rti Your systems. Working as one.

DDS for Simulation: How the Connectivity Framework is Meeting Interoperability Challenges

HARRIS®

NATIONAL INSTRUMENTS™

VT MÄK
A company of VT Systems

Welcome and THANK YOU for coming!

- Agenda:
  - Intro to Real-Time Innovations and Data Distribution Service
  - Intro to VT MAK's products
  - Customer testimonial
  - DEMO: Tying it all together
- We will end at 0855 for those who are attending the PALT
- You can play with the DEMO and tools after we break. We can go much more in-depth

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The Power of Simulation

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DUI Sim - How does it work?

- Inputs slowed down
- Reduced feedback
- Inaccurate response time
- Doesn’t keep up with physics
- Low-fidelity simulation of sober driving
- Effective feedback for those used to driving sober

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What if you learned to drive on the DUI Sim?

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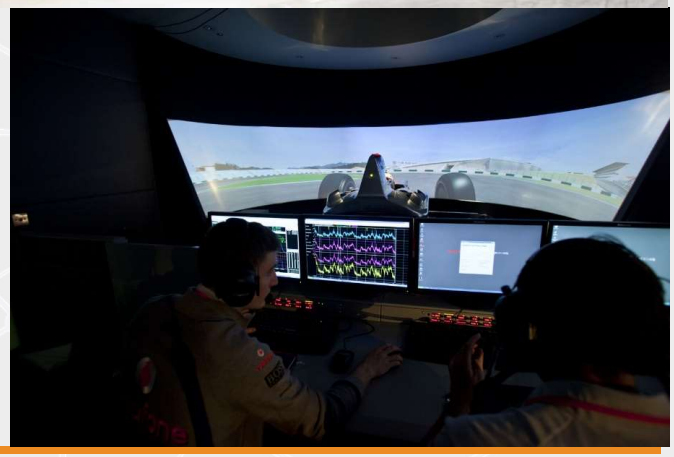
How do you train the world's best drivers?

Focus on fidelity



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How do you train the world's best military?

The same way: Focus on fidelity

Fidelity (n):
1. Faithfulness to a person, cause, or belief, demonstrated by continuing loyalty and support
2. The degree of exactness with which something can be copied or reproduced

Components of high-fidelity

- Good models (i.e. maps, missions, equipment, foes)
- Humans & real-world HW in the loop
- Live, virtual, & constructive realities
- Distributed, cross-branch, cross-ally
- Security
- Ability to monitor & instruct
- Fast, interoperable communications

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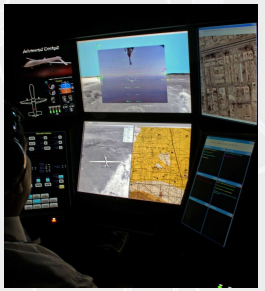
DDS for High-Fidelity Communication

- Low latency (real-time, physics speed)
- Highly available and fault-tolerant
- Autonomous – no admin required
- Robust security
  - Authentication
  - Encryption
  - Access Control
- TRL 9 – deployed in hundreds of systems


FACE™
Future Airborne Capability Environment

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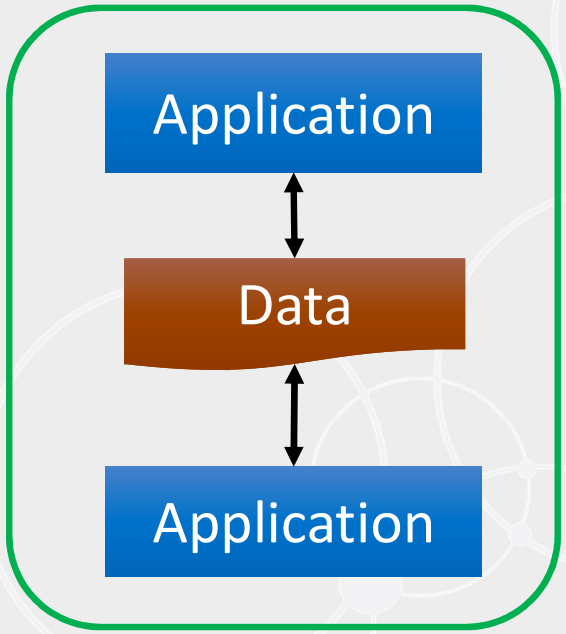
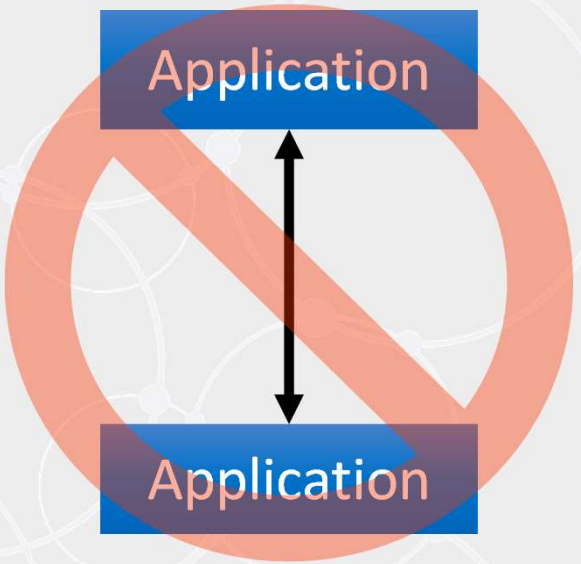
Data Distribution Service Technology Description

We Sell a *Databus*

DDS is the standard that defines a databus



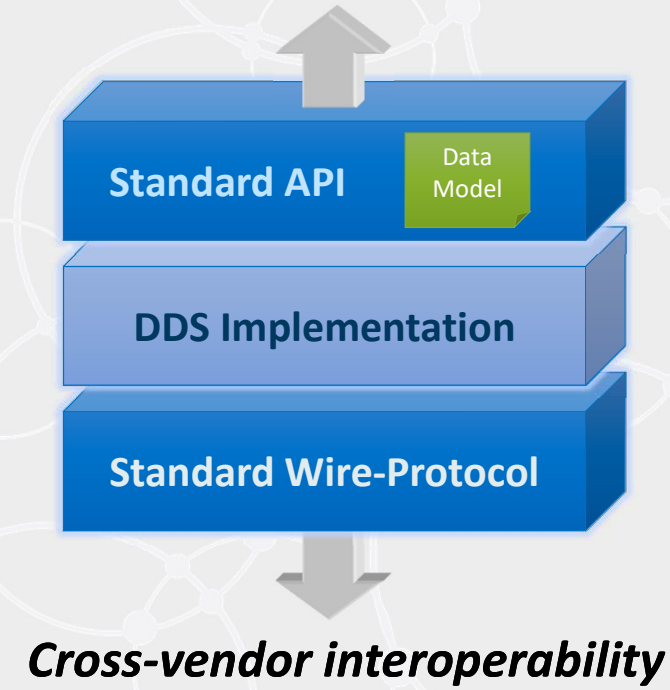
Data-centric technology connects applications to the data, not to each other



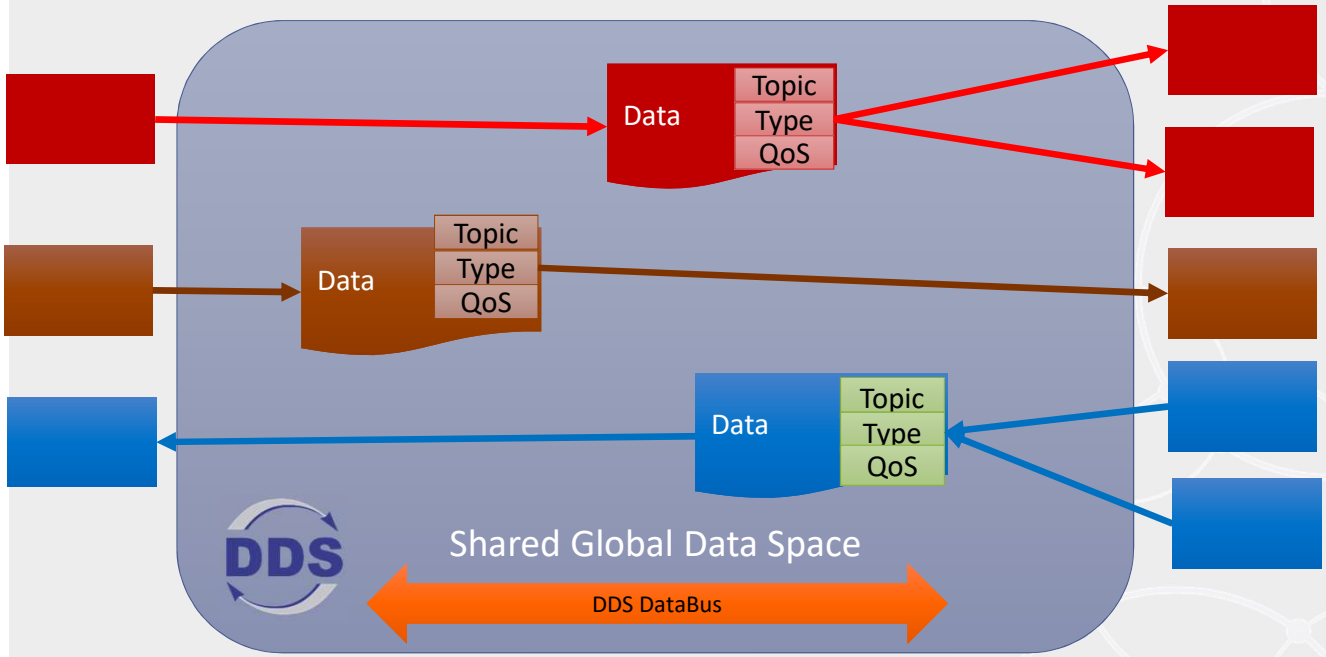
Message centric
Client/Server
Remote Objects
Publish-subscribe
SOA

DDS – An OMG Standard

- Managed by OMG
- Interoperability and portability
  - Programming interface
  - Network protocol
  - Data model specification
- Encompasses:
  - Data model and entity discovery
  - Messaging
  - Real-time data management and QoS
  - Security



We Enable a "Data Everywhere" Abstraction



- Doesn't actually send all data…
- Every application gets everything it needs, when it needs it
  - Applications declare needs and capabilities
  - Databus delivers data
- Applications interface only to data
  - Every app speaks its own language
  - Databus maps language, CPU, OS, transport
- Fast, reliable, scalable

The Databus Decouples Software Like No Other

- Flow: discovery, rates, reliability uncoupled
  - Any network, any transport
- Space: services live anywhere
  - Cloud, fog, devices
  - Move them transparently
  - Full, easy redundancy
- Time: robust system operations
  - No dependency on startup sequence
  - Participants come & go at will

And, Since Systems are All About The Data…

- Decoupled subsystems work independently
- Data-centric sharing lets them cooperate

Your Distributed Systems Work as One

Real-Time Innovations Connext DDS in A&D

Hundreds of A&D Programs

U.S. & Allied military adopt DDS to achieve Interoperability

- Dominant in military
  - DISA: DISR mandated
  - Navy: Open Architecture, FORCEnet, Product Line Architecture
  - Air Force, Navy and DISA: NESI
  - Army, OSD: UCS
  - NATO, UK MoD, South Korea, many more
  - TRL-9: proven reliability in battle
- Hundreds of active programs
  - Multiple interoperable implementations

US Army Asset Tracking System (JBC-P)

Legacy Capability:

- **500K** lines of code
- **8 yrs** to develop
- **21** servers
- *Achieved: **20K** tracked updates/sec, **reliability** and uptime **challenges***

Next-Gen Capability:

- **50K** lines of code
- **1 yr** to develop
- **1** laptop
- *Achieved: **250K+** tracked updates/sec, no single point of failure*

"This would not have been possible with any other known technology."

—Network Ops Center Technical Lead

AMRDEC-SED System Integration Labs

- Hardware-in-the-Loop labs for the UH-60, CH-47F and AH-64E Army Helicopters

Latest SIL: Apache AH-64E

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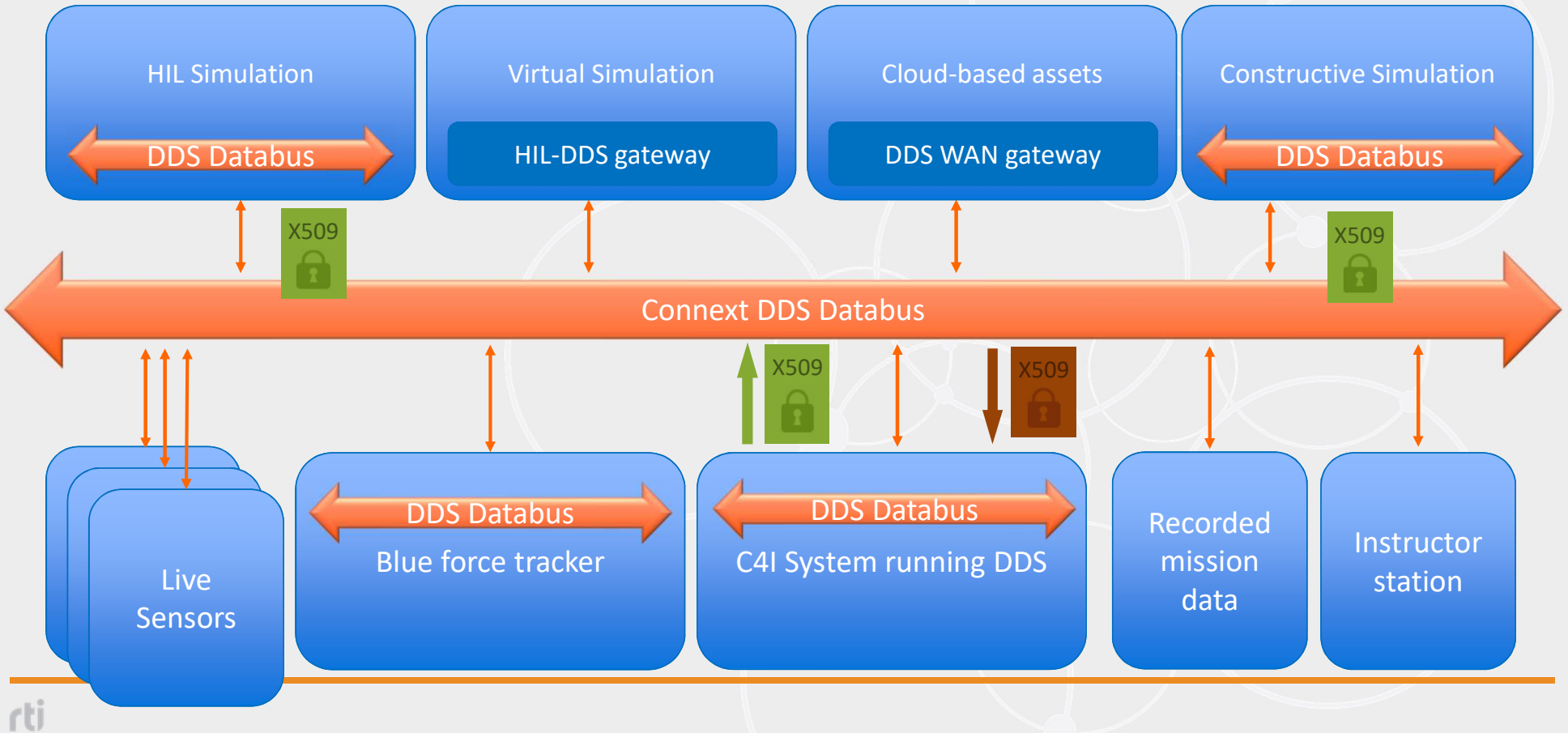
Results

- Reduced number of computers to be managed by 80%
- Shrank footprint from 6 full-sized racks to one
- Removed all costly reflective memory cards, hubs, cabling
- Increased I/O card stability under LabVIEW (Windows), superior to that in previous Linux architecture
- Reduced Cost

15 x 5U rack mount computers	2 x 1U computer
1 x 256MB reflective memory card	1 x RTI DDS Connext 1 x PXI-8260 chassis
10 x PCI 1553 cards	4 x PXI 1553 cards
8 x PCI ARINC 429 cards	4 x PXI A429 cards
$184,500	**$110,000**

Distributed Simulations enable Joint Mission Training



VT MAK
Product Overview

April 10, 2018

VT MAK

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

MAK Products

MAK offers a comprehensive suite of simulation software that provides state-of-the-art stand-alone capabilities, yet works harmoniously as components of an integrated system.

- **SIMULATE:** Complete scenario generation and virtual simulation solutions
- **VISUALIZE:** Beautiful scenes and informative content - experience your modeling and simulation from every vantage point
- **TERRAIN:** Creating the best synthetic environment for modeling and simulation
- **LINK:** Connecting every simulation with our powerful and flexible interoperability tools

VR-Forces

A robust simulation framework to design, develop, and execute complex scenarios

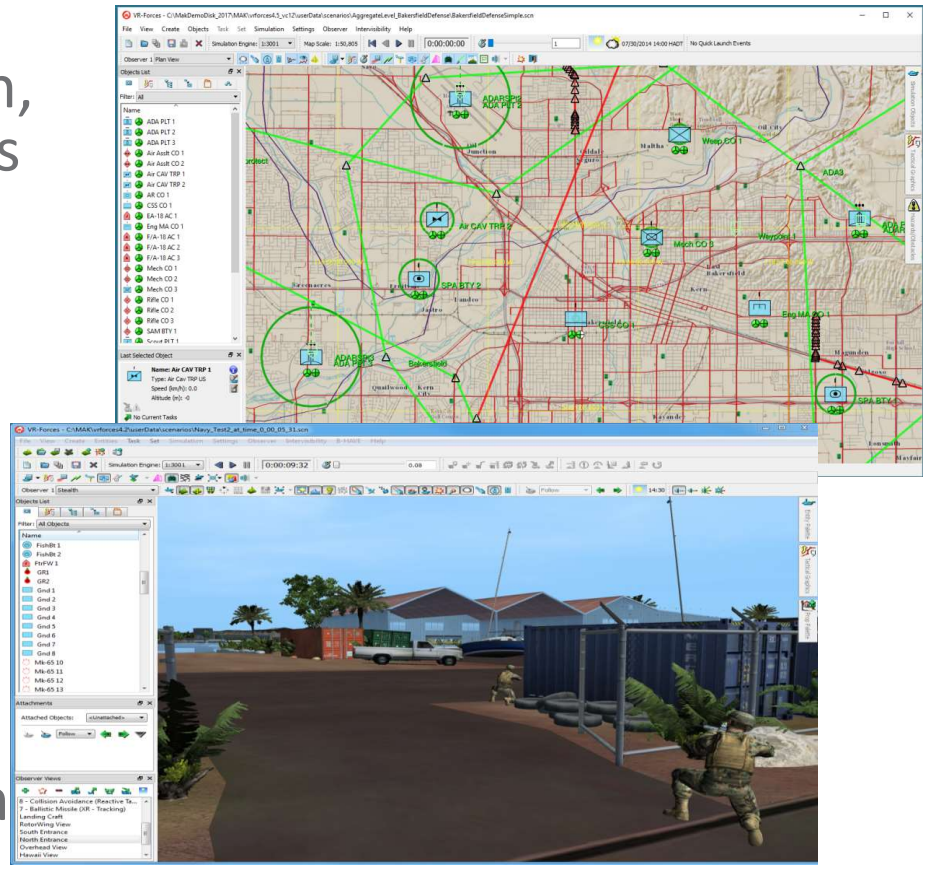
Integrated 2D/3D Display

Entity and Aggregate Level Simulation

Simulation of:

- Land, air and sea entities
- Behaviors and Interactions
- Sensors
- Weapons
- The Synthetic Environment

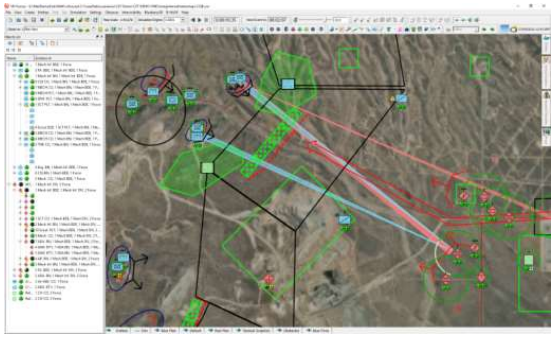
Powerful API supports full customization



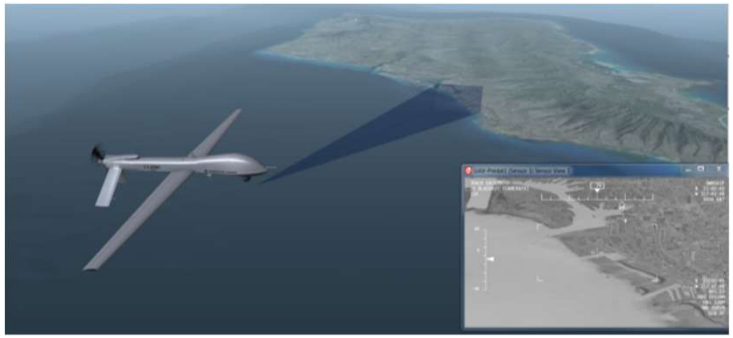
VR-Forces is used as…..

…a CGF

…a desktop trainer



…a Command Staff Trainer



…an experimentation platform

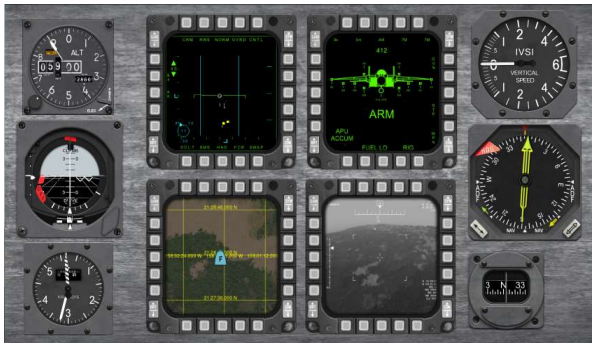
…a threat generator

…an embedded trainer

VR-Engage

A Flexible, Multi-role Virtual Simulator

First Person Shooter



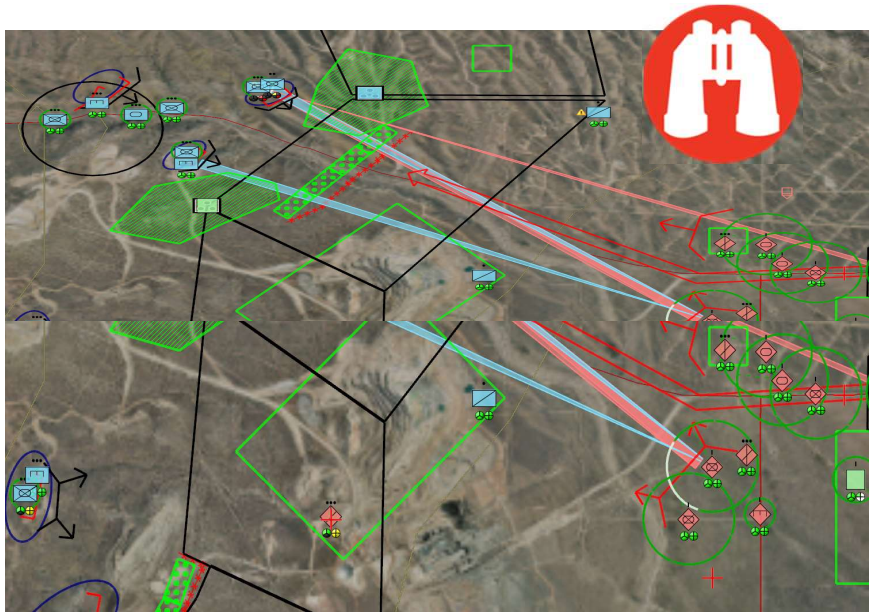
Flight Simulator

Vehicle Crew: Driver

Vehicle Crew: Gunner

VR-Vantage

- Multi-channel Image Generator
- 2D and 3D Visualization
  - Scenario Monitoring, Control and AAR
- Simulated Video & Sensor Simulation
- Interactive real-time tactical map



Sensor Simulation

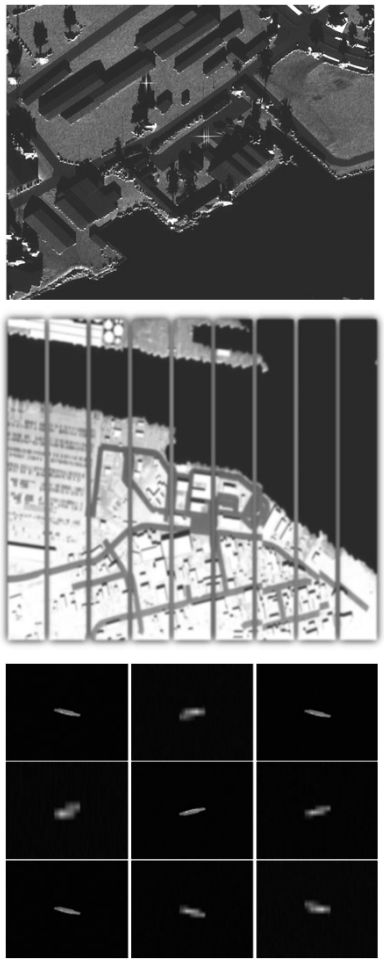
SensorFX high fidelity sensor visualization for VR-Vantage

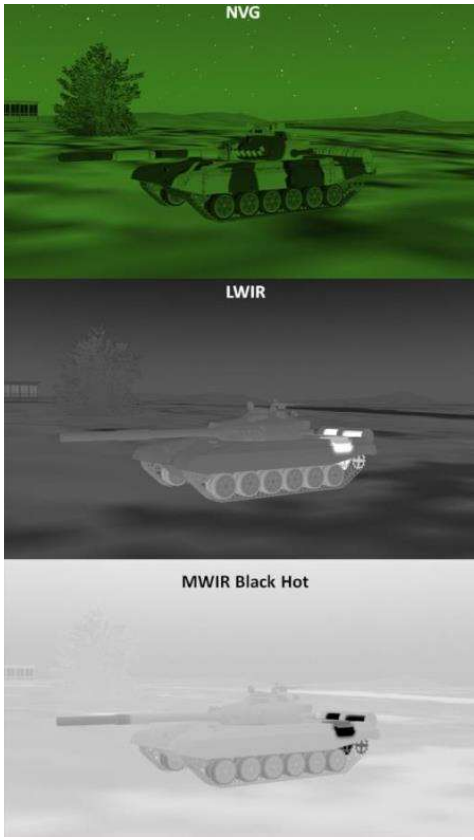
- FLIRs and Thermal Imagers
- Image Intensifiers/Night Vision Goggles
- EO Cameras

RadarFX Server for SAR/ISAR

Physics and EO-Engineering based

- Signatures, sensor effects
- Highly Configurable
- Semi-Automated Classification Tools

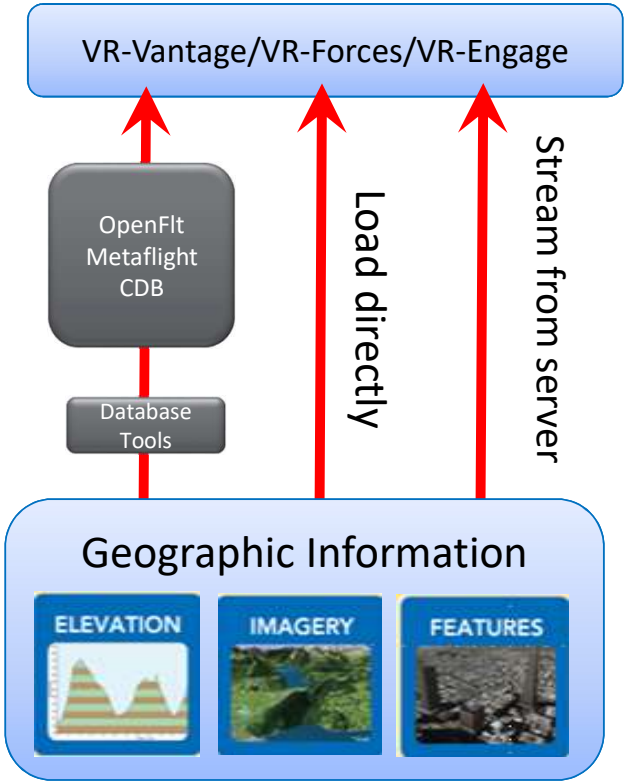




MAK's Terrain Agility Solutions

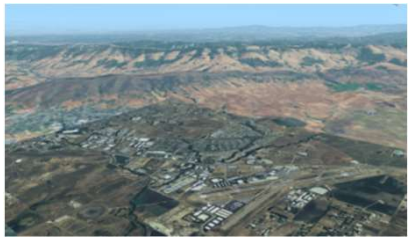
Hand Modeled

Direct From Source



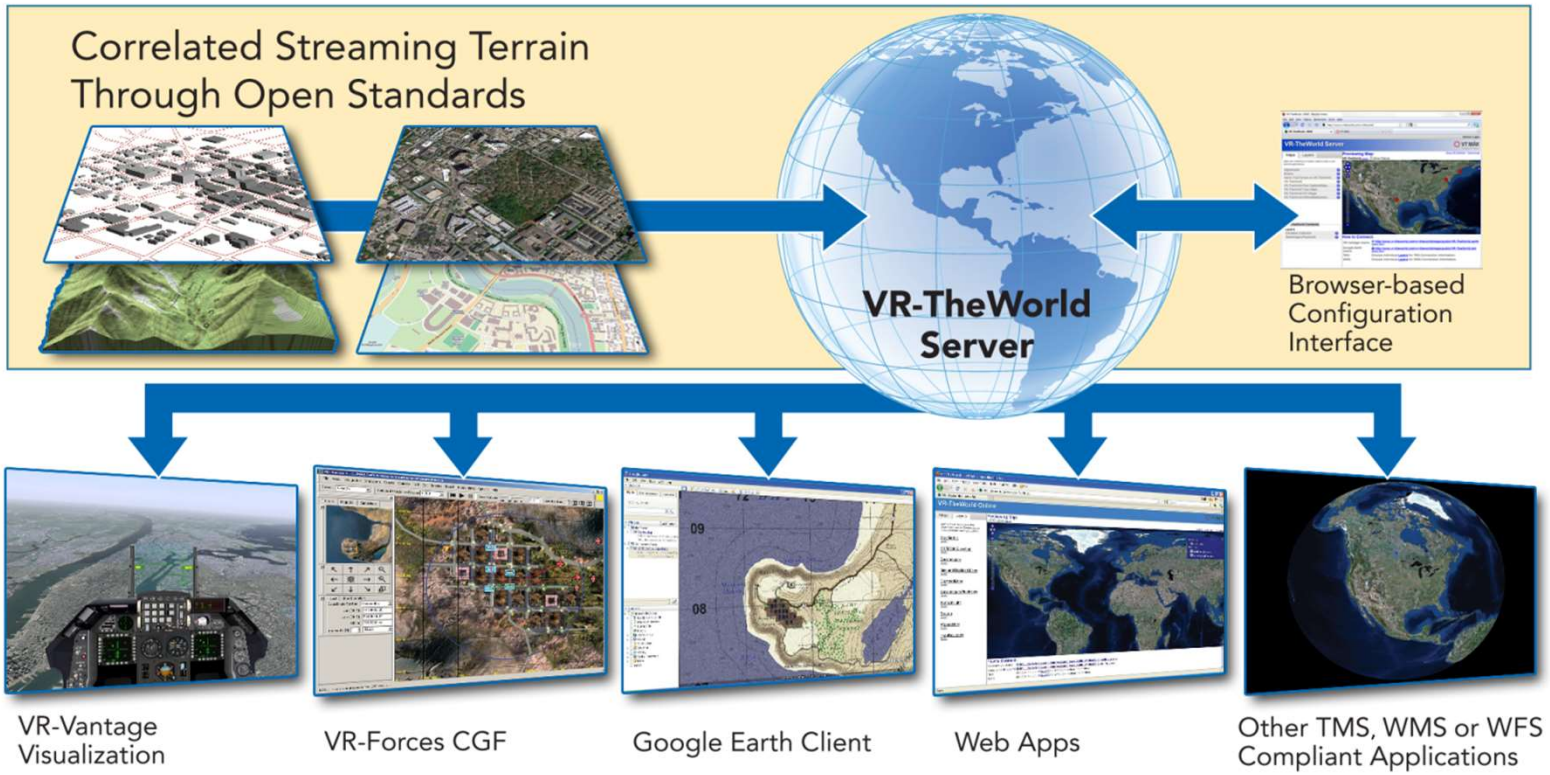
Procedural Terrain

Streaming Terrain



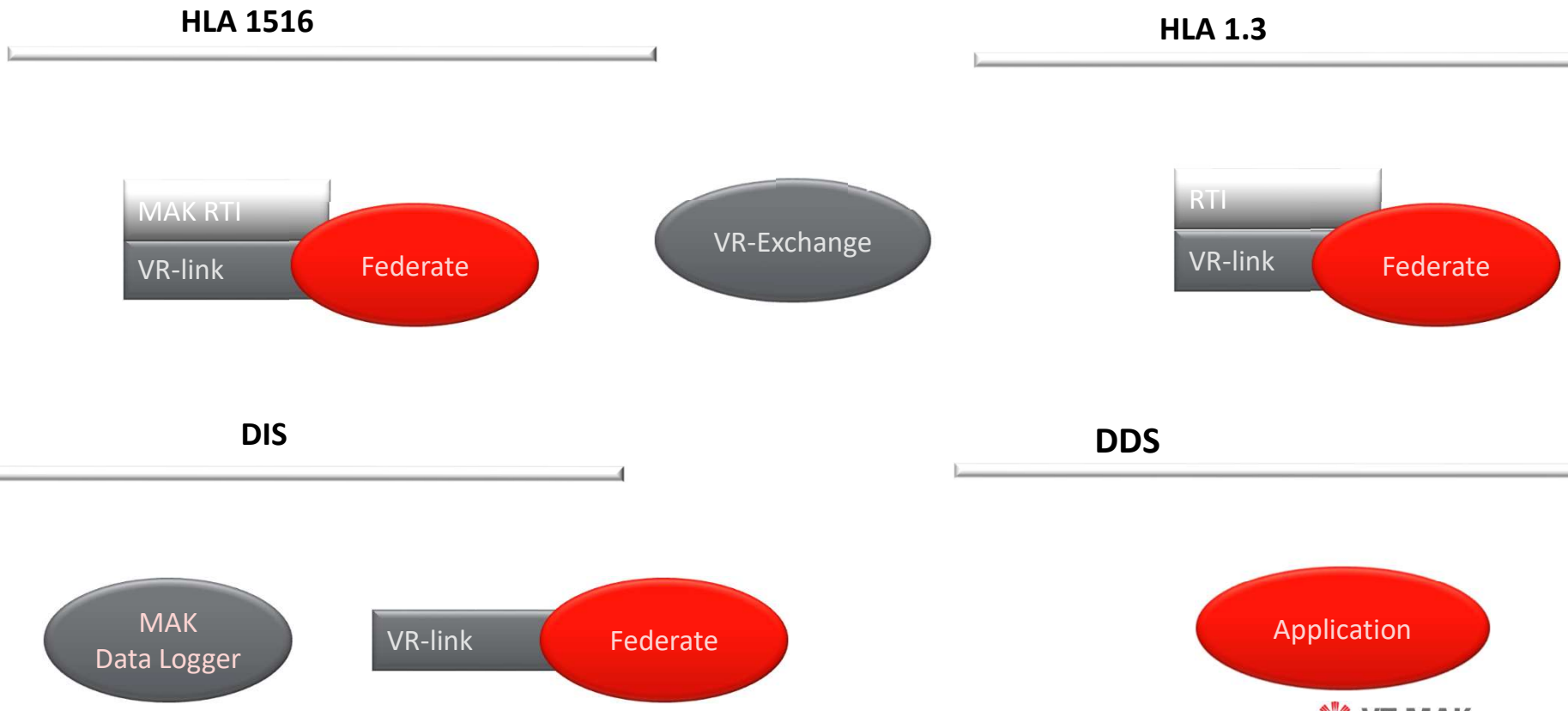
You choose which approach(es) to take

VR-TheWorld Server



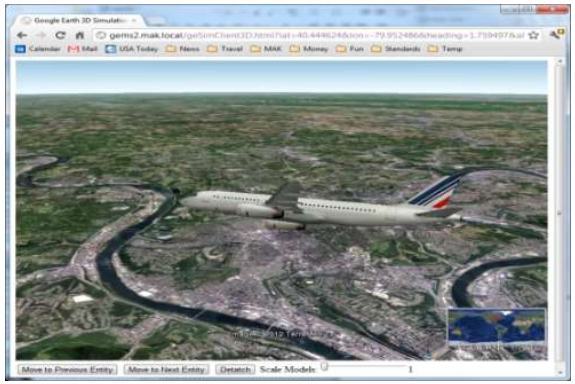
Interoperability Products

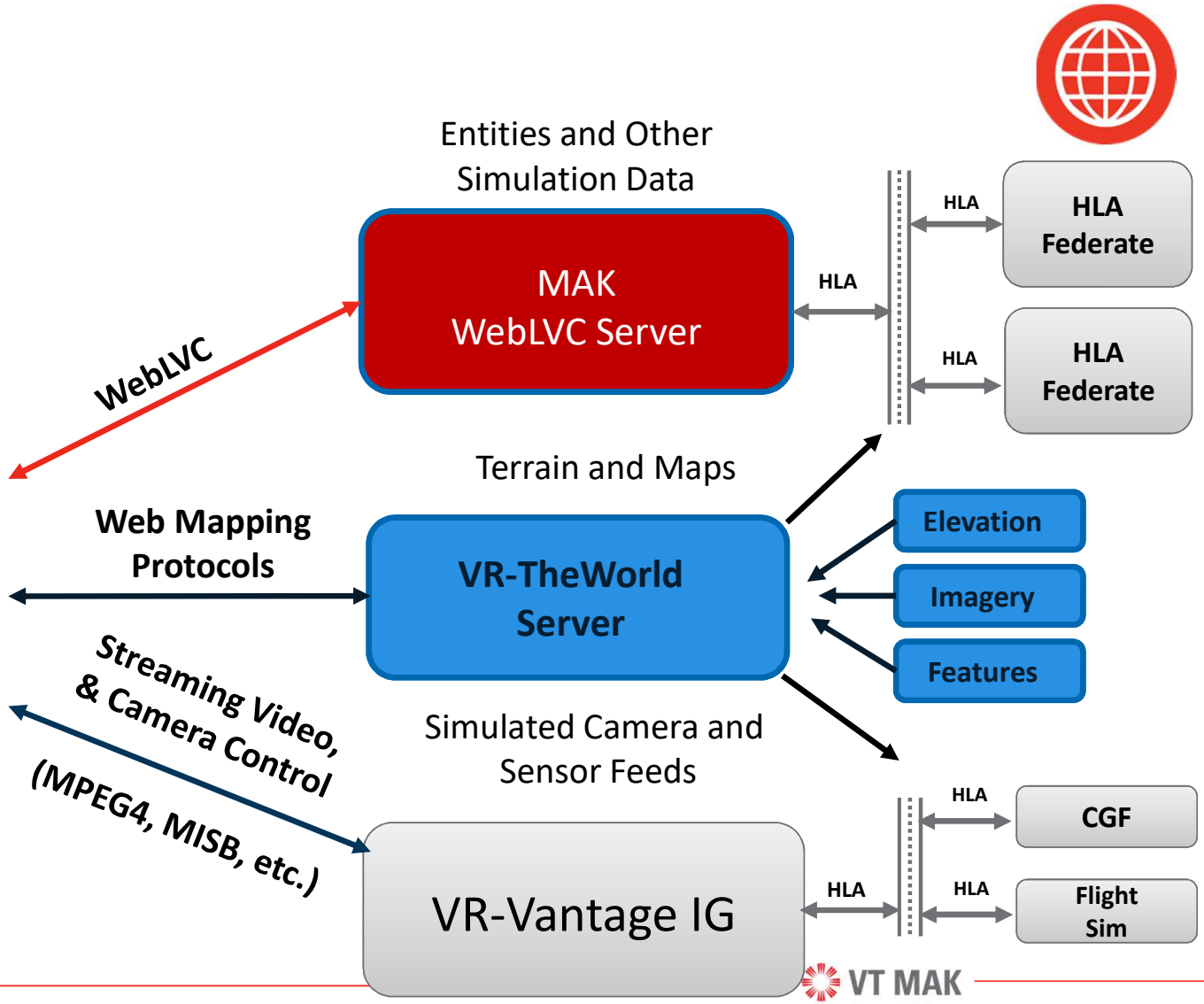
Connect Your Diverse Networks



WebLVC

Web App






VT MAK: Helping Customers develop simulation systems to train, plan, experiment, analyze, prototype and demonstrate.

Real-Time Innovations Customer testimonial

Real-Time Innovations DEMO

RTI TSS and Harris FliteScene

- Safety based Linux FliteScene
- OpenGL SC 1.0
- Uses TSS Callbacks
- RTI TSS Reference Implementation
- RTI Connext Micro

Integration of RTI's TSS with Harris FliteScene

- Create IDL from Data Model header files
- Generate DDS and TSS type specific code using RTI tools
- Created RTI TSS Configuration file
- Linked Harris object files with RTI TSS

Inc.

VT MAK
A company of VT Systems

F18 HLA Federate

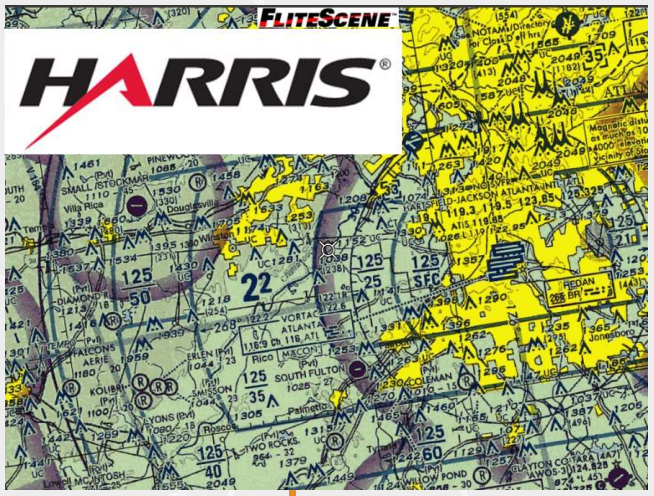
VR-Vantage Stealth

HLA Federation

VR-Exchange

HLA – DDS gateway

Simulated F18 data to Harris FliteScene FACE UoC through RTI's DDS and FACE TSS



FACE
Future Airborne Capability Environment

FACE TSS

Connext DDS

Connext DDS

rti

Tools & Services - Overview

- Data Persistence
  - Persistence Service
  - Recorder
  - Database Integration
- Monitoring / Debugging
  - Replay
  - Monitor
  - Distributed Logger
  - Administration Console
  - Spreadsheet Add-in
  - Wireshark
- Integration
  - Routing Service
  - Queuing Service

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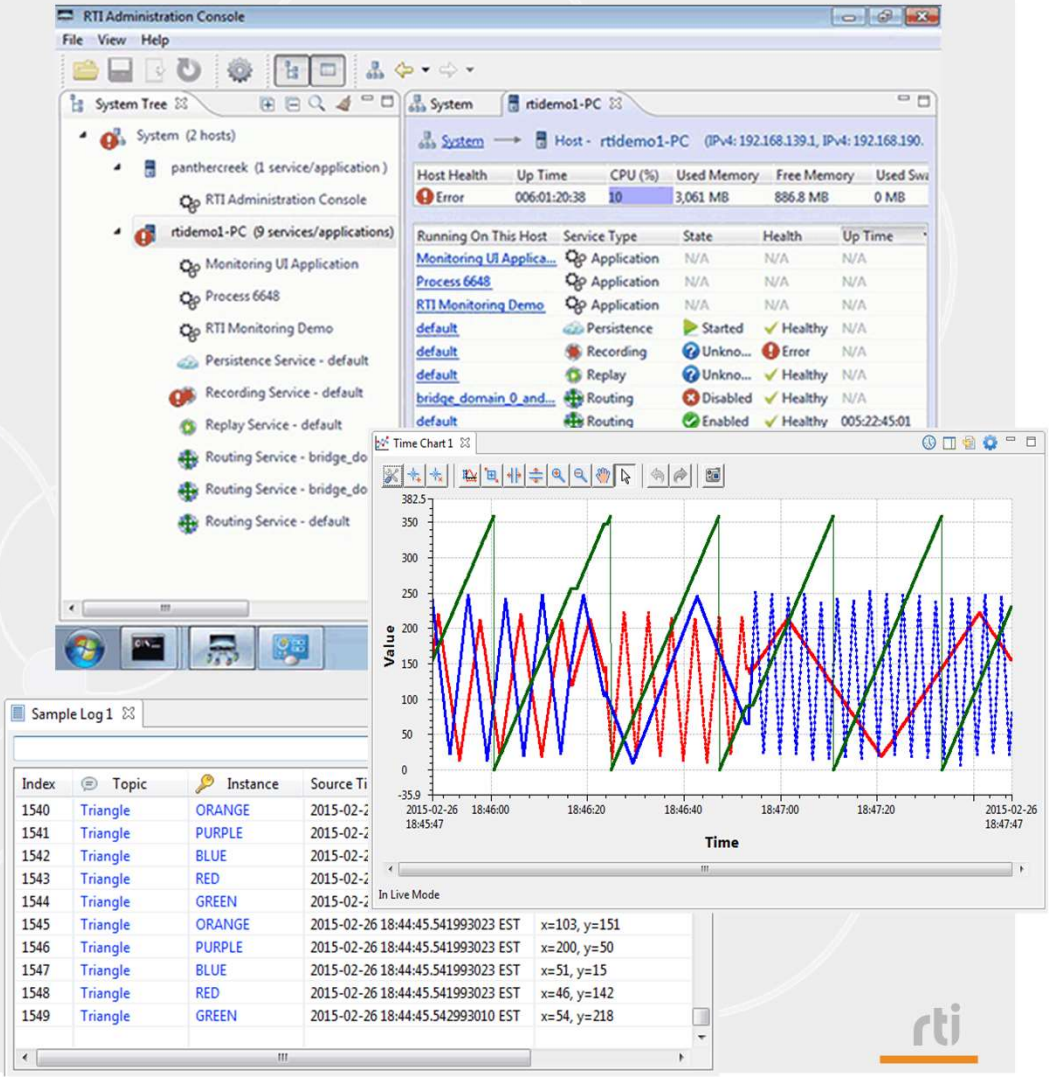
Admin Console

- System Awareness
  - Who/What/How?
  - Exactly data types published/subscribed?
  - System performance
- Debugging
  - QoSes and/or types mismatches.
  - View/administer the log messages
- Administration
  - Control RTI Services remotely.
- Data Visualization



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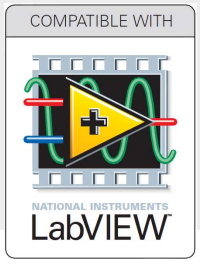
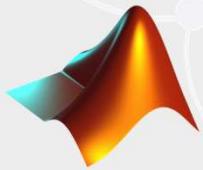
Integration with 3rd Party Tools

- Maintained by RTI
  - National Instruments LabVIEW toolkit
    - Windows and NI Linux (RT Targets)
  - Wireshark
  - Microsoft® Excel®
    - Provided with Professional
- IDL Generator for Enterprise Architect
  - Experimental tool

- Maintained externally
  - Mathworks Simulink and Matlab
  - InformeDDS by Simventions.
    - From Launcher
  - Rational Rhapsody





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OMG DDS vs. Army DDS

Feature	OMG DDS (Data Distribution Service)	Army DDS (Data Dissemination Service)
Architecture	Peer to Peer, Server-less (No single points of Attack, Failure or Congestion)	Federated Client/Server Broker, requires multiple hops, servers
API / Protocol	Standardized: API, Protocol(RTPS) (Code portability & wire interoperability)	HTTP
Data Model	IDL defined with Type Extensibility, Mutability (Efficient Binary Data only)	XML (Inefficient, Interoperability not enforceable)
QoS	20 QoS Policies (Reliable, Durable, Filtering, Liveliness, History, etc)	Content filtering at Server
Security	DDS Secure Framework Authentication, Topic Based Access Control, Tagging, Logging	HTTPS
Safety	DO-178C Certifiable versions	???