

Understanding AUTOSAR ARXML for Communication Networks

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E/E Evolution in Automotive

- All Innovations will happen in EE, it will shape the future of car
- Vehicle part of Digital world
- Highly Automated Driving, V2X
- SW centric Vehicle Design
- Vehicle EE design emerge out of being only deeply embedded

cameras

2D highres,
video stream
8x 1-4 Mpixel/frame X 30
frames/s X 12-24 bits/pixel

lidar sensors

24bit/point
4X300K-3M 3D points/s

Radar sensors

object/target list

ultrasonic sensors

object/target list

GPS

Status/Control Signaling

- 16/32 bit microcontroller based classical, deeply embedded
- Fixed processing predetermined before deployment
- Feature enhancement nearly impossible after deployment

IVN world has changed

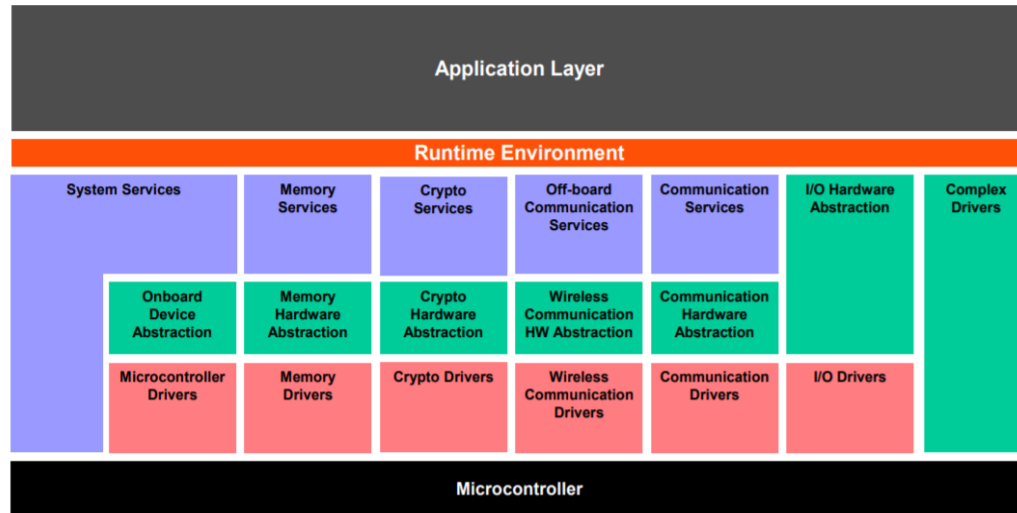


- Massive and Complex Data flow – stateful and stateless systems
- Static & Dynamic Discovery and deployment of Applications
- C++, POSIX, REST, SOME/IP, DDS, IPC, HTTPS **ara::com**
- E2E Protection - ASIL, Crypto, TimeSync, IPSec

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Quick overview of Classical AUTOSAR & ARXML

The Basic Software Layers are further divided into functional groups. Examples of Services are System, Memory and Communication Services.



- AUTOSAR Confidential -

- Layered ECU software – Model based
- Decoupling of Application e.g Airbag Deployment Algorithm to the ECU HW and SW infrastructure = VFB (Virtual Function Bus)
- SW and HW Independence – Application Layer -> Run Time Environment (RTE)-> Basic SW (BSW)

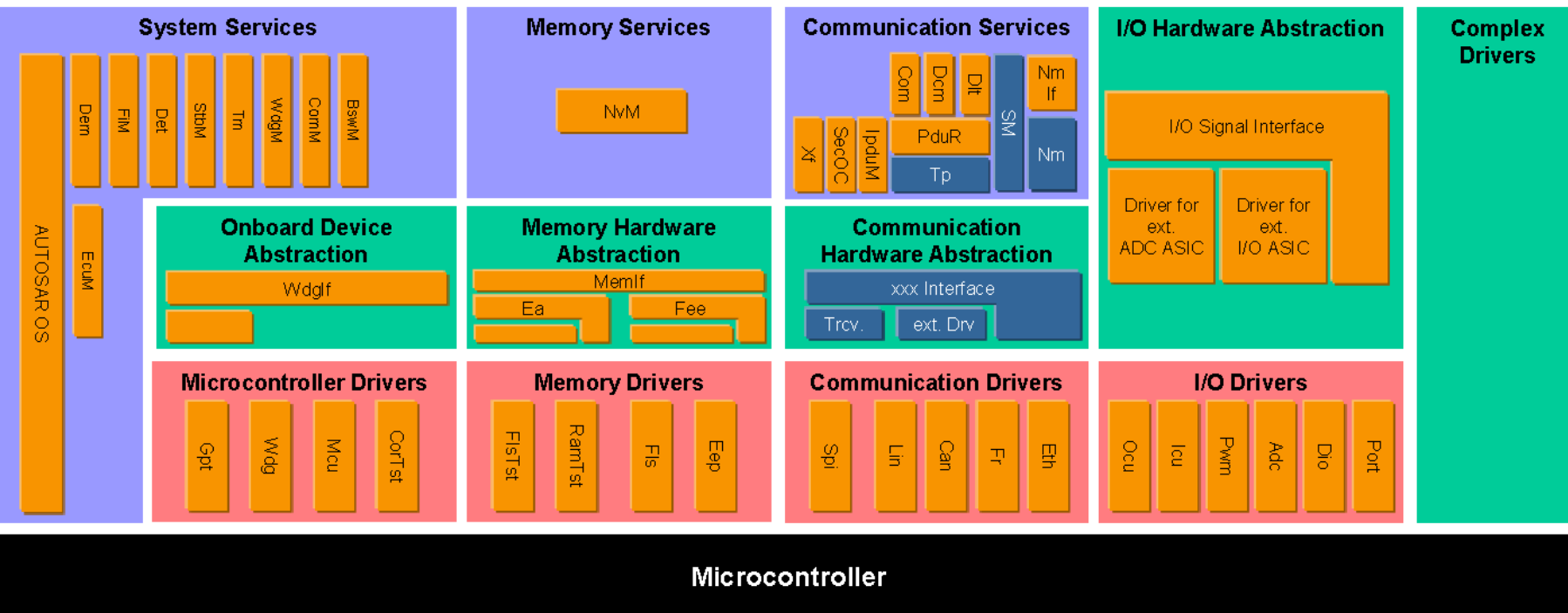
- Interop between different toolchains
- **Compete on Application – Collaborate on Infrastructure**
- ARXML = .arxml defines a template which can be used to generate RTE, BSW

Quick overview of Classical AUTOSAR & ARXML

– COM Layers

Application Layer

AUTOSAR Runtime Environment (RTE)



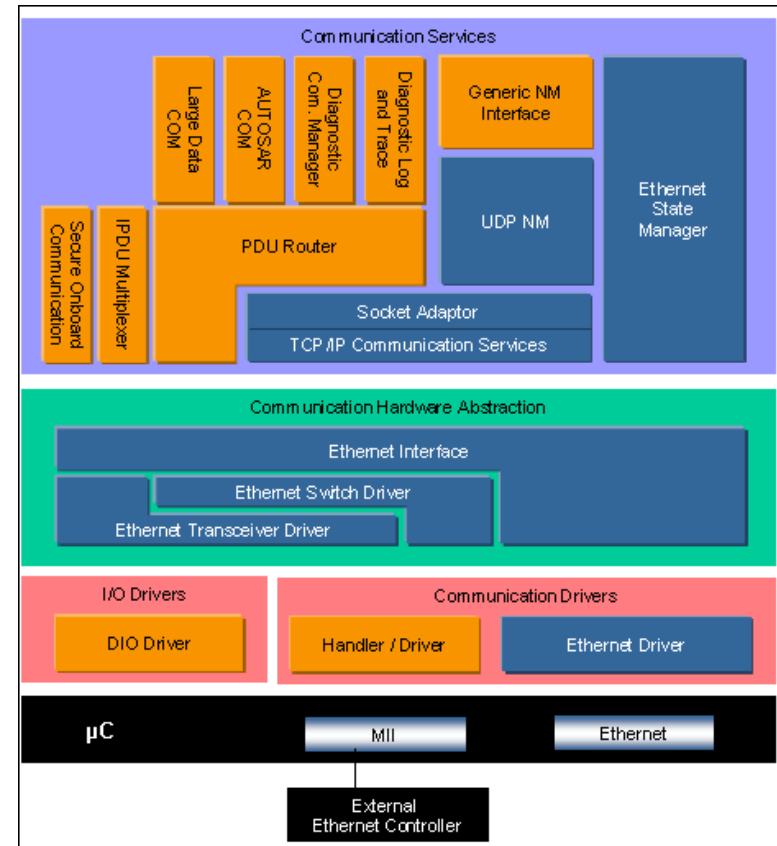
Not all modules are shown here

Ref: autosar.org

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ARXML and Communication Networks

- ARXML is a file/artifact used to manifest/represent a Autosar based ECU configuration
- COM is a layer in Autosar ECU – that also is described in ARXML



Ref: AUTOSAR.org

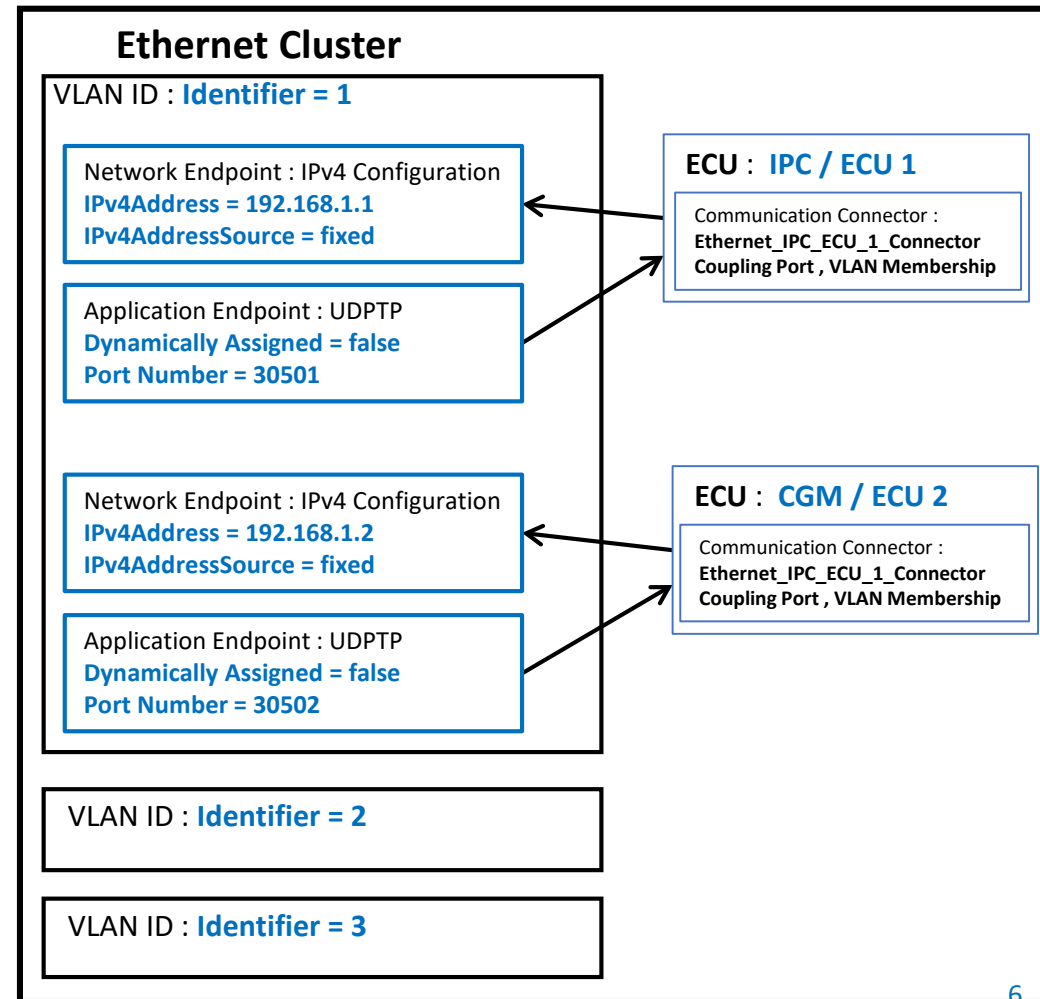
Autosar COM stack for TCP/IP

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DBC/LDF -> ARXML

- DBC files – Simple Classical static data structure description
- DBC files for CAN/CANFD – But, Automotive Ethernet description or FlexRay?
- LDF well suited for LIN and DBC for CAN

e.g. Define a socket connection for a Switched Ethernet Backbone



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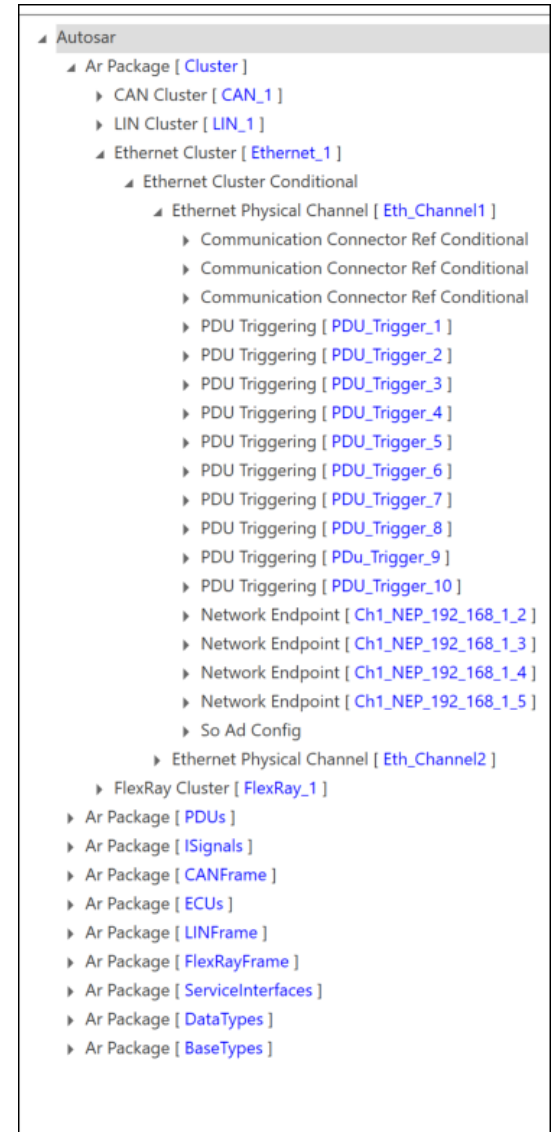
➤ Ability to describe COM architecture – Static and Dynamic nature of transactions seamlessly

ARXML for COM– collection of Autosar Packages

Packages can be constructed in different ways

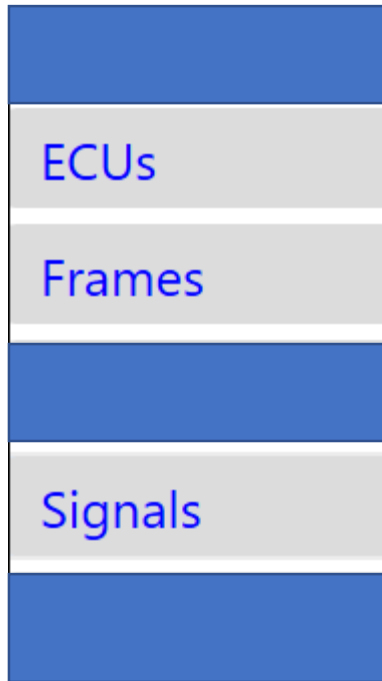
Entity relationships are all described in Autosar Model

System Description / COMM Matrix ->
System Extract -> ECU Extract

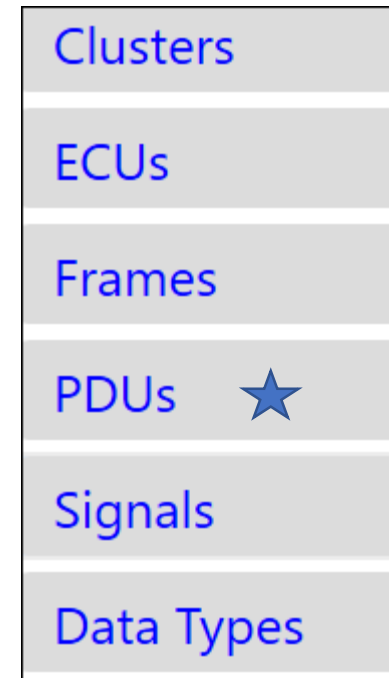


EEA COM Tool Tree View

ARXML for COM – Basic things to be aware off

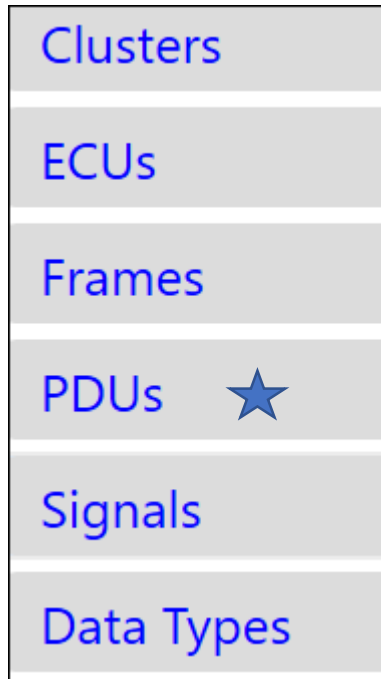


DBC



















ARXML

PDU's



- a collection of signals
- Primary unit in Autosar COM
- Client - Server Interface
- Sender- Receiver Interface
- Different layers in Autosar have different PDU's
- They have properties of how they are triggered and many others
- They may belong to a frame or to a socket

PDUs	
	Container I PDU
	DCM I PDU
	General Purpose I PDU
	General Purpose PDU
	I Signal I PDU
	J1939 DCM I PDU
	Multiplexed I PDU
	NM PDU
	N PDU
	Secured I PDU
	User Defined I PDU
	User Defined PDU
	XCP PDU
	DoIP PDU
	Ethernet PDU
	SOME/IP PDU

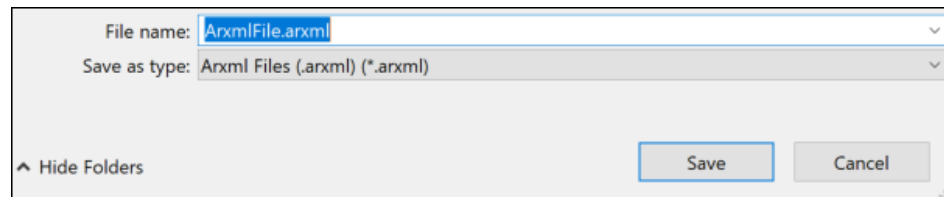
EEA COM Tool PDUs viewer

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ARXML for COM - Getting on-board

- Vehicle Network Engineers - Need to understand contents of the Autosar ARXML file.
- ECU test engineers - Need to perform testing using network analyzer tools such as VehicleSpy.
- Need to be able to **add**, **delete** and **modify** the network messages and save a new Autosar compliant ARXML file.
- System Engineers - Need to create test communication matrix to test on system or bench
- Engineers working on vehicle networks to make local changes in communication matrix for any purpose - avoid loop back to Network Architectural teams to re-generate the Communication Matrix for even small test changes.

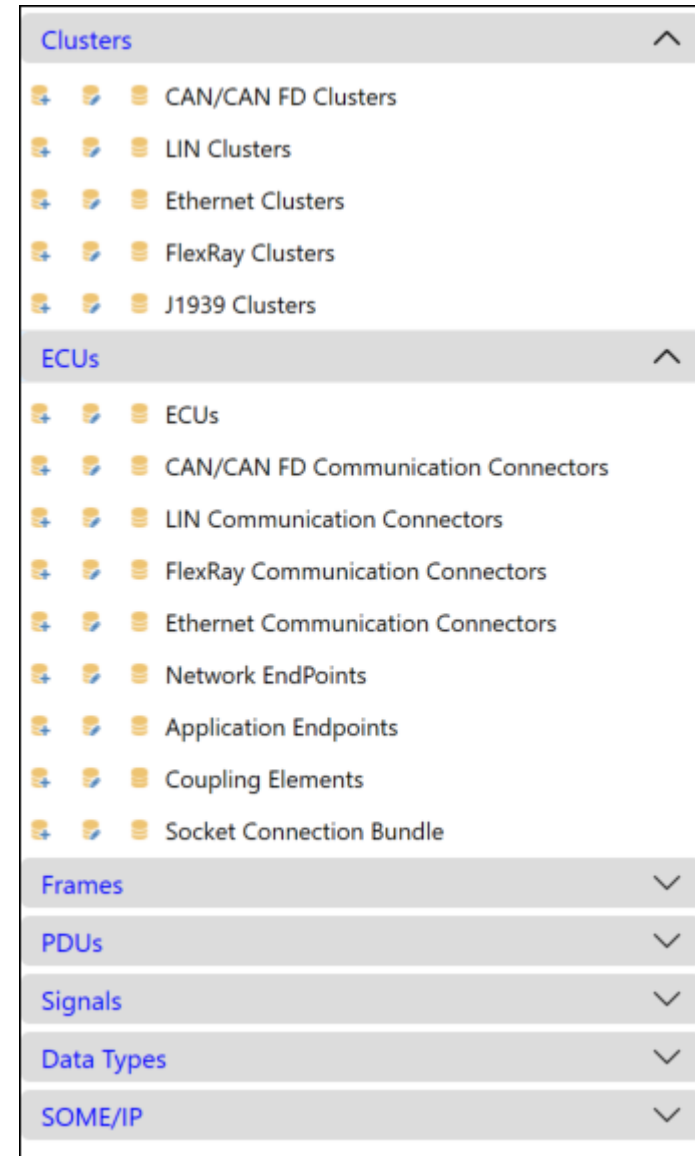
Intrepid EEA COM Tool



File name:

Save as type:

☐ Hide Folders



Clusters

- CAN/CAN FD Clusters
- LIN Clusters
- Ethernet Clusters
- FlexRay Clusters
- J1939 Clusters

ECUs

- ECUs
- CAN/CAN FD Communication Connectors
- LIN Communication Connectors
- FlexRay Communication Connectors
- Ethernet Communication Connectors
- Network EndPoints
- Application Endpoints
- Coupling Elements
- Socket Connection Bundle

Frames

PDUs

Signals

Data Types

SOME/IP

ARXML for COM – Clusters, Frames, PDUs, Signals

CAN Clusters

CAN Cluster	Channel	ECU
CAN_1	Channel_1	ECU_1
		ECU_2
		ECU_3

Number of Clusters : 1

Cluster Details

Short Name: CAN_1
Channel: Channel_1
Baudrate: 5000000
Protocol-Name:
Protocol-Version:
Speed:
CAN-FD-Baudrate:
Long Name: Text

CAN Frames

Short Name	Length(Bytes)
CAN_Frame_1	2
CAN_Frame_2	2
CAN_Frame_3	3
CAN_Frame_4	1
CAN_Frame_5	2
CAN_Frame_6	3

Number of Frames : 6

Frame Details

Long Name:
Description:
PDU To Frame Mappings:

Short Name	Start Position	Packing Byte Order
PDU_1	7	MOSTSIGNIFICA...

PDU Details:

Long Name:
Description:
Short Name: PDU_1
(Click on PDU for detail)

I Signal I PDUs

Short Name	Length(Bytes)
PDU_1	1
PDU_2	2
PDU_3	3
PDU_4	1
PDU_5	2
PDU_6	3
PDU_7	2
PDU_8	3
PDU_9	4
PDU_10	3
sb_pdu_11	2

Number of I Signal I PDUs : 20

I Signal I PDU Details

Long Name:
Description:
I Signal In I PDUs:

Short Name	Start Position
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I Signal Details:

Long Name:
Description:
Short Name: Signal_1
(Click on signal for detail)

I Signals

Short Name	Length(Bits)
Signal_1	8
Signal_2	16
Signal_3	24
Signal_4	1
Signal_5	2
Signal_6	3
Signal_7	4
Signal_8	5
Signal_9	6
Signal_10	7
sb_sig_11	8

Number Of I Signals : 20

State Encoding

Status	Lower Limit	Upper Limit
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Equation

Engineering Value = * Raw Value +
m(scaling factor) b(s)

Unit Details

Short Name:
Unit:

ARXML COM – Ethernet Network Endpoint, Application Endpoint

Network Endpoints

Clusters

Ethernet_1

Physical Channels

Eth_Channel1
Eth_Channel2

NEPs

Ch1_NEP_192_168_1_2
Ch1_NEP_192_168_1_3
Ch1_NEP_192_168_1_4
Ch1_NEP_192_168_1_5

Network Endpoint Details

Short NameCh1_NEP_192_168_1_2

Fully Qualified Domain Name

Priority

Mac Multicast Configuration

Mac Multicast Adre...

IPv4 Config Configuration

IPv4address	Network Mask	TTL	IPv4 Address Source
192.168.1.2			

IPv6 Config Configuration

Assignment Priority	Default Router	Enable Anycast	Hop Count	IP Address Keep Be...	IP Address
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Application Endpoints

Clusters

Ethernet_1

Physical Channels

Eth_Channel1
Eth_Channel2

AEPs

Eth1_Ch1_AEP_192_168_1_2_6000
Eth_Ch1_AEP_192_168_1_3_6001
Eth_Ch1_AEP_192_168_1_4_6002
Eth_Ch_AEP_192_168_1_5_6003

Application Endpoint Details

Short NameEth1_Ch1_AEP_192_168_1_2_6000

Connector ReferenceEth_Ch1_ECU1_Con (Click on Connector for detail)

Network Endpoint ReferenceCh1_NEP_192_168_1_2 (Click on NEP for detail)

TP Port

TCP Port☒

Socket Connection Bundles

Signal | PDU Groups

Ethernet Clusters

Ethernet_1

Physical Channels

Eth_Channel1
Eth_Channel2

Socket Connection Bundles

Bundle_6000_60002
Bundle_6003_6001

Socket Connection Bundle Details

Short NameBundle_6000_60002

Server Port RefsEth1_Ch1_AEP_192_168_1_2_6000 (Click on Server Port for detail)

Socket Connections

PDU Identifiers in Client Port

ARXML COM – Describes Socket Connections

Ethernet Clusters

Ethernet_1

Physical Channels

Eth_Channel1
Eth_Channel2

Socket Connection Bundles

Bundle_6000_60002
Bundle_6003_6001

Socket Connection Bundle Details

Short Name

Server Port Refs [Eth1_Ch1_AEP_192_168_1_2_6000](#) (Click on Server Port for detail)

Socket Connections

Client Port	Details
Eth_Ch1_AEP_192...	
Number of Socket Connections : 1	

PDU Identifiers in Client Port

I PDU Identifier	PDU Short Name	Details
Number of PDU Identifiers : 0		

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ARXML COM FlexRay Cluster

FlexRay Frames

FlexRay Communication Connectors

FlexRay Clusters

FlexRay Clusters

FlexRay_1

FlexRay Channel1

ECUs

ECU_1

ECU_2

ECU_3

FlexRay Cluster Details

Baudrate

1000000

Protocol Name

Protocol Version

2.1

Speed

Action Point Offset

Bit (Nominal Bit Time)

1

CAS Rx Low Max

1

Cold Start Attempts

1

Cycle Count Max

63

Detect NIT Error

True

Dynamic Slot Idle Phase

Ignore After Tx (Bitstrobing)

Listen Noise

Macro Per Cycle

MacroTick Duration

Max_Without Clock Correction Fatal

Max Without Clock Correction Passive

MiniSlot Action Point Offset

MiniSlot Duration

FlexRay Frames

Short Name	Message ID	
FlexRay_Trigger_1	1	^
FlexRay_Trigger_2	2	
FlexRay_Trigger_3	3	
FlexRay_Trigger_4	4	
FlexRay_Trigger_5	5	v

☒ Hex Arbid

Frame Details

Long Name

Description

Short Name

FlexRay_Frame_1

(Click on Frame for detail)

Frame Ports

ECU	Direction
ECU_1	OUT
ECU_2	IN

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ARXML COM – LIN Clusters, LIN Schedule Table, LIN Frames

FlexRay Frames

FlexRay Communication Connectors

FlexRay Clusters

LIN Clusters

LIN Clusters

LIN_1

ECUs

ECU_1[LINCOMMUNICATIONCONNECTOR]
ECU_2[LINCOMMUNICATIONCONNECTOR]

LIN Cluster Details

Baudrate
Protocol Name
Protocol Version
Speed

LIN Frames

Short Name	Identifier	LIN Checksum
Lin_Trigger_1	E7	
LIN_Trigger_2	283	
Lin_Trigger_3	1D1	CLASSIC
Lin_Trigger_4	3A4	

Number of Frames : 4

Frame Details

Long Name
Description
Short Name LIN_Frame_1
(Click on Frame for detail)

Frame Ports

ECU	Direction
ECU_1	OUT
ECU_2	IN

Number of ECU Port : 2

LIN Schedule Table

LIN Frames

LIN Clusters

LIN_1

Schedule Tables

Schedule Table	Resume Position	Run Mode
Schedule_Table	STARTFROMBEGI...	RUNCONTINUOUS

Number of Schedule Tables : 1

Table Entries

Frame	Position In Table	Delay(Seconds)
Lin_Trigger_1	0	0.01
LIN_Trigger_2	1	0.02
Lin_Trigger_3	2	0.03
Lin_Trigger_4	3	0.04

Number of Steps : 4

ARXML is the future

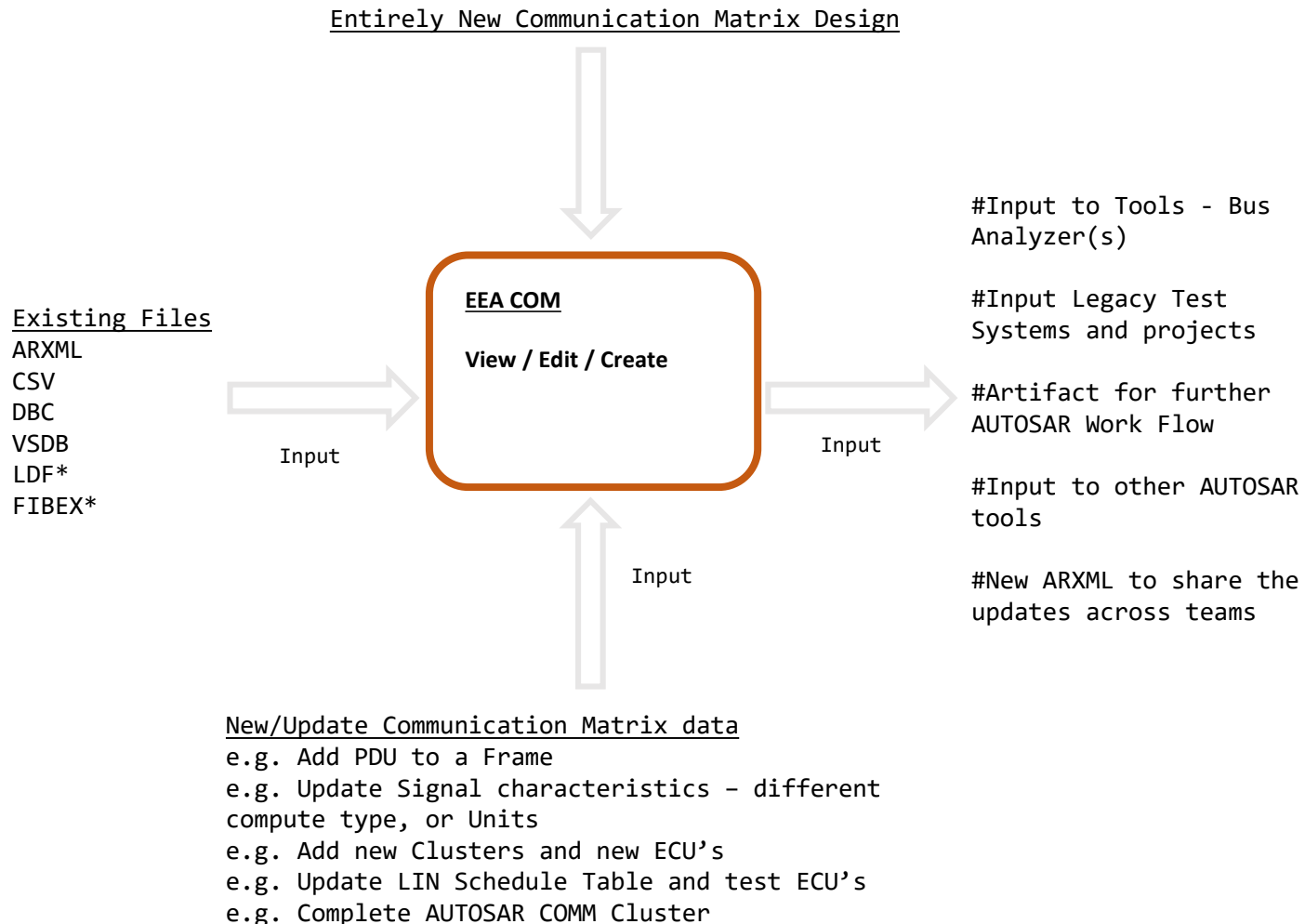
Intrepid EEA COM tool is an easy way to get on board for Autosar ARXML

EEA COM - An Autosar compliant new Vehicle Network Communication Databases tool

VehicleSpy supports ARXML files with all the features available as of DBC/LDF etc

In general if you are using DBC, LDF or FIBEX and ODX/PDX file's then there is a high probability that you will be working on ARXML files

ARXML is the future – EEA COM tool can help



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Thank you for your time.

**Hope you enjoyed learning
about AUTOSAR ARXML files.**