

# Multimodal Test & Measurement Solutions

TSN Box  
TSN Tools

**Control complexity.**

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# Control complexity

Complexity can be controlled by collective intelligence – whether in nature or with autonomous mobility.

Efficiently master the required technology change for time-sensitive Automotive Ethernet with our unique measurement and analysis tools

Solve complex tasks quickly and with high accuracy

With the imminent adoption of Automotive Ethernet as a backbone architecture, engineers can speed up quickly and easily without having to deal with understanding the underlying technology.



TSN Tools and TSN Box

Whether domains, zones, AVB, TSN, infotainment or backbone: The unique TSN Box and TSN Tools allow employees to get started quickly.



Our strengths lie in the following fields of application

PTP Analysis  
PTP Master/Slave

AVB/TSN Simulation & Signal Generation

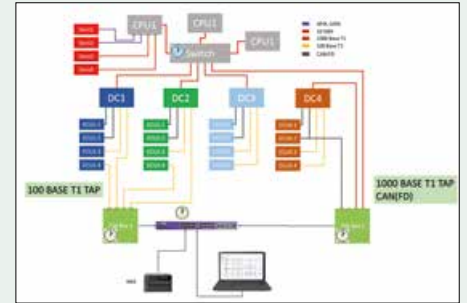
Sensor Data Simulation, Fusion and Time Stamping

TAP  
100/1000 Base T1  
1000 Base T  
HDBaseT  
CAN  
Audio

# TSN Box

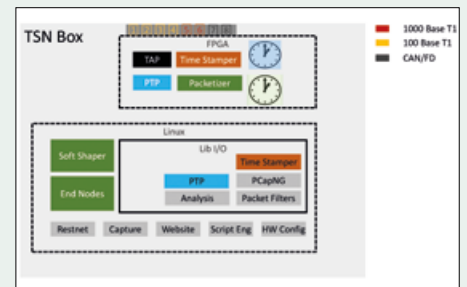
## The Network Interface and Gateway

The TSN Box functions as a network interface / gateway and media converter for time sensitive automotive Ethernet networks and CAN/CAN FD. The TSN Box prepares the data and communicates with TSN Tools. The FPGA-based hardware supports various modes as TAP, data logger and AVB Talker/Listener.



## Nanosecond precise time stamps

The TSN Box provides a FPGA timestamp engine with 8 ns precision, covering multiple clock domains. The timestamp engine can be driven by the DUT clock (car PTP), the local clock or an external PTP grandmaster. In this mode multiple TSN Boxes can be synchronized.



## Traffic Generator AVB/TSN Talker

The system provides a flexible signal generation unit that allows rest-net simulations of all relevant signal types in the TSN world. Signal generation and rest bus simulation can be done as audio/video talkers, sensor data generation/playback or general command and control data. The flexible yet precise AVB and TSN Talker within the TSN Box can handle the biggest challenges.

## Supports natively future TSN protocols

The TSN Box provides right away a feature rich set of support for the AVB and TSN protocols typically used in Automotive Ethernet architectures of 2021 and beyond. The solution is the ideal partner to explore PTPv2, 802.1ASrev and different shaping options within TSN such as credit based, time aware or asynchronous shapers.



# TSN Tools

Control  
Complexity

Platform  
independent

Easy-to-use

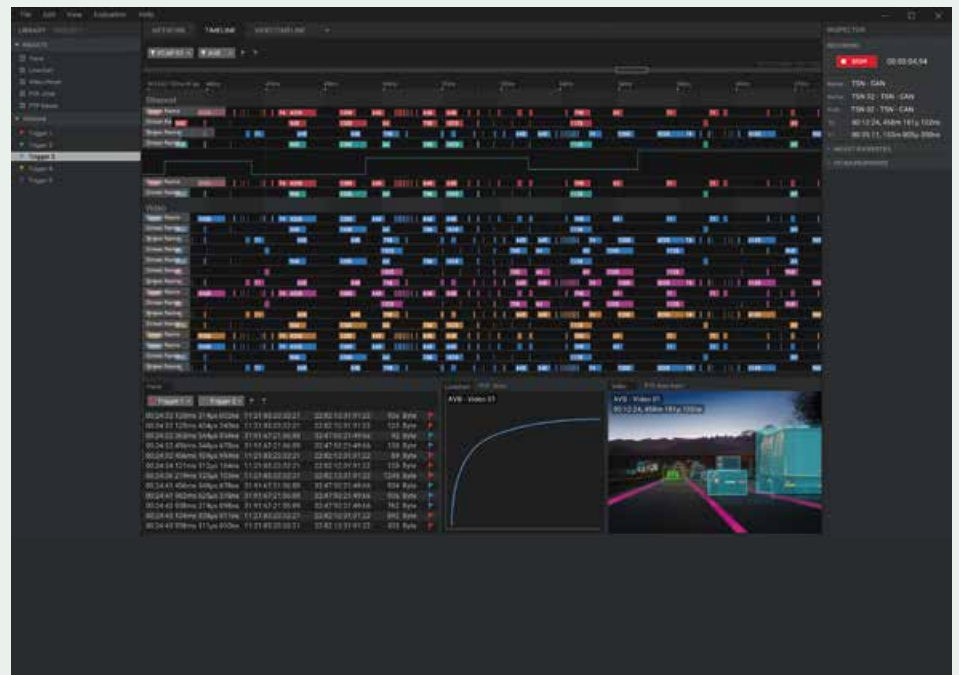
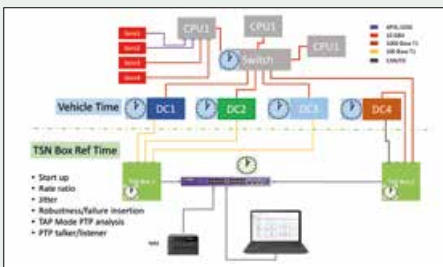
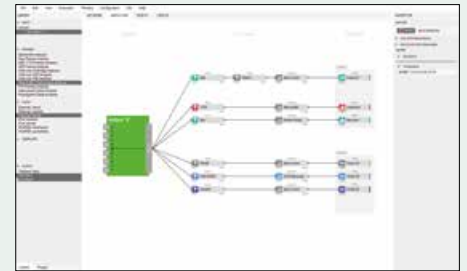
Audio & ADAS  
Testing

The TSN Tools software provides a high level network analysis and visualization approach to keep track at any time.

TSN Tools is available for Windows 7/10 and Linux platforms and tailored to fit into existing and new workflows of future automotive development. Embedded software specialists do not need to leave their well-known Linux development environment.

Debugging Automotive Ethernet can be complex. TSN Tools provides a Test & Measurement solution on expert technical level with a highly intuitive user interface. This eases the learning curve when starting ECU development within Automotive Ethernet.

Testing and analysis is a diverse and daunting challenge with future automotive architectures, ADAS and autonomous driving. TSN Tools supports a wide variety of use cases including payload analysis, deep trigger analysis, multi-signal time lines and much more.

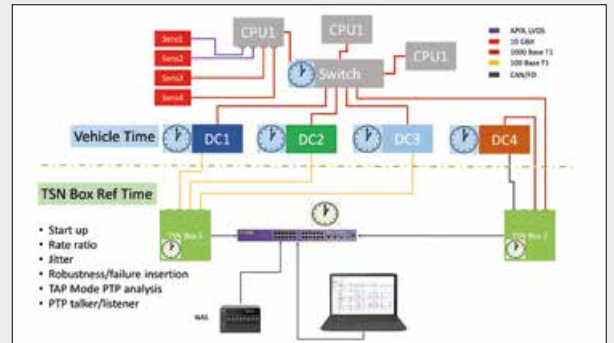


# Use cases

# 1

## PTP start up testing

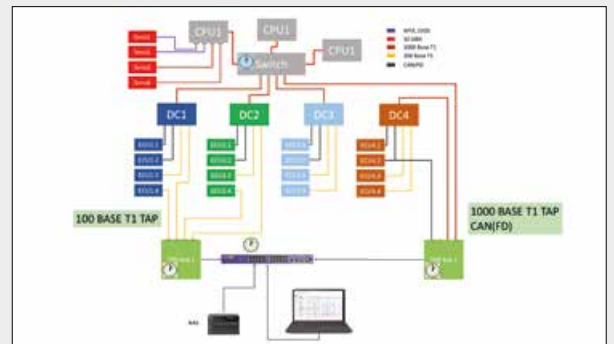
PTP timing is essential for any time sensitive network. PTP start-up and stability can be tested under many circumstances to ensure proper behaviour. TSN Tools and TSN Box support various PTPV2 testing scenarios (IEEE802.1AS and IEEE802.1AS-Rev).



# 2

## Multi-link TSN Tap

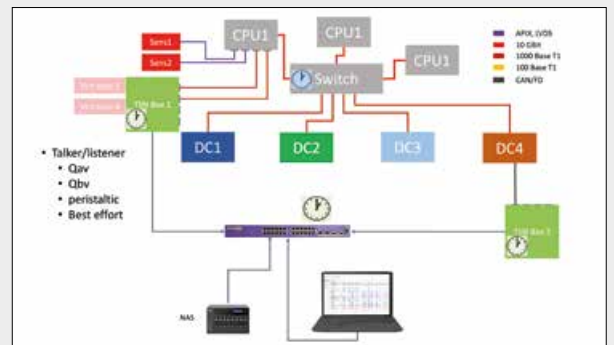
Since Ethernet is not a bus, looking into an automotive Ethernet link is not easy especially when PTP and AVB/TSN are involved. TSN Box provides a total of eight Ethernet ports serving as fully transparent 100/1000 BASE-T/T1 TAP with nanosecond precision timestamps.



# 3

## Sensor Data Simulation

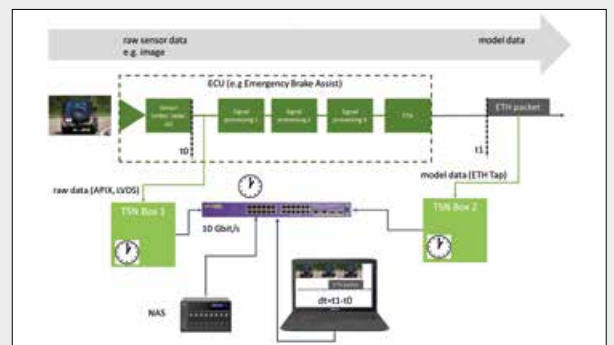
Setting up a REST-Net simulation, signal generation and sensor data simulation/playback are challenging tasks during development and testing of ADAS and autonomous functions. TSN Box supports the engineer in this setup phase.



# 4

## Audio & ADAS Testing

TSN Tools supports a wide variety of use cases, including payload analysis, deep trigger analysis, multi-signal timeline and much more to address future generations of automotive network architectures.



TAP 100/1000Base-T1, 1000Base-T  
HDBaseT  
AVB/TSN Talker/Listener  
PTP Analysis  
Audio (Analog, Digital, A2B)  
Rest Net Simulation  
CAN-Gateway

## TSN Box 3.0 Technical Data



Physical Parameters		
Dimensions	210 mm x 150 mm x 74 mm	
Maximum envelope with connectors	210 mm x 187 mm x 74 mm	
Weight	1.7 Kg	
External power supply	8-15 VDC	
Power consumption	27 W	
Temperature range	0 – 70 °C (-40 – 70 °C possible)	
Interfaces & Connectors		
General Interfaces	No.	
USB2.0	2	
USB3.0	1	
1Gb/s Ethernet	1	
USB Serial Terminal	1	
Front Panel Reset	1	
Recovery Button	1	
GPIO & Sync		
Isolated Input	2	
Isolated Outputs (open-collector)	2	
Output Power (12V non-isolated)	1	
High-speed GPI (SMA, 50 $\Omega$ load impedance)	2	up to 8 ns precision
High-speed GPO (SMA, 50 $\Omega$ source impedance)	2	up to 8 ns precision
BNC SYNC Module	2	1 x PPS in/1 x PPS out or SYNC in/out
Audio		
12x Audio Ports (6 x stereo connectors)	48 kHz, 24 Bit, line level	
Outputs channels	8	
Input channels	4	
A2B & Digital Audio (SPDIF)	2	each
Ethernet		
Dual 1Gb/s Modules	2	Configured as either 2 x 1000BASE-T & 2 x 1000Base-T1 or 4 x 1000BASE-T
Quad 100Mb/s Module	1	Configured as 4 x 100BASE-T1
CAN		
CAN Module	1	optional CAN-FD
HDBaseT		
VA6000 TAP Mode	2	

### Headquarter

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### Team Fulda


- » TSN Tools
- » Simulation & E/E Architecture
- » Marketing & Sales

### Team Cape Town

- » TSN Box
- » Hardware & Embedded Firmware
- » AVB/TSN Talker Listener
- » AVB/TSN Switch
- » TAP Device

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