Practical Experiences from HLA Evolved and Object-Oriented HLA in distributed simulations

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Outline

» About Pitch Technologies
» HLA Evolved
» Object-Oriented HLA and the Connected Enterprise
» MSG-068 – The NATO Education & Training Network Experiment.
» NTN – The Swedish National Training Network
» Viking 11 – The multi-national C2 exercise
» Conclusions
About Pitch

» Pitch Technologies specializes in interoperability and infrastructure components

» World leader in standards-based interoperability products
  » Performance
  » Robustness
  » Easy to Use

» Strong focus on R&D and innovation
  » Develops and delivers cutting-edge, industry-strength products
  » International R&D leader with several research awards and certifications

» Small, agile company with a large international partner network

» Independent company within BAE Systems
What do we do?

» We support organizations that develops simulation solutions for internal and/or external use

» We are your partner, not your competitor
  » With our products and services we aim to:
    » Improve the time to market for your products
    » Reduce your cost
    » Reduce your program risk

“Make Your Systems Work Together”
» Pitch Technologies has provided
  » More than 40,000 software licenses
  » to more than 330 customer organizations
  » In more than 30 different countries

» To a wide range of different domains:
To model "the bigger picture" we need to combine many different simulation models from different sources. Examples:

- Defense simulations: sensors, vehicles, weapons, effects, weather, tactical decision making, command and control...
- Environment simulations: chemical processes, ecology, meteorology, hydrology, human behavior...
- Offshore oil simulation: oil platforms, ships, drilling process, fluids, geology, people, ...

There is no single "correct" way to model a real world concept. It all depends on purpose!

Simulation Interoperability – making simulations work effectively together.
High Level Architecture
IEEE 1516-2010 (HLA Evolved)

M&S Interoperability Standard
High Level Architecture (HLA)

» Common services for simulation data exchange and coordination are provided by the RTI (Run-Time Infrastructure)

» These services are accessed by the participating members through well defined APIs (HLA Interface Specification)

» A **Federation Object Model (FOM)** is used to refer to shared simulation objects and their attributes and interactions
» Optimized data distribution – reduced network usage
  » Sender side filtering based on publish/subscribe
  » Smart update rate reduction
  » Data Distribution Management

» Fully customized and modular information model
Time and synchronization services

» Federation Time Management
  » Time Contrained/Regulating Federates
  » Support Real Time, Time Stepped, Event Driven, and Optimistic Time Warp simulations
  » NOTE: Federation Time is not Simulation or Scenario Time

» Synchronization Points
  » Federation defined synchronization, state transitioning, etc

» Save/Restore
  » Synchronized save and restore of federate and federation state
  » Restart from saved state
Ownership Transfer and RTI compatibility

» Modeling responsibility of individual attributes can be transferred
  » The ownership (modeling responsibility) of individual attributes can be transferred from one federate to another
  » Shared object modeling responsibility, backup for fault tolerance

» All RTIs provide standard APIs for C++ and Java
  » Switch easily between different RTI implementations – just re-link
  » Previous HLA standards have some issues in this area

» Evolved Dynamic Link Compatible Application Programming Interface (EDLC API)
  » Based on the SISO DLC standard
Object-Oriented HLA
Object Oriented Programming Paradigm

Object classes
- Single updates
- Time stamped values
- Synch points
- Save/Restore
- Etc

Methods
- Multiple Inheritance

Attribute ownership

Shared HLA Aircraft object

HLA Distributed Architecture Services

Most of this OO functionality can be mimicked using tailored HLA federation agreements

Most of this HLA functionality can be mimicked using tailored OO classes, methods and exceptions

Good match

C++ or Java Aircraft object
A Pitch COTS product has been developed that generates C++ and Java code for any FOM.

Introduces a "Design Step"
Local and remote instances

Federate A

OO-HLA Middleware

SetAltitude

"Local" Airplane-1

GetAltitude

"Remote" Airplane-2

Discover Reflect

Register Update

Federate B

"Remote" Airplane-1

"Local" Airplane-2

RTI

AKA the Proxy Pattern (Gang of Four)
Pitch Booster

Enabling the Connected Enterprise
Pitch Booster Technology

» Create a persistent simulation network across...
  » an organisation located at different geographic sites
  » countries participating in an international training event

Conceptual view

Geographical view
MSG-068
NATO Education and Training Network (NETN)
MSG-068 Objectives

» Assess the distributed simulation and learning capabilities that NATO, Partner and Contact Nations, Schools, and Agencies have that could contribute to the development of a NETN capability

» Recommend and demonstrate a way forward for interoperability, technical standards and architectures to link these training and education centers to provide a persistent capability

» Identify and recommend roles and responsibilities of the NATO, Partner and Contact Nation organizations responsible for distributing and maintaining M&S capabilities
The MSG-068 RTO Task Group provides recommendations on M&S aspects to be exploited by the ACT Snow Leopard Program when establishing the NETN/Snow Leopard capability a.k.a. NATO Snow Leopard a.k.a. NATO Distributed Training and Exercises (DTE)
Participating Systems Overview

NATO
- JCATS
- VBS2
- JTLS
- JPECT
- MäK Stealth
- HLA IEEE 1516
- ALLIGATOR

France
- ORQUE
- WAGRAM

Sweden
- CATS TYR
- Pitch GE Adapter
- Pitch Commander

The Netherlands
- LVC Game
- FACSIM
- VBS2

UK
- LVC Game
- VBS2

Germany
- KORA
- PsiWeb
- HLA 1.3 Adapter

Spain
- VR Forces
- Marcus

Hungary
- HLA IEEE 1516-2010 (HLA Evolved)

Germany
- LVC Game
- VBS2

Spain
- KORA
- PsiWeb

Hungary
- HLA 1.3 Adapter

The Netherlands
- LVC Game
- FACSIM
- VBS2
Swedish National Training Network
» Connect available training simulators across Sweden.
» Train joint scenarios on a national level
   » Air, naval, ground troops together.
» Train coalition scenarios on an international level
   » Air, naval, ground troops together.
   » NATO PfP operations, Nordic Battle Group, etc.
» Persistent training network, always available.
   » Connects to the NATO NETN network.
Swedish National Training Network

- Air Combat Training School, Uppsala
- Air Combat Training School, Luleå
- Air Defense Training School, Halmstad
- Air Combat Training Center, Kista
- Command and Control Regiment, Enköping
- FMV SMARTLab, Stockholm
- FMV T&E, Stockholm
- FMV T&E, Karlsborg
- FMV T&E, Enköping
- Land Warfare Center, Skövde
- Naval Warfare Centre, Karlskrona
- Mobile Node
- External Network/Application VPN Node
  - Artillery Regiment, Boden
  - Armed Forces International Center, Kungsängen
  - Land Warfare Center, Kvarn
  - FMV T&E, Linköping
  - Air Combat Training School, Linköping
  - FMV T&E, Karlskrona
  - TKSE, Stockholm
  - Defense CD&E, Enköping
  - NATO NETN, Enköping

14+ Facilities and Ranges by fall 2010

Supporting the US – SE Persistent Partnership for Pease Simulation Network (P2SN) and the Multinational, Cross-Domain Exercises at I/ITSEC 2010 and “VIKING 2011”
VIKING 11 Exercise
The VIKING 11 exercise

» The VIKING 11 is a multi-national distributed Computer Assisted Exercise (CAX) in the Spirit of Partnership for Peace

» UN mandated Crises Response Operation scenario
  » Civilian, military and police all participate

» Executed in VIKING 99, 01, 03, 05, 08

MAIN PARTNERS 1999-2008:
» Distributed across Europe:
  » Austria
  » Georgia
  » Germany
  » Ireland
  » Ukraine
  » Kungsängen, Enköping, Halmstad and Karlskrona in Sweden

» Estimated to have more than 2000 participants during the exercise

» Runs between 04-15th of April 2011

» Several federations, all based on HLA Evolved

» Current status: Exercise preparation, test and integration
Conclusions

» HLA Evolved is used in many different large scale simulations.
» Object-oriented HLA gives you new methods to make your simulations interoperable.
» Persistent training networks enables organisations to train and simulate in completely new ways.
» HLA Evolved has been battle proven in a number of different high profile distributed simulations:
  » NATO Education & Training Network
  » Swedish National Training Network
  » VIKING 11 - the premier Multi-national and Comprehensive Approach exercise in the world
  » And more…
THE END

“Make your systems work together”