Protocol Validation System for On-Board Communications

PVS Project Overview

17th SpaceWire Working Group, 14th December 2011
Noordwijk, Netherlands

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Rationale

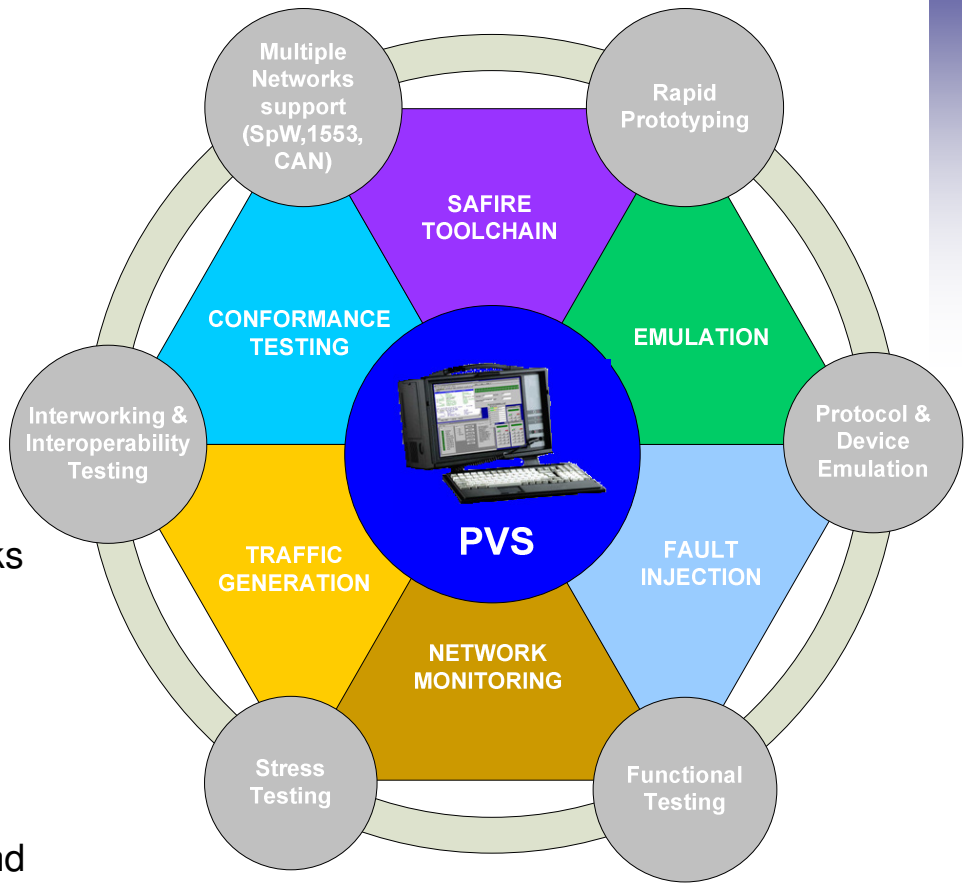
- Current **evolution of satellite on-board communications**, require the development & experimentation with new dedicated communication protocols and services (SpW, SOIS, etc.)
- **New generation of validation tools is required** to support advanced protocol development, test, integration & validation

- 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)

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

PVS Features

- **DEVICE EMULATION:** replacement of a network element in the testbed
- **PROTOCOL EMULATION**: experimentation with various protocol features (protocol variables, exclusion/inclusion of protocol optional functions etc.)
- **CONFORMANCE TESTING**: ECSS and CCSDS standards compliance testing.
- **FAULT-INJECTION:** Validation of devices/networks behavior under erroneous conditions
- **TRAFFIC GENERATION:** Bulk traffic injection for performance evaluation and network dimensioning
- **NETWORK MONITORING**: Traffic data capture and logging for post processing and playback



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Areas of Use / PVS Instances

The PVS shall cover the needs of:

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

- HW Board and SAFIRE basic, protocols on request

- Rugged Notebook, SAFIRE basic, pre-selected library of protocols/tests

- Portable (5 slots), SAFIRE basic, pre-selected library of protocols/tests, interworking tests

- Rackmount, SAFIRE basic, pre-selected library of protocols/tests, interworking tests, other tests

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Benefits

- All-in-one validation environment
- Suitable for use in many different areas and by many different users
- Easy integration of new physical interfaces, protocol emulators ,3rd party applications
- Support of multiple networks simultaneously for interworking validation scenarios

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PVS-Phase 1 Overview

- Duration: February 2009 – April 2011 (active duration 18 months)

- Objectives
  - Requirements definition for Protocol Validation Tools for on-board communication networks
  - Provision of a PVS proof of concept prototype instance for
    - SpW/SpW-T protocols
    - SpW-D protocol

- Partners
  - TELETEL
  - ASTRIUM SAS (Toulouse)

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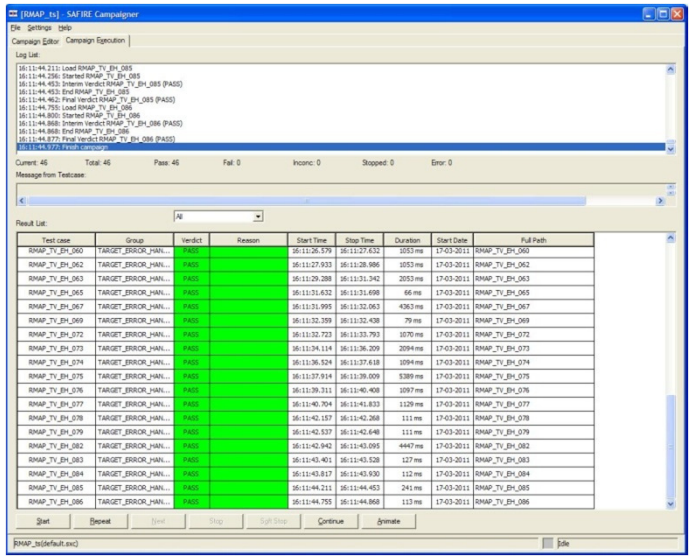
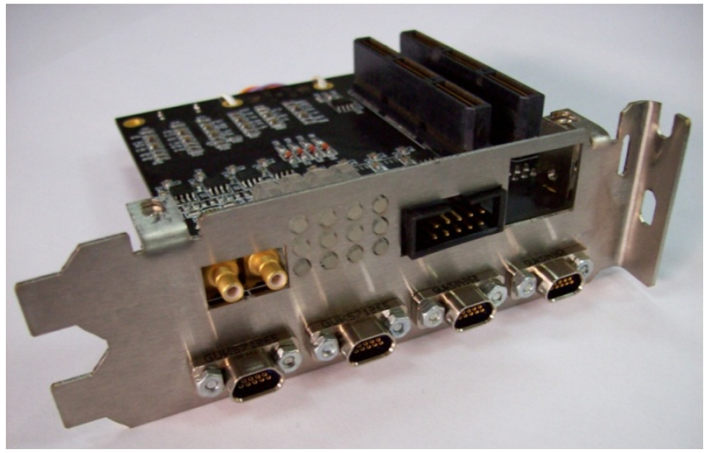
PVS-Phase 1 Results

- Realisation of a high throughput 4-port SpW network interface board with high capacity FPGA and fine programmable transmission rates
- Implementation & validation of the draft SpW-T protocol specification in the board's FPGA logic
- Implementation of the GAMMA protocol emulator test cases and protocol decoder
- Design and implementation of SpW-D & RMAP IP cores in the SpW network interface board FPGA logic
- Implementation of RMAP/SpW-D test cases
- Protocols Experimentation/Validation and contributions to the SpW WG





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PVS-Phase 2 Overview

- Duration
  - Period I: January 2012 – February 2013 (14 months)
  - Period II: March 2013 – June 2014 (16 months)

- Objectives
  - To provide a protocol validation system for the SpW family of protocols (PVS SpW product)
  - To provide a protocol validation system for the ECSS-E-ST-50-13C (MIL-STD-1553B) protocols (PVS 1553 product)
  - To provide a protocol validation system for the ECSS-E-ST-50-15C (CANBUS) protocols (PVS CAN product)
  - To validate the different PVS product instances in four (4) demonstrators

- Partners
  - TELETEL
  - Astrium SAS (Toulouse, Elancourt)

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PVS-P2 SpW activities (Period I)

- Extension of the SpW network Interface Board to support:
  - IRIG time-stamping for common time reference across different network technologies
  - Trigger I/F to allow synchronized traffic injection, “start of capture” events, etc.
  - UUT protection for connection to flight equipment
- Development of non-intrusive SpW monitoring functionality
  - Real-time Gbytes traffic capture
  - Filtering to support “information of interest” capture only
  - WireShark network analyzer protocol message decoders for RMAP, PTP/Space Packet
- Protocol emulators
  - RMAP
  - PTP/CCSDS Space Packet
  - API for custom applications development
- Protocol test suites
  - RMAP
  - PTP/CCSDS Space Packet

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PVS-P2 1553 activities (Period I)

- Integration of COTS MIL-STD-1553 boards with SAFIRE-PVS
- Implementation of 1553 Bus Monitoring functionality
- Implementation of RT emulation functionality supporting ECSS-E-ST-50-13C
- Implementation of ECSS-E-ST-50-13C (1553) validation tests
- Integration of SAE RT test plans

PVS-P2 CAN activities (Period II)

- Development of a ECSS-CAN network interface card with multiple ports, ISO/RS-485 PHYs, UUT protection, IRIG, Trigger I/F
- Implementation of CAN Bus Monitoring functionality
- Implementation of monitoring functionality for CAN, CANOpen and ECSS-E-50-15C messages
- Implementation of ECSS-E-50-15C (CAN) Slave node emulation functionality
- Implementation of CAN/CANopen Traffic Generation
- Implementation of ECSS-E- 50-15C (CAN) test suites

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PVS-P2 Demonstration/Validation (Period II)

- PVS Demonstration with GAIA Video Processing Unit (VPU)
  - Monitoring on the SpW and 1553 networks with common (IRIG) time-stamping
  - PVS will emulate the PDHU and will simultaneously monitor the SpW and 1553 links
  - PVS will emulate the CDMU and will simultaneously monitor the SpW and 1553 links
- Solar Orbiter platform
  - Link Monitoring of OBC, SSMM
  - OBC and SSMM emulation
- PVS Demonstration with Telecom Sensor Networks (RTU)
  - Monitoring of an RTU's 1553 and CAN links
  - S/C Computer Unit and/or CAN Slave Node Emulation with simultaneous monitoring of the 1553 (SCU) and CAN (sensors) networks
- 1553 bus controller validation controlled by SpW link
  - Remote control of a RASTA board through the SpW Link, and validation of the traffic exchanged over the 1553 network

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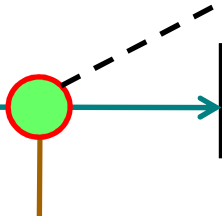
Usage Examples: SpW Scenarios

PVS: Protocol Emulator/ Analyser

N x Emulator/ Generation Ports

P x Monitoring Ports

Traffic Generation/Sinking (Node/Router/Network Conformance & Performance testing …)



SCPS-FP	SCPC FDP	TMTC
SCPS-TP		
SCPS-NP		
SpaceWire		

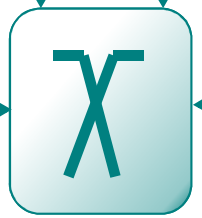
Telemetry Module

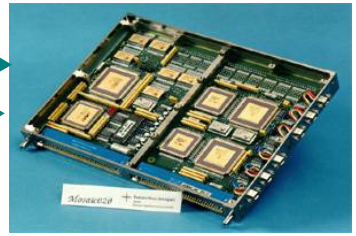
SOIS Memory Access
RMAP
SpaceWire

Redundancy management Tests (Primary Backup device management …)

Network Discovery	SOIS Memory Access	SCPS-FP	SCPC FDP	TMTC
RMAP		SCPS-TP		
		SCPS-NP		
SpaceWire				

Memory Module





Processor Module

PVS Monitoring ports

PVS Emulation ports

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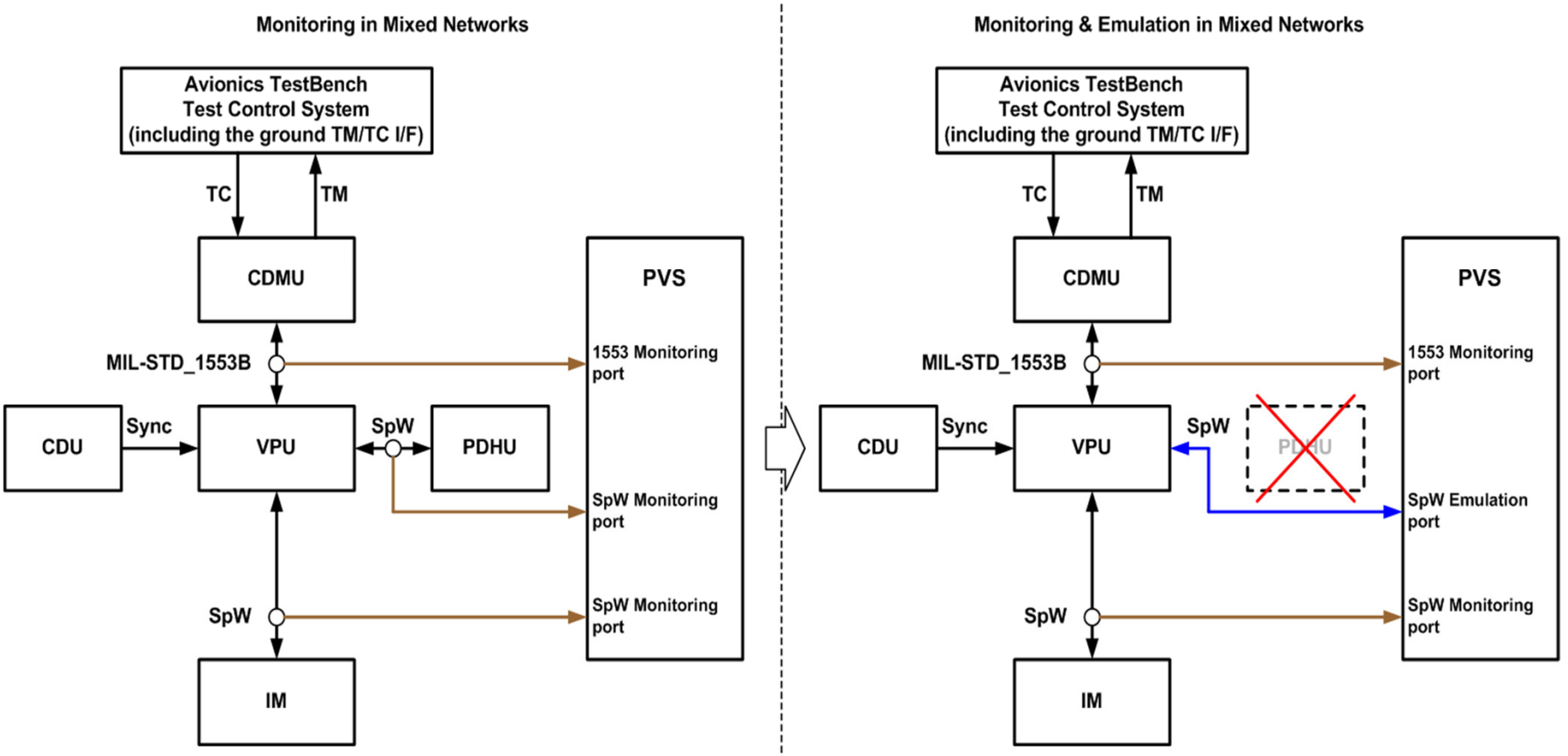
Usage Examples: Mixed network Scenarios



CDU: Clock Distribution Unit, VPU: Video Processing Unit, PDHU: Payload Data Handling Unit, CDMU: Clock & Data Management Unit, IM: Interconnection Module

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