OPAL-RT TECHNOLOGIES

RTI7 INNOVATE BEYOND

Aerospace and Defense Keynote

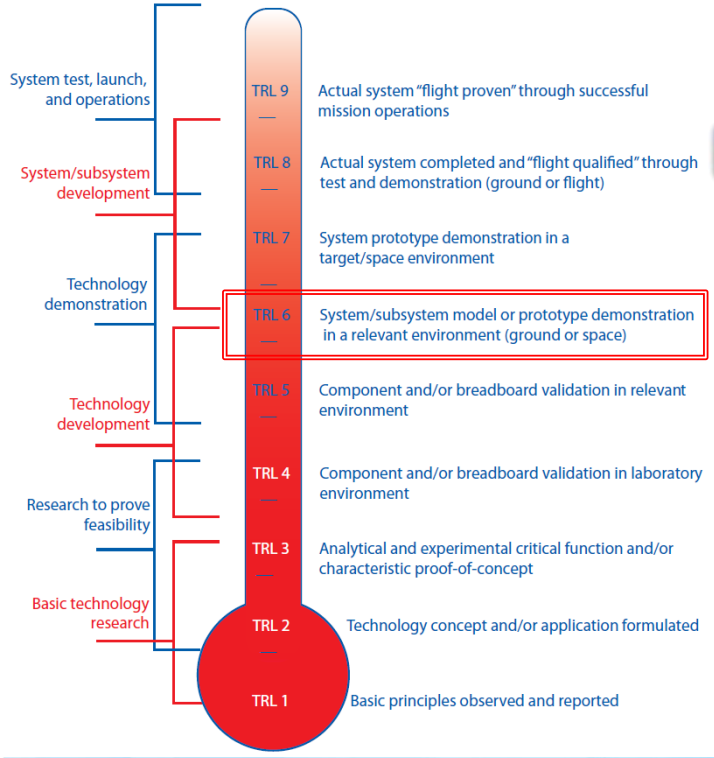
Alexandre Leboeuf

September 7th, 2017

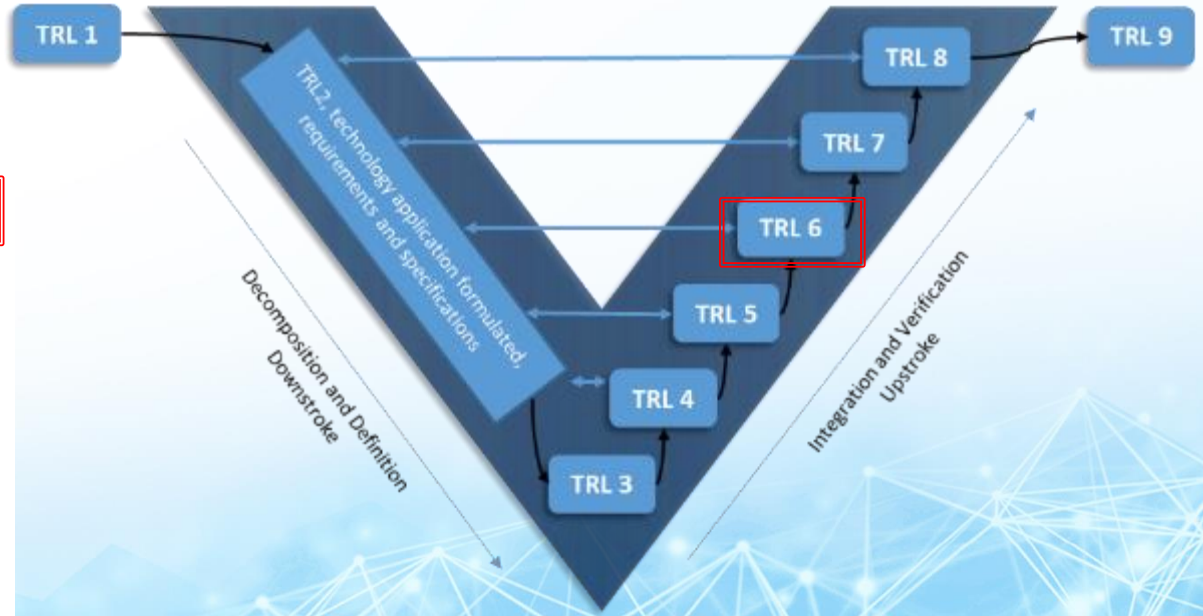
CONTENT

- Quick return on testing in aero and defense
- Automation’s new take
- CS Canada’s view on the Software and Systems trends
- Bombardier’s More Electric System Integrated Simulator (MESIS)

AEROSPACE TECHNOLOGY MATURITY LEVELS

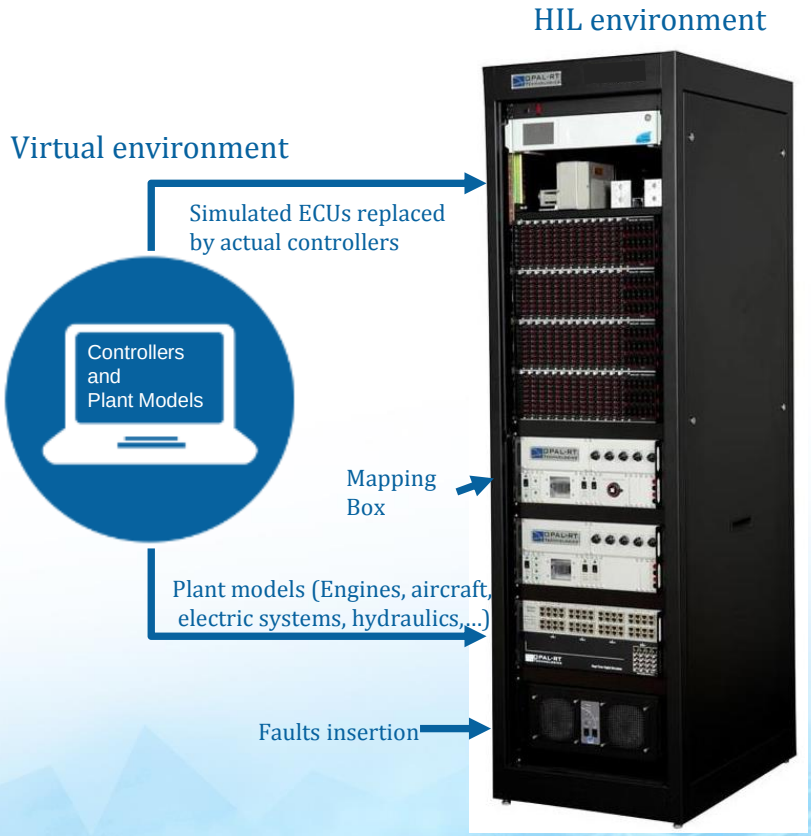


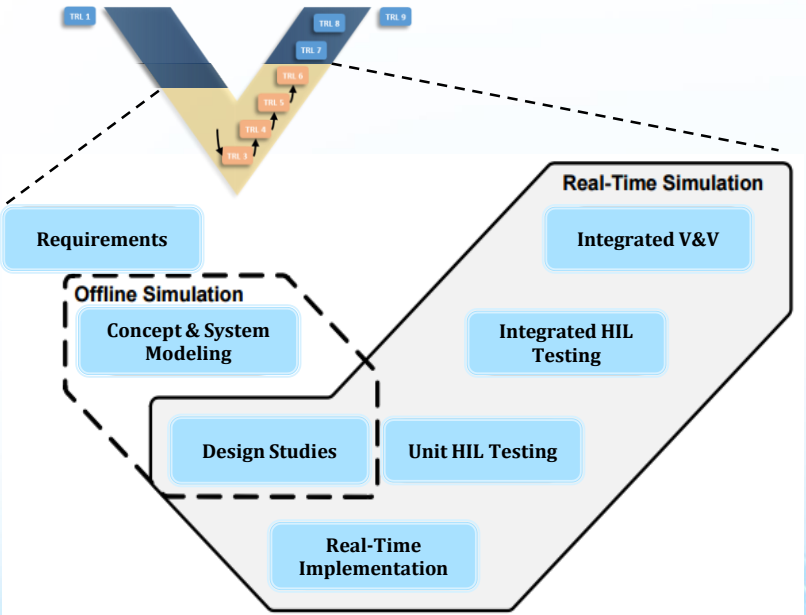
Source: "NASA Systems Engineering Handbook", Appendix G, SP-2007-6105, Rev1.



Source: H. Jimenez and D. N. Mavris, "Assessment of Technology Integration using Technology Readiness, Levels", American Institute of Aeronautics and Astronautics, Texas, 2013.

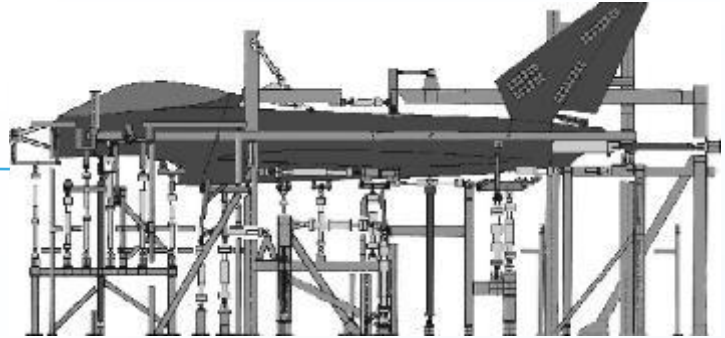
HIL TEST RIGS DEMONSTRATORS

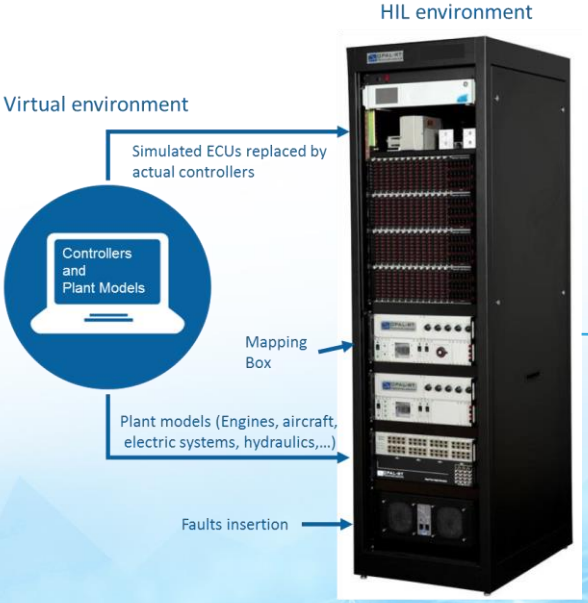




HIL SIMULATORS VS TRADITIONAL AEROSPACE TEST RIGS

- **COMPLEX HARDWARE SETUP**
- **HIGH MAINTENANCE**
- **LACK OF FLEXIBILITY**
- **HIGH COST**

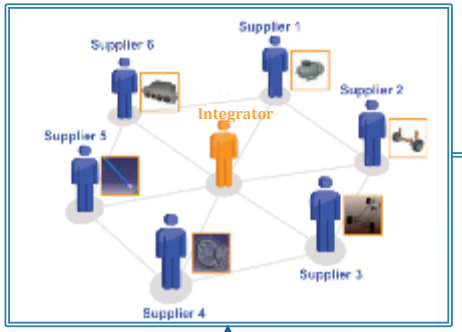




Source: www.opal-rt.com

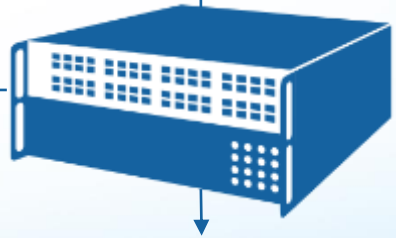
- **LESS HARDWARE AND EQUIPMENT**
- **FLEXIBLE**
- **AUTOMATED TESTING**
- **LOW MAINTENANCE**

AEROSPACE SIMULATION AND TESTING TRENDS



Security
- IP Protection
- Cyber-Security
- Signals encoding

Co-Simulation
- Multi-Rate Management
- Interface Management
- Decoupling Techniques



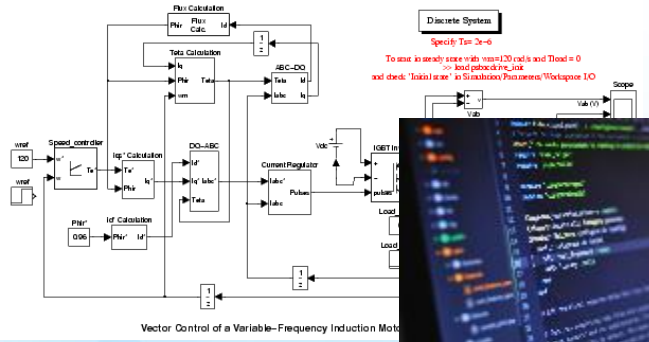
Data Management
- Fast logging
- Transmission and Storage
- Accessibility

Automated Testing
- Automated scripting
- Repeatability
- V&V

AUTOMATION – A MAJOR COST SAVER

Automated Model Creator

- Scripts that decode the EICDs and SICDs to generate and update models.



Automated Tests

- Scripts that decode written test description documents
- Generates the automation code for the tests
- Data storage for post test analysis.

OPAL-RT TECHNOLOGIES

RTI7 INNOVATE BEYOND

SUMMARY

- Trend buzz words to come in aero and defense:
  - Automation on multiple aspects
  - Systems of systems
  - Co-simulation
  - Data logger
  - IoT

CS Communication & Systems North America

Laurent Pieraut
CS Communications et Systèmes

September 2017

Agenda

- CS Introduction (Group, North America)
- Trends in aeronautics software and systems

CS Group – Development Strategy

The power of innovation

4 STRATEGIC SECTORS & 4 MULTISECTORAL TECHNOLOGICAL OFFERINGS

DEFENSE & SECURITY

Control Command & Communication IS

Tactical data links

SPACE

Control Ground segment

Users Ground segmer

AERONAUTICS

Avionics

Aeronautics Lifecycle Management &

ENERGY

Nuclear & Hydro Safety

OTHERS

➔ Passengers Information System

CYBERSECURITY

SAFETY CRITICAL SYSTEMS: EMBEDDED & INDUSTRIAL

DIGITAL CONTINUITY : SIMULATION & PLM

CRISIS MANAGEMENT & AREA SURVEILLANCE

OPAL-RT TECHNOLOGIES

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CS North America

- Customers
  - Design systems and subsystems that include embedded software used in critical conditions such as engine control avionics, and many other systems.
- Their challenges
  - Advanced skills linked to industry standards and the most cutting-edge methodologies
  - Variable development throughput linked to the product development cycles
  - Producing these activities within ever shrinking budgets
- What we provide
  - Advanced skills in embedded software development and verification in the fields of DO-178B/C, DO-326A, FACE, Formal Methods, ARP4754A/4761
  - A variable and significant engineering capability – 150 in Canada, 30 in the USA, + 200 offshore
  - Advanced test tools to speed-up and lower ongoing costs of the activity
  - After-market systems
- Why CS Canada
  - Involved successfully for more than 15 years with the most demanding and the highest level of critical systems in the aerospace industry DO-178B/C DAL A certification while serving several of the largest OEMs in North America.

Trends in Aeronautics Software and Systems

- Technologies
  - System software on the rise
    - Systems of systems (integration of multiple sensors)
    - Complex systems (multicore, AI)
  - Communications
    - Craft-to-Craft and Craft-to-X Communication
      - Traffic Collision Avoidance System (TCAS)
      - Multiple Airborne Systems, Multiple Links, Multiple Purposes (Airport/In-flight)
      - Automatic Dependent Surveillance-Broadcast (ADS-B)
    - Drones
      - Swarming
  - Data Handling
    - Big Data
    - Artificial Intelligence
  - Cybersecurity
    - More systems/links lead to more communications, lead to more risks.
    - IoT

Trends in Aeronautics Software and Systems

- Processes and Methods
  - Higher focus on system aspects
    - Software is never the root cause for major incident: DO-178B/C is not enough
    - ARP4754A – Aircraft System Certification
    - ARP4761 – Safety Assessment
  - Cybersecurity
    - DO-326A – Airborne Systems Security Solutions
  - Automatization
  - Standardization
    - IMA/ARINC818
    - FACE

THANK YOU

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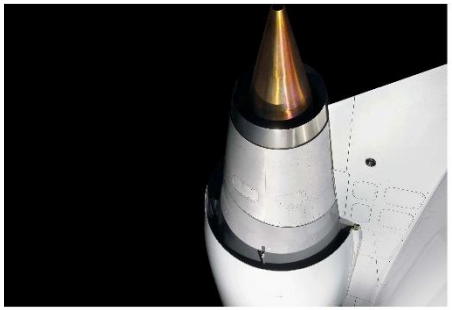
RT17 INNOVATE BEYOND

Ingenuity
in Flight.



More Electric System Integrated Simulator

September 2017

Marek Hicar
Advanced Systems

OPAL-RT's 9th International Conference

BOMBARDIER

Perspective view

1. ADVANCED ELECTRIC SYSTEMS SUB-MODELS TRL6 DEVELOPMENT
2. ELECTRIC POWER DISTRIBUTION MODEL (AC / DC)
3. INTEGRATION OF SYSTEM OEM'S MODELS
4. POWER QUALITY ANALYSIS
5. VALIDATION AND VERIFICATION OF SYSTEM REQUIREMENTS
6. **MULTI ELECTRICAL SYSTEM INTEGRATION RIG**

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Advanced Systems HORIZON mission

- improve Aircraft Operational Cost Efficiency by converting the conventional mechanical driving energy, of designated aircraft systems, into electrical driving energy
- achieve Technology Readiness Level 6 for Systems Components / Sub-Systems / Integrated Systems required for Aircraft installation and Ground / Flight testing

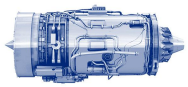
Multi **E**lectric **S**ystem **I**ntegration **S**imulator

Simulation TRL Progression

OPAL-RT Real-Time Simulation

BOMBARDIER **Power Distribution Architectural System Model**

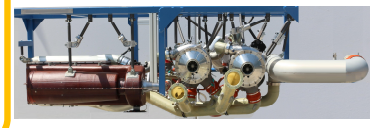
Engine System Models



eAPU System Models

VFSG System Models

eECS System Models



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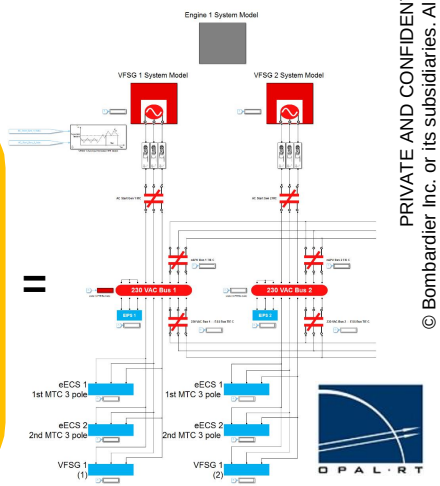

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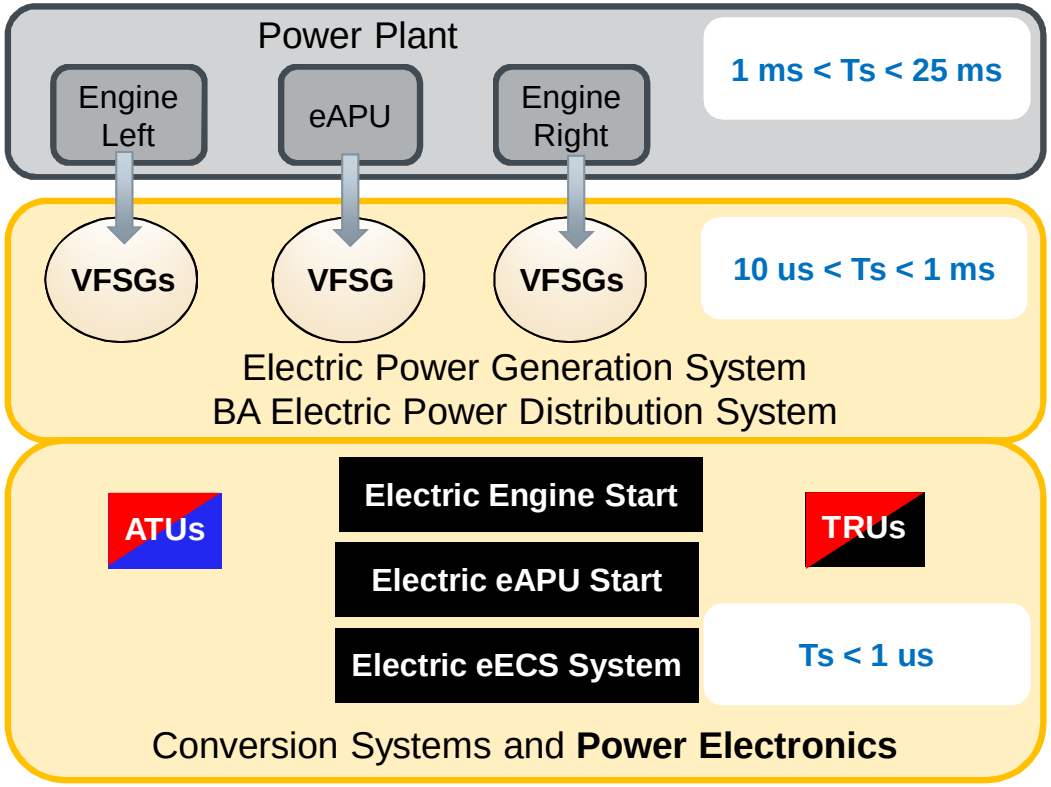
Power quality ... means ns sample time



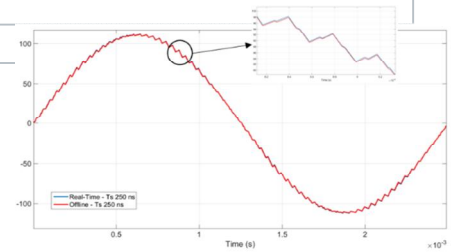
Real-Time MESIS Testing evolution

Phase 1.1
- generators kVA sizing analysis with a/c loads
- power quality transient, steady-state analysis (harmonic distortion as a function of flight conditions)
- system power electronics integration & performance

Phase 1.2
- normal and failure modes, monitor tolerance
- systems reconfiguration and Load shedding
- loss of the component and LRU functionality
- emulation of the loss of signals, erroneous data

Phase 2 (H-I-L)
- integrate controllers LRU replacing VLRU
- model validation activities to meet full hardware performance

FPGA 250 ns



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