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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

- Project Overview
- About TELETEL – Short company overview
- iSAFT Product Line – Short overview
- iSAFT TTE Verification/SPY Tool

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.

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.

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	ISAFAT 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

2000

2005

2010

Today



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)

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)



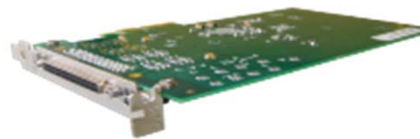
Site Rackmount System (3U)



Portable System



Quad/Octal SpaceWire PCIe NIC



Dual 1553 1Mbit PCIe NIC



Dual CAN PCIe NIC

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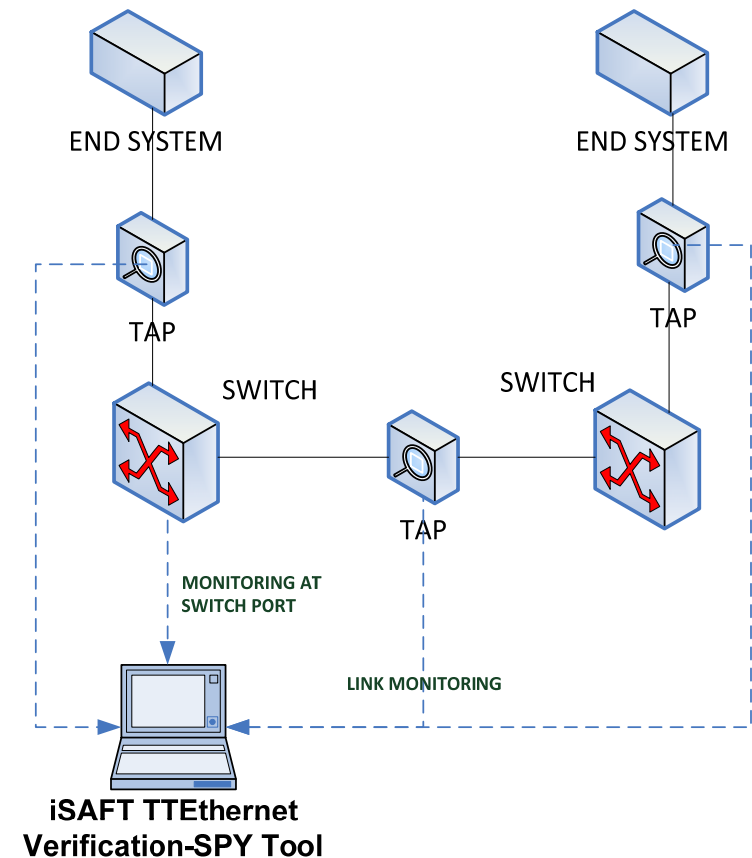
iSAFT TTEthernet Verification-SPY Tool - General Features

- 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 TTEch 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

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)



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

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

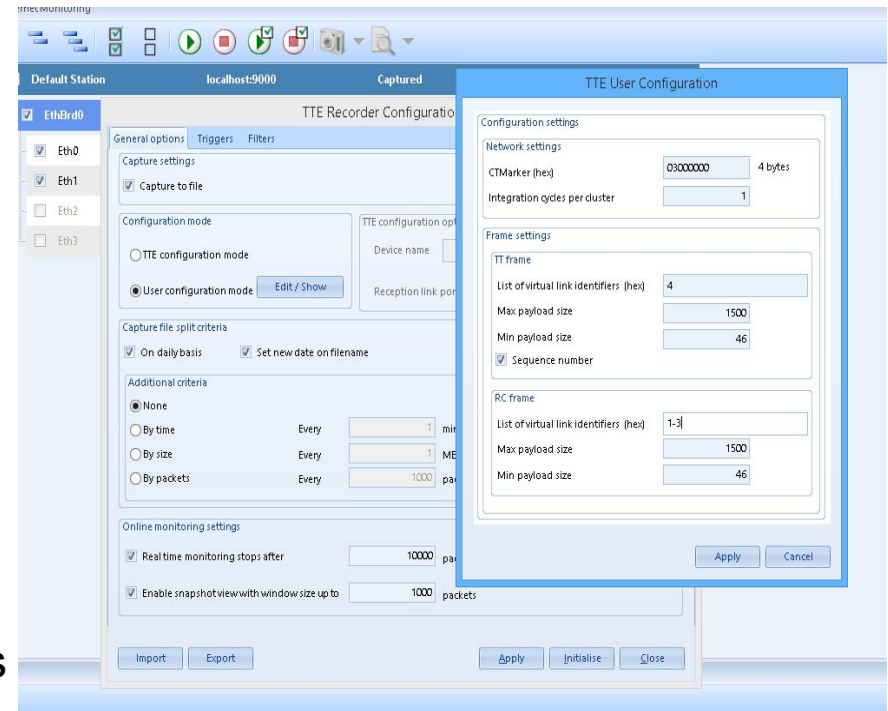
- PCIe Express Interface Gen3
- 8-lane bus width
- 8GT/s bus speed
- 4 x1 Gbps SFP ports
- Capture rate 4 Gbit/s(line speed, zero packet loss from 64 byte to 10000 byte frames)
- IEEE 802.3 10 / 100 / 1000 Mbps Ethernet
- 2 GB DDR3 RAM
- Frame and flow filtering
- 4 ns time-stamping



**Napatech NT4E2-4-PTP
Ethernet Interface Board**

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



iSAFT TTEthernet Verification/SPY Tool - Triggers/Filters

■ Triggers

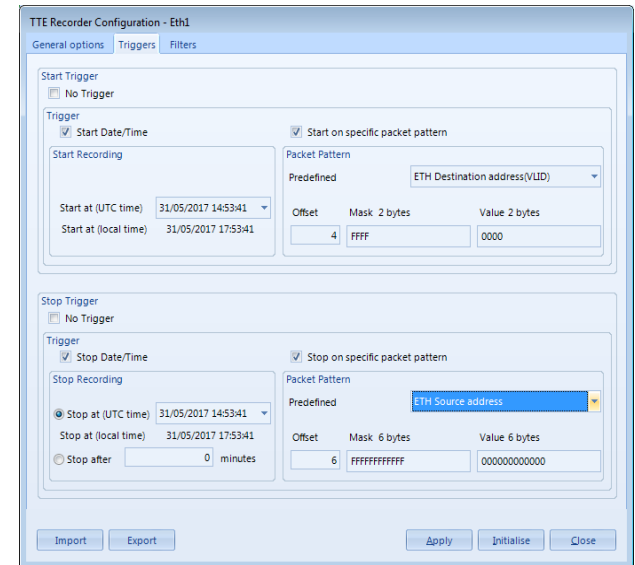
- Independently selectable triggers per port.
- Independent triggers for start/stop of capture.
- User defined packet pattern.
- Start/end time and duration.

■ Recording Filters

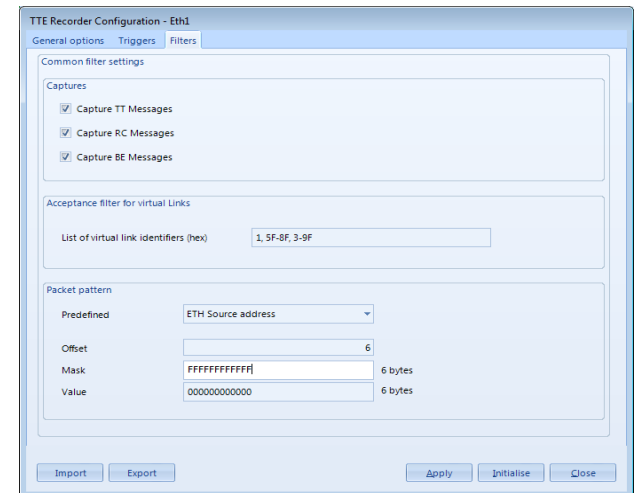
- VLID, Source address, Ether Type field (packet size or protocol)
- Captures per TT / RC / BE traffic class
- User defined packet pattern.

■ Display filters (supported by Wireshark)

- Filters based on any protocol header fields
- Combinations using logical expressions
- Configurable filters library



The screenshot shows the 'Triggers' tab of the 'TTE Recorder Configuration - Eth1' window. It is divided into 'Start Trigger' and 'Stop Trigger' sections. Both sections have a 'No Trigger' checkbox and a 'Trigger' checkbox. In the 'Start Trigger' section, 'Start Date/Time' and 'Start on specific packet pattern' are checked. The 'Start Recording' area shows 'Start at (UTC time)' as 31/05/2017 14:53:41 and 'Start at (local time)' as 31/05/2017 17:53:41. The 'Packet Pattern' is set to 'Predefined' with 'ETH Destination address(VLID)'. The 'Offset' is 4, 'Mask' is 2 bytes (FFFF), and 'Value' is 2 bytes (0000). The 'Stop Trigger' section has 'Stop Date/Time' and 'Stop on specific packet pattern' checked. The 'Stop Recording' area shows 'Stop at (UTC time)' as 31/05/2017 14:53:41, 'Stop at (local time)' as 31/05/2017 17:53:41, and 'Stop after' as 0 minutes. The 'Packet Pattern' is set to 'Predefined' with 'ETH Source address'. The 'Offset' is 6, 'Mask' is 6 bytes (FFFFFFFF), and 'Value' is 6 bytes (000000000000). Buttons for 'Import', 'Export', 'Apply', 'Initialise', and 'Close' are at the bottom.



The screenshot shows the 'Filters' tab of the 'TTE Recorder Configuration - Eth1' window. It has a 'Common filter settings' section with 'Captures' checked for 'Capture TT Messages', 'Capture RC Messages', and 'Capture BE Messages'. Below that is an 'Acceptance filter for virtual Links' section with a text box containing '1, 5F-8F, 3-9F'. The 'Packet pattern' section has 'Predefined' set to 'ETH Source address'. The 'Offset' is 6, 'Mask' is 6 bytes (FFFFFFFF), and 'Value' is 6 bytes (000000000000). Buttons for 'Import', 'Export', 'Apply', 'Initialise', and 'Close' are at the bottom.

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.

The screenshot displays the 'TTEthernet Verification/SPY Tool' interface. The main window is titled 'TTE Statistics' and shows a table of statistics for four Ethernet ports: Eth0, Eth1, Eth2, and Eth3. The table is organized into several sections: General, Size Distribution, Errors, and Rate Statistics. The 'General' section provides a comprehensive overview of frame counts, synchronization states, and clock drift. The 'Size Distribution' section shows the number of frames received in various size ranges. The 'Errors' section lists various error types and their counts. The 'Rate Statistics' section shows the number of frames received per second for each port.

Port name	Eth0	Eth1	Eth2	Eth3
Record duration (sec)	161	161	160	160
Total Frames	202,263	225,820	225,135	184,356
Good frames	202,263	225,820	225,135	184,356
Error Frames	0	0	0	0
TT Frames	24,272	48,390	48,244	24,046
RC Frames	0	0	0	0
BE Frames	161,810	161,300	160,810	160,310
PCF frames	16,181	16,130	16,081	0
Unknown Frames	0	0	0	0
Synchronization State	SC_STABLE	SC_STABLE	SC_STABLE	SC_STABLE
Absolute clock drift (nsec)	67,821,560	67,600,790	67,392,960	0
Cluster cycles	4,045	4,032	4,020	0
Integration cycles	16,181	16,130	16,081	0
Transparent clock Max (psec)	1,375,732,000	55,050,240	1,375,732,000	0
Transparent clock Min (psec)	464,519,200	50,855,940	464,519,200	0
Transparent clock Avg (psec)	798,375,900	52,945,480	982,046,700	0
Transparent clock last (psec)	920,649,700	55,050,240	647,249,400	0
Total bytes received	29498036	32937460	32837548	28198456

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)

iSAFT TTEthernet Verification/SPY Tool Frames with no errors

\\localhost\pipe\Eth0 [Wireshark 1.10.3 (SVN Rev 53022 from /trunk-1.10)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Destination	Traffic Class	Port name	Info
1	0.000000000	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
2	0.000014960	00:1b:21:04:e6:c8	03:00:01:01:ff:ff	TTE PCF	99	03:00:01:01:ff:ff	PCF	Eth0	Sync Domain: 0x00 Sync Priority: 0x80
3	0.001000010	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
4	0.001030730	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
5	0.001081930	10.1.33.1	224.224.0.3	UDP	552	03:00:00:00:00:03	RC	Eth0	Source port: 0 Destination port: 0
6	0.001212170	10.1.33.1	224.224.0.4	UDP	1540	03:00:00:00:00:04	TT	Eth0	Source port: 0 Destination port: 0
7	0.002000010	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
8	0.002030730	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
9	0.003000020	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
10	0.004000030	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
11	0.004014990	00:1b:21:04:e6:c8	03:00:01:01:ff:ff	TTE PCF	99	03:00:01:01:ff:ff	PCF	Eth0	Sync Domain: 0x00 Sync Priority: 0x80
12	0.005000030	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
13	0.005030760	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
14	0.005081960	10.1.33.1	224.224.0.3	UDP	552	03:00:00:00:00:03	RC	Eth0	Source port: 0 Destination port: 0
15	0.005212200	10.1.33.1	224.224.0.4	UDP	1540	03:00:00:00:00:04	TT	Eth0	Source port: 0 Destination port: 0
16	0.006000040	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
17	0.006030760	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
18	0.007000050	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
19	0.008000060	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
20	0.008015020	00:1b:21:04:e6:c8	03:00:01:01:ff:ff	TTE PCF	99	03:00:01:01:ff:ff	PCF	Eth0	Sync Domain: 0x00 Sync Priority: 0x80
21	0.009000060	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
22	0.009030780	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
23	0.009081980	10.1.33.1	224.224.0.3	UDP	552	03:00:00:00:00:03	RC	Eth0	Source port: 0 Destination port: 0
24	0.009212220	10.1.33.1	224.224.0.4	UDP	1540	03:00:00:00:00:04	TT	Eth0	Source port: 0 Destination port: 0
25	0.010000070	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
26	0.010030790	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
27	0.011000080	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
28	0.012000080	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
29	0.012015040	00:1b:21:04:e6:c8	03:00:01:01:ff:ff	TTE PCF	99	03:00:01:01:ff:ff	PCF	Eth0	Sync Domain: 0x00 Sync Priority: 0x80
30	0.013000090	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
31	0.013030810	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
32	0.013082010	10.1.33.1	224.224.0.3	UDP	552	03:00:00:00:00:03	RC	Eth0	Source port: 0 Destination port: 0
33	0.013212250	10.1.33.1	224.224.0.4	UDP	1540	03:00:00:00:00:04	TT	Eth0	Source port: 0 Destination port: 0
34	0.014000100	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
35	0.014030820	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
36	0.015000100	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
37	0.016000030	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
38	0.016014990	00:1b:21:04:e6:c8	03:00:01:01:ff:ff	TTE PCF	99	03:00:01:01:ff:ff	PCF	Eth0	Sync Domain: 0x00 Sync Priority: 0x80
39	0.017000120	10.1.33.1	224.224.0.1	UDP	104	03:00:00:00:00:01	RC	Eth0	Source port: 0 Destination port: 0
40	0.017030840	10.1.33.1	224.224.0.2	UDP	296	03:00:00:00:00:02	RC	Eth0	Source port: 0 Destination port: 0
41	0.017082040	10.1.33.1	224.224.0.3	UDP	552	03:00:00:00:00:03	RC	Eth0	Source port: 0 Destination port: 0
42	0.017212280	10.1.33.1	224.224.0.4	UDP	1540	03:00:00:00:00:04	TT	Eth0	Source port: 0 Destination port: 0

Frame 1: 104 bytes on wire (832 bits), 104 bytes captured (832 bits) on interface 0

Frame Information

TTEthernet Protocol

Ethernet II, Src: 02:00:00:01:21:08 (02:00:00:01:21:08), Dst: 03:00:00:00:00:01 (03:00:00:00:00:01)

Internet Protocol Version 4, Src: 10.1.33.1 (10.1.33.1), Dst: 224.224.0.1 (224.224.0.1)

User Datagram Protocol, Src Port: 0 (0), Dst Port: 0 (0)

Data (17 bytes)

```

0000 11 00 00 00 45 74 68 30 00 00 00 00 01 00 00 00  ....Eth0 .....
0010 02 00 57 00 40 00 00 00 02 00 00 00 5a a4 6c d7  ..w.θ... ..Z.l.
0020 00 00 00 00 00 00 00 00 03 00 00 00 00 01 02 00  ....E... ..θ...
0030 00 01 21 08 08 00 45 00 00 2d 00 00 40 00 01 11  ..!..E... ..θ...
0040 6d dd 0a 01 21 01 e0 e0 00 01 00 00 00 00 19  m...l... ..θ...
0050 00 00 41 46 44 58 20 54 65 73 74 20 4d 65 73 73  ..AFdx T est Mess
0060 61 67 65 57 d7 6c a4 5a                               agew.l.Z
    
```

File: C:\Users\iSAFT... \AppData\Local\Temp\wireshark-pcap-eth0-20170602161106... [Packets: 0/07 - Displayed: 0/07 (100%) - Disabled: 0 (0%)]

iSAFT TTEthernet Verification/SPY Tool Frames with timing errors

Wireshark 1.10.3 (SVN Rev 53022 from /trunk-1.10)

Filter: Expression... Clear Apply Save eth.dst VL11 n PCF PCF ERRORS NOSYNC

No.	Time	Port name	Source	Destination	Protocol	Length	Destination	Traffic Class	Delay Time	Virtual Link ID	Transparent Clock	Info
2968	0.003399700	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2969	0.001014130	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2970	0.000588460	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	-398	2	IEEE 802.3 Ethernet	
2971	0.003399650	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2972	0.001014170	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2973	0.000588310	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	
2974	0.003399760	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2975	0.00104080	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2976	0.000588340	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	-438	2	IEEE 802.3 Ethernet	
2977	0.003399700	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2978	0.001014130	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2979	0.000588320	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	
2980	0.003399760	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2981	0.001014200	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2982	0.000588310	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	
2983	0.003399730	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2984	0.001014110	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2985	0.000588440	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	-408	2	IEEE 802.3 Ethernet	
2986	0.003399660	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2987	0.001014170	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2988	0.000588300	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	-502	2	IEEE 802.3 Ethernet	
2989	0.003399730	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2990	0.001014100	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2991	0.000588450	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	
2992	0.003399690	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2993	0.001014140	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2994	0.000588440	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	
2995	0.003399700	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2996	0.001014170	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
2997	0.000588310	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	-514	2	IEEE 802.3 Ethernet	
2998	0.003399760	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
2999	0.001014200	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
3000	0.000588320	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	
3001	0.003399730	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
3002	0.001014100	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
3003	0.000588440	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	
3004	0.003399680	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
3005	0.001014160	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
3006	0.000588440	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	-412	2	IEEE 802.3 Ethernet	
3007	0.003399650	Eth1	00:11:22:33:44:35	ab:ad:ba:be:0f:e8	TTEthernet	104	ab:ad:ba:be:0f:e8	PCF	0	1	13107200	Sync Domain: 0x00 Sync Priority: 0x01
3008	0.001014180	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:01	Ethernet	1558	ab:ad:ba:be:00:01	TT	0	1	IEEE 802.3 Ethernet	
3009	0.000588300	Eth1	00:00:00:00:00:21	ab:ad:ba:be:00:02	Ethernet	105	ab:ad:ba:be:00:02	TT	0	2	IEEE 802.3 Ethernet	

Frame 2976: 105 bytes on wire (840 bits), 105 bytes captured (840 bits) on interface 0

- Frame Information
- TTEthernet Protocol
- IEEE 802.3 Ethernet
- Data (47 bytes)

```

0000 11 00 00 00 45 74 68 31 00 00 00 00 02 00 00 00  ....Eth1 .....
0010 04 01 ff ff 41 00 00 00 00 02 00 01 88 c5 df e9  ...A.....
0020 4c fe ff ff 00 00 00 00 ab ad ba be 00 02 00 00  L.....
0030 00 00 00 21 00 2f 3a 92 81 b6 a2 ca 18 68 64 d9  .../.....hd.
0040 82 ba 72 59 97 91 be ae f6 e6 e9 06 8f 23 fe 7e  ...rV.....#~
0050 33 ce f3 43 dc ac 54 5d e2 75 a7 79 dd 0b d1 de  3..C..T].u.y....
0060 44 43 37 5a d3 e9 df c5 88                      DC7Z.....
    
```

File: "C:\Users\ISAFT-1\AppData\Local\Temp\wireshark_pcapng_Eth1_201707201... Profile: Ethernet

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.



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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