Link: Connecting Every Great Simulation

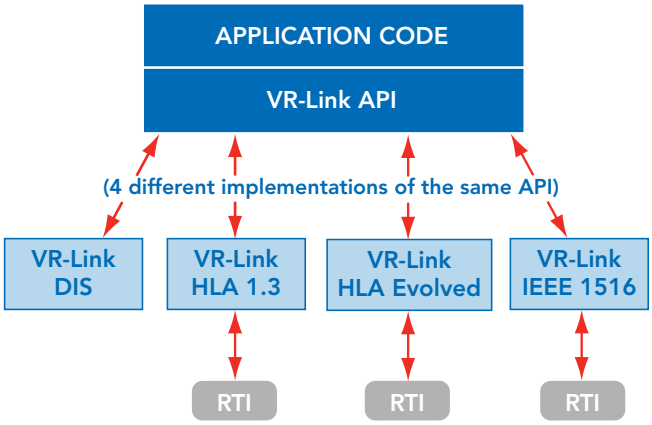
VR-Link

The VR-Link toolkit provides an easy way to network simulators and other virtual reality applications. It uses a protocol independent API that abstracts away specific networking details and provides your software with support for industry standard High Level Architecture (HLA) and the Distributed Interactive Simulation (DIS) protocols, including HLA 1.3, HLA 1516, HLA Evolved, DIS, and DIS 7.

Protocol-Independent API

VR-Link saves development dollars by providing a single documented C++ API that abstracts away the details of the networking protocols. When you write your code to the VR-Link API, your applications become natively compliant with DIS, DIS 7, HLA 1.3, IEEE 1516-2000, and HLA Evolved. For example, most applications that already use VR-Link to support HLA 1.3 can switch to IEEE 1516-2000 or HLA Evolved by merely recompiling.

Protocol-Independent VR-Link API



Behind the API

VR-Link's top level protocol-independent API is used to set the current state of locally simulated entities and objects. Any needed information is automatically sent to other applications through the HLA's RTI, or the DIS network. On the incoming side, VR-Link processes information from other applications and provides access to the current state of remote objects. Dead reckoning, thresholding, coordinate conversions, responding to attribute requests, and filtering are all handled by VR-Link. Of course, you can still fully control low-level networking details if you want. A lower layer API provides direct access to the RTI, to the contents of individual updates and PDUs, and to DIS networking parameters.

FOM Agility

VR-Link's FOM-Agile infrastructure allows you to build a simulation once and have it switch among several different HLA federations by choosing an appropriate FOM Mapper plug-in. For instant out-of-the-box interoperability, VR-Link comes with a RPR FOM Mapper. For flexibility to interoperate with other federations, VR-Link provides tools and examples to help you develop new FOM Mappers. Once a FOM Mapper has been created, just plug it into your VR-Link application (or any MÄK application) for immediate interoperability with your federation.

FEATURES

- HLA AND DIS COMPLIANT
- BUILT-IN RPR FOM SUPPORT
- FOM-AGILE
- FOM-BASED CODE GENERATION
- USER-EXTENSIBLE
- C++ API
- HLA 1.3, IEEE 1516-2000, HLA EVOLVED, DIS, AND DIS 7
- SUPPORTS HLA TIME MANAGEMENT, HLA OWNERSHIP MANAGEMENT, AND DDM
- EXPERT TECHNICAL SUPPORT

FOM-based Code Generation

Although the VR-Link API covers many of the most common concepts required by distributed simulations, some users need to extend VR-Link to support custom FOM elements. Whether your FOM just adds a few classes to the RPR FOM, or represents entirely different simulation concepts, the VR-Link Code Generator can help. The VR-Link Code Generator reads any HLA FOM, and automatically generates VR-Link extensions for that FOM. The tool produces fully-formed C++ source and header files, along with the Microsoft Visual C++ solution files and the UNIX® Makefiles required to compile them into a VR-Link extension library. The generated classes are ready to use for publishing and reflecting new classes of HLA objects, and for sending and receiving custom interactions.

Flexible, Portable, Supported

VR-Link's object-oriented design and C++ implementation provide you with the flexibility to override default functionality and extend

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the toolkit to work with modified or new FOMs, or user-defined DIS PDUs. A cross-platform toolkit, VR-Link includes source code examples and an extensive Developer's Guide, and is backed by MÄK's renowned technical support. Customers have direct access to VR-Link's core engineers. And because of MÄK's participation in standards development groups, you can be confident that VR-Link will always keep up with evolving networking protocols.

VR-Link for Unity

VR-Link for Unity brings HLA and DIS interoperability to the Unity game engine. Built on MÄK's VR-Link simulation networking toolkit, this asset package allows you to bring Unity-based games into existing distributed simulation environments using standard Modeling & Simulation protocols. VR-Link for Unity supports all the various flavors of HLA and DIS, including HLA 1.3, HLA 1516, and is compatible with any compliant HLA RTI.

Interact and Engage

Through VR-Link for Unity, a role player or trainee playing a Unity-based game can interact and engage with entities modeled by external simulations, including computer-generated forces. VR-Link for Unity handles dead-reckoning and smoothing of entity positions, conversion from Unity's local coordinate system to geocentric world coordinates, movement of articulated parts, fire and detonate events, embarkation of Unity entities on remotely simulated vehicles, transmitters, signal interactions, and laser designators.

Designed for Unity

VR-Link for Unity is an asset package that imports directly into and is fully integrated with the Unity editor. By dragging and dropping VR-Link for Unity scripts onto existing game entities, your Unity game objects will automatically start updating entity state information in your simulation. VR-Link for Unity also automatically creates, manages, and updates instances in the game environment to represent external entities discovered on the network.

MÄK RTI

The MÄK High Performance RTI is a proven solution that enables HLA federations to rapidly and efficiently communicate. It has been chosen for both large and small federations because of its support for a wide variety of network topologies and architectures (including sender-side filtering for efficient WAN operation), ease of configuration, and its range of supported platforms. With the MÄK RTI, connecting to an HLA federation is as intuitive as connecting your laptop to a WiFi network. An RTI configuration GUI allows you to switch between lightweight and fully-featured modes, choose from a list of available connections on your network, and even launch and configure a new rtiexec.

Complex Network Configurations

The MÄK RTI can support a variety of simple or complex network configurations, from simple multicast traffic with no rtiexec or RTI Forwarder to complex hierarchical forwarder networks. RTI Forwarders can be used to link different sites over the WAN, or just distribute TCP traffic load over multiple machines. Network packets can be compressed or bundled to optimize for throughput or processor utilization. The RTI also includes smart forwarding and multicast filtering to efficiently filter messages that are not needed by all federates. No matter how complex your network environment is, the MÄK RTI can be configured for optimal performance.

Ease of Use

With the MÄK RTI, connecting to an HLA federation is as intuitive as connecting your laptop to a WiFi network. An RTI configuration GUI allows you to switch between Lightweight and Fully Compliant mode, choose from a list of rtiexecs running on your network, and even launch and configure a new rtiexec. No RID file editing is necessary to configure the most commonly used connection options. An RTI icon in the system tray allows you to access preferences, force a federate to resign, run a network latency test, or launch the RTI Assistant Diagnostic GUI.

Compatibility

While the lack of an RTI network standard means that no two RTIs can interoperate directly, the MÄK RTI is fully HLA compliant and is "link" compatible with other fully compliant RTIs that meet the appropriate HLA interface specifications. Federations can switch between the MÄK RTI and other link-compatible RTIs without recompiling or relinking. And because all our versions of the

RTI are built from the same code base, we've retained network compatibility between all HLA versions. This means your HLA 1.3 federate can connect to your HLA Evolved federate with no extra software or gateway.

A Window into the RTI

Gone are the days when an RTI was considered an opaque black box. The RTI Assistant is a window into the RTI, shedding light on its inner workings. Through a flexible API and diagnostic GUI, you can reach into the RTI and monitor or alter its functionality. With the RTI Assistant, the power to debug connectivity problems, monitor network messages, and customize behavior is in your hands. Once you've used an RTI that gives you this level of insight, you'll wonder why all RTIs aren't built this way.

You can explore a graph of your federation's network topology, scan the objects that each LRC knows about, or the list of interactions it has sent and received. Browse the current state of FOM subscriptions and publications to track down connectivity issues, or trace the log of federate-ambassador-invoked and RTI-ambassador-invoked method calls to help solve complex timing problems. Network and CPU monitoring tools help you identify your federation's performance bottlenecks. Unlike MOM-based diagnostic tools, the RTI Assistant continues to provide data even when HLA connectivity is unsure, and can give insight into implementation-specific details unavailable through the MOM.

Licensing Options

The MÄK RTI is licensed per-federate. A single license supports all HLA versions and all the functionality of the RTI Assistant. An unlicensed mode allows you to run up to two federates for testing and evaluation, free of charge — download and start using the MÄK RTI for free! Other license modes are available.

FEATURES

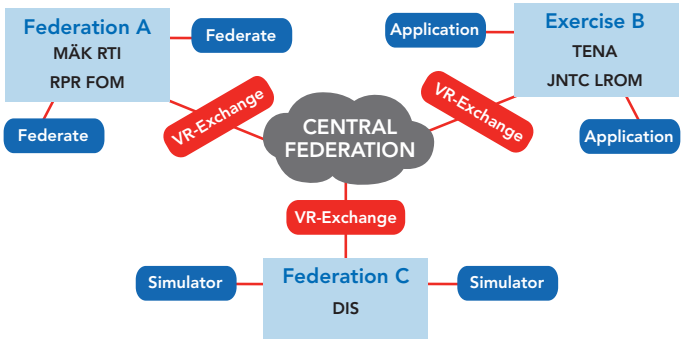
- FAST AND EFFICIENT
- FAULT TOLERANT
- LIGHTWEIGHT MODE—NO RTIEXEC REQUIRED
- CONFIGURE CONNECTIONS WITHOUT EDITING RID FILES
- SENDER-SIDE FILTERING FOR EFFICIENT WAN OPERATION
- SUPPORT FOR MODULAR FOMS
- RTI ASSISTANT DIAGNOSTIC GUI
- PLUG-IN API FOR USER CUSTOMIZATION
- FULLY HLA COMPLIANT AND VERIFIED

VR-Exchange

VR-Exchange is MÄK's universal translator for distributed simulations. It performs FOM-to-FOM translation, RTI-to-RTI bridging, DIS or HLA-to-TENA translation, and can support simulation-to-C4I interoperability. VR-Exchange's open architecture means that you can develop custom brokers for C4I protocols or other data standards. We provide a documented interface (API) to the data exchange, as well as sample code that shows you how to read and write to our protocol independent data format.

The Need for Bridging

In some cases, bridging is necessary because it is not practical to get everyone to agree on a protocol, HLA FOM or RTI, or TENA LROM. In other cases, bridging is needed because a system architect wants to implement a hierarchical "federation of federations" design. Bridging is often needed to support large-scale LVC (Live, Virtual and Constructive) integration, or to support Simulation-to-C4I interoperability. For all of these cases, VR-Exchange can provide the solution.



A System of Systems:
VR-Exchange bridges each LAN's federation to a central federation made up entirely of portals. The portals exchange data among the sites through the central federation.

Exceptionally Easy to Use

VR-Exchange lets you create and configure all aspects of a connection with a few simple clicks of a mouse. Even tasks like configuring which RTI to use can be accomplished through the intuitive GUI. Not only can you make connections to different LVC components, you can temporarily suspend connections and disconnect from a federation with a single click. Further, the data display allows you to see how many messages and what kind of traffic is flowing through VR-Exchange. If a particular object is updating too frequently and causing problems in your system, a simple right click menu lets you filter the object.

Built-in Translation

VR-Exchange comes with brokers for DIS, and TENA, as well as HLA 1.3, HLA 1516 2000, and HLA Evolved brokers for RPR, MATREX*, MRF*, and ERF* FOMs. The HLA and DIS brokers leverage MÄK's VR-Link FOM mapping infrastructure, allowing you to configure or extend them for custom object models. The HLA Brokers can also be configured for different RTIs, simply by pointing at the appropriate shared libraries.

Extensibility

VR-Exchange's open architecture means that you can also develop custom brokers for C4I protocols or other data standards. We provide a documented interface (API) to the Data Exchange, as well as sample code that shows how to read and write to our protocol independent data format.** Once you are able to translate your protocol to this *lingua franca*, your data can be read by any of the other VR-Exchange brokers. MÄK can also help you if you work on the following custom protocols: C2PC, COT (Cursor on Target), ADS-B, AviationSimNet, and DDS.

FEATURES

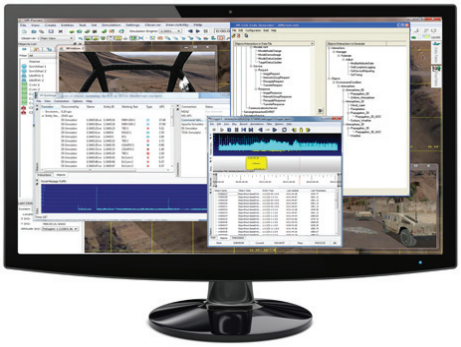
- SUPPORTS SYSTEMS OF SYSTEMS ARCHITECTURE
- OPTIMIZED FOR PERFORMANCE
- OPEN ARCHITECTURE — CUSTOM BROKERS CAN SUPPORT OTHER PROTOCOLS
- LVC INTEGRATION
- HLA 1.3, IEEE 1516-2000, AND HLA EVOLVED SUPPORT
- SUPPORT FOR RPR 1 AND RPR 2

**The MATREX, MRF and ERF brokers are available with limited distribution. Additionally, the full set of Objects/Interactions has not been translated. As always MÄK is willing to work with you to make sure your needs are met. Please contact MÄK Sales for more information regarding their availability.*

*** API requires a VR-Link Developer's License*

MÄK Data Logger

The MÄK Data Logger is an easy-to-use system for capturing and replaying simulation data. Using the intuitive GUI, you can record HLA or DIS messages to a file and replay them for easy analysis and After-Action Review. The MÄK Data Logger provides standard DVR-like features including pause, fast forward, and slow motion (both forward and reverse), to create more effective demonstrations and analysis.



FEATURES

- RECORD AND REPLAY USING ANY HLA FOM
- INTERACTIVE DISPLAY OF SIMULATION TIMELINE
- POINT AND RANGE ANNOTATIONS
- HLA TIME MANAGEMENT SUPPORT
- USER CONFIGURABLE FILTERING
- COMBINE LOGGERS TO SCALE FOR LARGE FEDERATIONS
- EXPORT DIS OR HLA DATA TO SQL DATABASES
- TOOLKIT API FOR CUSTOMIZATION
- REMOTE CONTROL INTERFACE AND API
- SUPPORTS HLA 1.3, IEEE 1516-2000, HLA EVOLVED, AND DIS

Visual Navigation and Editing

The MÄK Data Logger allows you to visually edit your simulation recordings much like an audio or video editor. You can cut out unwanted sections of your recording, create new Logger files by merging, offsetting, or concatenating existing recordings, or break a long scenario into individually playable sections for easy viewing and editing.

Instant HLA Traffic Analysis

With the HLA Traffic Analyzer, you can inspect any decoded HLA data no matter what FOM you are using. If you want to know exactly what data your HLA Object instances contain at any point in the recording, or if you need to see how certain objects are changing in real-time during the recording, you can. Quickly get a list of all the received HLA Interactions and with a click understand details of the update.

Export to SQL Database for Analysis

With the MÄK Data Logger's SQL Export Module, you can export simulation data to a SQL database while recording, during playback, or offline.* Database output for HLA is FOM-independent; the Logger will read your FOM, and automatically generate a database schema to use for export. Once the data has been stored, you can use standard tools like MATLAB® or Excel® to analyze the results of your simulation. You can even run specific SQL queries from custom data mining applications.

Logger Toolkit API

Using the MÄK Data Logger Toolkit API, you can embed its functionality into your own applications or build plug-ins to extend or alter the functionality of the MÄK Data Logger application. This gives you complete access to the stream of data, allowing data filtering, data modification, and conversion into alternate formats. A MÄK Data Logger File API provides direct offline access to the data stored in its files.**

** MySQL®and Microsoft Access database configurations are currently supported.*
*** Toolkit API requires a VR-Link Developer's License.*

For more information about any of our products, please contact us at info@mak.com.

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