Get a grip on high data rates while testing Automotive Ethernet networks

Vector Automotive Ethernet Symposium 2019, Stuttgart, Germany
Agenda

- Introduction
  Where the data rates accrues
  New Ethernet Interface Software
  New Ethernet Interface Devices
  Summary
Introduction

Trends in Automotive

- Connectivity (IoT)
- Electrification
- Automated Driving

Major Changes in E/E Architecture

Higher bandwidth requirements:
- 100M
- 1G
- 10G
- 25G

- Synchronization
- Reliability
- Latency
- Deterministic

Time Sensitive Ethernet (TSN)
Introduction

Possible solutions

1. Uplink to PC with higher bandwidth
2. Data reduction with protocol filters
3. Selection of relevant data streams
   ▶ Relive application from not required data
   ▶ Improve tool performance by clever data reduction
4. Load distribution on several uplinks

[Image of a car on a mountainous road]
Use-Cases

Introduction

Measurement and Analysis

Simulation

Testing

- Network Interface
- Ethernet
- CANoe
  - Application CAPL
  - IL
  - NM
  - TP
  - Real Node
  - physical network
  - simulated network

System Under Test

Network
Introduction

- Where the data rates accrues
  - New Ethernet Interface Software
  - New Ethernet Interface Devices
  - Summary
Example Network Architecture

Where the data rates accrue

ANT

COM

HPC1

DISP

HPC2

CAM R

CAM L

HU
Where the data rates accrues

100BASE-T1 Network
Bandwidth requirements on uplink side

Where the data rates accrues

Sum of data rates:

\[
382 \text{ Mbit/s} + 145 \text{ Mbit/s} = 527 \text{ Mbit/s}
\]

<table>
<thead>
<tr>
<th>Mbit/s</th>
<th>Uplink load</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB2.0</td>
<td>216</td>
</tr>
<tr>
<td>USB3.0</td>
<td>2.560</td>
</tr>
<tr>
<td>1000BASE-T</td>
<td>1.000</td>
</tr>
<tr>
<td>10GBASE-T</td>
<td>10.000</td>
</tr>
<tr>
<td>PCIe Gen3x16</td>
<td>126.032</td>
</tr>
</tbody>
</table>
Where the data rates accrues

**100BASE-T1/1000BASE-T1 Network**

- **ANT**
- **COM**
- **HPC1**
- **DISP**
- **HPC2**
- **CAM R**
- **CAM L**
- **HU**
Where the data rates accrue

100BASE-T1/1000BASE-T1 Network

Sum of data rates:

\[
\begin{align*}
2022 \text{ Mbit/s} + 565 \text{ Mbit/s} &= 2587 \text{ Mbit/s}
\end{align*}
\]

<table>
<thead>
<tr>
<th>Interface</th>
<th>Mbit/s</th>
<th>Uplink load</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB2.0</td>
<td>216</td>
<td>1198%</td>
</tr>
<tr>
<td>USB3.0</td>
<td>2.560</td>
<td>101%</td>
</tr>
<tr>
<td>1000BASE-T</td>
<td>1.000</td>
<td>259%</td>
</tr>
<tr>
<td>10GBASE-T</td>
<td>10.000</td>
<td>26%</td>
</tr>
<tr>
<td>PCIe Gen3x16</td>
<td>126.032</td>
<td>2%</td>
</tr>
</tbody>
</table>
Agenda

Introduction
Where the data rates accrues

- **New Ethernet Interface Software**
  - New Ethernet Interface Devices
  - Summary
Example Network

New Ethernet Interface Software
New Ethernet Interface Software

Simulation configuration
Hardware configuration

Segmentation elements

Network

Physical Port

virtual Port
New Ethernet Interface Software

Simulation Setup (I) – System View
Change configuration of one ECU

ECU “HU” is now connected as real ECU
Simulation Setup (II) – System View

New Ethernet Interface Software

Simulation Setup (II) – System View
New Ethernet Interface Software

Distribution and Reduction of Data
Agenda

Introduction
Where the data rates accrues
New Ethernet Interface Software

- **New Ethernet Interface Devices**

Summary
New Ethernet Interface Devices

Hardware

- New Ethernet Interface devices are in development
  - Flexibility due to new Software Architecture
    - Optimized support of high bandwidths
    - Relive application from not required data
  - Various amount of 100BASE-T1/1000BASE-T1 ports
  - Channel extension by cascading
  - Optimized support for a wide range of application areas (HiL, Logging, Simulation, ...)
  - Support of TSN (Time Sensitive Networking) in a later software release

- First devices available in early Q3/2019

- Special Interface for measurement and analysis use-cases
  - Prepared for in-vehicle usage
  - Support of fast uplinks (10Gb Ethernet)
  - Prepared for Multi-Gig Automotive Ethernet
New Ethernet Interface Devices

Overview

<table>
<thead>
<tr>
<th>Device</th>
<th>VN5620 Ethernet/CAN Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Interfaces</td>
<td>4 x 100/1000BASE-T1</td>
</tr>
<tr>
<td>Host Connection</td>
<td>1 x USB3.1Gen1</td>
</tr>
<tr>
<td></td>
<td>2 x 100BASE-TX/1000BASE-T</td>
</tr>
<tr>
<td>Powering</td>
<td>USB / External Power</td>
</tr>
<tr>
<td>IO</td>
<td>1 x IO-Channel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Device</th>
<th>VN5430 Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Interfaces</td>
<td>6 x 100/1000BASE-T1</td>
</tr>
<tr>
<td>Host Connection</td>
<td>2 x 100BASE-TX/1000BASE-T</td>
</tr>
<tr>
<td>Powering</td>
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Introduction
Where the data rates accrues
New Ethernet Interface Software
New Ethernet Interface Devices

Summary
High data rates in Automotive Ethernet networks require multiple options to handle these:
- Different approaches can lead to the desired result
- Higher bandwidth on the uplink side is not the only way to handle incoming data rates
  - Data selection
  - Protocol filters
  - Distribution of load and test tasks

New Vector Ethernet Interfaces are addressing the upcoming requirements on technology and:
- Have a various amount of 100BASE-T1/1000BASE-T1 ports
- Are prepared for the handling of high data rates
- Are prepared for relevant Physical Layers (today & tomorrow)