A Modular Distributed Architecture tailored for Flight Simulators

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TXT e-solutions

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Outline

- Introduction
- Software Architecture
  - Framework
  - Application Layer
- Simulation Software Tailoring
- Case Studies
TXT e-Solutions: Group Profile

- Geo Coverage
- Facts and Figures

57.6 M€ Revenues
600 Employees

Strong European Presence
(14 Offices in 6 EU Countries)
HQ in Milan, Italy

Steady YoY growth since inception (1984)

Global Business Network with US presence

Strong R&D Focus supported by an International Partner Network
Providing end-to-end support to all development phases for on-board and on-ground applications, all the way to the certification process support. Our services are rendered through deep knowledge of industry standards, related methodologies and processes.
The Challenge

- Our Customer was seeking to build a Simulation Software Facility, **modular, open** and **scalable**.
- Key requirement was to be able to accommodate **etherogeneous** training devices
  - Multiple Aircraft Models to be Simulated
  - Different Target Architectures
    - From Desktop to Full Flight Simulators
  - Etherogeneous trainee classes
    - Aircraft Pilots
    - Maintenance People
Our Solution

A Modular Distributed Architecture
tailored for Flight Simulations

- HLA Based Framework
- Federation of Aircraft Simulation Models
- FOM as Federate ICD
- Ad-Hoc Light-weighted RTI
- Configuration Tools for tailoring
  - Deploy on different targets
  - Deploy for different Simulations types
The Result

A Modular Distributed Architecture
tailored for Flight Simulations

- Two A109 LUH CPT deployed to military customer training facilities (South Africa, Sweden)
- An FTD with motion system under delivery for New Zealand army.
- An AW109SP FFS under development for REGA
- A series of customizable (AW109/AW139) Virtual Integrated Procedural Trainers delivered and under construction
- A series of customizable (AW109/AW139) Desktop Simulators under construction
SW Architecture – The Framework 1/2

- HLA Based Framework
  - Federates/Ambassadors/FOM templates
  - Core Component as Simulation Server
  - Simulation State Machine Management
  - IPC UDP/Mailbox Based (Synchronous at 10msec, Asynchronous with acknowledge management)
  - Simulation Scheduling/Timing
- High Performances (10ms Integration Time)
- High Data Throughput on Ethernet (5Mbps)
- Hardware In the Loop
SW Architecture – The Framework 2/2

- Etherogeneous technologies for Federates
  - Matlab/Simulink → C, C++, C#
- Etherogeneous HW target platforms
  - Linux/Windows7/WindowsXP/iOS
- Cross-Platform Application Framework
- C++ Class Library as Federate Template
- C/C#/Others Wrappers/Gateways
SW Architecture – Application Layer 1/3

- **Host**: set of core models for the simulation (e.g. Flight dynamic model, engines, plants, etc.)
- **Avionics**: set of components used to simulate real H/C avionic (e.g. Displays, FMS, etc)
- **I/O Gateways**: components used to interact with hardware or software provided by vendors via specific protocols or libraries (e.g. gateways to Image Generator, Instructor Operating Stations, etc.)
- **Tools**: plug-ins that add functionalities to the simulation software (e.g. Debrief Station, Automatic Certifications, etc.)
The Simulation Software is composed by HLA federates representing the different aircraft system/sub-systems (e.g. different federates for the flight dynamic, engine, electric, fuel, etc.)

Each Federate inherits a base class of the Framework specializing methods related to the different simulation states (e.g. run, setup, etc.) according to the specific behavior

A SOM set on messages to be exchanged with the other parts composing the simulator in order to be easily integrated/substituted to/by COTS vendor components

Each federate is associated to a set of metadata describing its nature (type, platform, aircraft model, dependencies)
A Set of Tools support the Simulation Software through its lifecycle

- **Design Phase**
  - Edit FOM/SOM
  - Define Federate MetaData
- **Deploy Phase**
  - Select Federates to Compose/Scale a federation
- **Run-Time Phase**
  - Federation Monitoring & Control
- **Test/Acceptance Phase**
  - Federation Monitoring & Control
  - Automatic Certification
A Modular Distributed Architecture tailored for Flight Simulation
A computer based simulator with a high fidelity graphical reproduction of the helicopter/aircraft cockpit to deliver cost-effective procedural and familiarization training. This system enables pilots to learn by practicing introduction to service, conversion and recurrent training tasks.
Computer based simulator with a full-scale reproduction of the helicopter/aircraft cockpit with visual, motion and vibration systems to deliver certified flight training.

<table>
<thead>
<tr>
<th>Training Capabilities</th>
<th>Key Technical Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic flight training (IFR, VFR,...)</td>
<td>Multi-channel video projection</td>
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<tr>
<td>Conversion to type training</td>
<td>Multi-Visual Databases</td>
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<tr>
<td>Continuous training</td>
<td>NVG compatibility</td>
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<tr>
<td>Refresher training</td>
<td>Warning Tone and Aural Cue Reproduction</td>
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<tr>
<td>Crew coordination training</td>
<td>Control Loading</td>
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<tr>
<td>Mission training</td>
<td>Malfunctions Simulation</td>
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<tr>
<td>Operational training (CARGO, HOIST, FLIR)</td>
<td>Record &amp; Replay</td>
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<tr>
<td>NVG training</td>
<td>Motion System</td>
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<tr>
<td>Normal &amp; Emergency Procedures</td>
<td>Vibration System</td>
</tr>
<tr>
<td>IFR operations</td>
<td>Environmental and Intercom Sound</td>
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