iSAFT Time Triggered Ethernet Verification-SPY Tool

("iSAFT PVS with time Triggered Ethernet capabilities", ESTEC Contract No. 4000114851)

May 2018

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Presentation Contents

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Project Overview

TELETEL has developed the iSAFT TTE Verification/SPY Tool in the context of the “iSAFT PVS with Time Triggered Ethernet capabilities” project:

- Project Title / Contract No: "iSAFT PVS with time Triggered Ethernet capabilities", (ESTEC Contract No. 4000114851)
- Start Date: 07 September 2015
- Duration: 24 months
- Main objective: Extension of TELETEL’s iSAFT Protocol Validation System with Time Triggered Ethernet capabilities
- Partners:
  - TELETEL (Prime Contractor)
  - Airbus Defence & Space (Sub-Contractor) – 2 sites, Les Mureaux (France) and Immenstaad (Germany)
- The resulted iSAFT TTE Verification/SPY Tool was successfully demonstrated at the Ariane Group TTEthernet testbed in Les Mureaux, France.

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Company Overview

TELETEL S.A. established in 1995

- HQ: Athens, Greece
- R&D Branch: Northern Greece (Ioannina)
- Subsidiary Teletel Space Srl - Romania

Space, Defence & Aeronautics Design & Development House

- 22 years of experience in developing industrial S/W & H/W products
- S/W & H/W Engineers: 35 (Ph.D., M.Sc., B.Eng.)
- Quality Assurance (ISO 9001:2008, NATO Clearance)

80% of Turnover by Major International Customers

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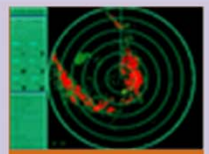
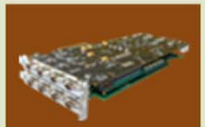
History

Since 1995, TELETEL has supplied SoA SW & HW products for major international defense, telecoms and aerospace industries.

	2000	2005	2010	Today
Research & Development	R&D in Telecoms (SS7, ISDN, IN)	R&D in Telecoms Convergence (IMS, UMTS, VoIP)	R&D in GNSS technologies (EGNOS, GALILEO, PRS)	R&D in aircraft/space avionics (SpW, SpFi, TTE, ARINC 664)
Testing & Validation	Protocol Test Systems for Telecoms	Test Benches for Defence and Telecoms Systems	iSAFT aircraft avionics test tools	EGSE for space missions (EUCLID, IASI-NG, MicroCarb)
Software	Interworking functions for Telecoms Technologies	SW development for command & control of anti-air missile systems	 SW development for Radar Systems	Development of flight SW components (EUCLID, JUICE)
Hardware	Communication Interception Systems	Tactical Communication Terminals	Modernisation of Aircraft Head Down Display (HDD)	 SpaceWire Network Interface Boards

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Customers

TELETEL has successfully completed projects with major companies, including:

- ALCATEL-LUCENT (Germany)
- THALES AIR DEFENCE (France)
- THALES COMMUNICATIONS (France)
- MOTOROLA Ltd (UK)
- SIEMENS ICN s.p.a. (Italy)
- SAGEM S.A. (France)
- MBDA (France)
- A1 TELEKOM AG (Austria)
- TRACKER SECURITY (Finland)
- HELILEO S.A. (France)
- THALES HELLAS SA (Greece)
- HELLENIC AEROSPACE INDUSTRY (Greece)
- MILTECH HELLAS S.A. (Greece)

SPACE

- EUROPEAN SPACE AGENCY (ESA)
- AIRBUS DEFENCE & SPACE (France, UK)
- THALES ALENIA SPACE (France, Italy)
- SYDERAL (Switzerland)
- SPACEBEL (Belgium)
- TERMA (Denmark)
- NEC Space Technologies (Japan)
- DELTA TECHNOLOGIES (France)
- ITTI (Poland)
- SEPROTRONIC (Germany)

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Aerospace on-board communications expertise

TELETEL has significant expertise in on-board communication networks and related data handling technologies:

- SpaceWire, SpaceFibre, MIL-STD-1553, CAN / CANOpen
- TTEthernet, ARINC-664 (AFDX)
- SPI, I2C, other
- Integrated Modular Avionics (partitioning kernels, ARINC 653, etc.)
- Expertise with Leon processors, RTEMS, Starkit, RASTA boards

Key member of the following standardization Working Groups (WGs)

- SpaceWire WG (ESA)
- SpaceFibre WG (ESA)
- TTEthernet WG (ESA)

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iSAFT Product Line – Validation of on-board data networks

TELETEL currently markets & supplies the iSAFT product line to different customers in Europe & Japan, for the validation of on-board data networks.

iSAFT Recorder – SpaceWire, 1553, CAN

iSAFT Simulator – SpaceWire, 1553, CAN

iSAFT UART, SPI, I2C, other
iSAFT Power Front End
iSAFT I/O Front End

iSAFT based test benches (EGSE)

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iSAFT Product Line – Flexible configuration

iSAFT can be provided in different heavy duty hardware platforms with high processing power. They can host multiple physical interfaces in any combination and they also provide multi-Gbytes storage capacity.

Server Based Site Rackmount System (2U)

Site Rackmount System (3U)

Portable System

Quad/Octal SpaceWire PCIe NIC

Dual 1553 1Mbit PCIe NIC

Dual CAN PCIe NIC

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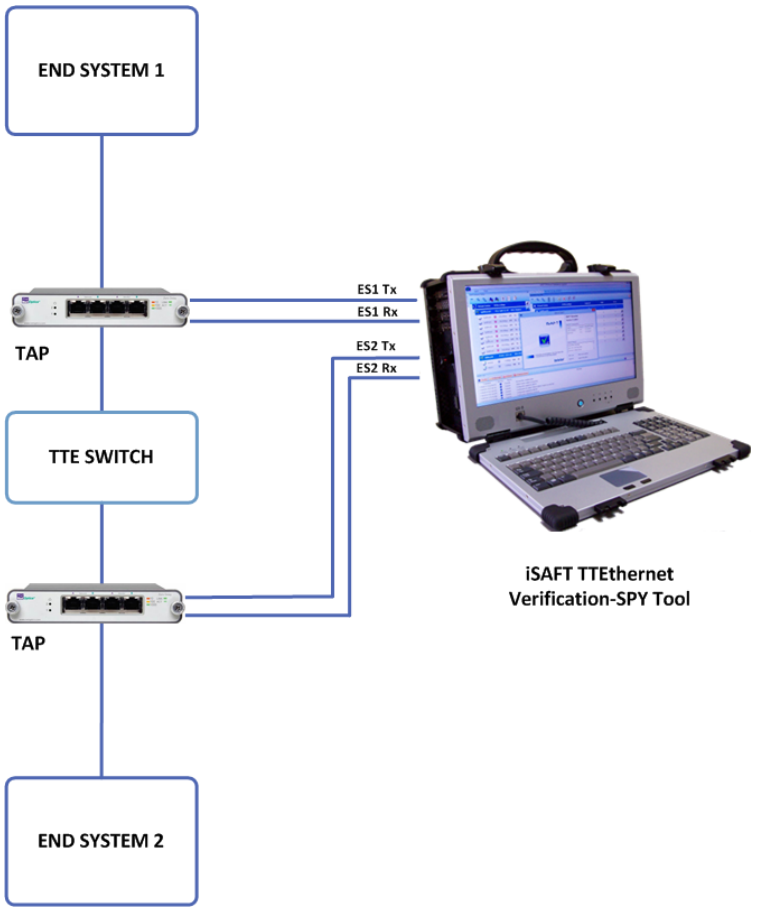
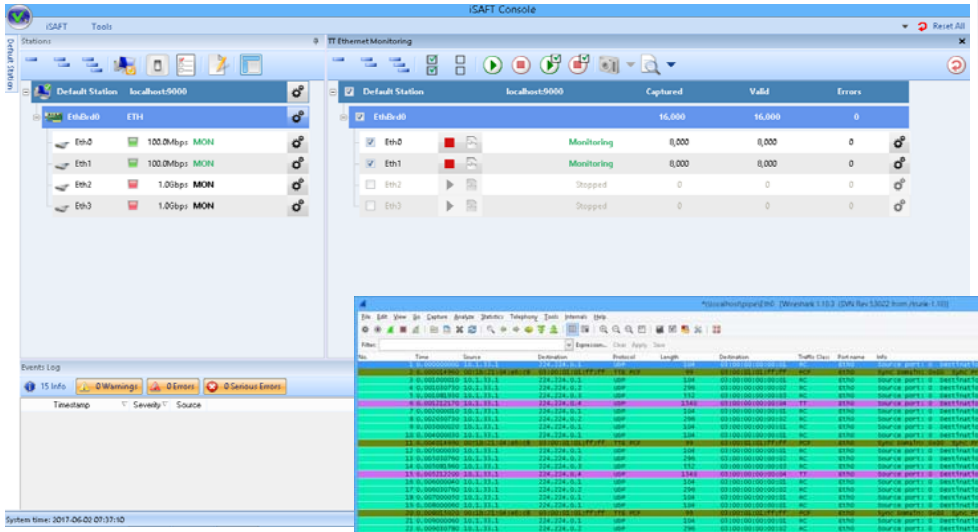
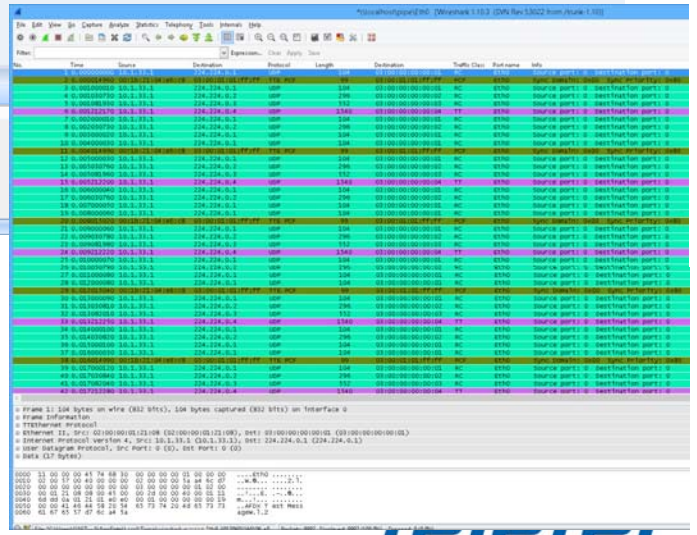
New iSAFT Product: TTEthernet Verification/SPY Tool

iSAFT TTEthernet Verification/SPY Tool is an advanced, integrated, high performing, modern network traffic capture, recording and analysis platform suitable for the independent verification of Time Triggered Ethernet features, data networks and protocols.



iSAFT TTEthernet Verification-SPY Tool





iSAFT TTEthernet Verification-SPY Tool - General Features

- Powerful HW platform (high processing power, Tbytes storage capacity), 4nsec Timestamp Resolution, 1.3 PPM clock.
- iSAFT graphical tool chain (Runtime engine, iSAFT Console, offline analysis with the Wireshark Protocol Analyzer, recordings management).
- Automatic configuration mode using TTTech network and device configuration files or manual mode using the graphical interface.
- Real-time analysis, event-trace trigger & selective tracing (online/offline filters) support, statistics per Ethernet ports, virtual links and traffic classes (TT, RC, BE).
- Network synchronization and traffic policing of all transmit and receive frames. Detection of network synchronization and timing errors, frames transmitted outside the acceptance windows.
- Capturing & recording of large volumes of traffic (multi-gigabyte) from multiple links. Advanced processing and export to XML, CSV, or plain text with user selected protocol fields per packet.
- Open APIs to 3rd-party applications, support for customization, adaptations to customer needs

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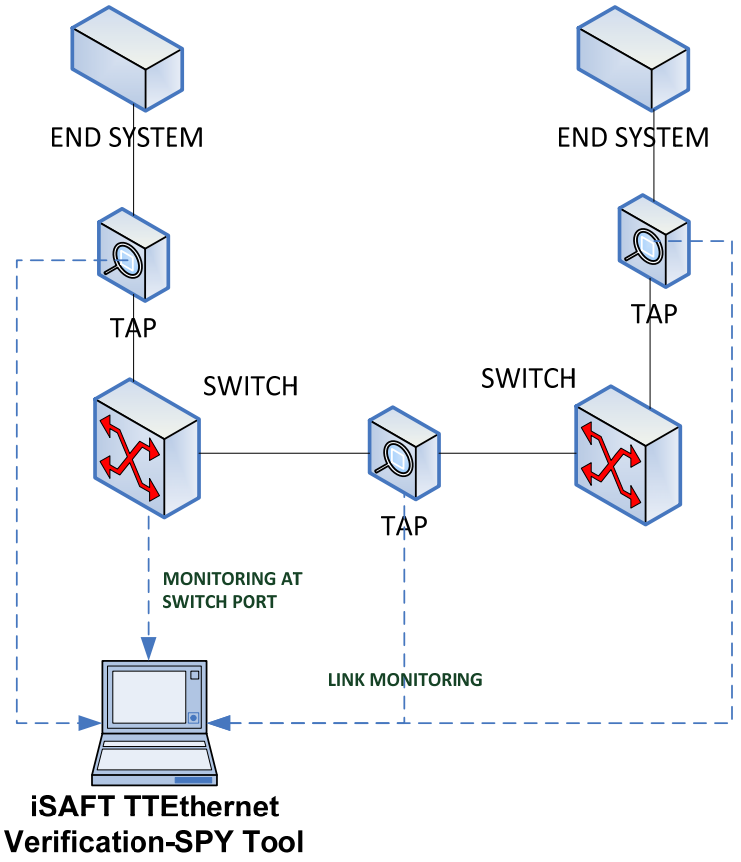
iSAFT TTEthernet Verification/SPY Tool – Features (1/2)

- TTE Network Monitoring
  - Direct physical traffic acquisition via Switch port or TAP
  - Full data recording with configurable filtering of received traffic
  - Traffic files in Wireshark format with Dissectors for all protocols
  - Real time traffic analysis and verification during monitoring
  - Analytical display & logging of statistics
  - Open interfaces for input configuration/output results data exchange with 3rd party tools
  - COTS Ethernet boards for traffic monitoring (with high accuracy time-stamping)



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iSAFT TTEthernet Verification/SPY Tool – Features (2/2)

- Traffic Analysis and Verification
  - Statistics per VLID, traffic class etc.
  - Detection of physical errors (short IFG, FCS etc.)
  - Errors detected based on traffic profile (invalid VL, synchronization errors, etc.)
  - Detection of scheduling / timing issues (for instance VL not received in a valid time slot)
- Monitoring of System-wide time synchronization
  - Interpret PCF frames as Synchronization Client
  - Detection of network synchronization state
  - Measure network clock accuracy w.r.t. accurate board clock
  - Statistics for transparent clock cluster/integration cycles

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iSAFT TTEthernet Verification-SPY Tool - Quad Ethernet 1Gbit PCIe Gen2 NIC

- PCIexpress Interface Gen3
- 8-lane bus width
- 8GT/s bus speed
- 4 x1 Gbps SFP ports
- Capture rate 4 Gbit/s(line speed, zero packet loss from 64 byte to 10000 byte frames)
- IEEE 802.3 10 / 100 / 1000 Mbps Ethernet
- 2 GB DDR3 RAM
- Frame and flow filtering
- 4 ns time-stamping

Napatech NT4E2-4-PTP Ethernet Interface Board

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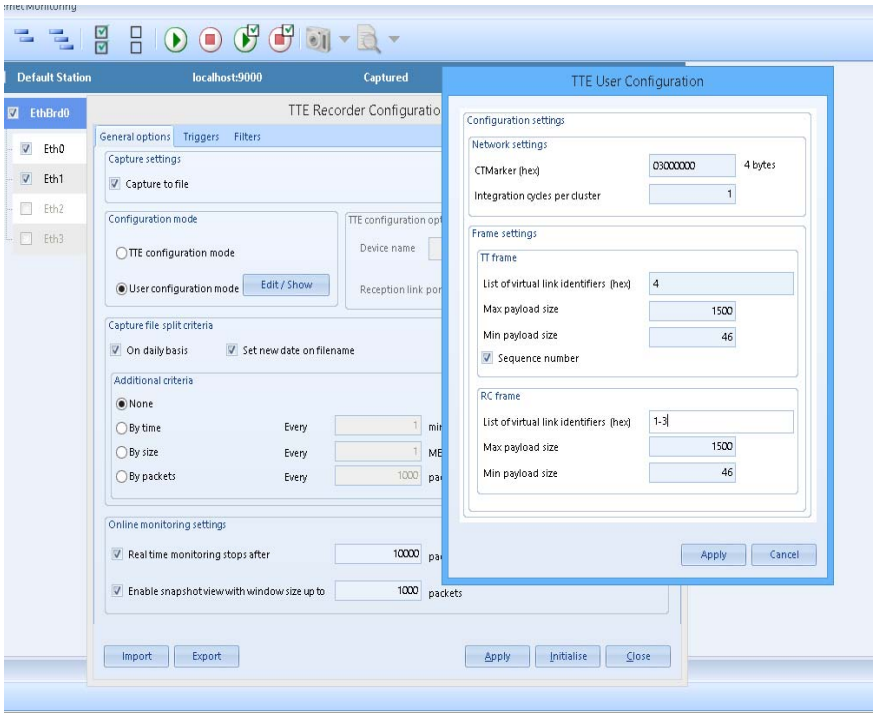
iSAFT TTEthernet Verification/SPY Tool - Configuration

- Automatic configuration mode using TTTech network and device configuration files
  - User selects the ES name that is monitored at each Ethernet port
  - Tool automatically loads the correct files and configures monitoring and traffic analysis
- Manual mode
  - User defines VLIDs,
  - Traffic classes per VLID
  - Network synchronisation is disabled in this mode



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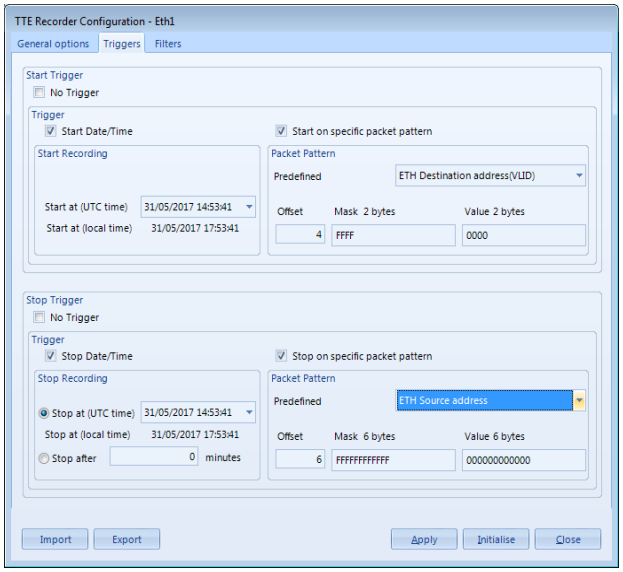
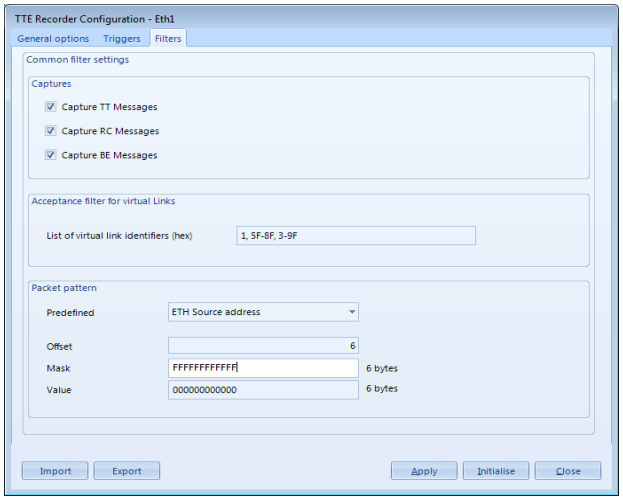
iSAFT TTEthernet Verification/SPY Tool - Triggers/Filters

- Triggers
  - Independently selectable triggers per port.
  - Independent triggers for start/stop of capture.
  - User defined packet pattern.
  - Start/end time and duration.

- Recording Filters
  - VLID, Source address, Ether Type field (packet size or protocol)
  - Captures per TT / RC / BE traffic class
  - User defined packet pattern.

- Display filters (supported by Wireshark)
  - Filters based on any protocol header fields
  - Combinations using logical expressions
  - Configurable filters library





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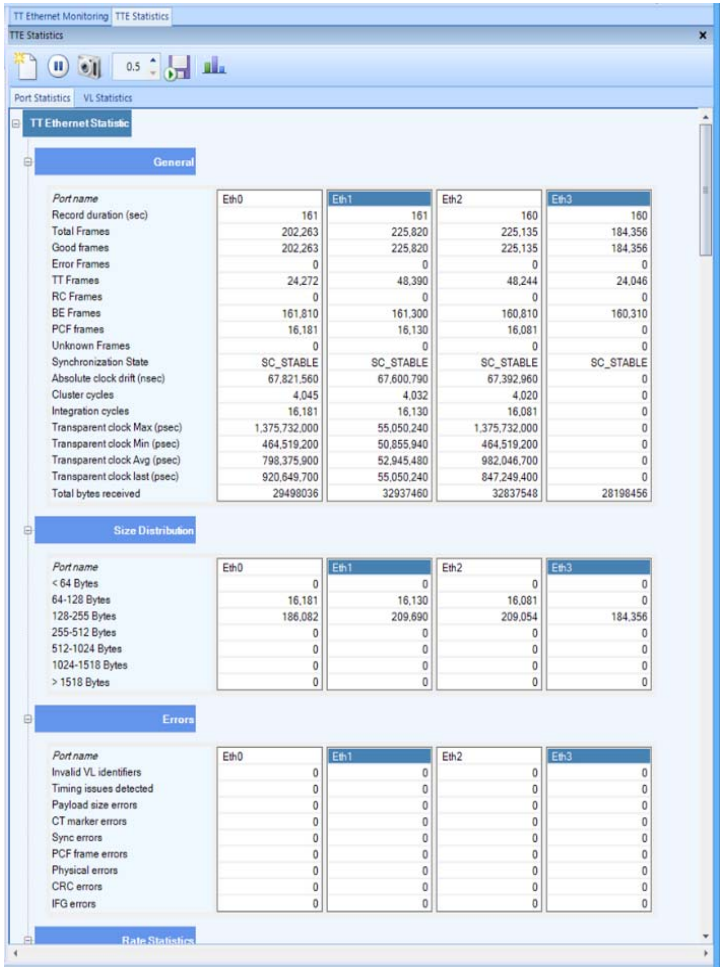
iSAFT TTEthernet Verification/SPY Tool – Real Time Statistics

- General Statistics: Total, Good and Error frames received, TT / RC / BE / PCF frames received, Total bytes received, Record duration.
- Synchronization State, Absolute clock drift, Cluster / Integration cycles, Transparent clock.
- Error statistics: Timing errors, payload size errors, synchronisation errors, PCF frame errors, CRC errors, Inter-frame gap errors.
- Rate statistics: Bytes per second, frames per second.
- Per VLID statistics: Good and Error frames, Traffic class, Type of errors occur at this VLID, Min, Max, Avg frames per integration cycle.
- Packet statistics distributed by size.



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iSAFT TTEthernet Verification/SPY Tool – Display of Frames

- Frames captured per port can be displayed real time or offline
- Using Wireshark network analyser and custom dissectors
- Custom Dissectors:
  - Low level Physical Dissector
    - *Display tool I/F port name*
    - *Info / errors detected by the tool (VLID, Traffic Class, VLID error, size error, Timing error, etc.)*
    - *Synchronisation info detected by the tool (Sync state, Timing delay w.r.t. time window)*
    - *Physical errors detected by the board (e.g. SOF, CRC, IFG)*
- Existing Wireshark Dissectors:
  - Ethernet, IP, UDP. TCP, etc.
  - TTE PCF frames Dissector
  - TFTP (data loading)
  - SNMP (diagnosis network management)
- Custom User Payload Data Dissectors:
  - PUS as an option
  - User configurable script dissector (Lua script language supported by Wireshark)

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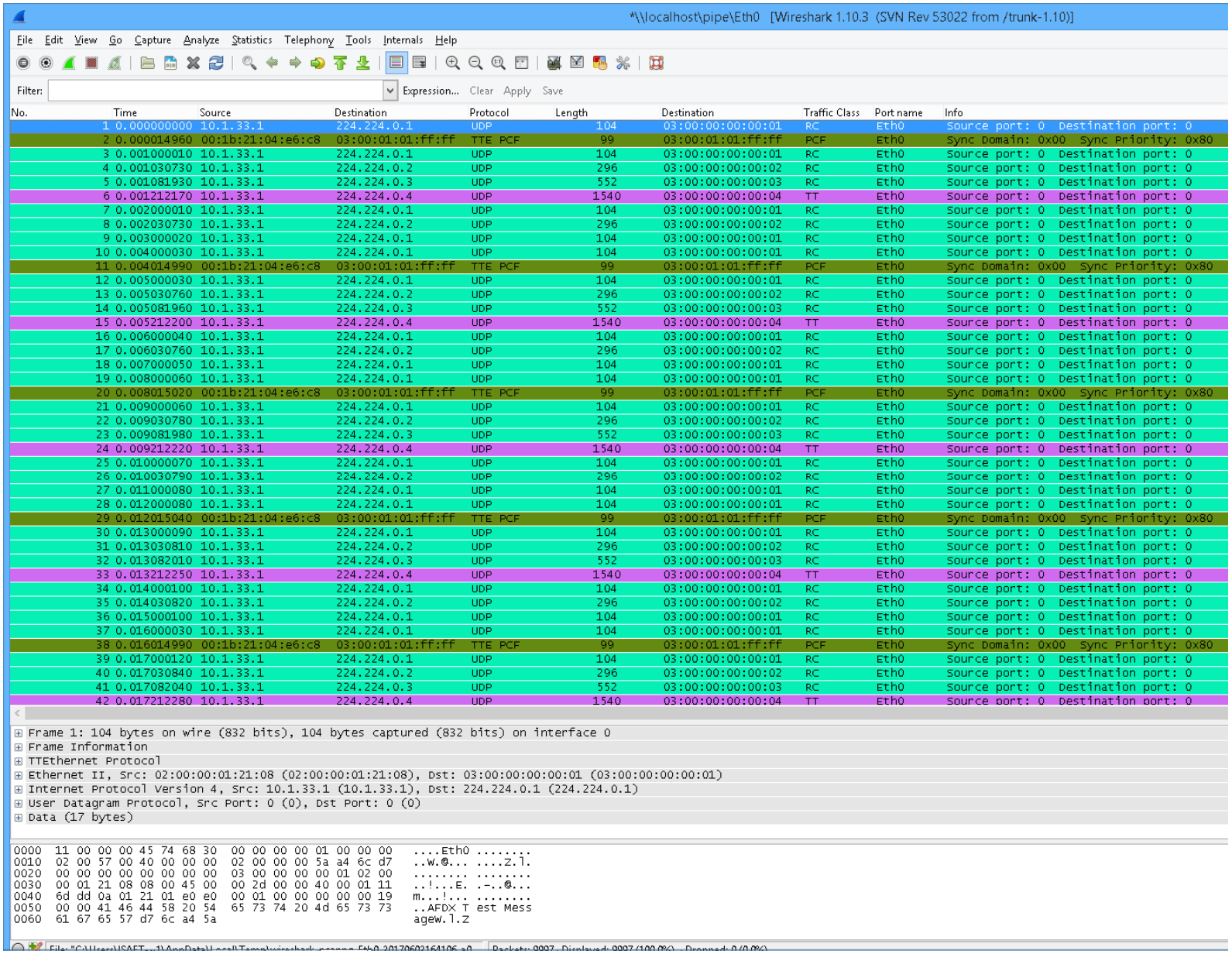
iSAFT TTEthernet Verification/SPY Tool
Frames with no errors



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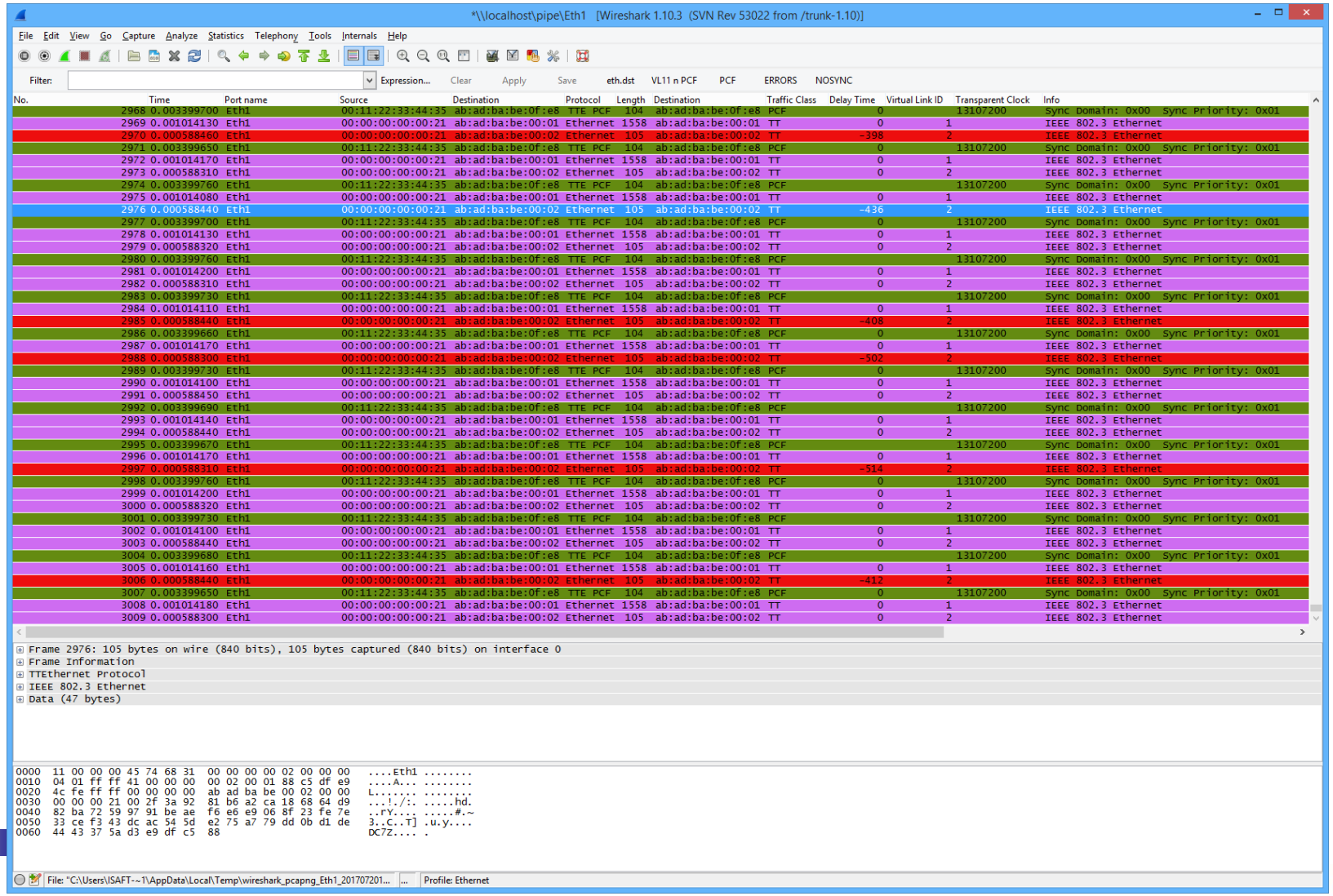
iSAFT TTEthernet Verification/SPY Tool
Frames with timing errors



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iSAFT TTE Verification/SPY Tool – Strengths at a glance

- Independent Verification of Time Triggered Ethernet traffic flows
- All-in-one recording, observation & verification environment
- Suitable for many different areas/users
- Customization for new protocols & interfaces
- Built on open and standard technologies.

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Feasibility Study for Development of TTE End System Validation / Traffic Generation / Fault Injection Tool

- Analysis of TTE End System Functional Blocks
- Preliminary Design Based on iSAFT Existing NIC Architecture
- Architectural Analysis and Preliminary Implementation of a Time Triggered Class Scheduler Block
- Functional / Performance Validation
- Assessment of Synthesis / Utilization Results

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