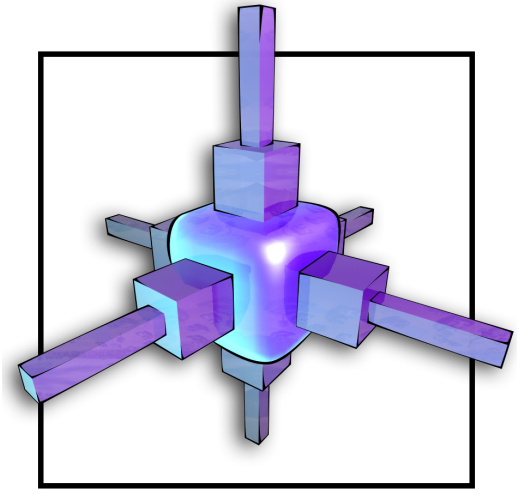
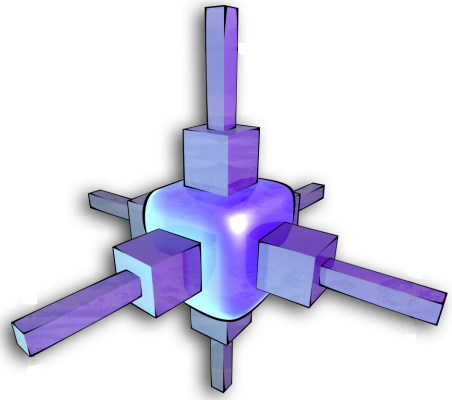


MÄK RTI

Users Guide

VT MÄK
A company of VT Systems



MÄK RTI

Users Guide

VT MÄK
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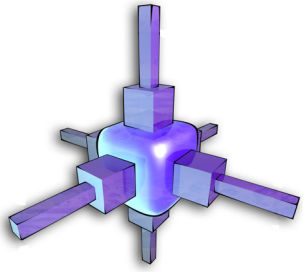
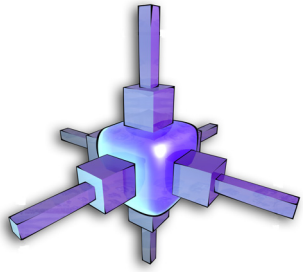
Revision RTI-4.1-3-120105



Contents



Preface

This manual is for persons who want to use the MÄK RTI to run HLA federates. It is oriented towards customers who simply want to run their applications with a minimum of attention to configuration and network topology issues. Developers who need to design network topologies for HLA exercises, develop HLA applications, or use the RTIspy API should read *MÄK RTI Reference Manual*.

This manual assumes that you are familiar with the command-line and graphical windowing environments for your operating system.

For information about changes to the MÄK RTI since this manual went to press, please see *MÄK RTI Release Notes*.

How the Manual is Organized

This manual is organized as follows:

Chapter 1, *Introduction to the MÄK RTI* describes the MÄK RTI and its features.

Chapter 2, *Installing the MÄK RTI* describes installation and configuration tasks, including setting up the license server.

Chapter 3, *HLA Concepts*, provides conceptual information about the HLA so that you can understand the terminology used elsewhere in the manual.

Chapter 4, *Connecting Federates to the MÄK RTI*, describes how to connect a federate to the MÄK RTI, how to start the rtiexec, and how to remove federates from a federation.

Chapter 5, *Managing Federations* describes some basic federation management procedures, primarily how to remove inactive federates and how to destroy a federation.

Chapter 6, *The RTI Assistant* provides a high-level introductions to the RTI Assistant.

Chapter 7, *The RTIspy Diagnostic GUI* introduces the RTIspy web-based GUI and explains how to start the network map and federate view.

Chapter 8, *Configuring the MÄK RTI Startup Environment*, explains how to configure your system to use a particular MÄK RTI version and RID file. It also explains how to configure connections that the rtiexec and federates can use when they start.

Chapter 9, *Licensing Issues* explains how to let the MÄK RTI check out licenses and how to troubleshoot license issues.

The *MÄK Products Glossary* defines terms common to HLA and real-time simulations.

Documentation

The MÄK RTI documentation set is as follows:

- *MÄK RTI Users Guide* is a brief introduction to HLA and the MÄK RTI and explains how to configure the MÄK RTI startup environment and run a federate.
- *MÄK RTI Reference Manual* provides detailed information about configuring the MÄK RTI, designing network topologies for HLA federations, and how to use the RTIspy API.
- *MÄK RTI First Experience Guide* shows you how easy it is to run HLA federates with the MÄK RTI.
- *MÄK RTI Release Notes* system information and updates for the current release.
- MÄK RTIspy API class documentation and MÄK RTI API class documentation in HTML format. You can access the class documentation from the Start menu in Windows or by opening *./classdoc/index.html*.
- Online help. The RTI Assistant windows and the RTIspy web GUI have online help.
- *MÄK Products Interoperability Guide* explains how MÄK products work together and provides troubleshooting information.

MÄK Products

The MÄK RTI 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 four end-user applications (VR-Vantage Stealth, VR-Vantage XR, VR-Vantage PVD, and VR-Vantage IG), the VR-Vantage Toolkit, and VR-Vantage FreeView.
  - VR-Vantage Stealth displays a realistic, 3D view of your virtual world. You can view this world from the inside of a simulated moving vehicle, or place the eyepoint at another moving or stationary location. The Stealth lets you switch rapidly among several predefined viewpoints while the simulation is underway.

  - 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 XR provides a common operational picture using the same 3D views as VR-Vantage Stealth, 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.
  - 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.
  - VR-Vantage Free View is a terrain and 3D model viewer that introduces some of the features of VR-Vantage applications in a useful, free utility.
- 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 RTI 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 68 Moulton St. Cambridge, MA, USA 02138

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.
Blue bold text	A hypertext link to class documentation.
{ }	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 UNIX 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**.
	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 RTI home directory. For example, the directory *makRtix.x/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 popup 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 which 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

Permission is hereby granted, free of charge, to any person or organization obtaining a copy of the software and accompanying documentation covered by this license (the "Software") to use, reproduce, display, distribute, execute, and transmit the Software, and to prepare derivative works of the Software, and to permit third-parties to whom the Software is furnished to do so, all subject to the following:

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.

THE SOFTWARE IS PROVIDED “AS IS”, WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT. IN NO EVENT SHALL THE COPYRIGHT HOLDERS OR ANYONE DISTRIBUTING THE SOFTWARE BE LIABLE FOR ANY DAMAGES OR OTHER LIABILITY, WHETHER IN CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

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/

pThreads Library

VR-Exchange links with the pThreads win32 library. The library is distributed under the GNU Lesser General Public License (LGPL). MÄK has made no modification to this library. For information about the pThreads win32 library please see: http://sourceware.org/pthreads-win32/

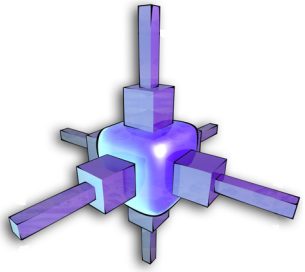
EHS, PCRE, and PME

The MÄK RTI links with the EHS, PCRE, and PME libraries. These libraries are distributed under the GNU Lesser General Public License (LGPL). MÄK has made modification to these libraries only to allow them to compile on the supported platforms. For more information about these libraries please see the following web sites:

- EHS: http://xaxxon.slackworks.com/ehs/
- PCRE: http://www.pcre.org/
- PME: http://xaxxon.slackworks.com/pme/index.html

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



1. Introduction to the MÄK RTI

An RTI is an implementation of the Run-Time Infrastructure portion of the High-Level Architecture (HLA).

1.1. The MÄK RTI

The MÄK RTI (Run-Time Infrastructure) is a software library (and supporting executables) that implements the High Level Architecture (HLA) 1.3, 1516, and 1516-2010 (HLA Evolved) interface specifications. The HLA was developed by the U. S. Department of Defense (DoD) to provide a means for the many different types of simulations in use by the DoD to interoperate. In HLA, applications exchange data through RTI calls, which means that all HLA applications must use an RTI.

Since the function of the RTI is to manage exchange of data between applications (called federates) in a simulation exercise (called a federation), a person running a federate typically does not need to (or want to) know how the RTI works or is configured. They just want to start their federate and participate in the federation.

A useful analogy would be that of calling someone on a telephone. If you pick up a telephone, you enter a phone number (specify a connection) and the phone system does the rest. If you call someone on a cell phone, you enter a phone number and press Send. The phone system does the rest. You do not need to know how either of these systems sends their signals or connects to other phones.

This Users Guide is oriented towards the person who needs to use the MÄK RTI the way they would use a telephone. It tells you how to start a federate and choose a connection. It also describes some of the user-oriented features of the MÄK RTI. If you need to configure the network topology for your simulation, optimize the MÄK RTI configuration, or use the RTIspy API to customize the MÄK RTI, please refer to *MÄK RTI Reference Manual*.

The MÄK RTI has been verified by the Modeling and Simulation Coordination Office (MSCO, formerly DMSO) as fully compliant with the HLA Interface Specification, version 1.3 and with the IEEE 1516 version of the HLA Interface Specification (SISO DLC HLA API 1516 (SISO-STD-004.1-2004)). All services are implemented.

1.1.1. MÄK RTI Components

The MÄK RTI consists of:

- The RTI library that implements the Local RTI Component (LRC).
- A central server executable called the rtiexec (short for RTI Executive).
- The RTI Forwarder supports centralized TCP forwarding, distributed TCP forwarding, and distributed UDP forwarding. (Section 5.3, "The RTI Forwarder Application", in *MÄK RTI Reference Manual*)
- A web server for the RTIspy diagnostic GUI. (Chapter 7, *The RTIspy Diagnostic GUI* and *MÄK RTI Reference Manual*)
- The RTI Assistant monitors federate and rtiexec activity and provides helpful messages when needed. It also provides access to error logs and configuration options. It is accessed through an icon in the system tray. (Chapter 6, *The RTI Assistant*)
- The RTI Chooser (Windows only) helps you configure your MÄK RTI environment. ("Configuring the MÄK RTI Version and RID File to Use," on page 53)

All of these components are optional for running a federate except use of the RTI library.

1.2. The rtiexec is not the RTI

MÄK RTI users are sometimes confused about the difference between the RTI executive (rtiexec) and local RTI components (LRCs) and what it means to install and run an RTI.

An LRC is the RTI library (DLL or *.so*) linked with a federate. The LRC provides an implementation of the HLA interface through which a federate interacts with the RTI and thus communicates with other federates in a federation.

The rtiexec is a centralized application that supports the RTI services that need centralized synchronization and control (for example, synchronization points, save/restore, and time management). The rtiexec is also required for some features of the RTIspy web-based GUI. If you do not need these services, you can use the MÄK RTI in lightweight mode, in which case you do not need to run the rtiexec. (For information about lightweight mode, please see "Lightweight Mode," on page 3.)

Only one instance of the rtiexec should be run for a federation.

It is not accurate to equate running the rtiexec with running the MÄK RTI. Nor is it sufficient to install and run the rtiexec to use the MÄK RTI. Since each federate must have access to an LRC, you must install the MÄK RTI on each computer on which a federate is located. For more information about the rtiexec, please see Section 5.1, "The rtiexec", in *MÄK RTI Reference Manual*.

1.3. Lightweight Mode

The MÄK RTI supports a lightweight mode, for which the rtiexec is not necessary. You can just run your federates, and all communication occurs directly between their LRCs. In general, lightweight mode is appropriate for small, simple federations that:

- Do not use the more complex RTI services
- Require only best effort transport
- Do not require strict compliance with the HLA Specification.

For more information about lightweight mode and when it is appropriate, please see Section 7.3, "Using Lightweight Mode", in *MÄK RTI Reference Manual*.

1.4. Compatibility with Other RTI Implementations

The two questions that HLA users most frequently ask are:

- Do I have to rebuild my application to use the MÄK RTI?

  When you build an HLA application, you must link it to RTI libraries. If the libraries support a dynamic-link compatible HLA API, then the application can work with any RTI that uses that same API without rebuilding.

  The MÄK RTI 1.3 implements the API dictated by the 1.3 version of the HLA Interface Specification, as amended by MSCO's official HLA 1.3 Interpretations document. Therefore, any application built with the MÄK RTI can work with any other RTI that supports the HLA 1.3 specification. Similarly any application built with an RTI that supports the HLA 1.3 specification can work with the MÄK RTI.

  The MÄK RTI 1516 implements the SISO DLC HLA API[1] 1516 (SISO-STD-004.1-2004). Applications built with it are compatible with any RTI written to this API.

  The MÄK RTI HLA Evolved implements the IEEE 1516-2010 specification. Applications built with it are compatible with any RTI written to this API.

- Can I use different RTIs for the different federates in my federation?

  No. Every federate in a federation must use the same RTI. Federates using the MÄK RTI must use the same version of the MÄK RTI.

  Furthermore, as mentioned in "The rtiexec is not the RTI," on page 3, every federate must have a copy of the RTI libraries installed on its local computer.

1.4.1. Obtaining HLA RTI Specification Documents

The HLA 1.3 and IEEE 1516 specifications are copyrighted by their owners and MÄK cannot distribute them to customers. You can get documentation for the RTI 1.3 and 1516 interface specifications at:

- http://www.msco.mil/TechSpecs.html
- http://shop.ieee.org/store/ (IEEE 1516 specifications)
- www.sisostds.org (SISO DLC HLA API 1516).

1.Simulation Interoperability Standards Organization Dynamic Link Compatible High Level Architecture Application Program Interface

1.5. The RTI Assistant

The RTI Assistant is the user interface for the MÄK RTI. It starts automatically when you log in or start a federate (this behavior is configurable) and monitors the status of all RTI-related activity on your computer. It also communicates with RTI Assistants on other computers on the network. The RTI Assistant lets you:

- View federation information (in the RTI Federations View)
- View information about your network components (in the RTI Network Component View)
- Configure connections
- Configure some MÄK RTI behaviors
- Configure and run latency testing
- Resign federates and shut down the rtiexec
- View federate logs and notification history for federates running on the local machine.

1.6. The RTIspy Diagnostic GUI

The RTIspy Diagnostic GUI is a web-based graphical user interface (GUI) for observing the rtiexec, RTI Forwarders, and federates in a federation. It allows you to monitor one or more of these components using a web browser from anywhere in the federation (or even remotely). The views range from a network map that shows all the components in the federation, to inspection of the internals of a specific federate. You can also monitor multiple RTI components simultaneously for further analysis and side-by-side comparisons. With the web-based GUI you can:

- View a network map
- View information about the federation and federates
- View information about RTI Forwarders
- View RID parameters
- View an LRC's FOM subscriptions and publications
- View a federate's registered and discovered objects
- View the interactions a federate has sent and received
- View a federate's log of calls invoked by the federate ambassador and RTI ambassador
- Monitor a federate's LRC network performance
- Profile a federate's interaction with the RTI API.

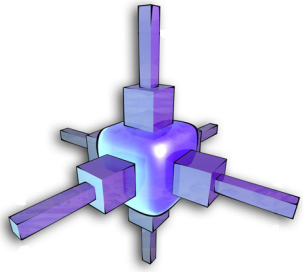
The RTIspy duplicates much of the federation information provided by the RTI Assistant views. Its advantage is its ability to monitor a federation from any web browser. It also adds the ability to monitor the LRC information for individual federates and view the network connections between RTI components. The procedures for configuring and running the RTIspy are in Chapter 7, *The RTIspy Diagnostic GUI* in this manual, and in Chapter 6, *Setting Up the RTIspy*, in *MÄK RTI Reference Manual*.

1.7. The Unlicensed Version of the MÄK RTI

The MÄK RTI supports an unlicensed (free) mode. The unlicensed mode permits two unlicensed federates to join a federation execution. It is identical to the licensed mode of the MÄK RTI and includes support for all RTI services and features except the RTIspy plug-in capability (therefore, it does not support the RTIspy GUI.)

The unlicensed version is ideal for evaluating the MÄK RTI. It also makes it easy for customers who have MÄK RTI licenses to test HLA federates in situations where they may not have access to their licenses, such as when working at home or traveling. You can download a copy of the MÄK RTI that supports unlicensed mode at http://www.mak.com/products/rti.php

For more information about running unlicensed federations, please see "Unlicensed Federations," on page 70.



2. Installing the MÄK RTI

This chapter explains how to install the MÄK RTI on a Windows or a UNIX operating system. You must also install the license manager files. (For details, please see "Installing and Setting Up the License Manager," on page 12.)

2.1. Installing the MÄK RTI on Windows

Windows versions of the RTI are provided as executable installer files on CD or DVD, or as downloaded files. The installers are named to indicate the compiler used to build that version of the RTI and whether it is a 32 bit or 64 bit version.

Before you install the MÄK RTI, please read *MÄK RTI Release Notes* to see if there are any special instructions for installation.

- The MÄK RTI installation wizard asks if you want to change the PATH environment variable to load the newly installed RTI. You can add it to the PATH for the current user or all users. If you do not add it to one of these PATHs, when you run a federate, it will not be able to find this version of the RTI unless you set the PATH using the RTI Chooser.
- You must have administrator privileges to install MÄK products on Windows Vista.

➤ To install the RTI, run the installer. Follow the instructions in the installation wizard.

2.2. Installing the MÄK RTI on a Linux System

Linux versions of the RTI are provided as compressed tar files on CD or DVD, or as downloaded files. Before you install the RTI, please read *MÄK RTI Release Notes* to see if there are any special instructions for installation.

To install the RTI on Linux:

1. Create the directory in which you want to install the RTI.
2. Copy the tar file to the install directory.
3. Uncompress and untar the file:

   `tar -vxzf application.tar.gz`

   where *`application`* is the product release identification.

2.3. Installing the MÄK RTI Java Bindings

The MÄK RTI provides a set of Java bindings for both the RTI1.3-NG API and the SISO DLC HLA 1516 API. The Java binding is a thin layer of C++ code that exposes the native C++ API of the MÄK RTI to Java applications.

To use the Java bindings, you must install the Java Development Kit (JDK) 1.2 or later and configure your system as described in the following sections.

2.3.1. Unix Installation

In addition to the normal MÄK RTI setup, you must add or edit the following environment variables:

- Add *makRti*4.1*/lib/hla.jar* to the CLASSPATH environment variable
- **`%MAK_RTIDIR%/lib/java`** must be the first entry in your PATH environment variable.
- Linux or Solaris: Add *makRti*4.1*/lib* to the LD_LIBRARY_PATH variable
- HLA 1516 only: Install the MÄK RTI HLA 1516 Java Fedtime Library as described in "Installing the HLA 1516 Java Fedtime Library".

2.3.2. Windows Installation

In addition to the normal MÄK RTI setup, you must add or edit the following environment variables:

- Add the *makRti*4.1*lib**hla.jar* to the CLASSPATH environment variable
- **`%MAK_RTIDIR%/lib/java`** must be the first entry in your PATH environment variable
- Add the *makRti*4.1*lib* directory to the PATH environment variable
- HLA 1516 only: Install the MÄK RTI HLA 1516 Java Fedtime Library as described in "Installing the HLA 1516 Java Fedtime Library".

2.3.3. Installing the HLA 1516 Java Fedtime Library

HLA 1516 specifies that the federate developer shall provide a Logical Time implementation. For Java federates the MÄK RTI offers two methods of doing this:

- You can create an HLA 1516 time implementation in Java and add the new time class files to the CLASSPATH environment variable.
- You can use the default time implementation provided by the MÄK RTI. The default implements time as a Java double.

Configuring UNIX Systems to use the HLA 1516 Java Fedtime Library

Add or edit the following environment variables:

Linux or Solaris

- Add the full path of the directory containing *libjvm.so* to the LD_LIBRARY_PATH variable. This library is distributed as part of the JDK. Its location is system dependent.
- Add the *makRti*4.1*lib**java* directory to the LD_LIBRARY_PATH environment variable in front of the *makRti*4.1*lib* directory. This ensures that the MÄK RTI loads the *libfedtime1516* library required by the Java bindings instead of the default *libfed-*
time library.

Configuring Windows to use the HLA 1516 Java Fedtime Library

Add or edit the following environment variables:

- Add the full path to the directory containing *jvm.dll* to the PATH variable. This library is distributed as part of the JDK. Its location is system dependent.
- Add the *makRti*4.1*lib**java* directory to the PATH environment variable in front of the *makRti*4.1*lib* and *makRti*4.1*bin* directories. This will ensure that the MÄK RTI loads the *libfedtime1516* library required by the Java bindings instead of the default *libfedtime* library.

Developing a Custom Logical Time Implementation

If you are developing a custom Logical Time implementation:

1. Add the custom classes to the CLASSPATH environment variable.
2. Create a new environment variable named RTI_JAVA_TIME_CLASS and set its value to the fully qualified name of the custom *LogicalTimeFactory* class. The fully qualified name is the name of the class preceded by the full package name. The package name must use "/" instead of "." as a separator. For example, the fully qualified name for the default MÄK RTI LogicalTimeFactory is *com/mak/makrti1516/time/DtLogicalTimeDoubleFactory*. In Java, this corresponds to:

   ```
   package com.mak.makrti1516.time;
   public class DtLogicalTimeDoubleFactory implements
     LogicalTimeFactory;
   ```

3. Create a new environment variable named RTI_JAVA_TIME_INTERVAL_CLASS and set its value to the fully qualified name of the custom *LogicalTimeIntervalFactory* class. The fully qualified name is the name of the class preceded by the full package name. The package name must use "/" instead of "." as a separator. For example, the fully qualified name for the default MÄK RTI LogicalTimeIntervalFactory is: *com/mak/makrti1516/time/DtLogicalTimeDoubleIntervalFactory*. In Java, this corresponds to:

   ```
   package com.mak.makrti1516.time;
   public class DtLogicalTimeDoubleIntervalFactory implements
     LogicalTimeIntervalFactory;
   ```

2.4. Managing Licenses for the MÄK RTI

The MÄK RTI rtiexec can check out RTI licenses for federates. When this feature is enabled, the federates do not need to have access to a license server or otherwise configure license management. This can be quite helpful when a federation has federates located on multiple LANs whose security configuration makes it difficult for a federate to connect to a license server.

To enable rtiexec license checkout, in *rid.mtl*, set the **RTI_rtiExecPerformsLicensing** parameter to 1. The RID file for the rtiexec and any federates using this feature must all have the **RTI_rtiExecPerformsLicensing** parameter enabled.

When rtiexec license checkout is enabled, the rtiexec must have access to a license server. You must have an MÄK RTI license for each federate that needs to join. If a federate tries to join the federation and there are no licenses available, the join fails.

The rtiexec license checkout feature does not support dongle licenses.

The license checkout feature only applies to MÄK RTI licenses. If you have other MÄK products, you must still run a license server and configure license management to serve them. This feature is designed to manage licenses for federates that only need RTI licenses.

2.5. Installing and Setting Up the License Manager

Before you can use a MÄK product, you must obtain a valid license file, install the License Manager, and configure the license server and client machines. The License Manager uses a client-server architecture, so you do not need to install the License Manager on every computer on which you install MÄK products. You only need to install it on the computer that you will use as the license server.

If you have already installed the License Manager for another MÄK product, you do not have to install it again. You just need to make sure you have licenses for your newly installed products.

The License Manager installer is included on MÄK installation media. It is separate from the product installers. You can download the installers from our web site at http://www.mak.com/license-support.html or you can download directly from:

- Windows: ftp://ftp.mak.com/out/MAKLicenseManager-win-setup.exe
- Linux: ftp://ftp.mak.com/out/MAKLicenseManager-linux-setup.tar.gz

Complete installation and configuration instructions are included with the License Manager installer. Instructions are also available at the license support page mentioned in a previous paragraph.

Some customers use dongle licenses instead of running a license server. Instructions for using dongles are in the License Manager documentation.

2.5.1. Specifying the License Server

The first time you run a MÄK application on a particular computer, the License Setup dialog box opens (Figure 2-1). It prompts you to enter the hostname of the license server and optionally, a port number.

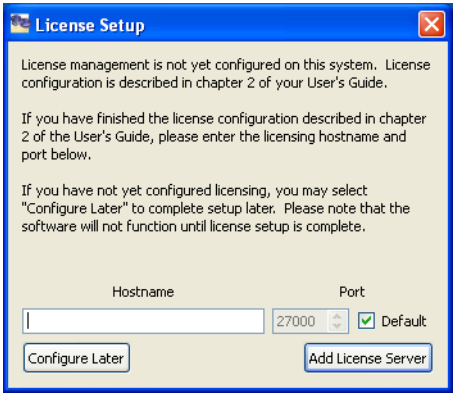


Figure 2-1. License Setup dialog box

If you do not know the hostname of the license server, click Configure Later. When you have the hostname, you can start the application again and complete the dialog box. You will not be able to run any MÄK applications until you set up license management.

If you know the hostname, type it in the Hostname box. Then click Add License Server. The application will start.

- If you are running MÄK products on the license server machine, it is also a client, so you must specify the license server on that machine too.
- If you change the license server, the saved configuration will no longer be valid and the License Setup dialog box will open the next time you start a MÄK application.
- You can clear the saved license configuration by deleting the cache file. On Windows it is *C:\Documents and Settings\user_name\Application Data\MAK\licenses<n>.xml*. On Linux, it is *.mak/licenses<n>.xml*. (There may be more than one cache file, for example, *licenses1.xml* and *licenses2.xml*.)

The MAKLMGRD_LICENSE_FILE Environment Variable

As an alternative to using the License Setup procedure described in the previous section, you can configure the license server in an environment variable. The MAKLMGRD_LICENSE_FILE environment variable identifies the server machine. If you set this environment variable, it overrides the settings stored by the License Setup procedure.

To view a video that illustrates this procedure on Windows, please go to http://www.mak.com/html/setenvvar.htm

The syntax for the environment variable is: `@Server_name`. For example, if the server machine is oak, set the environment variable to **`@oak`**.

The following sections explain how to set environment variables on the different platforms that MÄK products run on.

Windows

To add the MAKLMGRD_LICENSE_FILE in Windows:

1. Open the Control Panel.
2. Click System. The System Properties dialog box opens.
3. Click the Advanced tab.
4. Click the Environment Variables button. The Environment Variables dialog box opens.
5. Click the New button. The New System Variable dialog box opens.
6. In the Variable Name field, enter MAKLMGRD_LICENSE_FILE.
7. In the Variable Value field, enter `@server_name`, where `server_name` is the name of the license server.
8. Click OK to back out of each dialog box and set the variable.

Linux

On Linux, you set environment variables in your *.cshrc* (or equivalent startup file). Set the variable similarly to the following example:

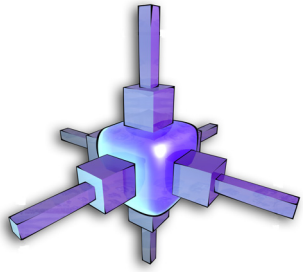
```
setenv MAKLMGRD_LICENSE_FILE @oak
```

If you are using the sh or bash shells, you set environment variables in your *.profile* file (or *.bashrc*). Set the variable similarly to the following example:

```
MAKLMGRD_LICENSE_FILE=@oak
export MAKLMGRD_LICENSE_FILE
```

Do not put spaces around the equal (=) sign.

You are ready to run the license server and use your new licenses or MÄK products.



3. HLA Concepts

This chapter provides a brief introduction to HLA and background information about how MÄK has implemented the RTI specifications. This information will help you understand and put to use the various configuration options described in later chapters.

3.1. The High Level Architecture

The High Level Architecture was developed by the U. S. Department of Defense to provide a means for the many different types of simulations in use by the DoD to interoperate. As an architecture, the HLA abstracts to a higher level how data is formatted and how it gets sent between simulations. Rather than the rigid and fixed protocol data units typical of DIS, the HLA provides a means for simulations to define their objects and interactions (the Federation Object Model (FOM)) and then provides an infrastructure (the RTI) to manage the data transmissions defined by the FOM.

3.1.1. The RTI

A Run-Time Infrastructure (RTI) is a software library (and possibly supporting executables) that implements the HLA Interface Specification. An RTI manages creation of federations and the distribution of data among federates. The HLA is conceived such that the RTI can distribute federation data without knowing anything about the structure or content of that data, while the federates can send data via the RTI without needing to know anything about the network details.

3.1.2. Federates and Federations

A federate is, technically, a connection to the RTI. Typically a single simulation application can be thought of as a federate.

A federation is a group of HLA federates capable of participating in the same federation execution.

A federation execution represents the actual operation, over time, of a subset of the federates and the RTI initialization data taken from a particular federation. A federation execution is the logical equivalent of a DIS simulation exercise.

3.2. RTI Services

An RTI provides the following set of services to a federation:

- Federation management
- Declaration management
- Object management
- Ownership management
- Time management
- Data distribution management.

These services are described briefly in the rest of this section.

3.2.1. Federation Management

Federation management provides services to the entire federation, including creating and destroying federations, allowing federates to join or resign from the federation, establishing synchronization points, and managing saves and restores.

3.2.2. Declaration Management

Declaration management services control publication of, and subscription to, objects and interactions. Individual federates declare which interactions and object attributes they will publish, that is, generate data for. Individual federates also declare which objects and interactions they want to subscribe to, that is, receive information about. The RTI ensures that federates receive only the data to which they have subscribed. This control of network traffic is one of the ways in which the HLA seeks to be more efficient than simulation methods that send all updates to all participants.

3.2.3. Object Management

Object management services allow a federate to generate objects and interactions that it has published. Federates can register new objects with the RTI (or acquire attribute ownership) and then send attribute updates as required. The RTI causes remote objects to be discovered and updated attributes to be reflected by federates that have subscribed to them. The object attributes represent persistent data whose state must be maintained between transmissions by both the sending and receiving federates (for example, the position of a vehicle). Federates can also send and receive interactions that typically represent a transitory event (for example, the collision of two vehicles, or a request for supplies).

3.2.4. Ownership Management

Ownership management services allow federates to seek ownership of objects they do not own and to give up ownership of objects to other federates.

3.2.5. Time Management

Time management is used in federations to coordinate the advancement of individual federates along a unified time axis. Time management is beneficial for federations that must maintain a causal ordering (that is, timestamp order) to the messages exchanged between federates. Because of the overhead involved in synchronization, time management is not usually used for real-time simulations, which can tolerate out of order messages, but have strict latency and throughput requirements.

3.2.6. Data Distribution Management

Data distribution management (DDM) provides filtering of data beyond that offered by declaration management. In declaration management, federates subscribe to interaction classes and object class attributes to express interest in the type of data. In DDM, the federate can define intervals that can effectively express an interest in a range of data values. A federation can specify dimensions (for 1.3 within routing spaces) that define intervals. Interactions and object attributes have a set of available dimensions that can be used to construct regions. The DDM services associate regions with interactions and object attributes for both sending (update regions) and receiving (subscription regions). An interaction or attribute update is delivered to a subscriber only when the subscription region intersects the update region. For details about how the MÄK RTI implements DDM, please see Chapter 13, *Using Data Distribution Management*, in *MÄK RTI Reference Manual*.

3.3. FOMs and FED Files

A Federation Object Model (FOM) defines a federation's objects and interactions. The RTI manages the data transmissions defined by the FOM.

In both the HLA 1.3 specification and the 1516 specifications, you must provide FOM data to the RTI. In the 1.3 specification, this is done with the federation execution data (FED) file. The 1516 specifications use a FOM Document Data (FDD) file.

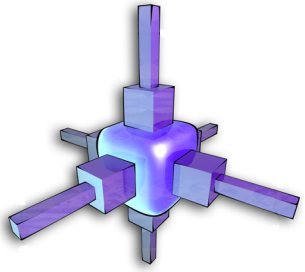
Since the FED file and FDD file perform the same function, and since for the MÄK RTI they are essentially interchangeable, in MÄK RTI documentation, unless otherwise noted, references to the FED file should be considered as references to the FED file and the FDD file.

A FED file contains information about your FOM that the RTI requires, including the names of all object and interaction classes, attributes, and parameters, the hierarchical relationships among the classes, and the default transport and order types to use for each class or attribute.

The LRC in each federate must read a valid FED file to successfully join a federation. It is very important that all federates read identical copies of the FED file, because unique handles for classes, attributes, and parameters are assigned based on their ordering in the FED file. You can configure the MÄK RTI to have the RTI distribute the FED file used by the federate that creates the federation, or to have each LRC read it from a local disk. For more information, please see Section 7.2, "Specifying the FED File", in *MÄK RTI Reference Manual*.

3.4. The RTI Initialization Data (RID) File

A RID file is a configuration file for an RTI. You use it to configure network connections and optimize performance. Because a RID file includes configuration parameters that are implementation-specific, there is no standard format for RID files. The default RID file for the MÄK RTI is *rid.mtl*. For more information about the RID file, please see Chapter 4, *The RID File*, in *MÄK RTI Reference Manual*.



4. Connecting Federates to the MÄK RTI

This chapter explains how to connect a federate to the MÄK RTI and how to start an rtiexec, if necessary.

4.1. Connecting a Federate to the MÄK RTI

The HLA specification defines the information that a federate must provide to an RTI to create or join a federation. This information might be built into your application or you might have to specify it when you start the application. For example, applications based on VR-Link have to specify, at a minimum, a federation name and a federate name. Please consult your application's documentation for its startup procedures.

The MÄK RTI uses the concept of an RTI connection. An RTI connection specifies a port and multicast address. All of the federates in a federation must use the same RTI connection. If a federation is using the rtiexec, an RTI connection includes the address of the RTI Forwarder being used by the rtiexec.

When you install the MÄK RTI, it is configured with a default lightweight connection and a default rtiexec connection.

By default, when you start a federate, the MÄK RTI prompts you to select an RTI connection configuration. If you always want to use the same connection, you can configure the MÄK RTI to always try to use that connection without prompting you to select it.

You can also configure connections in the RID file. (MÄK's VR-Link-based applications have a common set of command-line options for specifying RTI connections.) However these configuration methods are ignored unless you explicitly tell the MÄK RTI to use them. (For details about how to force use of the RID file parameters, please see Section 8.1.1, "Configuring Federate Connections in the RID File", in *MÄK RTI Reference Manual*.)

To connect to the MÄK RTI:

1. Start the federate. The Choose RTI Connection dialog box opens (Figure 4-1).

! If the federate has a splash screen, it is possible that the Choose RTI Connection dialog box will be obscured by the splash screen. The federate startup process may appear to hang while the Choose RTI Connection dialog box is waiting for input. You will have to use the methods available in your windowing system to get access to the Choose RTI Connection dialog box and specify the RTI connection so that the startup process can continue.

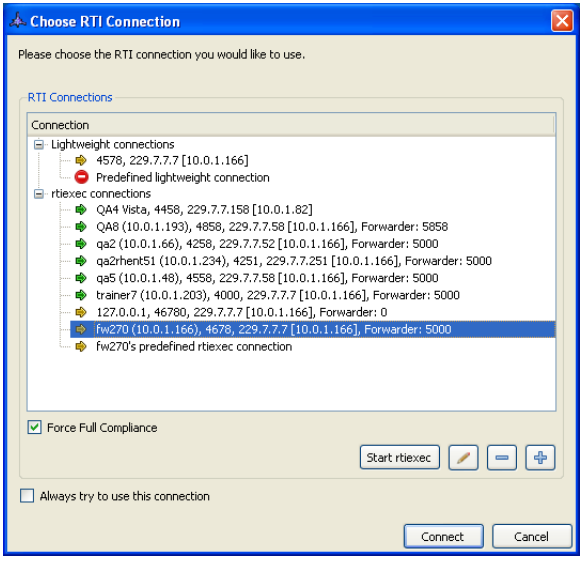


Figure 4-1. Choose RTI Connection dialog box

2. In the Connection window, select the connection that you want to use. (If the connection you want to use is not configured, you can create a new configuration. For details, please see Chapter 8, *Configuring the MÄK RTI Startup Environment*.) The dialog box lists all connections that are configured on the local computer and on any other computers on the network that are running RTI Assistants. Connections are organized into lightweight mode connections and rtiexec connections.

   The rtiexec connections are color coded as follows:

   – Green arrow: The RTI Assistant has verified that there is an rtiexec running on that connection.
   – Yellow arrow: The RTI Assistant knows that a connection configuration exists, but does not know if the rtiexec is running. This might mean that you have to start an rtiexec on this connection, or it might mean that an rtiexec is running, but there is no RTI Assistant on the connection to report its status. You can try to connect to this connection, but it is likely that the connection will fail. (For details about starting the rtiexec, please see "Starting the rtiexec when Starting a Federate," on page 30.)
   – Red "Do Not Enter icon": The federate cannot connect to it. This usually means that there is a conflict with another active connection. It might also mean that an RTI Forwarder is running on the connection, but there is no rtiexec running.

   Lightweight connections are color coded as follows:

   – Green arrow: The RTI Assistant has verified that there is a federate running on that connection. You can connect the federate to this connection.
   – Yellow arrow: The RTI Assistant knows that a connection configuration exists, but does not know if any federates are using it. You can connect the federate to this connection.
   – Red "Do Not Enter icon": The federate cannot connect to it. This usually means that there is a conflict with another active connection.

If you hover the mouse over a connection, a tooltip displays information about the connection, including, for example, why you cannot use a particular connection.

3. If you want federates on this machine to always try to use the selected connection, select the Always Try to Use this Connection check box.
4. Click Connect. The federate will try to connect to the federation. If it cannot do so, the Connection Failed dialog box opens. For details about resolving connection problems, please see "Troubleshooting Federate Connection Problems," on page 24.

4.1.1. Troubleshooting Federate Connection Problems

When you start a federate, the RTI Assistant monitors the connection process. If the connection fails, the RTI Assistant displays a dialog box indicating the problem (Figure 4-2).

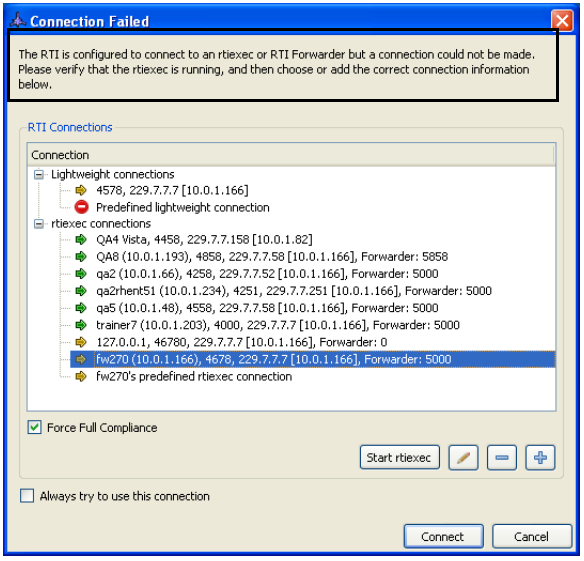


Figure 4-2. Connection Failed dialog box

The most likely reasons that a federate cannot connect are:

- The configuration requires the rtiexec and the rtiexec is not running
- If RID file parameters or command-line options are being used, the port specified does not match the port on which the rtiexec is running.

To connect a federate after a connection has failed, use one of the following methods:

- If the rtiexec is not running, start the rtiexec, then try to connect again. (For details about starting the rtiexec, please see "Starting the rtiexec when Starting a Federate," on page 30.)
- In the Connection Failed dialog box, select a valid connection (green arrow). Then click Connect.
- Update the RID file or command line to have the correct connection information and restart the federate.
- Edit an existing connection configuration or add a new connection configuration that resolves problems with the available connections. For details, please see "Managing Connection Configurations," on page 57.

4.2. Starting the rtiexec

Some federations require use of the rtiexec. When you start a federate, the rtiexec might already be running on the connection that you want to use. However, if it is not, you have to start it. You can start the rtiexec directly, or you can start it as part of the process of starting a federate. (For details, please see "Starting the rtiexec when Starting a Federate," on page 30.)

When you start the rtiexec, you must specify a connection configuration (a port and broadcast address). You can specify connection parameters in the RID file, on the command line, or in the RTI Assistant's Choose Connection Configuration dialog box (the default method). When you start the rtiexec using the RTI Assistant, you can start rtiexecs on remote computers.

Connection configurations override command-line options and settings in the RID file unless you force use of the command-line or RID file settings. For details, please see "Managing Connection Configurations," on page 57.

If the rtiexec is configured to connect to an RTI Forwarder running on a remote computer, you must start the RTI Forwarder before you can start the rtiexec. For details about starting the RTI Forwarder, please see Section 5.3, "The RTI Forwarder Application", in *MÄK RTI Reference Manual*.

To start the rtiexec on Windows:

1. Choose **Start** → **Programs** → **MÄK Technologies** → **MÄK RTI 4.1** → **rtiexec**. If the RTI Assistant is not already running, it starts and its icon is added to the system tray (Figure 4-3). The Choose Connection Configuration dialog box opens (Figure 4-4).

If the RTI Assistant has been configured to always try to use a particular connection and that connection is available, the Choose Connection Configuration dialog box is not displayed. The rtiexec starts immediately.

Figure 4-3. RTI Assistant icon

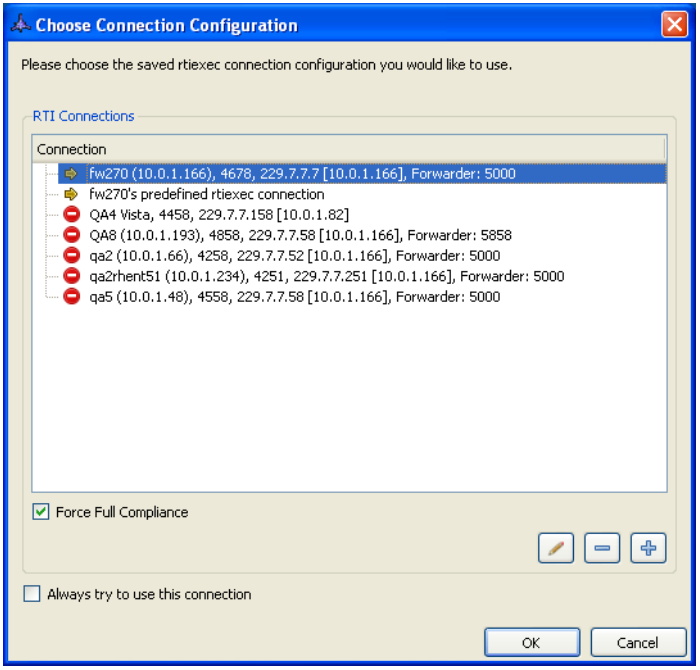


Figure 4-4. Choose Connection Configuration

2. Select the connection configuration that you want to use. (If necessary, edit an existing configuration or add a new one. For details, please see "Managing Connection Configurations," on page 57.)

- If a connection has a yellow arrow, it probably means that there is no RTI Forwarder or rtiexec running on this connection. You can probably start the rtiexec on this connection.
- If a connection has a green arrow, it means that an RTI Forwarder is running on that connection, but not an rtiexec. You can start an rtiexec on this connection.
- If a configuration has a red icon, it is already in use. You cannot use it.

3. Optionally, select the Force Full Compliance check box to force the rtiexec to run in fully compliant mode. For details about full compliance, please see Section 5.1, "The rtiexec" and Section 12.1, "Enabling and Disabling HLA Services", in *MÄK RTI Reference Manual*.
4. If you always want to use the same connection, select the Always Try to Use This Connection check box. If you want to choose a connection each time you start the rtiexec, clear the check box.
5. Click OK.

➤ To start the rtiexec on Linux or from the Windows command line, in the *./bin* directory, run rtiexec, for example:

```
rtiexec [options]
```

The rtiexec startup process is the same as described in the Windows startup procedure.

The rtiexec is a server application. Do not run more than one instance of the rtiexec per federation.

Table 4-1 lists command-line options for the rtiexec.

Table 4-1: rtiexec command-line options

Option	Description
(-- | --ignore_rest)	Ignore all command-line options that follow this one.
(-A | --destAddrString) *address*	Specifies the multicast group address to use if reliable transport is disabled. Equivalent to the RTI_destAddrString parameter. This option is ignored unless **--manual** is used.
(-d | --devAddrString) *address*	Specifies the address of the network device to be used for multicast traffic.
(-D | --distributedForwarderPort) *port*	Specifies the port that RTI Forwarders use to communicate with each other.
(-f | --forceFullCompliance)	Specifies that the rtiexec is to run in fully compliant mode. This option is ignored unless **--manual** is used.
(-F | --forwarderToConnectTo) *address*	Specifies the address of an additional forwarder that this forwarder should try to connect to instead of using the routes file.
(-h | --help)	Displays a list of command-line options.
(-K | --autoExit)	Specifies that the rtiexec exits automatically after the last connection exits.
(-l | --setLogFileName) *filename*	Enables logging to a file with the specified name.
(-M | --manual)	Specifies that the rtiexec use the connection configuration in the RID file or supplied on the command line rather than the configuration stored by the RTI Assistant. It is equivalent to setting RTI_configureConnectionWithRid to 1. Since command-line options override the RID file, using this option enables you to specify the connection configuration from the command line.
(-n | --notifyLevel) *level*	Sets the diagnostic output level.

Table 4-1: rtiexec command-line options

Option	Description
(-N | --networkInterfaceAddr) *address*	Specifies the IP address of the network card that you want this forwarder to use.
(-P | --setUdpPort) *port*	Specifies the port to listen to. Equivalent to the RTI_udpPort parameter. This option is ignored unless **--manual** is used.
(-q | --setNotifyQuiet)	Suppresses output of diagnostic messages.
(-r | --useReliable)	Specifies that the rtiexec use reliable message transport. Equivalent to setting RTI_internalMsgReliableWhenUsingRtiexec to 1 and RTI_fomDataTransportTypeControl to 0. This option is ignored unless **--manual** is used.
(-R | --setRidFileName) *RID_file*	Specifies the RID file to use. **-R** overrides the RTI_RID_FILE environment variable.
(-T | --setTcpPort) *port*	Specifies the port to be used to connect via TCP to the RTI Forwarder. Equivalent to the RTI_tcpPort parameter. This option is ignored unless **--manual** is used.
(-v | --version)	Display version information and exit.

4.2.1. Starting the rtiexec when Starting a Federate

When you start a federate it either displays the Choose RTI Connection dialog box (Figure 4-5) or it tries to connect to a federation using the default connection configuration. If a federate fails to connect to the default connection, the MÄK RTI displays the Connection Failed dialog box (Figure 4-6). Both of these dialog boxes let you choose the connection configuration to use, and if necessary, start the rtiexec.

The RTI Assistant lets you start an rtiexec on the local computer or on a remote computer. When you start the rtiexec, it starts an RTI Forwarder on the same computer. If it cannot run the forwarder, it exits. (You cannot run the rtiexec unless a forwarder is running.)

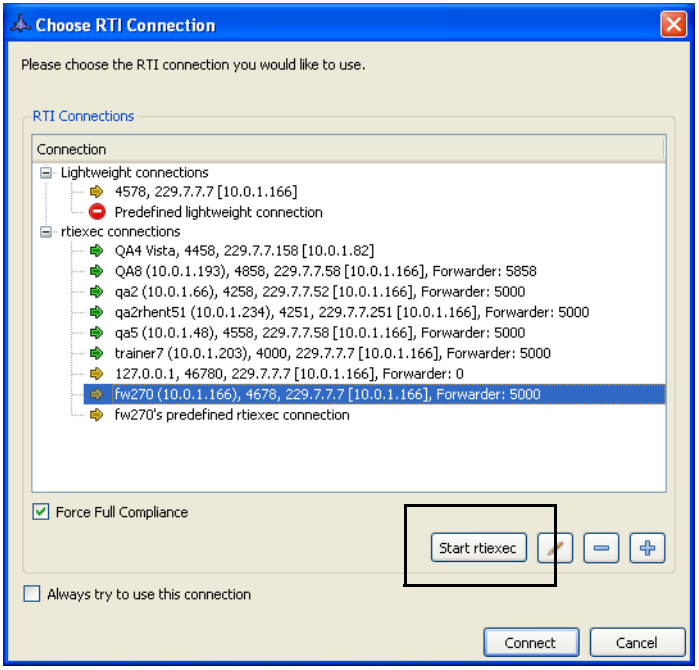


Figure 4-5. Choose RTI Connection dialog box

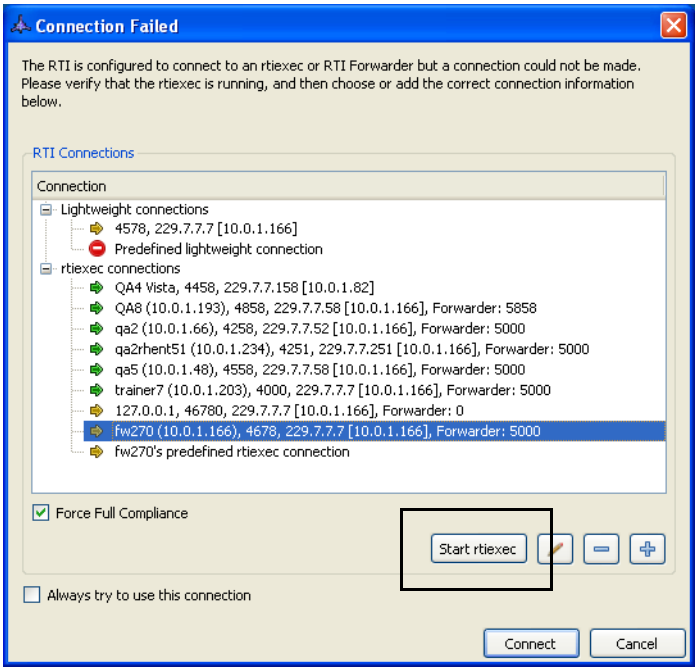


Figure 4-6. Connection Failed dialog box

To start the rtiexec from the Choose RTI Connection dialog box or Connection Failed dialog box:

1. In the dialog box, in the RTI Connections window, select the connection that you want to use for the rtiexec. If this is a valid connection on which to run an rtiexec, the Start rtiexec button is enabled.
2. Click Start rtiexec. The rtiexec starts on the computer specified by the connection.
3. To connect the federate, click Connect.

4.2.2. Shutting Down the rtiexec

To shut down the rtiexec, use one of the following procedures:

- In the RTI Network Component View, select the rtiexec you want to shut down and choose **File** → **Shut Down Current rtiexec**. (This is the preferred method.)
- Kill the rtiexec process.
- Use the RTI Command Line Tool to send a **`kill`** command. For details, please see Section 5.4, "The RTI Command Line Tool", in *MÄK RTI Reference Manual*.
- Choose **Shut Down All** on the RTI Assistant menu. (This may have unintended consequences. Not recommended for normal shutdown of rtiexecs and federates.)

4.3. Removing a Federate from a Federation

When you shut down a federate, it resigns from the federation. The RTI Assistant and RTIspy let you force a federate to shut down and resign from a federation.

4.3.1. Resigning a Federate Using the Federations View

To force a federate to resign from the federation:

1. In the system tray, right-click the RTI Assistant icon. A menu is displayed.
2. Choose **Federations View**. The RTI Federations View opens (Figure 4-7).

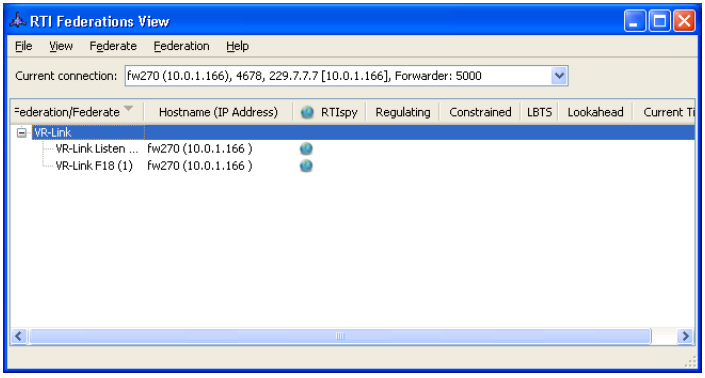


Figure 4-7. RTI Federations View

3. In the Current Connection box, select the connection that you want to view.
4. Select the federate that you want to resign.
5. Choose **Federate** → **Resign Selected Federate**.

4.3.2. Resigning a Federate Using the RTI Assistant Menu

The RTI Assistant menu has a command that lets you force federates on the local machine to resign.

To force a federate to resign from the federation from the RTI Assistant menu:

1. Right-click the RTI Assistant icon. A menu is displayed.
2. Select the federate that you want to resign. A submenu is displayed.
3. Choose **Force Resign**.

4.3.3. Resigning a Federate Using the RTIspy

To force a federate to resign from the federation in the RTIspy:

1. On the Federations page, select the federate that you want to remove.
2. Click the Delete Federate button (Figure 4-8).

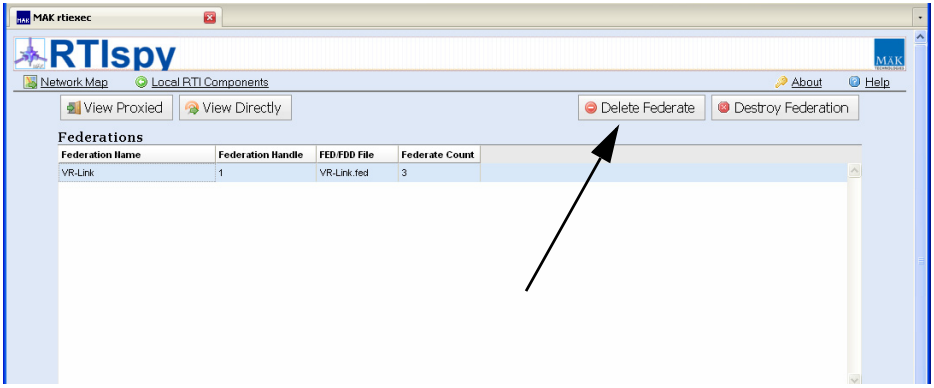
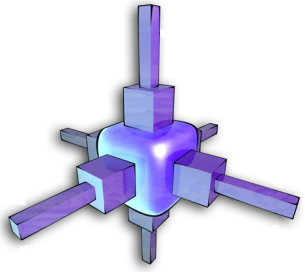


Figure 4-8. RTIspy Federations view



5. Managing Federations

Although this manual focuses on starting federates, with little attention to broader federation management issues, even if you are running only one federate, you are creating a federation. This chapter covers some basic federation management tasks.

The RTI Assistant lets you view and manage federations in the RTI Federations View (Figure 5-1).

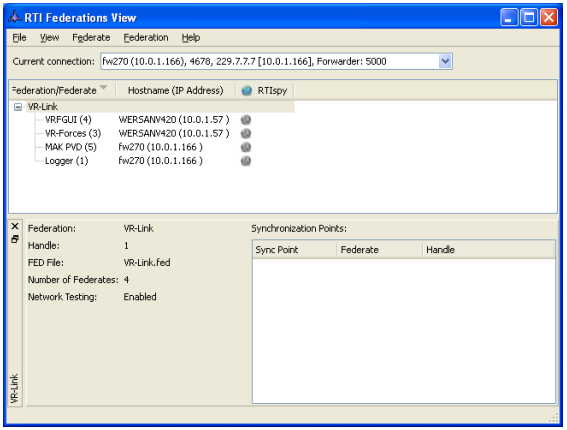


Figure 5-1. RTI Federations View

5.1. Destroying Federations

You can destroy federations explicitly in the RTI Federations View. You can also destroy all local rtiexecs and federations from the RTI Assistant menu.

To destroy a federation:

1. In the system tray, right-click the RTI Assistant icon. A menu is displayed.
2. Choose **Federations View**. The RTI Federations View opens.
3. In the Current Connection box, select the connection that you want to view.
4. Select the federation that you want to destroy
5. Choose **Federation** → **Destroy Selected Federation**.

5.1.1. Shutting Down all Local RTI Components

The Shut Down All command kills all local forwarders and rtiexecs and federations that are using them. It does not affect federates running in lightweight mode. It does not affect remote rtiexecs, even if you started them from the local computer.

If remote federates are using the local rtiexec, shutting down all local RTI components could affect them.

To shut down all local components:

1. In the system tray, right-click the RTI Assistant icon. A menu is displayed.
2. Choose **Shut Down All**.

5.1.2. Destroying a Federation in the RTIspy

If all of the federates in a federation have resigned or been removed, you can destroy the federation from the RTIspy. (For details about starting the RTIspy, please see Chapter 7, *The RTIspy Diagnostic GUI*.)

To destroy a federation:

1. On the Federations page, select the federation in the Federations list.
2. Click Destroy Federation (Figure 5-2).

Figure 5-2. Destroying a federation

5.2. Removing Disconnected Federates from the Display

When a federate terminates abnormally and does not resign from a federation, a disconnected federate entry is left in the federate list. You can configure the rtiexec to automatically remove disconnected federates from the display.

To automatically remove disconnected federates from the display:

1. Right-click the RTI Assistant icon in the system tray. A popup menu opens.
2. Choose **Preferences**. The RTI Preferences dialog box opens.
3. Select the Assistant Options page (Figure 5-3).

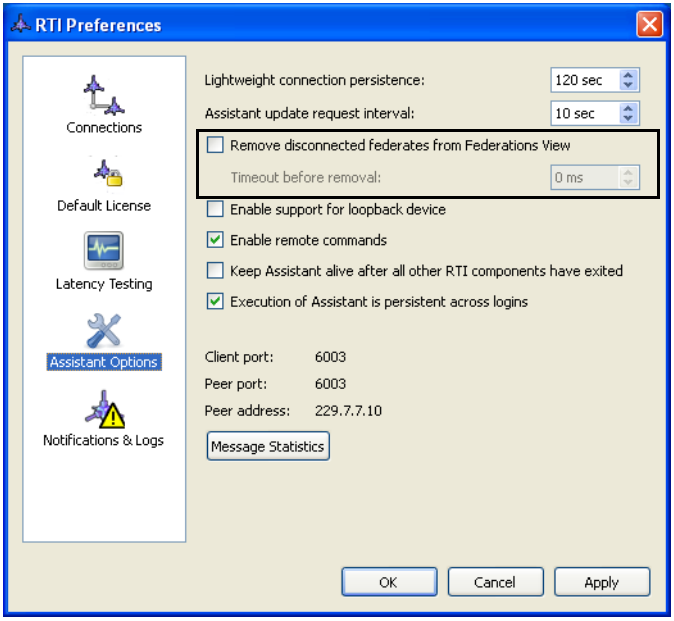
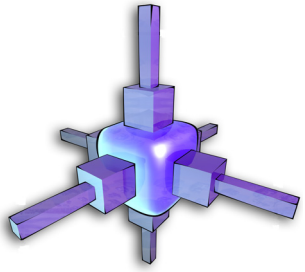


Figure 5-3. RTI Preferences dialog box, Assistant Options page

4. Select Remove Disconnected Federates from Federations View.
5. Optionally, specify the time to wait before removing the federates.
6. Click OK.



6. The RTI Assistant

We have already referred to the RTI Assistant numerous times in this manual in the context of various procedures. This chapter focuses on the RTI Assistant itself.

By default, the RTI Assistant remembers its state when you log off. If it was running when you logged off, it starts automatically when you log in. If it was off when you logged off, it does not start automatically when you log in. To configure this behavior, please see "Configuring the RTI Assistant's Startup Behavior," on page 44.

6.1. Starting the RTI Assistant

If the RTI Assistant is not already running, it starts automatically when you start a federate, the rtiexec, or the RTI Forwarder. On Windows, you can also start the RTI Assistant directly.

➤ To start the RTI Assistant on Windows, choose **Start** → **Programs** → **MÄK Technologies** → **MÄK RTI 4.1** → **Utilities** → **RTI Assistant**. The RTI Assistant icon is added to the system tray (Figure 6-1).

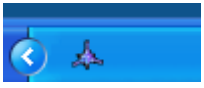


Figure 6-1. RTI Assistant icon

6.2. The RTI Assistant Windows

The RTI Assistant has the following windows and dialog boxes:

- Local Notification History
- RTI Federations View
- RTI Network Component View
- RTI Preferences dialog box.

You can open any of these windows by right-clicking the RTI Assistant icon in the system tray and selecting them from the menu.

6.2.1. RTI Federations View

The RTI Federations View (Figure 6-2) lists the federations running on each connection and the federates in those federations. It provides options for managing federations, viewing federation information, running latency testing, and starting the RTIspy diagnostic GUI.

The RTI Federations View does not list applications that are running on a connection, but which are not part of a federation, such as the rtiexec and RTI Forwarder. To see information about those applications, open the RTI Network Component View.

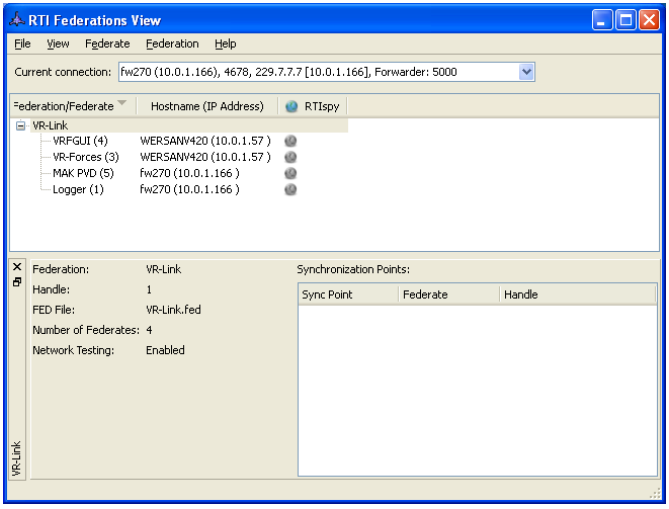


Figure 6-2. RTI Federations View

To open the RTI Federations View:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Federations View**.

To quickly open the RTI Federations View window, double-click the RTI Assistant icon.

6.2.2. RTI Network Component View

The RTI Network Component View (Figure 6-3) lists the applications (federates, rtiexecs, and RTI Forwarders) running on the selected connection. It provides the same information as the RTIspy network map. The RTI Network Component View lists applications without regard to their participation in a federation. For example, an application may be running, but not joined to a federation. It is displayed in the Network Component View, but not the RTI Federations View.

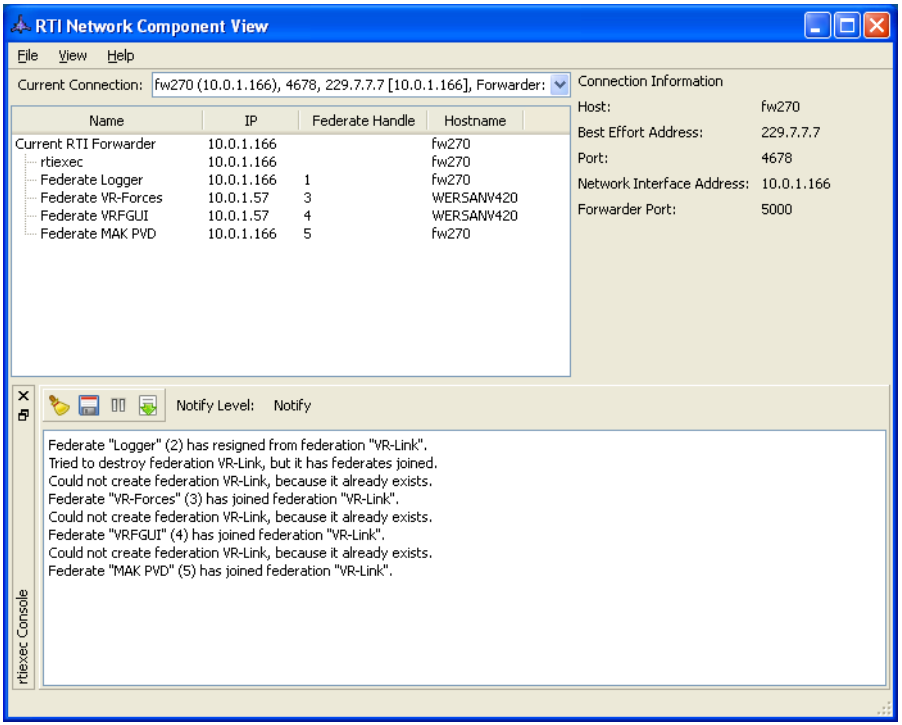


Figure 6-3. Network Component View

To open the RTI Network Component View:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Network Component View**.

6.2.3. RTI Preferences Dialog Box

The RTI Preferences dialog box (Figure 6-4) lets you configure the RTI Assistant. You can also configure latency testing from this dialog box.

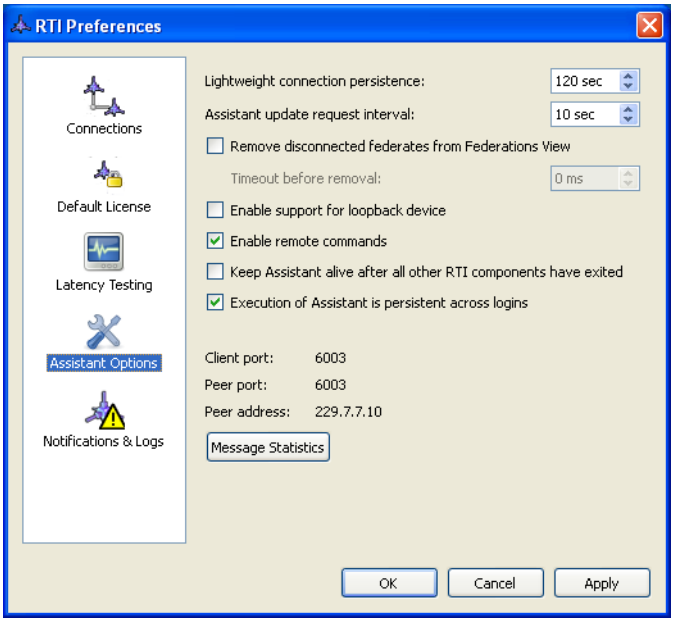


Figure 6-4. RTI Preferences dialog box

6.2.4. Local Component Notification History Window

The Local Component Notification History window (Figure 6-5) displays notification messages sent by the local rtiexec and LRCs.

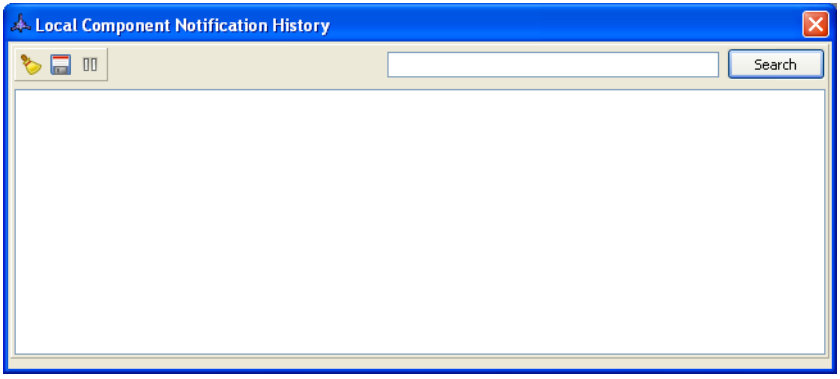


Figure 6-5. Local Component Notification History window

To open the Local Component Notification History window:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Local Notification History**.

6.3. Configuring the RTI Assistant's Startup Behavior

By default, when you log in, the RTI Assistant restores its status from when you logged off – if it was running when you logged off, it starts automatically; if it was not running it does not start.

To configure the RTI Assistant to never start automatically when you log in:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Preferences**. The RTI Preferences dialog box opens.
3. Select the Assistant Options page (Figure 6-4).
4. Clear the Execution of Assistant is Persistent Across Logins check box.
5. Click OK.

6.4. Specifying the RTI Assistant's Exit Policy

You can configure the RTI Assistant to close when all federates and the rtiexec exit, or you can configure it to keep running until you exit manually.

To configure when the RTI Assistant exits:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Preferences**. The RTI Preferences dialog box opens.
3. Select the Assistant Options page (Figure 6-4).

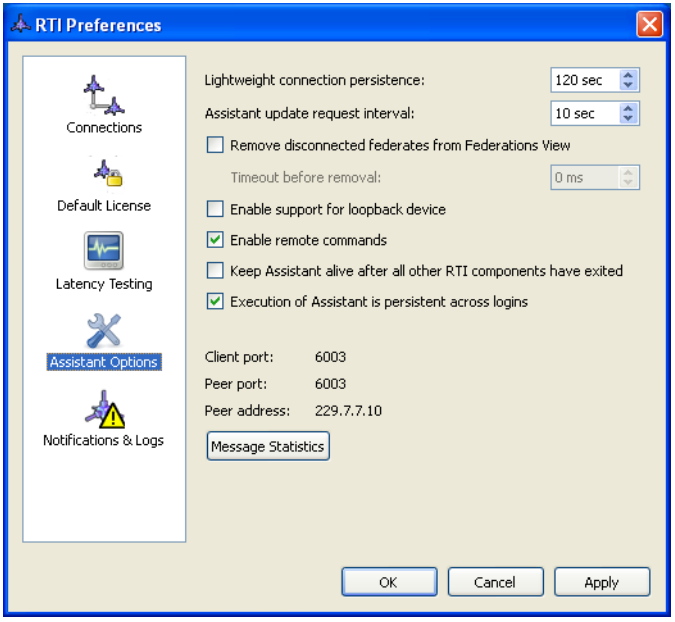


Figure 6-6. RTI Preferences dialog box, Assistant Options

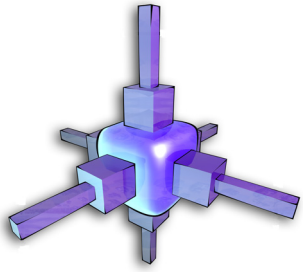
4. To keep the RTI Assistant running when federates and the rtiexec have shut down, select the Keep Assistant Alive After All Other RTI Components Have Exited check box. To have it shut down automatically when all components have shut down, clear the check box.
5. Click OK.

6.5. Shutting Down the RTI Assistant

If you do not configure the RTI Assistant to shut down automatically, you can shut it down manually. When you shut down the RTI Assistant, it forces all LRCs and rtiexecs on the local computer to shut down. It does not affect RTI components on remote computers.

To shut down the RTI Assistant:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Shut Down All**.



7. The RTIspy Diagnostic GUI

The RTIspy diagnostic GUI is a web-based view of federations and federates. It provides the same information as the RTI Federations View and RTI Network Component View, plus additional diagnostic information. To use the RTIspy GUI, you must enable it in *rid.mtl*. Once it is enabled, you can start the RTIspy GUI from the RTI Federations View, from the RTI Assistant menu, and by typing its URL in your web browser. This section provides basic information about enabling the RTIspy GUI and starting it. For more detailed information, please see Chapter 6, *Setting Up the RTIspy*, in *MÄK RTI Reference Manual*.

The RTIspy diagnostic GUI is disabled by default because its use can affect performance.

7.1. Enabling the RTIspy

You can run the RTIspy without running the rtiexec. However, if you want to use the RTIspy to view detailed federation information, or if you want to use the network map, you must run the rtiexec.

To enable RTIspy, the minimal settings in *rid.mtl* for each federate are as follows:

```
(setqb RTI_enableRtiexecWebservice 1)
(setqb RTI_enableLrcWebservice 1)
```

You must enable **RTI_internalMsgReliableWhenUsingRtiexec** to access the network map (described in Section 7.4, "Viewing Network Components", in *MÄK RTI Reference Manual*). If the network map is not available, you can access RTI components through the component list (described in Section 7.4.3, "Viewing the MÄK RTI Components List", in *MÄK RTI Reference Manual*.).

7.2. Opening the RTIspy Web Page from the RTI Federations View

To open the RTIspy in your browser, you can enter a URL as described in Section 6.2, "Running the RTIspy Web Servers", in *MÄK RTI Reference Manual*, or you can open it from the RTI Federations View.

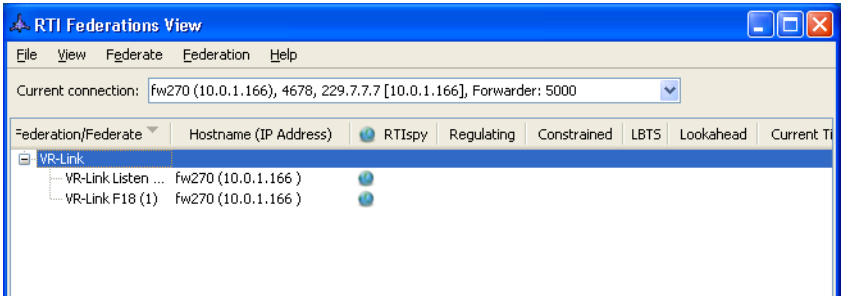


Figure 7-1. RTI Federations View

➤ To open the RTIspy to the network map (Figure 7-2), in the RTI Federations View choose **View** → **Open RTIspy**.

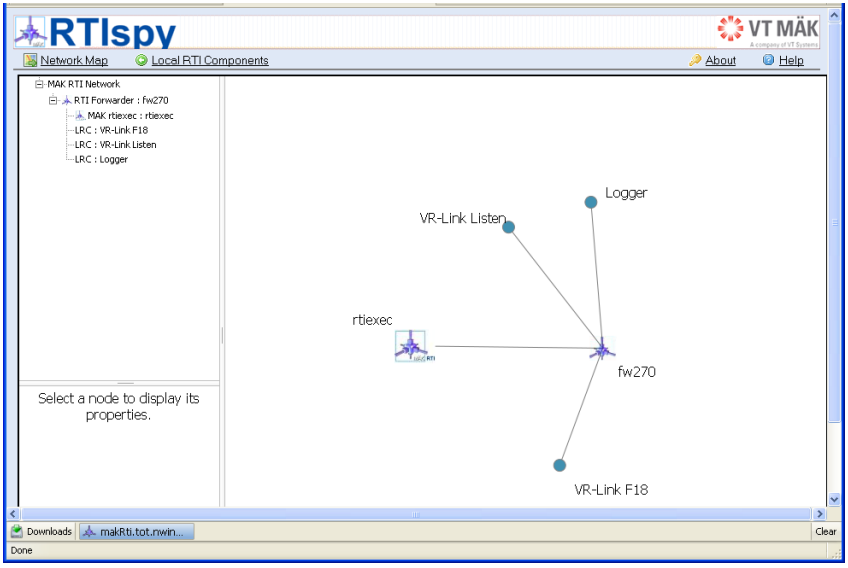


Figure 7-2. RTIspy network map

To open the RTIspy to a federate page:

1. In the RTI Federations View, select the federate.
2. Choose **Federate** → **Open Federate RTIspy**. The RTIspy displays information about the selected federate (Figure 7-3).

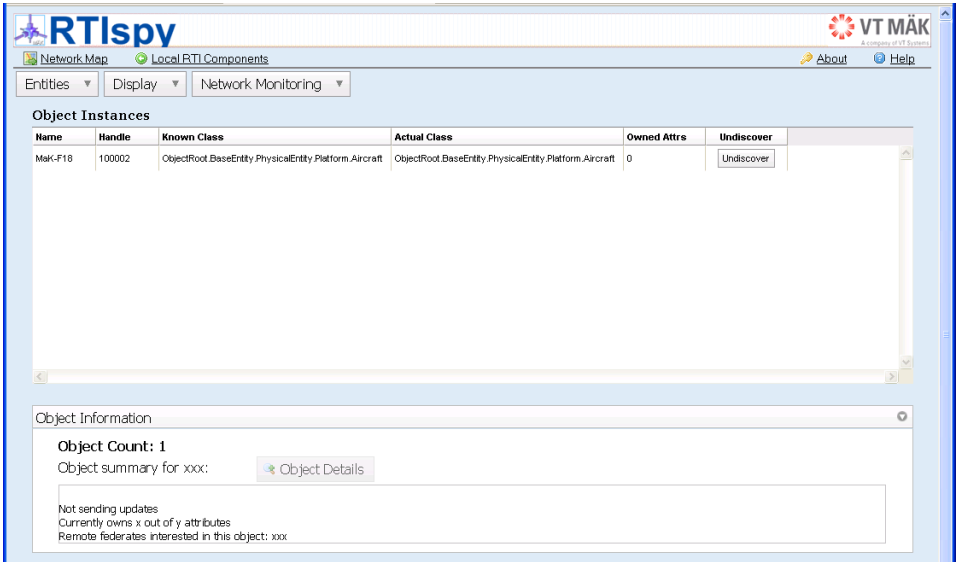
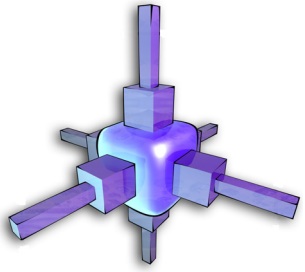


Figure 7-3. RTIspy federate page

7.3. Opening the RTIspy from the RTI Assistant Menu

To open the RTIspy from the RTI Assistant menu:

1. Right-click the RTI Assistant icon. A menu is displayed.
2. Select the RTI component for which you want to open an RTIspy page. A submenu is displayed.
3. On the submenu, choose **Open RTIspy**.



8. Configuring the MÄK RTI Startup Environment

This chapter explains how use with the RTI Chooser to configure the MÄK RTI version and RID file to use, and how to configure RTI connections in the Choose RTI Connection dialog boxes and the RTI Assistant.

8.1. Configuring Your System to Use the MÄK RTI

When you start the rtiexec or a federate, the system determines which RTI to use and which RID file to use based on several environment variables. If you have several RTIs installed or several versions of the MÄK RTI, switching between them can be a cumbersome process of editing environment variables or maintaining batch files or shell scripts. On Windows, you can use the RTI Chooser to simplify this process. For details, please see "Configuring the MÄK RTI Version and RID File to Use," on page 53.

The RTI dynamic library needs to be located in your dynamic library search path. This path is specified in an environment variable, as listed in Table 8-1.

Table 8-1: Path environment variable

System	Environment Variable
Solaris	LD_LIBRARY_PATH
Linux	LD_LIBRARY_PATH
Windows XP	PATH

If you have more than one RTI installed on your computer, federates will try to use the first RTI found in the path. If you want to use the MÄK RTI or a particular version of the MÄK RTI, make sure that it is the first RTI in your path.

8.1.1. MÄK RTI Environment Variables

The MÄK RTI uses the following environment variables if they are set. Some of these may simplify federate configuration, and some may be required by older federates that rely on the environment settings used by variants of the DMSO RTI.

- RTI_RID_FILE – Specifies the absolute path to the *rid.mtl* file including the name of the file (usually *rid.mtl*)
- RTI_CONFIG – Specifies the absolute path to the directory containing the RTI configuration files, such as FED, FDD, RID, routes configuration file and fixed grid DDM configuration. The MÄK RTI automatically searches in this directory for these configuration files after looking in the current working directory.
- MAK_RTIDIR – Specifies the location of the MÄK RTI binaries and libraries. It is set during installation (unless opted out) and when running the RTI Chooser. If modified outside of the RTI Chooser, it should be set to the full path of the MÄK RTI. For example, on Windows, by default this is *C:\MAK\makRtiX.X.X*. It is used to add the MÄK RTI to search paths for libraries and executables. It is also used to build the VR-Link examples.
- RTI_HOME – This environment variable is not used by the MÄK RTI, but some legacy federates may require it. RTI_HOME should be set to the full path to the RTI.
- RTI_BUILD_TYPE – This environment variable is not used by the MÄK RTI, but some legacy federates may require it (these federates will also require RTI_HOME). RTI_BUILD_TYPE should be set to ".". This variable was used by the DMSO RTI to indicate a platform type that was appended to RTI_HOME to determine the location of the RTI libraries.

The following environment variables are used by the RTI Assistant. For more information, please see Section 5.2, "The RTI Assistant", in *MÄK RTI Reference Manual*.

- RTI_ASSISTANT_PORT
- RTI_ASSISTANT_CLIENT_PORT
- RTI_ASSISTANT_ADDRESS
- RTI_ASSISTANT_DISABLE.

8.1.2. Specifying RID Parameters Programmatically in HLA 1516

You can specify RID parameters programmatically in HLA 1516. For details, please see Section 4.1.5, "Specifying RID Parameters Programmatically in HLA 1516", in *MÄK RTI Reference Manual*. (You cannot specify parameters programmatically in HLA Evolved.)

8.2. Configuring the MÄK RTI Version and RID File to Use

If you have more than one version of the MÄK RTI installed, you can use the RTI Chooser to quickly change which one to use without needing to manually edit your path or other environment variables. You can also specify which RID file to use with a particular MÄK RTI version.

The RTI Chooser is only available on Windows.

- When you change the RTI or RID file version in the RTI Chooser, any federates on the computer are forcibly resigned and the rtiexec, RTI Forwarder, and RTI Assistant are shut down.
- Federates that use the Java bindings cannot use the RTI Chooser. The Java bindings require that the *.\lib\java* directory be the first directory in your PATH so that the Java fedtime library is used instead of the C++ fedtime library. However, the RTI Chooser places the *.\bin* directory ahead of the *.\lib\java* directory.

To configure the MÄK RTI version and RID file to use:

1. Choose **Start** → **Programs** → **MÄK Technologies** → **MÄK RTI 4.1** → **Configuration** → **RTI Chooser**. The RTI Chooser opens (Figure 8-1). The RTI Chooser window lists the known RTI configurations.

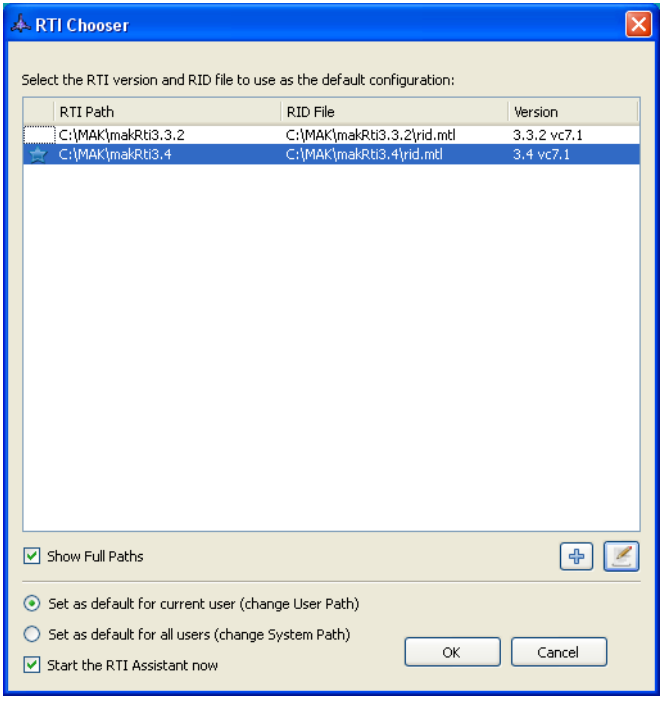


Figure 8-1. RTI Chooser

2. If you want to use an existing configuration, select it in the window. (You can add configurations. For details, please see "Adding an RTI Configuration," on page 55.)
3. Specify whether you want to change the PATH environment variable for the current user (yourself), or for all users of this computer (system PATH).
4. If the RTI Assistant is not running and you want to start it, select Start the RTI Assistant Now.
5. Click OK. The PATH is updated. The next time you start the rtiexec or a federate, it will use the MÄK RTI version and RID file in the selected configuration.

8.2.1. Adding an RTI Configuration

You can add configurations to the RTI Chooser. Each configuration specifies a version of the MÄK RTI and the RID file that you want to use with it.

To add a configuration to the RTI Chooser:

1. Choose **Start** → **Programs** → **MÄK Technologies** → **MÄK RTI 4.1** → **Configuration** → **RTI Chooser**. The RTI Chooser opens (Figure 8-1).
2. Click the Plus button. The Add RTI Configuration dialog box opens (Figure 8-2).

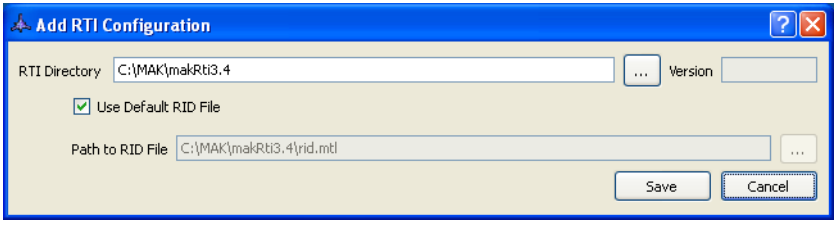


Figure 8-2. Add RTI Configuration dialog box

3. Type the path to the MÄK RTI version that you want to configure, or click the browse button and select the installation directory for the MÄK RTI version. The RTI Chooser automatically tries to detect the compiler version of the MÄK RTI installation.
4. To use the default RID file (*rid.mtl*), select Use Default RID File. To specify a different RID file, type its path in the Path To RID File text box or select it using the chooser.
5. Click Save.

8.2.2. Editing an RTI Configuration

You can edit RTI configurations in the RTI Chooser.

To edit a configuration to the RTI Chooser:

1. Choose **Start** → **Programs** → **MÄK Technologies** → **MÄK RTI 4.1** → **Configuration** → **RTI Chooser**. The RTI Chooser opens (Figure 8-1).
2. In the window, select the configuration you want to edit.
3. Click the Edit button. The Edit RTI Configuration dialog box opens (Figure 8-3).

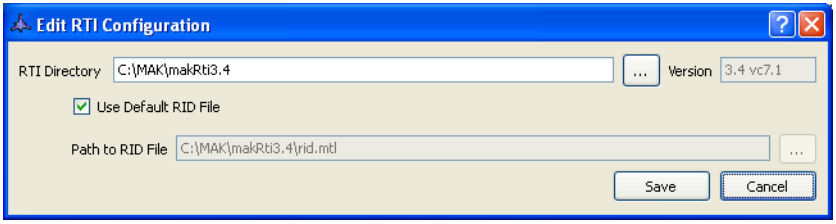


Figure 8-3. Edit RTI Configuration dialog box

4. Change the MÄK RTI version or RID file.
5. Click Save.

8.3. Managing Connection Configurations

The RTI Assistant manages two types of connection configurations, rtiexec connections and RTI connections.

The MÄK RTI supports IPv4 and IPv6, but you cannot mix the two protocols. If your federation is using IPv4, then all IP addresses in the RID file and RTI Assistant must be in the IPv4 format. The same applies to use of IPv6.

An rtiexec connection configuration specifies the port and multicast or broadcast address an rtiexec should use to connect to the network. Optionally, it can specify that the rtiexec run in full compliance mode. The MÄK RTI installs a predefined connection, which uses port 4001 and the address 229.7.7.7, running in full compliance mode.

An RTI connection specifies the port and multicast or broadcast address that a federate should use when it connects to the network. This might be the same configuration that an rtiexec is using or it could be a configuration for running in lightweight mode (no rtiexec).

You can create and remove rtiexec connection configurations in the Choose Connection Configuration dialog box and in the RTI Preferences dialog box, Connection page. You can also set a default connection.

You can create and remove RTI connection configurations in the Choose RTI Connection dialog box and in the RTI Preferences dialog box, Connections page. You can also set a default connection.

Table 8-2 describes the parameters in a connection. Table 8-3 lists parameter combinations that must be unique.

Table 8-2: Connection parameters

Parameter	Connection	Default	Description
Hostname or IP address	rtiexec	Local computer	IP address or hostname of rtiexec computer.
Reliable Port	rtiexec	4001	Port used for reliable communications.
Best Effort Port	rtiexec lightweight	rtiexec: 4001 lightweight: 4000	Port used for best effort communications.
Best Effort Address	rtiexec lightweight	229.7.7.7	Multicast address used for best effort traffic.

Table 8-2: Connection parameters

Parameter	Connection	Default	Description
Network Interface Address	rtiexec lightweight	First device found	Local network interface on which RTI traffic will be sent and received.
Forwarder Port	rtiexec	5000	Port RTI Forwarders use to communicate with each other.

Table 8-3: Connection parameter uniqueness requirements

Parameter combinations that must be unique	Connection	Reason
Hostname/IP,Reliable Port,Interface	rtiexec	Two rtiexecs cannot be bound to the same port on the same machine.
Hostname/IP,Forwarder Port	rtiexec	Two rtiexecs cannot be bound to the same port on the same machine.
Best Effort Port,Best Effort Addr,Interface	rtiexec lightweight	Two connections using the same be address and port will overlap traffic.

Connection configurations managed from the RTI Assistant override command-line options and RID file parameters unless you force the MÄK RTI to use them. The following parameters are affected as indicated:

- **RTI_forceFullCompliance**, **RTI_useRtiExec**, **RTI_udpPort**, **RTI_destAddrString**, **RTI_distributedForwarderPort**, **RTI_networkInterfaceAddr**, **RTI_tcpPort**, and **RTI_tcpForwarderAddr** are all set based on the selected configuration.
- **RTI_internalMsgReliableWhenUsingRtiexec** is always forced to 1.
- **RTI_fomDataTransportTypeControl** and **RTI_mcastDiscoveryEnabled** are always forced to 0.
- The **RTI_forwarderRoutesFile** parameter is ignored. If you want to use a routes file, you must use the configuration in the RID file, not the RTI Assistant connection configurations.

- To force RTI Forwarders, rtiexecs, and federates to use the values specified for these parameters in *rid.mtl* instead of those in the connection configuration, set RTI_configureConnectionWithRid to 1.
- To force the rtiexec or RTI Forwarder to use the connection values specified by command-line options instead of those in the connection configuration, use the **`--manual`** command-line option.

8.3.1. Adding rtiexec Connection Configurations

You can add rtiexec connection configurations for your computer in the Choose Connection Configuration dialog box and in the RTI Preferences dialog box, Connections page. If you have specified that the rtiexec always try to use a selected connection, the Choose Connection Configuration dialog box does not open when the rtiexec starts up. In that case you would have to make changes in the RTI Preferences dialog box. (For details, please see "Adding RTI Connection Configurations," on page 62.)

To add an rtiexec connection configuration in the Choose Connection Configuration dialog box:

1. Start the rtiexec. The Choose Connection Configuration dialog box opens (Figure 8-4).

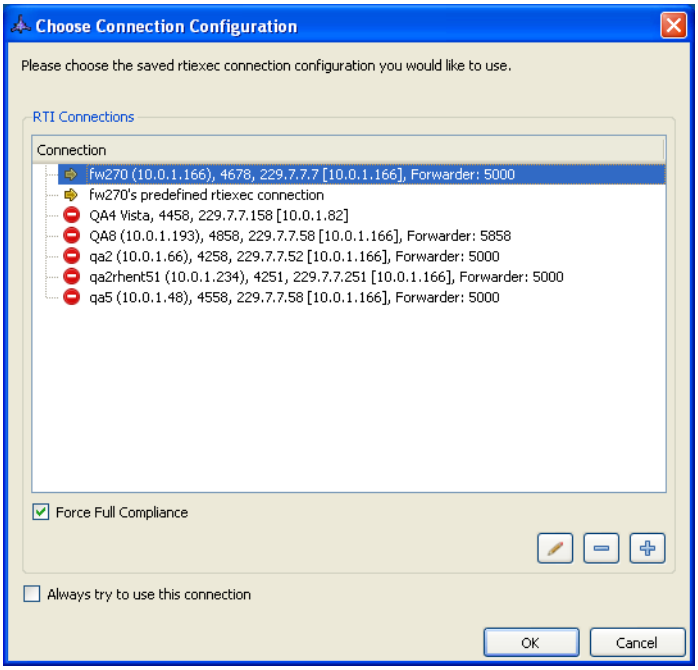


Figure 8-4. Choose Connection Configuration dialog box

2. Click the Plus (+) button. The Add New Local rtiexec Connection dialog box opens (Figure 8-5). The dialog box is populated with default parameters and a connection name built from those parameters.
3. Optionally, change the connection name.

The name can be seen everywhere on the network when the connection becomes active. You can change the name after the connection is created, but only on the machine on which the connection was created, and only when it is not being used.

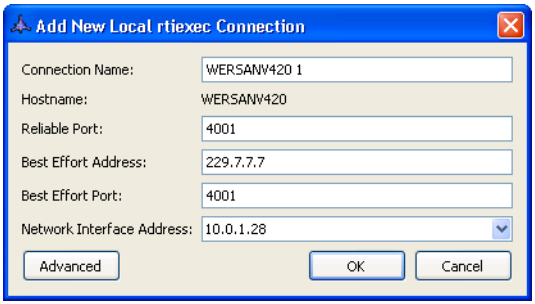


Figure 8-5. Add New Local rtiexec Connection dialog box

You can only add rtiexec connection configurations for the local host.

4. Type the ports you want to use in the Reliable Port and Best Effot Port text boxes.
5. Type the best effort address that you want to use in the Best Effort Address text box. It should be a multicast or broadcast address.
6. If your computer has multiple network cards, select the device address that you want to use.
7. Optionally, configure connections for distributed forwarding. For details, please see Section 11.6.1, "Configuring RTI Forwarders Using the RTI Assistant", in *MÄK RTI Reference Manual*.
8. Click OK.

8.3.2. Adding RTI Connection Configurations

You can add RTI connection configurations on the RTI Preferences dialog box Connections page and in the Choose RTI Connection dialog box. The MÄK RTI installs a predefined lightweight connection, which uses port 4000 and the address 229.7.7.7.

To add a connection configuration on the Connections page or the Choose RTI Connection dialog box:

1. To open the Choose RTI Connection dialog box (Figure 8-6), start a federate.

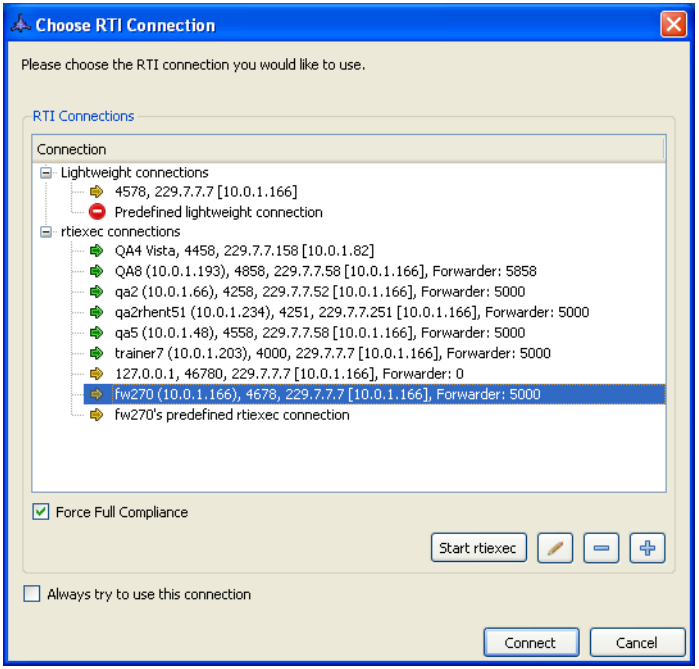


Figure 8-6. Choose RTI Connection dialog box

To open the Connections page:

a. Right-click the RTI Assistant icon in the system tray. A menu is displayed.

b. Choose **Preferences**. The RTI Preferences dialog box opens.

c. Select the Connections page (Figure 8-7).

You can also open the RTI Preferences dialog box to the Connections page by choosing **Start** → **Programs** → **MÄK Technologies** → **MÄK RTI 4.1** → **Configuration** → **Configure Connections**.

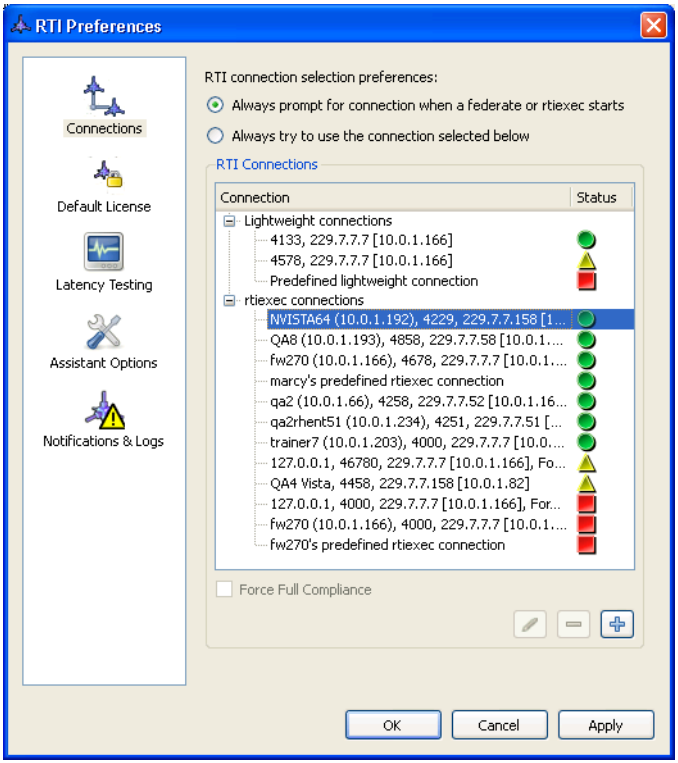


Figure 8-7. RTI Preferences dialog box, Connections page

2. Click the Plus (+) button. The Add New RTI Connection dialog box opens (Figure 8-8). The dialog box is populatd with default parameters and a connection name built from those parameters.

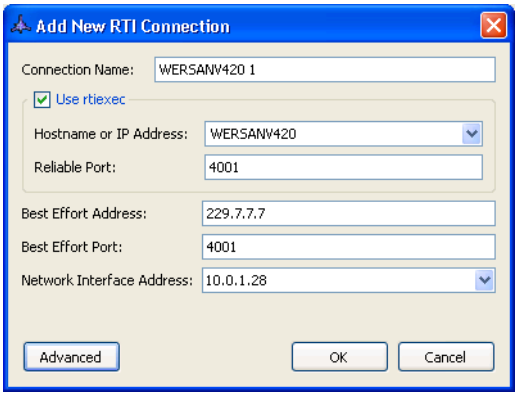


Figure 8-8. Add RTI Connection dialog box

3. Optionally, change the connection name.

The name can be seen everywhere on the network when the connection becomes active. You can change the name after the connection is created, but only on the machine on which the connection was created, and only when it is not being used.

4. If you want to add an rtiexec connection configuration:
   a. Select the Use rtiexec check box.
   b. Type the hostname or IP Address of the computer on which the rtiexec will run.
5. Type a port values in the Reliable Port and Best EFfort Port text boxes.
6. Type the best effort address in the Best Effort Address text box. This should be a multicast or broadcast address.
7. If you have multiple network cards on the computer, type the device address of the one you want to use.
8. Optionally, set advanced forwarder options, as follows:
   a. Click the Advanced button. The dialog box expands (Figure 8-9).
   b. Specify a port for the RTI Forwarder.
   c. Optionally, specify an additional forwarder connection by selecting Specify Additional Forwarder Connection and typing an address in the Address box.

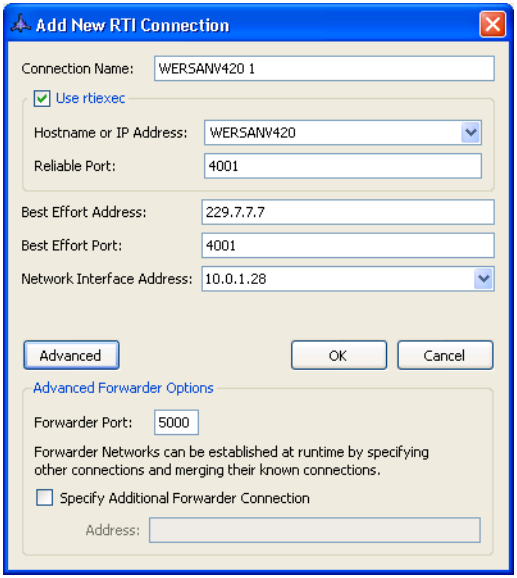


Figure 8-9. Expanded Add New RTI Connection dialog box

9. Click OK. If you selected Use rtiexec, the configuration is added to the list of rtiexec connections in the RTI Connections window. If you did not select Use rtiexec, the configuration is added to the Lightweight connections list.

8.3.3. Editing Connections

Connections can only be edited on the machine on which they were originally defined. When a connection is used after being edited, other RTI Assistants on the network are updated to be aware of the changed parameters. You cannot edit predefined connections or connections that are in use.

To edit a connection:

1. In the Choose Connection Configuration dialog box (Figure 8-4), Choose RTI Connection dialog box (Figure 8-6), or RTI Preferences dialog box, Connections page (Figure 8-7), select the connection that you want to edit. If the connection can be edited (it was created on this machine and it is not in use) the edit icon is activated.
2. Click the Edit icon. The Edit RTI Connection dialog box (Figure 8-8), or Edit Local rtiexec Connection dialog box (Figure 8-5) opens.
3. Change the connection parameters as desired.
4. Click OK.

8.3.4. Viewing Connection Status

The Connections page on the RTI Preferences dialog box (Figure 8-7) displays a status icon for each connection. Status icons have the following meanings:

- Green circle. This connection is *verified*. For a lightweight connection, this means another federate is actively using it. For rtiexec connections this means there is a known rtiexec and RTI Forwarder using this connection.
- Green half circle. This connection is *forwarder-verified* It has an RTI Forwarder using it, but no rtiexec.
- Yellow triangle. The RTI Assistant knows of no rtiexecs, forwarders, or federates using this connection. Therefore it cannot determine if the connection is active.
- Red square. This connection conflicts with another active (verified or forwarder-verified) connection.

In addition to the information conveyed by status icons, the RTI Assistant provides detailed information about each connection in tooltips. All parameters are listed as well as the current status, owning machine (the machine that defined the connection and has permission to edit it), and reason for conflict if it conflicts with another connection.

8.3.5. Removing Connection Configurations

To remove a connection configuration:

1. In the Choose Connection Configuration dialog box, the Choose RTI Connection dialog box, or on the Connections page of the RTI Preferences dialog box, select the configuration that you want to remove.

- You cannot remove a connection that is being used.
- You cannot remove the predefined connections.

2. Click the Minus (–) button.
3. Click OK.

8.4. Default Port Values

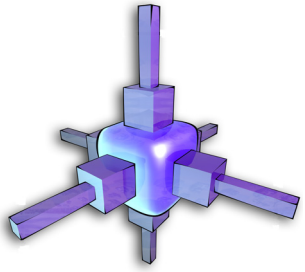
Table 8-4 lists the default ports for the various MÄK RTI components.

Table 8-4: Default port values

Port	Use	Req*	Asst‡	RID Parameter
4000	UDP Port	Yes	Yes	RTI_udpPort
4001	TCP Port	No	Yes	RTI_tcpPort
6001	Multicast Discovery Port	No	No	RTI_mcastDiscoveryPort
	Notes:	Only needed if multicast discovery is on.		
8008	Web Services Port	No	No	RTI_webserviceHttpPort
	Notes:	Only used if web services is enabled.		
6002	Web Services RTI Port	No	No	RTI_webserviceRtiPort
	Notes:	Port used by RTI components to communicate with the web server. Only used if the RTIspy diagnsotic GUI is enabled.		
5000	RTI Forwarder Port	No	Yes	RTI_distributedForwarderPort
	Notes:	The port used by RTI Forwarders to communicate with each other.		
6003	RTI Assistant Port	No	No	RTI_ASSISTANT_PORT (environment variable)
	Notes:	The port used by RTI Assistants to communicate with each other.		

* Required

‡ Overridden by RTI Assistant



9. Licensing Issues

This chapter explains how to handle problems checking out a license.

9.1. Configuring a Federate to Let the rtiexec Check Out a License

You can configure the rtiexec to check out licenses for federates. When rtiexec license checkout is enabled, federates do not have to configure license management. For details, please see "Managing Licenses for the MÄK RTI," on page 11.

If, as a result of relying on rtiexec license checkout, you do not configure license management on the PC on which a federate is running, or do not have access to a license server, you cannot run the federate in lightweight mode (except in unlicensed mode).

9.2. Unlicensed Federations

A federate can use the MÄK RTI without a license; however, only two federates can participate in a federation. Unlicensed mode has the following conditions and restrictions:

When using an rtiexec:

- A federation execution will not allow a third unlicensed federate to join.
- Licensed and unlicensed federates cannot interoperate.
  - If a licensed federate has joined a federation execution, then an unlicensed federate will not be allowed to join even if it would only be the second federate.
  - If an unlicensed federate has joined a federation execution, then a licensed federate will not be allowed to join.
- If a federate resigns from a two federate federation, another federate can take its place.

If you are using lightweight mode (no rtiexec):

- A third unlicensed federate that attempts to join will be forcibly resigned by the MÄK RTI. Any subsequent call to services that require the federate to be joined will result in a FederateNotExecutionMember exception.
- If unlicensed and licensed federates are running simultaneously, they will not exchange any messages even if they join the same federation execution. Other than a warning message, unlicensed federates behave as if licensed federates do not exist and vice versa.

The **RTI_disableUnlicensedForTwo** parameter allows you to disable unlicensed mode (even if the **RTI_forceUnlicensedForTwo** parameter is set). When unlicensed mode is disabled, if a license is not available, the MÄK RTI exits with an error indicating that unlicensed mode has been disabled. Default: 0 (unlicensed mode is enabled).

9.3. Troubleshooting License Problems

To run the licensed MÄK RTI, you must have a license for each LRC and a license server must be running. When you try to start the rtiexec or a federate, if the RTI Assistant detects a license problem, it displays the License Not Found dialog box to help you resolve the issue (Figure 9-1).

If the RTI Assistant is disabled (or you are running a federate using MÄK RTI LS), **RTI_disableUnlicensedForTwo** is set to 0, and the MÄK RTI cannot check out a license, the federate automatically runs in unlicensed mode.

The License Not Found dialog box lets you choose to run in unlicensed mode. However, if you need to run in licensed mode and there are no license servers running, none of the options in the dialog box will help you. You must start a license server. Then start the rtiexec (if you are using it) and your federates.

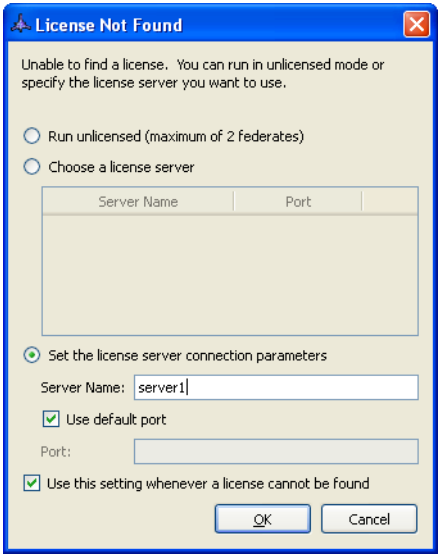


Figure 9-1. License Not Found dialog box

To resolve license issues:

1. In the License Not Found dialog box, select one of the following options:
   - Run in unlicensed mode.
   - Select a known license server in the list.
   - Specify the license server to use. Enter a server name, and optionally, a port.

For the second two options to work, a license server must be running. If there is no server running, you must start one before you can run in licensed mode.

2. Click OK.

9.3.1. Specifying a Default License Server

If the MÄK RTI cannot connect to a license server and displays the License Not Found dialog box, you can save the server name and port to the RTI Assistant. Thereafter, if the MÄK RTI cannot find a server, the RTI Assistant will try to connect to the default server.

To save default license server data:

1. In the License Not Found dialog box, select the Use This Setting Whenever a License Cannot Be Found check box.
2. Click OK.

9.3.2. Displaying Default License Server Settings

To display the license server default settings that have been saved in the License Not Found dialog box:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Preferences**. The RTI Preferences dialog box opens.
3. Select the Default License page. The license server settings are displayed (Figure 9-2).

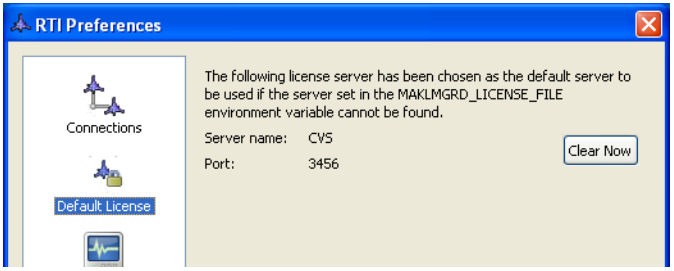
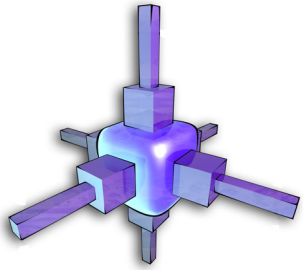


Figure 9-2. Default license server

9.3.3. Clearing Default License Server Settings

To clear the default license server settings:

1. Right-click the RTI Assistant icon in the system tray. A menu is displayed.
2. Choose **Preferences**. The RTI Preferences dialog box opens.
3. Select the Default License page. The license server settings are displayed (Figure 9-2).
4. Click Clear Now.
5. Click OK.



MÄK Products Glossary

This glossary defines terms used in MÄK product documentation.

absolute dead reckoning

A method of dead-reckoning in which an application uses the time stamps contained within state updates if the sender is using absolute time stamping. Contrast with relative dead reckoning.

aggregate

The combination of individual entities, aggregates, or both into a single object. For example, an organizational group such as a platoon.

AMO

See Application Management Object.

Application Management Object

An Application Management Object (AMO) is a standard TENA object that is supposed to be used by every TENA application. It gives other applications information about the local application. The VR-Link exercise connection, by default, publishes an AMO object, updates it at a specified rate (the rate is part of the AMO's state repository; the default is 30 seconds), and updates the number of objects published and proxies (TENA reflected objects) held.

API

Application Programming Interface.

articulated part

A part of an entity that is capable of movement relative to the entity, such as a turret or gun.

attached part

An object that is attached to another object, such as a rocket attached to a jet.

body coordinate frame

A coordinate framework centered on an entity. To represent the orientation of an entity, an application uses Euler angles or a rotation matrix that rotates from a reference frame to the body coordinate frame.

channel

A channel renders the view of an observer in a 3D visualization application.

clipping

A feature that prevents the display of terrain and objects or parts of objects, that are closer than or farther than specific distances from the observer.

clipping planes

The range of distances from the observer (near clipping and far clipping) in which an application clips objects.

culling

The process of discarding database objects which are not within view, and therefore need not be rendered and displayed.

Cartesian coordinates

A system for indicating location by means of three planes intersecting at right angles to one another at the origin.

Data Distribution Management

The set of HLA services used to specify the routing of data between publishers and subscribers. DDM adds greater control over the Declaration Management (DM) services that only specify filtering based on the class of the data (e.g., ground vehicle versus aircraft). DDM uses the data content to express regions of interest and regions of affect whose overlap establish a communication channel. An example is geographic filtering where a publisher indicates a region around the entity or effect and a subscriber indicates a region expressing its sensor range.

dead-reckoning

A process by which an application calculates the expected location of an entity during periods between state updates, based on velocity, acceleration, and rotational velocity.

DDM

Data Distribution Management.

Defense Modeling and Simulation Office

The former name of the executive secretariat for the Executive Council on Modeling and Simulation (EXCIMS), which provided a full-time focal point for information concerning Department of Defense modeling and simulation (M&S) activities. Renamed Modeling and Simulation Coordination Office. Currently the MSCO promulgates M&S policy, initiatives, and guidance to promote cooperation among DoD components to maximize efficiency and effectiveness.

DIS

Distributed Interactive Simulation.

DIS data packets

See Protocol Data Unit.

display engine

An object in an application that can render 3D data.

Distributed Interactive Simulation

The DIS protocol is a set of standards that govern how participating applications share information about the virtual world. The protocol specifies a set of packets, called protocol data units (PDUs), that communicate this information. Each PDU identifies the sender and contains other information depending on the PDU type. The DIS protocol also specifies when and how frequently PDUs are sent.

The DIS protocol has been superseded by the High-Level Architecture for use by the Department of Defense.

DMSO

See Defense Modeling and Simulation Office.

emitter

A simulated device on an entity that emits electromagnetic radiation, for example, radar.

entity

An element in a simulation, such as a vehicle or a person, that is represented in the simulation through the issuance of state messages.

entity maintenance

A process by which the MÄK Data Logger compensates for discontinuities following a time jump. The Logger sends out interim state messages for entities that were present before the time jump so that they do not time out before the next update message arrives.

entity-type

A list of seven components as specified by the DIS protocol and the HLA RPR FOM. If none of the seven components contains a wildcard (-1) value, then the entity type refers to a specific, narrowly-defined entity. If some components contain a wildcard, then the entity type refers to a class of entities. A larger number of wildcards indicates a broader, more general class.

The components of an entity-type are:

- Entity kind
- Domain
- Country
- Category
- Subcategory
- Specific
- Extra.

environmental process

According to the IEEE 1278.1a specification (DIS), environmental process PDUs communicate simple environment variables, small scale environmental updates, and embedded processes.

Euler angles

A set of three angles used to describe the orientation of an entity as a set of three successive rotations about three different orthogonal axes (x, y, and z). These angles specify successive rotations needed to transform from a reference coordinate system to the entity's body coordinate system.

event

An interaction between objects or between an object and the terrain, such as firing of a munition, or a collision of entities.

execution

The TENA term for one or more interacting simulation applications.

Execution Manager

An Execution Manager governs a TENA execution for applications joining, resigning, or changing subscriptions to that execution.

exercise

The DIS term for a one or more interacting simulation applications. Compare to federation execution in HLA.

exercise connection

The object (*DtExerciseConn*) through which a VR-Link application connects to the network. State messages are sent through the exercise connection and information about remote entities is received through the exercise connection. (All MÄK products are VR-Link applications.)

exercise ID

A numeric identification for a DIS simulation exercise.

FED file

federate

A connection to the RTI. Typically a single simulation application can be thought of as a federate.

federation

A group of HLA federates capable of playing in the same federation execution.

Federation Object Model

Defines the data content of a federation execution.

federation execution

The federation execution represents the actual operation, over time, of a subset of the federates and the RTI initialization data taken from a particular federation. A federation execution is the logical equivalent of a DIS simulation exercise.

field of view

Controls the perspective of the observer.

A wide field of view creates an effect like that of a wide-angle camera lens. Objects appear smaller and farther away from the observer, since the observer coverage spans a wider area. Depth become exaggerated.

A narrow field of view creates an effect like that of a telephoto lens. Objects appear larger and closer to the observer, and the overall scene depth appears flattened. The distances between objects appears compressed.

filter range

A setting that prevents distant entities from being processed while allowing distant terrain to appear normally.

FOM

See Federation Object Model.

FOM Module

In HLA Evolved, defines additional modular data content for a federation execution, usually extensions to an existing FOM. (Also supported by the HLA 1.3 and HLA 1516 versions of the MÄK RTI. Per the HLA Evolved interface specification:

"A partial FOM (containing some or all OMT tables) that specifies a modular component of a FOM. A FOM module may contain classes not inherent to it but upon which the FOM module depends, i.e., superclasses to the modular components. These superclasses will be included in the FOM module either as complete or scaffolding definitions."

frame rate

The rate at which the application displays updated images.

ground clamping

A process by which the a 3D visualization application keeps an entity anchored to the surface of its terrain database, regardless of the altitude data contained in its entity state message.

geocentric coordinates

A coordinate system calculated with respect to the earth's center. The origin of the geocentric coordinate system is the center of the earth. The positive X-axis passes through the prime meridian at the equator; the positive Y-axis passes through 90 degrees east longitude at the equator; and the positive Z-axis passes though the north pole.

geodetic coordinates

A coordinate system in which position is determined relative to a reference ellipsoid, such as the surface of the earth at sea level. In MÄK applications, geodetic coordinates consist of latitude and longitude in radians, and altitude in meters above the reference ellipsoid.

gridded data

Data that has been processed in a rectangular array of points, in X, Y or latitude/longitude, at which single data values define a two dimensional function. According to the IEEE 1278.1a specification, gridded data transmits information about large-scale or high-fidelity spatially and temporally varying ambient fields and about environmental processes and features.

guise

An alternative entity type used to display an object depending on the force ID. For example, a tank could look like an M1A1 to friendly forces and a T72 to hostile forces.

head-up display

A set of indicators and readouts superimposed onto a graphics display. Also called an overlay.

heartbeat

In DIS, the frequency with which current PDUs are sent to the network regardless of whether or not the entity's state has changed.

High-Level Architecture

The High Level Architecture (HLA) for simulations is a U. S. Department of Defense (DOD)-wide initiative to provide an architecture to support interoperability and reuse of simulations. The HLA supersedes DIS for the DOD.

HLA

See High-Level Architecture.

interaction

A message describing a simulation event. An interaction describes an event, it does not update an object's state.

Logger control PDUs

logical range

A suite of TENA Resources, sharing a common object model, that work together for a given range event. Similar in concept to the HLA Federation.

Local RTI Component

The libraries on a computer that implement an RTI. A federate communicates with the HLA network through the LRC.

Logical Range Object Model

The data definition file for TENA exercises. It contains the set of object and message definitions that may be used in the exercise.

LRC

See Local RTI Component.

LROM

See Logical Range Object Model.

MÄK Technologies Lisp

An adaptation of the Lisp language used in configuration files for MÄK products.

message

A general term used to refer to DIS PDUs and HLA interactions and state updates. In TENA, a message is similar to an HLA interaction.

MIM

The MOM & Initialization Module (MIM) allows for extensions to be made to the HLA standard MOM. It is a subset of the FOM that contains OMT tables that describe the HLA MOM. The MIM also contains additional predefined HLA constructs such as object and interaction roots, data types, transportation types and dimensions. HLA specifies a standard MIM that is incorporated into all FDDs automatically by the RTI. The standard MIM can be replaced with a user-supplied MIM containing the standard MIM plus extensions.

Modeling and Simulation Coordination Office

The executive secretariat for the Executive Council on Modeling and Simulation (EXCIMS), which provided a full-time focal point for information concerning Department of Defense modeling and simulation (M&S) activities. The MSCO promulgates M&S policy, initiatives, and guidance to promote cooperation among DoD components to maximize efficiency and effectiveness. (Formerly DMSO)

MSCO

Modeling and Simulation Coordination Office. (Formerly DMSO.)

MTL

See MÄK Technologies Lisp.

Network Naming Service

Acts as a registry for TENA Execution Managers.

NNS

See Network Naming Service.

orientation clamping

Adjusts the pitch and roll of an entity so that it appears properly seated when the terrain is inclined. For example, if a tank is moving horizontally across the face of a hill, orientation clamping prevents the tank from appearing level, and therefore, partially embedded into the hillside. Used with ground clamping.

object

An element in a simulation that has persistence, as opposed to an interaction, which is a transient element.

object handle

An integer that an application uses to identify a particular object in RTI service calls. An object handle is meaningful only to a particular federate. The same object can be known to different federates by different object handles.

object name

A character string that can be used to identify an object. In HLA, the object name is known to the RTI, and the RTI provides functions to find out an object's name, given its handle, and vice versa. Object names can be chosen by applications that register the objects with the RTI, however if you do not want to choose names for objects, the RTI will assign names for you.

observer

In MÄK 3D applications, the point of view into the scene. (Called the eyepoint in MÄK Stealth 6.x and earlier.)

PDU

See Protocol Data Unit.

Protocol Data Unit

A unit of data message (packet) that is passed on a network between DIS simulation applications.

proxy

In TENA, a reflected object (Stateful Distributed Object).

radio transmitter

A simulated device on an entity, capable of transmitting radio communications.

radio receiver

A simulated device on an entity, capable of receiving radio communications.

range resource

A participant in a TENA execution (similar in concept to the HLA federate).

Realtime Platform Reference FOM

An HLA reference FOM based on the DIS protocol.

recording

A Data Logger file that stores a history of the interactions in a simulation for playback.

reflected entity list

A list of entities simulated by remote applications (federates in HLA) and about which the local simulation has received information over the network.

reference FOM

A FOM designed to be used as a whole, or with modification, by a wide variety of similar federation executions.

relative dead reckoning

A method of dead reckoning in which an application approximates the location of an object based on the local time of receipt of the last state update message.

remote display engine

A display engine running in an application that is separate from the master application, and which is controlled by the master application.

RID file

See RTI Initialization Data.

RTI Initialization Data

The initialization data required by the RTI for operation.

Data required by an RTI during initialization, independent of the FOM being used. RID data is usually dependent on a specific implementation of the RTI.

RPR FOM

See Realtime Platform Reference FOM.

RTI

See Run-Time Infrastructure.

Run-Time Infrastructure

A library and other supporting software that implements the HLA interface specification. All federates communicate with one another in an HLA environment through RTI functions.

SDO

See Stateful Distributed Object.

servant

A published object (SDO) in TENA.

Simulation Interoperability Standards Organization

A group that seeks to promote modeling and simulation interoperability and reuse for the benefit of diverse M&S communities, including developers, procurers, and users, worldwide.

simulation time

In VR-Forces, simulation time is used in dead-reckoning of remote entities and thresholding of local entities. Typically, simulation time is set once during each iteration of the application's main simulation loop so that all entities are dead-reckoned based on the same value of current time.

SISO

See Simulation Interoperability Standards Organization.

smooth period

The period of time over which trajectory smoothing takes place.

smoothing

A method of ensuring that transitions from an entity's dead-reckoned position to its actual position are not so abrupt as to be visually disconcerting.

state

The current status of an object, including location, direction of movement, extent of damage, and so on.

Stateful Distributed Object

An object in a TENA exercise.

tape

An alternative term for a Logger recording. Not a physical magnetic tape.

TENA

See Test and Training Enabling Architecture.

TENA Middleware

terrain following

In a 3D visualization application, causes the observer (eyepoint) to maintain a constant distance above the terrain surface. The observer's height changes in tandem with the peaks and valleys as it passes over the geography.

Test and Training Enabling Architecture

Test and Training Enabling Architecture (TENA) is an interoperability architecture used to pass data in the form of object updates and messages (like HLA objects and interactions) from one application to another.

timeout

The period of time in which an application continues to display an entity after that entity's update messages have stopped appearing on the network. Time-outs are usually not used in HLA because there is no set frequency (no heartbeat) for transmitting messages.

timescale

A factor by which time is accelerated or slowed during playback of a Data Logger recording.

topographic coordinates

A right-handed Cartesian coordinate system whose X-Y plane is tangent to the earth's surface at the origin, with the positive X axis pointing north, the positive Y axis pointing east, and the positive Z axis pointing down. There are an infinite number of topographic coordinate systems – one for each point on the earth's surface.

topographic coordinate frame

A coordinate frame in the context of the terrain.

trajectory smoothing

A method used by to smooth positional discontinuities that could occur when new state updates arrive.

UDP port

A network channel through which an application sends and receives data for DIS exercises.

Universal Transverse Mercator

In general, a non-cartesian coordinate system in which the X, Y, and Z correspond to easting (nearly east), northing (nearly north), and height above an ellipsoid that approximates the surface of the earth.

UTM

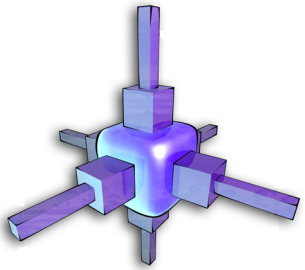
See Universal Transverse Mercator.

view control messages

A set of programmatic messages that let you control the view in VR-Vantage applications remotely.

view floor

In MÄK Stealth 6.x and earlier, a minimum height above the terrain in Absolute or Track mode, below which the observer is not allowed to go. The view floor is measured relative to the terrain surface.



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Link - Simulate - Visualize

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