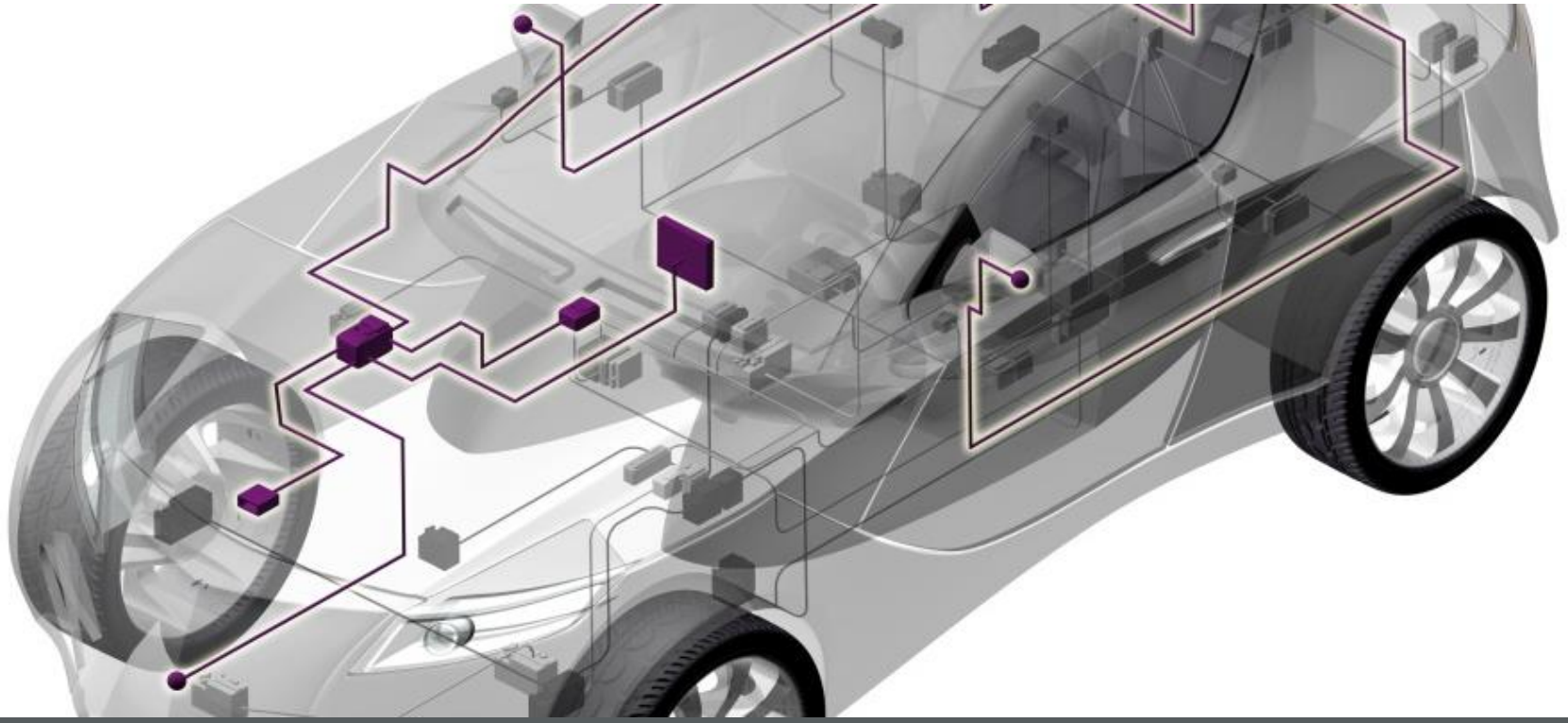
VECTOR



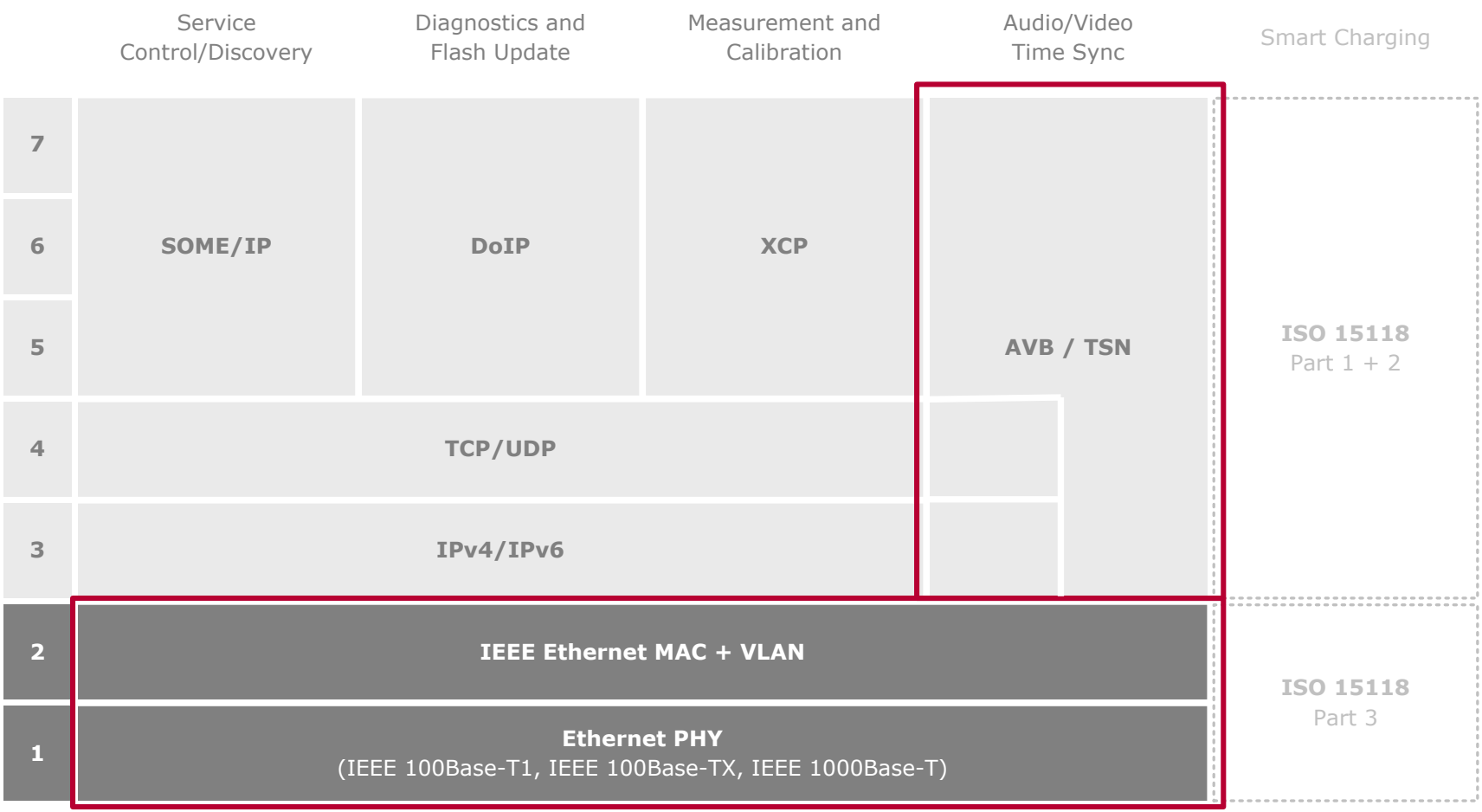
Ethernet@Automotive webinar series

Moving Forward: Tool Supported Development for Automotive Ethernet in Time Sensitive Networks

V1.06 | 2016-07-04

Agenda

Application area



Agenda

VECTOR

Network Characteristics

CAN (FD)

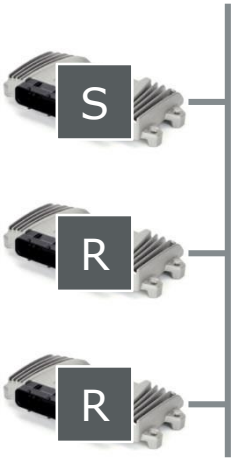
- Bus
- Broadcast

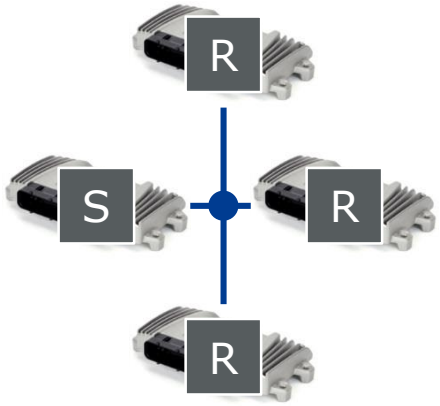
FlexRay

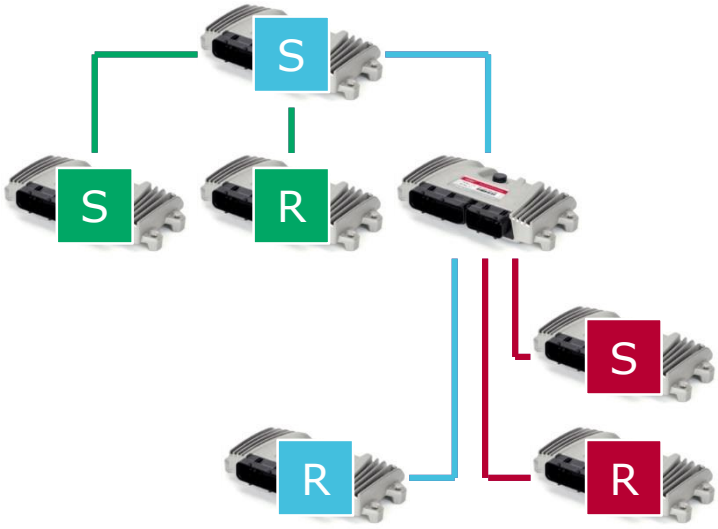
- Active Star
- Broadcast

Ethernet

- Fully switched network (point-to-point)
- Unicast
- Multicast and broadcast

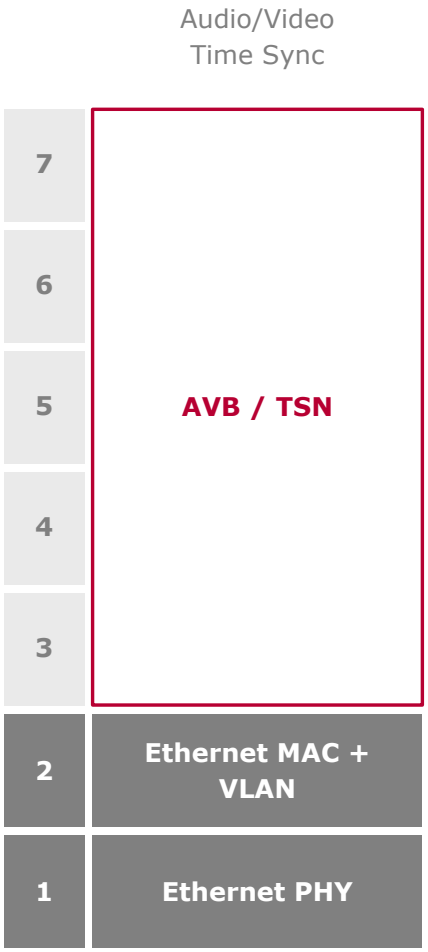






VECTOR

AVB/TSN: Audio Video Bridging / Time Sensitive Networking

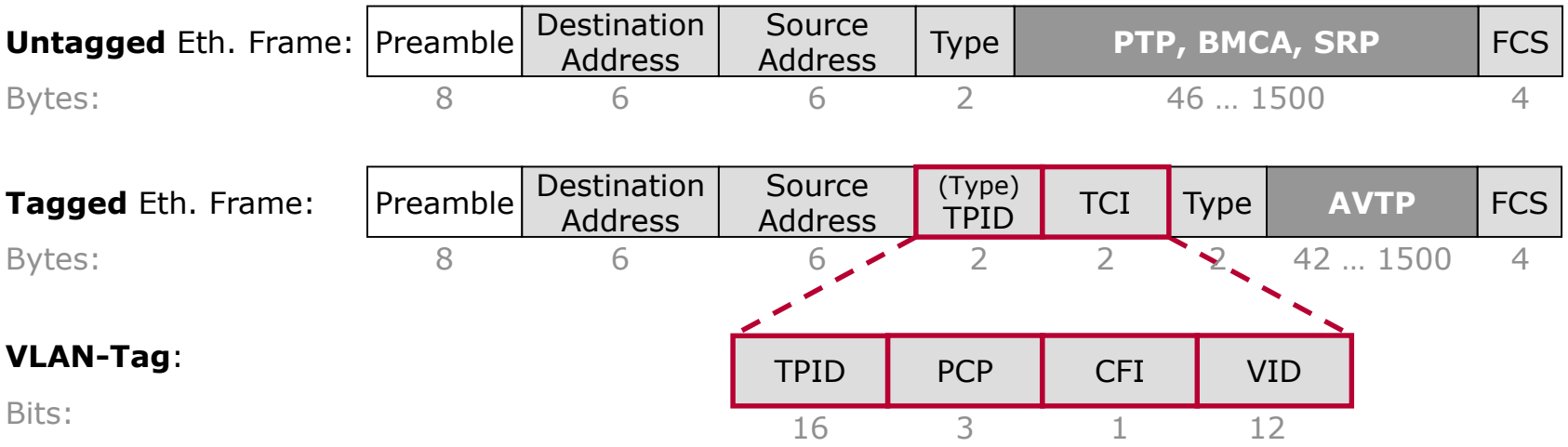


- Application area:
  - Time synchronous data transmission
  - Assured worst case latency for data transmission
  - Priority controlled data transmission
- Needs Ethernet Frames or VLAN Frames:
  - Various Ethernet Types: e.g. 0x88F7 (**gPTP**)
- Standards surrounding AVB:
  - **IEEE 802.1AS**: Timing and synchronization
  - **IEEE 802.1Qav/Qat**: Forwarding and queuing, stream reservation (QoS)
  - **IEEE 1722**: **A**udio/**V**ideo **T**ransport **P**rotocol

Agenda

VECTOR

Basic Message Layout



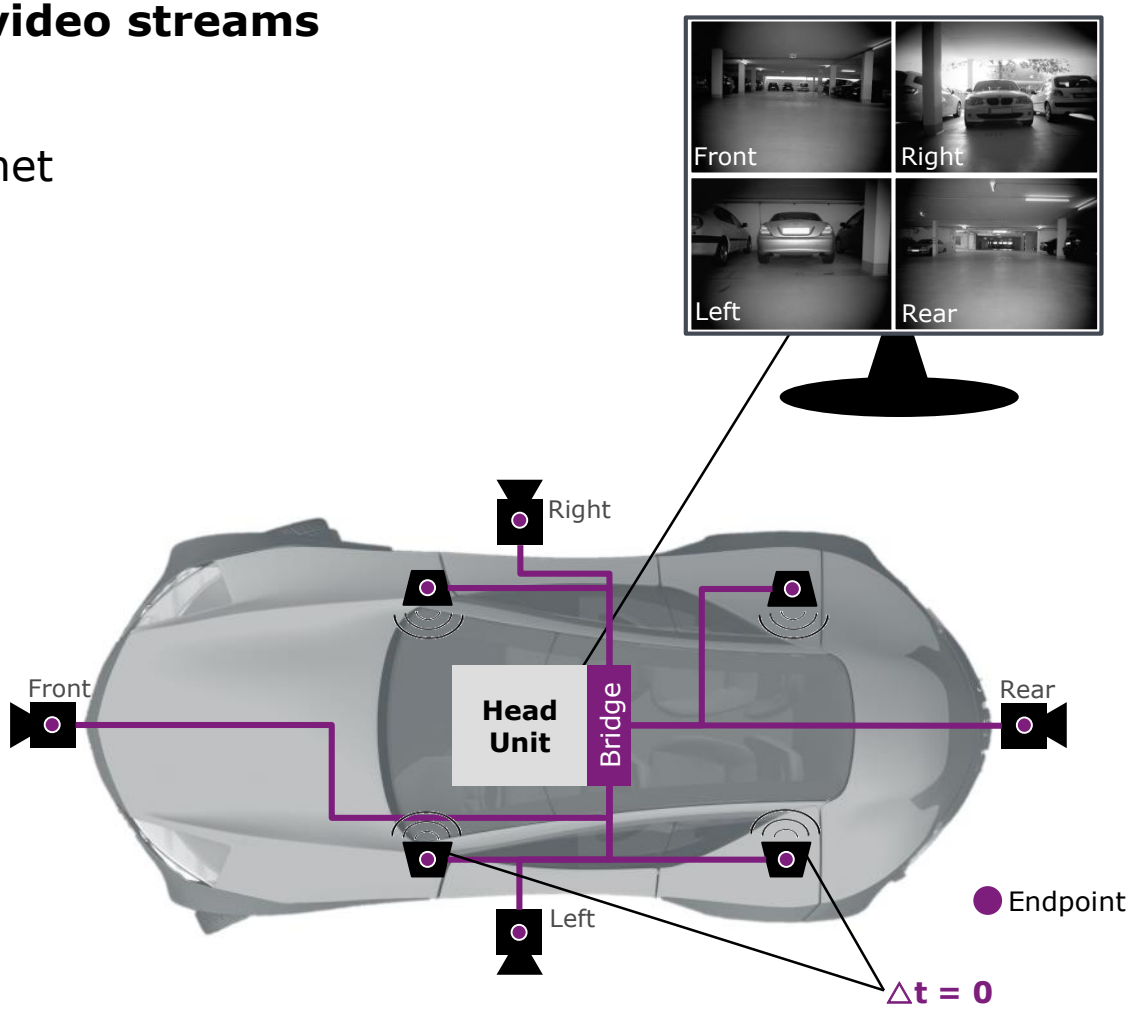
- TPID – Tag Protocol Identifier; fix value of 0x8100 (Ethertype for VLAN)
- TCI – Tag Control Identifier
  - PCP – Priority Code Point (large value represents high priority)
  - CFI – Canonical Format Indicator
  - VID – VLAN Identifier

VECTOR

Audio Video Bridging - AVB

Transport of audio and video streams

- Through standard Ethernet network technology
- With simple cabling
- Fast and in real-time
- Well synchronized with a global time and prioritized compared to other streams and/or frames



VECTOR

Why AVB?

Significant increase of Audio/Video applications

- Camera devices (rear view, front view, side view)
  - Virtual surround view, accident avoidance, pre-crash preparation
- Infotainment

Significant increase for control data as well

- Fast backbone needed
- Consideration of time-data relation required

Guarantees for Quality of Service (QoS) required

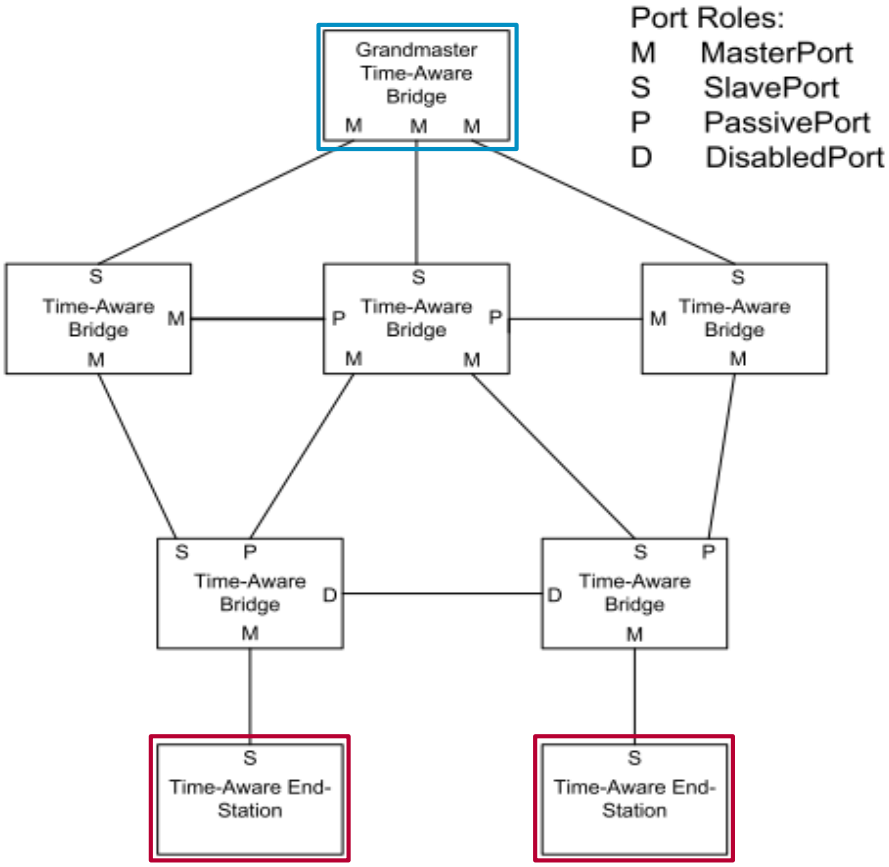
- Fast-Ethernet (*Full-Duplex*)
  - No message priority consideration
  - Latency not defined
- vs. AVB (*Full-Duplex with Bandwidth Reservation*)
  - Time synchronization
  - Bandwidth reservation
  - Worst-case latency presetting

Best Master Clock Algorithm (BMCA)

Time-Synchronization Spanning Tree

The result of all BMCA measures is the "Time-Synchronization Spanning Tree" with

- well defined port roles
- well defined priority
- well defined position



Source: IEEE 802.1AS

VECTOR

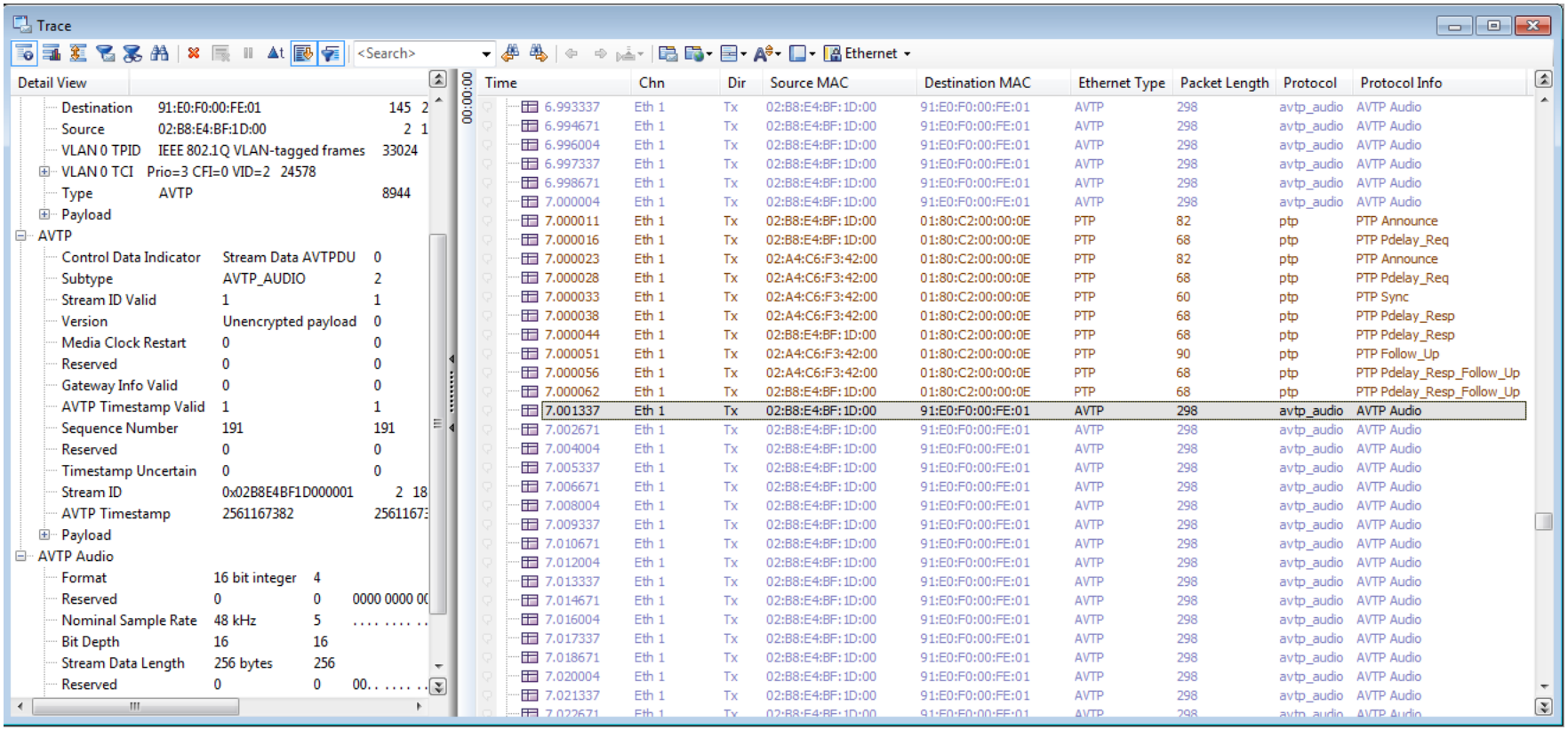
Audio Video Transport Protocol (AVTP)

- AVTP delivers the data stream from one Endpoint to another by carrying:
  - Stream and control data
  - Sequence number
  - Presentation time
  - Validation flags
  - Sub-protocols
  - Sub-protocol data

- Support of several A/V formats
- Presentation time synchronizes Talker and Listener

Agenda

Trace Window



VECTOR

AVB IL

- Simulation of Stream Talker
  - Provides media data
    - Direct access to media source files (audio, video*) to simplify streaming
  - Protocol handling (e.g. gPTP, AVTP, …)
  - AVTP
    - Support various media protocol formats (AAF, CVF, …)
    - Clock Reference Format
  - Quality of Service
    - Support Forwarding and Queueing of Time Sensitive Streams (FQTSS)

- Simulation of Stream Listener
  - Counterpart to talker
    - Enable communication (e.g. when SRP is used)
  - Protocol handling (gPTP, AVTP)
  - Register to stream(s)
    - Easy access to media data and protocol information

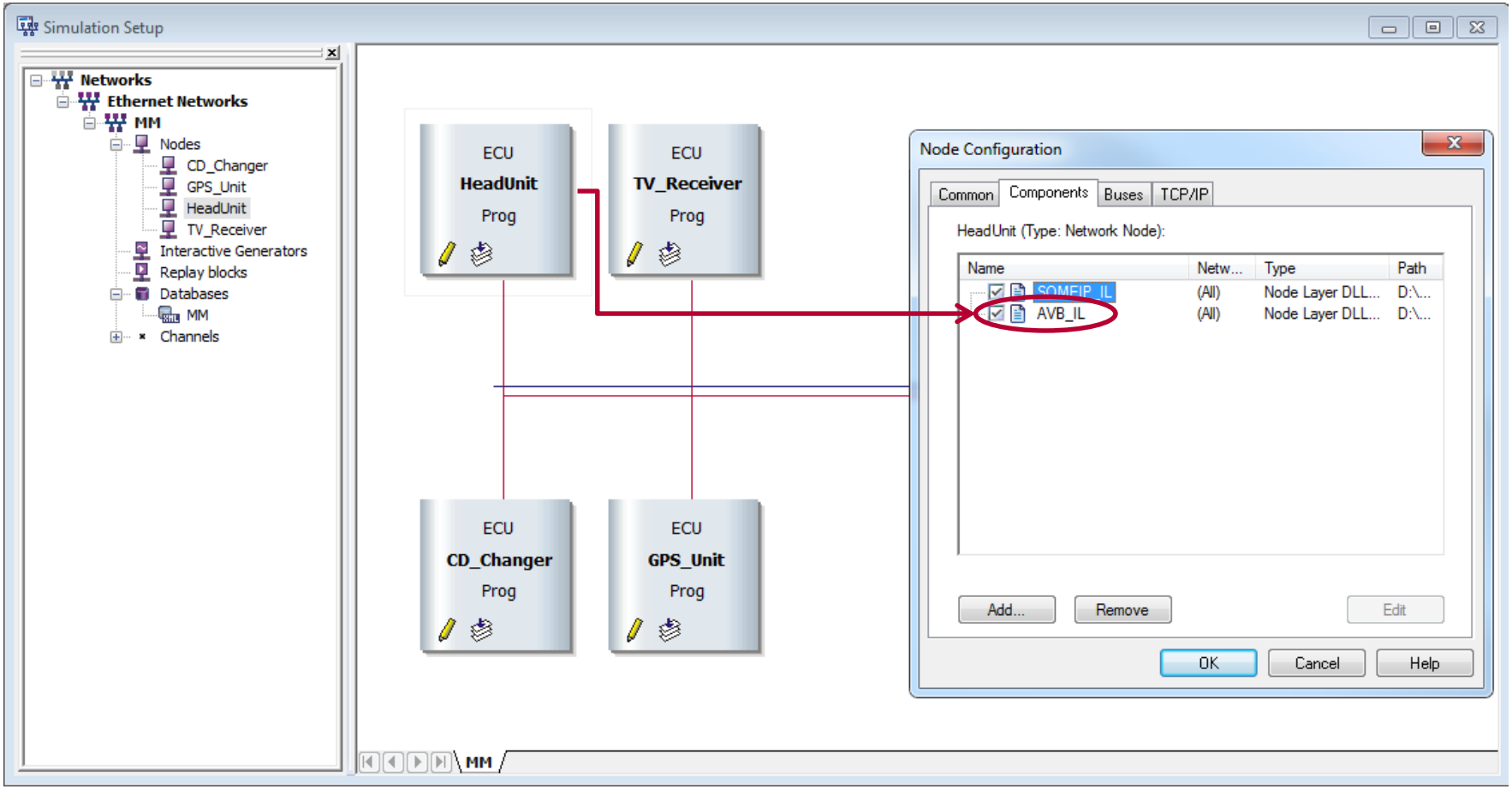
VECTOR

AVB IL

- Simulation of Clock Master
  - Best Master Clock Selection Algorithm (BMCA)
  - Support IEEE 802.1AS
    - Clock synchronization for phase and frequency
  - gPTP
    - Precise gPTP time due to interface hardware time stamps
    - gPTP is equal to CANoe simulation time
- Simulation of Clock Slave
  - Precise gPTP time due to interface hardware time stamps
- Stream Reservation Protocol*

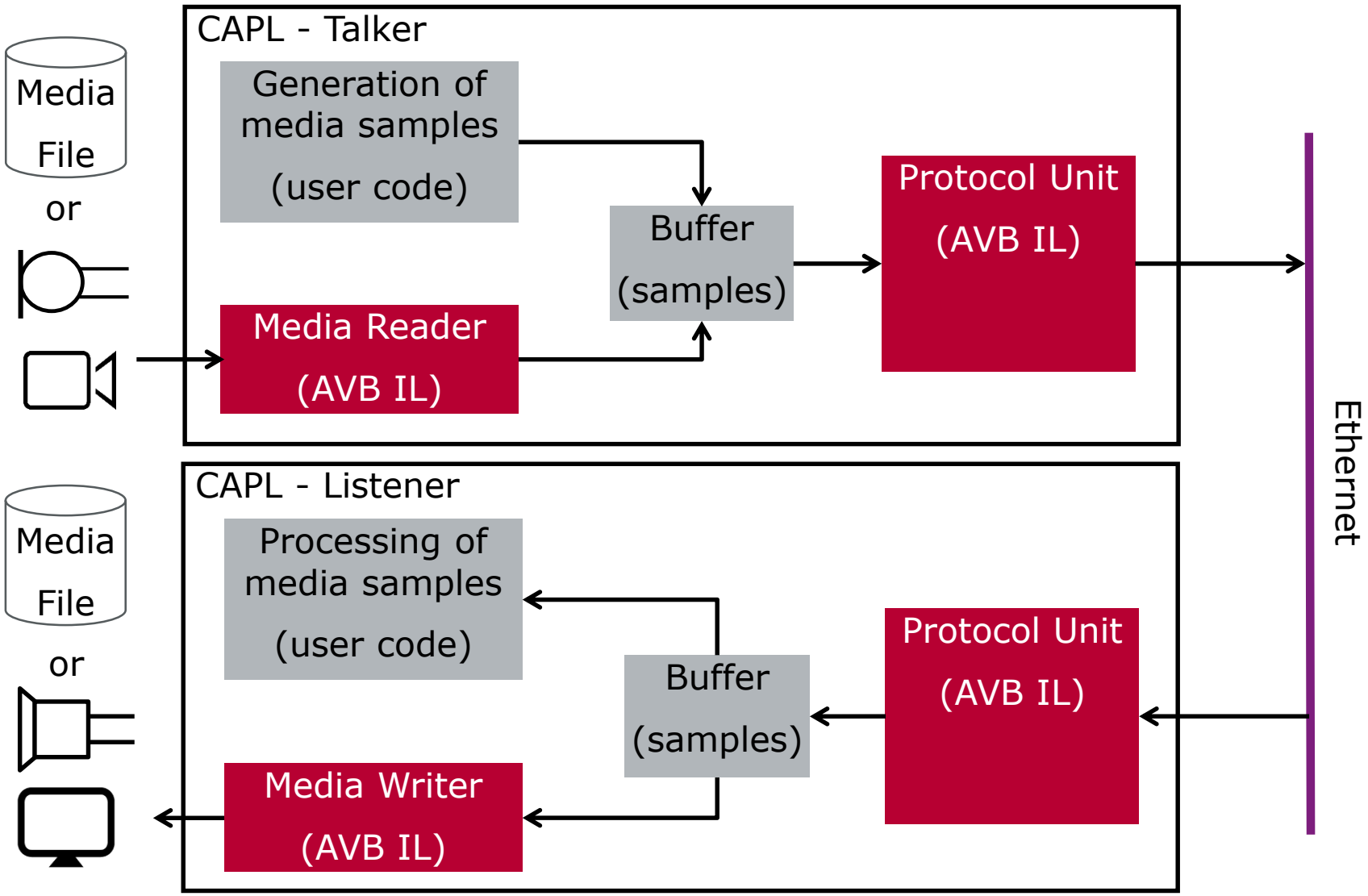
* Not used in automotive profile (defined by AVnu Alliance)

AVB IL

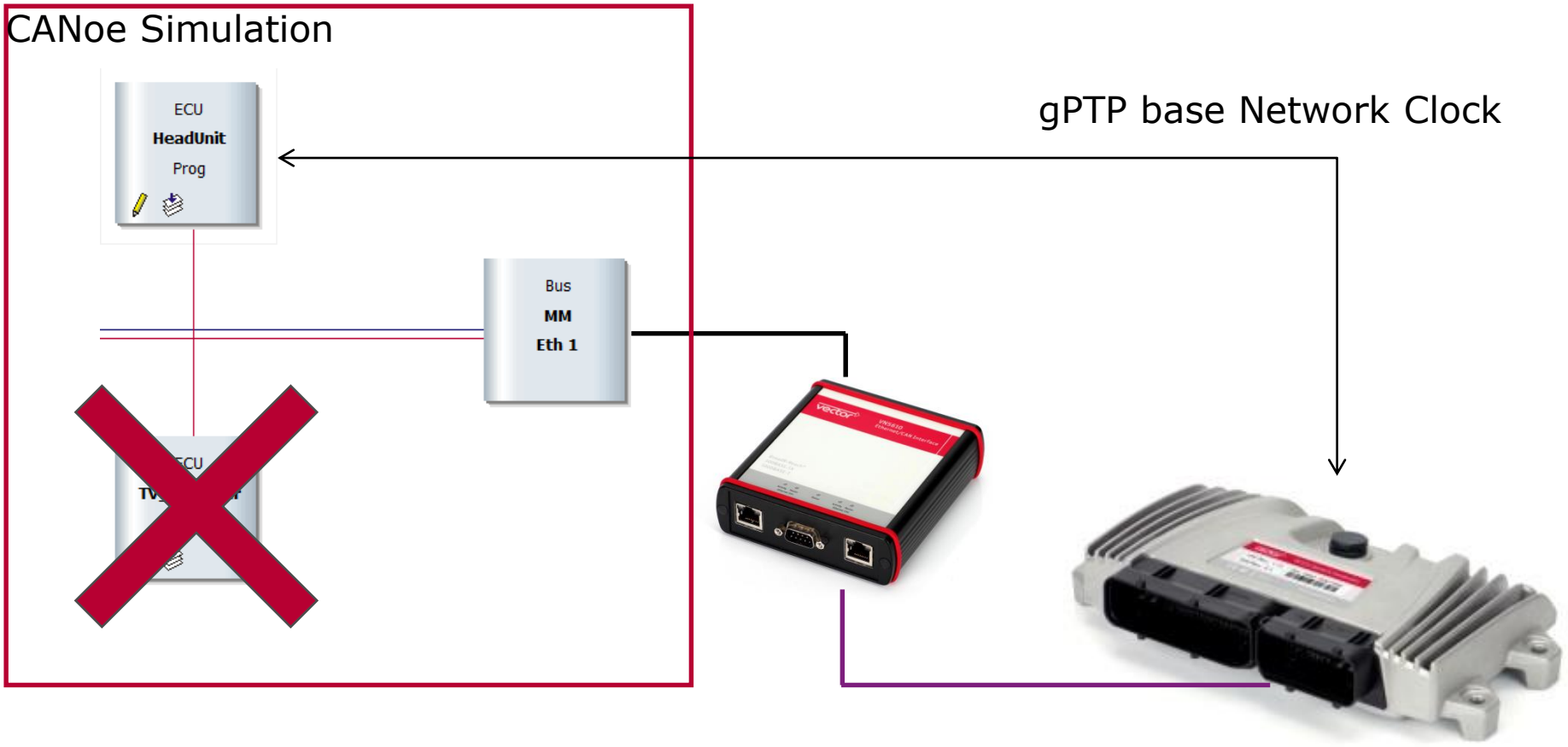

Simulation Setup
Networks
Ethernet Networks
MM
Nodes
CD_Changer
GPS_Unit
HeadUnit
TV_Receiver
Interactive Generators
Replay blocks
Databases
MM
Channels
ECU
HeadUnit
Prog
ECU
TV_Receiver
Prog
ECU
CD_Changer
Prog
ECU
GPS_Unit
Prog
Node Configuration
Common
Components
Buses
TCP/IP
HeadUnit (Type: Network Node):
Name
Netw...
Type
Path
SOMEIP_IL
(All)
Node Layer DLL...
D:\...
AVB_IL
(All)
Node Layer DLL...
D:\...
Add...
Remove
Edit
OK
Cancel
Help
MM

VECTOR

AVB IL

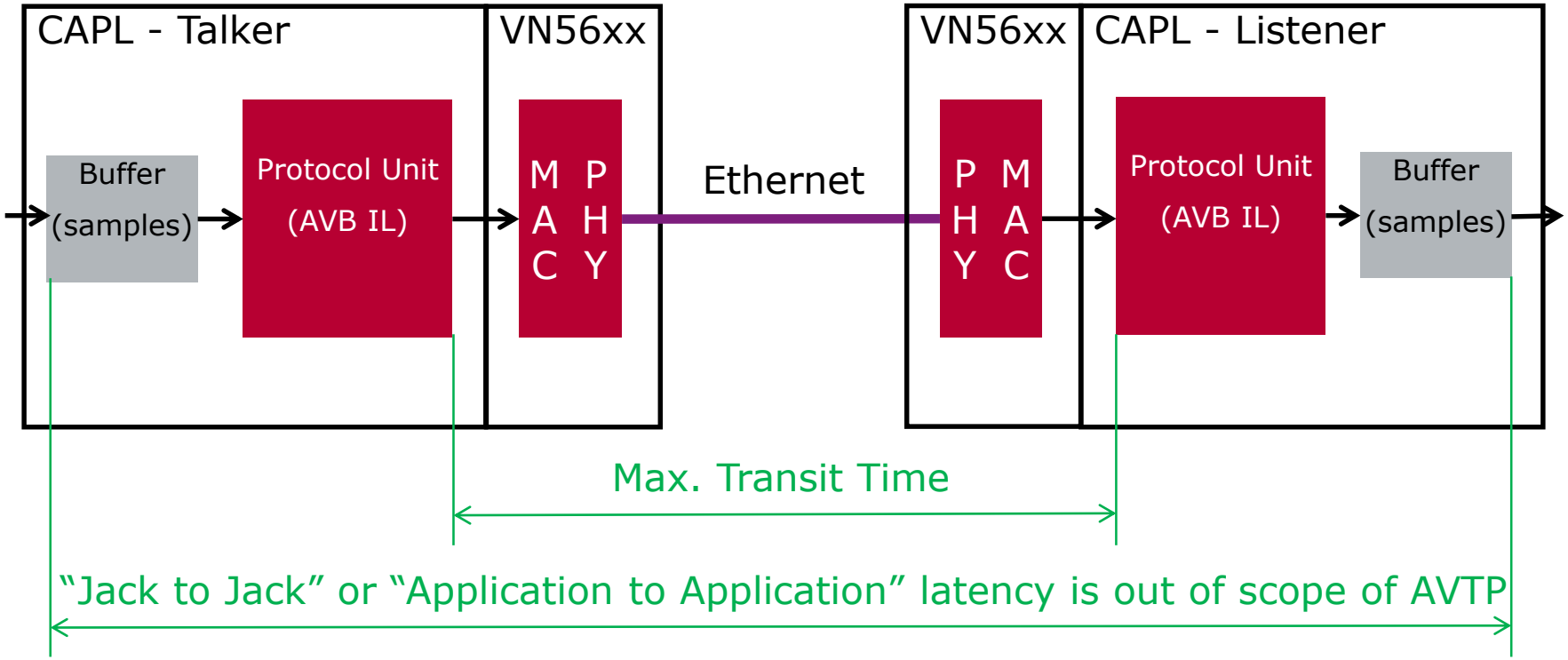


AVB IL – Time Synchronization



VECTOR

AVB IL – AVTP Timing

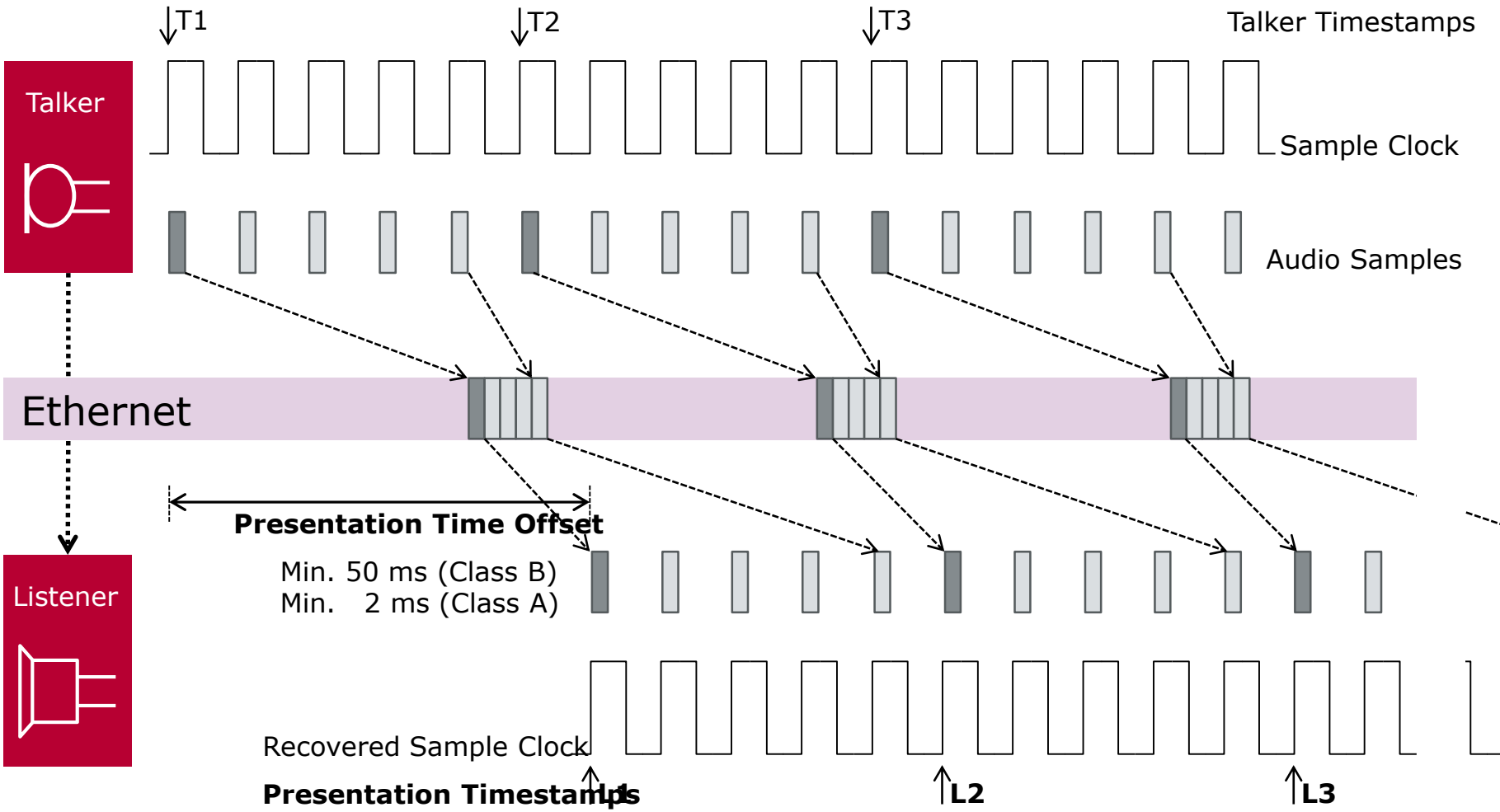


- Max. Transit Time Class A Network < 2 ms
- Max. Transit Time Class B Network < 50 ms

—— IEEE Definition

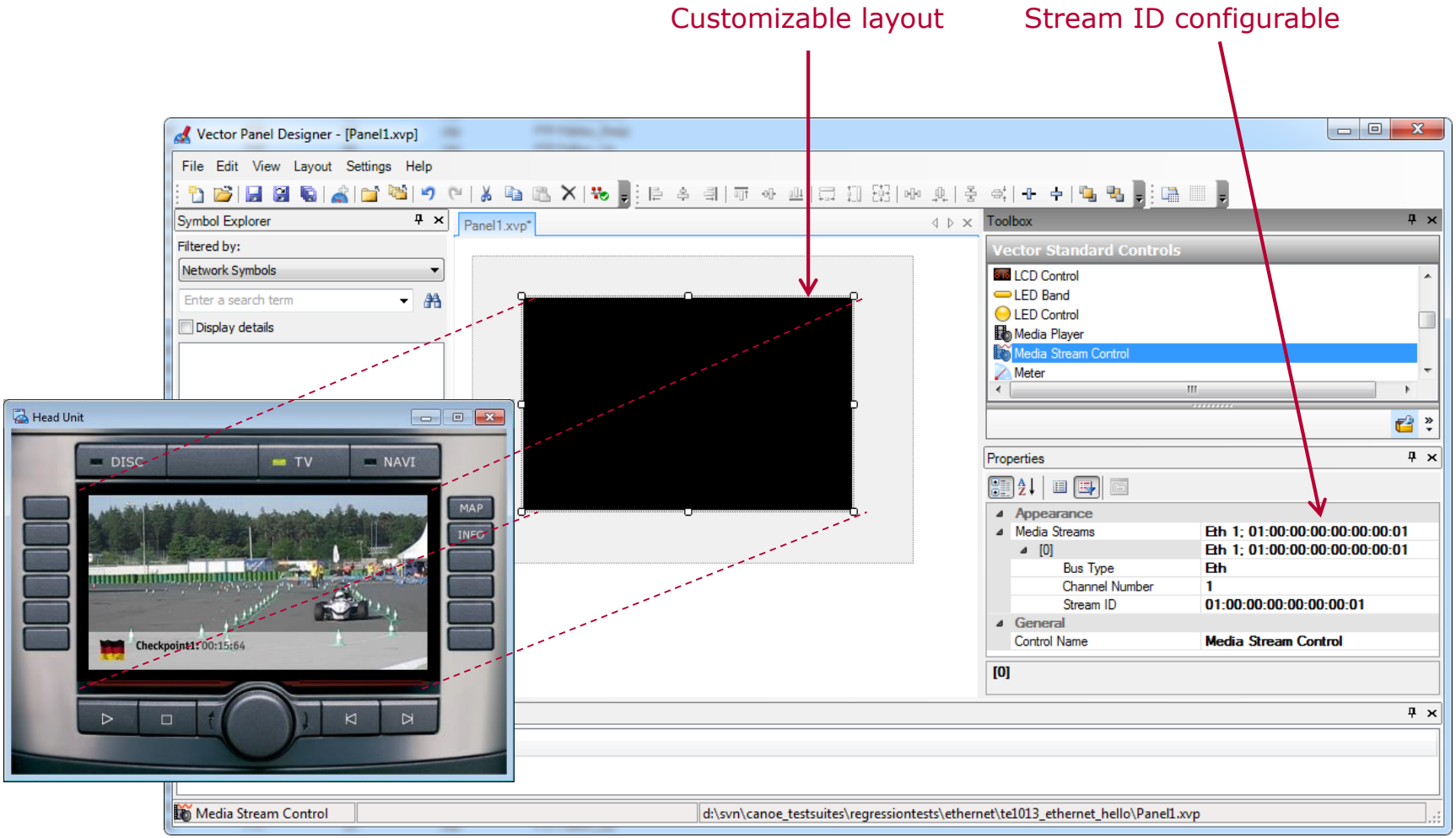
VECTOR

AVB IL – AVTP Audio Packetization (FQTSS)



Audio / Video

Media Stream Control for Panels



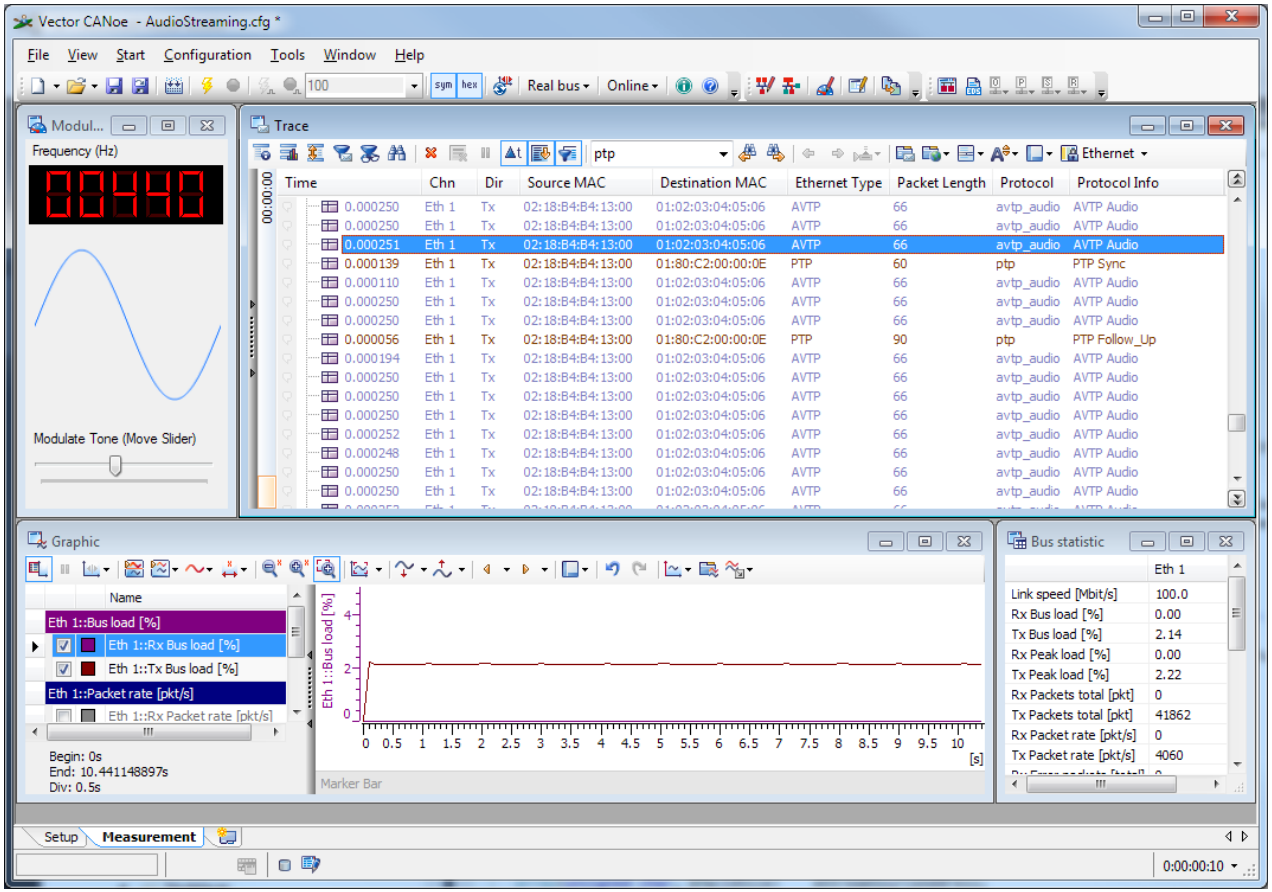
Ethernet Interface VN5610

- 2 x RJ45 for IEEE802.3 (100BASE-TX and 1000BASE-T) physical layer
- 1 x D-Sub9 for 2 Channel BroadR-Reach
- 1 x USB2.0 (connection to PC)
- 2 x Binder (Hw-Sync + ext. Power)
- D-Sub9 for 2 Channel CAN/CAN-FD
- 1 x RJ45 (reserved)

Ethernet Interface VN5640

- New member of the Ethernet interface family
  - Supported starting CANalyzer / CANoe 9.0 SP3
  - 16 Ethernet channels for efficient network access (12 x BR; 4 X IEEE)
  - TAP and switch capabilities
  - One I/O port for DoIP activation line trigger
  - Seamless integration into tool chain
  - Two high speed CAN/CAN-FD channels
  - USB3.0 (connection to PC)

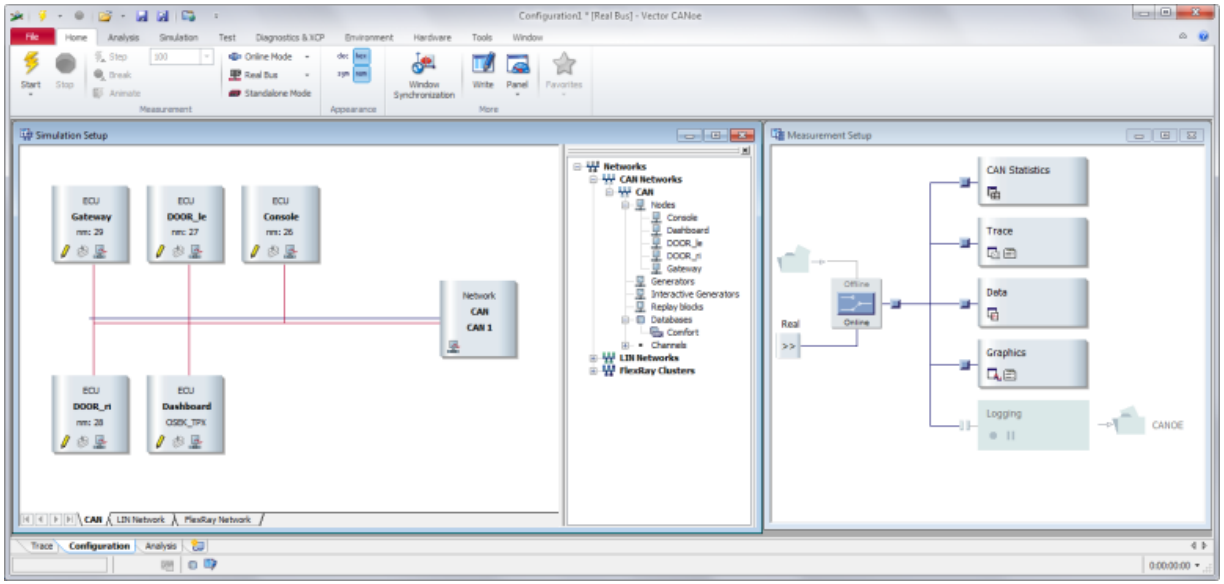
Expected AVTP timing with hardware supported transmission



- Repetition rate ±20µs
- Guaranteed repetition rate ±50µs

Agenda


CANoe
CANalyzer


Configuration1 * [Real Bus] - Vector CANoe
Simulation Setup
Measurement Setup
Networks
CAN Networks
CAN
LIN Networks
FlexRay Clusters
CAN Statistics
Trace
Data
Graphics
Logging
CANOE
Real
Offline
Online

Agenda

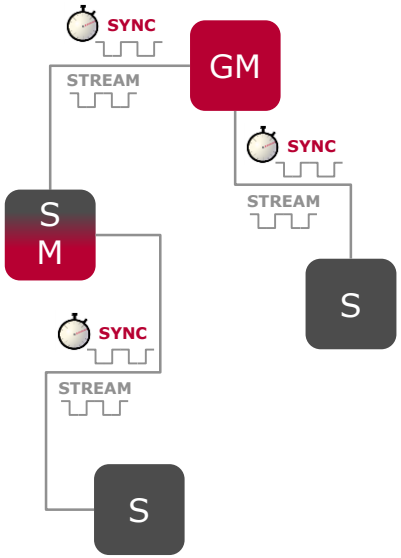
VECTOR

Summary

- AVB / TSN provides mechanisms for the **synchronization** of network participants for **reliable, low-latency** media transmission.

- „Lip-sync" is achieved

- A **common time base** is shared amongst all network components

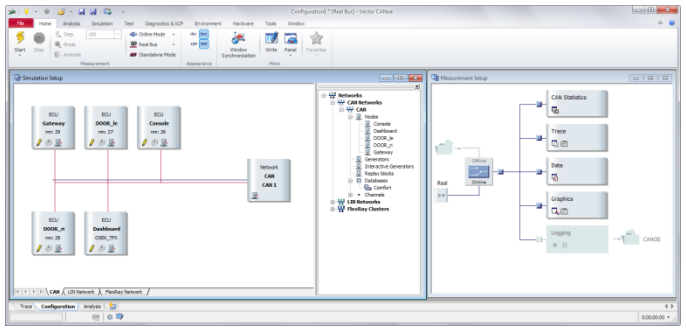


Summary

- A well defined **protocol set** is described to fulfil the requirements

	Service Control/Discovery	Diagnostics and Flash Update	Measurement and Calibration	Audio/Video Time Sync	Smart Charging
7	SOME/IP	DoIP	XCP	AVB / TSN	ISO 15118 Part 1 + 2
6					
5					
4	TCP/UDP				
3	IPv4/IPv6				
2	IEEE Ethernet MAC + VLAN				ISO 15118 Part 3
1	Ethernet PHY (IEEE 100Base-T1, IEEE 100Base-TX, IEEE 1000Base-T)				

- Mature **PC tools & hardware** for analysis & simulation purposes are available

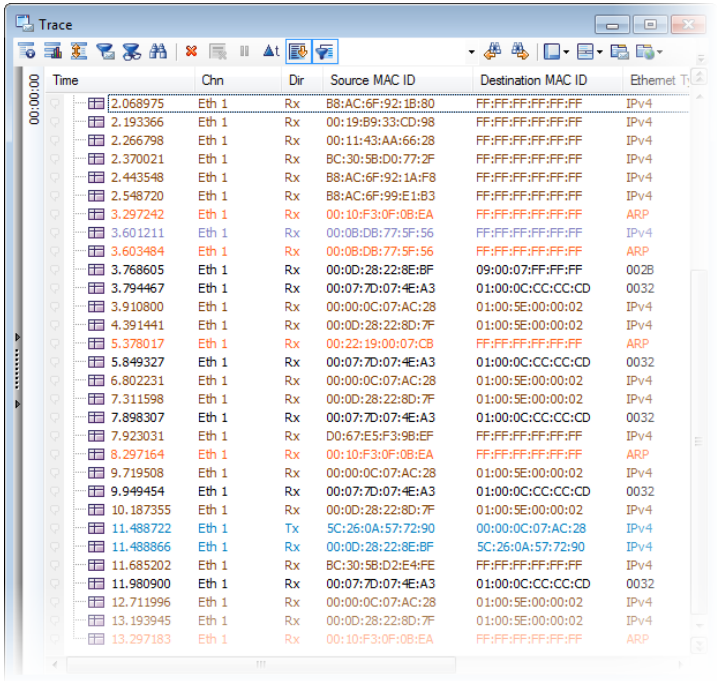


CANoe/CANalyzer.Ethernet

- CANoe/CANalyzer Demo including Ethernet:
  - Measuring, analyzing, simulation, testing of Ethernet and IP based communication
  - Free demo version:

    www.vector.com/vi_downloadcenter_de.html

    Products: CANoe, Categories: Demos



CANoe/CANalyzer.Ethernet

For more information about Vector
and our products please visit

www.vector.com

Author:
Pfeifer, Patrick
Vector Informatik GmbH