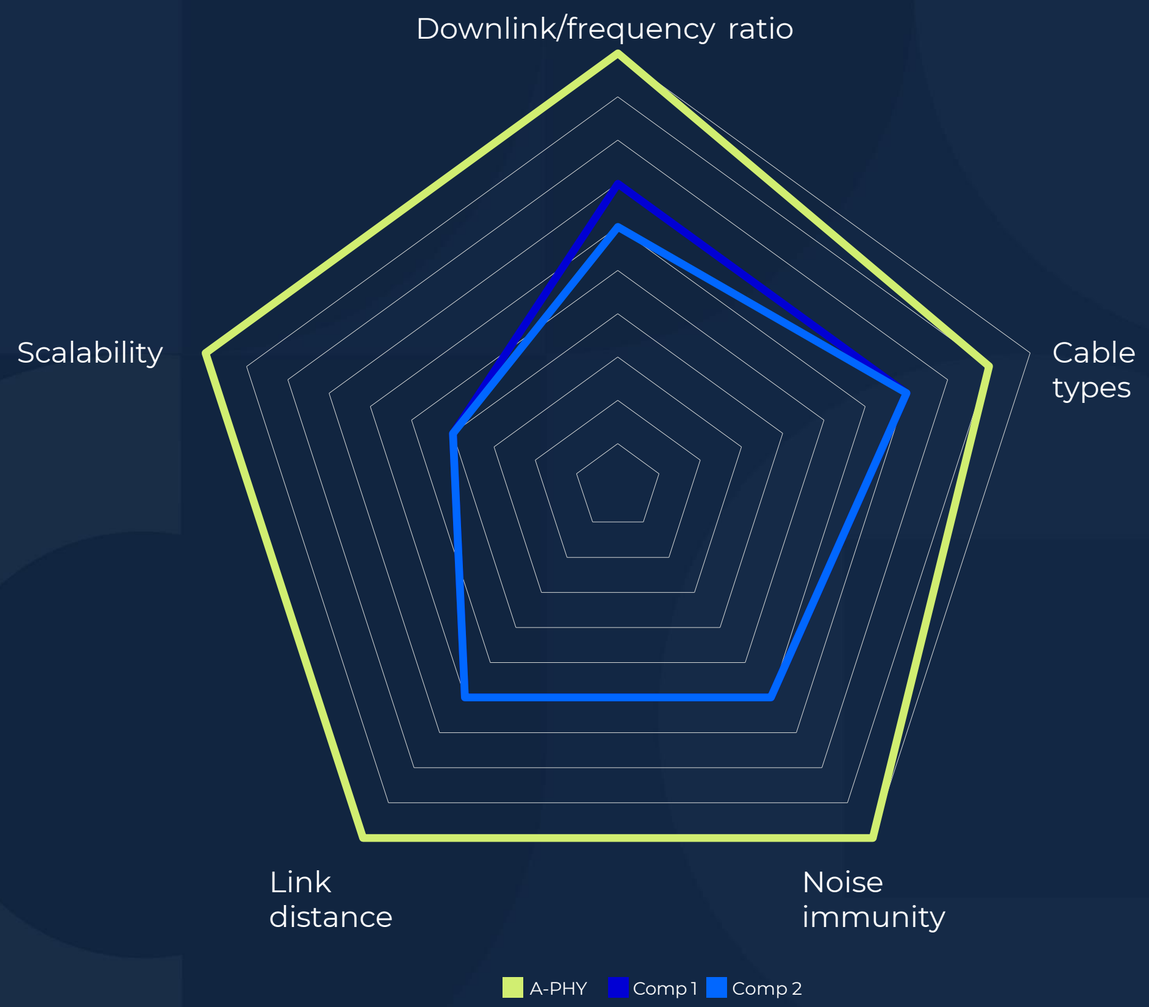
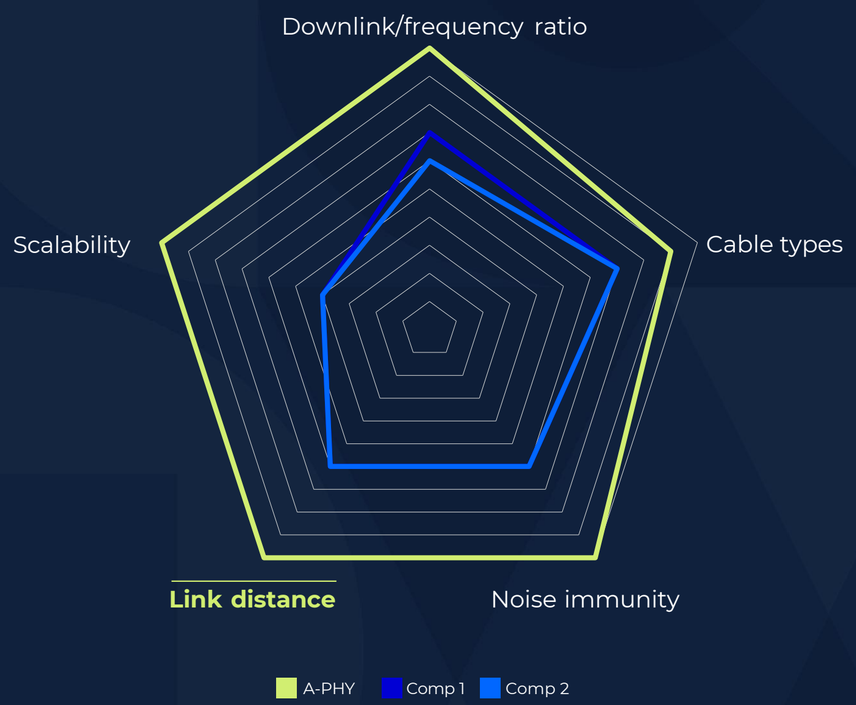
High Performance Connectivity – Technology Shootout



High Performance Connectivity



How we do it

Link Distance

Valens		
A-PHY G1	**A-PHY G2**	**A-PHY G3**
15m for the full lifecycle of the car		

Competitor 1	
Current Gen	**Next Gen**
Cannot meet 15m cable requirements	

Competitor 2	
Current Gen	**Next Gen**
Cannot meet 15m cable requirements	

Only Valens chipsets can support 15 meter cable lengths for the full lifecycle of the vehicle.

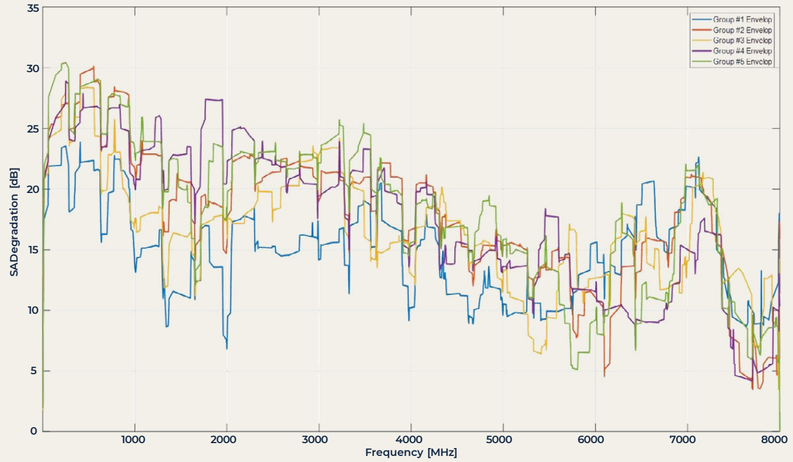
EMC Study on Aged Shielded Cables

Published: IEEE

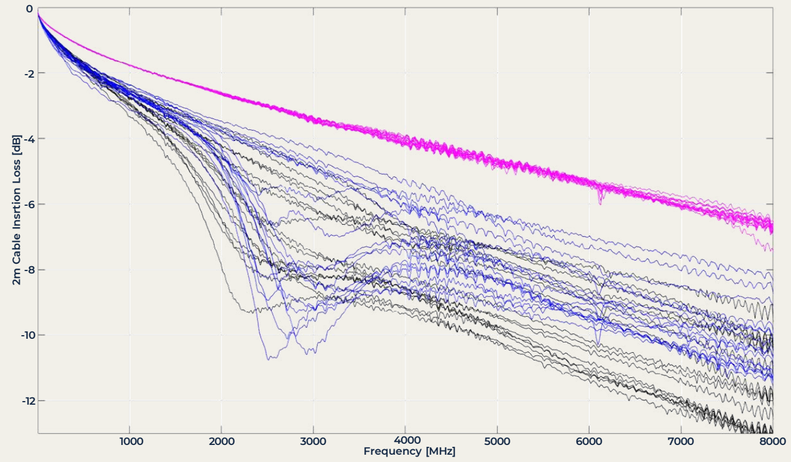
Henrik Wiebe, Huber Automotive ; Dr. Matthias Spägele, Huber Automotive

Stage	Tested cable groups	Description
A	#1, #2, #3, #4 & #5	10000 cycles at a temperature of +40°C
B	#2, #3, #4 & #5	20000 cycles at a temperature of +40°C
C	#3, #4 & #5	10000 cycles at a temperature of -20°C
D	#4 & #5	10000 cycles at a temperature of +85°C
E	#5	2500 cycles at a temperature of +40°C

Research shows that the effectiveness of shielding degrades as cables age, leaving safety-critical links vulnerable to Electromagnetic Interference

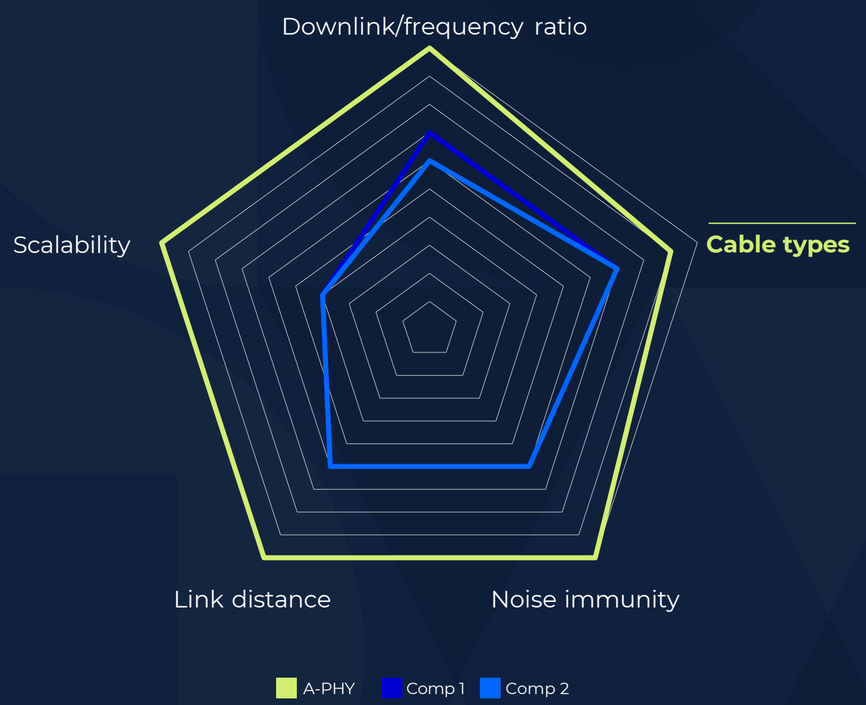


Dynamic Coax Shielding Attenuation (SA) Degradation: Even after the first stage of testing, shielding Attenuation degrades significantly and quickly



Dynamic Coax Insertion Loss (IL) Degradation: Aging leads to major Insertion Loss degradation and distortions

High Performance Connectivity



How we do it ›

Cable Types

	Valens			Competitor 1		Competitor 2	
	A-PHY G1	A-PHY G2	A-PHY G3	Current Gen	Next Gen	Current Gen	Next Gen
Coax	✓	✓	✓	✓	✓	✓	✓
STP	✓	✓	✓	✓	✓	✓	✓
UTP	✓	✓	✓	✗	✗	✗	✗

Only Valens can support Unshielded Twisted Pair cables, which are more flexible than their counterparts and can lower total system cost.

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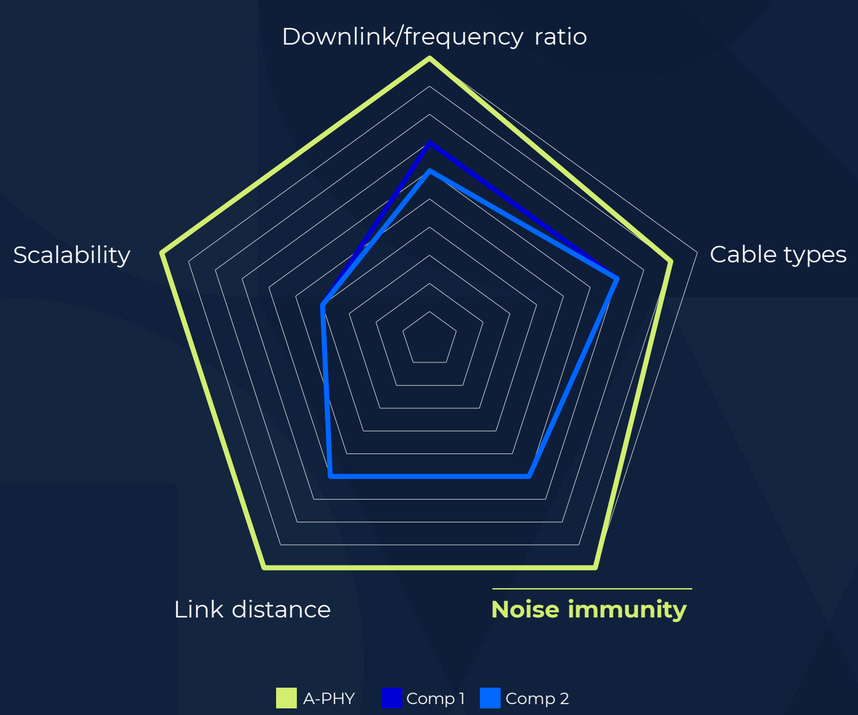
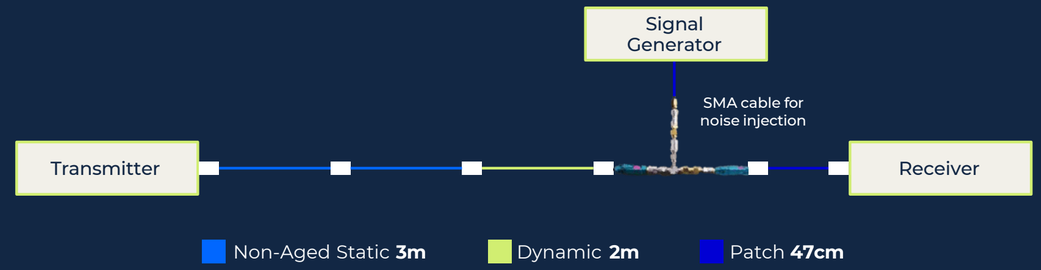
High Performance Connectivity



How we do it ›

Noise Immunity



Channel	A-PHY 4Gbps	A-PHY 8Gbps	Competitor 1 6Gbps	Competitor 2 8Gbps
1	100mV	89mV	14mV	16mV
2	100mV	79mV	2mV	No Link
3	100mV	79mV	10mV	11mV
4	100mV	79mV	7mV	11mV
5	89mV	89mV	No Link	3mV

Valens can withstand all common automotive noise profiles, when others can’t.

EMC Testing of Valens VA7000 Chipsets

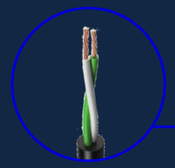
Coax Cabling, 8Gbps

DENSO JasPar HUBER AUTOMOTIVE

Using 15m cables!

Table 1.1: Overview EMC-Tests

Test	Operating Mode	Setup	Result	Comment
RE-Test	Gear 3 with BIST	Setup C	Pass	according to RE-Test Class 5
CP-Test	Gear 3 with BIST	Setup C	Pass	according to CP-Test Class 4
RI-Test	Gear 3 with BIST	Setup C	Pass	according to RI-Test Criteria A
BCI-Test	Gear 3 with BIST	Setup C	Pass	according to BCI-Test Criteria A
TOL-Test	Gear 3 with BIST	Setup C	Pass	according to TOL-Test Criteria A
ESDI-Test	Gear 3 with BIST	Setup C	Pass	according to ESDI-Test Criteria A
RE-Test	Gear 3 with BIST	Setup D	Pass	according to RE-Test Class 5
CP-Test	Gear 3 with BIST	Setup D	Pass	according to CP-Test Class 4
RI-Test	Gear 3 with BIST	Setup D	Pass	according to RI-Test Criteria A
BCI-Test	Gear 3 with BIST	Setup D	Pass	according to BCI-Test Criteria A
TOL-Test	Gear 3 with BIST	Setup D	Pass	according to TOL-Test Criteria A
ESDI-Test	Gear 3 with BIST	Setup D	Pass	according to ESDI-Test Criteria A



UTP Cabling, 4Gbps

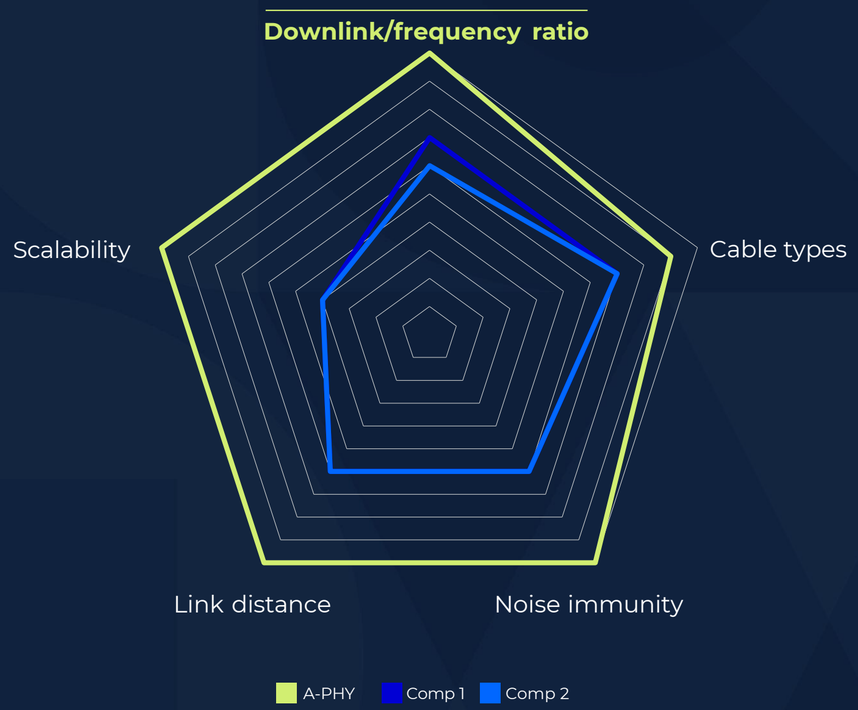
HUBER AUTOMOTIVE

Table 1.1: Overview EMC-Tests

Test	Operating Mode	Setup	Result	Comment
RE-Test	Gear 2U with BIST	Setup A	Pass	according to RE-Test Class 5
CP-Test	Gear 2U with BIST	Setup A	Pass	according to CP-Test Class 4
RI-Test	Gear 2U with BIST	Setup A	Pass	according to RI-Test Criteria A
BCI-Test	Gear 2U with BIST	Setup A	Pass	according to BCI-Test Criteria A
TOL-Test	Gear 2U with BIST	Setup A	Pass	according to TOL-Test Criteria A
ESDI-Test	Gear 2U with BIST	Setup A	Pass	according to ESDI-Test Criteria A
RE-Test	Gear 2U with BIST	Setup B	Pass	according to RE-Test Class 5
CP-Test	Gear 2U with BIST	Setup B	Pass	according to CP-Test Class 4
RI-Test	Gear 2U with BIST	Setup B	Pass	according to RI-Test Criteria A
BCI-Test	Gear 2U with BIST	Setup B	Pass	according to BCI-Test Criteria A
TOL-Test	Gear 2U with BIST	Setup B	Pass	according to TOL-Test Criteria A
ESDI-Test	Gear 2U with BIST	Setup B	Pass	according to ESDI-Test Criteria A

Valens' A-PHY-compliant VA7000 chipsets passed all listed EMC tests with margin

High Performance Connectivity



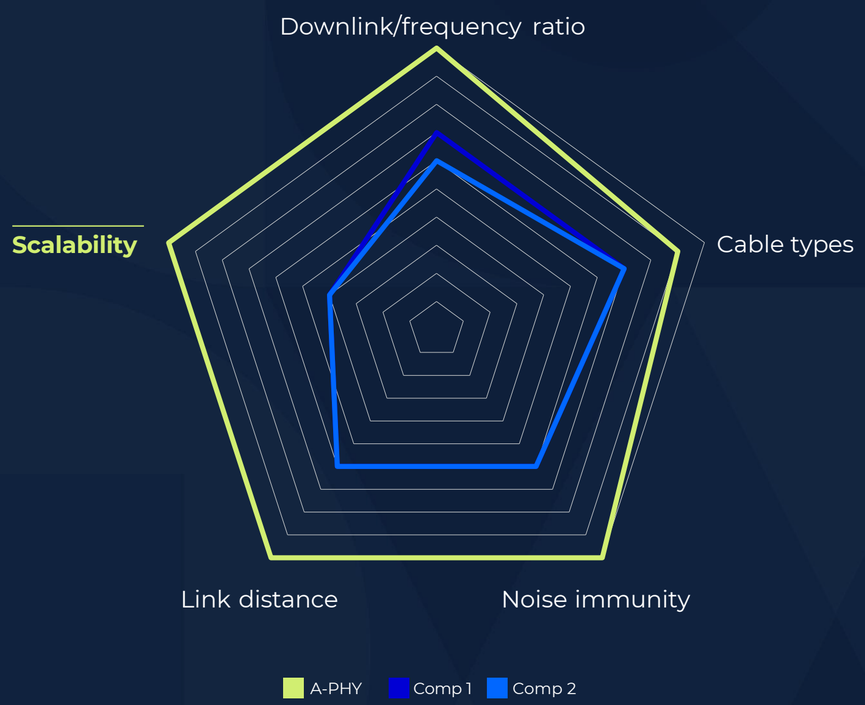
How we do it ›

Downlink-Frequency Ratio

	Valens			Competitor 1		Competitor 2	
	A-PHY G1	A-PHY G2	A-PHY G3	Current Gen	Next Gen	Current Gen	Next Gen
Line Rate (Gbps)	2	4	8	6	12	4.16	10
Data Rate (Gbps)	1.8	3.6	7.2	5.15	TBD	3.32	7.55
Frequency (GHz)	0.5	1	2	3	3	2.08	5

Valens chipsets offer the best combination of downstream bandwidth and low frequency (never rising above 2GHz) for reduced radiated emissions.

High Performance Connectivity



How we do it

Scalability

Valens	Competitor 1	Competitor 2
G4: 12Gbps, G5: 16Gbps With no impact on noise immunity	Legacy analog - Cannot reach noise immunity for the required cable length	Legacy analog - Cannot reach noise immunity for the required cable length

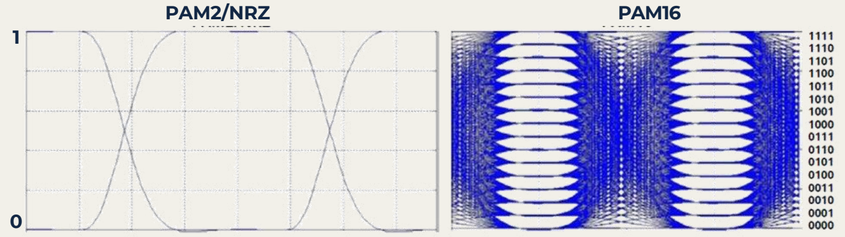
MIPI A-PHY has a clear roadmap to 16Gbps with no impact on the integrity of the channel; proprietary solutions have reached the limits of analog technologies and cannot scale to support higher bandwidth.

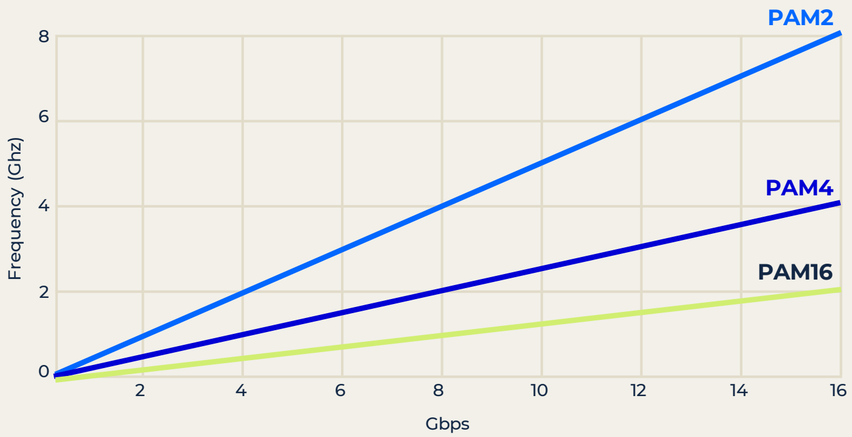
Valens' A-PHY Chipsets:
A DSP-Based Approach to EMI

Pulse Amplitude Modulation

- Higher levels of PAM encode more bits per symbol, leading to:
  - Stream sensitive transmissions operating at different PAM levels (PAM2 for Header, PAM4 for Controls, PAM4/8/16 for payload)
  - Lower frequency on the cable
  - Lower insertion loss
  - Lower noise due to lower receiver bandwidth

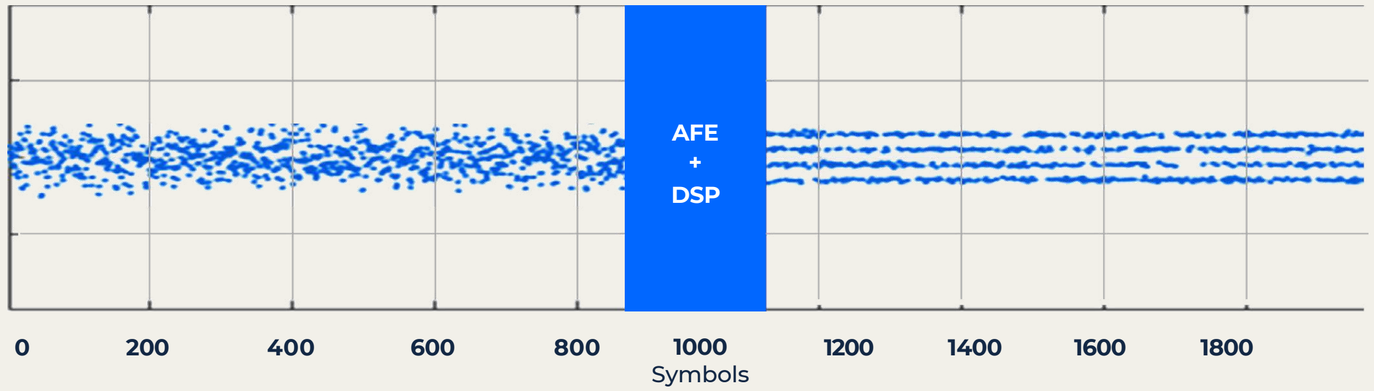
Higher levels of PAM lower the required link frequency; while competing solutions use PAM2/4, MIPI A-PHY solutions reach PAM16



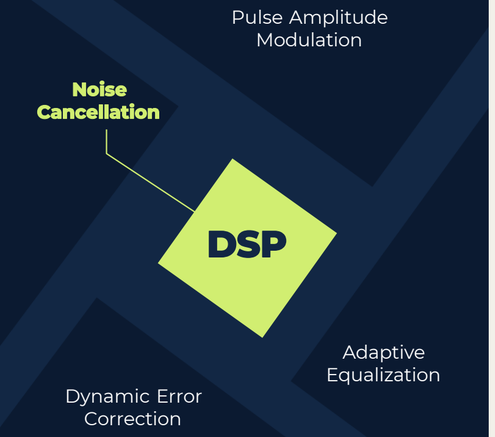


Fully Adaptive Equalization

- Fully adaptive equalization tracks channel variations in real time, while competing solutions only select from pre-defined parametric/discrete filters
- Equalizes timing variations of the channel
- Compensates reflections from concatenated multi-inline cable structures

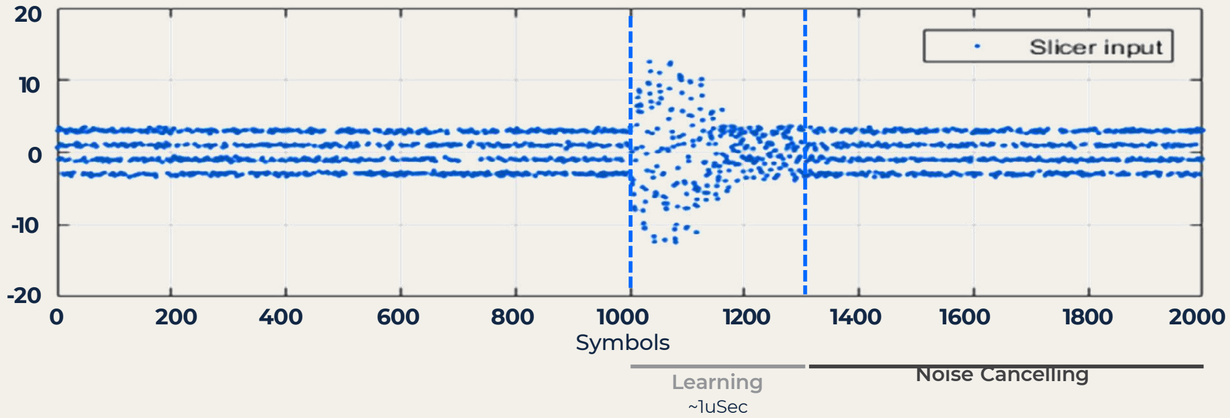


Compensates for channel insertion loss throughout the length of the cable.



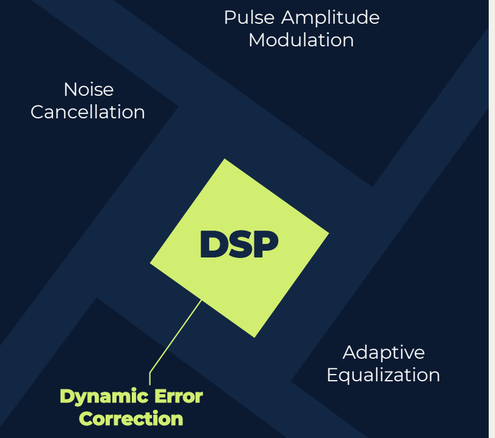
Noise Canceling for EMI attacks

- Just-in-time noise canceller: Synchronized mechanisms that speed up canceller convergence
- Optimized for EMI attacks (NBI), including non-linear harmonic distortions



The Valens solution is fully adaptive and optimized for Narrowband Interference (NBI), while competing solutions rely mainly on shielding and application-level retransmission to deal with this noise profile

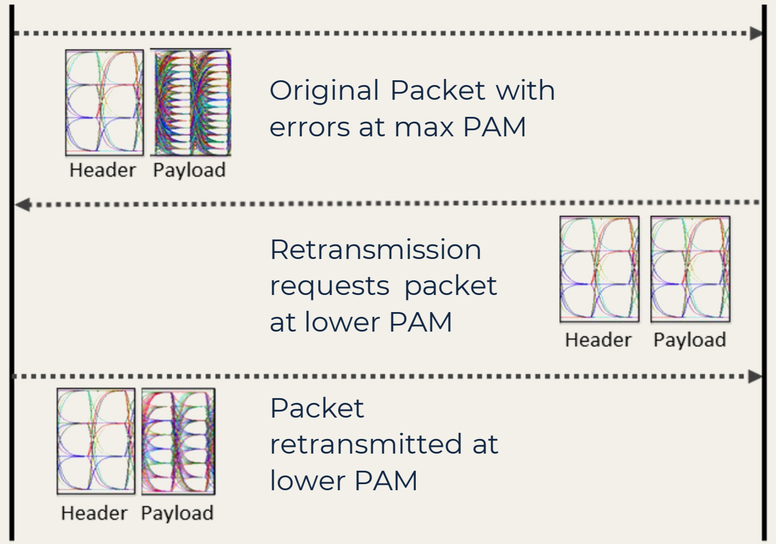
Dynamic Error Correction (RTS) – Optimized for NBI



- Ultra-fast: occurs at the physical level (PHY)
- Dynamic modulation ensures retransmitted packets arrive uncorrupted

	FEC Forward error corrections	**DMLR** Dynamically Modulated Local Retransmission
Bounded latency	✓	✓
White noise correction	✓	✓
EMI noise correction	✗	✓

Dynamically modulated local retransmission (DMLR)



Transparent to upper layers, bounded to ~10us latency

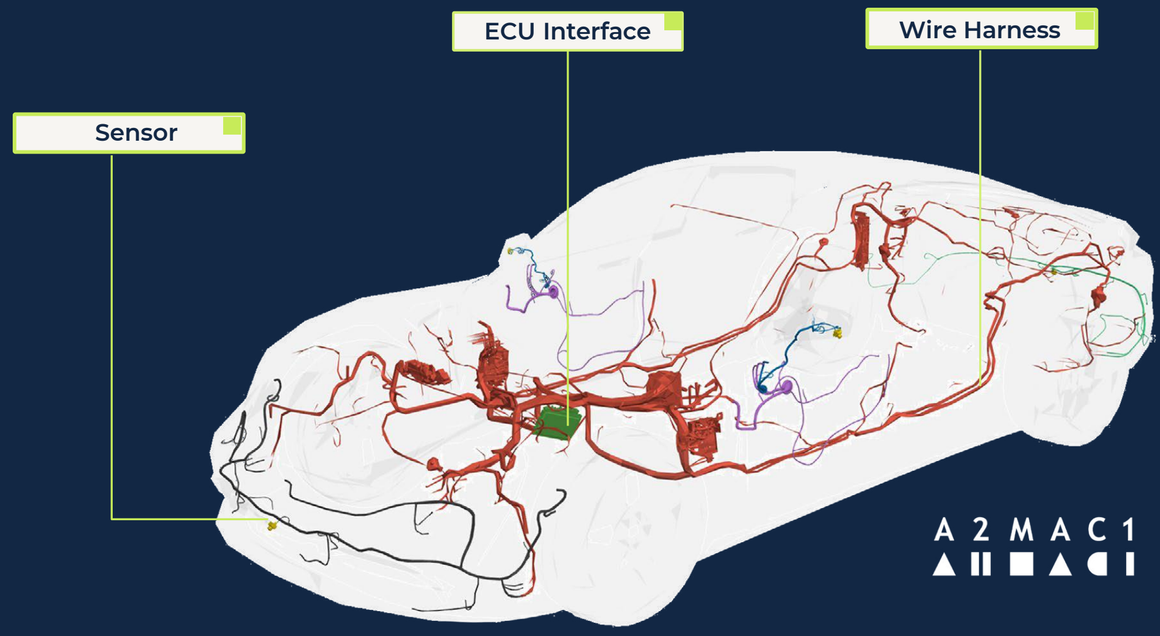
DMLR is specifically designed to handle electromagnetic noises present in the vehicle, while FEC is extremely limited in its ability to deal with such noises

Reduced Total System Cost

Surround View System

15%

TOTAL SYSTEM COST

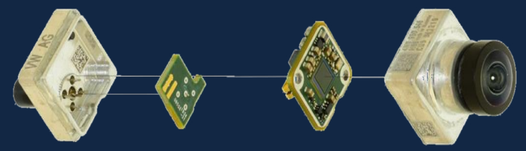


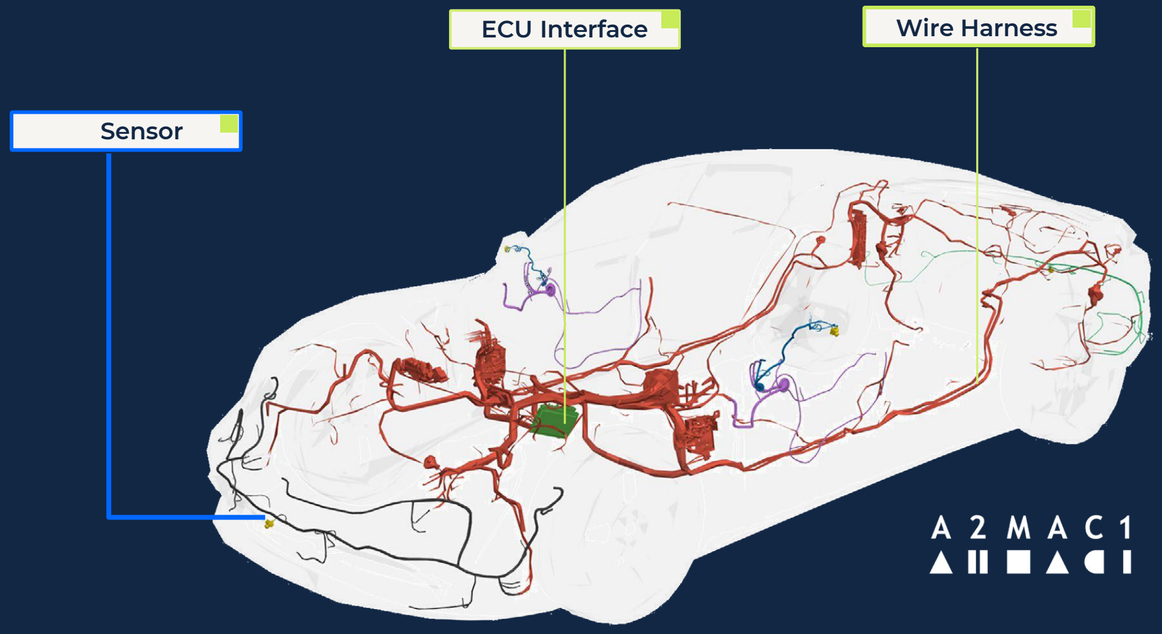
Reduced Total System Cost

Surround View System

Reduced Total System Cost
Sensor

- Direct integration of MIPI A-PHY into the image sensor results in $0.90 savings per sensor ($3.60 in a 4-camera surround view system).



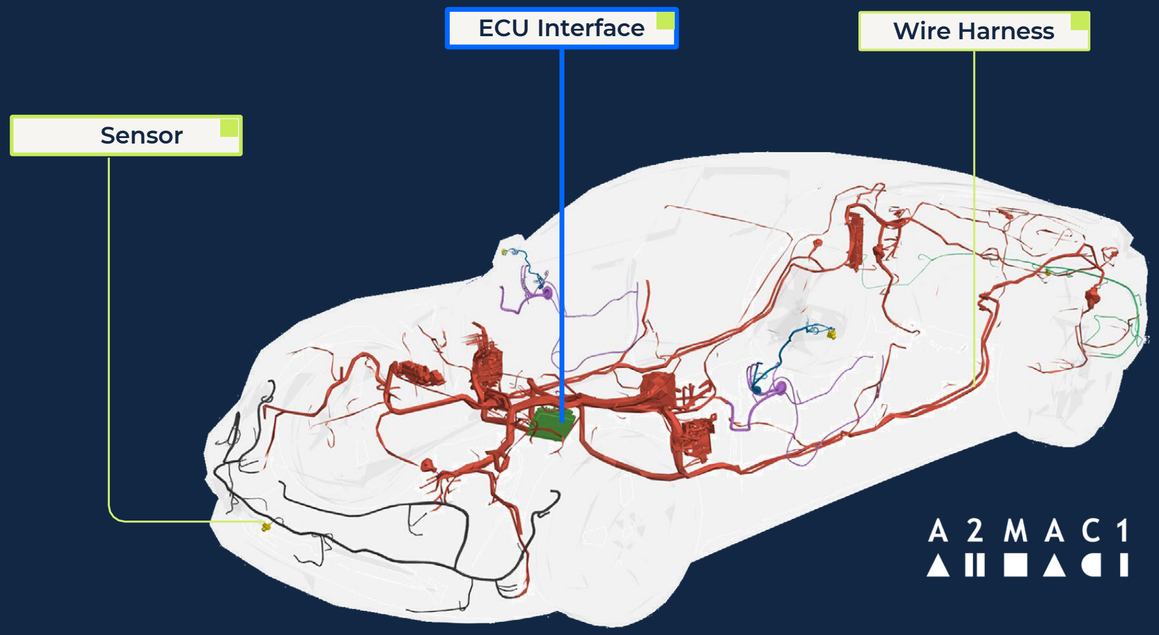


Reduced Total System Cost

Surround View System

Reduced Total System Cost
ECU Interface

The UTP-based Surround View System can replace dedicated Fakra connectors with a single shared multi-pin connector.

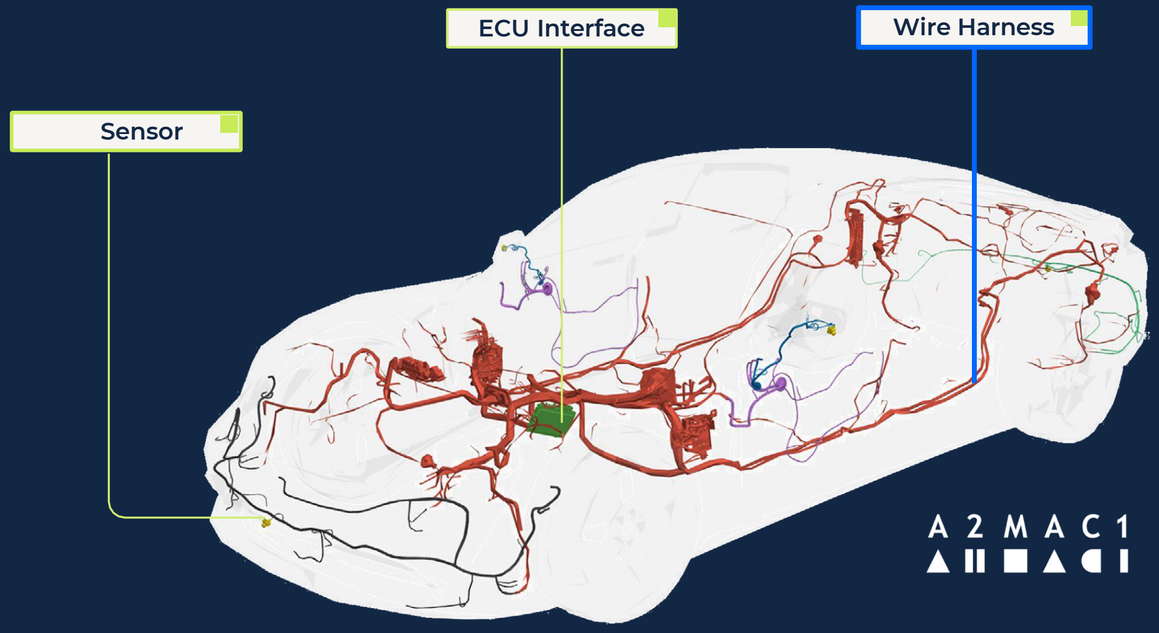


Reduced Total System Cost

Surround View System

Reduced Total System Cost
Wire Harness

- Use of UTP cables and MQS connectors/inlines instead of Coaxial cable and Fakra connectors/inlines.



Reduced Total System Cost

Surround View System

Reduced Total System Cost

Cost Breakdown: 1.3 MP

Surround view system			Conventional GMSL based	MIPI A-PHY based
			2021 28k	2021 28k
			USD / Unit	USD / Unit
Material	1001	Mechanical Parts	33,70	32,71
	1002	Optics module Assy	19,31	19,31
	1003	Electronics	44,52	45,78
	1004	Wireharness	23,49	9,77
	Total BOM		121,03 $	107,57 $
	MGK	3,50%	4,24	3,76
	Scrap	0,50%	0,61	0,54
	Total Material		125,87 $	111,87 $
Assembly	1001	PCB 1	1,40	1,40
	1002	Final Assy	3,05	2,98
	Total Production		4,46 $	4,38 $
Totals				
	Manufacturing Cost		130,33 $	116,25 $
	Overhead	12%	15,64	13,95
	Profit	6%	7,82	6,98
	Total Cost		153,78 $	137,18 $

Cost Breakdown: 4 MP

Conventional TI based	MIPI A-PHY based
2021 28k	2021 28k
USD / Unit	USD / Unit
33,70	32,71
19,31	19,31
61,37	54,02
23,49	9,77
137,87 $	115,81 $
4,83	4,05
0,69	0,58
143,39 $	120,45 $
1,40	1,40
3,05	2,98
4,46 $	4,38 $
147,85 $	124,83 $
17,74	14,98
8,87	7,49
174,46 $	147,30 $