10BASE-T1S in AUTOSAR

Stéfany Chourakorn (BMW)

Ethernet & IP @ Automotive – Virtual Event

14 Sept 2020    IEEE SA
Agenda

- 10BASE-T1S what is new?
- AUTOSAR overview
- AUTOSAR solution for 10BASE-T1S
  - Impact
  - Solution approach
- Summary
Situation today

Diverse technologies co-existing

- Legacy buses
  - Signal based, gateways
- Ethernet
  - Service oriented, switches, mostly for high data rates

More than 90% communication below 10Mbps

AUTOSAR Ethernet support today

- Switched network only
- 10Mbps up to Gbps

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-2009</td>
<td>1st Ethernet specification in AUTOSAR</td>
</tr>
<tr>
<td>11-2019</td>
<td>10BASE-T1S publication, IEEE 802.3cg</td>
</tr>
<tr>
<td>11-2020</td>
<td>AUTOSAR R20-11, target for 10BASE-T1S support</td>
</tr>
</tbody>
</table>
Agenda

› 10BASE-T1S what is new?

› AUTOSAR overview

› AUTOSAR solution for 10BASE-T1S
  › Impact
  › Solution approach

› Summary
10BASE-T1S what is new?

1. More PHY products

- MII PHY
  - µC
  - MAC
  - MII
  - PHY

- MACPHY
  - µC
  - MAC
  - OA- SPI
  - PHY

- CAN-like
  - µC
  - MAC
  - PHY digital
  - OA3p
  - PHY analog

- Full integrated
  - µC
  - MAC
  - PHY
10BASE-T1S what is new?

2. New E/E architecture

- 10BASE-T1S enables Ethernet bus/multidrop topologies
10BASE-T1S what is new?

3. Efficient medium access

- PLCA as an efficient new medium access allows for:
  - Reuse of the existing CSMA/CD structure
  - Fair medium access for all participant (Round robin)
  - Bandwidth optimization

Example early rescheduling scenarios

- Case 1 (Cycle N): only one node transmits.
  ⇒ Transmission at t1 instead of t1'.

- Case 2 (Cycle N+1): one node does send shorter packet.
  ⇒ Transmission at t2 instead of t2'
Agenda

- 10BASE-T1S what is new?
- AUTOSAR overview
- AUTOSAR solution for 10BASE-T1S
  - Impact
  - Solution approach
- Summary
AUTOSAR motivations

AUTOSAR aims to improve complexity management of integrated E/E architectures through increased reuse and exchangeability of SW modules between OEMs and suppliers:

- Decouple SW application from the HW
- Defines clear interfaces
- Specifies data exchange format

Sources: AUTOSAR
AUTOSAR standard

- Set of open specifications (application and basis software stack)
- Unified methodology and exchange format for system description as well as configuration
- Two platforms

Adaptive Platform (AP)

Classic Platform (CP)

Fondation (FO)

Source: AUTOSAR
Agenda

› 10BASE-T1S what is new ?

› AUTOSAR overview

› AUTOSAR solution for 10BASE-T1S
  › Impact
  › Solution approach

› Summary
Integration of 10BASE-T1S in AUTOSAR step by step

- Milestones

2019: Concept Announcement in AUTOSAR by BMW
Dedicated team for the elaboration of the concept

Cooperation BMW – Microchip for the validation

- MS1: Assessment
- MS2: Elaboration
- MS3a: Detail
- MS3b: Validation
- MS4: Incorporation
Agenda

- 10BASE-T1S what is new?
- AUTOSAR overview
- AUTOSAR solution for 10BASE-T1S
  - Impact
  - Solution approach
- Summary
10BASE-T1S impacts in AUTOSAR

MS2: Elaboration

Which PLCA specificities are relevant for AUTOSAR?
- Reconciliation Sublayer located in Layer 1
- Remains transparent from MAC perspective
- Half-duplex in multidrop / P2P or P2P for full-duplex / half-duplex

Pre-analysis of the main topics to details in MS3a:
- Component above driver layer untouched
- New configurations parameter related to PLCA
- Multidrop topology

Use cases
✓ Multidrop
✓ Burst
✓ DoIP / OBD
✓ Partial network
✓ TimeSync (static Pdelay)

PLCA Configuration Parameters
- plcaActive
- plcaStatus
- toTimer
- nodeID
- nodeCount
- burstCounter
- burstTimer
10BASE-T1S impacts in AUTOSAR

First approach is to identify all the concerned working group within the consortium

- 10BASE-T1S is a physical layer
- Constrains: one head node per cluster and all nodes must have same time configuration

New AUTOSAR Working Group for Time Synchronization is initiated for September 2020

Source: AUTOSAR
Agenda

» 10BASE-T1S what is new?

» AUTOSAR overview

» AUTOSAR solution for 10BASE-T1S

» Impact

» Solution approach

» Summary
Solution approach

MS3a: Detail

Software Specification:
- Impact localized in the low level layers: Eth Driver and Eth Trcv
- Addition configuration parameter for PLCA (node id, burst, …)
- Buffer handling to prioritize traffic

System Template / Manifest:
- Implement multidrop topology for Ethernet in model
- Constrain related (Head node unique in sub-cluster,… )
Solution approach: buffer handling

MS3a: Detail

- Affects SWS_EthDriver
- Optional implementation
- Scheduling before transmission
- Scheduler: simplified CBS (token bucket)
- Priorities from socket connexion

Step 1

- `Eth_ProvideTxBuffer`<br>  Prio 7
- `BufIdx 0`

Step 2

- `Eth_transmit`<br>  `BufIdx 0`

Step 3

- `Eth_MainFunction`
- `ThresholdCounter`

- `CBS (token bucket)`
- Priorities from socket connexion
Solution approach
MS3b: Prototype validation

The 10BASE-T1S support should be validated by a prototypical implementation mostly focused on the Ethernet driver and transceiver driver (CP) for multidrop scenario.

Scope:
- Ensure message routing through the stack and timing are respected
- Buffer handling
- Error scenarios:
  - Lost of Head-node
  - Reactivation Head-node (Reset)
Agenda

» 10BASE-T1S what is new?

» AUTOSAR overview

» AUTOSAR solution for 10BASE-T1S
  » Impact
  » Solution approach

» Summary
Summary

Concept split in 2 parts
- R20-11: 10BASE-T1S MII/Transceiver PHY
- R21-11: 10BASE-T1S with SPI interface and 10BASE-T1S switch integration

10BASE-T1S keeps evolving…
- IEEE
- Open Alliance

…and so does Autosar
- Will keep track on the coming modifications on the Ethernet stack
Thank you for your attention

Concept owners
S. Chourakorn
M. Zajicek
G. Veloso Cauce

Supporters and Reviewers
B. Sostawa
K. Matheus
Microchip
IVC-CP