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# OSSIE-based GRA Testbed

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- *"Distribution A – Unlimited Public Release"*

# GRA-Compliant Software / Hardware Module Testbed

- This effort will produce an inexpensive, open source testbed for developing and testing GRA-compliant software or hardware modules. The GRA testbed promotes a modular, building block approach with the advantages of upgradeability with new technology over the life cycle and reusability of software or hardware designs across product lines.

- Goal is to leverage existing, open source components, the GRA reference design testbed consists of an OSSIE Core Framework augmented by a GRA infrastructure and waveform applications on a Linux platform as shown in Figure 1.

- The GRA infrastructure consists of replaceable CIL Modules (common Devices and Terminal Control Services) each with GRA specified interfaces and operations. In the GRA Testbed, any CIL Module can be replaced by an actual Device, Terminal Control Service, or Waveform Application to test for conformance with GRA specified APIs through a set of regression test cases.

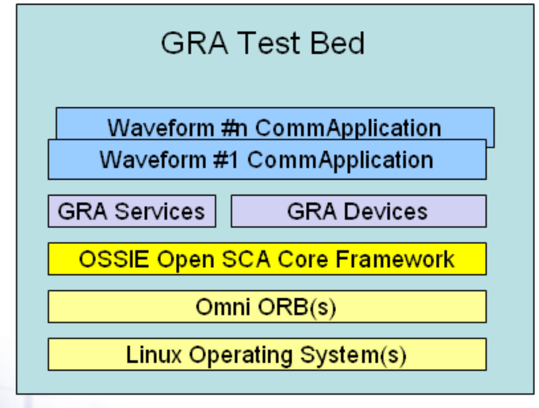



Figure 1

# GRA PROCESS



**The GRA consists of three levels using terms defined by OMG**

- Computation Independent Model (CIM)
  - Defines use cases distributed over black box modules
  - Focuses on the environment of the system and the requirements for the system
  - Does not show details of the structure of systems.
  - Is Government Open Source for GRA

- Platform Independent Model (PIM)
  - Defines the entire set of potential subsystem interfaces
  - Defines utility and infrastructure functions.
  - Software System Architecture that supports the requirements defined by the CIM.
  - Independent of specific technological platforms that can be used to implement it.
  - Limited to abstract interface definitions
  - Defines the structure of the CIL Modules
  - Is Government Open Source for GRA

- Platform Specific Model (PSM)
  - PSM is expected to take the PIM and realize it into an operational system.
  - Contains Proprietary Intellectual Property for GRA

# GRA TESTBED METHODOLGY

- The GRA Reference Design Services, Devices and Waveform Application modules are developed and generated in a Windows station using the Rhapsody tool (Graphical SysML/UML development and simulation environment).

- Over the past year, 5 industry partners refined the definition of the GRA standard interfaces and operations, developed a Platform Independent Model (PIM) for each CIL Module, developed 14 Validation Test Cases, and developed representative implementations of the PIM using executable state charts, activity diagrams (flow charts) or stub implementation code.

- The testbed is compiled natively for Windows for software-only versions or cross-compiled to the OSSIE Linux target for hardware in the loop versions. As shown in Figure 2, the cross-generated source code targeted for the Linux profile can be loaded into the GRA Testbed either manually or deployed from the Rhapsody platform into the LINUX based Testbed.

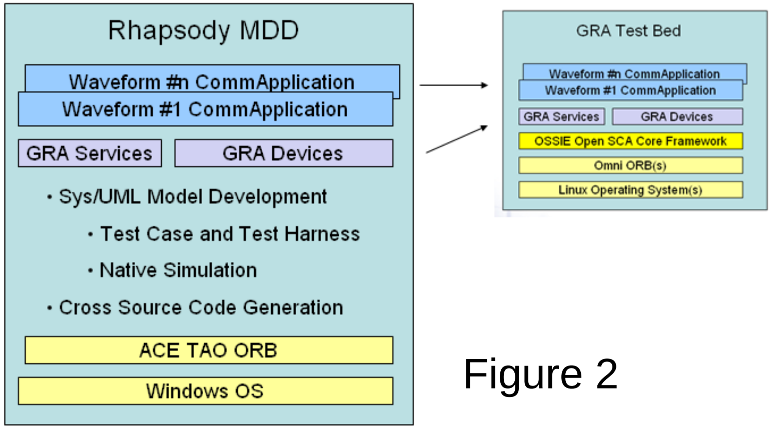



Figure 2

# GRA TESTBED METHODOLGY (cont.)

- Rhapsody Graphical SysML/UML simulation environment develops & Generates:
  - Reference Design Services
  - Devices
  - Waveform Applications
- GRA provides:
  - Definition of the GRA standard interfaces and operations,
  - Platform Independent Model (PIM) for each CIL Module,
  - 14 Validation Test Cases
  - Representative implementations of the PIM (via executable state charts)
  - Activity Diagrams (flow charts) or Stub Implementation Code.
- TESTBED METHODOLGY:
  - The Testbed is compiled natively for Windows (software-only version)
  - The Testbed is crosscompiled to the OSSIE Linux target (hardware in the loop version)
  - Cross-generated source code targeted for the Linux profile can be loaded into the GRA Testbed manually or
  - Cross-generated source code targeted for the Linux profile deployed from the Rhapsody platform into the LINUX based Testbed.
  - Testbed User uses Rhapsody to develop and test Replacement Devices, Services, and Waveform Applications.
  - Execution in the GRA Testbed can be monitored through the OSSIE ALF on the Linux Testbed
  - Components may be deployed to Single Board Computers (SBC)
    - Commercial Off-The-Shelf (COTS) programmable modem.
  - Devices may be deployed as daughterboards or separate modules:
    - INFOSEC
    - Terrestrial Wide-area Network (WLAN)
    - Satellite Wireless LAN (WLAN or Network Interface Module NIM)
  - Seperate modules have their own programmable processor and address spaces.
- Figure 3 Shows deployment of GRA Waveforms, Devices and Services to the GRA Testbed

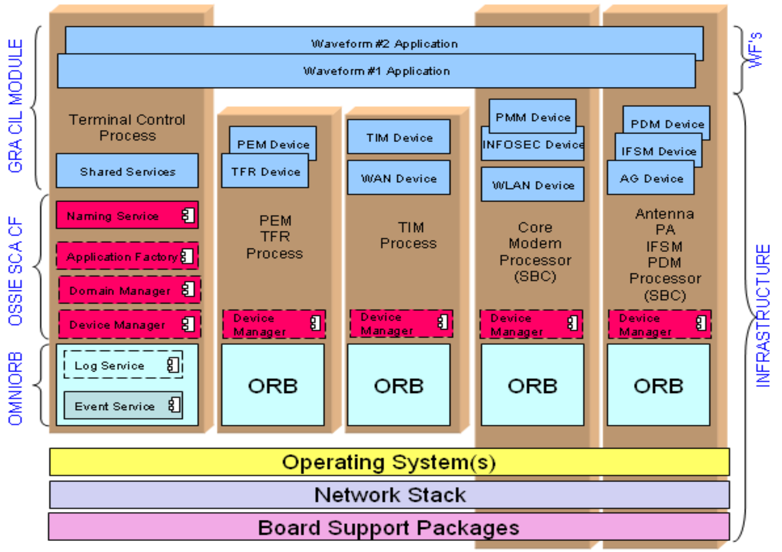



Figure 3

# USE OF OSSIE IN THE GRA DEMONSTRATION

- By coupling the GRAs architecture with a representative PSM for validation purposes, a testbed is created that can be used for unit integration test during development of GRA-compliant terminals.
- The purpose of bringing OSSIE (Figure 4) in to this testbed is the productivity improvement of having a functional, platform-specific implementation to test against while developing implementations for the various subsystems of the GRA.
- The reduced cost and increased visibility of open source software is the driving force in selecting the OSSIE tool to do the data plane implementation.

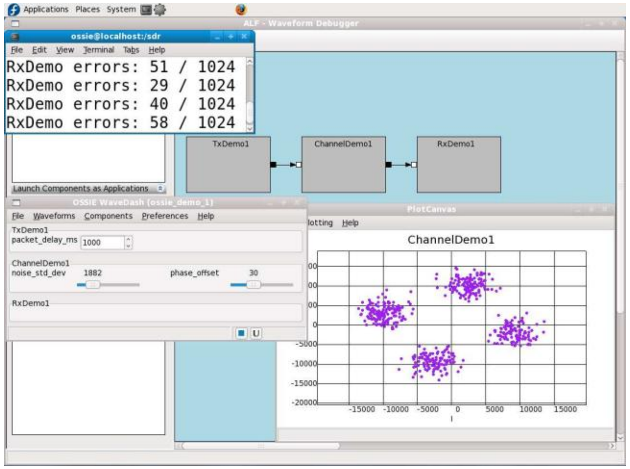


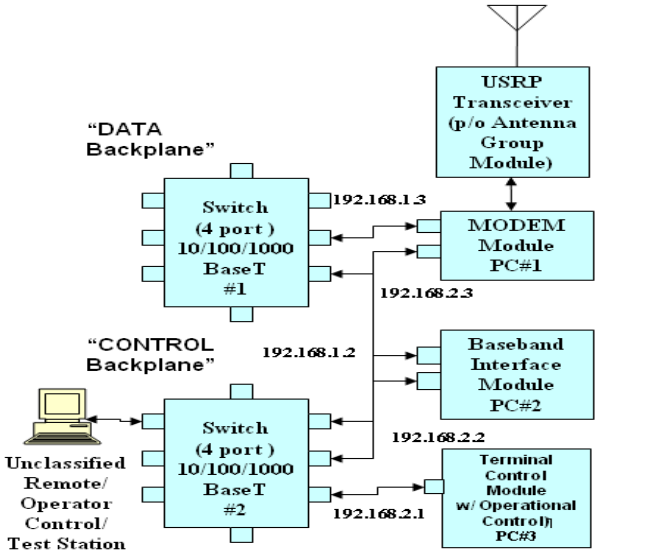

Figure 4 OSSIE

- Multiple nodes with the OSSIE Domain Manager on one node and one OSSIE Device Manager per node are supported. The GRA is used to start the Domain Manager and Device Managers and to install and run waveform applications. The testbed utilizes the GRA infrastructure for the control plane of the terminal.
- OSSIE-developed devices comprise the data plane and react to command, control, and configuration commands from the GRA applications and device drivers received via the SCA Core Framework operations realized by the OSSIE devices.
- Hardware in the loop is incorporated by tying in a USRP board with OSSIE-defined devices to the GRA-defined programmable modem implementation which is itself an SCA CF device but interfaces to the remainder of the modem via the SCA CF composite device interface.

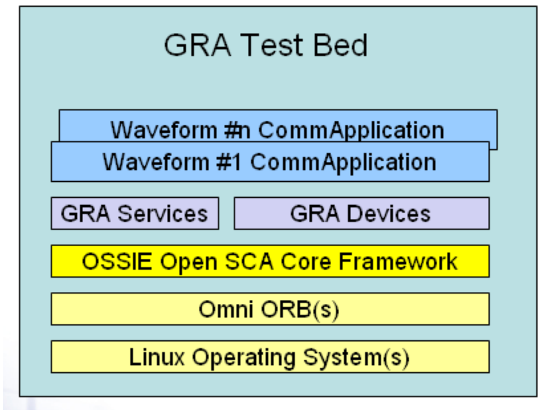
# GRA OSSIE Test Bed Deliverables

## HBHT GRA OSSIE Test Bed will deliver:

- Deliver a working model of the HBHT GRA architecture
  - Hardware/ software/ documentation
- Deliver SCA compliant OSSIE with USRP
- Deliver target operating environment
- Deliver Upgraded OSSIE
  - 5 modules connected on Layer 2 Switch
  - Separate control LAN and Data LAN Demonstrated
  - GRA Test Bed
    - Waveform Comm Application
    - GRA Services
    - GRA Devices
    - OSSIE Open SCA Core Framework
    - Omni ORB
    - Linux Operation System
- Deliver UML/SysML Stub code for selected GRA Modules




- *Hardware view*




- *Software view*

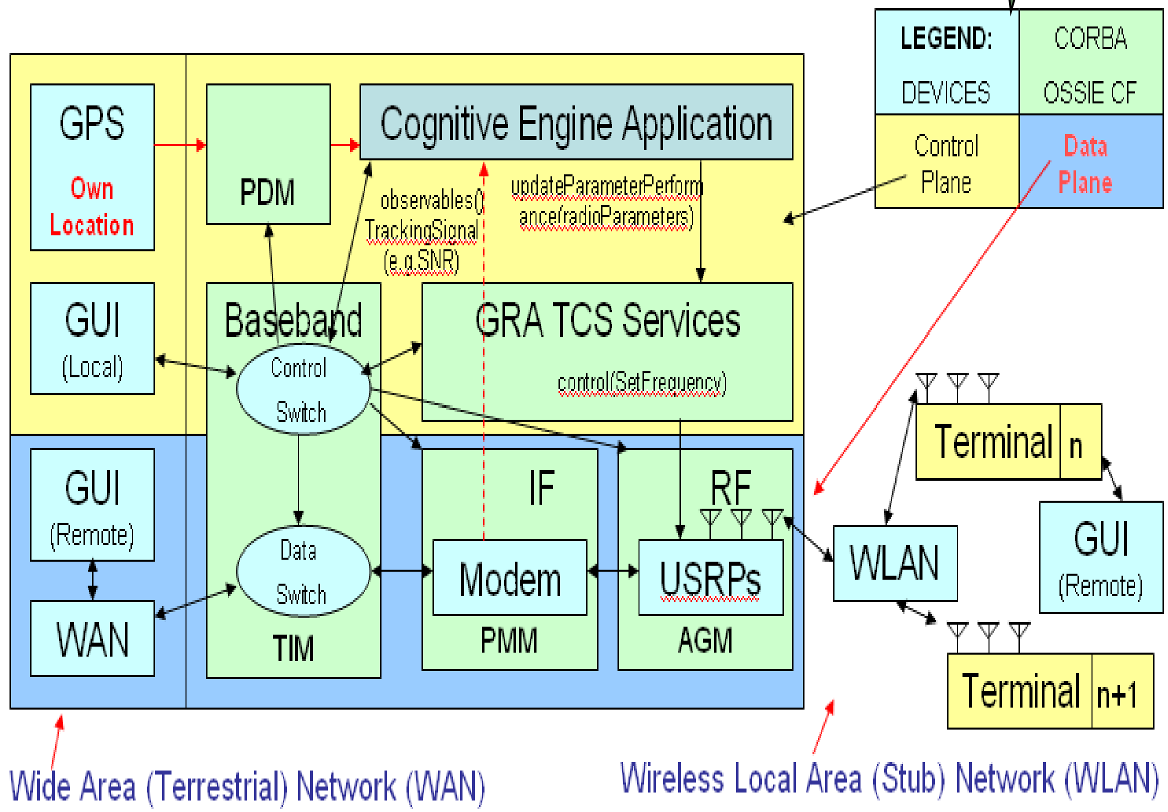
# Follow on effort (2010): Cognitive Radio GRA



Modular CR Architecture through leveraging of GRA

- Develop Cognitive Radio GRA CIM that define hardware, software, and system level requirements for current and future CR technology elements

- *Tasks:*
  - *Define necessary hardware/software interfaces*
  - *Establish a common data storage, transfer, and access mechanism*
  - *Identify computational processing boundaries to allow integration of future "smart" devices such as a Cognitive Antenna*
  - *Impact analysis/trade space study detailing the operation of a Cognitive Radio utilizing the JTRS SCA and HC3 GRA*
  - *Apply Open Source Methods to ensure source code reusability*




Cognitive Radio GRA Architecture