2014-05-27, BMW Group, Dr. Lars Völker

SOME/IP SERVICE DISCOVERY

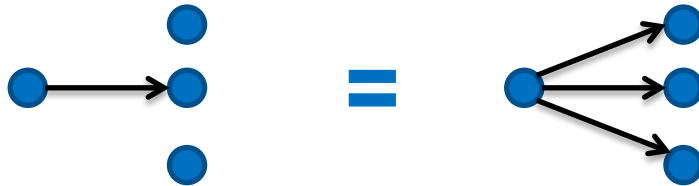## THE NEED FOR SERVICE DISCOVERY IN THE VEHICLE

BMW
GROUP

AGENDA

- Motivation
  - Where do we come from?
  - What does Ethernet bring to the table?

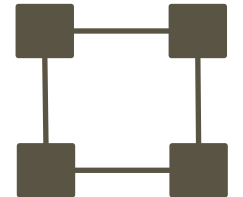- Efficiency of Ethernet communication

- SOME/IP-SD

- Conclusion

MOTIVATION
WHERE DO WE COME FROM?

– CAN, FlexRay, MOST

    – Shared medium, shared bandwidth

    – 1:1 costs the same as 1:n communication
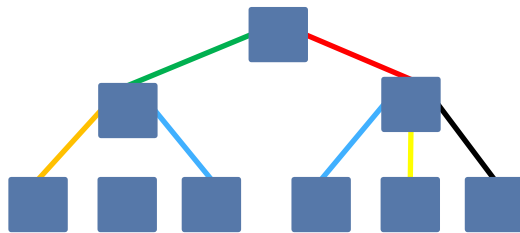
    – Somewhat limited bandwidth

        – And small messages

        – "Scales" by adding another CAN or FR bus

MOTIVATION
WHAT DOES ETHERNET BRING TO THE TABLE?

– With switched Ethernet the paradigm changes

  – Switch medium, efficient unicast communication
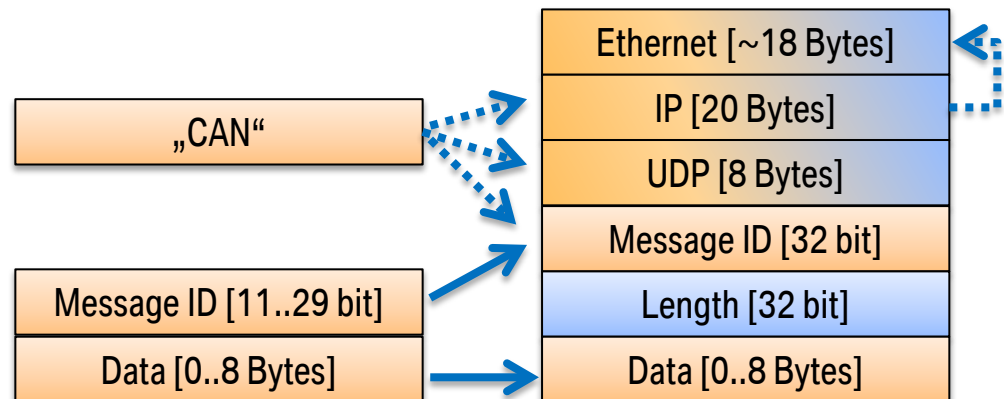
  – Unicast scales with additional links

  – Larger messages (up to ~1500 bytes) supported

  – Higher bandwidth (100Mbit/s today, 1000Mbit/s soon)
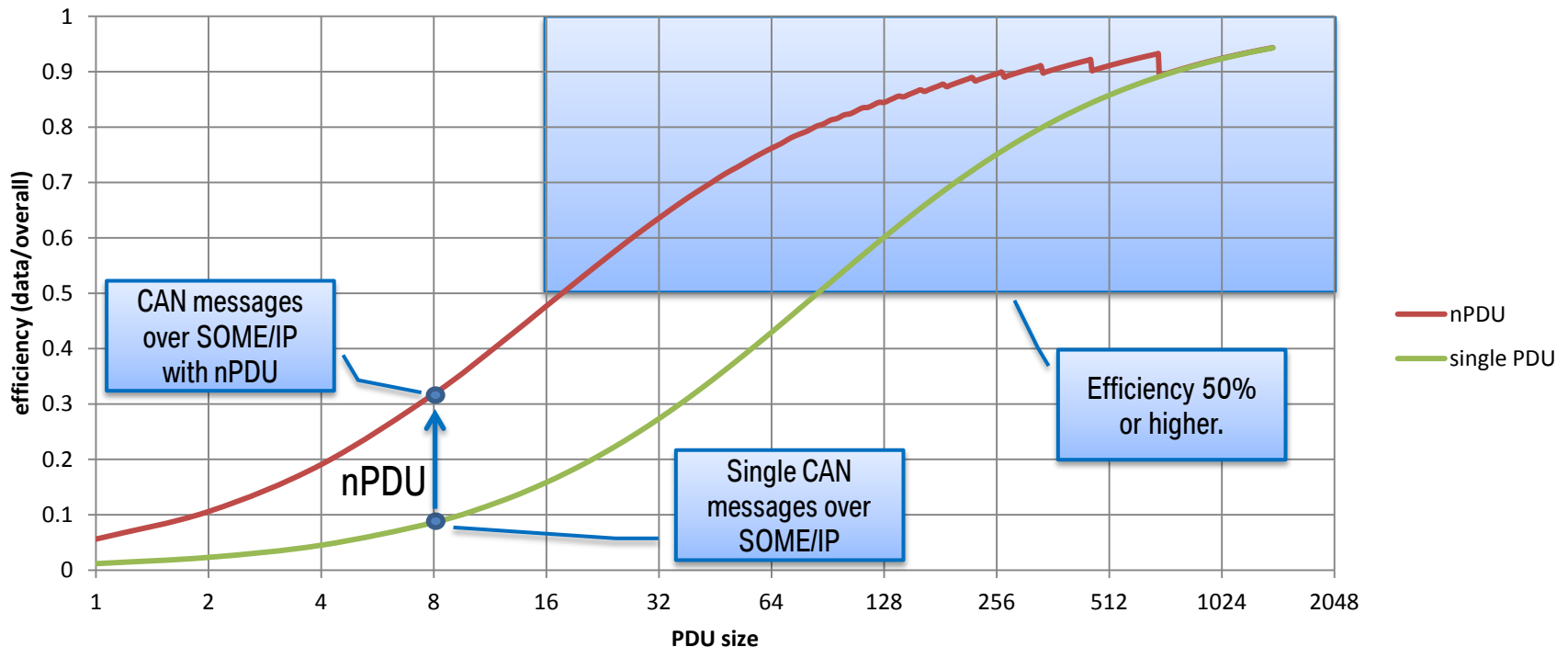
  – Mixing speeds possible

WHAT IF…
… WE JUST TRANSPORT "CAN OVER IP"

– One could just use Ethernet as a "super fast CAN"

– AUTOSAR 4.0 added Ethernet support

  – Header Mode to transport ID + data

  – nPDU allows multiple CAN messages combined

– Send multicast

– Receiver is the limit!

– Lots of overhead

"CAN"

Message ID [11..29 bit]
Data [0..8 Bytes]

Ethernet [~18 Bytes]
IP [20 Bytes]
UDP [8 Bytes]
Message ID [32 bit]
Length [32 bit]
Data [0..8 Bytes]

ETHERNET EFFICIENCY (DATA/OVERALL) SINGLE PDUS AND BPDU

- — "Overall" includes Ethernet header, 1x VLAN, IP, UDP, SOME/IP, inter frame gap, and PDU

- — nPDU allows dynamic combination of PDUs using a SOME/IP header per PDU

- — In this graph: nPDU combines as many PDUs of the stated size as possible

Small messages are more inefficient than large ones. nPDU increases efficiency for same size.

ETHERNET EFFICIENCY
HOW CAN WE HANDLE THE HIGH BANDWIDTH?

– Sending is easier than processing of received data at high bandwidth

– Limit incoming message rate and data at receiver side:

  1. **Increase data size and use nPDU to lower overhead**

  2. **Send only needed PDUs to receiver**

– Use large messages, nPDU, and unicast communication

– But how to tailor unicast communication?

TAILORED UNICAST COMMUNICATION
AVOID FLOODING AND TAILOR MESSAGES AS NEEDED

– Solution 1: statically configure switches and PDU for each receivers

  – Inflexible/complicated with different topology options and partial networking

  – Very difficult to reach optimal efficiency

– Solution 2: improve processing support for received messages

  – Possibly higher cost for the additional hardware

  – As well as disadvantages of solution 1

– Solution 3: dynamically handle availability and publish/subscribe

  – Overhead by dynamic protocol

  – But: handles complexity and makes it easy to reach efficiency

SOME/IP-SD DESCRIPTION

– Scalable Service-Oriented MiddlewarE on IP (SOME/IP)

    – SOME/IP allows service based communication

Service Availability

– SOME/IP Service Discovery was built to control SOME/IP messaging

    – Learn and find available services

    – Learn receivers of messages (What? When? Where?)

    – Allows efficient use of unicast and multicast (switching as well)

    – Invalid marking and fast cycles not required anymore

    – Can learn ARP tables (saves resources for ARP)
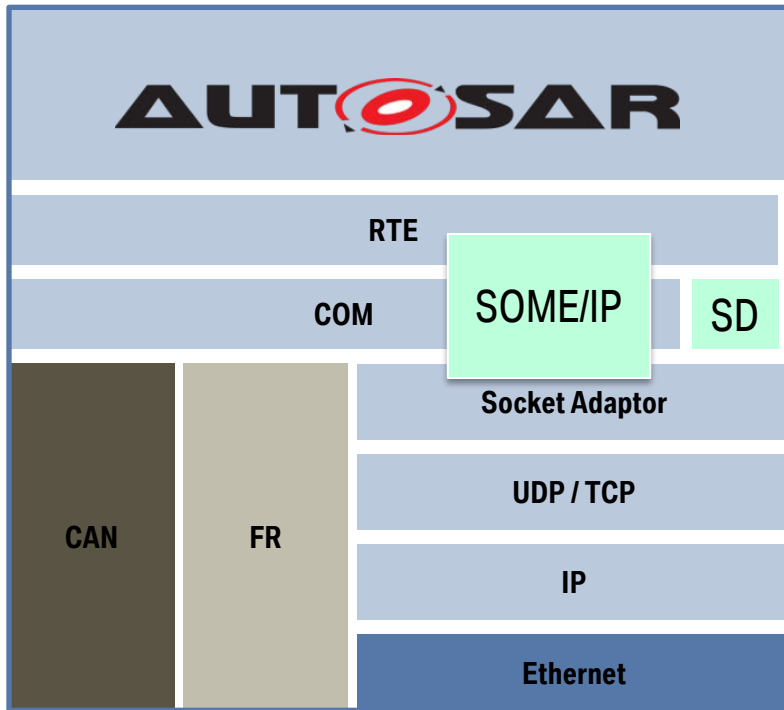
SOME/IP-SD ADVANTAGES/DISADVANTAGES

Advantages:

– Scaling (Multicast and Unicast supported)

– Flexibility (Communication partner can be learned, …)

– Fast sync after startup (independent of message cycle)

– Removes complexity of data path
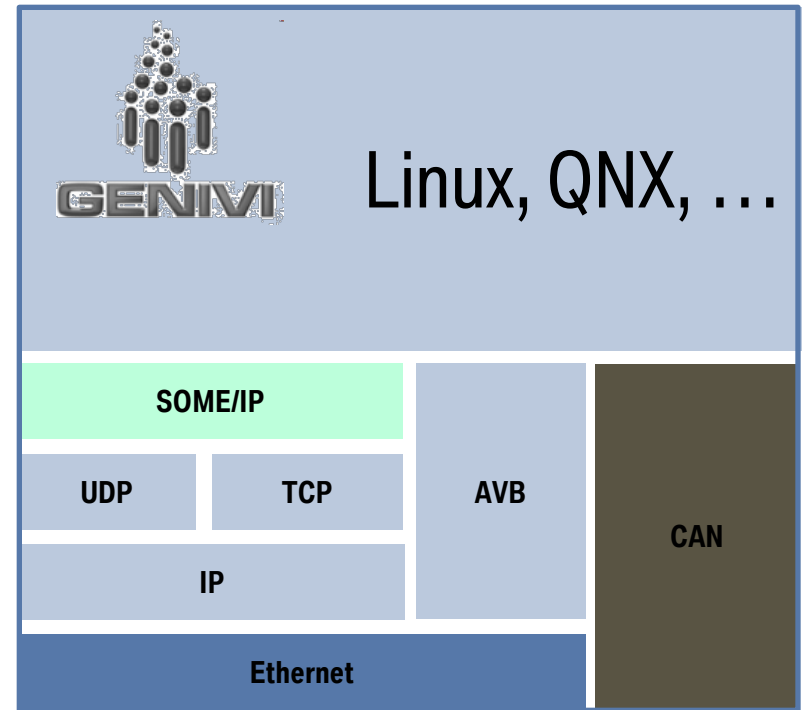
Service
Availability

Disadvantages:

– Extra signaling and state (hold subscriptions)

– Adds complexity to control path

SOME/IP-SD
INTEGRATION INTO AUTOMOTIVE ECUS

VS.

AUTOSAR side:
- RTE
- COM
- SOME/IP
- SD
- Socket Adaptor
- UDP / TCP
- IP
- CAN
- FR
- Ethernet

GENIVI / Linux, QNX, … side:
- SOME/IP
- UDP
- TCP
- AVB
- IP
- CAN
- Ethernet

Socket Adaptor, COM and RTE for SOME/IP. SD has own module.

SOME/IP and SOME/IP-SD are implemented using library.

CONCLUSION

– With growing bandwidth needs, Ethernet is an attractive solution

    – Can replace different expensive technologies in the vehicle

– The reap all benefits, you want

    – Unicast support without restrictions

    – Support for CAN-like and MOST-like applications

    – Flexibility (change of IP with unicast or even service migration)

    – Fast sync after startup (even without very fast cyclic messages)

– SOME/IP-SD offers these benefits and is supported by AUTOSAR and GENIVI today

THANK YOU FOR YOUR ATTENTION!
ANY QUESTIONS?

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