Disclaimer:

The following slides were originally shown in November 2010 at the
2011 Ethernet & IP @ Automotive Technology Day in Munich.

They are made available here to preserve one of the first public SOME/IP presentations as they are not publicly accessible anymore.

Slides might have changed slightly do to formatting and conversion.

Keep in mind:
The usage of Bonjour as Service Discovery technology was changed shortly after this presentation. Due to different concerns SOME/IP-SD was created.

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ONE FOR ALL

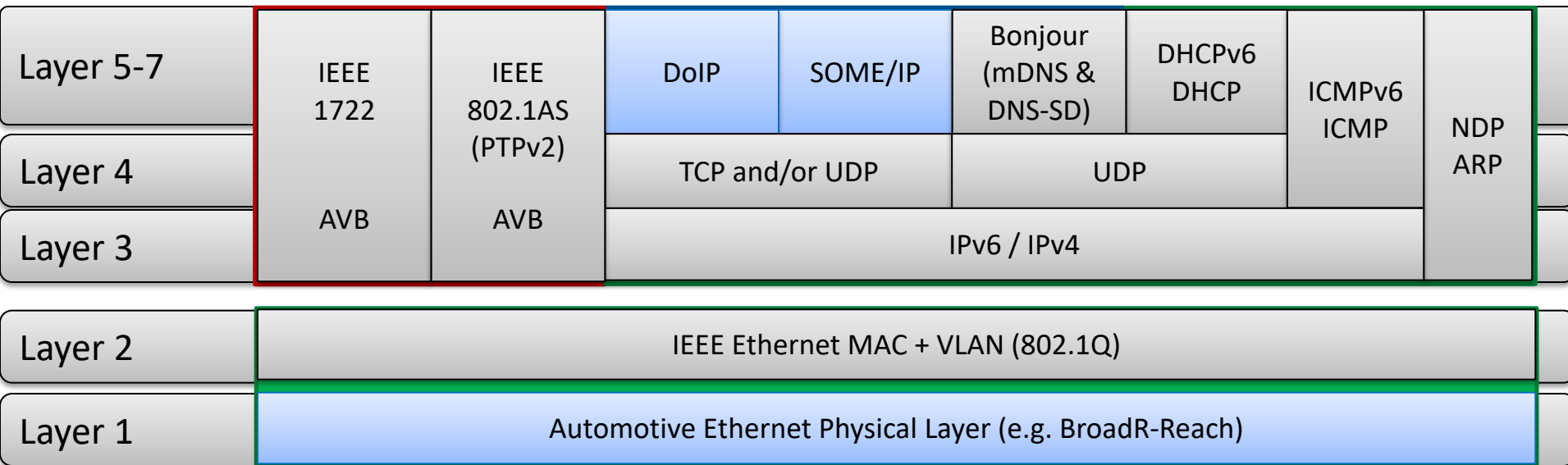## INTEROPERABILITY FROM AUTOSAR TO GENIVI

BMW GROUP

Agenda

- Introduction
  - Middleware as one building block of Ethernet- and IP-based vehicles

- Different existing Middleware solutions

- SOME/IP – as Middleware building block

- Summary and Next Steps

Communication Protocols

	Audio/Video Transport	Time Sync	Diagnosis and Flash Update	Control Communication	Service Discovery	Address Configuration	Address Resolution, Signaling, etc.

Layer 5-7	IEEE 1722	IEEE 802.1AS (PTPv2)	DoIP	SOME/IP	Bonjour (mDNS & DNS-SD)	DHCPv6 DHCP	ICMPv6 ICMP	NDP ARP
Layer 4	AVB	AVB	TCP and/or UDP		UDP			
Layer 3			IPv6 / IPv4					
Layer 2	IEEE Ethernet MAC + VLAN (802.1Q)							
Layer 1	Automotive Ethernet Physical Layer (e.g. BroadR-Reach)							

IT Standard

Automotive

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Communication Protocols

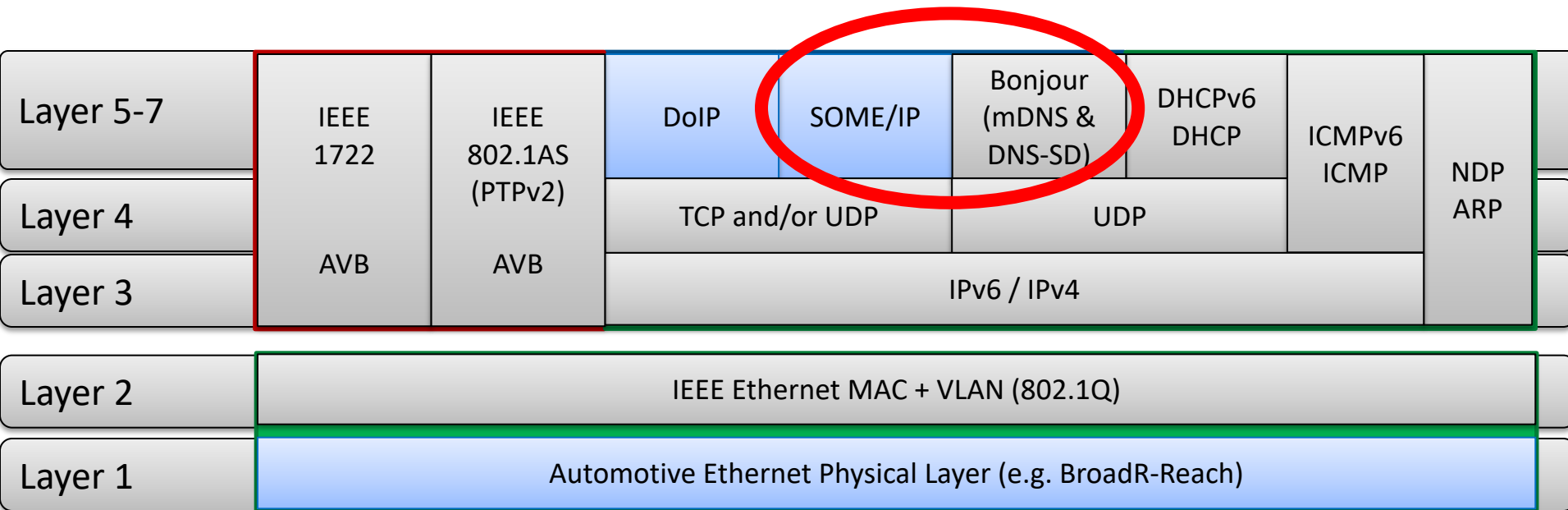|	Audio/Video Transport	Time Sync	Diagnosis and Flash Update	Control Communication	Service Discovery	Address Configuration	Address Resolution, Signaling, etc.

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IT Standard
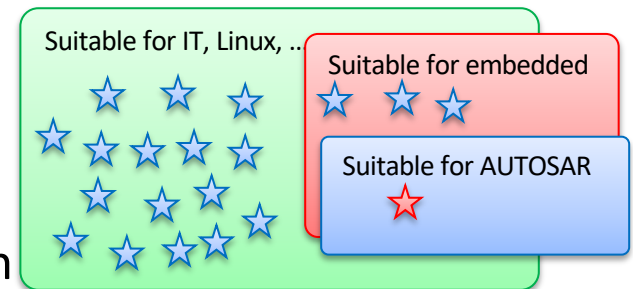Automotive

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Definition „Middleware"

- Allows applications to transparently communication
  - Simplifies development using unique APIs
  - Uses communication protocols and Ethernet

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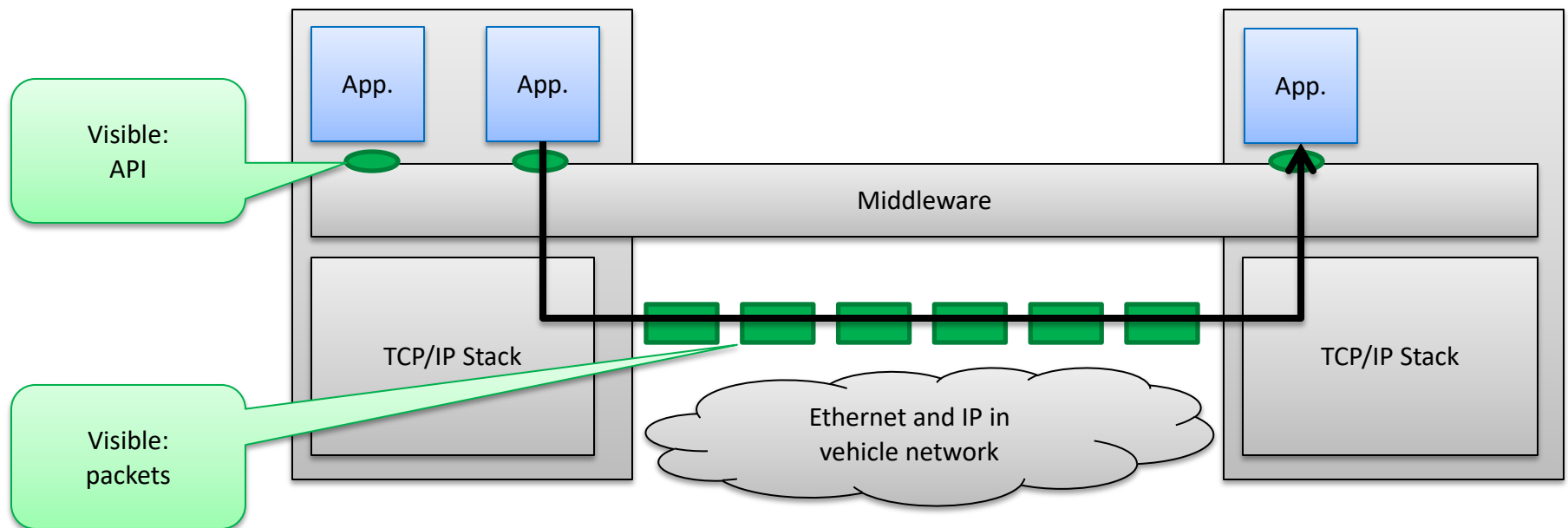
Existing solutions

- A large number of solutions exists
- Many of them (e.g. DCE RPC, Etch, Corba, GPB, THRIFT, …) were evaluated
  - Propagation/usage, standards, performance, size, availability, licenses, …

- Results:
  - Most of them IT-centered
  - Limited propagation, often single application
  - No 100% fit for the automotive requirements
    - add-on (e.g. UDP support) and strip-down needed
  - No AUTOSAR solution
  - Integration and standardization inside AUTOSAR critical
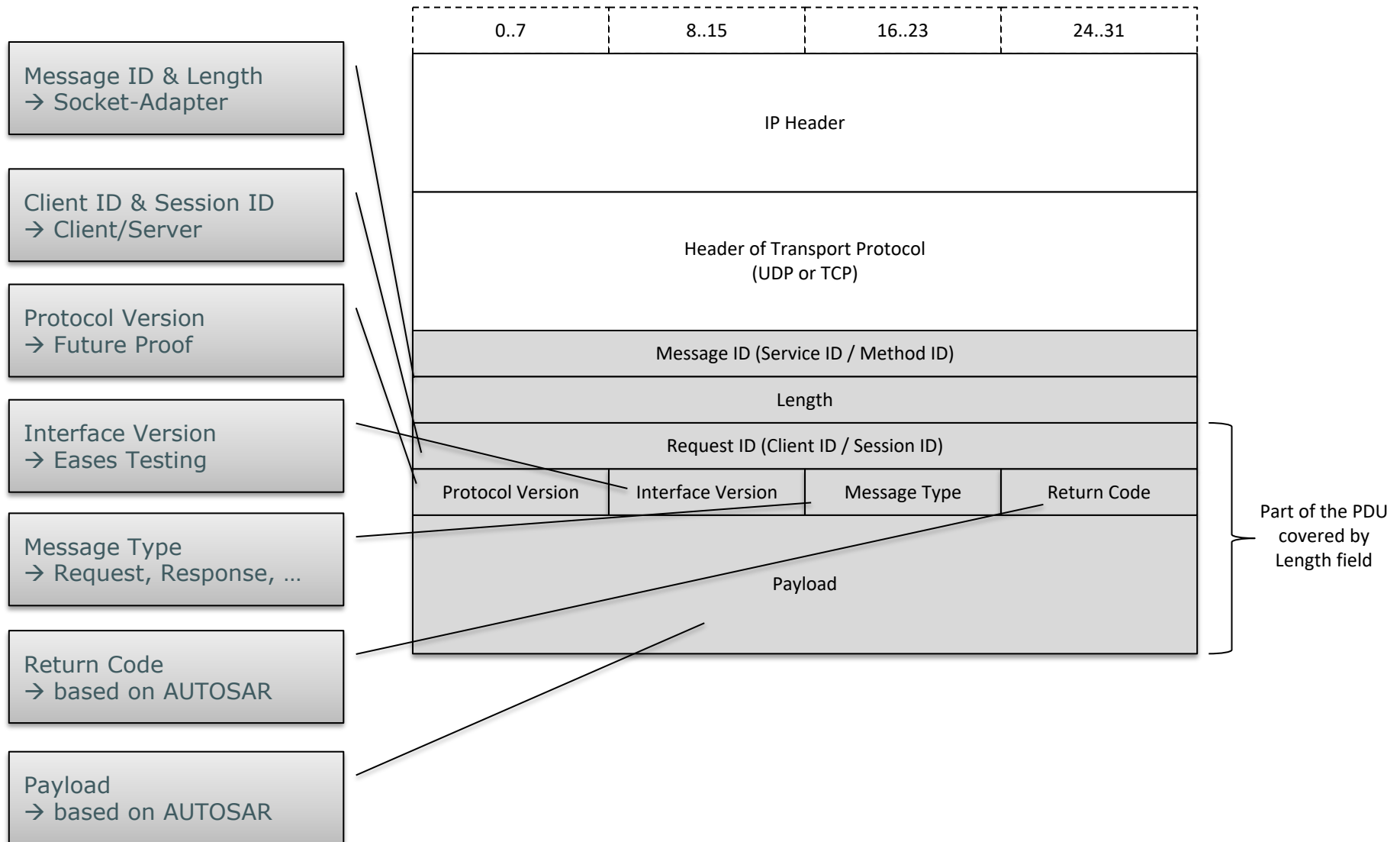 - OEMs did not converge on single IT-solution

Suitable for IT, Linux, …

Suitable for embedded

Suitable for AUTOSAR

There is no existing solution meeting automotive requirements!

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The solution: SOME/IP

- AUTOSAR today:
  - Socket-Adapter integrates TCP/IP-Stack
  - Client/Server allows Request/Response-Communication
  - Sender/Receiver allows „Fire-and-Forget"-Communication

- However:
  - All these have requirements on the header layout!

- Solution:
  - Development of a solution based on AUTOSAR (mappings, …) that is independent of AUTOSAR (license, …)

Service **O**riented **M**iddlewar**e** over **IP** (SOME/IP). ⭐

Header Layout

	0..7	8..15	16..23	24..31
		IP Header		
		Header of Transport Protocol (UDP or TCP)		
		Message ID (Service ID / Method ID)		
		Length		
		Request ID (Client ID / Session ID)		
	Protocol Version	Interface Version	Message Type	Return Code
		Payload		

Message ID & Length
→ Socket-Adapter

Client ID & Session ID
→ Client/Server

Protocol Version
→ Future Proof

Interface Version
→ Eases Testing

Message Type
→ Request, Response, …

Return Code
→ based on AUTOSAR

Payload
→ based on AUTOSAR

Part of the PDU covered by Length field

De/Serialization

- AUTOSAR Types (Integer LE oder BE):

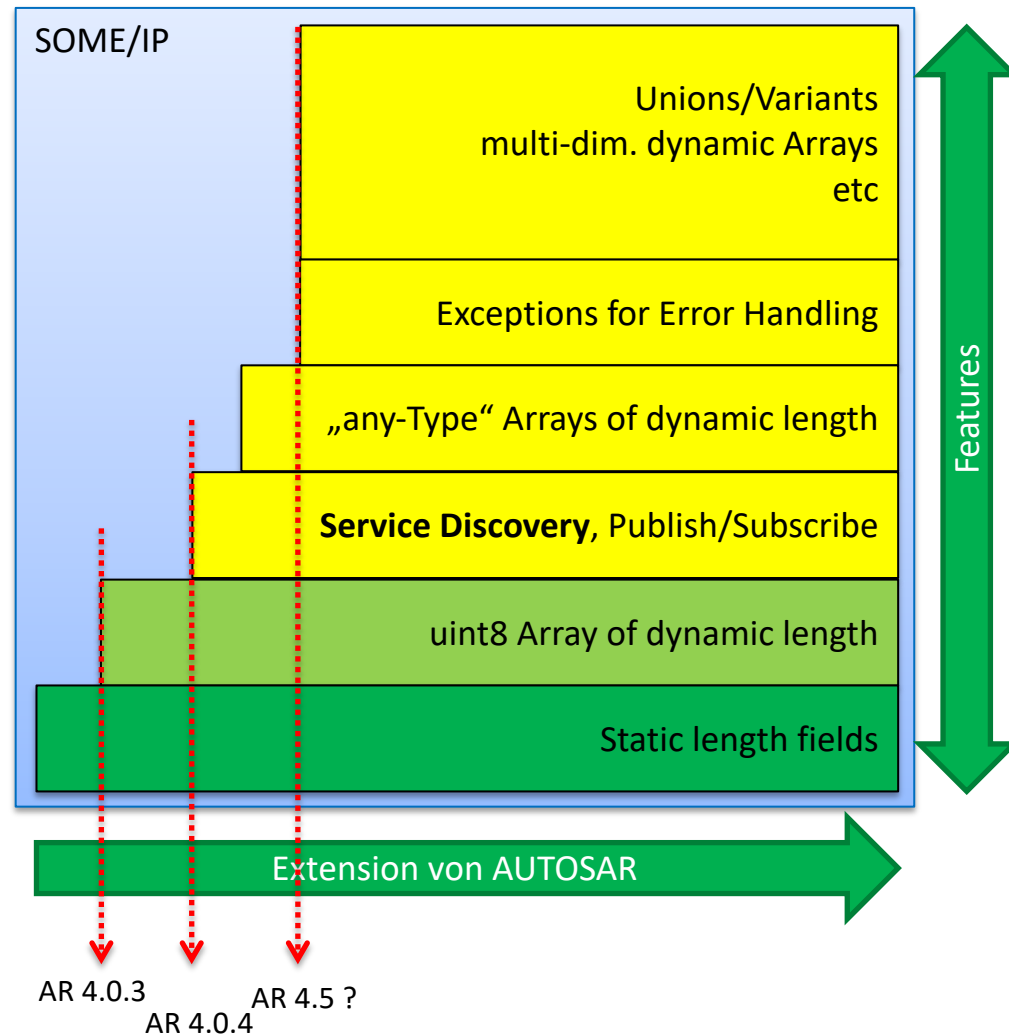| Type	Description	Size [bit]	Remark
boolean	TRUE/FALSE value	8	
uint8	unsigned Integer	8	
uint16	unsigned Integer	16	
uint32	unsigned Integer	32	
sint8	signed Integer	8	
sint16	signed Integer	16	
sint32	signed Integer	32	
float32	floating point number	32	IEEE 754 binary32 (Single Precision)
float64	floating point number	64	IEEE 754 binary64 (Double Precision)

- Selected additional features for Infotainment and other:
  - Unicode Strings (fixed length / dynamic length)
  - Arrays (fixed length / dynamic length)
  - Structs, Union/Variants, …
- Based on ECU's in-memory-layout
  - no compression or dynamic encoding
  - static mapping → easier migration
  - today's tools can be easily adapted

Additional Features

- Service Discovery
    - Signal startup/shutdown of services (e.g. camera)
    - Can announce certain parameters (capabilities)
    - Is also used to implement publish/subscribe/notification
        - Receiver announces notification-consumer

    - Based on Apple Bonjour and is going to be IETF-Standard:
        – https://datatracker.ietf.org/doc/draft-cheshire-dnsext-multicastdns/
        – https://datatracker.ietf.org/doc/draft-cheshire-dnsext-dns-sd/

Service Oriented Middleware over IP (SOME/IP).

- Goal: Solution for AUTOSAR, GENIVI and others

- **Interoperability** with AUTOSAR 4.0.2/.3 and later

- For the future: Back port additional features for infotainment into AUTOSAR

- AUTOSAR-compatiblity enables acceptability over OEMs (political reasons)

- Interface definition based on FIBEX4Services (FIBEX 4.0)

SOME/IP

Unions/Variants
multi-dim. dynamic Arrays
etc

Exceptions for Error Handling

„any-Type" Arrays of dynamic length

Service Discovery, Publish/Subscribe

uint8 Array of dynamic length

Static length fields

Features

Extension von AUTOSAR

AR 4.0.3

AR 4.0.4

AR 4.5 ?

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Next Steps and targets

- Standardization
    - Extending AUTOSAR for additional features (e.g. Infotainment)
    - Introducing and extending SOME/IP concepts in GENIVI
    - SOME/IP as proposal for ISO 17215 (Ethernet Cameras)

- Implementation
    - Different implementations started or will start soon
    - Target plattforms: AUTOSAR, GENIVI, and very small embedded ECU (e.g. Ethernet Camera)

- Tooling
    - Supporting tool vendors to introduce SOME/IP

Conclusion

- Many solutions exist, none fits the requirements
    - BMW created SOME/IP based on AUTOSAR
    - Features for Infotainment are being added

- SOME/IP scales:
    - Small ECU (e.g. Ethernet Cameras)
    - AUTOSAR ECU
    - Infotainment ECUs like Head Units

- SOME/IP is efficient
    - In-Memory-Layout -> efficient de/serialization
    - Can run on embedded (small micro in camera)
    - On-wire efficiency only second degree criterion

Backup

SOME/IP as the bridge between AUTOSAR and GENIVI
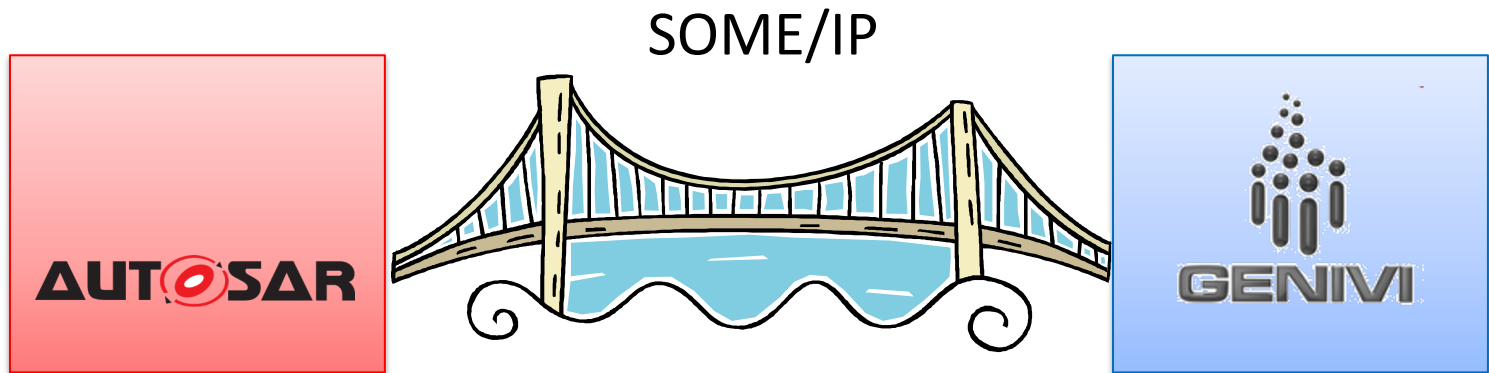
SOME/IP

- SOME/IP is one of the building blocks needed to …
  - allow infotainment and driver assistance to easier communicate
  - simplify design of ECUs and vehicle network (less gateways)

- Allows for an extensible platform enabling innovations

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Middleware: Missing pieces

- Needed pieces to create a middleware:
  - Signals and RPC → SOME/IP
  - Service Discovery → Bonjour
  - Security → (different solutions possible)

- What else do you need?
  - Ethernet
  - TCP/IP protocols
  - Audio Video Bridging (AVB)

Requirements of ISO 17215 Use Cases

- Use cases
  - Camera <-> ECU <-> HU
  - Camera <-> HU

- Resulting requirements:
  - ECU and HU must understand:
    - Video Stream
    - Control Communication
  - **Protocols must be supported by automotive systems**
    - **AUTOSAR, GENIVI, and others**