Linking Virtual Simulation and 3D Visualization Applications with Live Equipment and Operational Systems

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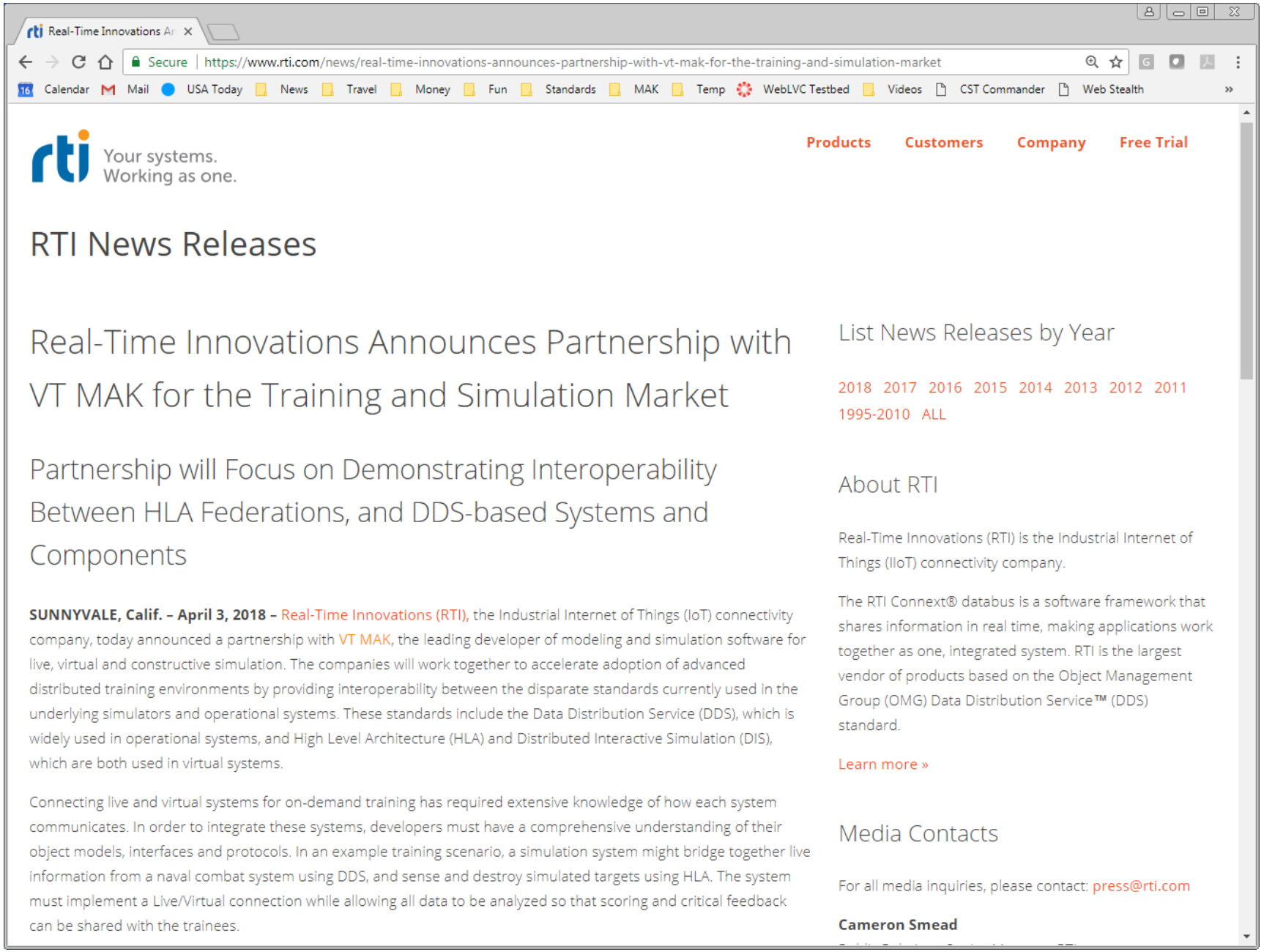
VT MAK

VT MAK delivers compelling simulation & visualization solutions for…

- Experimentation
- Systems integration & test
- Man-in-the-loop training
- Virtual Prototypes
- Concept Demonstrations

VT MÄK

Why are we here?


Real-Time Innovations
Secure https://www.rti.com/news/real-time-innovations-announces-partnership-with-vt-mak-for-the-training-and-simulation-market
Calendar Mail USA Today News Travel Money Fun Standards MAK Temp WebLVC Testbed Videos CST Commander Web Stealth
Your systems. Working as one.
Products Customers Company Free Trial
RTI News Releases
Real-Time Innovations Announces Partnership with VT MAK for the Training and Simulation Market
Partnership will Focus on Demonstrating Interoperability Between HLA Federations, and DDS-based Systems and Components
SUNNYVALE, Calif. – April 3, 2018 – Real-Time Innovations (RTI), the Industrial Internet of Things (IoT) connectivity company, today announced a partnership with VT MAK, the leading developer of modeling and simulation software for live, virtual and constructive simulation. The companies will work together to accelerate adoption of advanced distributed training environments by providing interoperability between the disparate standards currently used in the underlying simulators and operational systems. These standards include the Data Distribution Service (DDS), which is widely used in operational systems, and High Level Architecture (HLA) and Distributed Interactive Simulation (DIS), which are both used in virtual systems.
Connecting live and virtual systems for on-demand training has required extensive knowledge of how each system communicates. In order to integrate these systems, developers must have a comprehensive understanding of their object models, interfaces and protocols. In an example training scenario, a simulation system might bridge together live information from a naval combat system using DDS, and sense and destroy simulated targets using HLA. The system must implement a Live/Virtual connection while allowing all data to be analyzed so that scoring and critical feedback can be shared with the trainees.
List News Releases by Year
2018 2017 2016 2015 2014 2013 2012 2011
1995-2010 ALL
About RTI
Real-Time Innovations (RTI) is the Industrial Internet of Things (IIoT) connectivity company.
The RTI Connext® databus is a software framework that shares information in real time, making applications work together as one, integrated system. RTI is the largest vendor of products based on the Object Management Group (OMG) Data Distribution Service™ (DDS) standard.
Learn more »
Media Contacts
For all media inquiries, please contact: press@rti.com
Cameron Smead

Relevance to Users of Connext DDS

Interoperability between the real-world protocols (DDS) and simulation interoperability protocols (e.g. HLA and DIS)

Bringing simulation assets to bear to help solve real-world problems (stimulation of equipment, training on real equipment in simulated scenarios, etc.)

Visualization of real world systems and data

Agenda

Modeling and Simulation Market, and where VT MAK Tools Fit

Interoperability in the M&S Community (HLA, DIS)

How we can help

- Interoperability Between Operational Systems and Simulation Applications
- Use of 3D Virtual Environments to Visualize Real-world Data

MAK Profile

World-wide leader for software products and services to the global defense simulation market

Headquartered in Cambridge, MA

Founded in 1990 by two MIT alums from that had worked at BBN on DARPA's first distributed simulation project (SIMNET)

Acquired by VT Systems in 2006 – a US-based subsidiary of Singapore Technologies

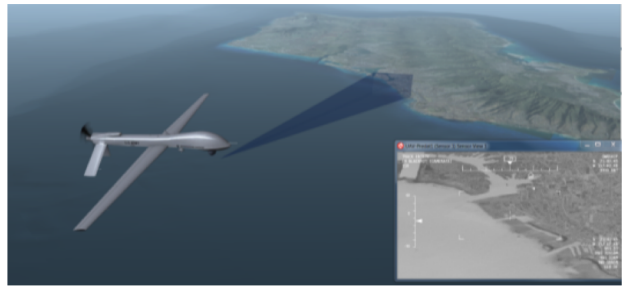
Over Two Decades Helping Customers Build and Populate 3D Simulated Environments

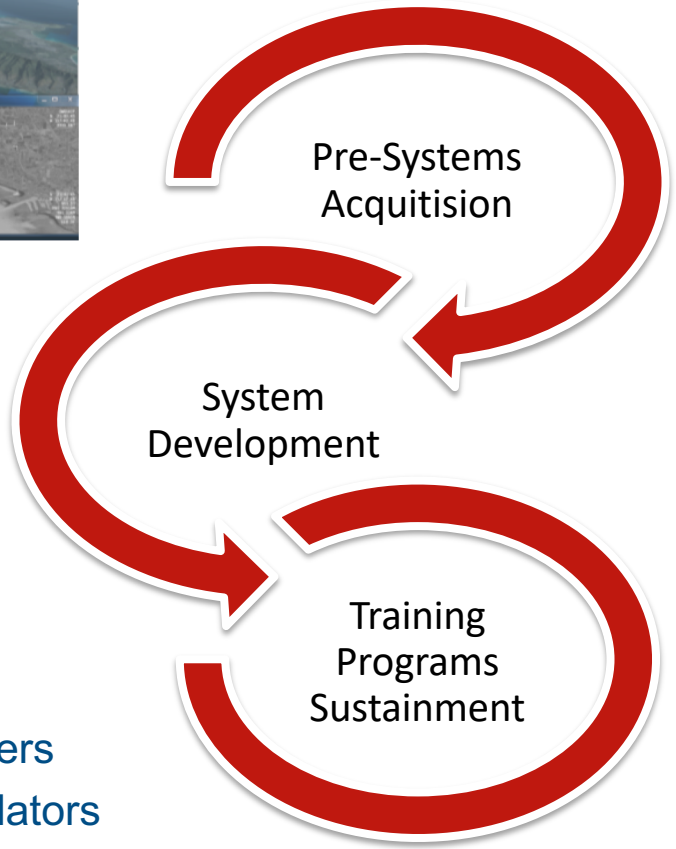
DEPARTMENT OF THE ARMY · UNITED STATES OF AMERICA · 1775
DEPARTMENT OF THE NAVY · UNITED STATES OF AMERICA
DEPARTMENT OF THE NAVY · UNITED STATES MARINE CORPS
NASA
FEDERAL AVIATION ADMINISTRATION

LOCKHEED MARTIN
BOEING
Raytheon
GENERAL DYNAMICS
Strength On Your Side
NORTHROP GRUMMAN
MEGGITT
smart engineering for extreme environments
ST Electronics
Training & Simulation Systems
A member of ST Engineering
Bell Helicopter
A Textron Company
DRAPER LABORATORY
EADS
Elbit SYSTEMS Ltd
RUAG
Aerospace Defence Technology
L3 communications
THALES
EMBRAER
BAE SYSTEMS
INSPIRED WORK
SAIC
From Science to Solutions
RAFAEL
SMART AND TO THE POINT
CSC
SELEX GALILEO

MAK Helps Customers in all Phases of Programs

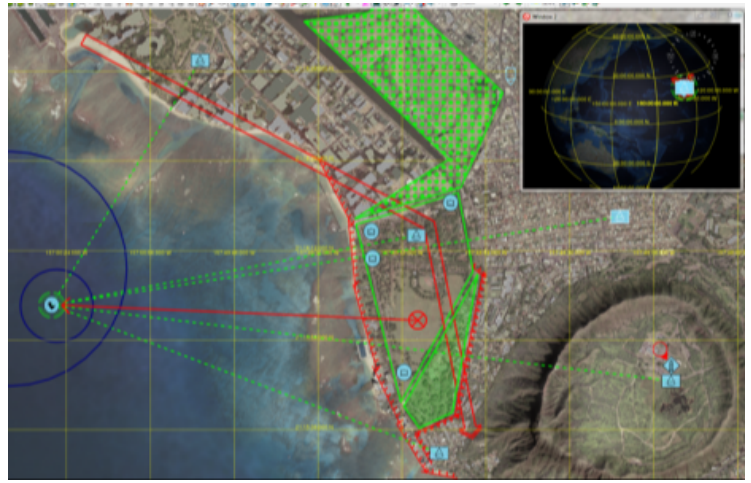
- Proposals
- Demonstration
- Concept Development
- Experimentation



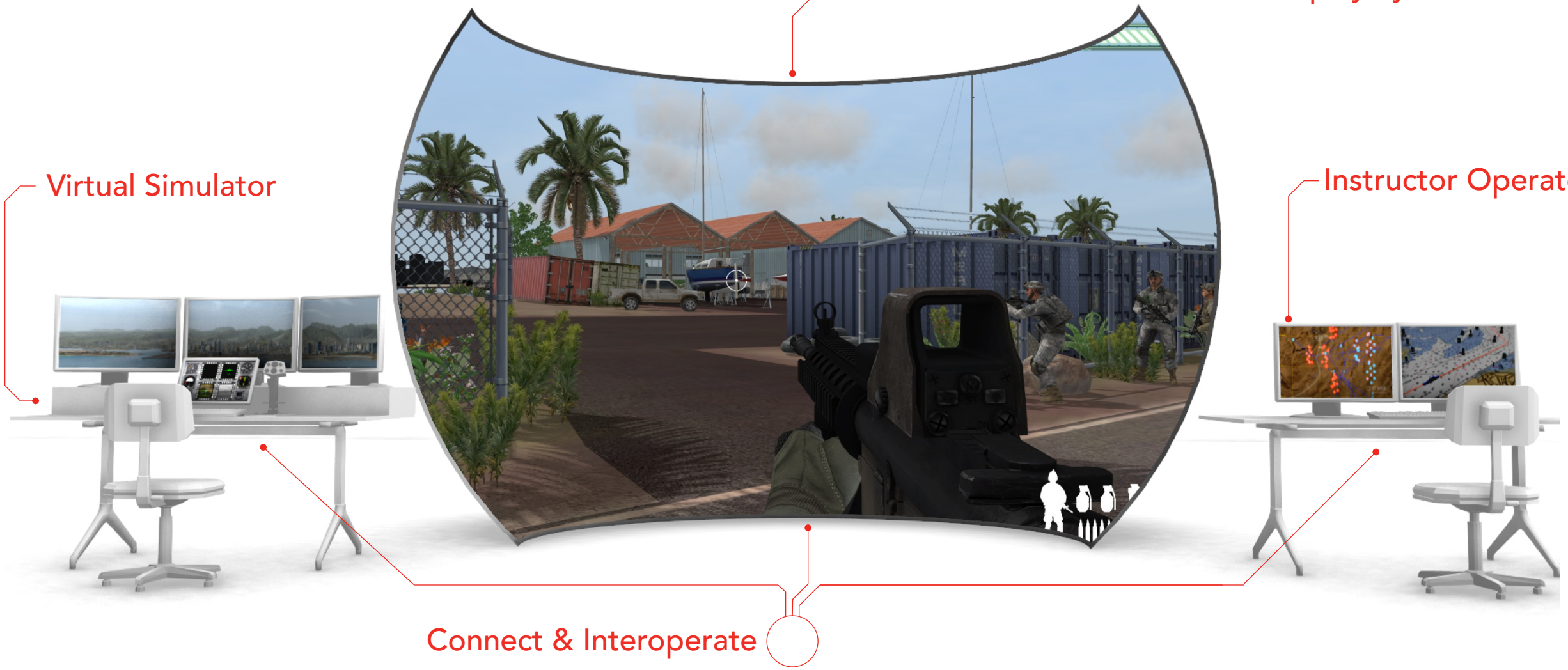


- Systems Prototyping
- Systems Integration
- Systems Test
- TTP Development

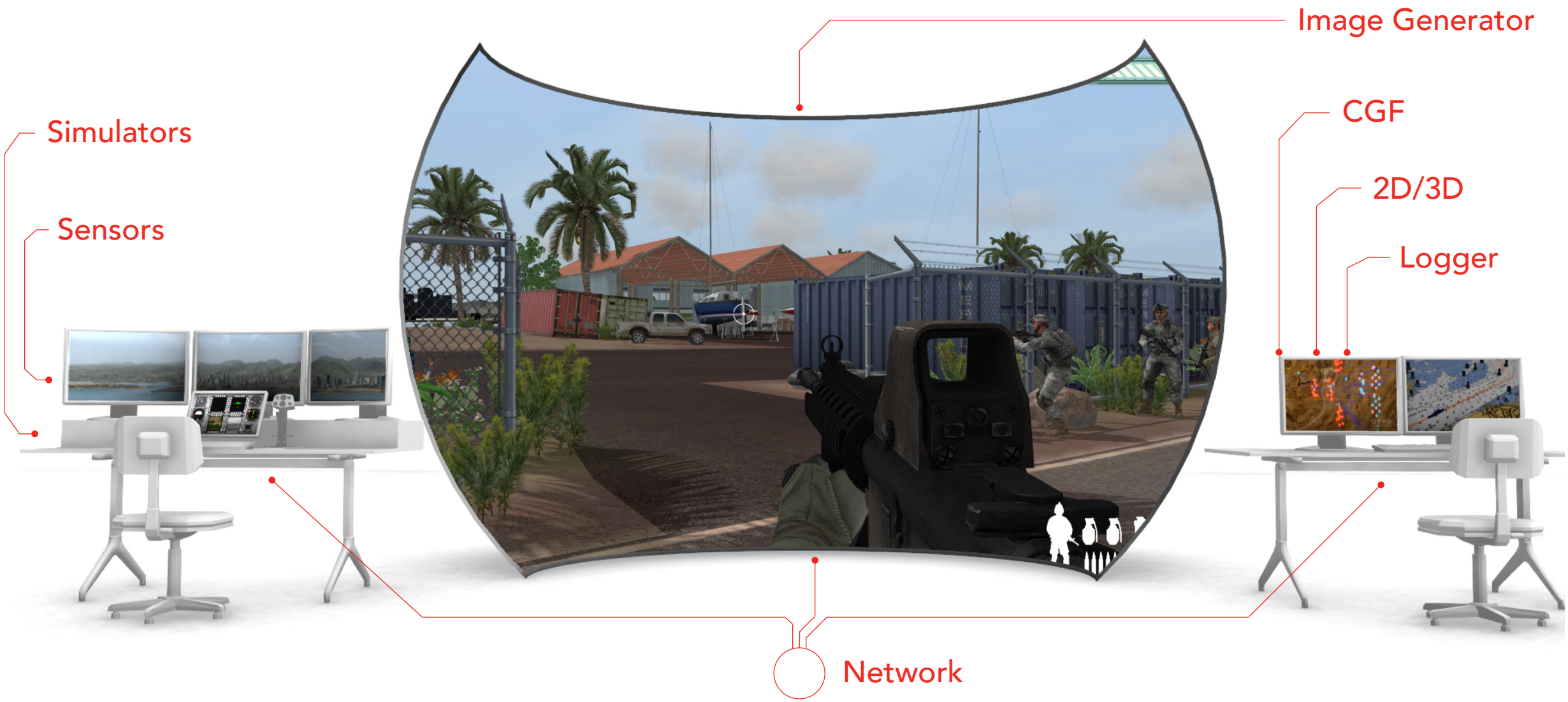
- Trainers
- Simulators
- Embedded Training



Typical Training Example



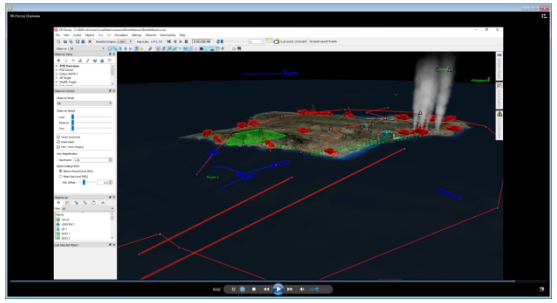
Technology Components



MAK Products

MAK Capability Overviews

Synthetic Training Environment Demo



VR-Forces Introduction

VR-Engage Introduction

Photo-Realistic Terrains

Interoperability in Defense M&S

History

1980s: SIMNET Protocol developed by DARPA / BBN

- First US DoD interoperability protocol for real-time simulation

Early 1990s: DIS (Distributed Interactive Simulation)

- Developed as an open standard
- Wire protocol, built-in object model, real-time focused, low-bandwidth
- IEEE 1278.1

Mid 1990s-2000s: HLA (High-level Architecture) IEEE 1516.1

- Scalable publish-subscribe architecture
- Object model flexibility
- Standardized API with middleware implementations

DIS PDUs (Protocol Data Units)

Table 134—Entity State PDU

Field size (bits)	Entity State PDU fields	
96	PDU Header	Protocol Version—8-bit enumeration
		Exercise ID—8-bit unsigned integer
		PDU Type—8-bit enumeration = 1
		Protocol Family—8-bit enumeration = 1
		Timestamp—32-bit unsigned integer
		Length—16-bit unsigned integer
		PDU Status—8-bit record
		Padding—8 bits unused
48	Entity ID	Site Number—16-bit unsigned integer
		Application Number—16-bit unsigned integer
		Entity Number—16-bit unsigned integer
8	Force ID	8-bit enumeration
8	Number of Variable Parameter Records (*N*)	8-bit unsigned integer
64	Entity Type	Entity Kind—8-bit enumeration
		Domain—8-bit enumeration
		Country—16-bit enumeration
		Category—8-bit enumeration
		Subcategory—8-bit enumeration
		Specific—8-bit enumeration
		Extra—8-bit enumeration
64	Alternate Entity Type	Entity Kind—8-bit enumeration
		Domain—8-bit enumeration
		Country—16-bit enumeration
		Category—8-bit enumeration
		Subcategory—8-bit enumeration
		Specific—8-bit enumeration
		Extra—8-bit enumeration
96	Entity Linear Velocity	*x*-component—32-bit floating point
		y-component—32-bit floating point
		z-component—32-bit floating point
192	Entity Location	*X*-component—64-bit floating point
		Y-component—64-bit floating point
		Z-component—64-bit floating point
96	Entity Orientation	Psi (ψ)—32-bit floating point
		Theta (θ)—32-bit floating point
		Phi (ϕ)—32-bit floating point
32	Entity Appearance	32-bit record
320	Dead Reckoning Parameters	Dead Reckoning Algorithm—8-bit enumeration
		Other Parameters—120 bits
		Entity Linear Acceleration—3 × 32-bit floating point
		Entity Angular Velocity—3 × 32-bit floating point
96	Entity Marking	Character Set—8-bit enumeration
		11, 8-bit unsigned integers
32	Capabilities	32-bit record
128	Variable Parameter record #1	Record Type—8-bit enumeration
		Record-Specific fields—120 bits

HLA (High-level Architecture)

Rather than standardize communications protocol, standardize communications API

Applications communicate with each other through middleware called a Run-time Infrastructure (RTI) by making calls to API

Networking details are handled by RTI and hidden from applications

More Fundamental Concepts

Federate is any application participating in distributed simulation

Federation is named set of interacting federates with common Federation Object Model (FOM) and supporting Run-Time Infrastructure (RTI)

- Used as a whole to achieve some specific objective (i.e., simulation exercise)

Federation Execution is one instance of a federation running.

Objects

Physical components of federation

- Entities, radios, munitions

Objects have attributes

- Federates exchange information on an attribute basis, not on an object basis

Supports hierarchy structure

- Federates can subscribe to information about broad class of objects, such as all tanks

Interactions

Explicit action taken by an object

- Detonations, Collisions, Signals

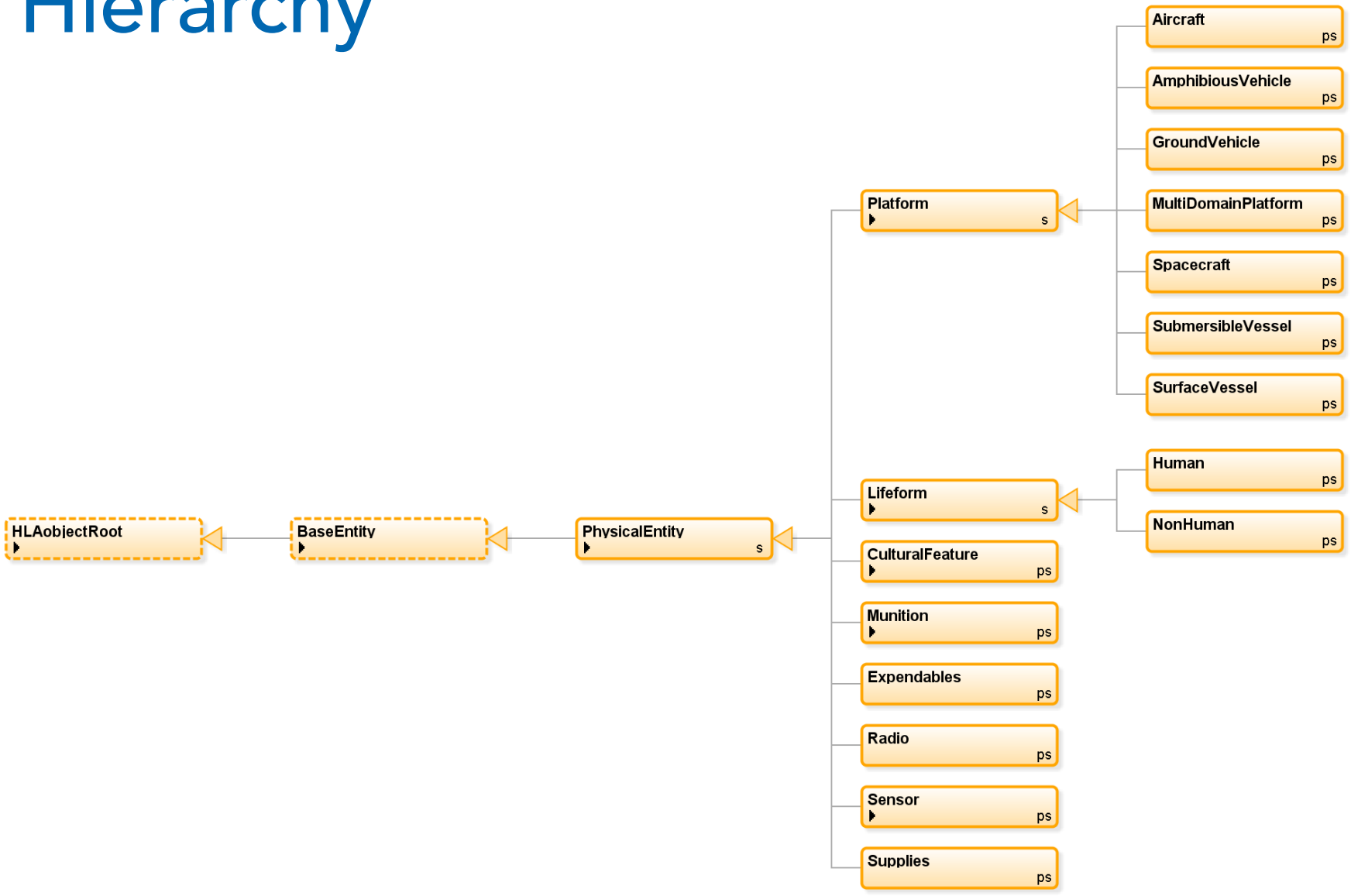
Interactions have parameters

- Federates transmit and receive interactions that contain all of the parameters, simultaneously

Supports hierarchy structure

- Federates can subscribe to information about broad class of interactions, such as
  - All engagements or just air-to-ground engagements

Example Object Class Hierarchy



Example Attribute Table

DamageState	**Datatype**	**Sharing**	**Ownership**	**Order**	**Transportation**	**Dimensions**
	DamageStatusEnum32	PS	DA	RO	HLAbestEffort	
	Update type	**Update Condition**				
	Conditional	*On change*				
	Semantics					
	The state of damage of the entity.					
EngineSmokeOn	**Datatype**	**Sharing**	**Ownership**	**Order**	**Transportation**	**Dimensions**
	RPRboolean	PS	DA	RO	HLAbestEffort	
	Update type	**Update Condition**				
	Conditional	*On change*				
	Semantics					
	Whether the entity's engine is generating smoke or not.					
FirePowerDisabled	**Datatype**	**Sharing**	**Ownership**	**Order**	**Transportation**	**Dimensions**
	RPRboolean	PS	DA	RO	HLAbestEffort	
	Update type	**Update Condition**				
	Conditional	*On change*				
	Semantics					
	Whether the entity's main weapon system has been disabled or not.					
FlamesPresent	**Datatype**	**Sharing**	**Ownership**	**Order**	**Transportation**	**Dimensions**
	RPRboolean	PS	DA	RO	HLAbestEffort	
	Update type	**Update Condition**				
	Conditional	*On change*				
	Semantics					
	Whether the entity is on fire (with visible flames) or not.					
ForceIdentifier	**Datatype**	**Sharing**	**Ownership**	**Order**	**Transportation**	**Dimensions**
	ForceIdentifierEnum8	PS	DA	RO	HLAbestEffort	
	Update type	**Update Condition**				
	Conditional	*On change*				
	Semantics					
	The identification of the force that the entity belongs to.					

MAK Interoperability / Infrastructure Tools

MAK plays a similar role in the HLA (and DIS) community as Real Time Innovations does in the DDS community

- Leading middleware provider
- Leading contributor to standards efforts
- Provider of expertise and interoperability support
- Provider of a variety of higher-level tools and products

MAK Interoperability / Infrastructure Tools

MAK RTI (HLA Middleware)

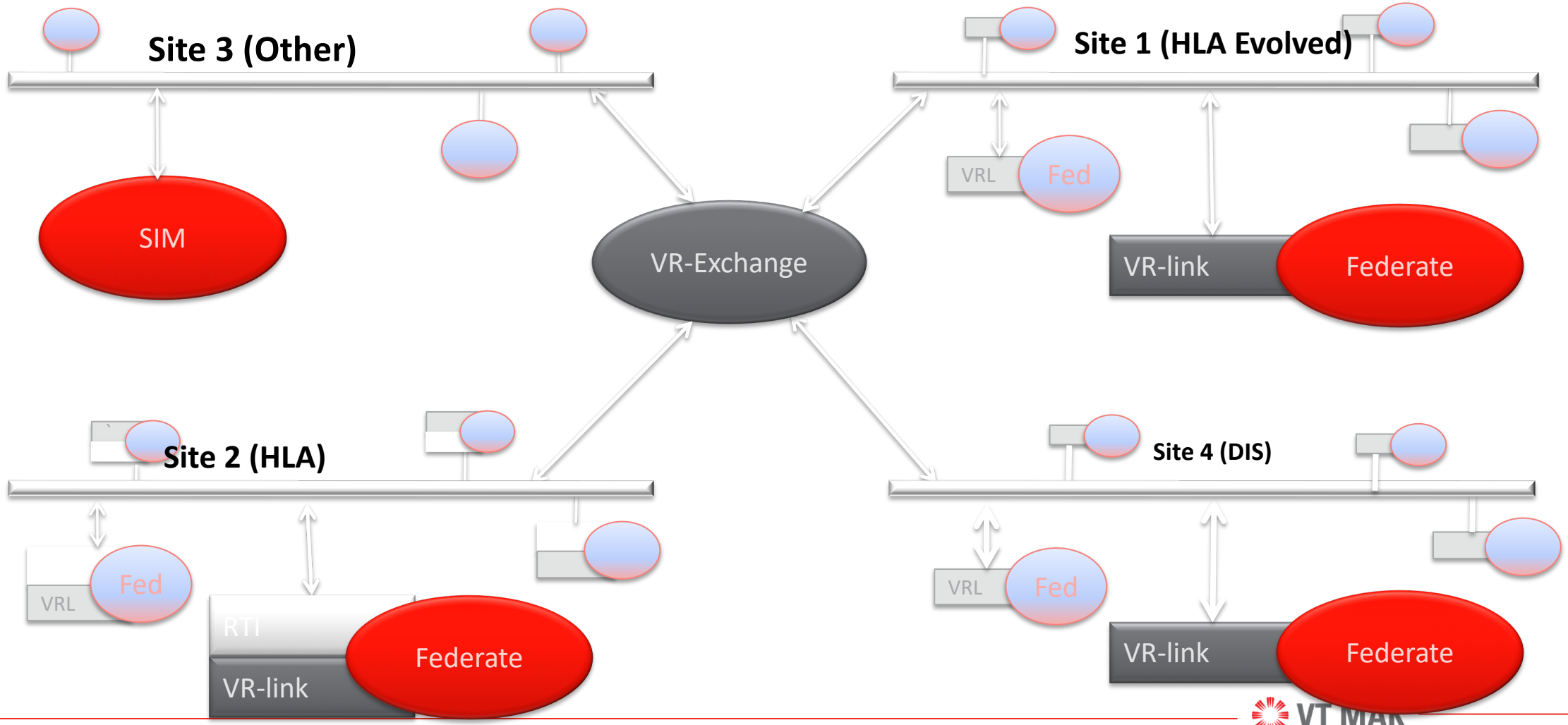
VR-Link (High-level SDK for achieving native compliance with both HLA and DIS – VR-Link sits on top of the RTI in the HLA case)

MAK Data Logger (Records and replays DIS/HLA traffic, along with video and audio streams, and exports for analysis)

VR-Exchange (Flexible Gateway for translation among multiple protocols)

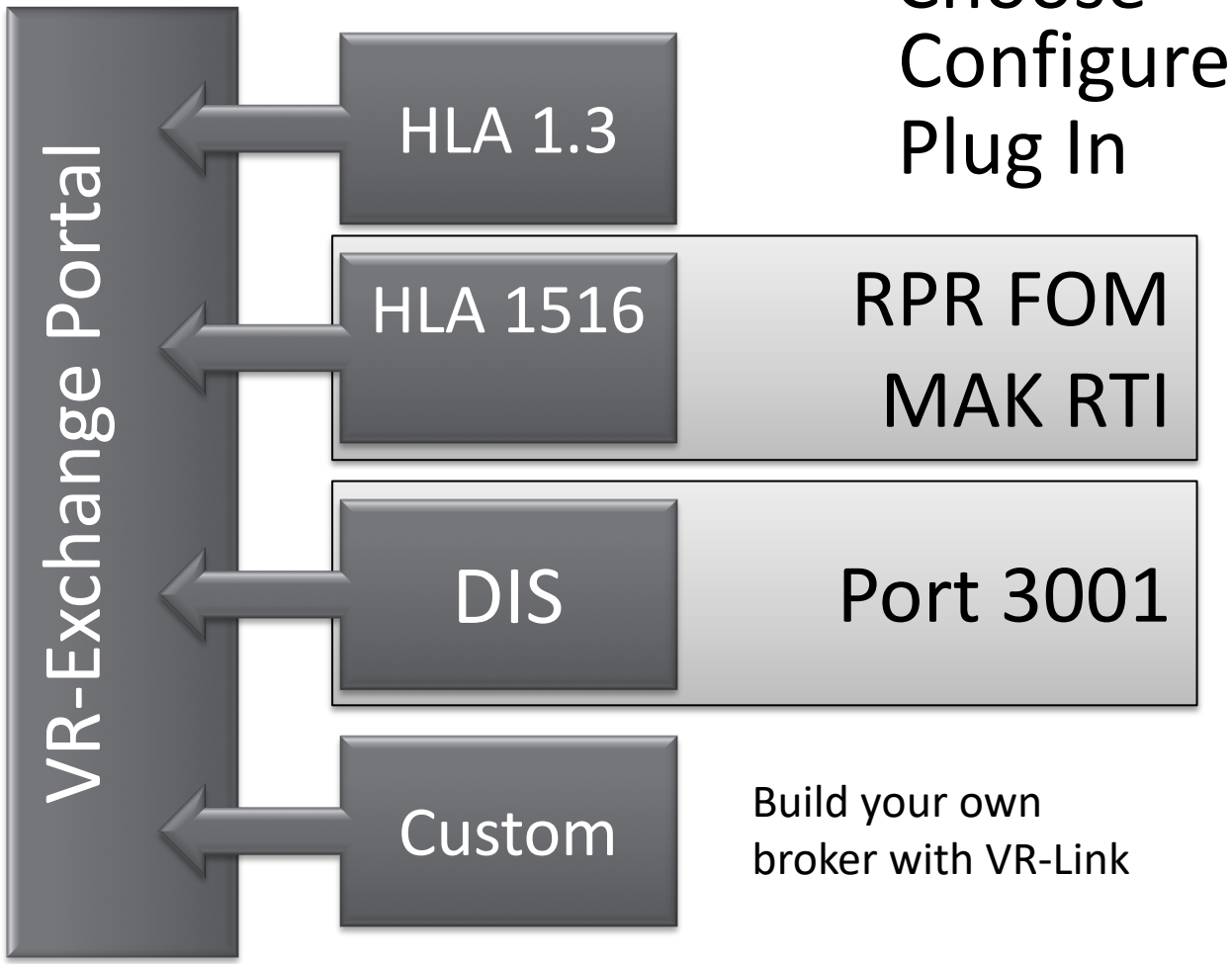
WebLVC Server (Bridging web and mobile apps with traditional, native applications)

VR-Exchange connects your diverse network



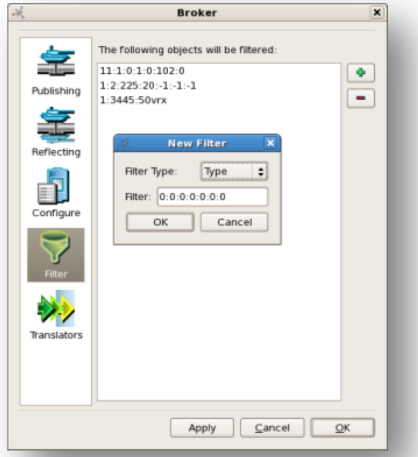
VR-Exchange

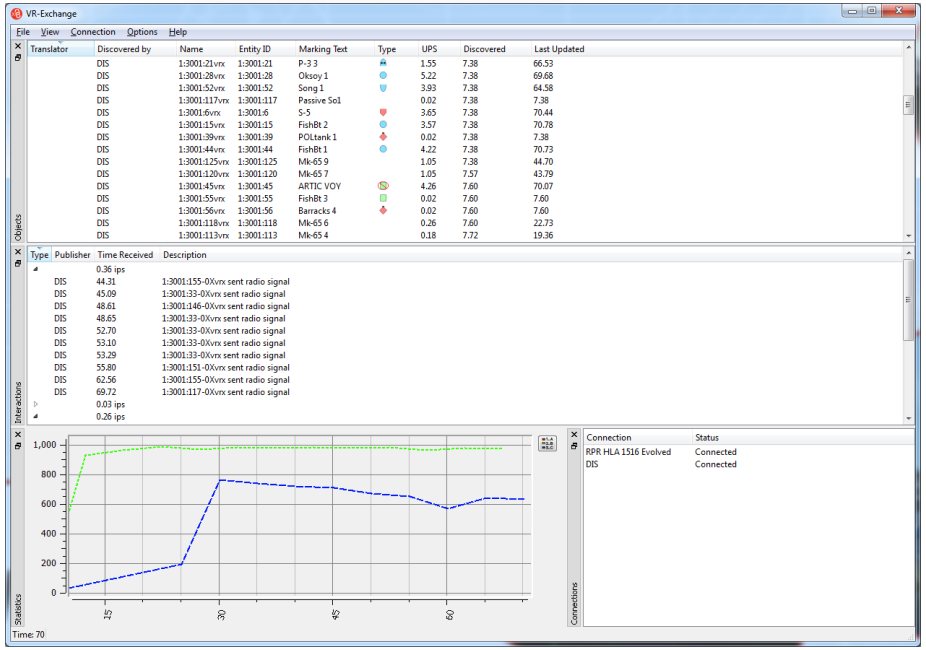
Connectivity in 3 steps



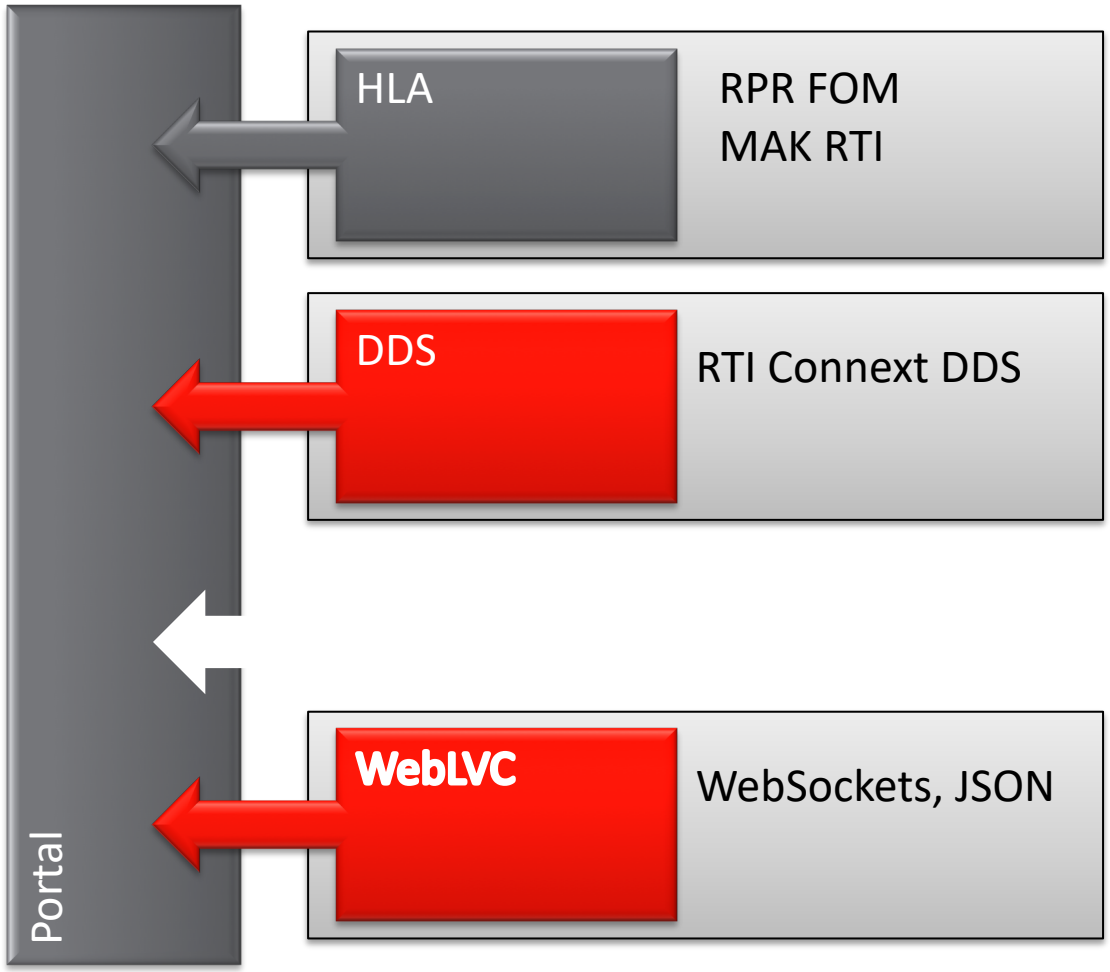
Choose
Configure
Plug In

Build your own
broker with VR-Link





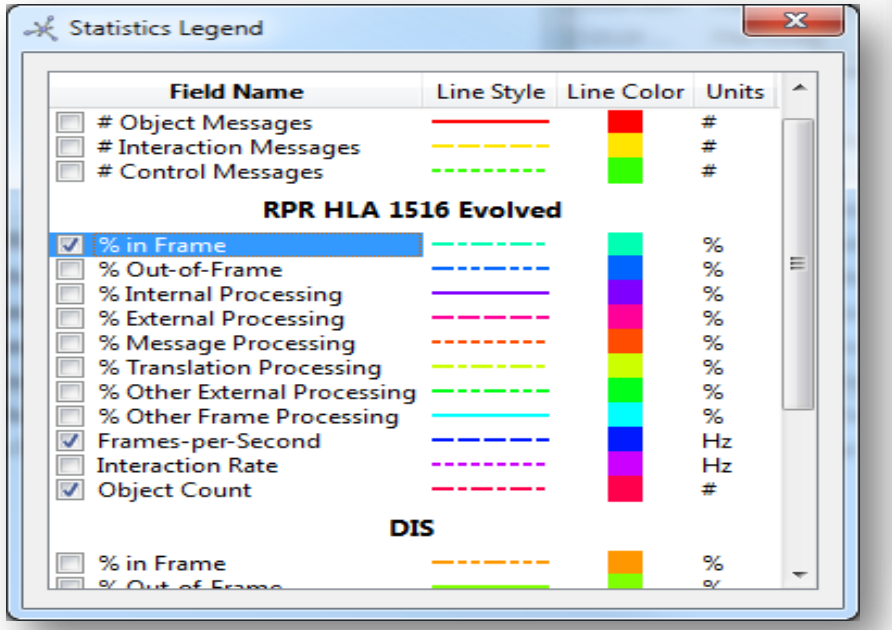
VR-Exchange
Any combination you can imagine

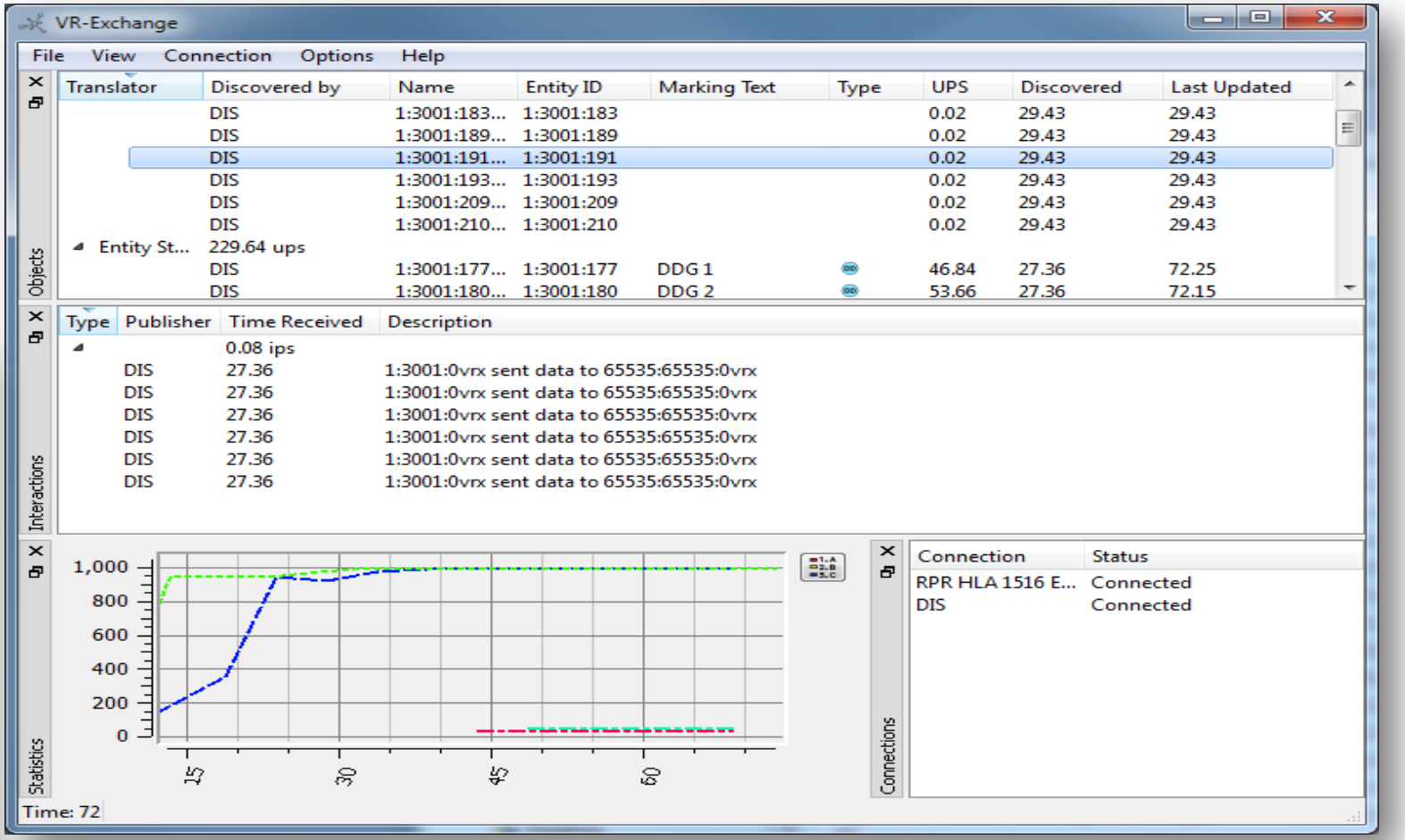


HLA (RPR) 1.3
HLA (RPR) 1516
HLA (RPR) Evolved
DIS 4
DIS 5
DIS 6
DIS 7
DDS
COT
TENA 5
WebLVC
AFMSTT
ERF
MATREX
MRF
AviationSimNet
ADS-B
AIS

Filter and monitor entire simulation

- Real time Charting of Performance
- Filter objects by Area, Object Type, and Object Id, and others.





MAK and DDS

Various DDS projects over the past decade

Analysis of data from live, instrumented training range

- Built after-action review system for Meggitt Training System's NGLF (Next Generation Live Fire) program

Support for HLA-to-DDS translation on various programs

Displaying data from DDS applications in our visualization tools

Netherlands Tacticos Program – Using VR-Forces scenario generation software to stimulate tactical systems on naval ships – to support training at sea

New partnership with RTI

RTI and MAK have collaborated to create a Broker for VR-Exchange based on RTI's Connext DDS software

VR-Exchange's open API allows RTI to maintain this Broker as - to keep up with future Connext DDS versions, etc.

Demonstrated integration at National Center for Simulation in Orlando in April, 2018

- VR-Forces scenario data (HLA) translated through VR-Exchange to DDS, and visualized in real-time on a Harris Corpmoving map display

Use Cases

Stimulation of operational displays, UIs, and devices with simulated data

- During testing and development of operational systems
- For training on the live systems after deployment

Simulated video to stimulate security or Command and Control systems; train machine vision systems (autonomous vehicles)

Bringing input from live systems into the virtual environment for LVC (live, virtual, constructive) simulation

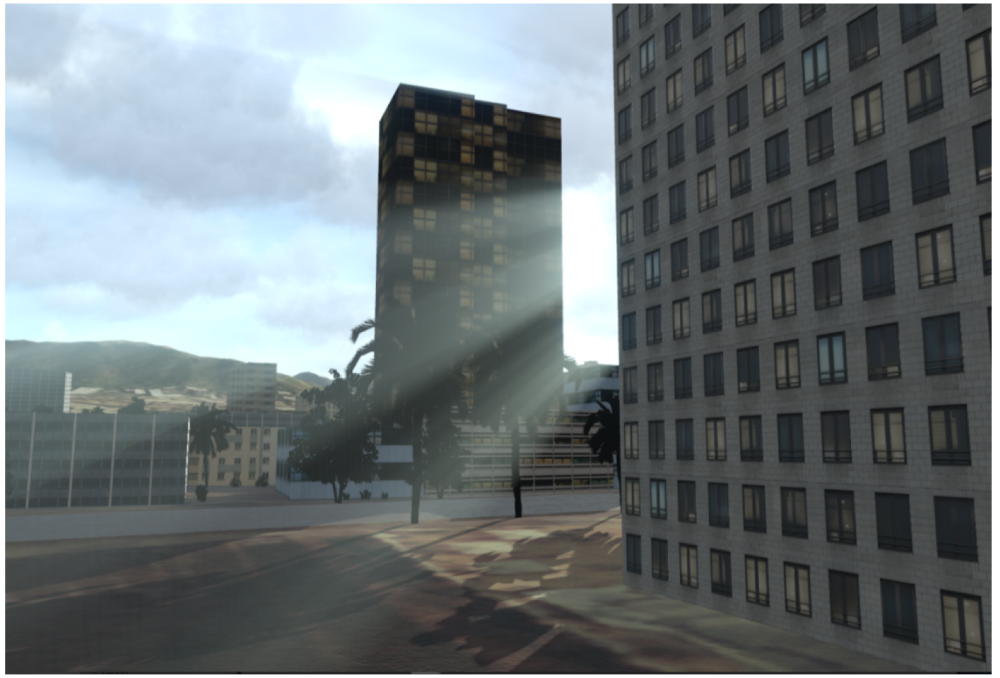
General interoperability between DDS and HLA

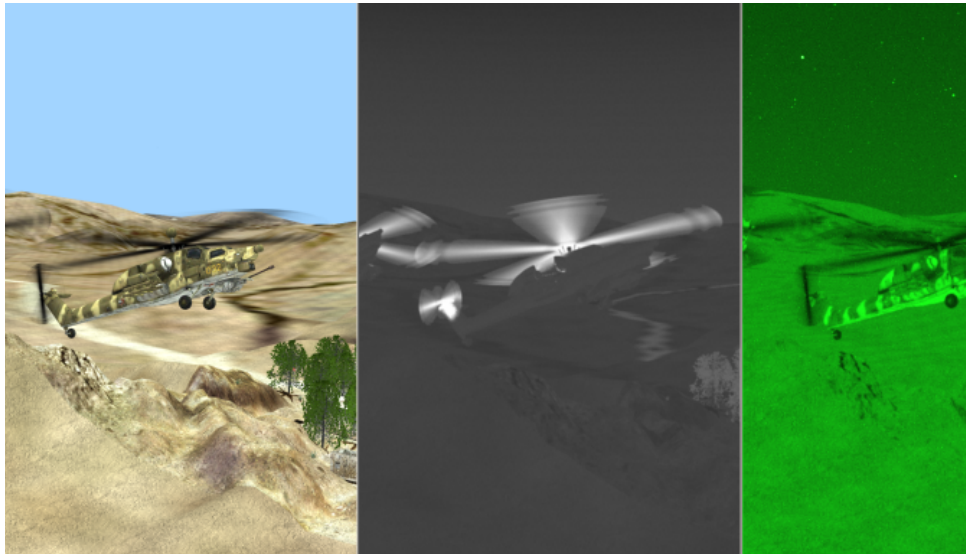
Visualization of DDS data

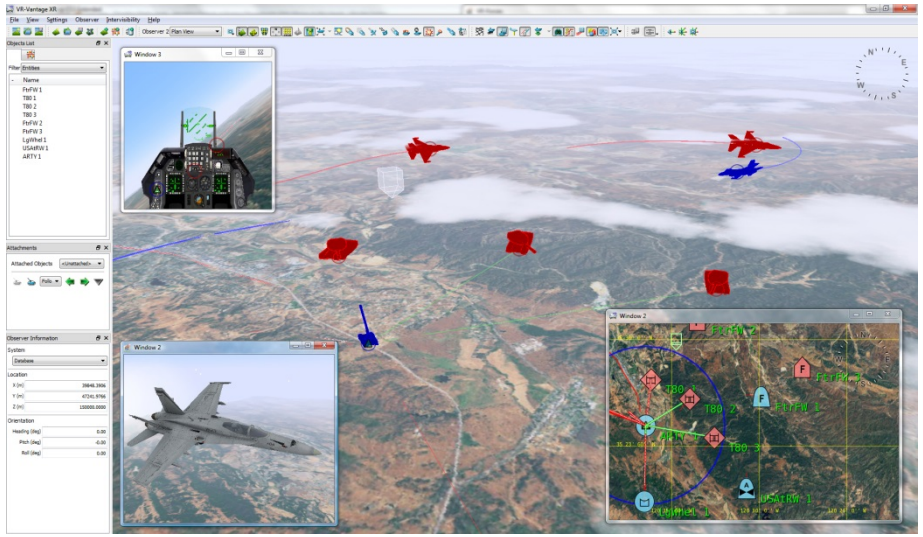
Desktop, large custom displays, or Virtual Reality / Augmented Reality environments

MAK tools are particularly useful when data needs to be visualized in real-world environments (terrains built on GIS data, import OpenStreetMap, etc.)

Example: OPNET Modeler uses MAK's 3D engine to visualize locations and relationships between nodes of mobile ad-hoc networks (nodes, relays, towers, etc.) and overlays 3D information data onto the display

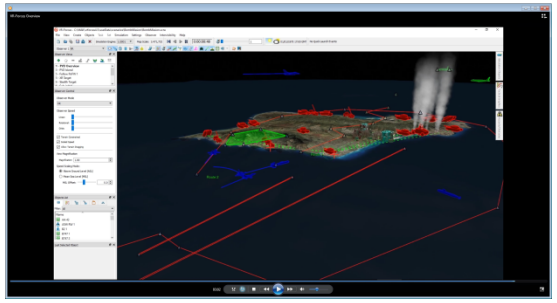






MAK Capability Overviews

Synthetic Training Environment Demo



VR-Forces Introduction

VR-Engage Introduction

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