4th UCAAT User Conference on Advanced Automated Testing

ETSI World Class Standards

MODELLING OF COMPLEX DISTRIBUTED TEST SCENARIOS

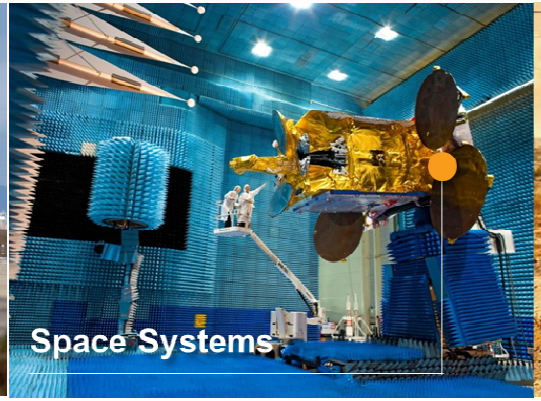
Presented by Dr. Karl Ambrus & Andreas Weitl

AIRBUS DEFENCE & SPACE

CONTENT

- Introduction
- Objectives
- Virtual Integration Platform
- Use Cases & Test Scenarios
- Model Based Test Generation
- Conclusion & Outlook

AIRBUS DEFENCE & SPACE



Europe's number No.1 defence and space company

Employees
33,500+

2015 Revenues
€13.0 bn

2015 Order Book
€42.9 bn

2015 Major Orders
14 A330 MRTTs, 5 telecommunications satellites, WorldDEM

2015 Highlights
- Delivery of 11 A400Ms to 5 customers
- C295 best selling aircraft in its category
- Agreement with OneWeb for constellation of 900 small telecommunications satellites

Introduction: Integration of Aircraft Systems

Integration of A/C Systems

- Aircraft are long living products (40 years)
- A lot of upgrade programs, enhancements & national adaptions during their lifetime
- Growth of functionality & complexity of the aircraft subsystems
- Increase and diversification of A/C variants during lifetimes
- New agile development methods

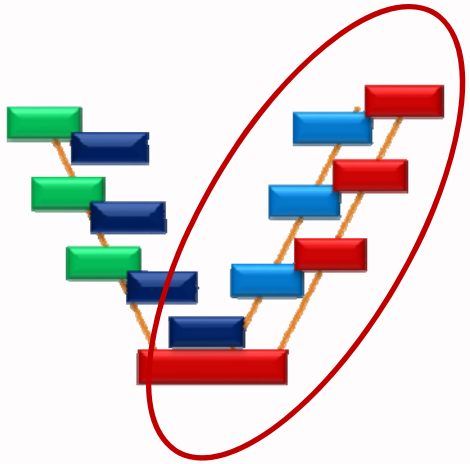
Integration Environment

- Complex, rare and expensive test facilities & aircraft components
- Compatibility of the integration environment for all integration levels & methods
- Reuse of test procedures during system lifetime (regression testing)
- Create synergies between different programs & testing methods
- Long Term Obsolescence handling for complex
    - Test environments
    - Test procedures

Introduction: Test Levels and Test Strategies

Levels of system integration testing:

- System specification & design model testing
- S/W and unit testing
- Component & subsystem testing
- System testing
- Virtual system integration
- System integration
- System qualification & certification

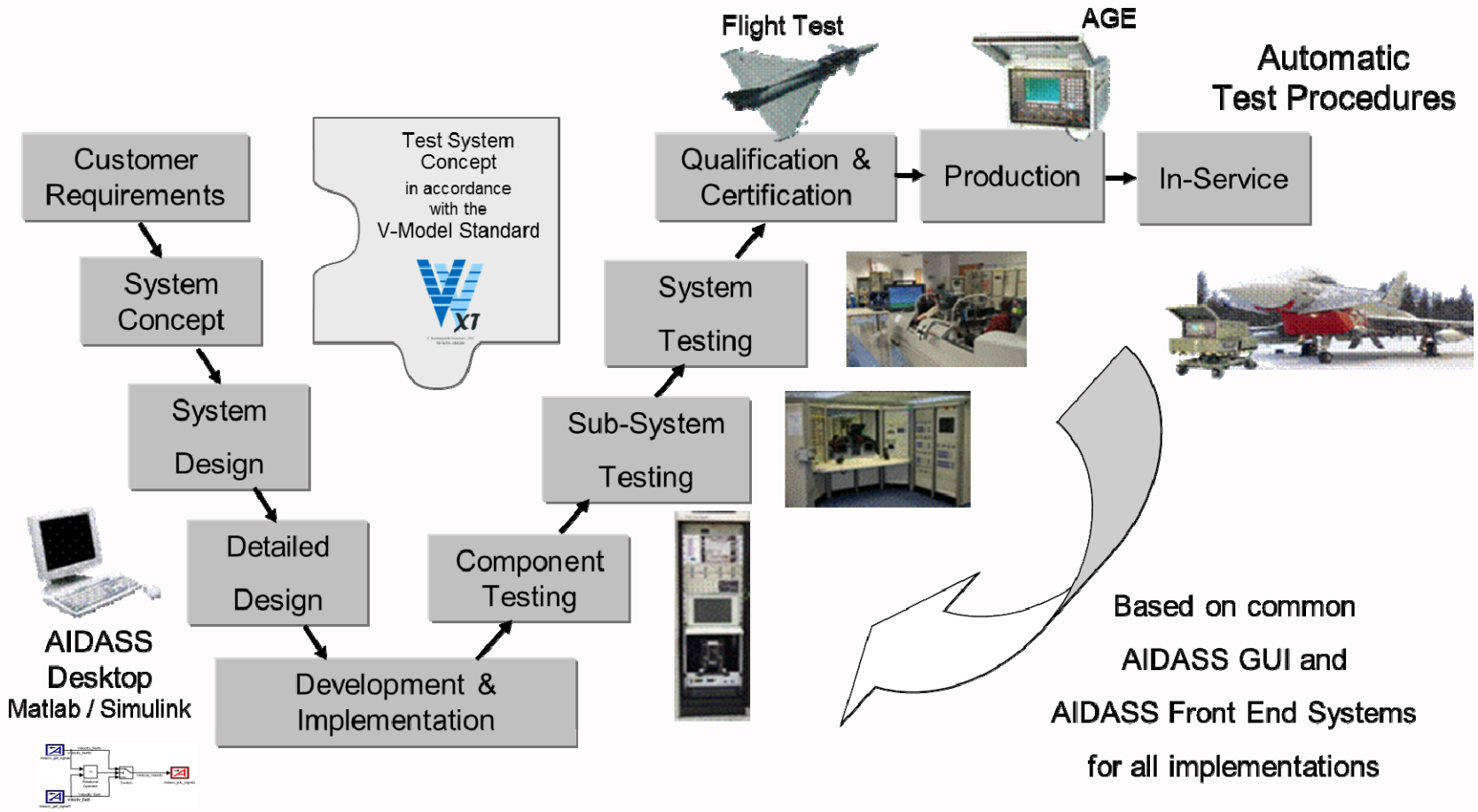


Test & Integration strategies:

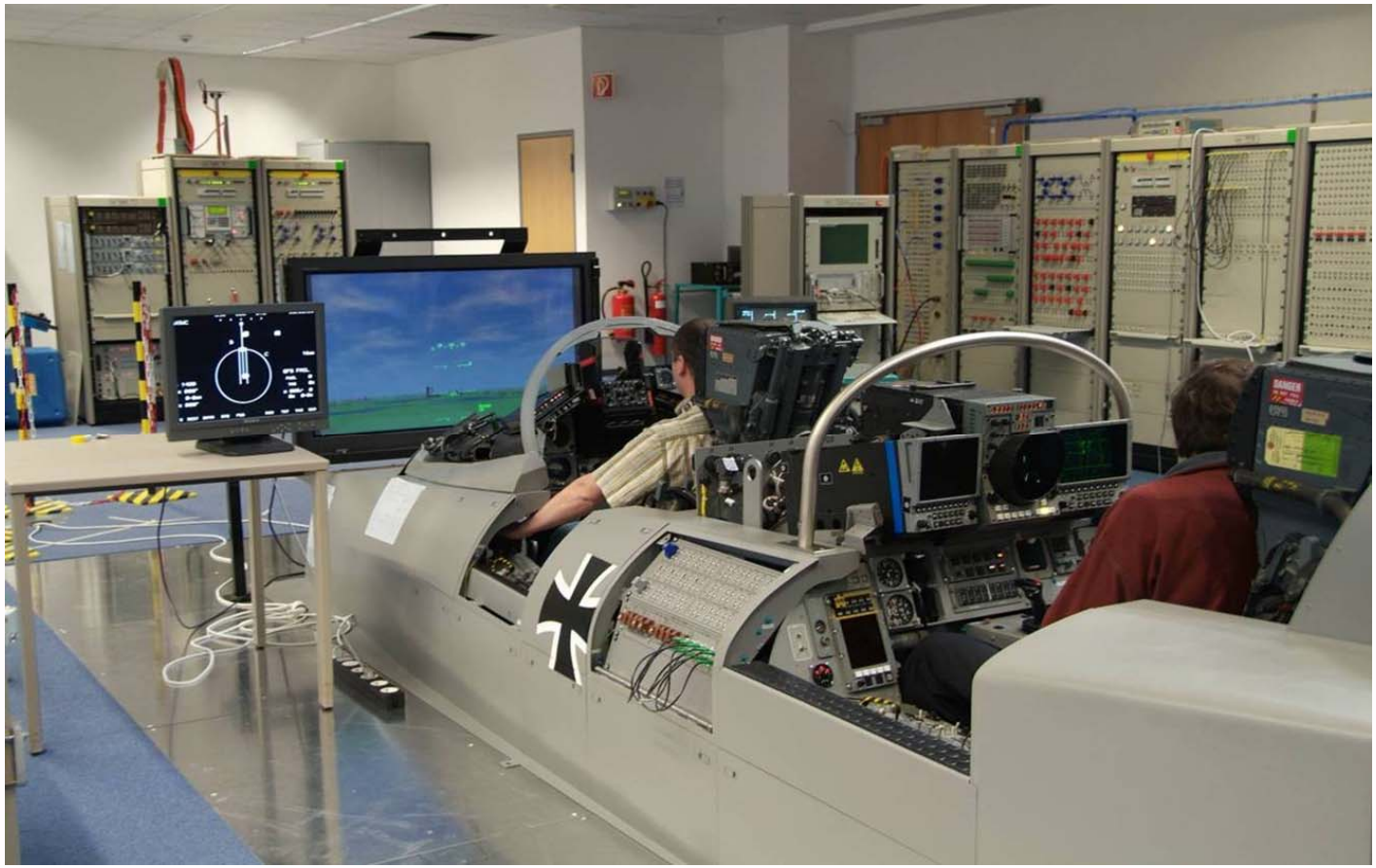
- Test & analysis of system models (design, specification, S/W)
- Development tests using special development tools (agile development)
- Functional tests to ensure system operation under all use case conditions
- Formal qualification tests for requirement verification
- Automated regression tests to ensure system functionality

Introducton: AIDASS® Test System Family

for all steps of the Product Life Cycle



Introduction: TORNADO System Integration Rig



Introduction: Eurofighter System Integration Facility

Objectives for System Test & Integration

Reduce overall project cost for

system development, system integration
and system operation

by improving product quality

It is not the primary goal to reduce the cost for system integration & test,
but to **increase test coverage and quality of testing**
to find more problems in early integration phases.

Objectives for System Test & Integration

- **Increase availability and reduce cost of test environments**
- **Offline (desktop) test preparation & test execution**
- **Agile automatic development testing**
- **Distributed System Integration**
  - **Remote operation** of Test Benches & Test Tools
  - **Distributed real-time testing** of real and virtual systems
  - Standards for **interoperability** & communication (Commands, Data, Time, Files, OSLC …)
- **Virtual System Integration**
  - Integrate **virtual equipment** on **virtual integration facilities**
  - **Portability of test procedures** between real and virtual test environment
  - **Service Based Testing** on distributed hybrid computing infrastructure
- **Model Based System Integration**
  - Test variant management
  - Modelling of **Test Scenarios**
  - Automatic **Test Case generation**
  - Tracing of requirements

STEVE "Virtual Integration Platform – Next Generation"

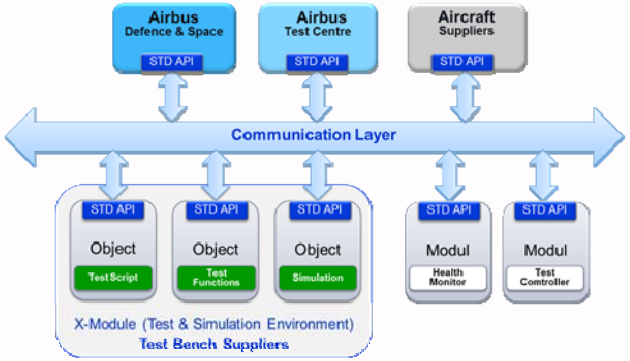
Modular Distributed Test Environment & Communication Layer

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

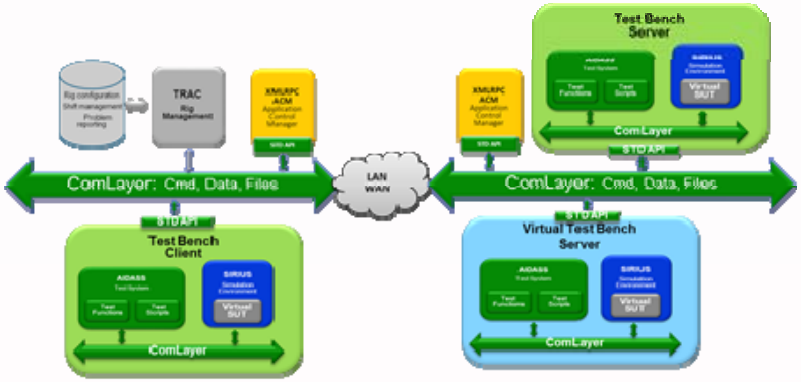
STEVE "System-Technik und Virtuelle Erprobung"
VIP-NG "Virtual Integration Platform – Next Generation"

- Virtual & Hybrid Integration Benches
- Distributed System Integration
- Portability of Test Procedures
- Enhance availability of Test Environments
- Replacement of obsolete Modules

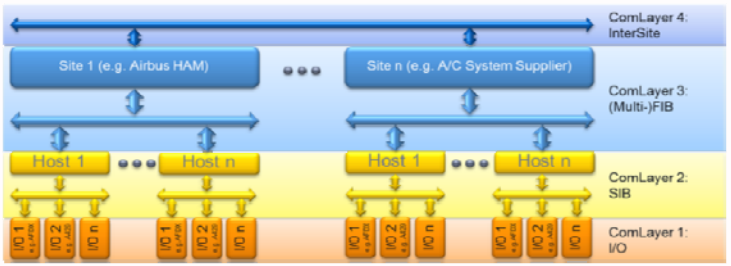
STEVE VIP-NG Modular Concept



Distributed Test Environment



STEVE VIP-NG Communication Layer Definition

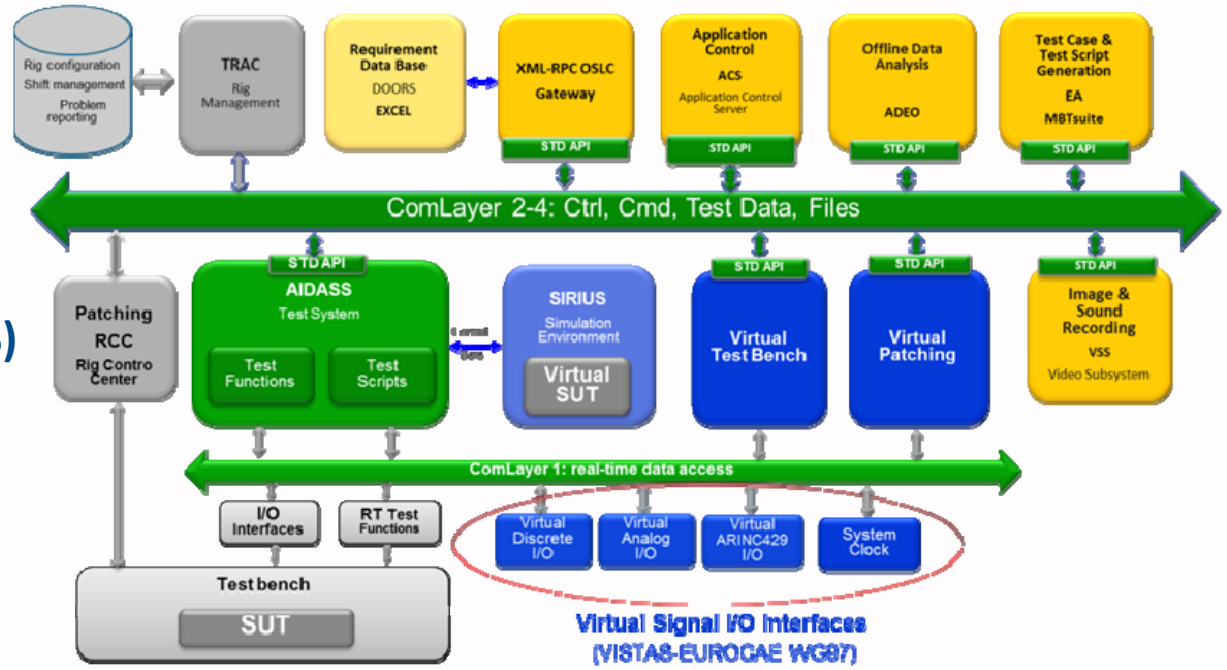


Airbus D&S - Virtual Integration Platform

Service based system Architecture

- **Modules & Objects (Services)**
  - Desktop, Virtual & Target
  - Test Environment (AIDASS)
  - Simulation Environment (SIRIUS)
  - Test Tools
- **Communication**
  - Local, LAN, WAN
- **Computing Host (H/W, OS)**
  - Desktop PC (Windows) & Servers
  - Test PC (Linux, Windows)
  - I/O Front Ends
  - Test Bench Modules
  - Desktop, Virtual, Target & hybrid configurations
- **System under Test**
  - Real & simulated equipment

AIDASS System Integration Environment & Test Tools

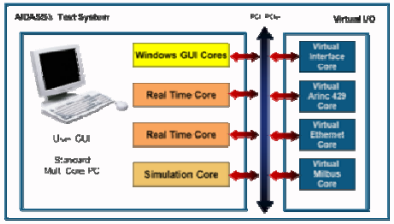


Airbus D&S - Virtual Integration Platform

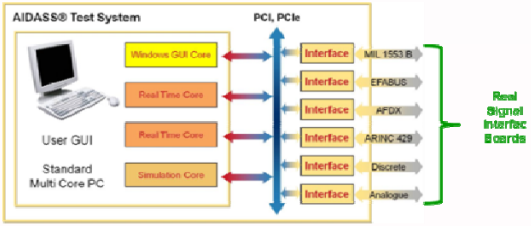
VIP Demonstrator: AIDASS Environments & Computing Clusters

Desktop Integration Environment shall run on any Windows - PC

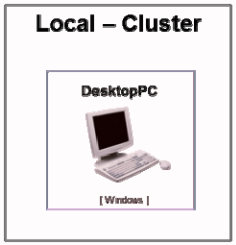
Virtual Integration Environment

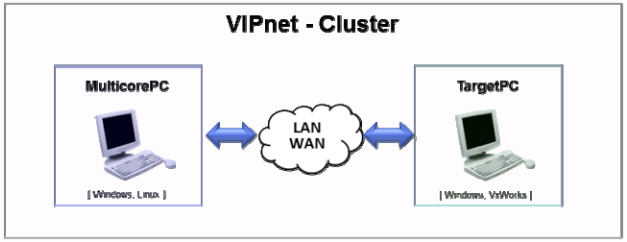


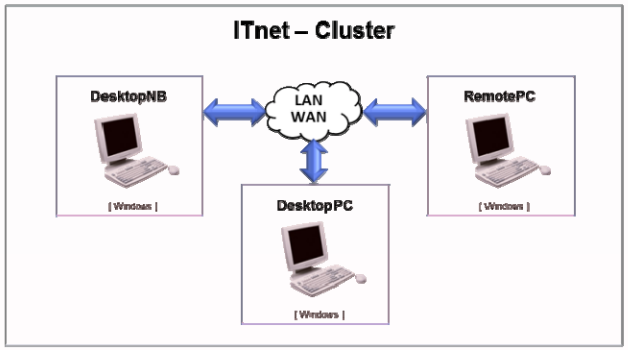
Target Integration Environment



VIP Network Clusters

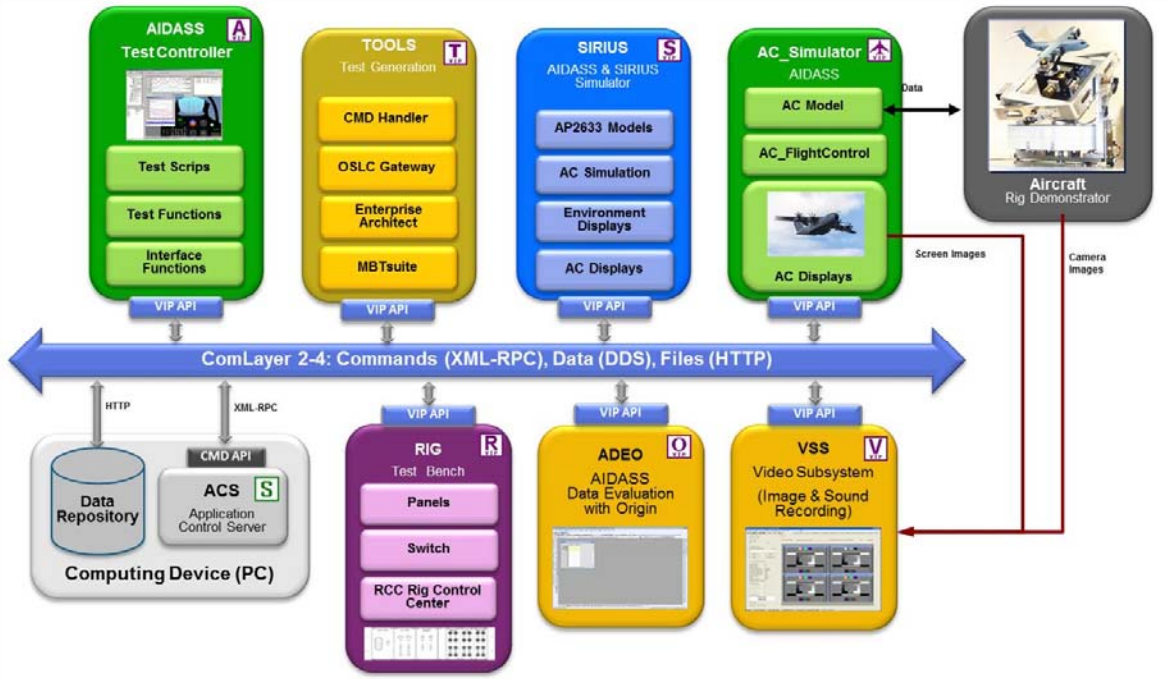






Airbus D&S - Virtual Integration Platform

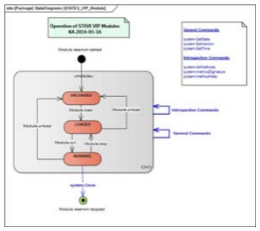
VIP Demonstrator: Modules & Objects



Distributed Test Services (Network Cluster, Modules, Objects, H/W)

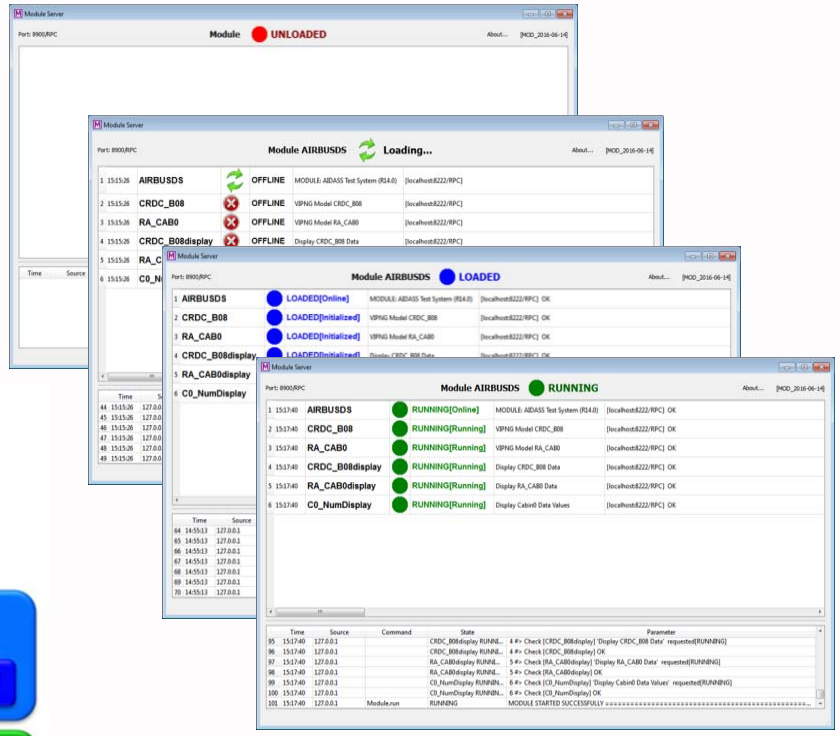
Airbus D&S - Virtual Integration Platform

VIP Demonstrator: AIDASS Module Controller

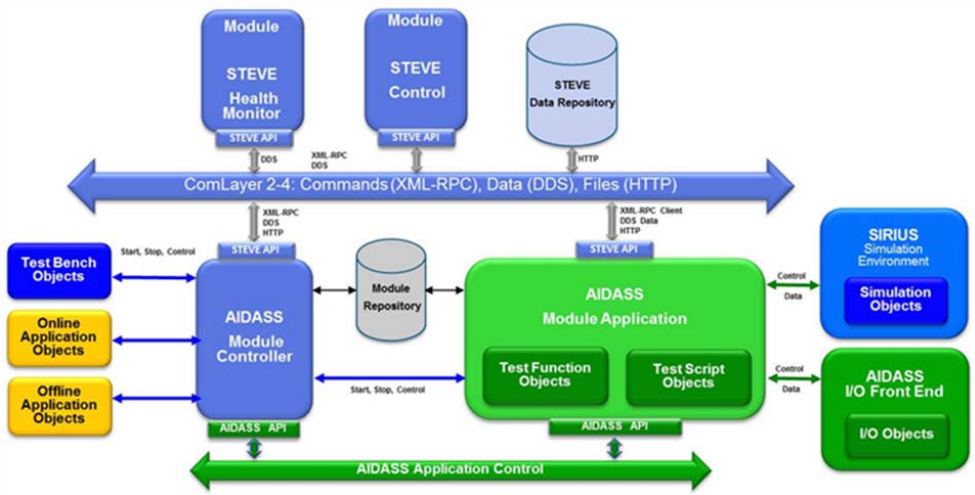


Unique commands & states for VIP Modules & Objects

Local Status Monitor



AIDASS Module Controller
Gateway for Commands & States

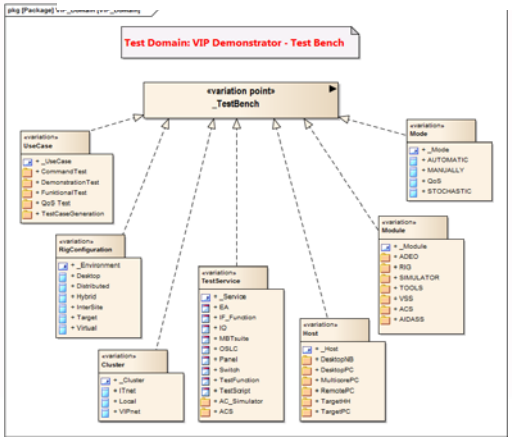


Use Cases & Test Scenarios

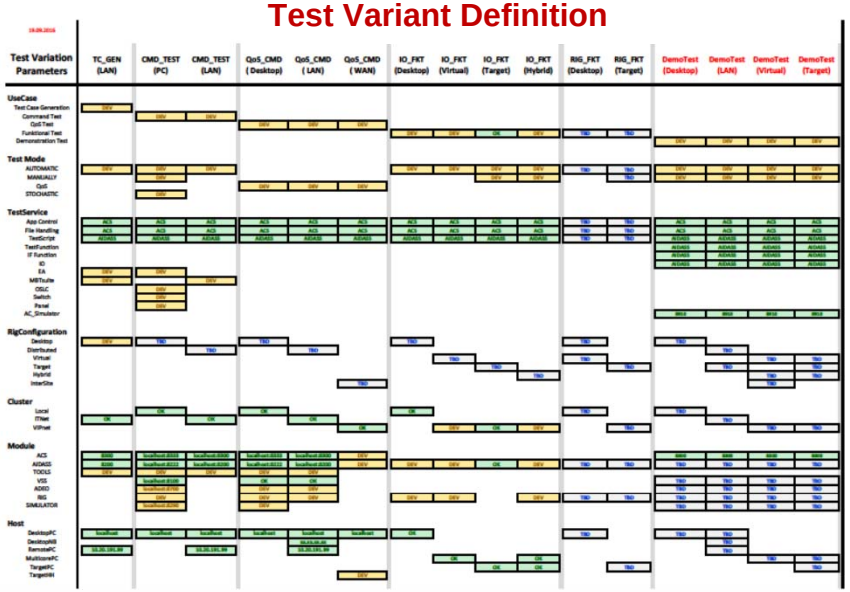
Show portability of Test Procedures

- **Automated Generation of Test Scenarios**
  - Automated model based generation Test Cases & Test Scripts
  - EA, MBTsuite, AIDASS Desktop
- **Functional I/O Test:**
  - Test I/O interfaces and Test Rig functions
  - AIDASS (Desktop, Virtual, Target & Hybrid)
  - Test Rig (Desktop & Target)
- **Command Test**
  - Test of XML-RPC Command interfaces
  - Local & remote operation
- **Quality of Service Test**
  - Commands (XML-RPC) & Data (DDS)
- **VIP Demonstration Test**
  - Show operation of VIP Test Environments
  - Virtual Flight Test (AC simulation & Displays)
  - Real & virtual data I/O
  - Distributed test environment (Computing Clusters)
  - Image recording (VSS) & automated offline analysis (ADEO)

Test Variation Parameters



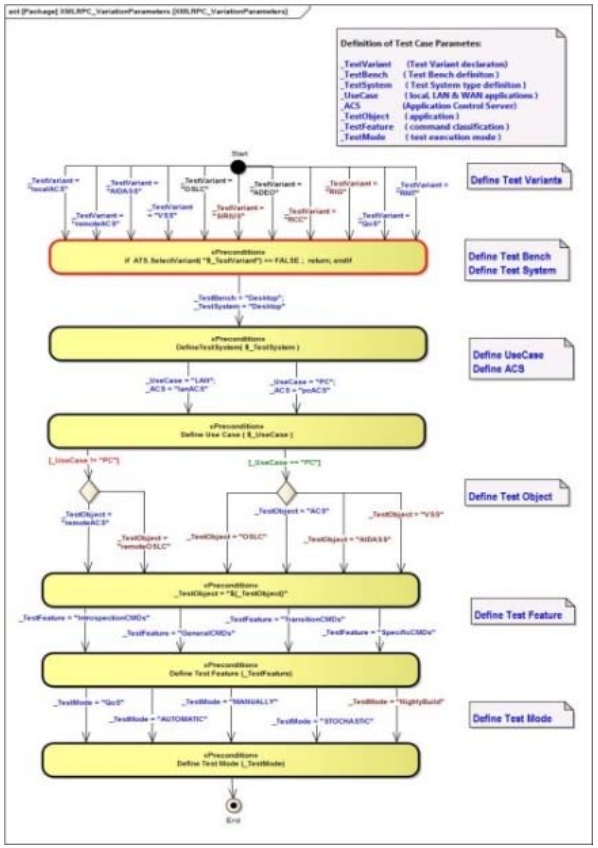
Test Variant Definition



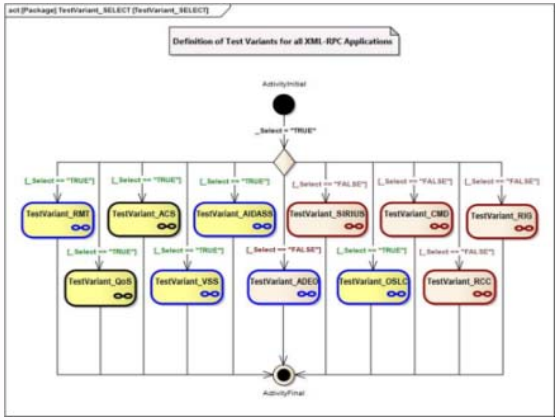
Model Based Test Generation

Design Test Scenarios (Test Model)

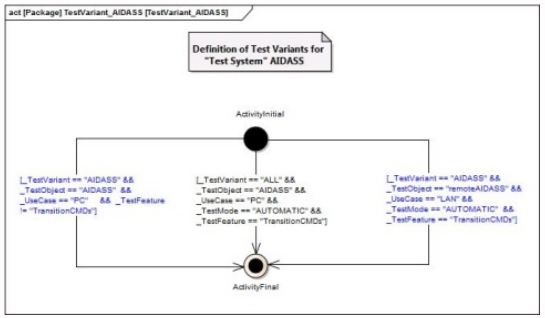
Define Test Variation Parameters



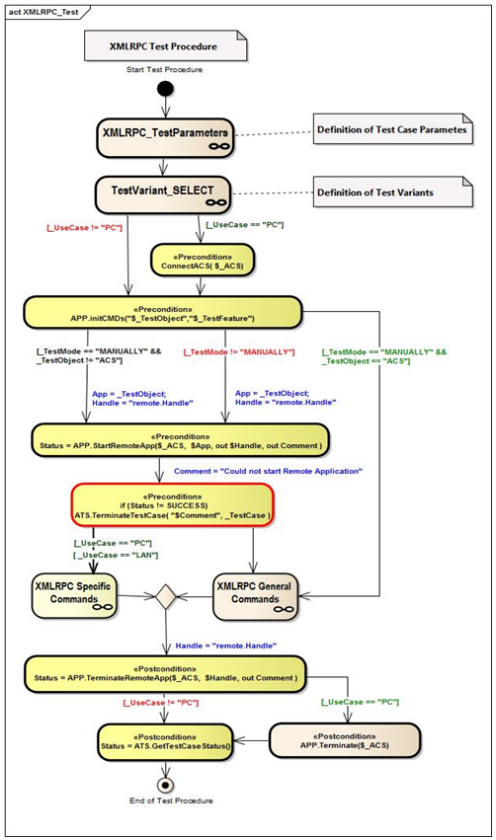
Define Test Variants



Define Test Variant Rules



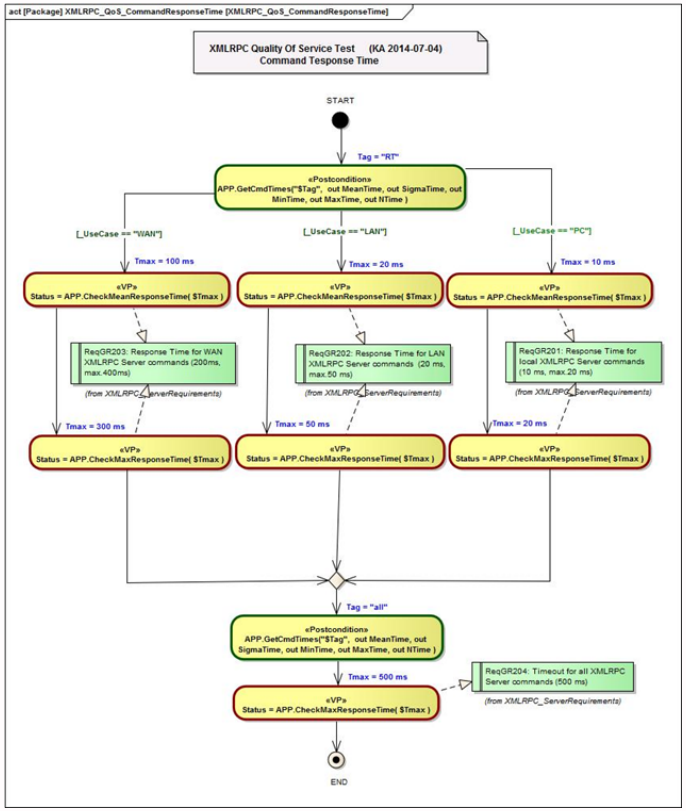
Modelling of Test Sceanrios



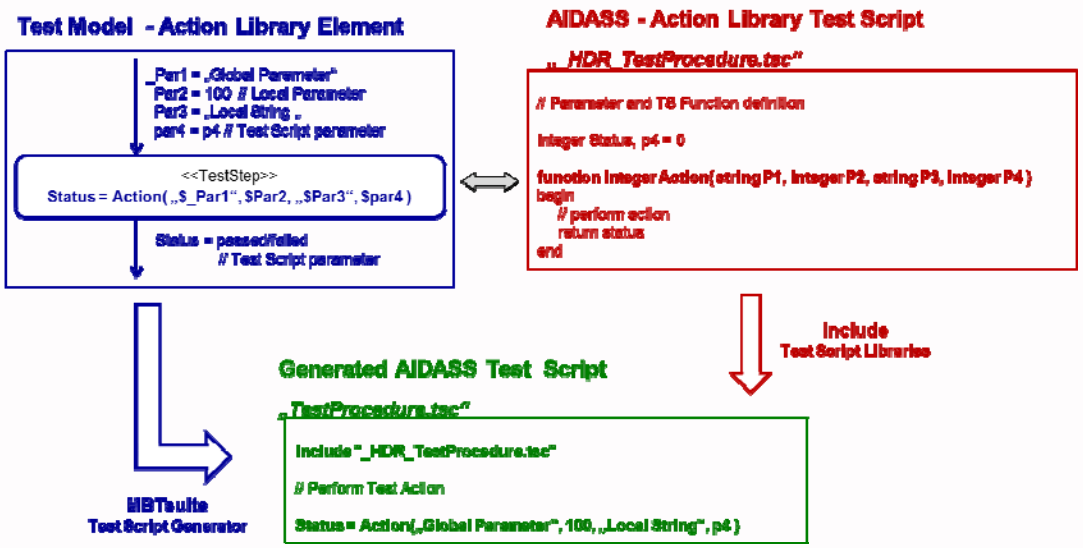
Model Based Test Generation

Design Test Scenarios (Test Actions)

Modelling of Test Actions

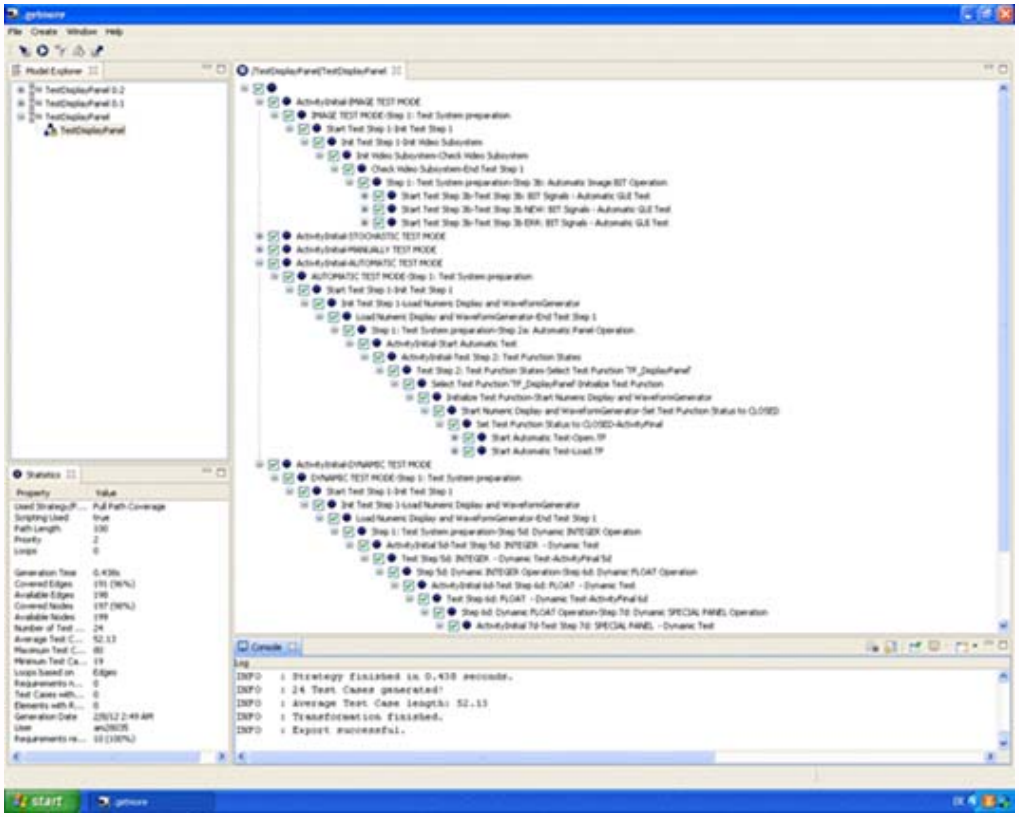


Action Libraries for Test Model Development



Model Based Test Generation

Test Case & Test Script Generation (MBTsuite)



```
// main function, calling all testcases

function main()
begin
        BeginTestLog()

        DisplayPanel_IMAGE()
        DisplayPanel_IMAGE_ERROR()
        DisplayPanel_IMAGE_ERROR_002()
        DisplayPanel_IMAGE_ERROR_003()
        DisplayPanel_STOCHASTIC()
        DisplayPanel_MANUALLY_ERROR()
        DisplayPanel_MANUALLY()
        DisplayPanel_AUTOMATIC()
        DisplayPanel_AUTOMATIC_002()
        DisplayPanel_AUTOMATIC_003()
        DisplayPanel_AUTOMATIC_004()
        DisplayPanel_AUTOMATIC_005()
        DisplayPanel_AUTOMATIC_006()
        DisplayPanel_AUTOMATIC_007()
        DisplayPanel_AUTOMATIC_008()
            ..........
        DisplayPanel_AUTOMATIC_035()
        DisplayPanel_AUTOMATIC_036()
        DisplayPanel_AUTOMATIC_037()
        DisplayPanel_AUTOMATIC_038()
        DisplayPanel_AUTOMATIC_039()
        DisplayPanel_AUTOMATIC_040()
        DisplayPanel_AUTOMATIC_041()
        DisplayPanel_AUTOMATIC_042()
        DisplayPanel_AUTOMATIC_043()

        RequirementCoverageTable()

        EndTestLog()
end
```

Conclusion & Outlook

- Integration of Modules, AIDASS Environments & Network Clusters
  - Desktop, Virtual, Target & Hybrid Environments
  - Configuration & Setup of Service based Network Clusters
  - Health monitoring
  - ICD handling
- Use Cases and Test Variation Model for Airbus D&S - VIP Demonstrator
- Generation of Test Cases and Demonstrator Test Procedures
  - Portability of Test Procedures on Desktop, Virtual and Target Environments
  - Distribution of Modules & Objects (Test Tasks) in different Network Clusters
- Communication Layer API & Protocols
  - XML-RPC (remote application control)
  - DDS (real-time data exchange)
  - Configuration & File handling protocols (http)
  - System Time synchronisation (NTP, PTP, virtual Clock, target Clock)
  - VISTAS – EUROCAE WG 97 Avionic Bus Interfaces for Simulation Environments
  - Benchmarks for distributed test applications