Protocol Validation System for On-Board Communications

Project Status

13th SpaceWire Working Group Meeting, 14th-15th September 2009
Noordwijk, Netherlands

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Presentation Contents

- PVS Project Rationale
- PVS Overall Objectives
- PVS Phase 1 Objectives (current contract)
- PVS Phase 1 Achievements
- Future Activities & expected results

PVS Project Rationale

- Current **evolution of satellite on-board communications**, require the development & experimentation with new dedicated communication protocols and services (SpW, SOIS, etc.)
- **New generation of validation tools is required** to support advanced protocol development, test, integration & validation

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- A **protocol validation tool** with more than 20 years of experience in the **telecommunication sector** & with hundreds of installations worldwide
- Has been widely used for testing various telecommunication networks (ISDN, V5, SS7, IN, GSM, UMTS, VoIP, custom)

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The basic motivation is to provide an open, generic and fully integrated protocol validation system (PVS) for satellite on-board communications supporting multiple physical interfaces (SpW, MIL-STD-1553) and functionalities (emulation, validation, interworking testing).

PVS Overall Objectives

- Provide an open, generic and integrated validation environment:
  - Support for multiple networks simultaneously (SpW, 1553, CAN)
  - Broad protocol support
  - Validated test suites library
  - Easily expandable to support new physical interfaces
  - Easily expandable to support new protocols/tests
  - Powerful and easy-to-use graphical tool chain (Protocol Editor, Analyser, test campaigner, protocol emulators, etc.)
  - Fast customization due to rapid prototyping

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PVS target usage

The PVS shall cover the needs of:

- **Rapid prototyping**
  - *R&D and feasibility studies (R&D section and academics)*
  - *System analysis teams*
- **Functional testing**
  - *Device providers*
  - *AIV teams*
- **Interoperability testing**
  - *Device providers*
  - *AIT teams*
- **Stress testing**
  - *All users*
- **Protocol Analysis**
  - *All users*

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PVS usage scenarios

The PVS system shall support the following modes of operation:

- **PROTOCOL EMULATION**: experiments with various protocol features and assignment of values to the corresponding parameters.
- **PROTOCOL CONFORMANCE TESTING**: ensures that a device is operating in accordance with the applicable ECSS and CCSDS standards.
- **NETWORK MONITORING**: network monitoring, through direct physical traffic acquisition
- **FAULT-INJECTION**: injection of errors at various protocol layers to validate the response of the devices
- **TRAFFIC GENERATION**: generation of traffic for validation of higher layer protocols or bulk traffic injection at lower layers for performance testing and network dimensioning

PVS Phase 1 Objectives

- Phase 1 (current contract):
  - Requirements capturing & analysis, based on requirements by ESA and Astrium, and PVS system top level partitioning
  - Technology review on related technologies, tools and protocols
  - Build a basic SpW development platform
  - Identification of SpW-RT features to validate
  - Realisation of the proof-of-concept prototype
  - Evaluation and demonstration of the PVS with SpW-RT and RMAP (or GAMMA)
  - Development plan definition for the full PVS

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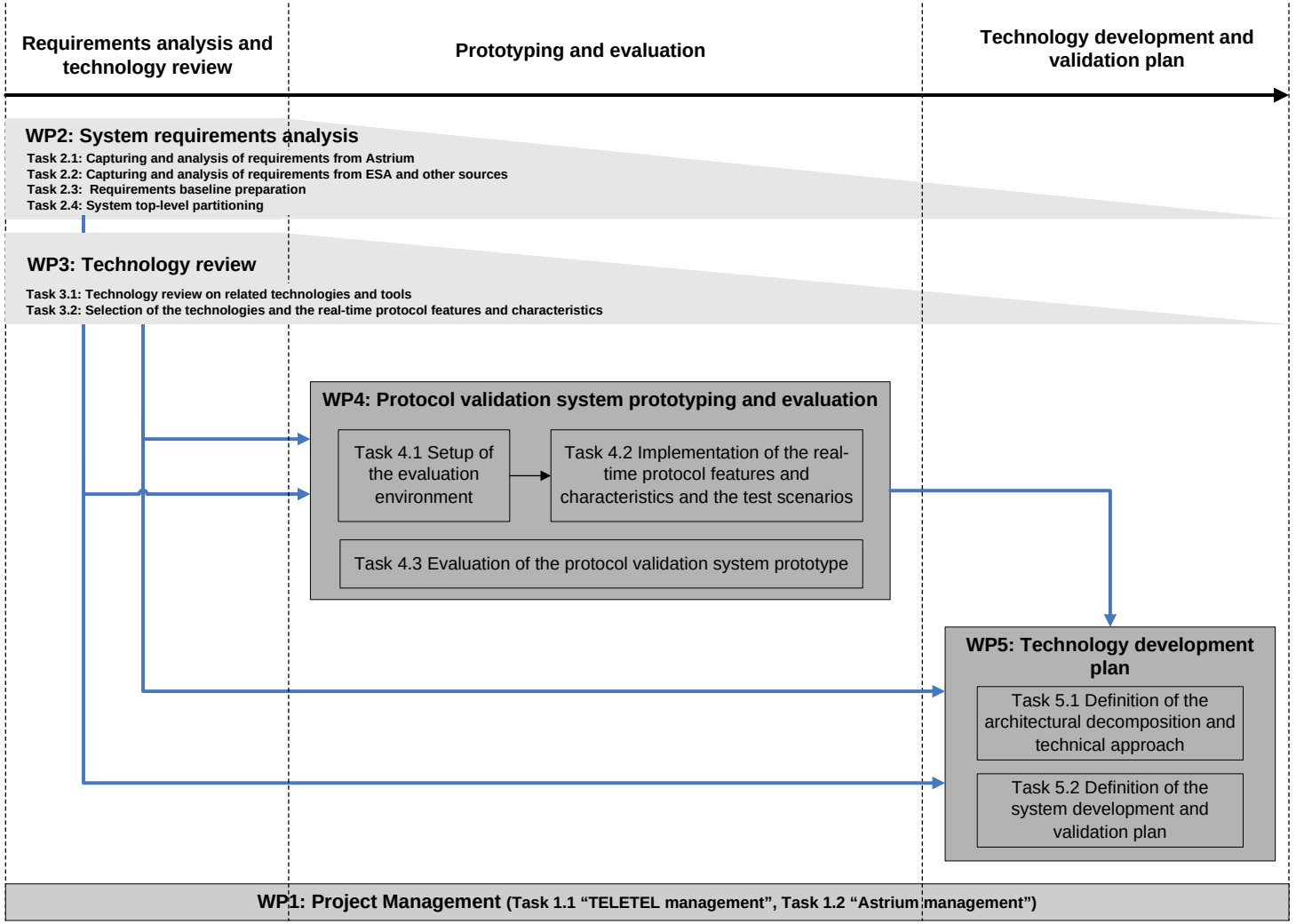
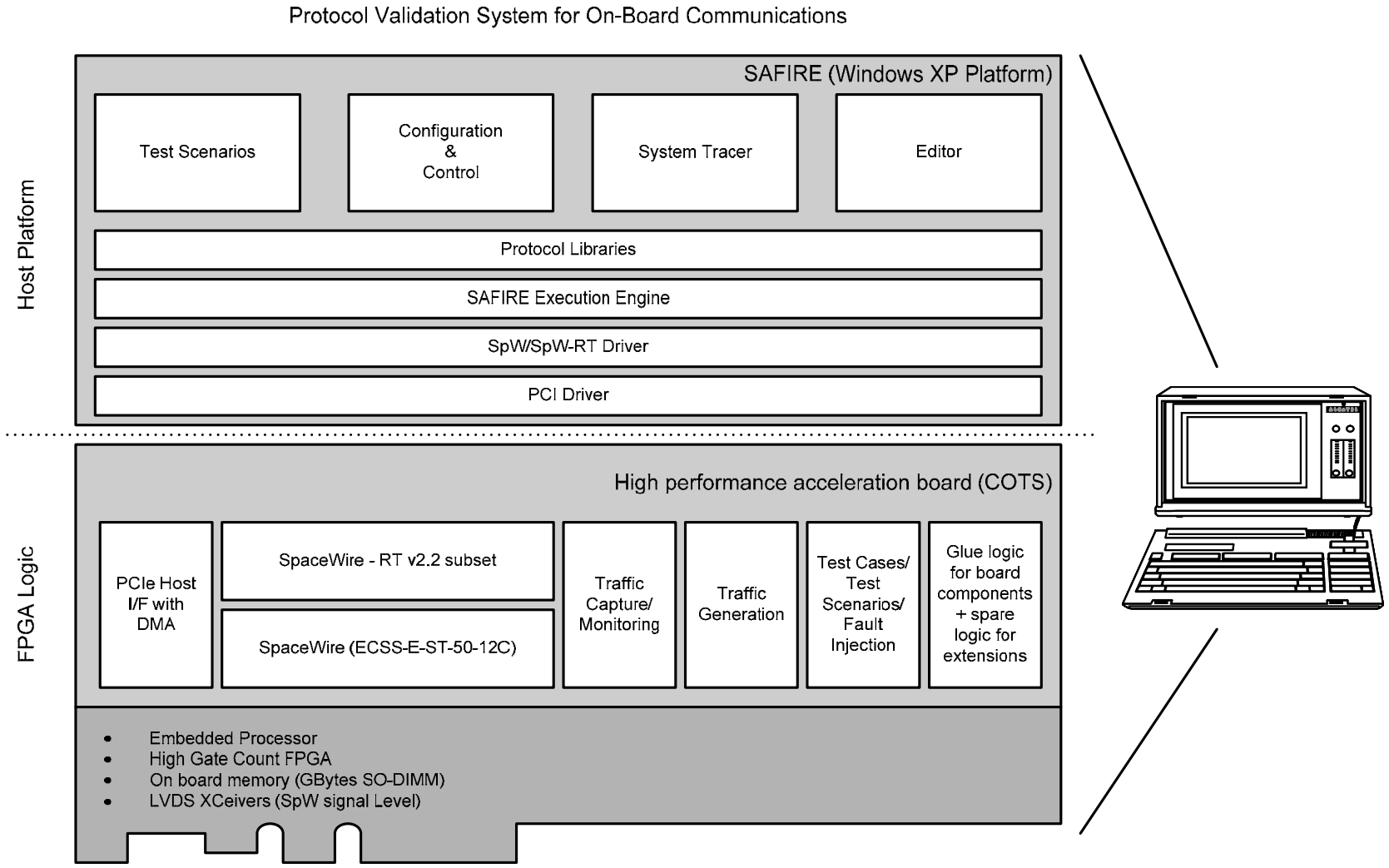
Project Workplan

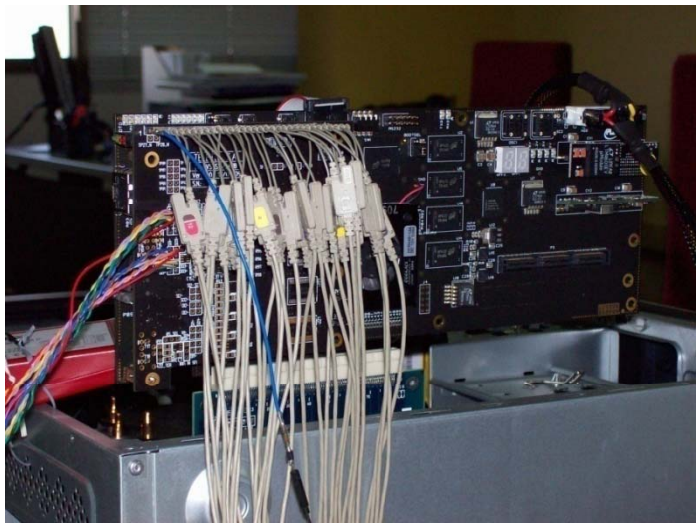


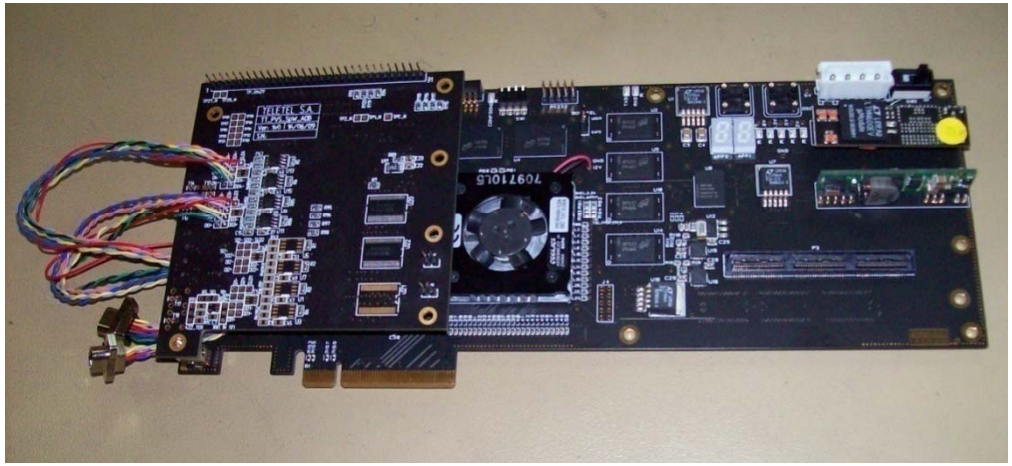
PVS Phase 1 target system



PVS Phase 1 Achievements today

- Requirements for the envisaged PVS system defined
- Selection of technology components completed
- Selection & design of SpW-RT features to validate completed
- PVS SpW development platform integrated & verified
- Detailed Validation scenarios defined





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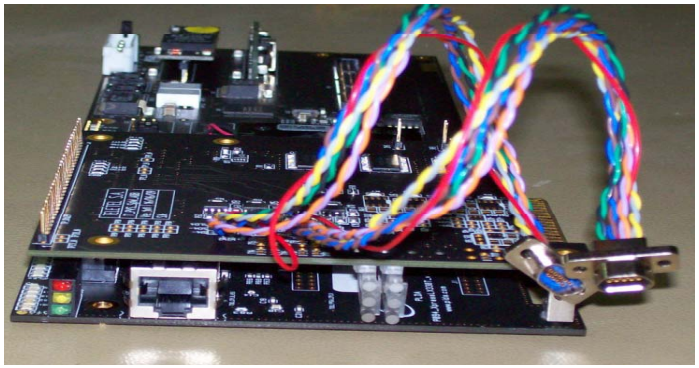
PVS SpW Development Platform
Main activities performed

- Selection and setup of a High capacity COTS FPGA development board with PCIe-DMA host I/F
- Design, production & verification of a 4-port SpW add-on-board with fine programmable transmission rates
- Integration of the DMA, PCIe IP cores
- Integration of the UoD SpW-b IP core
- Development of additional VHDL logic (DMA extensions, time-code logic, interrupt controller)
- Development of PC driver functions
- Development of configuration & control software
- Overall platform integration & tests
- Validation with SpW Conformance Tester successful (Athens 03 Sep 09)



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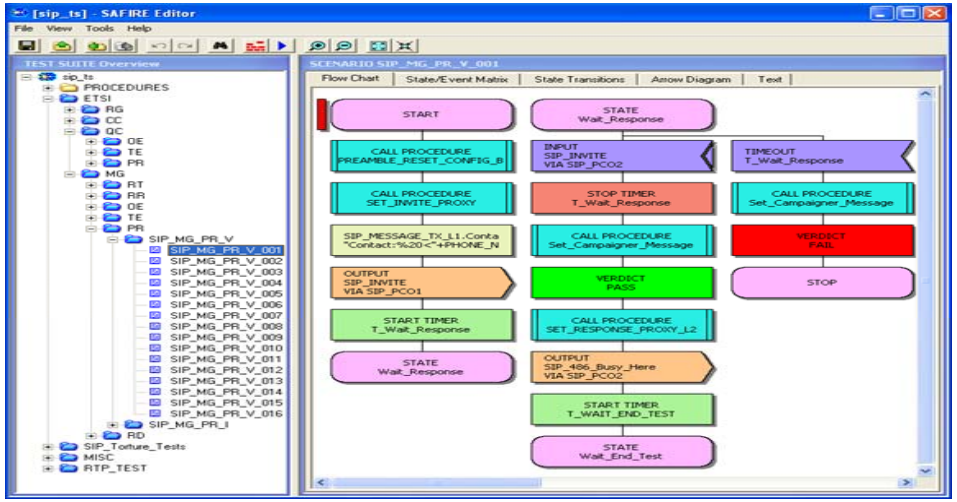
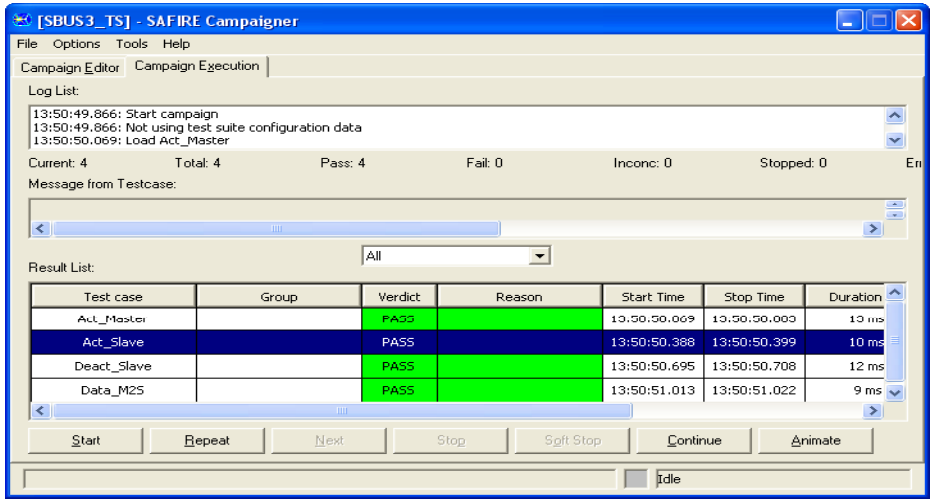
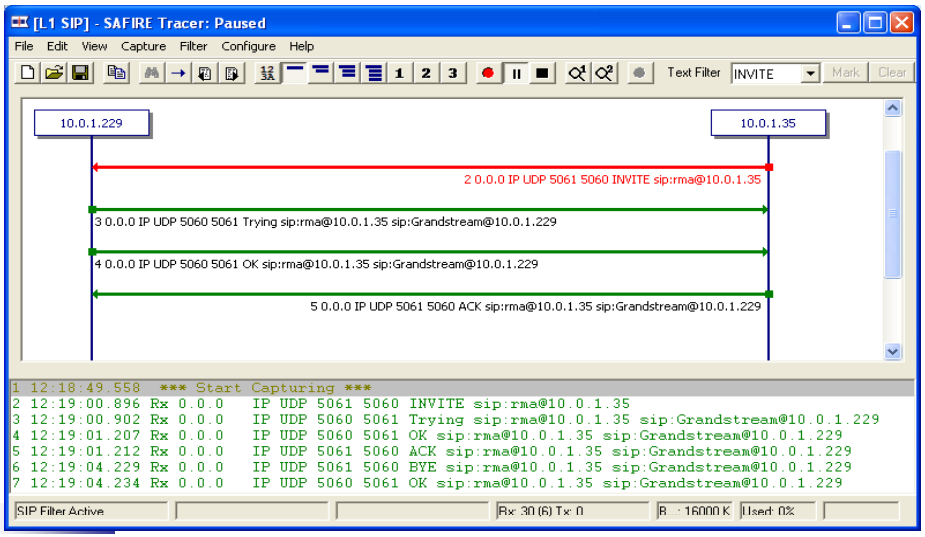
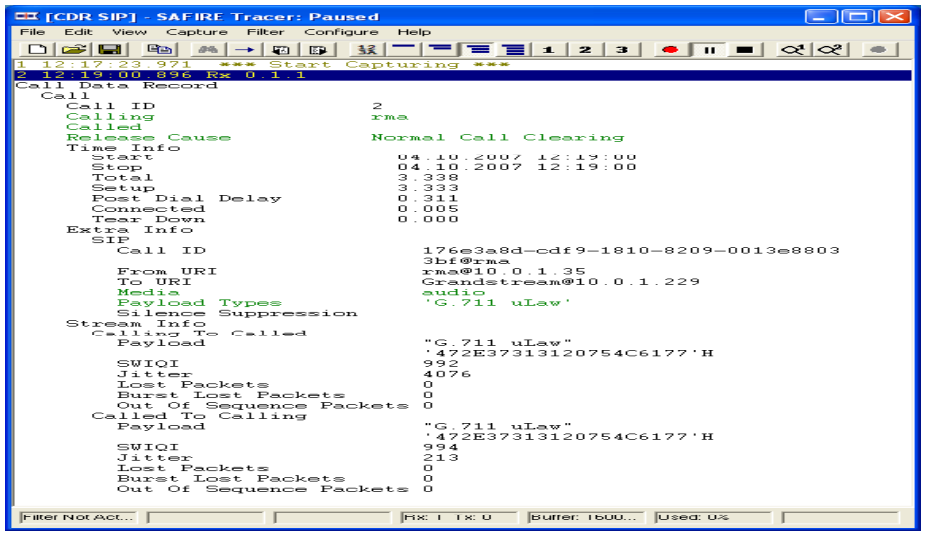
SAFIRE Graphical Environment (example)









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Selection of SpW-RT features to validate

- ✓ Segmentation
- ✓ End to End flow Control
  - ✓ BFCT
  - ✓ BACK
  - X SBFCT
  - ✓ SACK
- X Retry
  - X Automatic retransmission
  - ✓ ACK, ACK timeout
- ✓ Error Detection
  - ✓ Header/data CRC
  - ✓ Wrong destination address
  - ✓ Sequence Number
  - ✓ EEP
- X Redundancy
  - X Simultaneous retry
  - X Autonomous/Managed switching
  - X Managed switching
- ✓ Address Translation
- ✓ PDU Encapsulation
  - ✓ PDU
  - ✓ (S)ACK
  - ✓ BFCT
  - ✓ BACK
- ✓ Resource Reservation

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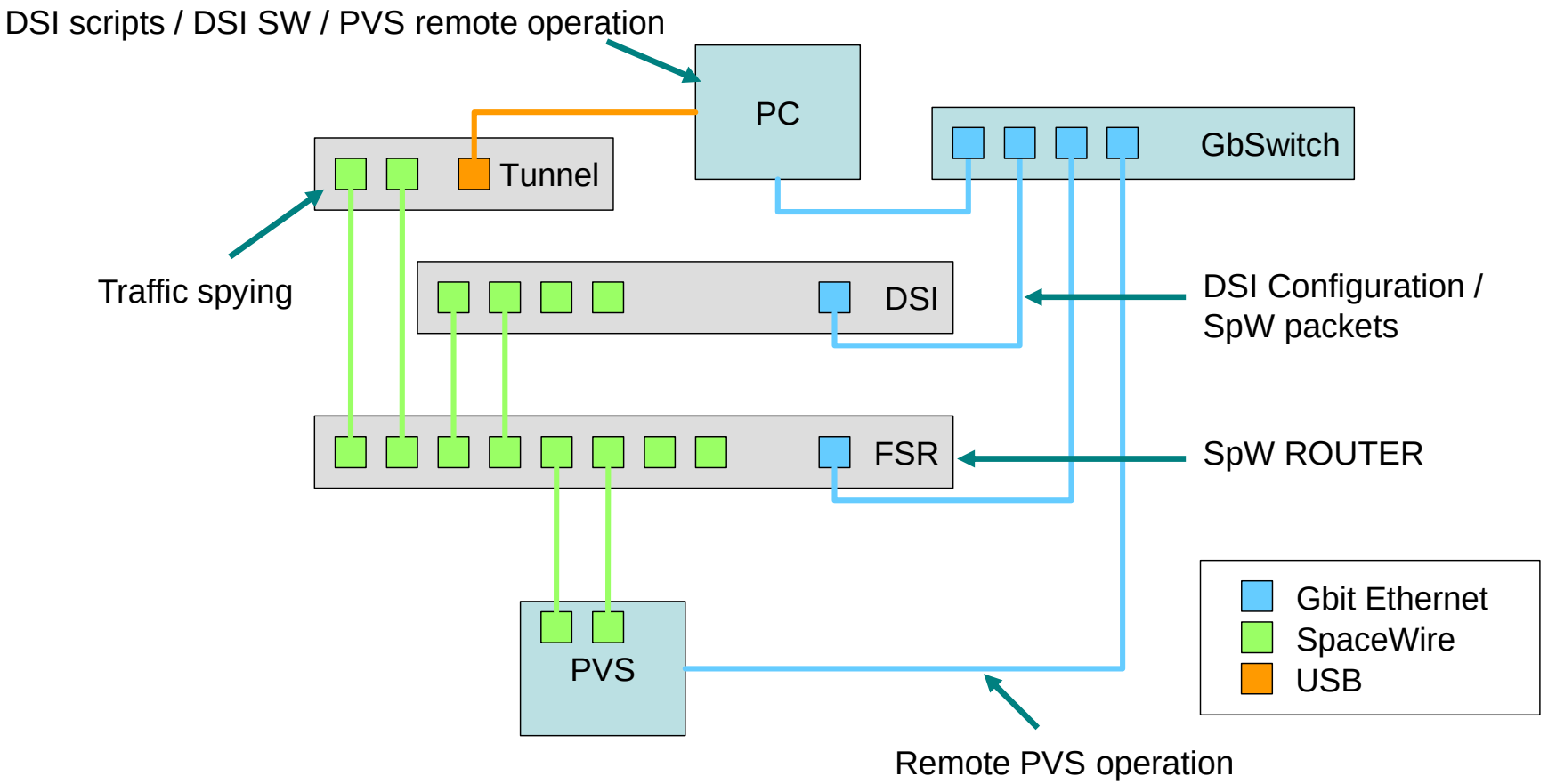
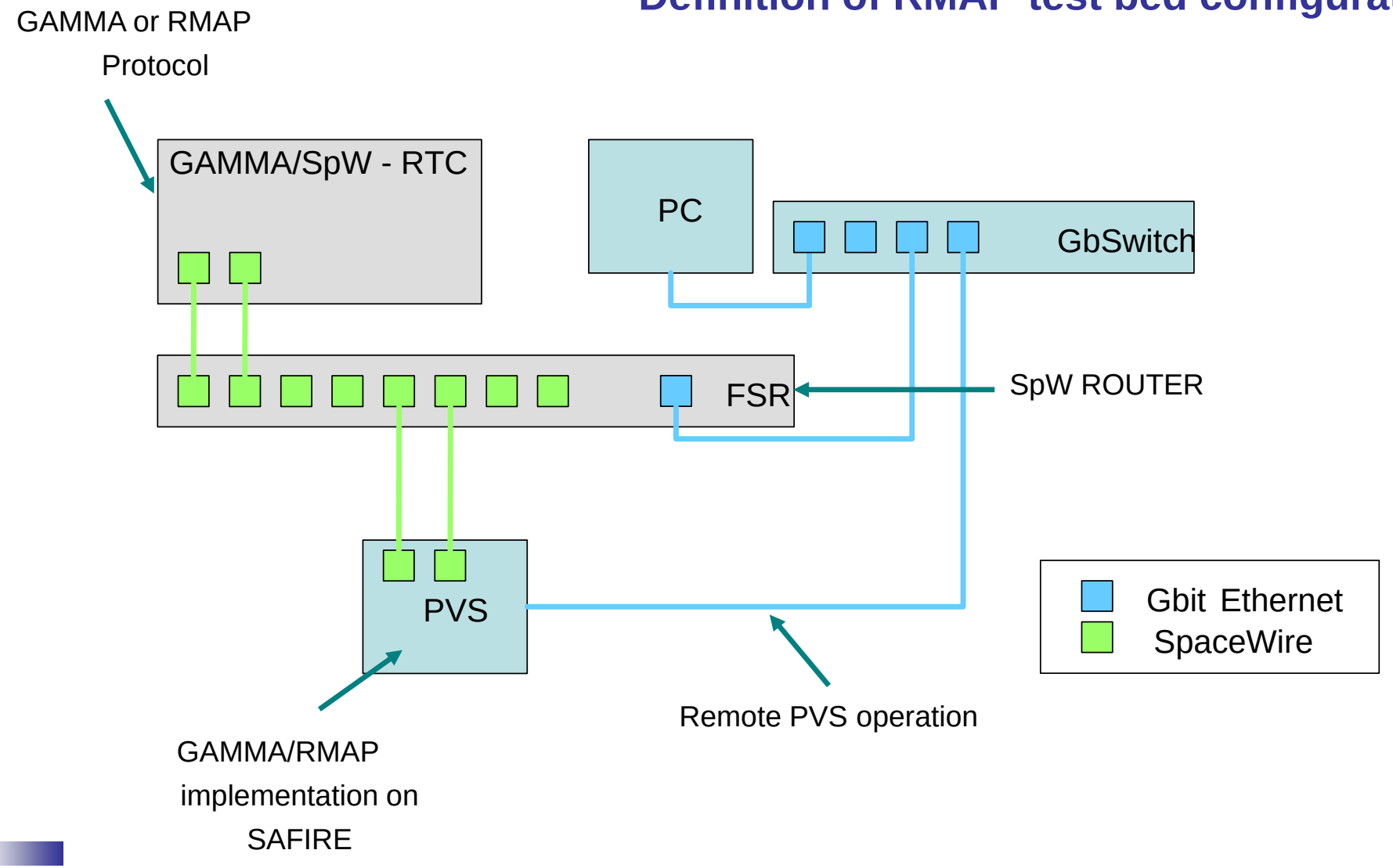
Definition of SpW-RT Validation test bed configuration



Definition of RMAP test bed configuration



Future activities

- Implementation of the SpW-RT terminal functionality in the FPGA (Oct-Nov)
- Implementation of the SpW-RT tests functionality in the FPGA (Oct-Nov)
- Implementation of PC test & control software (Oct)
- Integration of the PVS board with the SAFIRE environment (Oct)
- Implementation of RMAP test cases in SAFIRE (Oct)
- Verification and validation tests in Athens (Nov)
- Verification and validation tests in Toulouse (Dec)
- Definition of Phase 2 system features and development roadmap (Nov)

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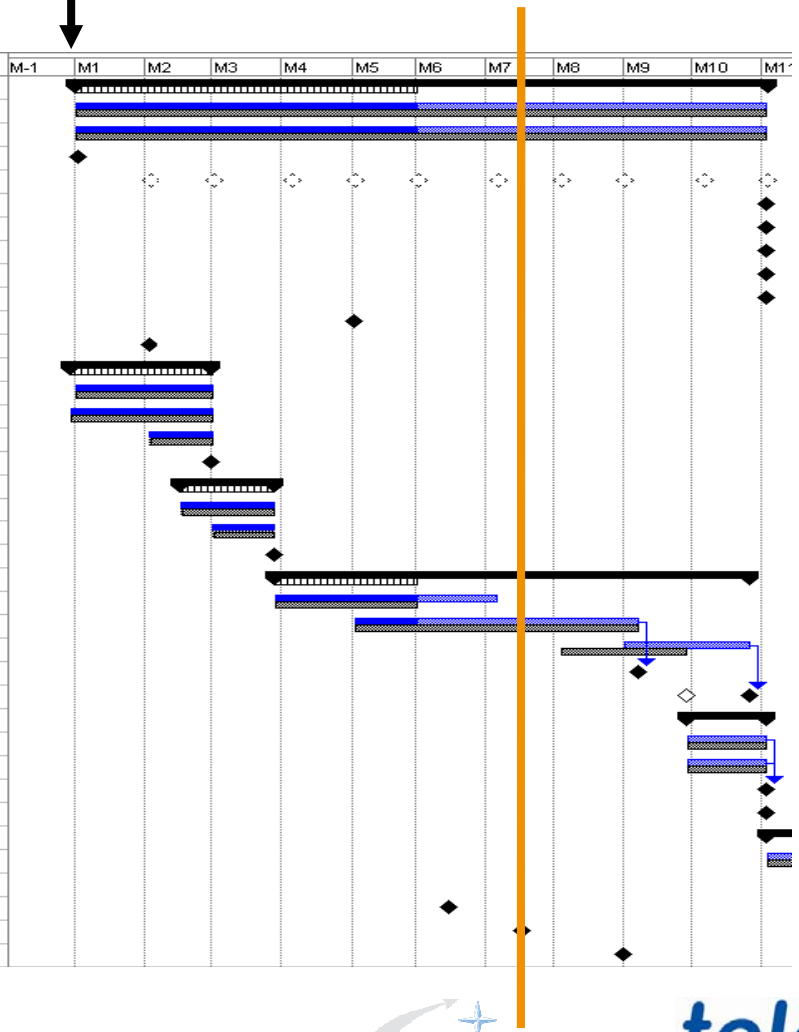
Project Schedule

T0 – 16th February 2009

ID	Task Name
1	**WP1 - Project Management**
2	Task 1.1: TELETEL management
3	Task 1.2: Astrium management
4	Kick-Off Meeting and Contract Signature
5	**R-11 Periodic Progress reports**
16	R-12: Final Report
17	R-13: Technical Data Package
18	R-14: Summary Report
19	R-15: Executive Summary Report
20	R-16: Abstract
21	O-11: Brochure
22	O-12: Web Site
23	**WP2 - System requirements analysis**
24	Task 2.1: Requirements from Astrium
25	Task 2.2: Requirements from ESA and other sources
26	Task 2.3: Requirements baseline specification and system partitioning
27	TN 201: Requirements baseline and system top-level partitioning (IRD,RB;SRR)
28	**WP3 - Technology review**
29	Task 3.1: Technology review on related technologies and tools
30	Task 3.2: Selection of the technologies and the real-time protocol features and characteristics
31	TN 301 - Technologies and protocols selection
32	**WP4 - Protocol validation system prototyping and evaluation**
33	Task 4.1: Setup of the evaluation environment
34	Task 4.2: Implementation of the real-time protocol features and characteristics and the test scenarios
35	Task 4.3: Evaluation of the protocol validation system prototype
36	TN 411: Protocol validation system first prototype
37	TN 421: Evaluation report
38	**WP5 - Technology development plan**
39	Task 5.1: Definition of the architectural decomposition and technical approach
40	Task 5.2: Definition of the system development and validation plan
41	TN-501: PVS technical approach and development plan
42	R-51: Commercial Evaluation Report
43	**WP6 - Software guarantee**
44	Task 6.1: Software maintenance
45	**Meetings**
46	PDM 1
47	PDM 2 + SVM 1
48	SVM 2



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www.teletel.eu/esa_pvs_p1
login/passwd: same as for SpW WG web site