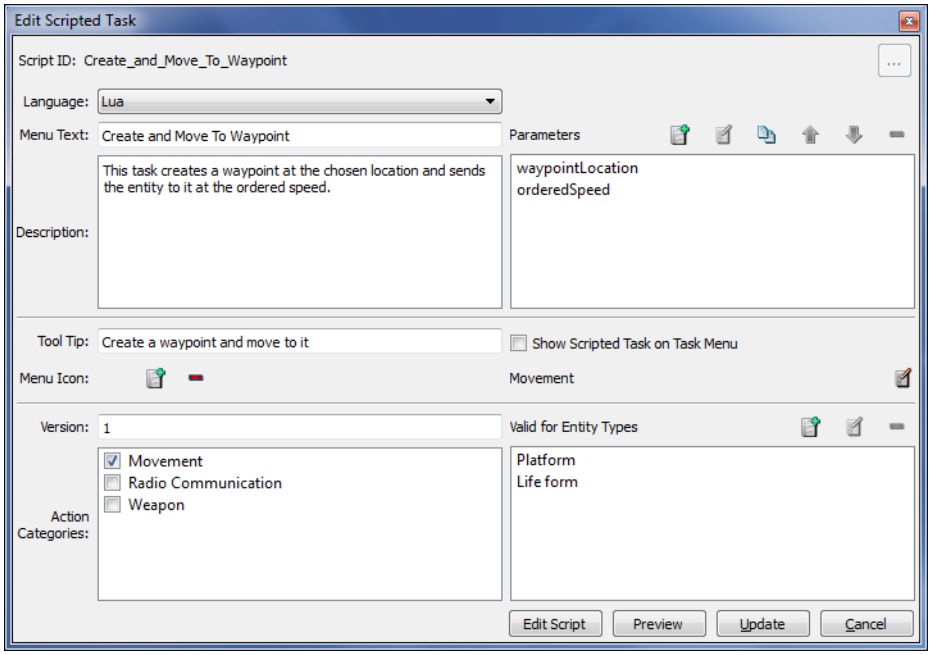


Figure 14-7. Create and Move to Waypoint scripted task

To view the meta data:

1. Choose **Simulation** → **Scripted Tasks**. The Scripted Tasks dialog box opens.
2. Expand the Examples folder (Figure 14-8).

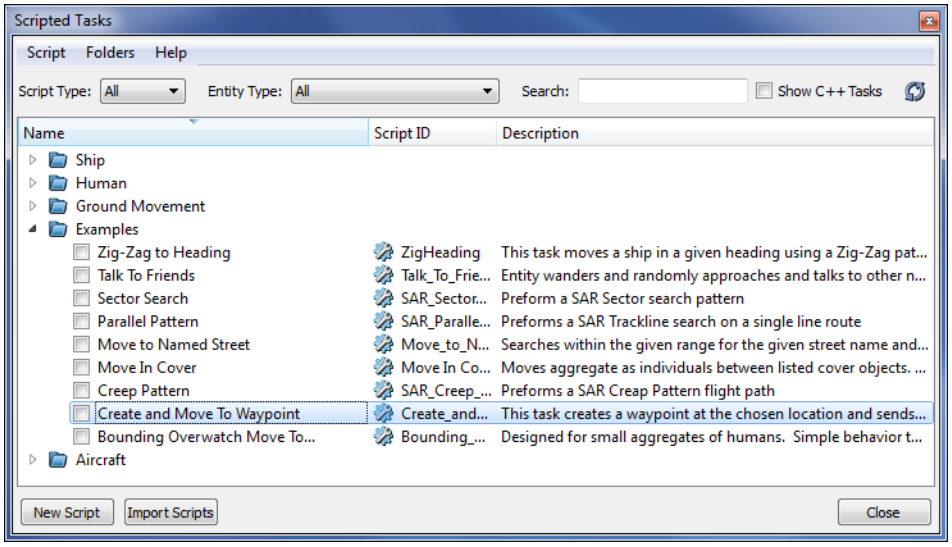


Figure 14-8. Scripted Tasks dialog box

3. Select Create and Move to Waypoint.
4. Choose **Script** → **Scripted Task**. The Edit Scripted Task dialog box opens (Figure 14-7).

Note how the Name column of the Create and Move To Waypoint entry in the Scripted Tasks dialog box matches the Menu Text in the Edit Scripted Task dialog box. The Script ID and Description fields are also drawn from the scripted tasks meta data.

Now let's look at the parameters. This scripted task has two parameters, waypointLocation and orderedSpeed. To see the definition of a parameter, select it and click the Edit button (). Figure 14-9 shows the dialog boxes that specify the parameters.

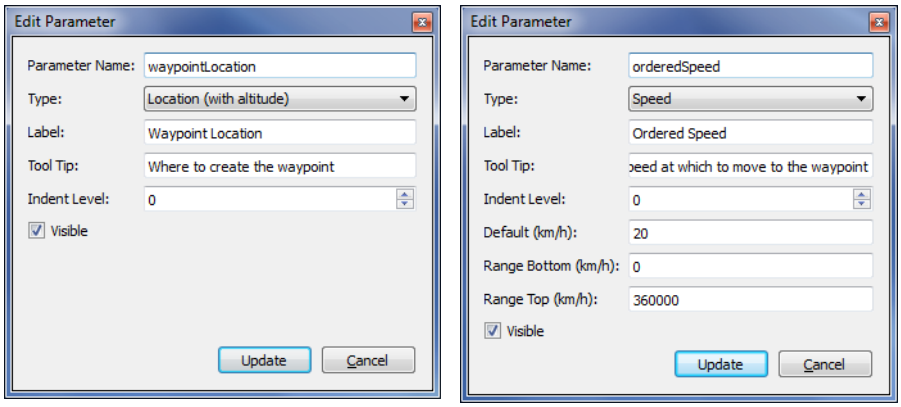


Figure 14-9. Parameter definitions

Figure 14-10 shows the dialog box that is displayed when you assign an entity this task. Note that the description of the task on the dialog box matches the description in the meta data. The parameter labels in the dialog box match the labels specified for the two parameters. The labels are not the same thing as the parameter name. The parameter name is the name used in the Lua script for this scripted task.

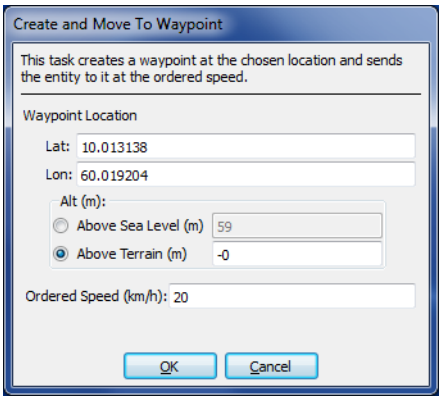


Figure 14-10. Create and Move to Waypoint dialog box

When this scripted task is assigned to an entity, the user will specify the waypoint and the ordered speed. Then the scripted task will be executed. Now we will look at the Lua script to see what happens.

14.7.2. The Create and Move To Waypoint Lua Script

The entire Lua script for this scripted task (without comments) is as follows:

```
require "vrfutil"
moveToWaypointSubtaskId = -1
function init()
  vrf:setTickPeriod(0.5)

  waypoint =
    vrf:createWaypoint({location=taskParameters.waypointLocation,
    force=this:getForceType()})

  vrf:sendSetData(this, "set-speed",
    {speed=taskParameters.orderedSpeed})
end
function tick()
  if moveToWaypointSubtaskId == -1 then
     moveToWaypointSubtaskId = vrf:startSubtask("move-to",
      {control_point=waypoint:getName()})
  end
  if vrf:isSubtaskComplete(moveToWaypointSubtaskId) then
     vrf:endTask(true)
  end
end
function shutdown()
  vrf:deleteObject(waypoint)
end
```

The comments in the script describe the control flow. The essence is that using the input from the task dialog box, the waypoint gets created and the speed gets set in init(). The first time the task is ticked, it sends the Move to Waypoint subtask. Thereafter, each time the task is ticked, it checks to see if the subtask is complete. When the subtask is complete, the task is ended and the waypoint is removed.

The functions in this script are all in the *vrf* class, which is described in "Lua Classes," on page 14-2. The createWaypoint() function takes its location from the waypointLocation parameter that was defined in the scripted task meta data and whose value was provided in the Create and Move To Waypoint dialog box when the task was assigned. Similarly, the ordered speed is set with the sendSetData() function and the value is taken from the orderedSpeed parameter for the task. The script gets the parameter values with the `taskParameters.`*`parameter`* syntax.

This script uses three of the entry point functions – init(), tick(), and shutdown(). If you were to checkpoint the scenario while the script was executing, the standard save actions would take place, but no script-specific actions would be taken, because there is no saveState() function in the script. Similarly, no special action would be taken when the scenario was loaded again because loadState() is not used.

For details about the parameters and return values of the functions, please see the VR-Forces Lua API documentation. Similarly, the tasks and set data requests that you can assign with the startSubtask() and sendSetData() functions are described on the Task and Set pages of the Lua API documentation. You should review the lists of functions to see what you can do in a scripted task.

14.8. A Simple Reactive Task

The difference between a scripted task and a reactive task is the use of the check() and checkInit() functions in the reactive task. The check() function tests a condition at whatever tick rate you specify. If the condition returns true, the task runs.

The simple reactive task in this section monitors the speed of an entity. When it exceeds 15 meters per second, the entity is destroyed. The script works as follows:

1. The checkInit() function sets the tick rate to 1.0 second.
2. In check(), VR-Forces gets the speed of the entity and prints it to the console.
3. It tests to see if the speed is greater than 15 meters per second. If the condition is met, the function returns true.
4. If the function returns true, the script executes init() and begins to tick().
5. In the tick() function, the entity is destroyed and the task is complete. Note that in the executeSetData() function, set-destroy does not have parameters, but the command must include empty braces.

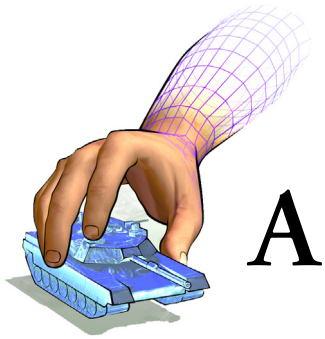
```
function checkInit()
  vrf:setTickPeriod(1.0)
end

function check()
  currentSpeed = this:getSpeed()
  print("speed is:", currentSpeed)
  if currentSpeed > 15 then
    return true
  end

  return false
end

function init()
  vrf:setTickPeriod(0.5)
end

function tick()
  vrf:executeSetData("set-destroy", {})
  vrf:endTask(true)
end
```



A

Example Scenarios

VR-Forces includes several sample scenarios. This appendix explains how to create the breaching scenario and the embarkexample scenario. It assumes some basic knowledge of VR-Forces concepts and the VR-Forces interface, such as how to select objects, how to pan and zoom the terrain, and so on. If you have not yet reviewed the sample tutorial in *VR-Forces Getting Started Guide*, you may want to try that tutorial before trying these example scenarios.

A.1. The Breaching Scenario

This scenario simulates a breaching exercise. In this exercise, four hostile vehicles are arrayed behind a minefield. Three platoons of four tanks each suppress the hostile vehicles, allowing two engineering vehicles to clear the minefield.

Figure A-1 illustrates the order of battle and tactical graphics in the scenario.

Figure A-1. Breaching scenario order of battle

The scenario demonstrates the following features of VR-Forces:

- Creating entities.
- Creating tactical graphics (waypoints, routes, areas).
- Creating a pre-defined aggregate and creating an aggregate from individual entities.
- Creating plans, using:
  - Move To.
  - Follow Entity.
  - Follow Route.
  - Conditions.

The scenario plays out as follows for the Blue force units:

- White Platoon stays in position and fires on hostile forces.
- Red Platoon advances to waypoint red and provides cover for the engineers.
- Blue Platoon advances to waypoint blue and provides cover for the engineers.
- When the hostile forces are destroyed, the engineering entities advance on the minefield to clear it.

The scenario has entities that represent engineering entities, but VR-Forces does not actually have models for engineering entities.

You can view videos that demonstrate this tutorial at *./doc/vrforces_tutorialvideos.htm*.

A.1.1. Create the Scenario

To create the scenario:

1. Start VR-Forces. The VR-Forces window opens.
2. Choose **File** → **New Scenario**. The Select Simulation Database dialog box opens.
3. Select a terrain database. We used the *SanLuisObispo.mtf* database.
4. Click Open. The New Scenario dialog box opens.
5. Type a name in the Scenario Name box, such as myBreachingScenario. Accept all of the default values for the scenario parameters.
6. Click OK. The San Luis Obispo database is displayed. This database covers a portion of California, U.S.A.

Save the Scenario

Save the scenario periodically as you work on it.

To save the scenario:

1. Choose **File** → **Save Scenario**. The Save Scenario dialog box opens. By default, the name you gave to the scenario when you created it is automatically entered.
2. Click the New Folder button. A new folder is added to the window.
3. Type a name for the new folder, such as myBreaching.
4. Select the folder.
5. Accept the default name or type a name of your choice.
6. Click OK.

A.1.2. Create the Minefield

We will create the minefield first, since it becomes a good reference around which to create the entities and other objects.

To create the minefield:

1. Zoom in on a relatively flat portion of the terrain. This is to minimize the impact of hilly terrain and intervisibility issues on how the simulation runs. For this scenario, we used an area just to the northeast of the center of the terrain (Figure A-2).

Figure A-2. San Luis Obispo terrain

2. Click the Tactical Graphics tab on the right side of the window. The Tactical Graphics Palette opens.
3. In the Categories list, select Engineering.
4. In the list of tactical graphics, select Minefield. The Create Minefield tab gets added to the window and the cursor changes to a vertex marker.
5. Click the Create Minefield tab. The Create Minefield dialog box opens (Figure A-3).
6. In the Name box, type Minefield.

7. Draw an oblong area to define a minefield (Figure A-3). Click to define the first three vertices. Right-click to define the last vertex.

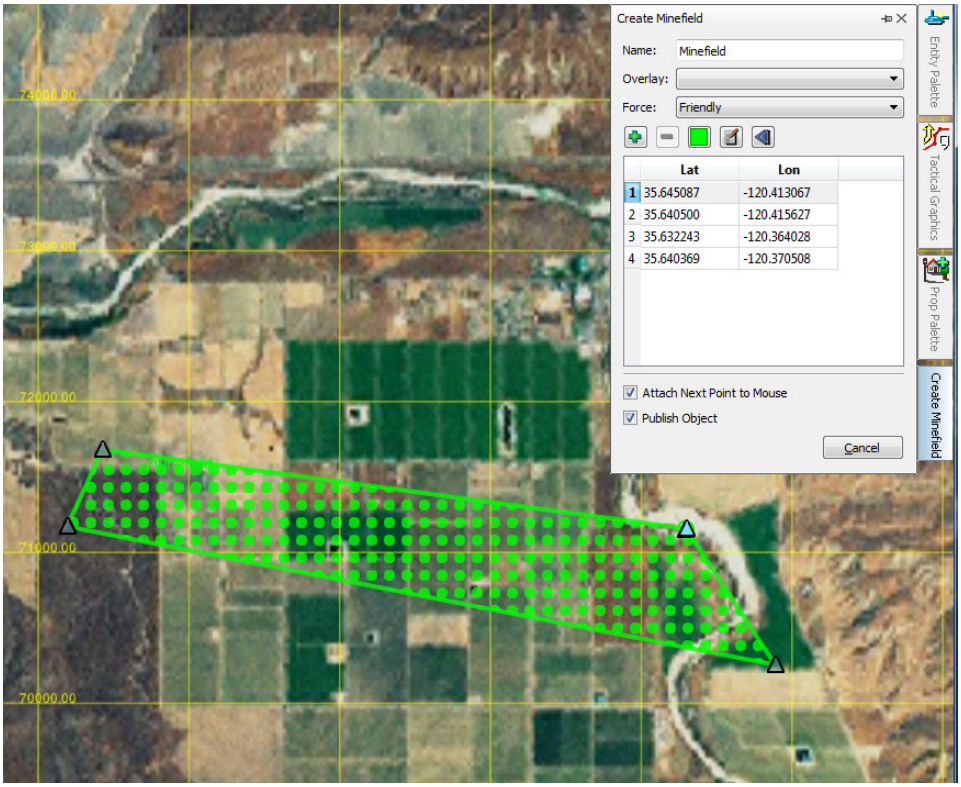


Figure A-3. Create the minefield

A.1.3. Create the Opposing Forces

Now that we have the minefield as a reference point, we can create the hostile entities.

To create the opposing forces:

1. Click the Entity Palette (on the right margin of the window).
2. In the Category list, select Ground.
3. In the Force list, select Opposing.
4. In the list of entities, select T-80 Main Battle Tank.
5. Click on the map north of the minefield four times, as indicated in Figure A-1, to place the T-80s.
6. Right-click to exit create mode.

Aggregate the Opposing Forces

We will want to test for when all of the opposing forces are destroyed. This will be easier to do if they are in an aggregate.

To aggregate the opposing forces:

1. Select the four T-80 tanks.
2. Choose **Entities** → **Aggregates As**. The Aggregate As dialog box opens (Figure A-4).

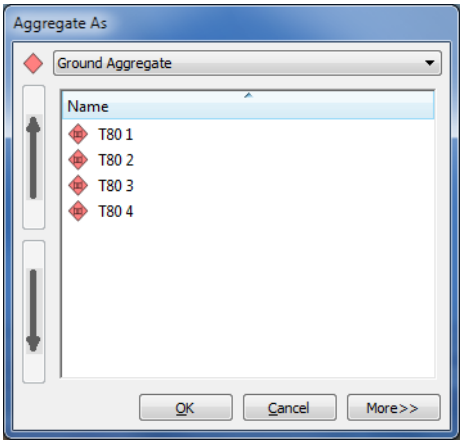


Figure A-4. Aggregate As dialog box

3. In the list, select Ground Aggregate.
4. Click OK. The tanks are aggregated into a platoon.
5. In the Echelon View tab on the Object tab, expand the aggregate (Figure A-5).

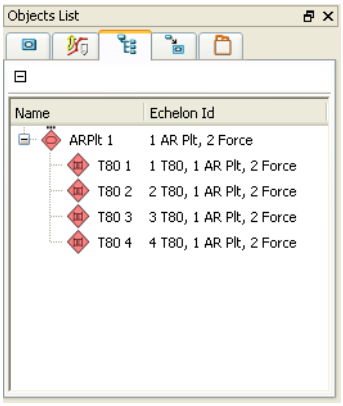


Figure A-5. Echelon View

A.1.4. Create the Tactical Graphics

We need to create two waypoints and a route for the Blue Force.

Create the Waypoints

To create the waypoints:

1. Click the Tactical Graphics Palette (on the right margin of the window).
2. In the Category list, select Control Objects.
3. In the list of control objects, select Waypoint. The Create Waypoint tab is added to the window.
4. Click the Create Waypoint tab. The Create Waypoint dialog box opens.
5. Type a name for the waypoint, such as Red.
6. Using Figure A-1 as a guide, click on the map where you want to place the waypoint for Red platoon.
7. In the Create Waypoint dialog box, type a name for the second waypoint, such as Blue.
8. Click on the terrain where you want to place the waypoint.
9. Right-click to exit draw mode.

Create the Route

The route will guide the engineers as they swing past the Red Platoon and move to the minefield. The route is shown as Breach route in Figure A-1.

To create the route:

1. Click the Tactical Graphics Palette.
2. In the list of control objects, select Route. The Create Route tab is added to the window.
3. Click the Create Route tab. The Create Route dialog box opens.
4. Type a name for the route, such as “Breach route”.
5. Click on a point just east of waypoint Red.
6. Move the mouse cursor to the edge of the minefield.
7. Right-click to place the end point in the route.
8. Save the scenario.

At this point, the scenario should look something like Figure A-6.

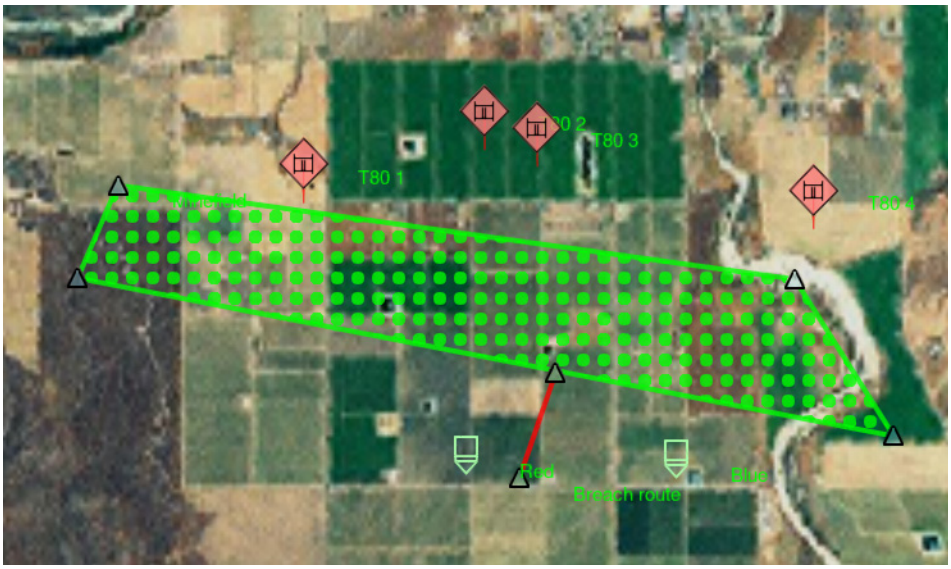


Figure A-6. Breaching scenario progress

A.1.5. Create the Friendly Entities

Using Figure A-1 as a guide to location, create the friendly entities. We will create one platoon from individual entities, and the other two using pre-configured platoons.

To create the friendly entities:

1. Click the Entity Palette.
2. In the Categories list, select Aggregate.
3. In the Force list, select Friendly.
4. In the list of entities displayed, select Armor Plt(US).
5. Click on the map to place the red platoon and blue platoon as shown in Figure A-1. Right-click to exit create mode. The aggregates are created with default names (ARPlt 2 and ARPlt 3). They are disaggregated and expanded, so you can see the individual entities.
6. Select one of the platoons. To select a platoon, you must select the platoon icon, not one of its subordinates. The easiest place to do that is on the Echelon View tab of the Object Lists panel (Figure A-7).

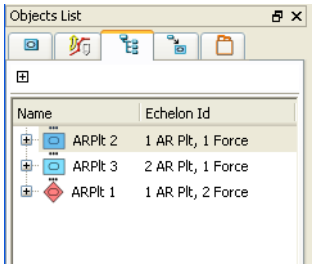


Figure A-7. Echelon View tab

7. Choose **Entities** → **Edit**. The Edit Armor Plt (US) dialog box opens.
8. In the name text box, replace the default name with Red Plt or Blue Plt, depending on which platoon you selected.
9. Click Update.
10. Rename the other platoon that you created.
11. Click the Entity Palette.
12. In the Categories list, select Ground.
13. In the list of entities, click M1A2 Tank. The cursor changes to draw mode.
14. Click on the map where White Platoon should be. An entity icon is displayed.
15. Click three more times to create the rest of the tanks in White Platoon. Right-click to exit create mode. (We will create the aggregate from these entities in the next section.)
16. Open the Entity Palette.
17. In the Ground/Friendly category, select M58 MICLIC.
18. Click twice on the map to the South of Red Plt to create two MICLIC entities.
19. Right-click to exit create mode.
20. Save the scenario.

Create White Platoon

To create the white platoon:

1. Select the four members of White Platoon.
2. Choose **Entities** → **Aggregates As**. The Aggregate As dialog box opens.
3. Select Ground Aggregate from the list.
4. Click OK.
5. Select the new platoon.
6. Choose **Entities** → **Edit**. The Edit Scene Object dialog box opens.
7. Change the name to White Plt.
8. Save the scenario.

A.1.6. Write the Plans

The plans tell the entities how to carry out their roles in the scenario. The White platoon just stays in place. We do not give it a plan. It will just respond to any opposing force entities that it detects.

Write the Plan for Blue Platoon

Blue Platoon will move to a waypoint. As it moves it responds to any opposing force entities that it detects. The plan is quite simple to write.

To write the plan for Blue Platoon:

1. Select Blue Platoon.
2. Choose **Entities** → **Plan**. The Plan window opens (Figure A-8).

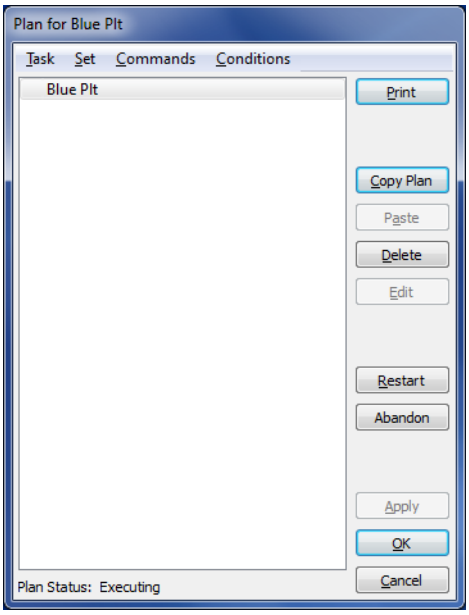


Figure A-8. Blue Platoon plan

3. In the Plan window, choose **Task** → **Movement** → **Move To Waypoint (Direct)**. The Move To Waypoint (Direct) dialog box opens (Figure A-9).

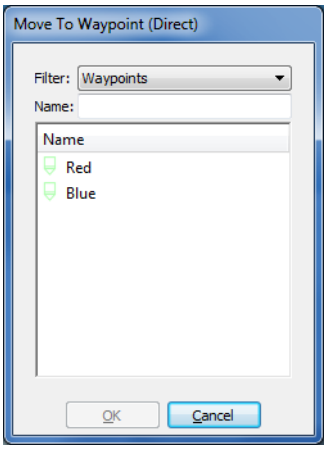


Figure A-9. Move To Waypoint (Direct) dialog box

4. In the Move To Waypoint (Direct) dialog box, or on the map, select the Blue waypoint.
5. Click OK. The task is added to the plan. The plan is now complete (Figure A-10).

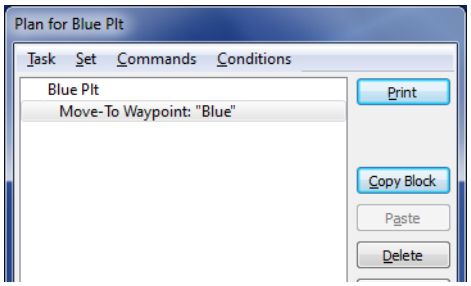


Figure A-10. Blue plan - complete

6. In the Plan window, click OK.

Write the Plan for Red Platoon

The Red Platoon moves to the Red waypoint. It has another job to do. When all the opposing forces are destroyed, it sends a message on the radio network. The MICLICs are listening for the message. They will not try to clear the minefield until they receive it.

To write the plan for red platoon:

1. Select Red Platoon.
2. Press **p**. The Plan window opens.
3. In the Plan window, choose **Task** → **Movement** → **Move To Waypoint (Direct)**. The Move To Waypoint (Direct) dialog box opens (Figure A-9).
4. In the Move To Waypoint (Direct) dialog box, or on the map, select the Red waypoint.
5. Click OK. The task is added to the plan (Figure A-11).

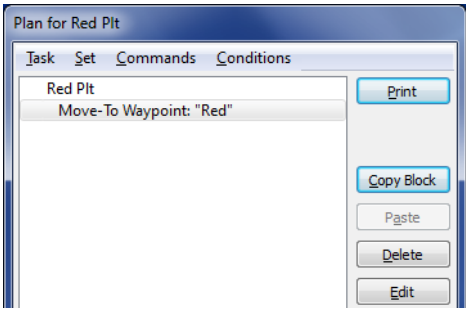


Figure A-11. Plan for Red Platoon - move to waypoint

6. Select the top line in the plan.
7. In the Plan window, choose **Conditions** → **When**. The When Expression dialog box opens (Figure A-12).

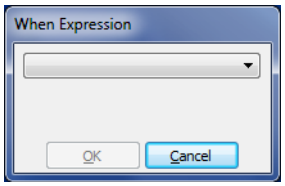


Figure A-12. When Expression dialog box

8. In the list, select Entity Destroyed. The Entity Destroyed dialog box opens.
9. In the list of entities, select ArPlt 1 (Figure A-13).

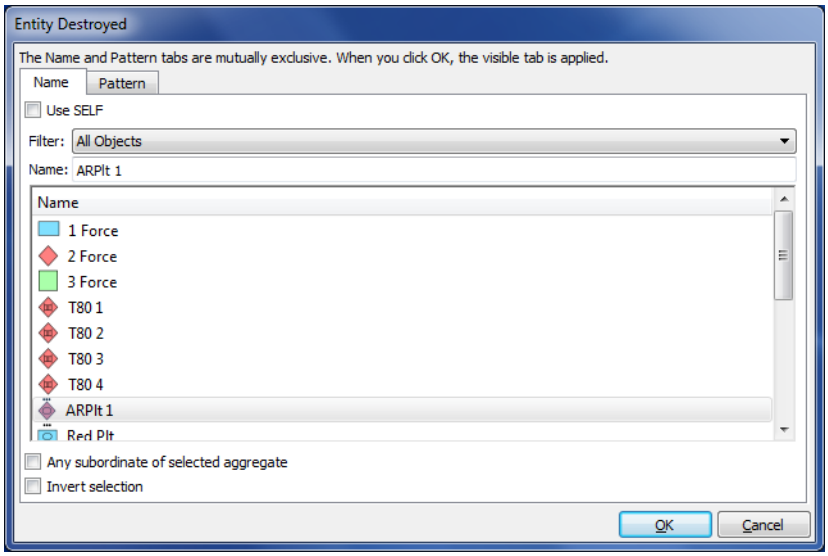


Figure A-13. Entity Destroyed dialog box

10. Click OK. The expression is added to the When Expression dialog box (Figure A-14).

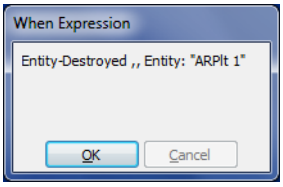


Figure A-14. Completed When Expression dialog box

11. In the When Expression dialog box, click OK. The When expression is added to the plan (Figure A-15). Now we need to add tasks to execute when the expression becomes true.

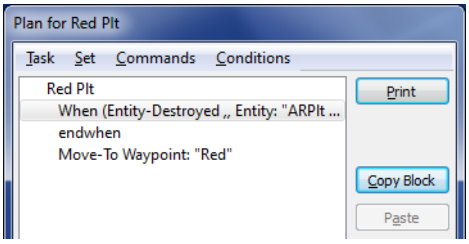


Figure A-15. Red Plan with incomplete When expression

12. The When expression should be selected. If not, select it.
13. Choose **Task** → **Radio** → **Send Text Message**. The Send Text dialog box opens.
14. In the Send Text dialog box, select the Broadcast check box. This means the message will be sent to all entities.
15. In the Message Text box, type Opposing Force Destroyed (Figure A-16).

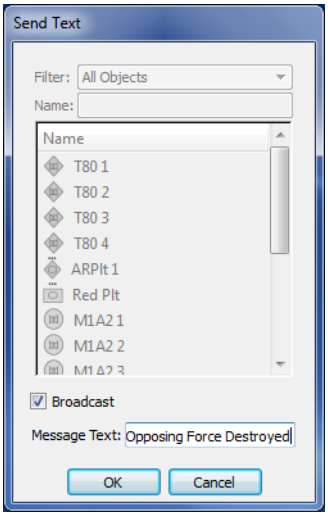


Figure A-16. Send Text dialog box

16. Click OK. The plan for Red Platoon is finished (Figure A-17).

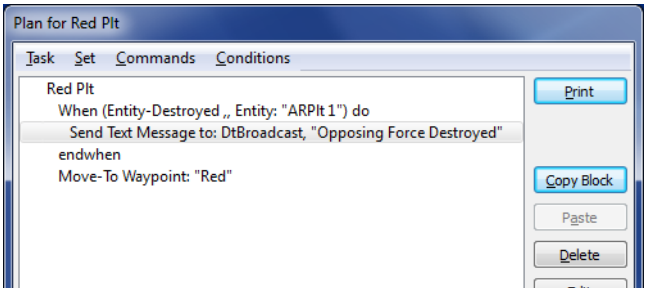


Figure A-17. Completed plan for Red Platoon

17. Click OK.
18. Save the scenario.

Write the Plans for the Engineering Units

When the the MICLICs are notified that the opposing force has been destroyed, they move along a route to the edge of the minefield. Then they clear it.

The MICLICs provided with VR-Forces do not actually have the ability to simulate clearing a minefield. We are going to provide some visual interest by using global commands to remove the original minefield and replace it with two minefields with a space between them.

We will start with the plan for SmWhel 1:

1. Select SmWhel 1.
2. Press **p**. The Plan window opens.
3. In the Plan window, choose **Conditions** → **When**. The When Expression dialog box opens.
4. In the list, select Receive Text Message. The Receive Text Message dialog box opens.
5. Type the message that we are waiting for (Opposing Force Destroyed) (Figure A-18).

Figure A-18. Receive Text Message dialog box

6. Click OK.

7. In the When Expression dialog box, click OK. The empty expression is added to the plan window (Figure A-19). Now we need to tell the entity what to do when it gets this message (move along the route, then redraw the minefield).

Figure A-19. Plan for SmWhel 1

8. In the Plan window, choose **Task** → **Movement** → **Move Along Route**. The Move Along Route dialog box opens.
9. Select Breach route, then click OK. The task is added to the plan.

   As we said earlier, VR-Forces does not actually model minefields or the types of entities that could clear one. To provide the visual illusion of clearing a corridor through the minefield, after the MICLICs arrive at the end of the route, we will delete the minefield and create two new minefields that occupy most of the space of the original one, but leaves a corridor for entities to travel through.
10. Choose **Commands** → **Delete**. The Delete dialog box opens.
11. In the list, select Minefield.
12. Click OK.
13. Choose **Commands** → **Create** → **Tactical Graphics** → **Engineering** → **Minefield**. The Create Minefield dialog box opens.
14. Type Minefield-left in the Name box.
15. Draw an area over most of the minefield to the left of where the breach route intersects the minefield.
16. Click OK. You will not see this new area, because it does not exist in the simulation yet. It will not exist until the command gets executed.
17. Repeat steps 13 through 16, but this time draw the minefield to the right of the route. Call it Minefield-right. The plan should now be similar to Figure A-20.

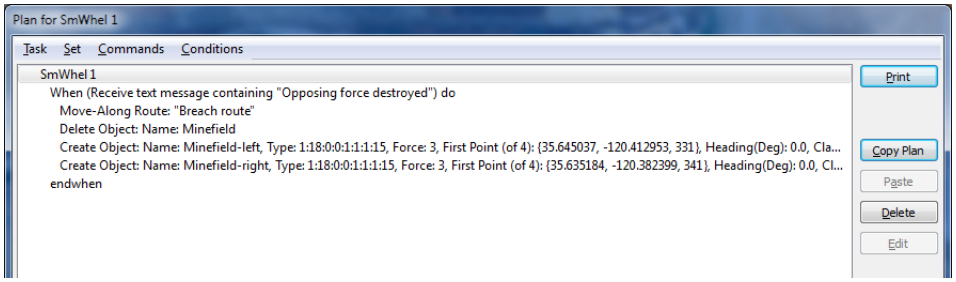


Figure A-20. Plan for SmWhel 1 after When expression complete

18. Click OK. The plan is now complete.

19. Save the scenario.

Write the Plan for SmWhel2 2

The plan for SmWhel 2 is a bit simpler than that of SmWhel 1. It follows SmWhel 1, offset to the right, so that it arrives at the minefield next to the other entity. Try creating the plan yourself. It should look like (Figure A-21).

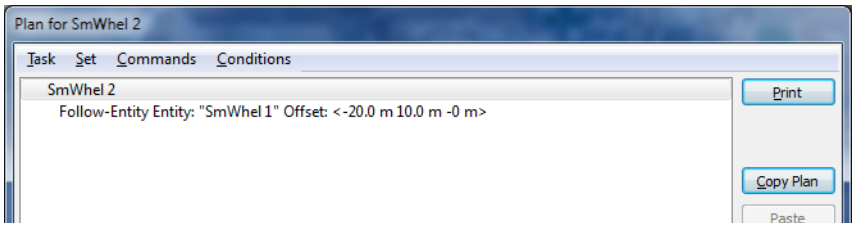


Figure A-21. Plan for SmWhel 2

A.1.7. Save the Scenario

Be sure to save the scenario before you run the simulation. If you want to save it in its starting state, do not save it after you run the simulation.

A.1.8. Running the Scenario

Once you have created the scenario and saved it, click the Run button and watch the simulation run. Open the plan windows for the MICLICs and observe the progression of tasks through the plan.

If hostile entities do not get destroyed, it may be that the blue entities cannot see them. If they cannot see them, they cannot shoot each other. Use the intervisibility feature to test line-of-sight. Move the entities around, or find a flatter section of the terrain until you get the results you want.

You can run the breaching scenario included with VR-Forces and see how it compares to the one that you created.

Figure A-22 shows the breaching scenario after the MICLICs have completed their plans. All of the aggregates are expanded so that you can see the individual entities.

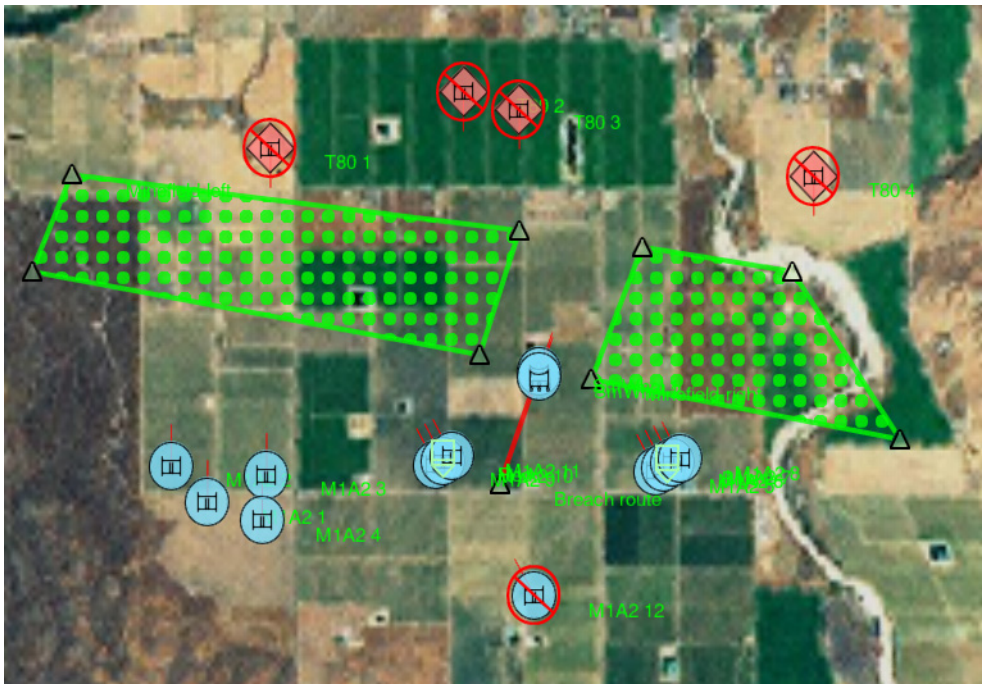


Figure A-22. Breaching scenario after minefield cleared

A.2. The Embarkexample Scenario

The embarkexample scenario (Figure A-23) demonstrates the embarkation feature. It shows the following:

- Embarking and disembarking DIs to and from a Bradley vehicle.
- Embarking and disembarking a helicopter to and from a Harpers Ferry ship and an aircraft carrier.
- Embarking a fixed-wing aircraft on the aircraft carrier.
- Embarking DIs onto a helicopter and disembarking one of them onto the aircraft carrier.
- Directly embarking a DI on an aircraft carrier and walking on the flight deck.

The scenario uses immediate embarkation and the embark and disembark tasks. It also demonstrates various types of conditional statements, including nested conditional statements.

A completed scenario is included with VR-Forces in *./userData/scenarios/embarkex-ample*. This section is a step-by-step explanation of how to create the scenario. It assumes that you have completed the breaching scenario example and does not provide quite as much detail for how to create entities and tactical graphics.

If you are using HLA, you must use RPR FOM 2 draft 17 for scenarios that use embarkation.

Figure A-23. Embark scenario

A.2.1. Create the Entities and Objects

The scenario has the following entities:

- A fixed-wing aircraft on the airport runway.
- A helicopter embarked on an LSD-49 Harpers Ferry ship.
- A dismounted infantry entity (DI) embarked on an aircraft carrier.
- A DI standing behind a Bradley vehicle in the town.
- A DI standing in the courtyard of the palace.

The scenario has the following tactical graphics:

- A route for the fixed-wing plane to follow to take off.
- A waypoint in front of the palace for the Bradley vehicle to drive to.
- A waypoint in front of the palace for the helicopter to land at.
- A waypoint on the carrier deck for the DI to walk to.

Create the Surface Entities

To create the surface entities:

1. Start VR-Forces.
2. Choose **File** → **New Scenario**. The Choose Simulation Terrain dialog box opens.
3. Select *Makland.mtf*.
4. Click Open. The New Scenario dialog box opens.
5. Click OK. The Makland database is displayed.
6. Navigate to the Makland peninsula, the bay and the airport.
7. On the Entity Palette, select the Surface category and the Friendly force.
8. In the entity list, select CVN-75 Harry S. Truman
9. Click in Makland Bay midway to the left of the peninsula.
10. Right click to exit create entity mode.
11. Place a LSD- 49 Harpers Ferry Class Ship in the middle of Makland Bay (Figure A-24).

Figure A-24. Surface entities

12. Save the scenario.

Create the Aircraft

To create the aircraft:

1. Zoom in on the airport, located northeast of the bay.
2. On the Entity Palette, select the Fixed Wing category.
3. Select force Friendly.
4. Select an F/A 18 Hornet entity.
5. Click the northern end of the north/south runway.
6. Right-click to exit create entity mode.
7. Select the entity.
8. Choose **Set** → **Position** → **Heading**. The Heading dialog box opens.
9. Type 180 and click OK.
10. Zoom out to see a larger area of the map.
11. On the Entity Palette, select the Rotary Wing category.
12. Select a CH46E Sea Knight entity.
13. Click anyplace on the map.
14. Right-click to exit create mode.
15. Select the helicopter.

16. Choose **Entities** → **Embark On**. The Embark On dialog box opens.
17. In the list window, select the LSD 49 (Harper 1).
18. Click OK. The helicopter is immediately embarked on the LSD 49. If you select the Embarkation View on the Objects List Panel, you can see that the helicopter is listed as being embarked on the LSD 49 (Figure A-25).

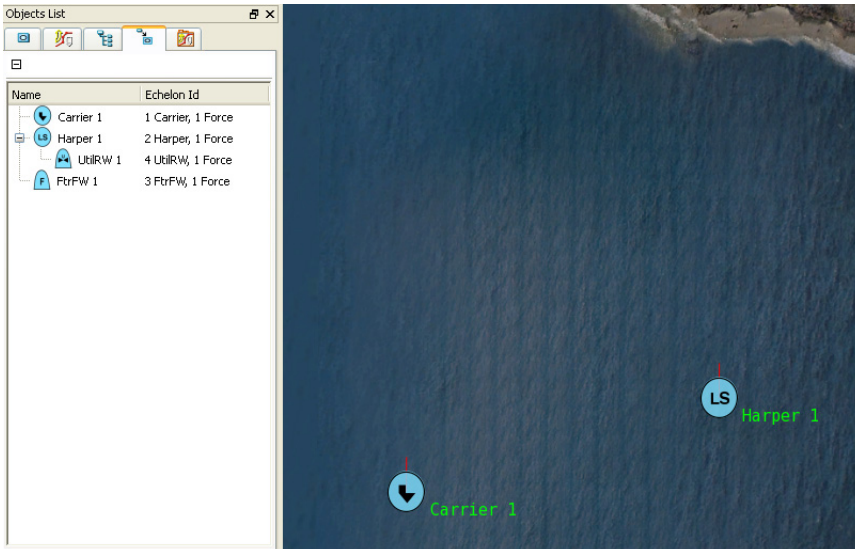


Figure A-25. Helicopter embarked on LSD 49 Harpers Ferry

19. Save the scenario.

Create the Bradley Vehicle

To create the Bradley Vehicle:

1. Zoom in on the town on the peninsula.
2. On the Entity Palette, change the category to Ground.
3. Select force Friendly.
4. Select an M2A2 Bradley IFV entity.
5. Place the Bradley vehicle where the road to the palace intersects a north/south street, as shown in Figure A-26.

Figure A-26. Bradley vehicle

6. Save the scenario.

Create Dismounted Infantry

The scenario has two dismounted infantry that ride in the helicopter, and one that is embarked on the aircraft carrier. Embarking the DI on the carrier requires a bit of discussion.

There are two ways to embark an entity – immediate embarkation and the embarkation task. If you want to use the Embark task, the receiving entity must be configured to accept the embarking entity. We will use the Embark task a little later in this example.

We want to embark one of the DI entities on the aircraft carrier. However, aircraft carriers are not configured to accept DI entities, so we cannot use an Embark task to do this. However, we can use the immediate embark feature to embark an entity on any other entity. To do this, we must specify the coordinates at which to place the entity. In this example, we want to place a DI on the carrier deck and make it look good in the 3D view. Through experimentation, we know that using the model supplied with VR-Forces, the altitude offset to place an entity on the carrier deck is 21 meters. We also offset the location to move the entity to the side of the deck.

1. On the Entity Palette, change the category to Human.
2. Select a Dismounted-Infantry entity.
3. Select force Friendly.
4. Place one DI directly behind (south of) the Bradley vehicle.
5. Place one DI in the courtyard area of the palace at the top of the hill in Makland (Figure A-27).

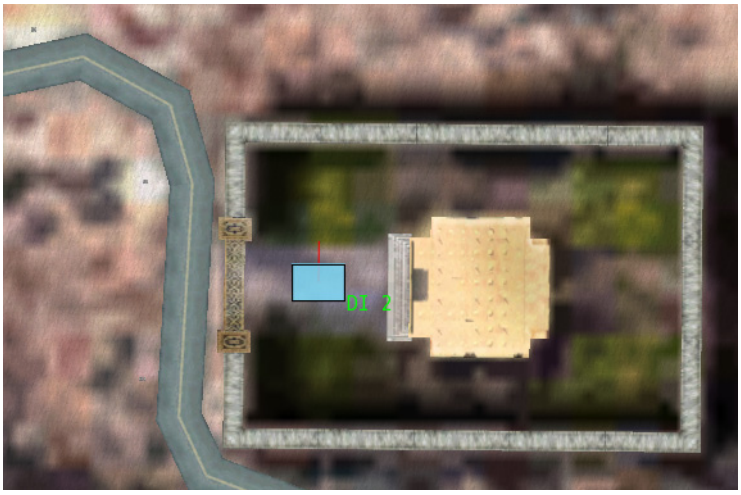


Figure A-27. DI at palace

6. Place a third DI anyplace in town. This is just a temporary location. In a moment you will embark this entity on the aircraft carrier.

7. Double-click the DI in the palace to make its position editable. Hold down the Shift key and drag the mouse to change the heading indicator to 270 degrees (Figure A-28).

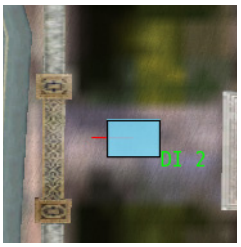


Figure A-28. DI at palace after setting heading

8. Select the DI that you placed temporarily in town.
9. Choose **Entities** → **Embark On**. The Embark On dialog box opens.
10. In the entity list, select the carrier.
11. Select the Override Position option.
12. In the Position Override group box, set the X value to 15 and the altitude value to 21. This places the DI at the deck level of the carrier (Figure A-29).

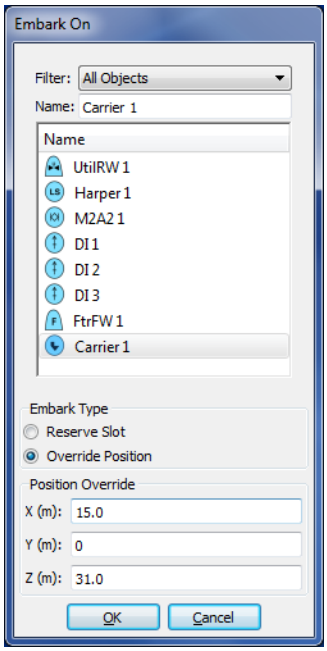


Figure A-29. Embark On dialog box

13. Click OK. The DI is embarked on the carrier.
14. Save the scenario.

Create the Tactical Graphics

We need a few tactical graphics to specify the movement tasks for the entities.

Create a Runway at the Airport

At the airport, create a route from North to South along the runway. Call it Runway (Figure A-30).

Figure A-30. Runway

Create Waypoints at the Palace

To create the waypoints at the palace:

1. Zoom in on the palace at the top of the hill near the town.
2. Place a waypoint on the edge of the road just before the palace entryway. Call it “palace”.
3. Place a waypoint on the ground in front of the palace between the trees. Call is “helipad” (Figure A-31).

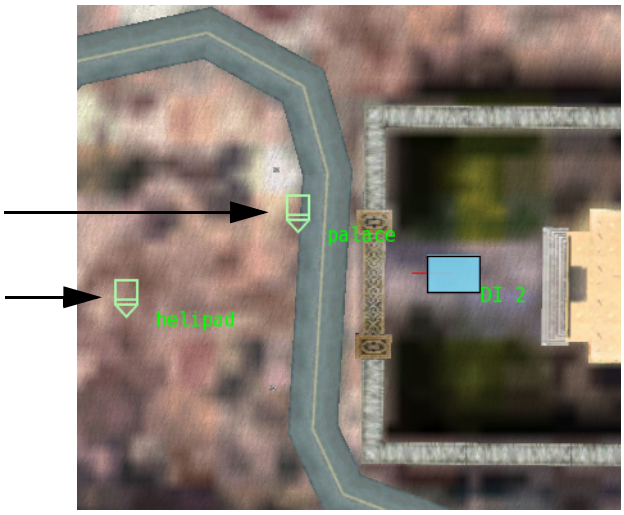


Figure A-31. DI and waypoints at palace

Attach a Waypoint to the Carrier

We want to attach a waypoint to the carrier. However, in the 2D view, there is no way to figure out where to place the waypoint because the carrier is shown as a 2D icon. So, we will switch to the 3D view.

To attach a waypoint to the carrier:

1. Move the observer so that you are looking at the 2D icon for the aircraft carrier.
2. Check the Attachment button ( ) on the Attach Object toolbar to make sure that you are not attached to an entity. If it is depressed, click it to unattach the observer.
3. In the Observer list on the Observer toolbar, select Stealth. The view changes to 3D. However we are still looking down on the terrain, so we have a nice top-down view of the aircraft carrier (Figure A-32).

Figure A-32. Aerial view of carrier in 3D

4. Zoom in on the aircraft carrier.
5. Choose **Create** → **Waypoint**.
6. Expand the Create Waypoint dialog box.
7. Clear the Attach Object to Mouse check box.
8. Type a name for the waypoint, such as Carrier.
9. For the Altitude option, select Above Sea Level.
10. Type a value of 21 (to put the waypoint on the carrier deck).
11. Select the Attach Object to Mouse check box.
12. Click on the deck of the carrier toward the lower right (Figure A-33).

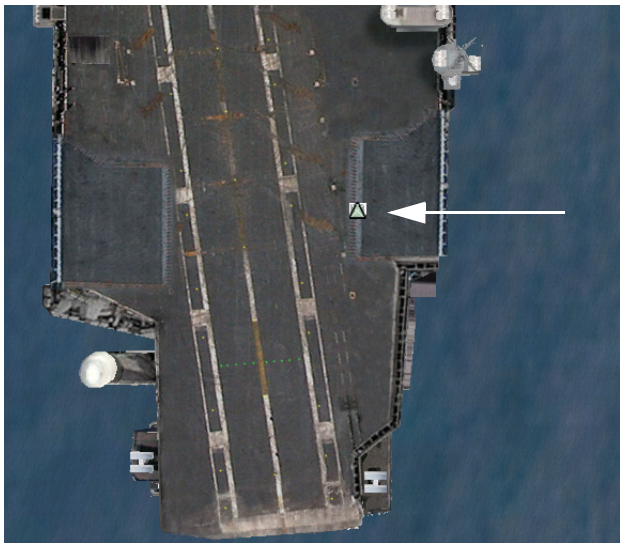


Figure A-33. Waypoint on carrier

13. Right-click.

    Now we will attach the waypoint to the aircraft carrier. When you attach a tactical graphic to an entity, it moves with the entity. Even though the aircraft carrier is not moving in this scenario, this extra step will teach you about this procedure.

14. Select the waypoint.
15. Choose **Entities** → **Attach Object To**. The Attach Object To dialog box opens.
16. Select Carrier 1.
17. Save the scenario.

A.2.2. Write the Plans for the Entities

We need to write plans for the entities to do the following:

- The jet will take off from the airport and embark on the carrier (land and taxi to a parking place).
- The helicopter will disembark from the LSD-49 and fly to the palace, where it will land. Two DIs will embark on it. Then it will take off and embark on the carrier, disembark, and embark back on the LSD-49.
- The DI in town will embark on the Bradley and ride with it to the palace. It will then disembark from the Bradley and embark on the helicopter.
- The DI in the palace courtyard will embark on the helicopter.
- The DI on the carrier will walk to the waypoint.

Write the Fixed-Wing Aircraft's Plan

To write the fixed-wing aircraft's plan:

1. Select the fixed-wing entity.
2. Choose **Entities** → **Plan**. The Plan window opens.
3. In the Plan window, choose **Task** → **Movement** → **Fixed Wing Takeoff**. The Fixed Wing Takeoff dialog box opens.
4. In the Fixed Wing Takeoff dialog box, select Runway from the list of routes.
5. Click OK. The task is added to the plan.
6. Choose **Task** → **Embarkation** → **Embark**. The Embark On dialog box opens.
7. In the Embark On dialog box, select Carrier 1 from the list and click OK (Figure A-34).

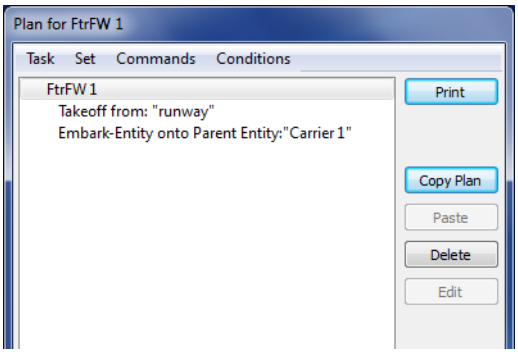


Figure A-34. Fixed-wing entity plan

8. In the Plan window, click OK. The plan for the fixed-wing entity is finished.

Write the Helicopter's Plan

To write the helicopter's plan:

1. If you are in the 2D view, on the Objects List Panel, Entity List view, select the helicopter entity. (Since the helicopter is embarked, it is not visible on the map, so you cannot select it there.) If you are in the 3D view, you can select the copter in the Objects List Panel or by clicking the model.
2. Choose **Entities** → **Plan**. The Plan window opens.
3. Choose **Task** → **Disembark**.
4. Choose **Task** → **Move To Altitude**. The helicopter is going to fly to the palace, which is on top of a hill with steep cliffs. Sometimes the terrain following feature of the helicopter cannot handle steep cliffs well, causing the helicopter to crash, so we want to get it up to a good altitude to avoid crashing.
5. Set the altitude to 200 meters and click OK.
6. Choose **Task** → **Rotary Wing Land**. The Rotary Wing Landing dialog box opens.
7. In the list of waypoints, select helipad and click OK.

   When the helicopter lands, it sends a message to the DIs to tell them that it is OK to embark.
8. Choose **Task** → **Send Text Message**. The Send Text dialog box opens.
9. Select DI 1. This will direct the message just to this entity.
10. In the Message Text box, type Load up.
11. Click OK. When the helicopter lands, it will tell DI 1 to load up, so that it knows it is time to embark on the helicopter.

    After the helicopter lands at the palace, it needs to wait until the two DI have embarked before it takes off. So we use a When statement with an Entity Embarked condition. The helicopter doesn't need to watch for this entity to be embarked until it lands at the palace, so we can put the When statement in the middle of the plan rather than at the beginning as we might with other conditions.
12. Choose **Conditions** → **When**. The When Expression dialog box opens.
13. Select Entity Embarked. The Entity Embarked dialog box opens.
14. On the Name tab, in the top list, select DI 2. This is the entity whose embarkation status we want the helicopter to montor.
15. In the bottom list, select UtilRW1. This is the name of the helicopter. We want to test the condition that DI 2 is embarked on UtilRW 1.
16. In the Entity Embarked dialog box, click OK. Then, click OK in the When Expression dialog box. The condition is added to the plan. Now we need to specify what the helicopter should do when the condition is true.

17. The line in the plan window that starts “When (Entity-Embarked” should already be selected. If it is not, select it now.
18. In the Plan window, choose **Task** → **Embark**.
19. Specify that the helicopter embark on Carrier 1.
20. In the Plan window, choose **Task** → **Wait Duration**.
21. Specify a duration of 1 minute. This is how long the helicopter will wait on the carrier deck after it embarks.
22. In the Plan window, choose **Task** → **Disembark**. This disembarks the helicopter from the carrier.
23. In the Plan window, choose **Task** → **Embark**.
24. Specify that the helicopter is to embark on the LSD-49 Harpers Ferry.
25. The plan is complete (Figure A-35), so click OK.

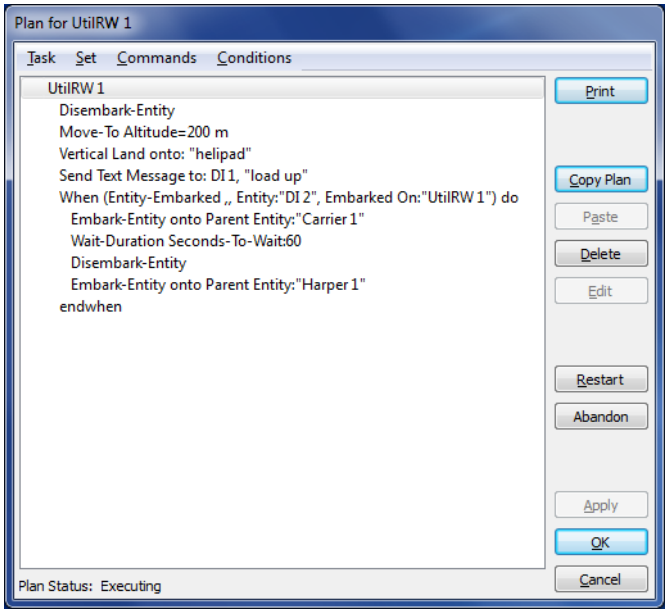


Figure A-35. Rotary-wing entity plan

Write the Plan for the DI on the Carrier

By now you should have a pretty good feel for the mechanics of adding tasks to a plan, so we will just tell you which tasks to add to the plans for the DI entities. To view the plans for the entities, load the supplied example scenario and open the Plan window for the entity you are interested in.

Give the DI on the carrier a task to Move to Waypoint “carrier”.

Write the Plan for the DI in Town

To write the plan for the DI in the town:

1. Task this entity to embark on the Bradley vehicle.

   The DI will have to disembark from the Bradley to embark on the helicopter. We will do this by having the helicopter send a message to the DI when it lands. That will trigger the disembarkation task.

2. Select the top line in the plan window. (The line that says *entity_name*.) We want this condition to be at the top of the plan so it gets registered immediately because we do not know when it will come true.

3. Choose **Conditions** → **When**.

4. In the When Expression dialog box, select Receive Text Message.

5. In the Receive Text Message dialog box, type the message text “load up”.

6. Click OK to back out of the dialog boxes.

7. In the When block, add a Disembark task.

8. Send a text message to DI2 that says “Let’s go”.

9. Set the speed to 10.0 km/h. This is fast enough so that the DI will run to the helicopter instead of walking.

10. Add a task to embark on the UtilRW1.

11. Add another When condition. Select the Entity Embarked condition and specify the helicopter embarked on the carrier.

12. In the When block, add a Wait Duration, 30 seconds task. This task means that when the helicopter embarks on the carrier, the DI entity waits 30 seconds.

13. Add a Disembark task. This disembarks the DI from the helicopter. Since the helicopter is embarked on the carrier, the DI is automatically embarked on the carrier.

14. Add a Move To task and specify Waypoint “carrier”. After the DI disembarks from the helicopter, it walks across the deck to the waypoint.

15. Save the plan.

Write the Plan for the DI in the Courtyard

The DI in the courtyard (DI 2) waits until DI 1 sends a "Let's go" message, then it embarks on the helicopter.

To write the plan for the DI in the courtyard:

1. Open the Plan window for DI 2.
2. Add a When condition that tests for receipt of the "Let's go" message from DI1.
3. In the When block, set the speed to 10.0 km/h and add an Embark task for DI 2 to embark on the helicopter.
4. Save the plan.

Write the Bradley Vehicle's Plan

We want the Bradley to wait until DI 1 embarks on it, then drive to the palace.

To write the plan for the Bradley vehicle:

1. Add a When statement that tests for DI 1 being embarked on the Bradley.
2. Within the When block, add a Move To Waypoint (On Roads) task for the Bradley to move to waypoint "palace".
3. Save the plan.

B

Merging Scenarios

This chapter explains how to merge scenarios with the Scenario Merge tool.

B.1. The Scenario Merge Tool

VR-Forces users often assign scenario development to multiple persons or teams. Then they merge the separately-developed scenarios into a master scenario. Merging scenarios by hand can be a difficult task due to the requirement to reconcile entity and object names, plans, and other scenario elements that could be duplicated, particularly if objects are named using the default conventions.

The Scenario Merge tool allows you to combine two or more VR-Forces scenarios into a single scenario. Scenario Merge detects and resolves conflicts so that the simulated objects can co-exist in a single scenario, without losing their unique identity. Likewise, references to conflicting names are resolved, so that the plans from both scenarios work properly.

Scenario Merge has a graphical user interface and a command-line interface. It is an off-line tool for combining existing scenarios.

Scenario Merge has an API that lets you merge scenarios programmatically. For details, please see the *DtScenarioMergeDirector* class (*scenarioMergeDirector.h*) in the class documentation.

Scenario Merge does not merge scripted tasks, selection groups, or observer views.

To merge scripted tasks, export the tasks for each scenario and import them into the merged scenario. For details, please see "Exporting and Importing Scripted Tasks," on page 13-23.

To merge observer views, export the observer views from the original scenarios and import them into the merged scenario. For details, please see Section 11.10, "Saving and Recalling Views," in *VR-Forces Users Guide*.

There is no way to save and merge in selection groups. However, you could use the selection groups file from the original base scenario.

B.2. Starting Scenario Merge

The graphical user interface is the primary way to use the Scenario Merge tool.

➤ To start Scenario Merge in Windows, on the Start menu, choose **Programs** → **MAK Technologies** → **VR-Forces 4.2** → **Tools** → **Scenario Merge**.

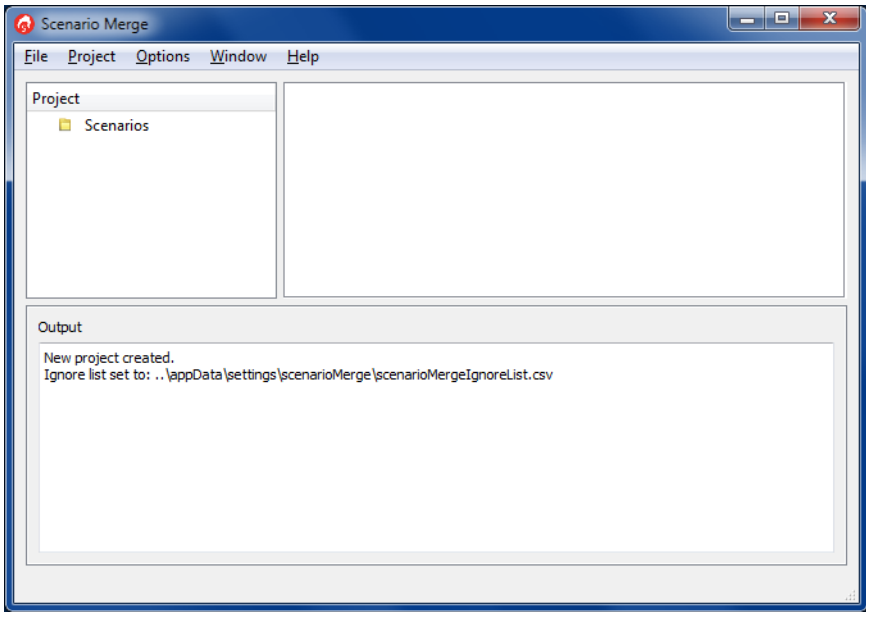


Figure B-1. Scenario Merge window at startup

➤ To start the Scenario Merge from the command line, enter the following:

```
./bin/scenarioMerge [projectFile]
```

If you start Scenario Merge from the command line and specify `projectFile`, Scenario Merge loads the project file. Otherwise, it opens a new project. command-line syntax is described in "Using the Scenario Merge Command-Line Interface," on page B-9.

B.3. Creating a Scenario Merge Project

Before you can merge scenarios, you must create a Scenario Merge project. A project identifies the scenarios to merge, where to write the merged scenario, and optionally, a list of attributes to ignore during the merge process.

All of the scenarios in a project should be created with the same version of VR-Forces. If you have a scenario that you created with a previous version of VR-Forces and you want to merge it with a newer scenario, open it in the latest version of VR-Forces and save it.

When you start Scenario Merge, it automatically creates a new, empty project. However, you can also start a new project manually.

➤ To open a new project, choose **File** → **New Project**.

B.3.1. Adding Scenarios to a Project

You can add as many scenarios as you want to a project. However, the first scenario you add is the key scenario. It determines the parameters of the final scenario, including, terrain database, object parameter database, exercise start time, and so on. If any of the scenarios that you merge into the first scenario have different scenario parameters, they are ignored and a diagnostic message is recorded in the project log file.

If you add scenarios from different terrains, Scenario Merge uses only geocentric coordinates for entity position data. This is accomplished using the Ignore List File, which is explained in "Specifying an Ignore List File," on page B-5.

Before you add a scenario created in VR-Forces 3.10.x or earlier to a project, open it in the current version of VR-Forces and save it.

To add a scenario to a project, use one of the following methods:

- Choose **Project** → **Add Scenario**, and select a scenario to add.
- Drag a scenario file (*.scn*) from Windows Explorer to the Scenario Merge Project tree view.
- Drag a scenario folder from Windows Explorer to the Scenario Merge Project tree view. If you drag a folder, Scenario Merge adds all scenario files in the folder to the project.

B.3.2. Removing Scenarios from a Project

To remove a scenario from a project:

1. In the Project window, select the scenario that you want to remove.
2. Choose **Project** → **Remove Scenario**.

B.3.3. Specifying an Ignore List File

Sometimes it is useful to suppress values when writing to the final scenario. For example, Scenario Merge suppresses any reference to a local coordinate system in the Order of Battle file (*.oob*) file. You can specify values to ignore in an ignore list file. The ignore list file is a comma-delimited text file, for example:

```
local-kinematics-state,IGNORE
local-vertices,IGNORE
```

The first value is the string to search for during a merge operation. The second value is a text string that will replace the key in the merged scenario.

If a substitution is specified in the ignore list, it is applied to the following files in the scenario:

- Order of Battle (*.oob*)
- Plan (*.pln*)
- Global Plan (*.gpl*)
- Object Map (*.omp*).

To create an ignore list file, you must use a text editor. Scenario Merge just lets you specify which file to use. You must include the following lines from the default ignore list:

```
local-kinematics-state,IGNORE
local-vertices,IGNORE
```

These entries are needed when merging scenarios that use different terrains.

To specify the Ignore List file:

1. Choose **Project** → **Specify Ignore List**. The Specify Ignore File dialog box opens.
2. Type a filename or click Browse and select the Ignore List file.
3. Click OK.

B.3.4. Saving a Project

When you save a project, Scenario Merge creates a project file. You can load the project at a later date to merge the scenario again or change which scenarios you want to merge. You can also use a project file to merge files from the command-line. For details about running from the command-line, please see "Using the Scenario Merge Command-Line Interface," on page B-9.

To save a project:

1. Choose **File** → **Save Project**. The Scenario Merge dialog box opens.
2. Select a directory and type a name for the project.
3. Click Save. The project gets saved with the extension *.smp*.

The Scenario Merge Project File

A merge project is a comma-delimited text file that lists the scenarios to merge, the desired location for the final result, and merge options. The following is an example of a Scenario Merge project file:

```
OUT,..\data\scenarios\demoMerge
IGN,..\config\scenarioMergeIgnoreList.csv
SCN,..\data\scenarios\scenarioOne\scenarioOne.scn
SCN,..\data\scenarios\scenarioTwo\scenarioTwo.scn
SCN,..\data\scenarios\scenarioThree\scenarioThree.scn
SCN,..\data\scenarios\scenarioFlour\scenarioFlour.scn
```

Each line starts with one of the following keywords:

- OUT specifies the location for the output scenario files.
- IGN specifies an Ignore List file. For details, please see "Specifying an Ignore List File," on page B-5.
- SCN specifies the path of a scenario to merge in.

Paths are relative to the location of *scenarioMerge.exe*.

B.3.5. Loading a Project

If you have saved a project, you can load it, edit it as necessary, and regenerate the merged scenario.

To load a project:

1. Choose **File** → **Load Project**. An Open dialog box opens.
2. Select the Scenario Merge project file that you want to load.
3. Click Open.

B.4. Merging Scenarios

➤ To merge the scenarios in a project, choose **Project** → **Merge**. The scenarios are merged and informational messages are displayed in the console.

B.5. Displaying Scenario Files

You can display the text of one or more of the scenario files in a project.

➤ To display a scenario file, in the Project window, double click the file. It is displayed to the right of the Project window.

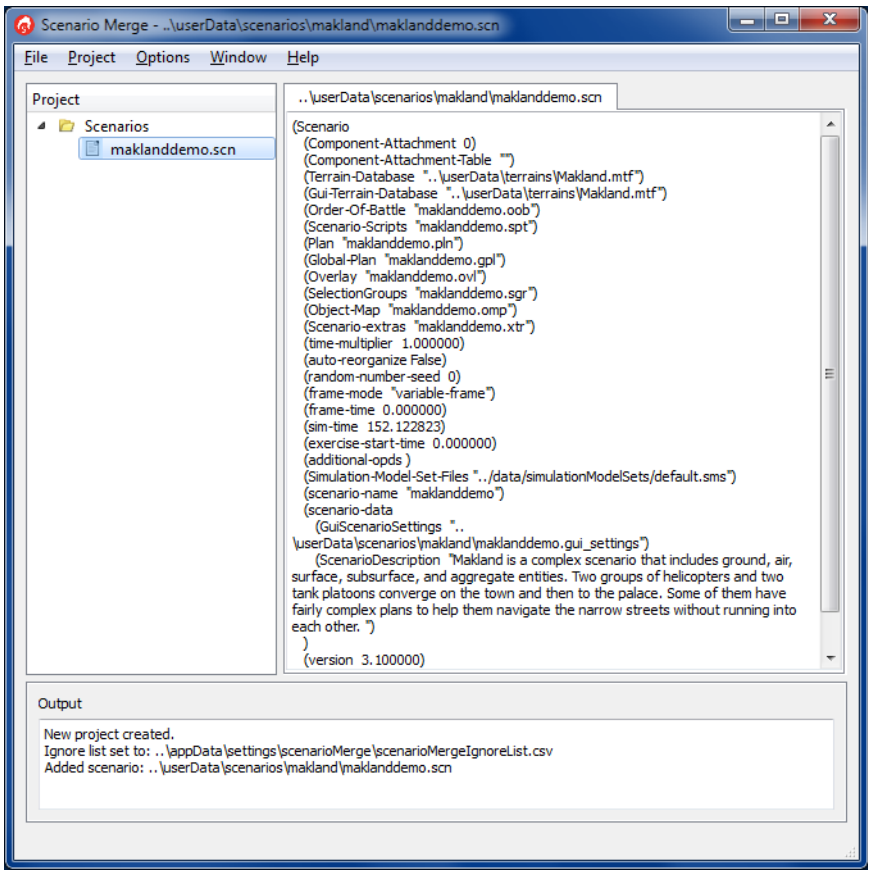


Figure B-2. Scenario file display

B.5.1. Editing Scenario Files

If you display a scenario file, you can edit it. Any edits you make are saved back to the original scenario. You cannot edit the scenario file that gets created when you merge scenarios.

! Editing scenario files is risky to scenarios and is advisable only for experienced VR-Forces users. Be sure you fully understand the contents of the file.

To edit a scenario file:

1. In the scenario file display window, make any edits desired.
2. Choose **File** → **Save Scenario** or **Save All**.

B.5.2. Closing Scenario Files

To close a scenario file that is displayed by Scenario Merge, use one of the following methods:

- Choose **Window** → **Close**. If multiple files are open, this closes the most recently opened one.
- Choose **Window** → **Close All**.
- Choose **File** → **Close Scenario**.

B.6. Specifying the Output Notification Level

You can specify the notification level used for sending messages to the output console. The notification levels correspond to the notification levels used throughout MÄK products and described in Chapter 2, *VR-Forces Configuration Files*.

➤ To set the notification level, choose **Options** → **Set Notify Level** → *level*, where *level* is one of the following:

- Fatal
- Warning
- Info
- Verbose
- Debug.

B.7. Using the Scenario Merge Command-Line Interface

To run the Scenario Merge tool from the command line, use the following syntax:

```
scenarioMerge -c projectFile
```

where:

`-c` specifies that Scenario Merge should run in command-line mode.

`projectFile` specifies a Scenario Merge project file to load. For details about creating project files, please see "Adding Scenarios to a Project," on page B-4.

C

Systems and System Usage

The tables in this appendix provide information about the systems provided with VR-Forces and list the entities that use them.

C.1. VR-Forces Systems

Table C-1 lists all of the systems provided with VR-Forces and provides information about them. Table C-2 lists each system and the entity types that use it.

Table C-1: System descriptions

System	Category	Entity Types	Description
120mm Gun	weapon	ground	Turreted 120mm gun, typical of tanks such as the M1A2. Fires M829A1-AP and M830-HEAT rounds. Targets ground vehicles.
125mm Gun	weapon	ground	Turreted 125mm gun, typical of tanks such as the T-80. Fires both BM-9-AP and BM-14m-HEAT rounds. Targets ground vehicles.
ADA Quad 14.5mm Machine Gun	weapon	ground	ADA Quad Machine Gun , multi-barreled machine gun used for ADA. Found on ZPU-4. 14.5mm rounds. Targets Air entities.
25mm Gun	weapon	ground	Turreted 25mm gun. Fires M791-AP 25mm rounds. Targets ground vehicles.
30mm Gun	weapon	ground	Turreted 30mm gun. Fires AT-30mm rounds. Targets ground vehicles.
Active RADAR Sensor	sensor	all	Allows an entity to detect other objects through RADAR. Also publishes emitter beams that represent the emissions from the sensor.
Active SONAR Sensor	sensor	all	Allows an entity to detect other objects through SONAR.
Air Aggregate	movement	aggregate	Basic movement capabilities for any air-based aggregate, fixed wing or rotary wing.
Air Cushion	movement	ground	Air cushion movement; allows entity to cross both land and water.
Airborne Targeting RADAR	sensor	fixed-wing, rotary-wing	RADAR used by aircraft to detect targets. Publishes an emitter beam.
Anti-Submarine Missile (Vertically Launched)	weapon	surface	Missile launched from deck of ship, flies out to submarine target and drops a homing torpedo.
Building Default Damage	damage	cultural-feature	Default damage system for a building.

Table C-1: System descriptions

System	Category	Entity Types	Description
CIS Air Defense Missile Package	weapon	fixed-wing	Missile launcher with loadout for CIS air defense entity. Fires Aphid AA-8 missiles against air targets and Kedge AS-14 missiles against ground targets.
CIS Attack Helicopter Missile Package	weapon	rotary-wing	Missile launcher with loadout for CIS attack helicopter. Fires Archer AA-11 missiles against air targets and Spiral AT-6 missiles against ground targets.
CIS Attack/Strike Missile Package	weapon	fixed-wing	Missile launcher with loadout for CIS attack/strike entity. Fires Aphid AA-8 missiles against air targets and Kerry AS-7 missiles against ground targets.
CIS Counter Measures Launcher	other	all	Allows an entity to launch counter measures for self defense. Configured with CIS flares and chaff.
CIS Fighter Bomber Bomb Bay	weapon	fixed-wing, rotary-wing	Releases bombs in response to Release Bomb on Target, Location and Laser Spot tasks. Configured to launch bombs manufactured in the Commonwealth of Independent States.
CIS Heavy Bomber Bomb Bay	weapon	fixed-wing, rotary-wing	Releases bombs in response to Release Bomb on Target, Location and Laser Spot tasks. Configured to launch bombs manufactured in the Commonwealth of Independent States.
Counter Measures Launcher	other	all	Allows an entity to launch counter measures for self defense.
Cruise Missile	movement	fixed-wing	Cruise missile flight dynamics. Fast and maneuverable, but with limited tasking capabilities.
DI Laser Designator	other	all	A laser designator, which can aim a laser at targets. For use with a laser guided missile delivery system. This laser designator can be explicity tasked to designate particular targets, or set to autonomous lasing mode. In autonomous lasing mode, the laser will automatically designate hostile ground vehicles.
Exocet Cruise Missile Launcher (Forward Launched)	weapon	fixed-wing	Launcher for Exocet anti-ship cruise missiles. Launches missiles forward of the entity, appopriate for aircraft.

Table C-1: System descriptions

System	Category	Entity Types	Description
Exocet Cruise Missile Launcher (Vertically Launched)	weapon	surface, ground	Launcher for Exocet anti-ship cruise missiles. Launches missiles at an upward angle, appropriate for ships.
Explosive Device	weapon	all	Explosive device system. Allows 3 types of detonations -- instant, time-delayed, and proximity.
Fall From Sky Dynamics	movement	all	Movement dynamics for based on gravity and drag of object.
Maverick Missile Launcher	weapon	fixed-wing	Fixed Maverick Missile Launcher. Fires Air-To-Ground missiles at ground targets. Fixed to the entity (no turret) and always fires forward.
Sidewinder Missile Launcher	weapon	fixed-wing, rotary-wing	Fixed Maverick Missile Launcher. Fires Air-To-Air missiles at air targets. Fixed to the entity (no turret) and always fires forward.
Fixed Wing Default Armor	damage	fixed-wing	Basic armor for a fixed-wing aircraft.
Fixed-wing Disaggregated Movement	disaggregated	aggregate	Basic movement capabilities for any fixed-wing-based disaggregated unit.
Fighter Jet	movement	fixed-wing	Fighter jet, such as the A-10.
Heavy Plane	movement	fixed-wing	Heavy plane flight dynamics, such as a cargo plane.
High Manuverability Fighter	movement	fixed-wing	Highly maneuverable fighter jet, such as the F-16.
Frictionless Gravity Dynamics	movement	all	Movement dynamics solely based on gravity.
Ground Aggregated Movement	aggregated	aggregate	Basic movement capabilities for any ground-based aggregated unit, both vehicle and DI.
Ground Convoy Movement	disaggregated	aggregate	Basic movement capabilities for any ground-based convoy unit.

Table C-1: System descriptions

System	Category	Entity Types	Description
Ground Disaggregated Movement	disaggregated	aggregate	Basic movement capabilities for any ground-based disaggregated unit, both vehicle and DI.
Heavy Armor	damage	ground	Heavy armored ground vehicle, such as a tank.
Light Armor damage model.	damage	ground	Component that computes damage for lightly armored ground vehicles. Maps munition types to damage tables.
Tracks	movement	ground	Movement model for ground entities with tracks.
Tracks/Amphibious	movement	ground	Amphibious tracked vehicles that can move over land and water.
No Armor	damage	ground, vrf object	Unarmored ground vehicle, such as a civilian vehicle.
Wheels (off road)	movement	ground	Wheeled vehicle designed for off road use, such as a HMMWV. Can switch into road following mode.
Wheels (road)	movement	ground	Wheeled vehicle designed for on-road use, such as a civilian car.
AK-47	weapon	human	Handheld AK-47 rifle. Targets human entities.
AT4	weapon	human	Handheld AT4 Anti-Tank weapon. Targets ground vehicles and helicopters.
M16 rifle	weapon	human	Handheld M16 rifle. Targets human entities.
M240B Machine Gun	weapon	human	Hand carried M240B 7.62mm Machine Gun. Targets lifeforms.
M249 SAW	weapon	human	M249 Squad Automatic Weapon, 5.56mm fully automatic rifle. Targets lifeforms.
M60 Machine Gun	weapon	human	Hand carried M60 7.62mm Machine Gun. Targets lifeforms.
RPG Launcher	weapon	human	Handheld RPG Launcher. Targets ground vehicles and helicopters.
High Manuverability Fighter	movement	fixed-wing	Highly maneuverable fighter jet, such as the F-16.

Table C-1: System descriptions

System	Category	Entity Types	Description
Homing Torpedo Capability (Forward Launched)	weapon	subsurface, , , surface, , , rotary-wing, , , fixed-wing	Homing torpedo capability. Launched from forward tubes.
Human Disaggregated Movement	disaggregated	aggregate	Basic movement capabilities for any human disaggregated unit, both vehicle and DI.
Suicide Vest	weapon	human	Explosive device system that is worn by a lifeform.
Human Default	movement	human	Default movement dynamics for human entities. Manages movement and posture.
IFF Transponder	other	all	Sends IFF data, when turned on. IFF is off by default.
IR Sensor	sensor	all	Allows an entity to detect other objects through Infrared.
Laser Designator	other	all	A laser designator, which can aim a laser at targets. For use with a laser guided missile delivery system. This laser designator can be explicity tasked to designate particular targets, or set to autonomous lasing mode. In autonomous lasing mode, the laser will automatically designate hostile ground vehicles.
Laser Guided Hellfire Missile Launcher	weapon	fixed-wing, rotary-wing	Launches Hellfire missiles at targets that are lased with the laser code matching the one set in the launcher. Can only fire on targets designated with a laser.
Laser Guided Missile Dynamics	movement	missile	Movement dynamics for a laser guided missile. A missile using this type will require a laser on its target.
Default Armor	damage	human	Basic damage model for lifeform entities.
Limit Entity Existence	other	all	Used to control the life span of the object this system is attached to. Once it's life span is up the object is removed from the simulation.
M2HB Machine Gun	weapon	ground	Turreted M2 .50 Caliber Machine Gun, typical of the secondary gun on tanks such as the M1A2. M2 12.7mm rounds. Targets lifeforms.

Table C-1: System descriptions

System	Category	Entity Types	Description
M230 Chain Gun	weapon	ground, rotary-wing	M230 chain gun, mounted on the AH-64 Apache. Fires High Explosive Dual Purpose rounds that can penetrate 2 inches of armor, and that fragment to kill soft targets.
M240 Machine Gun	weapon	ground, rotary-wing	Vehicle mounted M240 7.62mm Machine Gun. Typical secondary gun on tanks such as the M1A2. Targets life-forms and unarmored vehicles.
M250 smoke grenade launcher	other	all	Allows an entity to launch thermal obscuring white phospherous (WP) smoke.
M252 81mm mortar	weapon	human	
M270 MLRS Launcher	weapon	ground	Turreted indirect fire weapon. Fires M26 rockets on command. Targets must be at least 2km away.
M284 155mm Cannon	weapon	ground	Turreted indirect fire weapon. Fires 155mm M107 rounds on command. Targets must be at least 2km away.
M60 Machine Gun	weapon	ground, rotary-wing	M60 7.62mm Machine Gun, typical vehicle machine gun. Replaced by M240. Targets lifeforms and unarmored vehicles.
MAD Sensor	sensor	all	Allows an entity to detect Subsurface entities using Magnetic Anomoly Detection.
Missile Default Armor	damage	missile, fixed-wing, scripted-movement	Basic armor for a missile.
Guided Missile Dynamics	movement	missile	Movement dynamics for a basic guided missile.
Missile Warhead	weapon	fixed-wing, subsurface, surface	Missile warhead. It explodes as soon as it hits another entity, the ground, or the surface of the water.
MK 45 Naval Gun	weapon	surface	Turreted indirect fire weapon. Fires 127mm rounds on command.
Naval Depth Charge Deployment	weapon	fixed-wing	Depth charge release system for naval depth charges.

Table C-1: System descriptions

System	Category	Entity Types	Description
Naval Mine Deployment	weapon	fixed-wing, subsurface, surface	Mine release system for naval (under-water) mines.
Naval Mine Dynamics	movement	all	Movement dynamics based on gravity and drag of object. Will also allow the object to stop at a certain altitude.
Naval Mine Explosive Device	weapon	bomb	Naval Mine device system. Allows 3 types of detonations -- instant, time-delayed, and proximity.
Naval Mine Sweep	other	surface	Execute task to sweep and disable naval mines.
Passive RADAR Sensor	sensor	all	Allows an entity to detect other objects through RADAR. No emitters are published for this sensor.
Passive SONAR Sensor	sensor	all	Allows an entity to detect other objects through SONAR.
Patriot Missile Launcher	weapon	ground	Turreted Patriot Missile Launcher. Targets air vehicles.
Periscope	other	subsurface	System that will allow modeling of a periscope.
Rotary Wing Attack	movement	rotary-wing	Attack Helicopter, such as the A-64.
Rotary Wing Default Armor	damage	rotary-wing	Basic armor for a rotary wing aircraft.
Rotary-wing Disaggre-gated Move-ment	disaggre-gated	aggregate	Basic movement capabilities for any rotary-wing-based disaggregated unit.
Cargo	movement	rotary-wing	General Cargo helicopter, such as the CH-53 Super Stallion.
Dipping SONAR Sensor	sensor	rotary-wing	Allows an entity to detect other objects through SONAR.
Utility	movement	rotary-wing	General utility helicopter, such as the UH-60 Blackhawk.
VTUAV	movement	rotary-wing	General Vertical Takeoff Unmanned Arial Vehicle such as the Dragon Warrior

Table C-1: System descriptions

System	Category	Entity Types	Description
SA-9 SAM Missile Launcher	weapon	ground	Turreted surface-to-air missile launcher which fires SA-9 missiles. Targets air vehicles.
Scripted Movement	scripted-movement	scripted-movement	System that will allow for scripted movements.
Small boat	movement	surface	Movement dynamics for small boats.
Bomb Dynamics	movement	bomb	Movement dynamics for a guided smart bomb.
SONAR Sensor	sensor	all	Allows an entity to detect other objects through SONAR.
Sonobuoy Deployer	other	all	System that allows an entity to deploy sonobuoys.
Space Shuttle	movement	fixed-wing	Based on the heavy plane flight dynamics.
Spot Report Generator	other	all	Allows the entity to send spot reports through its radio when its sensors detect other entities in the scenario.
Spot Report Receiver	other	all	Allows an entity to receive spot reports from other entities over the radio, and add these contacts to its list of known entities. By default, spot reports expire after 5 minutes.
Stinger Missile Launcher	weapon	ground	Turreted Stinger Missile Launcher. Targets air vehicles beteween 1km and 8km away, and fires guided stinger missiles at them.
Subsurface Entity Default	damage	subsurface	Basic damage model for subsurface entities.
Subsurface	movement	subsurface	Movement dynamics for a subsurface vessel.
Surface Entity Default	damage	surface	Basic damage model for a surface vessel
Surface Disaggregated Movement	disaggregated	aggregate	Basic movement capabilities for any surface-entity-based disaggregated unit.
Large Ship	movement	surface	Movement dynamics for a large ship.
Surface Multiple Hit Damage	damage	surface	Hit point based surface damage model

Table C-1: System descriptions

System	Category	Entity Types	Description
Torpedo Warhead	weapon	subsurface, , , surface	Torpedo warhead. It explodes as soon as it hits another entity, the ground, but not the surface of the water. Can also explode proximal to entity.
TOW Missile Launcher	weapon	ground	Turreted TOW Missile Launcher. Targets ground vehicles.
US Fighter Bomber Bomb Bay	weapon	fixed-wing, rotary-wing	Releases bombs in response to Release Bomb on Target, Location and Laser Spot tasks. Configured to launch bombs manufactured in the United States of America.
US Heavy Bomber Bomb Bay	weapon	fixed-wing, rotary-wing	Releases bombs in response to Release Bomb on Target, Location and Laser Spot tasks. Configured to launch bombs manufactured in the United States of America.
Vertical SAM Missile Launcher	weapon	ground, surface	surface-to-air missile launcher which fires SM-2 missiles. Targets cruise missiles.
Visual Sensor	sensor	all	Allows an entity to detect other objects through visible light.

Table C-2: System usage

System	Entities that Use System
120mm Gun	AMX-30 MBT, AMX-56 Leclerc MBT, Arjun MBT (No 3D), C1 Ariete MBT (No 3D), FV4030/4 Challenger MBT (No 3D), FV4034 Challenger 2 MBT (No 3D), K1A1 MBT (No 3D), Leopard 2 Tank, M1A2 Abrams MBT, Merkava III MBT (No 3D), Merkava IV MBT (No 3D), PT-91 Twardy MBT (No 3D), Type 10 MBT (No 3D), Type 90 Kyu-maru MBT (No 3D)
125mm Gun	MBT 2000 (No 3D), T-69 MBT, T-72 MBT, T-80 MBT, T-84 MBT (No 3D), T90A MBT (No 3D), Type 99 MBT (No 3D)
ADA Quad 14.5mm Machine Gun	ZPU-4 AA Gun, ZSU-23-4 Shilka
25mm Gun	AAVC7A1 Landing Vehicle, FV101 Scorpion CVR, M2A2 Bradley IFV, M3A2 Bradley CFV, MBT 2000 (No 3D), T-69 MBT, T-72 MBT, T-80 MBT, T-84 MBT (No 3D), T90A MBT (No 3D), Type 99 MBT (No 3D), XM7 FIST-Bradley
30mm Gun	BMP-2 AFV, FV 510 Warrior (No 3D), FV107 Scimitar (No 3D)

Table C-2: System usage

System	Entities that Use System
Active RADAR Sensor	Aircraft Carrier, Arleigh Burke-class Destroyer, Bay-class DLS (No 3D), Sentinel R1 (No 3D), Dabur-class Patrol Boat (No 3D), Durand de la Penne-class Destroyer (No 3D), Echo-class Survey Ship (No 3D), Guided Missile Destroyer, Guided Missile Frigate, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Henry J Kaiser-class Oiler (No 3D), Horizon-class Destroyer (No 3D), Hunt-class Minehunter (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), Kingston-class Patrol vessel (No 3D), L 14 Albion (No 3D), LPH01 Ocean (No 3D), Harpers Ferry-class LSD, MIM-104 Patriot Launcher, Osprey-class Mine CMS (No 3D), Nimitz-class Carrier, River-class Patrol Vessel (No 3D), Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), Sandown-class Minehunter (No 3D), Skjold-class Patrol (No 3D), Sovremenny-class Destroyer, Super Dvora Mark II (No 3D), Tiger-class Fast Attack Craft (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D)
Active SONAR Sensor	Sonobuoy (Passive)
Air Aggregate	
Air Cushion	, LCAC
Airborne Targeting RADAR	A-10 Thunderbolt, A-4 Skyhawk (No 3D), AV-8B Harrier II, B-2 Spirit, BAE CT-155 Hawk (No 3D), C-130 Hercules, C-17 Globe-master III (No 3D), C-5 Galaxy (No 3D), Cypher VTUAV, Dragon Warrior VTUAV, E-3 Sentry, EA-6B Prowler, Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, Hermes 450 (No 3D), Maveric UAS (No 3D), MiG-27 Flogger, MiG-29 Fulcrum, Mirage 2000, Mirage F1, MQ-9 Reaper UAV, P-3 Orion, MQ-1 Predator, RQ-11 Raven UAV, RQ-4 Global Hawk UAV (No 3D), RQ-7 Shadow UAV (No 3D), ScanEagle UAV (No 3D), SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker, Tornado ADV
Anti-Submarine Missile (Vertically Launched)	Arleigh Burke-class Destroyer, Type 23 Frigate (No 3D)
Building Default Damage	POL Storage Tank, Tower Radio
CIS Air Defense Missile Package	, MiG-29 Fulcrum, SU-27 Flanker
CIS Attack Heli-copter Missile Package	, KA-50 Hokum, Mi-24 Hind, Mi-28 Havoc
CIS Attack/Strike Missile Package	, MiG-27 Flogger, SU-25 Frogfoot, Su-37 Flanker

Table C-2: System usage

System	Entities that Use System
CIS Counter Measures Launcher	, KA-50 Hokum, Mi-24 Hind, Mi-28 Havoc, MiG-27 Flogger, MiG-29 Fulcrum, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker
CIS Fighter Bomber Bomb Bay	, MiG-27 Flogger, MiG-29 Fulcrum, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker
CIS Heavy Bomber Bomb Bay	
Counter Measures Launcher	A-10 Thunderbolt, A-4 Skyhawk (No 3D), AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), AV-8B Harrier II, BAE CT-155 Hawk (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), C-130 Hercules, C-17 Globemaster III (No 3D), C-5 Galaxy (No 3D), CH-148 Cyclone (No 3D), CH-46E Sea Knight, CH-47 Chinook (No 3D), CH-53E Super Stallion, EA-6B Prowler, EC145 (No 3D), EH101 Merlin (No 3D), Eurofighter Typhoon, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, HH-65 Dolphin (No 3D), KA-50 Hokum, MD 500 (No 3D), MH-47 Chinook (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-24 Hind, Mi-28 Havoc, Mi-2 Hoplite, MiG-27 Flogger, MiG-29 Fulcrum, Mirage 2000, Mirage F1, OH-58 Kiowa, P-3 Orion, RAH-66 Comanche, SA 330 Puma (No 3D), SH-3 Sea King (No 3D), SH-60 Seahawk, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker, Tornado ADV, UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D), V-22 Osprey (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D)
Cruise Missile	Exocet Cruise Missile, RUR-5 ASROC (No 3D)
DI Laser Designator	DI Lasing (CIS), DI Lasing (US)
Exocet Cruise Missile Launcher (Forward Launched)	, MiG-27 Flogger, Mirage 2000, SU-25 Frogfoot, Su-37 Flanker
Exocet Cruise Missile Launcher (Vertically Launched)	Arleigh Burke-class Destroyer, Durand de la Penne-class Destroyer (No 3D), Guided Missile Destroyer, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Horizon-class Destroyer (No 3D), Iroquois-class Destroyer (No 3D), KD-III-class Destroyer (No 3D), Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), Skjold-class Patrol (No 3D), Sovremenny-class Destroyer, Tiger-class Fast Attack Craft (No 3D), Type 42 Destroyer (No 3D), Type 22 Frigate (No 3D), Udaloy-class Destroyer (No 3D)
Explosive Device	Car Bomb, Duffle Bag, Naval Mine, Quickstrike Mk 65, Roadside IED, Sea Lance ASW, Suicide Bomber

Table C-2: System usage

System	Entities that Use System
Fall From Sky Dynamics	CIS Chaff, CIS Flare, , US Chaff, US Flare
Maverick Missile Launcher	A-10 Thunderbolt, A-4 Skyhawk (No 3D), AV-8B Harrier II, EA-6B Prowler, Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, Mirage F1, P-3 Orion, MQ-1 Predator, Tornado ADV
Sidewinder Missile Launcher	A-10 Thunderbolt, A-4 Skyhawk (No 3D), AV-8B Harrier II, BAE CT-155 Hawk (No 3D), Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, Mirage F1, Tornado ADV
Fixed Wing Default Armor	A-10 Thunderbolt, A-4 Skyhawk (No 3D), Airbus 310, Airbus 320, Airbus 380 (No 3D), AT-802 (No 3D), AV-8B Harrier II, B-2 Spirit, Beechcraft 36 Bonanza (No 3D), Beechcraft C-12 Super King (No 3D), Beechcraft T-6 (No 3D), BN-2 Islander (No 3D), Boeing 707, Boeing 737 British Midland, Boeing 747-400, Boeing 757 (No 3D), Boeing 767 (No 3D), Boeing 777 (No 3D), Boeing 787 (No 3D), Bombardier CL-600 (No 3D), Bombardier DHC-8 (No 3D), Sentinel R1 (No 3D), Bombardier CRJ100 Conrad Air, Bombardier CRJ200 Air France, C-130 Hercules, C-17 Globemaster III (No 3D), C-5 Galaxy (No 3D), Dornier DO 228-200 LGW, E-3 Sentry, EA-6B Prowler, Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, Gulfstream G550 (No 3D), Hermes 450 (No 3D), IAI 1124 Sea Scan (No 3D), Lockheed L-1011 (No 3D), Maveric UAS (No 3D), MiG-27 Flogger, MiG-29 Fulcrum, Mirage 2000, Mirage F1, MQ-9 Reaper UAV, P-3 Orion, MQ-1 Predator, RQ-11 Raven UAV, RQ-4 Global Hawk UAV (No 3D), RQ-7 Shadow UAV (No 3D), ScanEagle UAV (No 3D), Space Shuttle, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker, Tornado ADV
Fixed-wing Disaggregated Movement	
Fighter Jet	A-10 Thunderbolt, AV-8B Harrier II, B-2 Spirit, F-117A Nighthawk, MiG-27 Flogger, SU-25 Frogfoot, Su-37 Flanker
Heavy Plane	Airbus 310, Airbus 320, Airbus 380 (No 3D), AT-802 (No 3D), Beechcraft 36 Bonanza (No 3D), Beechcraft C-12 Super King (No 3D), Beechcraft T-6 (No 3D), BN-2 Islander (No 3D), Boeing 707, Boeing 737 British Midland, Boeing 747-400, Boeing 757 (No 3D), Boeing 767 (No 3D), Boeing 777 (No 3D), Boeing 787 (No 3D), Bombardier CL-600 (No 3D), Bombardier DHC-8 (No 3D), Sentinel R1 (No 3D), Bombardier CRJ100 Conrad Air, Bombardier CRJ200 Air France, C-130 Hercules, C-17 Globemaster III (No 3D), C-5 Galaxy (No 3D), Dornier DO 228-200 LGW, E-3 Sentry, EA-6B Prowler, Gulfstream G550 (No 3D), IAI 1124 Sea Scan (No 3D), Lockheed L-1011 (No 3D), P-3 Orion

Table C-2: System usage

System	Entities that Use System
High Manuver-ability Fighter	
Frictionless Gravity Dynamics	M107 155mm, M374A2 81mm
Ground Aggre-gated Movement	ADA Plt (CIS), ADA Plt (US), Armor Co (CIS), Armor Co (US), Armor Co HQ (CIS), Armor Co HQ (US), Armor Plt (CIS), Armor Plt (US), COLT Team (CIS), COLT Team (US), CSS Plt (CIS), CSS Plt (US), DI Plt (CIS), DI Squad (CIS), DI Squad (US), FA Battery (US), Ground Aggregate, MI Plt (CIS), MI Plt with IFV (US), USMC FT, USMC SQD, US Army LtInf FT, US Army LtInf SQD, US Army Mech FT A (Javelin), US Army Mech FT B, US Army Mech SQD
Ground Convoy Movement	Convoy
Ground Disaggre-gated Movement	ADA Plt (CIS), ADA Plt (US), Armor Co (CIS), Armor Co (US), Armor Co HQ (CIS), Armor Co HQ (US), Armor Plt (CIS), Armor Plt (US), CSS Plt (CIS), CSS Plt (US), DI Squad (US), FA Battery (US), Ground Aggregate, MI Plt (CIS), MI Plt with IFV (US)
Heavy Armor	AMX-30 MBT, AMX-56 Leclerc MBT, Arjun MBT (No 3D), Badger AEV (No 3D), Beaver AVLB (No 3D), Buffalo MRAP III (No 3D), Buffel ARV (No 3D), C1 Ariete MBT (No 3D), FV4030/4 Chal-lenger MBT (No 3D), FV4034 Challenger 2 MBT (No 3D), K1A1 MBT (No 3D), Leopard 2 Tank, M1A2 Abrams MBT, MBT 2000 (No 3D), Merkava III MBT (No 3D), Merkava IV MBT (No 3D), MRAP-ATV (No 3D), MRAP-CAT II Cougar (No 3D), MRAP-CAT I MaxxPro (No 3D), PT-91 Twardy MBT (No 3D), T-69 MBT, T-72 MBT, T-80 MBT, T-84 MBT (No 3D), T90A MBT (No 3D), Taurus ARV (No 3D), Type 10 MBT (No 3D), Type 90 Kyu-maru MBT (No 3D), Type 99 MBT (No 3D), VM 90 LSVW (No 3D)
Light Armor damage model.	Aardvark JSFU (No 3D), AAVC7A1 Landing Vehicle, Achzarit APC (No 3D), AS-90 Artillery (No 3D), Bison APC (No 3D), BMP-2 AFV, BTR-80 APC, CAESAR SP Howitzer, Cougar FSV (No 3D), Coyote APC (No 3D), FV 510 Warrior (No 3D), FV101 Scor-pion CVR, FV107 Scimitar (No 3D), FV432 APC (No 3D), Grizzly APC (No 3D), Husky ARV (No 3D), L-118 Howitzer (No 3D), LAV III APC (No 3D), LG1 Howitzer (No 3D), M-71 Howitzer (No 3D), M109 Howitzer, M1126 Stryker ICV, M113 APC, M252 Mortar (No 3D), M2A2 Bradley IFV, M3A2 Bradley CFV, M577A2 Command Post, M777 Howitzer (No 3D), M88 Medium Recovery Vehicle, M993 MLRS, M9 ACE, Mamba APC (No 3D), MT-LB APC, Namer APC (No 3D), Puma CEV (No 3D), Rapier SAM (No 3D), SA-15 Gauntlet SAM, SA-19 Grison, SA-6 Gainful SAM, SA-9 Gaskin SAM System, VAB APC, VBL ATV, XM7 FIST-Bradley, ZPU-4 AA Gun, ZSU-23-4 Shilka

Table C-2: System usage

System	Entities that Use System
Tracks	Aardvark JSFU (No 3D), Achzarit APC (No 3D), AMX-30 MBT, AMX-56 Leclerc MBT, Arjun MBT (No 3D), AS-90 Artillery (No 3D), Badger AEV (No 3D), Beaver AVLB (No 3D), Bison APC (No 3D), BMP-2 AFV, BTR-80 APC, Buffel ARV (No 3D), C1 Ariete MBT (No 3D), Cougar FSV (No 3D), Coyote APC (No 3D), FV 510 Warrior (No 3D), FV101 Scorpion CVR, FV107 Scimitar (No 3D), FV4030/4 Challenger MBT (No 3D), FV4034 Challenger 2 MBT (No 3D), FV432 APC (No 3D), Grizzly APC (No 3D), Husky ARV (No 3D), K1A1 MBT (No 3D), LAV III APC (No 3D), Leopard 2 Tank, LG1 Howitzer (No 3D), M-71 Howitzer (No 3D), M109 Howitzer, M1A2 Abrams MBT, M252 Mortar (No 3D), M2A2 Bradley IFV, M3A2 Bradley CFV, M577A2 Command Post, M777 Howitzer (No 3D), M88 Medium Recovery Vehicle, M993 MLRS, M9 ACE, Mamba APC (No 3D), MBT 2000 (No 3D), Merkava III MBT (No 3D), Merkava IV MBT (No 3D), MT-LB APC, Namer APC (No 3D), PT-91 Twardy MBT (No 3D), Puma CEV (No 3D), Rapier SAM (No 3D), SA-15 Gauntlet SAM, SA-19 Grison, SA-6 Gainful SAM, T-69 MBT, T-72 MBT, T-80 MBT, T-84 MBT (No 3D), T90A MBT (No 3D), Taurus ARV (No 3D), Type 10 MBT (No 3D), Type 90 Kyu-maru MBT (No 3D), Type 99 MBT (No 3D), VAB APC, VBL ATV, XM7 FIST-Bradley, ZSU-23-4 Shilka
Tracks/Amphibious	AAVC7A1 Landing Vehicle
No Armor	Actros AHSVS (No 3D), Ambulance, BV206 SUSV (No 3D), Car Bomb, Civilian vehicle, Cow, Defense Satellite, Duffle Bag, Female On Bike, Fire Engine, Fuel Tanker Trailer, G-Wagen (No 3D), GAZ-69 Utility Vehicle, Goat, HMMWV Utility Vehicle, HMMWV with Avenger, HMMWV with M2, HMMWV with Shelter, HMMWV with TOW launcher, Horse, Horse with Rider, Iveco LMV (No 3D), Jackal MWMIK (No 3D), Jet Ski, Land Rover Wolf (No 3D), LCAC, M-Gator ATV (No 3D), M35 Truck, M58 MICLIC, M939A2 5-Ton Truck, M977 HEMTT Cargo Truck, M978 HEMTT Fuel Truck, Male On Bike, MILCOTTS Silverado (No 3D), MIM-104 Patriot Launcher, Mule, Navistar 7000 (No 3D), Police Car, Rigid-Hulled Inflatable Boat, Rigid-Hulled Inflatable Boat - Civilian, Roadside IED, Sailboat, Sheep, Speedboat, Technical Truck, Tractor Trailer Cab, Tractor Trailer with Cab, Water Buffalo, ZIL-135 8x8 Truck

Table C-2: System usage

System	Entities that Use System
Wheels (off road)	Actros AHSVS (No 3D), Buffalo MRAP III (No 3D), CAESAR SP Howitzer, Cow, Female On Bike, Fire Engine, GAZ-69 Utility Vehicle, Goat, HMMWV Utility Vehicle, HMMWV with Avenger, HMMWV with M2, HMMWV with Shelter, HMMWV with TOW launcher, Horse, Horse with Rider, Iveco LMV (No 3D), Jackal MWMIK (No 3D), Land Rover Wolf (No 3D), M1126 Stryker ICV, M113 APC, M35 Truck, M58 MICLIC, M939A2 5-Ton Truck, M977 HEMTT Cargo Truck, M978 HEMTT Fuel Truck, Male On Bike, MIM-104 Patriot Launcher, MRAP-ATV (No 3D), MRAP-CAT II Cougar (No 3D), MRAP-CAT I MaxxPro (No 3D), Mule, Navistar 7000 (No 3D), SA-9 Gaskin SAM System, Sheep, Technical Truck, VM 90 LSVW (No 3D), Water Buffalo, ZIL-135 8x8 Truck
Wheels (road)	Ambulance, BV206 SUSV (No 3D), Car Bomb, Civilian vehicle, Fuel Tanker Trailer, G-Wagen (No 3D), M-Gator ATV (No 3D), MILCOTTS Silverado (No 3D), Police Car, Tractor Trailer Cab, Tractor Trailer with Cab
AK-47	DI AK-47, DI Lasing (CIS), Mideast Combatant, Taliban
AT4	Chilean AT4, US Army AT4
M16 rifle	Chilean IMI Galil, Chilean M16-M203, Chilean M16, Chilean M4, DI Lasing (US), DI SMAW And Rifle, Police Officer, Sergeant M16, Suspect, USMC M16-M203, USMC M16, USMC M4, US Army M16-M203, US Army M16, US Army M4, US Army M9
M240B Machine Gun	Chilean M240, USMC M240, US Army M240
M249 SAW	Chilean M249, USMC M249, US Army M249
M60 Machine Gun	Chilean M60, US Army M60
RPG Launcher	DI RPG, , Mideast Combatant with RPG, US Army Javelin
High Manuverability Fighter	Maveric UAS (No 3D), RQ-11 Raven UAV, RQ-7 Shadow UAV (No 3D), ScanEagle UAV (No 3D)
Homing Torpedo Capability (Forward Launched)	Arleigh Burke-class Destroyer, Astute-class Submarine (No 3D), Dolphin-class Submarine (No 3D), Durand de la Penne-class Destroyer (No 3D), Guided Missile Destroyer, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Iroquois-class Destroyer (No 3D), KD-III-class Destroyer (No 3D), Kingston-class Patrol vessel (No 3D), Los Angeles-Class Submarine, Ohio-class Submarine, Romeo-class Submarine, RUR-5 ASROC (No 3D), Scorpene-class Submarine (No 3D), SH-60 Seahawk, Song-class Submarine, Sovremenny-class Destroyer, Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D), Ula-class Submarine (No 3D), Vanguard-class Submarine (No 3D), Victoria-class (No 3D), Walrus-class submarine (No 3D)

Table C-2: System usage

System	Entities that Use System
Human Disaggregated Movement	COLT Team (CIS), COLT Team (US), DI Plt (CIS), DI Squad (CIS), USMC FT, USMC SQD, US Army LtInf FT, US Army LtInf SQD, US Army Mech FT A (Javelin), US Army Mech FT B, US Army Mech SQD
Suicide Vest	Suicide Bomber
Human Default	Cameraman, Chicken, Child, Child (Crowd Behavior), Chilean AT4, Chilean IMI Galil, Chilean M16-M203, Chilean M16, Chilean M240, Chilean M249, Chilean M4, Chilean M60, Civilian (Chem/Bio Behavior), Civilian Female, Civilian Male, DI AK-47, DI Lasing (CIS), DI Lasing (US), DI RPG, DI SMAW And Rifle, Factory Worker, Female Civilian (Crowd Behavior), Female Dancer, Fireman (Extinguisher), Fireman (Hose), Flight Deck Crew, Flight Deck Crewman, Flight Deck Crew (Chock And Chains), Flight Deck Crew (Grounding Cable), Flight Deck Crew (Pallet Handler), Flight Deck Worker, Male Civilian (Crowd Behavior), Man in Wheelchair, Mideast Combatant, Mideast Combatant with RPG, Mideast Female, Mideast Female (Crowd Behavior), Mideast Male, Mideast Male (Crowd Behavior), Mother, Police Officer, Sergeant M16, Suicide Bomber, Suspect, Taliban, US Army Medic, US EOD, USMC M16-M203, USMC M16, USMC M240, USMC M249, USMC M4, US Army AT4, US Army Javelin, US Army M16-M203, US Army M16, US Army M240, US Army M249, US Army M4, US Army M60, US Army M9, Western Teen

Table C-2: System usage

System	Entities that Use System
IFF Transponder	A-10 Thunderbolt, A-4 Skyhawk (No 3D), AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), Airbus 310, Airbus 320, Airbus 380 (No 3D), AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), Astute-class Submarine (No 3D), AT-802 (No 3D), AV-8B Harrier II, B-2 Spirit, BAE CT-155 Hawk (No 3D), Bay-class DLS (No 3D), Beechcraft 36 Bonanza (No 3D), Beechcraft C-12 Super King (No 3D), Beechcraft T-6 (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), BN-2 Islander (No 3D), Boeing 707, Boeing 737 British Midland, Boeing 747-400, Boeing 757 (No 3D), Boeing 767 (No 3D), Boeing 777 (No 3D), Boeing 787 (No 3D), Bombardier CL-600 (No 3D), Bombardier DHC-8 (No 3D), Sentinel R1 (No 3D), Bombardier CRJ100 Conrad Air, Bombardier CRJ200 Air France, C-130 Hercules, C-17 Globemaster III (No 3D), C-5 Galaxy (No 3D), Canadair CT-114 (No 3D), CH-148 Cyclone (No 3D), CH-149 Cormorant, CH-46E Sea Knight, CH-47 Chinook (No 3D), CH-53E Super Stallion, Cypher VTUAV, Dabur-class Patrol Boat (No 3D), Dornier DO 228-200 LGW, Dragon Warrior VTUAV, Durand de la Penne-class Destroyer (No 3D), E-3 Sentry, EA-6B Prowler, EC145 (No 3D), Echo-class Survey Ship (No 3D), EH101 Merlin (No 3D), Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, Gulfstream G550 (No 3D), Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), HH-65 Dolphin (No 3D), Horizon-class Destroyer (No 3D), Hunt-class Minehunter (No 3D), IAI 1124 Sea Scan (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), KA-50 Hokum, KD-III-class Destroyer (No 3D), L 14 Albion (No 3D), Lockheed L-1011 (No 3D), LPH01 Ocean (No 3D), MD 500 (No 3D), MH-47 Chinook (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-24 Hind, Mi-28 Havoc, Mi-2 Hoplite, MiG-27 Flogger, MiG-29 Fulcrum, Mirage 2000, Mirage F1, Nimitz-class Carrier, OH-58 Kiowa, P-3 Orion, RAH-66 Comanche, River-class Patrol Vessel (No 3D), SA 330 Puma (No 3D), Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), SH-3 Sea King (No 3D), SH-60 Seahawk, Sovremenny-class Destroyer, Space Shuttle, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker, Tornado ADV, Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D), UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D), V-22 Osprey (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D)

Table C-2: System usage

System	Entities that Use System
IFF Transponder (continued)	A-10 Thunderbolt, A-4 Skyhawk (No 3D), AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), Airbus 310, Airbus 320, Airbus 380 (No 3D), AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), Astute-class Submarine (No 3D), AT-802 (No 3D), AV-8B Harrier II, B-2 Spirit, BAE CT-155 Hawk (No 3D), Bay-class DLS (No 3D), Beechcraft 36 Bonanza (No 3D), Beechcraft C-12 Super King (No 3D), Beechcraft T-6 (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), BN-2 Islander (No 3D), Boeing 707, Boeing 737 British Midland, Boeing 747-400, Boeing 757 (No 3D), Boeing 767 (No 3D), Boeing 777 (No 3D), Boeing 787 (No 3D), Bombardier CL-600 (No 3D), Bombardier DHC-8 (No 3D), Sentinel R1 (No 3D), Bombardier CRJ100 Conrad Air, Bombardier CRJ200 Air France, C-130 Hercules, C-17 Globemaster III (No 3D), C-5 Galaxy (No 3D), Canadair CT-114 (No 3D), CH-148 Cyclone (No 3D), CH-149 Cormorant, CH-46E Sea Knight, CH-47 Chinook (No 3D), CH-53E Super Stallion, Cypher VTUAV, Dabur-class Patrol Boat (No 3D), Dornier DO 228-200 LGW, Dragon Warrior VTUAV, Durand de la Penne-class Destroyer (No 3D), E-3 Sentry, EA-6B Prowler, EC145 (No 3D), Echo-class Survey Ship (No 3D), EH101 Merlin (No 3D), Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, Gulfstream G550 (No 3D), Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), HH-65 Dolphin (No 3D), Horizon-class Destroyer (No 3D), Hunt-class Minehunter (No 3D), IAI 1124 Sea Scan (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), KA-50 Hokum, KD-III-class Destroyer (No 3D), L 14 Albion (No 3D), Lockheed L-1011 (No 3D), LPH01 Ocean (No 3D), MD 500 (No 3D), MH-47 Chinook (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-24 Hind, Mi-28 Havoc, Mi-2 Hoplite, MiG-27 Flogger, MiG-29 Fulcrum, Mirage 2000, Mirage F1, Nimitz-class Carrier, OH-58 Kiowa, P-3 Orion, RAH-66 Comanche, River-class Patrol Vessel (No 3D), SA 330 Puma (No 3D), Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), SH-3 Sea King (No 3D), SH-60 Seahawk, Sovremenny-class Destroyer, Space Shuttle, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker, Tornado ADV, Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D), UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D), V-22 Osprey (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D)

Table C-2: System usage

System	Entities that Use System
IR Sensor	AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), Arleigh Burke-class Destroyer, AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), CH-148 Cyclone (No 3D), CH-149 Cormorant, CH-46E Sea Knight, CH-47 Chinook (No 3D), CH-53E Super Stallion, Dabur-class Patrol Boat (No 3D), EC145 (No 3D), Echo-class Survey Ship (No 3D), EH101 Merlin (No 3D), Hermes 450 (No 3D), HH-65 Dolphin (No 3D), HMMWV with Avenger, Island-class Patrol Vessel (No 3D), KA-50 Hokum, Maveric UAS (No 3D), MD 500 (No 3D), MH-47 Chinook (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-24 Hind, Mi-28 Havoc, Mi-2 Hoplite, MQ-9 Reaper UAV, OH-58 Kiowa, MQ-1 Predator, RAH-66 Comanche, River-class Patrol Vessel (No 3D), RQ-11 Raven UAV, RQ-4 Global Hawk UAV (No 3D), RQ-7 Shadow UAV (No 3D), SA 330 Puma (No 3D), Sandown-class Minehunter (No 3D), ScanEagle UAV (No 3D), SH-3 Sea King (No 3D), SH-60 Seahawk, Type 42 Destroyer (No 3D), UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D), V-22 Osprey (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D)
Laser Designator	DI Lasing (CIS), DI Lasing (US)
Laser Guided Hellfire Missile Launcher	AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MQ-9 Reaper UAV, RAH-66 Comanche
Laser Guided Missile Dynamics	Laser Guided Hellfire Missile
Default Armor	Cameraman, Chicken, Child, Child (Crowd Behavior), Child (Injured), Chilean AT4, Chilean IMI Galil, Chilean M16-M203, Chilean M16, Chilean M240, Chilean M249, Chilean M4, Chilean M60, Civilian (Chem/Bio Behavior), Civilian Female, Civilian Male, DI AK-47, DI Lasing (CIS), DI Lasing (US), DI RPG, DI SMAW And Rifle, Factory Worker, Female Civilian (Crowd Behavior), Female Dancer, Fireman (Extinguisher), Fireman (Hose), Flight Deck Crew, Flight Deck Crewman, Flight Deck Crew (Chock And Chains), Flight Deck Crew (Grounding Cable), Flight Deck Crew (Pallet Handler), Flight Deck Worker, Male Civilian (Crowd Behavior), Man in Wheelchair, Mideast Combatant, Mideast Combatant with RPG, Mideast Female, Mideast Female (Crowd Behavior), Mideast Male, Mideast Male (Crowd Behavior), Mother, Police Officer, Sergeant M16, Suicide Bomber, Suspect, Taliban, US Army Medic, US EOD, USMC M16-M203, USMC M16, USMC M240, USMC M249, USMC M4, US Army AT4, US Army Javelin, US Army M16-M203, US Army M16, US Army M240, US Army M249, US Army M4, US Army M60, US Army M9, Western Teen
Limit Entity Existence	CIS Chaff, CIS Flare, , Mk-46 MOD 5 Torpedo (No 3D), Mk-48 ADCAP Torpedo, RUR-5 ASROC (No 3D), US Chaff, US Flare

Table C-2: System usage

System	Entities that Use System
M2HB Machine Gun	Achzarit APC (No 3D), Badger AEV (No 3D), BTR-80 APC, Buffel ARV (No 3D), HMMWV with M2, Leopard 2 Tank, M1126 Stryker ICV, M113 APC, MT-LB APC, Namer APC (No 3D), Rigid-Hulled Inflatable Boat, Taurus ARV (No 3D), Technical Truck, Type 10 MBT (No 3D), Type 90 Kyu-maru MBT (No 3D), VAB APC
M230 Chain Gun	AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), MH-60L Black Hawk DAP (No 3D), RAH-66 Comanche, Westland Lynx (No 3D)
M240 Machine Gun	Arjun MBT (No 3D), Bison APC (No 3D), C1 Ariete MBT (No 3D), Cougar FSV (No 3D), Coyote APC (No 3D), FV4034 Challenger 2 MBT (No 3D), FV432 APC (No 3D), Grizzly APC (No 3D), HH-65 Dolphin (No 3D), Husky ARV (No 3D), Iveco LMV (No 3D), Jackal MWMIK (No 3D), LAV III APC (No 3D), M1A2 Abrams MBT, Mamba APC (No 3D), MBT 2000 (No 3D), MH-47 Chinook (No 3D), MRAP-ATV (No 3D), MRAP-CAT II Cougar (No 3D), MRAP-CAT I MaxxPro (No 3D), PT-91 Twardy MBT (No 3D), T-84 MBT (No 3D), T90A MBT (No 3D), Type 99 MBT (No 3D), USMC M240, V-22 Osprey (No 3D), VM 90 LSVW (No 3D)
M250 smoke grenade launcher	Achzarit APC (No 3D), Arjun MBT (No 3D), Badger AEV (No 3D), Buffel ARV (No 3D), M1A2 Abrams MBT, Merkava III MBT (No 3D), Merkava IV MBT (No 3D), Namer APC (No 3D), Puma CEV (No 3D), Taurus ARV (No 3D), Type 10 MBT (No 3D)
M252 81mm mortar	M252 Mortar (No 3D)
M270 MLRS Launcher	M993 MLRS
M284 155mm Cannon	AS-90 Artillery (No 3D), CAESAR SP Howitzer, L-118 Howitzer (No 3D), LG1 Howitzer (No 3D), M-71 Howitzer (No 3D), M109 Howitzer, M777 Howitzer (No 3D)
M60 Machine Gun	CH-148 Cyclone (No 3D), CH-47 Chinook (No 3D), MH-60 Black Hawk, SH-3 Sea King (No 3D)
MAD Sensor	CH-46E Sea Knight
Missile Default Armor	AA-11 Archer Missile, AA-8 Aphid Missile, AGM-65 Maverick Missile, AIM-9 Sidewinder Missile, AS-12 Kegler Missile, AS-14 Kedge Missile, AS-7 Kerry Missile, AT-6 Spiral Missile, BGM-71 TOW Missile, Exocet Cruise Missile, FIM-92 Stinger Missile, Hell-fire Missile, Laser Guided Hellfire Missile, M39 Missile, MIM004 Patriot Missile, RUR-5 ASROC (No 3D), SA-9 Missile, Scud-B Missile, SM-2 Standard Missile, SS-24 Scalpel Missile, SS-24 Scalpel Stage

Table C-2: System usage

System	Entities that Use System
Guided Missile Dynamics	AA-11 Archer Missile, AA-8 Aphid Missile, AGM-65 Maverick Missile, AIM-9 Sidewinder Missile, AS-12 Kegler Missile, AS-14 Kedge Missile, AS-7 Kerry Missile, AT-6 Spiral Missile, BGM-71 TOW Missile, Exocet Cruise Missile, FIM-92 Stinger Missile, Hellfire Missile, Laser Guided Hellfire Missile, MIM004 Patriot Missile, RUR-5 ASROC (No 3D), SA-9 Missile, SM-2 Standard Missile
Missile Warhead	Exocet Cruise Missile, M107 155mm, M374A2 81mm, SM-2 Standard Missile
MK 45 Naval Gun	Arleigh Burke-class Destroyer, Bay-class DLS (No 3D), Dabur-class Patrol Boat (No 3D), Durand de la Penne-class Destroyer (No 3D), Echo-class Survey Ship (No 3D), Guided Missile Destroyer, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Hunt-class Minehunter (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), KD-III-class Destroyer (No 3D), Kingston-class Patrol vessel (No 3D), L 14 Albion (No 3D), LPH01 Ocean (No 3D), Oskoy-class Minehunter (No 3D), River-class Patrol Vessel (No 3D), Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Skjold-class Patrol (No 3D), Sovremenny-class Destroyer, Super Dvora Mark II (No 3D), Tiger-class Fast Attack Craft (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D)
Naval Depth Charge Deployment	B-2 Spirit, P-3 Orion
Naval Mine Deployment	B-2 Spirit, Durand de la Penne-class Destroyer (No 3D), Halifax-class Frigate (No 3D), Horizon-class Destroyer (No 3D), Hunt-class Minehunter (No 3D), Osprey-class Mine CMS (No 3D), P-3 Orion, Sandown-class Minehunter (No 3D), Skjold-class Patrol (No 3D), Sovremenny-class Destroyer, Tiger-class Fast Attack Craft (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D)
Naval Mine Dynamics	Naval Mine, Quickstrike Mk 65, Sea Lance ASW
Naval Mine Explosive Device	Naval Mine, Quickstrike Mk 65, Sea Lance ASW
Naval Mine Sweep	Alta-class Minehunter (No 3D), Hunt-class Minehunter (No 3D), Kingston-class Patrol vessel (No 3D), Osprey-class Mine CMS (No 3D), Oskoy-class Minehunter (No 3D), Sandown-class Minehunter (No 3D), Tiger-class Fast Attack Craft (No 3D)

Table C-2: System usage

System	Entities that Use System
Passive RADAR Sensor	Arleigh Burke-class Destroyer, Dabur-class Patrol Boat (No 3D), Echo-class Survey Ship (No 3D), Hunt-class Minehunter (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), KD-III-class Destroyer (No 3D), Rapier SAM (No 3D), River-class Patrol Vessel (No 3D), SA-15 Gauntlet SAM, SA-19 Grison, SA-6 Gainful SAM, SA-9 Gaskin SAM System, Sandown-class Minehunter (No 3D), Scorpene-class Submarine (No 3D), Type 209 Submarine (No 3D), Type 23 Frigate (No 3D), Vanguard-class Submarine (No 3D), Victoria-class (No 3D)
Passive SONAR Sensor	Sonobuoy (Passive)
Patriot Missile Launcher	MIM-104 Patriot Launcher
Periscope	Astute-class Submarine (No 3D), Dolphin-class Submarine (No 3D), Los Angeles-Class Submarine, Ohio-class Submarine, Romeo-class Submarine, Scorpene-class Submarine (No 3D), Song-class Submarine, Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Ula-class Submarine (No 3D), Vanguard-class Submarine (No 3D), Victoria-class (No 3D), Walrus-class submarine (No 3D)
Rotary Wing Attack	AH-1W SuperCobra, AH-64A Apache, AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), HH-65 Dolphin (No 3D), KA-50 Hokum, Mi-24 Hind, Mi-28 Havoc, RAH-66 Comanche
Rotary Wing Default Armor	AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), CH-148 Cyclone (No 3D), CH-149 Cormorant, CH-46E Sea Knight, CH-47 Chinook (No 3D), CH-53E Super Stallion, Cypher VTUAV, Dragon Warrior VTUAV, EC145 (No 3D), EH101 Merlin (No 3D), HH-65 Dolphin (No 3D), KA-50 Hokum, MD 500 (No 3D), MH-47 Chinook (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-24 Hind, Mi-28 Havoc, Mi-2 Hoplite, OH-58 Kiowa, RAH-66 Comanche, SA 330 Puma (No 3D), SH-3 Sea King (No 3D), SH-60 Seahawk, UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D), V-22 Osprey (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D)
Rotary-wing Disaggregated Movement	
Cargo	CH-148 Cyclone (No 3D), CH-47 Chinook (No 3D), CH-53E Super Stallion, EH101 Merlin (No 3D), MH-47 Chinook (No 3D), SA 330 Puma (No 3D), SH-3 Sea King (No 3D), V-22 Osprey (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D)
Dipping SONAR Sensor	CH-46E Sea Knight, SH-3 Sea King (No 3D)

Table C-2: System usage

System	Entities that Use System
Utility	AH-6 Little Bird (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), CH-149 Cormorant, CH-46E Sea Knight, EC145 (No 3D), MD 500 (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-2 Hoplite, OH-58 Kiowa, SH-60 Seahawk, UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D)
VTUAV	Cypher VTUAV, Dragon Warrior VTUAV
SA-9 SAM Missile Launcher	Rapier SAM (No 3D), SA-15 Gauntlet SAM, SA-19 Grison, SA-6 Gainful SAM, SA-9 Gaskin SAM System
Scripted Movement	M39 Missile, Scud-B Missile, SS-24 Scalpel Missile, SS-24 Scalpel Stage
Small boat	Dabur-class Patrol Boat (No 3D), Echo-class Survey Ship (No 3D), Hauk-class Fast Attack (No 3D), Island-class Patrol Vessel (No 3D), Jet Ski, Rigid-Hulled Inflatable Boat, Rigid-Hulled Inflatable Boat - Civilian, River-class Patrol Vessel (No 3D), Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), Sailboat, Skjold-class Patrol (No 3D), Speedboat, Super Dvora Mark II (No 3D), Tiger-class Fast Attack Craft (No 3D)
Bomb Dynamics	CBU-105 SFW, GBU-31A JDAM, KAB-500N Bomb
SONAR Sensor	Aircraft Carrier, AN/BLQ-11 UUV (No 3D), Arleigh Burke-class Destroyer, Astute-class Submarine (No 3D), Bay-class DLS (No 3D), CH-46E Sea Knight, Dolphin-class Submarine (No 3D), Durand de la Penne-class Destroyer (No 3D), Guided Missile Destroyer, Guided Missile Frigate, Halifax-class Frigate (No 3D), Horizon-class Destroyer (No 3D), Hunt-class Minehunter (No 3D), Iroquois-class Destroyer (No 3D), KD-III-class Destroyer (No 3D), Kingston-class Patrol vessel (No 3D), L 14 Albion (No 3D), Los Angeles-Class Submarine, LPH01 Ocean (No 3D), Harpers Ferry-class LSD, Osprey-class Mine CMS (No 3D), Mk-46 MOD 5 Torpedo (No 3D), Mk-48 ADCAP Torpedo, Nimitz-class Carrier, Ohio-class Submarine, REMUS UUV (No 3D), Romeo-class Submarine, Saar 5-class Corvette (No 3D), Sandown-class Minehunter (No 3D), Scorpene-class Submarine (No 3D), SH-3 Sea King (No 3D), SH-60 Seahawk, Skjold-class Patrol (No 3D), Song-class Submarine, Sonobuoy (Passive), Sovremenny-class Destroyer, Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D), Ula-class Submarine (No 3D), Victoria-class (No 3D)

Table C-2: System usage

System	Entities that Use System
Sonobuoy Deployer	Bay-class DLS (No 3D), Dabur-class Patrol Boat (No 3D), Echo-class Survey Ship (No 3D), Halifax-class Frigate (No 3D), Horizon-class Destroyer (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), L 14 Albion (No 3D), LPH01 Ocean (No 3D), P-3 Orion, River-class Patrol Vessel (No 3D), Tiger-class Fast Attack Craft (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D)
Space Shuttle	Space Shuttle
Spot Report Generator	A-10 Thunderbolt, A-4 Skyhawk (No 3D), Aardvark JSFU (No 3D), AAVC7A1 Landing Vehicle, Achzarit APC (No 3D), Actros AHSVS (No 3D), AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), Aircraft Carrier, AMX-30 MBT, AMX-56 Leclerc MBT, AN/BLQ-11 UUV (No 3D), Arjun MBT (No 3D), Arleigh Burke-class Destroyer, AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), AS-90 Artillery (No 3D), AV-8B Harrier II, B-2 Spirit, Badger AEV (No 3D), BAE CT-155 Hawk (No 3D), Bay-class DLS (No 3D), Beaver AVLB (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), Bison APC (No 3D), BMP-2 AFV, BN-2 Islander (No 3D), BTR-80 APC, Buffalo MRAP III (No 3D), Buffel ARV (No 3D), C-130 Hercules, C-17 Globe-master III (No 3D), C-5 Galaxy (No 3D), C1 Ariete MBT (No 3D), CAESAR SP Howitzer, Canadair CT-114 (No 3D), CH-148 Cyclone (No 3D), CH-149 Cormorant, CH-46E Sea Knight, CH-47 Chinook (No 3D), CH-53E Super Stallion, Chilean AT4, Chilean IMI Galil, Chilean M16-M203, Chilean M16, Chilean M240, Chilean M249, Chilean M4, Chilean M60, Cougar FSV (No 3D), Coyote APC (No 3D), Cypher VTUAV, Dabur-class Patrol Boat (No 3D), Defense Satellite, DI AK-47, DI Lasing (CIS), DI Lasing (US), DI RPG, DI SMAW And Rifle, Dolphin-class Submarine (No 3D), Dragon Warrior VTUAV, E-3 Sentry, EA-6B Prowler, EC145 (No 3D), Echo-class Survey Ship (No 3D), EH101 Merlin (No 3D), Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, FV 510 Warrior (No 3D), FV101 Scorpion CVR, FV107 Scimitar (No 3D), FV4030/4 Challenger MBT (No 3D), FV4034 Challenger 2 MBT (No 3D), FV432 APC (No 3D), F/A-18 Hornet, GAZ-69 Utility Vehicle, Grizzly APC (No 3D), Guided Missile Destroyer, Guided Missile Frigate, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Hermes 450 (No 3D), HH-65 Dolphin (No 3D), HMMWV Utility Vehicle, HMMWV with Avenger, HMMWV with M2, HMMWV with Shelter, HMMWV with TOW launcher, Husky ARV (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), Iveco LMV (No 3D), Jackal MWMIK (No 3D), K1A1 MBT (No 3D), KA-50 Hokum, KD-III-class Destroyer (No 3D), Kingston-class Patrol vessel (No 3D), L 14 Albion (No 3D), L-118 Howitzer (No 3D), Land Rover Wolf (No 3D), LAV III APC (No 3D), LCAC, Leopard 2 Tank

Table C-2: System usage

System	Entities that Use System
Spot Report Generator	LG1 Howitzer (No 3D), Lockheed L-1011 (No 3D), Los Angeles-Class Submarine, LPH01 Ocean (No 3D), Harpers Ferry-class LSD, M-71 Howitzer (No 3D), M109 Howitzer, M1126 Stryker ICV, M113 APC, M1A2 Abrams MBT, M2A2 Bradley IFV, M35 Truck, M3A2 Bradley CFV, M577A2 Command Post, M58 MICLIC, M777 Howitzer (No 3D), M88 Medium Recovery Vehicle, M939A2 5-Ton Truck, M977 HEMTT Cargo Truck, M978 HEMTT Fuel Truck, M993 MLRS, M9 ACE, Mamba APC (No 3D), Maveric UAS (No 3D), MBT 2000 (No 3D), MD 500 (No 3D), Merkava III MBT (No 3D), Merkava IV MBT (No 3D), MH-47 Chinook (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-24 Hind, Mi-28 Havoc, Mi-2 Hoplite, Mideast Combatant, Mideast Combatant with RPG, MiG-27 Flogger, MiG-29 Fulcrum, MIM-104 Patriot Launcher, Mirage 2000, Mirage F1, MQ-9 Reaper UAV, MRAP-ATV (No 3D), MRAP-CAT II Cougar (No 3D), MRAP-CAT I MaxxPro (No 3D), MT-LB APC, Namer APC (No 3D), Navistar 7000 (No 3D), Nimitz-class Carrier, OH-58 Kiowa, Ohio-class Submarine, Oskoy-class Minehunter (No 3D), P-3 Orion, Police Officer, MQ-1 Predator, PT-91 Twardy MBT (No 3D), Puma CEV (No 3D), RAH-66 Comanche, Rapier SAM (No 3D), REMUS UUV (No 3D), Rigid-Hulled Inflatable Boat, River-class Patrol Vessel (No 3D), Romeo-class Submarine, RQ-11 Raven UAV, RQ-4 Global Hawk UAV (No 3D), RQ-7 Shadow UAV (No 3D), SA 330 Puma (No 3D), SA-15 Gauntlet SAM, SA-19 Grison, SA-6 Gainful SAM, SA-9 Gaskin SAM System, Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), ScanEagle UAV (No 3D), Scorpene-class Submarine (No 3D), Sergeant M16, SH-3 Sea King (No 3D), SH-60 Seahawk, Skjold-class Patrol (No 3D), Song-class Submarine, Sonobuoy (Passive), Sovremenny-class Destroyer, Space Shuttle, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker, Super Dvora Mark II (No 3D), Suspect, T-69 MBT, T-72 MBT, T-80 MBT, T-84 MBT (No 3D), T90A MBT (No 3D), Taurus ARV (No 3D), Technical Truck, Tiger-class Fast Attack Craft (No 3D), Tornado ADV, Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 10 MBT (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Type 90 Kyu-maru MBT (No 3D), Type 99 MBT (No 3D), Udaloy-class Destroyer (No 3D), UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D), Ula-class Submarine (No 3D), US Army Medic, US EOD, USMC M16-M203, USMC M16, USMC M240, USMC M249, USMC M4, US Army AT4, US Army Javelin
Spot Report Generator (continued)	US Army M16-M203, US Army M16, US Army M240, US Army M249, US Army M4, US Army M60, US Army M9, V-22 Osprey (No 3D), VAB APC, Vanguard-class Submarine (No 3D), VBL ATV, Victoria-class (No 3D), VM 90 LSVW (No 3D), Walrus-class submarine (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D), XM7 FIST-Bradley, ZIL-135 8x8 Truck, ZPU-4 AA Gun, ZSU-23-4 Shilka

Table C-2: System usage

System	Entities that Use System
Spot Report Receiver	A-10 Thunderbolt, A-4 Skyhawk (No 3D), Aardvark JSFU (No 3D), AAVC7A1 Landing Vehicle, Achzarit APC (No 3D), Actros AHSVS (No 3D), AH-1W SuperCobra, AH-64A Apache, AH-6 Little Bird (No 3D), Aircraft Carrier, AMX-30 MBT, AMX-56 Leclerc MBT, AN/BLQ-11 UUV (No 3D), Arjun MBT (No 3D), Arleigh Burke-class Destroyer, AS-365 Dauphin (No 3D), AS-565 Panther (No 3D), AS-90 Artillery (No 3D), AV-8B Harrier II, B-2 Spirit, Badger AEV (No 3D), BAE CT-155 Hawk (No 3D), Bay-class DLS (No 3D), Beaver AVLB (No 3D), Bell 412 (No 3D), Bell 206 JetRanger (No 3D), Bell 406 (No 3D), Bison APC (No 3D), BMP-2 AFV, BN-2 Islander (No 3D), BTR-80 APC, Buffalo MRAP III (No 3D), Buffel ARV (No 3D), C-130 Hercules, C-17 Globe-master III (No 3D), C-5 Galaxy (No 3D), C1 Ariete MBT (No 3D), CAESAR SP Howitzer, Canadair CT-114 (No 3D), CH-148 Cyclone (No 3D), CH-149 Cormorant, CH-46E Sea Knight, CH-47 Chinook (No 3D), CH-53E Super Stallion, Chilean AT4, Chilean IMI Galil, Chilean M16-M203, Chilean M16, Chilean M240, Chilean M249, Chilean M4, Chilean M60, Cougar FSV (No 3D), Coyote APC (No 3D), Dabur-class Patrol Boat (No 3D), Defense Satellite, DI AK-47, DI Lasing (CIS), DI Lasing (US), DI RPG, DI SMAW And Rifle, Dolphin-class Submarine (No 3D), E-3 Sentry, EA-6B Prowler, EC145 (No 3D), Echo-class Survey Ship (No 3D), EH101 Merlin (No 3D), Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, FV 510 Warrior (No 3D), FV101 Scorpion CVR, FV107 Scimitar (No 3D), FV4030/4 Challenger MBT (No 3D), FV4034 Challenger 2 MBT (No 3D), FV432 APC (No 3D), F/A-18 Hornet, GAZ-69 Utility Vehicle, Grizzly APC (No 3D), Guided Missile Destroyer, Guided Missile Frigate, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Hermes 450 (No 3D), HH-65 Dolphin (No 3D), HMMWV Utility Vehicle, HMMWV with Avenger, HMMWV with M2, HMMWV with Shelter, HMMWV with TOW launcher, Husky ARV (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), Iveco LMV (No 3D), Jackal MWMIK (No 3D), K1A1 MBT (No 3D), KA-50 Hokum, KD-III-class Destroyer (No 3D), Kingston-class Patrol vessel (No 3D), L 14 Albion (No 3D), L-118 Howitzer (No 3D), Land Rover Wolf (No 3D), LAV III APC (No 3D), LCAC, Leopard 2 Tank, LG1 Howitzer (No 3D), Lockheed L-1011 (No 3D), Los Angeles-Class Submarine

Table C-2: System usage

System	Entities that Use System
Spot Report Receiver	LPH01 Ocean (No 3D), Harpers Ferry-class LSD, M-71 Howitzer (No 3D), M109 Howitzer, M1126 Stryker ICV, M113 APC, M1A2 Abrams MBT, M2A2 Bradley IFV, M35 Truck, M3A2 Bradley CFV, M577A2 Command Post, M58 MICLIC, M777 Howitzer (No 3D), M88 Medium Recovery Vehicle, M939A2 5-Ton Truck, M977 HEMTT Cargo Truck, M978 HEMTT Fuel Truck, M993 MLRS, M9 ACE, Mamba APC (No 3D), Maveric UAS (No 3D), MBT 2000 (No 3D), MD 500 (No 3D), Merkava III MBT (No 3D), Merkava IV MBT (No 3D), MH-47 Chinook (No 3D), MH-60L Black Hawk DAP (No 3D), MH-60 Black Hawk, MH-6 Little Bird (No 3D), Mi-24 Hind, Mi-28 Havoc, Mi-2 Hoplite, Mideast Combatant, Mideast Combatant with RPG, MiG-27 Flogger, MiG-29 Fulcrum, MIM-104 Patriot Launcher, Mirage 2000, Mirage F1, MQ-9 Reaper UAV, MRAP-ATV (No 3D), MRAP-CAT II Cougar (No 3D), MRAP-CAT I MaxxPro (No 3D), MT-LB APC, Namer APC (No 3D), Navistar 7000 (No 3D), Nimitz-class Carrier, OH-58 Kiowa, Ohio-class Submarine, Oskoy-class Minehunter (No 3D), P-3 Orion, Police Officer, MQ-1 Predator, PT-91 Twardy MBT (No 3D), Puma CEV (No 3D), RAH-66 Comanche, Rapier SAM (No 3D), REMUS UUV (No 3D), Rigid-Hulled Inflatable Boat, River-class Patrol Vessel (No 3D), Romeo-class Submarine, RQ-11 Raven UAV, RQ-4 Global Hawk UAV (No 3D), RQ-7 Shadow UAV (No 3D), SA 330 Puma (No 3D), SA-15 Gauntlet SAM, SA-19 Grison, SA-6 Gainful SAM, SA-9 Gaskin SAM System, ScanEagle UAV (No 3D), Scorpene-class Submarine (No 3D), Sergeant M16, SH-3 Sea King (No 3D), SH-60 Seahawk, Skjold-class Patrol (No 3D), Song-class Submarine, Sovremenny-class Destroyer, Space Shuttle, SU-25 Frogfoot, SU-27 Flanker, Su-37 Flanker, Super Dvora Mark II (No 3D), Suspect, T-69 MBT, T-72 MBT, T-80 MBT, T-84 MBT (No 3D), T90A MBT (No 3D), Taurus ARV (No 3D), Technical Truck, Tiger-class Fast Attack Craft (No 3D), Tornado ADV, Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 10 MBT (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Type 90 Kyu-maru MBT (No 3D), Type 99 MBT (No 3D), Udaloy-class Destroyer (No 3D), UH-1N Twin Huey (No 3D), UH-60 Blackhawk, UH-72 Lakota (No 3D), Ula-class Submarine (No 3D), US Army Medic, US EOD, USMC M16-M203, USMC M16, USMC M240, USMC M249, USMC M4, US Army AT4, US Army Javelin, US Army M16-M203, US Army M16, US Army M240, US Army M249, US Army M4, US Army M60, US Army M9, V-22 Osprey (No 3D)
Spot Report Receiver (continued)	VAB APC, Vanguard-class Submarine (No 3D), VBL ATV, Victoria-class (No 3D), VM 90 LSVW (No 3D), Walrus-class submarine (No 3D), Westland Lynx (No 3D), WS-61 Sea King (No 3D), XM7 FIST-Bradley, ZIL-135 8x8 Truck, ZPU-4 AA Gun, ZSU-23-4 Shilka
Stinger Missile Launcher	HMMWV with Avenger

Table C-2: System usage

System	Entities that Use System
Subsurface Entity Default	AN/BLQ-11 UUV (No 3D), Astute-class Submarine (No 3D), Dolphin-class Submarine (No 3D), Los Angeles-Class Submarine, Mk-46 MOD 5 Torpedo (No 3D), Mk-48 ADCAP Torpedo, Ohio-class Submarine, REMUS UUV (No 3D), Romeo-class Submarine, Scorpene-class Submarine (No 3D), Song-class Submarine, Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Ula-class Submarine (No 3D), Vanguard-class Submarine (No 3D), Victoria-class (No 3D), Walrus-class submarine (No 3D)
Subsurface	AN/BLQ-11 UUV (No 3D), Astute-class Submarine (No 3D), Dolphin-class Submarine (No 3D), Los Angeles-Class Submarine, Mk-46 MOD 5 Torpedo (No 3D), Mk-48 ADCAP Torpedo, Ohio-class Submarine, REMUS UUV (No 3D), Romeo-class Submarine, Scorpene-class Submarine (No 3D), Song-class Submarine, Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Ula-class Submarine (No 3D), Vanguard-class Submarine (No 3D), Victoria-class (No 3D), Walrus-class submarine (No 3D)
Surface Entity Default	Aircraft Carrier, Alta-class Minehunter (No 3D), AN/BLQ-11 UUV (No 3D), Arleigh Burke-class Destroyer, Astute-class Submarine (No 3D), Bay-class DLS (No 3D), Container Ship, Container Ship Loaded, Cruise Ship (No 3D), Dabur-class Patrol Boat (No 3D), Dolphin-class Submarine (No 3D), Durand de la Penne-class Destroyer (No 3D), Echo-class Survey Ship (No 3D), Fishing Boat, Guided Missile Destroyer, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Henry J Kaiser-class Oiler (No 3D), Horizon-class Destroyer (No 3D), Hunt-class Minehunter (No 3D), Iroquois-class Destroyer (No 3D), Island-class Patrol Vessel (No 3D), L-class Frigate (No 3D), Jet Ski, M-class Frigate (No 3D), KD-III-class Destroyer (No 3D), Kingston-class Patrol vessel (No 3D), L 14 Albion (No 3D), Los Angeles-Class Submarine, LPH01 Ocean (No 3D), Harpers Ferry-class LSD, Osprey-class Mine CMS (No 3D), Mk-46 MOD 5 Torpedo (No 3D), Mk-48 ADCAP Torpedo, Nimitz-class Carrier, Ohio-class Submarine, Oskoy-class Minehunter (No 3D), Queen Elizabeth-class Carrier (No 3D), REMUS UUV (No 3D), Rigid-Hulled Inflatable Boat, Rigid-Hulled Inflatable Boat - Civilian, River-class Patrol Vessel (No 3D), Romeo-class Submarine, Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), Sailboat, Sandown-class Minehunter (No 3D), Scorpene-class Submarine (No 3D), Skjold-class Patrol (No 3D), Song-class Submarine, Sovremenny-class Destroyer, Speedboat, Super Dvora Mark II (No 3D), Super Tanker (No 3D), Trafalgar-class Submarine (No 3D), Type 209 Submarine (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D), Ula-class Submarine (No 3D), Vanguard-class Submarine (No 3D), Victoria-class (No 3D), Walrus-class submarine (No 3D)
Surface Disaggregated Movement	

Table C-2: System usage

System	Entities that Use System
Large Ship	Aircraft Carrier, Alta-class Minehunter (No 3D), Arleigh Burke-class Destroyer, Bay-class DLS (No 3D), Container Ship, Container Ship Loaded, Cruise Ship (No 3D), Durand de la Penne-class Destroyer (No 3D), Fishing Boat, Fridtjof Nansen-class (No 3D), Guided Missile Destroyer, Guided Missile Frigate, Halifax-class Frigate (No 3D), Henry J Kaiser-class Oiler (No 3D), Horizon-class Destroyer (No 3D), Hunt-class Minehunter (No 3D), Invincible-class Carrier (No 3D), Iroquois-class Destroyer (No 3D), L-class Frigate (No 3D), M-class Frigate (No 3D), KD-III-class Destroyer (No 3D), Kingston-class Patrol vessel (No 3D), L 14 Albion (No 3D), LPH01 Ocean (No 3D), Harpers Ferry-class LSD, Osprey-class Mine CMS (No 3D), Nimitz-class Carrier, Oskoy-class Minehunter (No 3D), Queen Elizabeth-class Carrier (No 3D), Sandown-class Minehunter (No 3D), Sovremenny-class Destroyer, Super Tanker (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D)
Surface Multiple Hit Damage	Guided Missile Frigate
Torpedo Warhead	Mk-46 MOD 5 Torpedo (No 3D), Mk-48 ADCAP Torpedo
TOW Missile Launcher	HMMWV with TOW launcher, MRAP-ATV (No 3D), MRAP-CAT II Cougar (No 3D), MRAP-CAT I MaxxPro (No 3D), VM 90 LSVW (No 3D)
US Fighter Bomber Bomb Bay	A-10 Thunderbolt, A-4 Skyhawk (No 3D), AV-8B Harrier II, Eurofighter Typhoon, F-117A Nighthawk, F-15 Eagle, F-16A Fighting Falcon, F-22 Raptor (No 3D), F-35 Lightning II, F/A-18 Hornet, Mirage 2000, Mirage F1, Tornado ADV
US Heavy Bomber Bomb Bay	B-2 Spirit, P-3 Orion
Vertical SAM Missile Launcher	Arleigh Burke-class Destroyer, Durand de la Penne-class Destroyer (No 3D), Guided Missile Destroyer, Halifax-class Frigate (No 3D), Hauk-class Fast Attack (No 3D), Horizon-class Destroyer (No 3D), Iroquois-class Destroyer (No 3D), KD-III-class Destroyer (No 3D), Saar 4-class Missile Boat (No 3D), Saar 4.5-class Missile Boat (No 3D), Saar 5-class Corvette (No 3D), Skjold-class Patrol (No 3D), Sovremenny-class Destroyer, Tiger-class Fast Attack Craft (No 3D), Type 42 Destroyer (No 3D), Type 45 Destroyer (No 3D), Type 22 Frigate (No 3D), Type 23 Frigate (No 3D), Udaloy-class Destroyer (No 3D)

Table C-2: System usage

System	Entities that Use System
Visual Sensor	Aardvark JSFU (No 3D), AAVC7A1 Landing Vehicle, Achzarit APC (No 3D), Actros AHSVS (No 3D), AMX-30 MBT, AMX-56 Leclerc MBT, Arjun MBT (No 3D), AS-90 Artillery (No 3D), Badger AEV (No 3D), Beaver AVLB (No 3D), Bison APC (No 3D), BMP-2 AFV, BTR-80 APC, Buffalo MRAP III (No 3D), Buffel ARV (No 3D), C1 Ariete MBT (No 3D), CAESAR SP Howitzer, Car Bomb, CH-46E Sea Knight, Chilean AT4, Chilean IMI Galil, Chilean M16-M203, Chilean M16, Chilean M240, Chilean M249, Chilean M4, Chilean M60, Cougar FSV (No 3D), Coyote APC (No 3D), DI AK-47, DI Lasing (CIS), DI Lasing (US), DI RPG, DI SMAW And Rifle, Durand de la Penne-class Destroyer (No 3D), Fishing Boat, FV 510 Warrior (No 3D), FV101 Scorpion CVR, FV107 Scimitar (No 3D), FV4030/4 Challenger MBT (No 3D), FV4034 Challenger 2 MBT (No 3D), FV432 APC (No 3D), GAZ-69 Utility Vehicle, Grizzly APC (No 3D), HMMWV Utility Vehicle, HMMWV with M2, HMMWV with Shelter, HMMWV with TOW launcher, Husky ARV (No 3D), Iveco LMV (No 3D), Jackal MWMIK (No 3D), Jet Ski, K1A1 MBT (No 3D), Land Rover Wolf (No 3D), LAV III APC (No 3D), LCAC, Leopard 2 Tank, M109 Howitzer, M1126 Stryker ICV, M113 APC, M1A2 Abrams MBT, M2A2 Bradley IFV, M35 Truck, M3A2 Bradley CFV, M577A2 Command Post, M58 MICLIC, M88 Medium Recovery Vehicle, M939A2 5-Ton Truck, M977 HEMTT Cargo Truck, M978 HEMTT Fuel Truck, M993 MLRS, M9 ACE, Mamba APC (No 3D), Maveric UAS (No 3D), MBT 2000 (No 3D), Merkava III MBT (No 3D), Merkava IV MBT (No 3D), Mideast Combatant, Mideast Combatant with RPG, MRAP-ATV (No 3D), MRAP-CAT II Cougar (No 3D), MRAP-CAT I MaxxPro (No 3D), MT-LB APC, Namer APC (No 3D), Navistar 7000 (No 3D), Police Officer, PT-91 Twardy MBT (No 3D), Puma CEV (No 3D), Rigid-Hulled Inflatable Boat, Rigid-Hulled Inflatable Boat - Civilian, Roadside IED, RQ-11 Raven UAV, RQ-7 Shadow UAV (No 3D), Sailboat, ScanEagle UAV (No 3D), Sergeant M16, Suicide Bomber, Super Dvora Mark II (No 3D), Suspect, T-69 MBT, T-72 MBT, T-80 MBT, T-84 MBT (No 3D), T90A MBT (No 3D), Taliban, Taurus ARV (No 3D), Technical Truck, Type 10 MBT (No 3D), Type 90 Kyu-maru MBT (No 3D), Type 99 MBT (No 3D), US Army Medic, US EOD, USMC M16-M203, USMC M16, USMC M240, USMC M249, USMC M4, US Army AT4, US Army Javelin, US Army M16-M203, US Army M16
Visual Sensor (continued)	US Army M240, US Army M249, US Army M4, US Army M60, US Army M9, VAB APC, VBL ATV, VM 90 LSVW (No 3D), XM7 FIST-Bradley, ZIL-135 8x8 Truck, ZPU-4 AA Gun, ZSU-23-4 Shilka

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