

Supporting development testbeds
iSAFT Protocol Validation System



Vangelis Kollias

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teletel

iSAFT PVS Rationale

- Evolution of S/C on-board communications (SpW, SOIS, CAN, etc.), require new generation of EGSE tools to support advanced testing, integration & validation
- TELETEL develops the iSAFT (previously known as SAFIRE) protocol validation product family which has more than 20 years of experience in the telecommunications and avionics (i.e. IP, AFDX) sectors



- ✓ Since 2009, TELETEL, with industrial/mission requirements from ESA & Space Primes, is developing the **new** iSAFT product family aiming at supplying State-of-the-Art EGSE instances (SCOE) supporting multiple on-board interfaces (SpW, MIL-STD-1553, CAN) and functionalities (traffic recording, interfaces simulation, protocol test execution (conformance, acceptance, etc.) instrument simulation, interworking testing)



ESTEC PVS current contract: Project Snapshot

- Period I: February 2012 – October 2013
 - ✓ Support SpW recording, SpW simulation
 - ✓ Support RMAP (RMAP tester), CCSDS
 - ✓ Support 1553 recording, 1553 RT emulation
 - ✓ Support 1553 SAE 4112 protocol & electrical tests
 - ✓ Support 1553 ECSS-13C RT tests
 - ✓ Support CAN recording
 - ✓ Industrial integration & certification (CE, FMEA, etc.) for connection to flight equipment for missions
 - ✓ *Already validated in Astrium Toulouse & ESTEC for SpW & 1553 interfaces*

- Period II: November 2013 – February 2015
 - Support advanced SpW traffic generation, simulation
 - Support 1553 ECSS-13C BC tests, BC/RT simulation of ECSS-E-ST-13C services
 - Support ECSS-15C CAN/CANOpen recording & simulation
 - Support instrument (TM/TC) simulation
 - Further validation in the Solar Orbiter EGSE testbed in Astrium UK

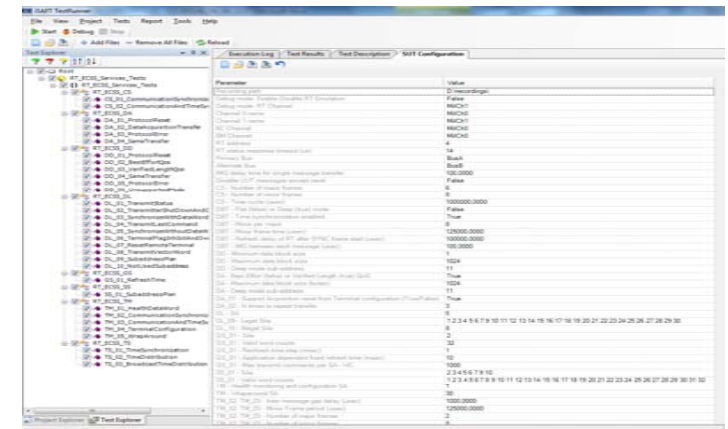


iSAFT Products Available Today

- ✓ iSAFT SpaceWire / MIL-STD-1553 / CAN Recorder - available

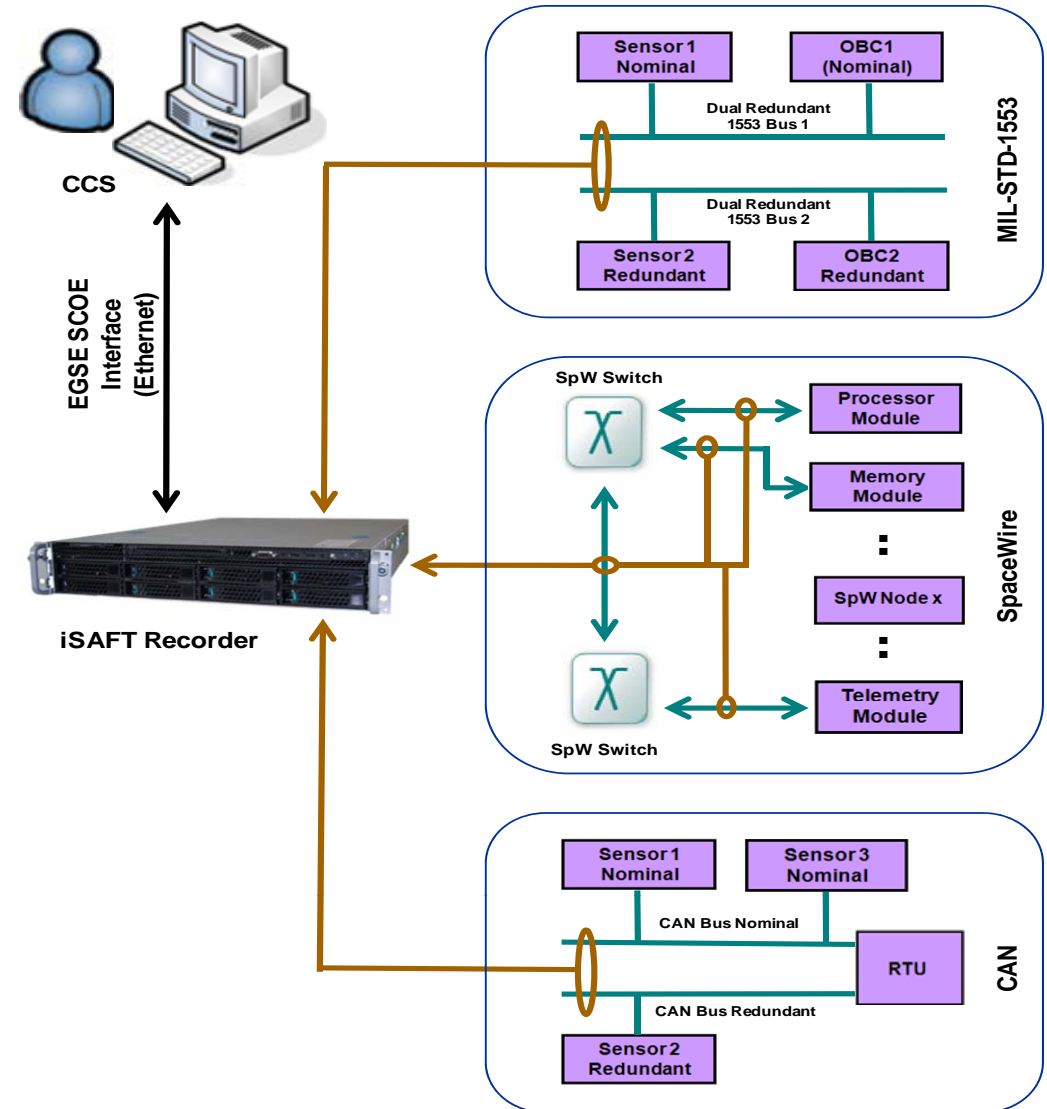


- ✓ ECSS-E-ST-13C 1553 RT services tester (includes SAE4112) - available



iSAFT SpW / MIL-STD-1553 / CAN Recorder

- Advanced, integrated, high performing, modern network traffic capture, recording and analysis tool for the validation of satellite/spacecraft on-board data networks
- Traffic capturing on multiple SpW links, MIL-STD-1553 and/or CAN buses, time stamping, recording, and delivering them to a powerful Protocol Analyzer for further processing and analysis
- One station for SpW, 1553, CAN recording, recording files management, interface to CCS, IRIG synchronisation, etc.



iSAFT PVS Graphical Tool Chain (1)

System Status

Default Station D:\Recordings

- SpWBoard0 (PCIe-SpW-8, IRIG: Disabled)
 - SpWPort0: MON
 - SpWPort1: MON
 - SpWPort2: MON
 - SpWPort3: MON
 - SpWPort4: MON
 - SpWPort5: MON
 - SpWPort6: MON
 - SpWPort7: MON
- MilBoard0 (PCIe-4L1553, IRIG: Disabled)
 - MilCh0: BM, BC, RT
 - MilCh1: BM, BC, RT

SpaceWire Recorder

Default Station		D:\Recordings		Captured	Valid	Errors
SpWBoard0				27,188,473	27,188,473	0
<input checked="" type="checkbox"/>	SpWPort0	Packet	Monitoring	27,188,473	27,188,473	0
<input checked="" type="checkbox"/>	SpWPort1	Packet	Waiting for trigger	0	0	0
<input type="checkbox"/>	SpWPort2	Packet	Stopped	0	0	0
<input type="checkbox"/>	SpWPort3	Packet	Stopped	0	0	0
<input type="checkbox"/>	SpWPort4	Packet	Stopped	0	0	0
<input type="checkbox"/>	SpWPort5	Packet	Stopped	0	0	0
<input type="checkbox"/>	SpWPort6	Packet	Stopped	0	0	0
<input type="checkbox"/>	SpWPort7	Packet	Stopped	0	0	0

Default Station

Station information

Station name: Default Station
 IP address & port: net.tcp://localhost:9000

RAM

Used: 2066 MB (8%)
 Free: 22510 MB
 Total: 24576 MB

Recording drive

Used: 207 GB (87%)
 Free: 29 GB
 Total: 236 GB

CPU utilization (%)

Average	28%
Core #1	3%
Core #2	85%
Core #3	88%
Core #4	0%
Core #5	6%
Core #6	12%
Core #7	6%
Core #8	24%

MIL-STD-1553 Bus Monitor

Default Station		D:\Recordings		Captured	Valid	Errors
MilBoard0				35,803	2,505	33,298
<input type="checkbox"/>	MilCh0	Bus Monitor	Monitoring	35,803	2,505	33,298
<input type="checkbox"/>	MilCh1	Bus Monitor	Stopped	0	0	0



iSAFT PVS Graphical Tool Chain (2)

ISAF T Tools

System Status

Default Station D:\Recordings

SpWBoard0 PCIe-SpW-8 IRIG: Disabled

SpWPort0 MON

SpWPort1 MON

SpWPort2 MON

SpWPort3 MON

SpWPort4 MON

SpWPort5 MON

SpWPort6 MON

SpWPort7 MON

MilBoard0 PCIe-4L1553 IRIG: Disabled

MilCh0 BM BC RT

MilCh1 BM BC RT

Default Station

Station information

Station name Default Station

IP address & port net.tcp://localhost:9000

RAM 9 %

Used: 2338 MB

Free: 22238 MB

Total: 24576 MB

Recording drive 84 %

Used: 200 GB

Free: 36 GB

Total: 236 GB

CPU utilization (%)

Average 16 %

Core #1 52 %

Core #2 0 %

Core #3 0 %

Core #4 0 %

Core #5 3 %

Core #6 0 %

Core #7 0 %

Core #8 0 %

SpaceWire Recorder SpaceWire Statistics

SpaceWire Statistics

General

	Default Station SpWBoard0 SpWPort0 Packet	Default Station SpWBoard0 SpWPort1 Packet	Default Station SpWBoard0 SpWPort2 Character	Default Station SpWBoard0 SpWPort3 Character	Default Station SpWBoard0 SpWPort4 Packet	Default Station SpWBoard0 SpWPort5 Packet	Default Station SpWBoard0 SpWPort6 Packet	Default Station SpWBoard0 SpWPort7 Packet
Station name	Default Station	Default Station	Default Station	Default Station	Default Station	Default Station	Default Station	Default Station
Board name	SpWBoard0	SpWBoard0	SpWBoard0	SpWBoard0	SpWBoard0	SpWBoard0	SpWBoard0	SpWBoard0
Port name	SpWPort0	SpWPort1	SpWPort2	SpWPort3	SpWPort4	SpWPort5	SpWPort6	SpWPort7
Monitoring level	Packet	Packet	Character	Character	Packet	Packet	Packet	Packet
Total packets (EOP & EEP-terminated)	1,577,039	1,576,895	532	197,381	0	0	1,576,324	1,576,184
Valid packets (EOP-terminated)	1,577,037	1,576,893	532	197,381	0	0	1,576,322	1,576,182
Total bytes (Data characters)	1,629,079,558	1,628,929,633	548,848	203,894,300	0	0	1,628,340,087	1,628,195,728
Total packets/sec	0	0	0	0	0	0	0	0
Total bytes/sec	0	0	0	0	0	0	0	0

Control and character codes

	Default Station SpWBoard0 SpWPort0 Packet	Default Station SpWBoard0 SpWPort1 Packet	Default Station SpWBoard0 SpWPort2 Character	Default Station SpWBoard0 SpWPort3 Character	Default Station SpWBoard0 SpWPort4 Packet	Default Station SpWBoard0 SpWPort5 Packet	Default Station SpWBoard0 SpWPort6 Packet	Default Station SpWBoard0 SpWPort7 Packet
Total signalling codes	0	0	0	0	0	0	0	0
Time codes	0	0	0	0	0	0	0	0
Interrupts (INTR)	0	0	0	0	0	0	0	0
Interrupt acknowledgments (INTA)	0	0	0	0	0	0	0	0
Signalling code 01	0	0	0	0	0	0	0	0
Signalling code 11	0	0	0	0	0	0	0	0
FCTs	203,832,165	203,813,401	68,673	25,511,461	0	0	203,739,761	203,723,520
Nulls	169,942,678	171,196,975	0	0	0	0	176,214,162	177,468,457

Errors

	Default Station SpWBoard0 SpWPort0 Packet	Default Station SpWBoard0 SpWPort1 Packet	Default Station SpWBoard0 SpWPort2 Character	Default Station SpWBoard0 SpWPort3 Character	Default Station SpWBoard0 SpWPort4 Packet	Default Station SpWBoard0 SpWPort5 Packet	Default Station SpWBoard0 SpWPort6 Packet	Default Station SpWBoard0 SpWPort7 Packet
Error packets (EEP-terminated)	2	2	0	0	0	0	2	2
Esc errors	0	0	0	0	0	0	0	0
Parity errors	1	2	0	0	0	0	2	2
Disconnects	2	2	0	0	0	0	2	2

Packet size distribution

	Default Station SpWBoard0 SpWPort0 Packet	Default Station SpWBoard0 SpWPort1 Packet	Default Station SpWBoard0 SpWPort2 Character	Default Station SpWBoard0 SpWPort3 Character	Default Station SpWBoard0 SpWPort4 Packet	Default Station SpWBoard0 SpWPort5 Packet	Default Station SpWBoard0 SpWPort6 Packet	Default Station SpWBoard0 SpWPort7 Packet
0 Bytes - 64 Bytes	1	2	0	0	0	0	1	1
> 64 Bytes - 128 Bytes	0	0	0	0	0	0	0	0
> 128 Bytes - 192 Bytes	0	1	0	0	0	0	0	0
> 192 Bytes - 256 Bytes	0	0	0	0	0	0	1	1
> 256 Bytes - 384 Bytes	0	0	0	0	0	0	1	0
> 384 Bytes - 512 Bytes	0	0	0	0	0	0	0	0
> 512 Bytes - 1024 Bytes	2	0	0	0	0	0	0	1
> 1 KB - 4 KB	1,577,036	1,576,892	0	0	0	0	1,576,321	1,576,181
> 4 KB - 16 KB	0	0	0	0	0	0	0	0
> 16 KB - 64 KB	0	0	0	0	0	0	0	0
> 64 KB	0	0	0	0	0	0	0	0



iSAFT PVS Graphical Tool Chain (3)

SpW-1553 merged

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply Save

No.	Time	Protocol	Port	Length	SpW Path Addresses	SpW Logical Address	SpW Protocol ID	1553 Type
2668	2.120486488	Spacewire	SpwPort4	97	11,12,13,14,15	41	Remote Memory Access Protocol	
2669	2.120494496	Spacewire	SpwPort4	89	1,2,3	42	3	
2670	2.120501832	Spacewire	SpwPort4	60019		43	42	
2671	2.120578832	1553	1553Ch0	40				Mode code
2672	2.120627312	1553	1553Ch0	164				BC-RT
2673	2.121320512	1553	1553Ch0	164				RT-BC
2674	2.122013712	1553	1553Ch0	164				RT-RT
2675	2.125131016	Spacewire	SpwPort5	41	1,2,3	40	Remote Memory Access Protocol	
2676	2.125133168	Spacewire	SpwPort5	97	11,12,13,14,15	41	Remote Memory Access Protocol	
2677	2.125141280	Spacewire	SpwPort5	89	1,2,3	42	3	
2678	2.125148624	Spacewire	SpwPort5	60019	7,6,5,4,3,2,1,0	255	254	
2679	2.126787480	Spacewire	SpwPort4	41	1,2,3	40	Remote Memory Access Protocol	
2680	2.126789736	Spacewire	SpwPort4	97	11,12,13,14,15	41	Remote Memory Access Protocol	
2681	2.126797744	Spacewire	SpwPort4	89	1,2,3	42	3	
2682	2.126805024	Spacewire	SpwPort4	60019		204	203	
2683	2.130578832	1553	1553Ch0	40				Mode code
2684	2.130627312	1553	1553Ch0	164				BC-RT
2685	2.131320512	1553	1553Ch0	164				BC-RT
2686	2.131434264	Spacewire	SpwPort5	41	1,2,3	40	Remote Memory Access Protocol	
2687	2.131436520	Spacewire	SpwPort5	97	11,12,13,14,15	41	Remote Memory Access Protocol	
2688	2.131444528	Spacewire	SpwPort5	89	1,2,3	42	3	
2689	2.131451872	Spacewire	SpwPort5	60019		173	172	
2690	2.132013712	1553	1553Ch0	164				BC-RT
2691	2.133090672	Spacewire	SpwPort4	41	1,2,3	40	Remote Memory Access Protocol	
2692	2.133092984	Spacewire	SpwPort4	97	11,12,13,14,15	41	Remote Memory Access Protocol	
2693	2.133101096	Spacewire	SpwPort4	89	1,2,3	42	3	

Frame 2671: 40 bytes on wire (320 bits), 40 bytes captured (320 bits)

Frame Information

- Frame type: 1553 Packet (11)
- Port name: 1553Ch0

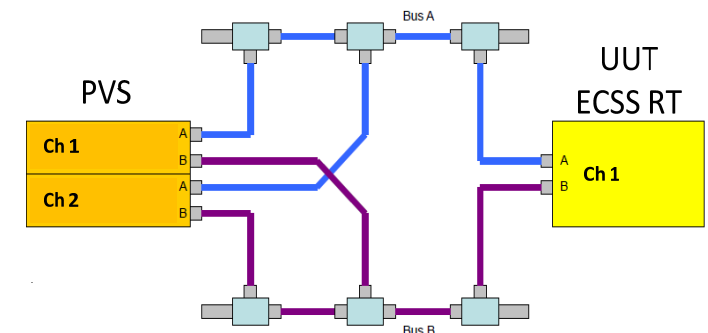
1553 Protocol

- Packet Information
 - Inter-Message Gap: 7826,8 usec
 - Data Word Count: 1 words
 - Bus detect: A
 - Message type: Mode code
 - Broadcast: true
- CMD: (31-R-0-17)



New Product: ECSS-E-ST-13C 1553 RT services tester

- 1553 RT validation with respect to the ECSS 1553 Services
- iSAFT tester operates as Bus Controller and Bus Monitor and performs validation of the RT unit under test (UUT) against the ECSS-E-ST-50-13C RT requirements.
- Currently supported test suites :
 - RT_ECSS_CS: Communication Synchronization Service tests
 - RT_ECSS_DA: Data Acquisition transfers tests
 - RT_ECSS_DD: Data Distribution transfers tests
 - RT_ECSS_DL: Data Link layer tests
 - RT_ECSS_GS: Get Service tests
 - RT_ECSS_SS: Set Service tests
 - RT_ECSS_TM: Terminal Management Service test
 - RT_ECSS_TS: Time Service tests



ECSS-E-ST-13C 1553 RT services tester – iSAFT TestRunner

The screenshot displays the iSAFT TestRunner interface. On the left, the Test Explorer shows a tree view of test cases under the root 'RT_ECSS_Services_Tests'. The selected test case is 'DD_04_SameTransfer' under the 'RT_ECSS_DD' category. The main window shows the configuration for this test case, including its purpose, suite, input/output data, configuration parameters, and a detailed step-by-step description of the test procedure.

Test Case Id DD_04_SameTransfer

Test Purpose
Data distribution same transfer
Verify that the RT UUT complies with the data block distribution protocol requirements in [ECSS1553 §8.6.1.2]

Test Suite RT_ECSS_DD: Validation of ECSS Data Distribution Service

Input/Output Data
-

Configuration Time synchronisation enabled or not (param: DBT - Time synchronisation enabled)
"Flat" or "Deep" sub-addressing mode (param: DBT - Flat (false) or Deep (true) mode)
Maximum data block size: 1024 bytes for "Flat" and 4096 for "Deep" mode (param: DD - Maximum data block size)
SA for Deep Mode: (param: DD - Deep Mode sub-address)

Comments
DBC shall continue incrementing from previous test executed or the UUT shall be reset and the DBC shall start from 1

Test Step Description

- 1 Start communication synchronisation (with optional time synchronization) and initiate a data block transfer - data distribution with verified length QoS using flat or deep modes depending on UUT capabilities, with the maximum block size
Check that CS response occurs for each DTD and Data Block BCRT command sequence and for each DTC RTBC command sequence
Check that the DTC Number of bytes, Mode, SA and Distribution block count fields are a copy of the DTD and the Error and Reset flags are zero
At the UUT, check that the SendData.Deliver primitive is invoked for each Data Block transferred
- 2 At the next major frame repeat the previous transfer by sending the DTD BCRT message with unchanged DBC (block count is not incremented)
Check that CS response occurs for the Data Blocks and the DTD command sequences
- 3 After 2 minor frames read the DTC
Check that CS response occurs for the DTC command sequence
Check that UUT ignores this transfer and the DTC is unchanged (same data words with step 1)
- 4 At the next major frame repeat step 1 by incrementing the DBC
Check that the data block transfer - data distribution completes successfully
Check that UUT does not ignore this transfer



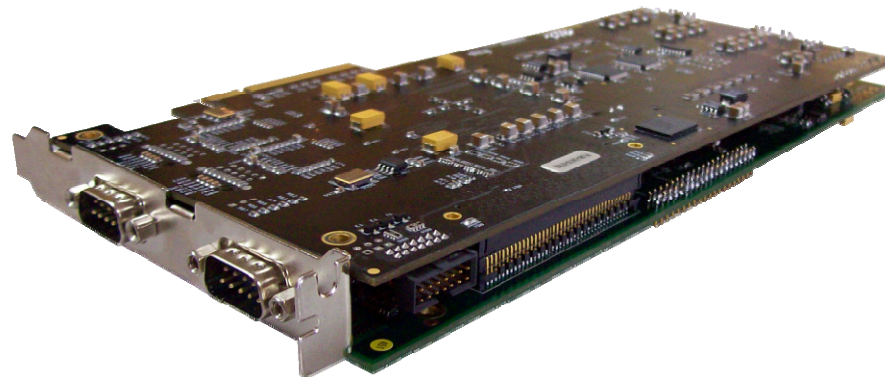
Coming Products

- iSAFT RMAP tester – available 4th quarter 2013
- iSAFT SpaceWire simulation interface (Front End SpW interface) - available 1st quarter 2014
- BC, RT simulation of ECSS-E-ST-13C 1553 services – available 2nd quarter 2014
- iSAFT instrument interface simulator (TM/TC simulation) - available 3rd quarter 2014
- iSAFT ECSS-15C CAN/CANOpen recorder/simulator – available 4th quarter 2014



iSAFT CAN – CAN PCIe NIC

- Full size PCIe form factor board
- High data throughput
- Support both ISO-11898-2 and RS-485 physical layers, electrically isolated
- Configurable as 4 single channels or 2 redundant (ECSS-15C)
- IRIG-B002 generator/receiver TTL/RS-422 electrical levels, with down to 8 nano-seconds accuracy/resolution
- Hardware triggers for synchronized operation among multiple cards/iSAFT units
- Flight equipment protection against internal failures (FMEA)



■ General Features

- Recording and decoding of standard ECSS-CAN / CANopen messages over CAN Buses.
- Continuous real-time capture of 2 - 4 channels.
- Down to 8 ns Timestamp Accuracy.
- ECSS-E-50-15C TIME messages monitoring and decoding.
- Can support of EDS and DCF files import enabling decoding and automatic interpretation of CANopen PDO frame values & parameters.

■ Filters & Triggers

- CAN frame type.
- Specific errors.
- Specific CAN Ids / COB-Ids.

■ Real-time statistics

- CAN bus statistics (Bus load, Total number of received messages, Remotes frame statistics).
- CANopen statistics (SDO response times, TPDO response times, Heartbeat event times, Node Guarding response times, Bootup time).



■ General Features

- CAN/CANopen simulation & Traffic Generation for full bus loading.
- Configurable as 4 independent channels, 2 redundant, 2 independent and 1 redundant.
- Programmable bit rates.

■ ECSS-15C/CANopen

- Asynchronous or deterministic operation with multiple PDOs support.
- High resolution timestamp, ECSS-15C Time Distribution & Redundancy Management.
- Support of EDS and DCF files import.

■ Master/Slave Node simulation

- Multiple nodes simulation.
- Deterministic operation (SYNC, TIME, PDOs, ...)
- CANopen real-time statistics (SDO response times, TPDO response times, Heartbeat event times, Node Guarding response times, Bootup time statistics)

■ ECSS-15C/CiA 310 CANopen conformance tests





teletel

- 124 Kifissias Avenue
- 115 26 Athens, Greece

- Tel: +30 210 6983393
- Fax: +30 210 6983391

- email: rtd@teletel.eu
- <http://www.teletel.eu>

