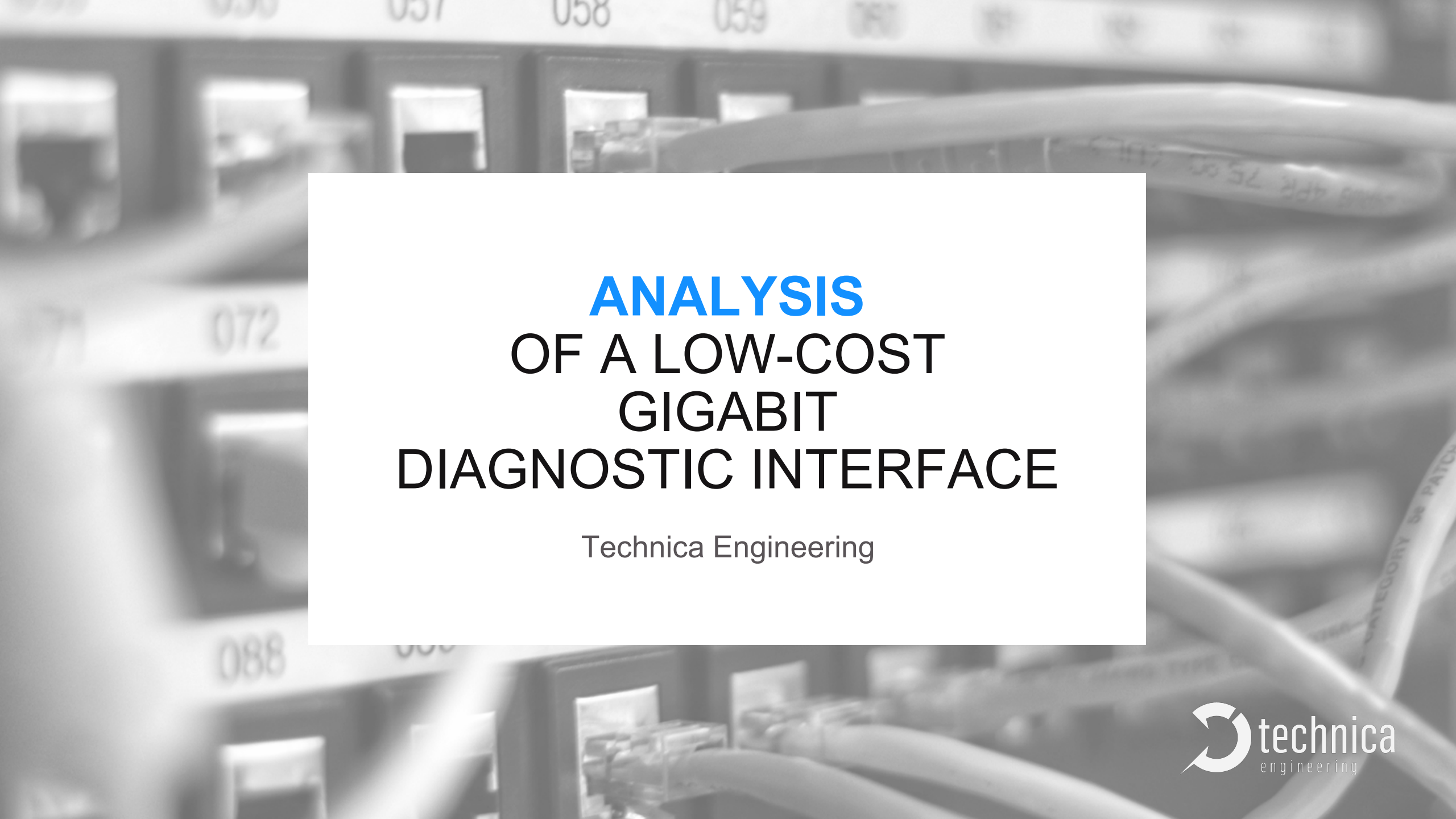

ANALYSIS
OF A LOW-COST GIGABIT DIAGNOSTIC INTERFACE

Technica Engineering

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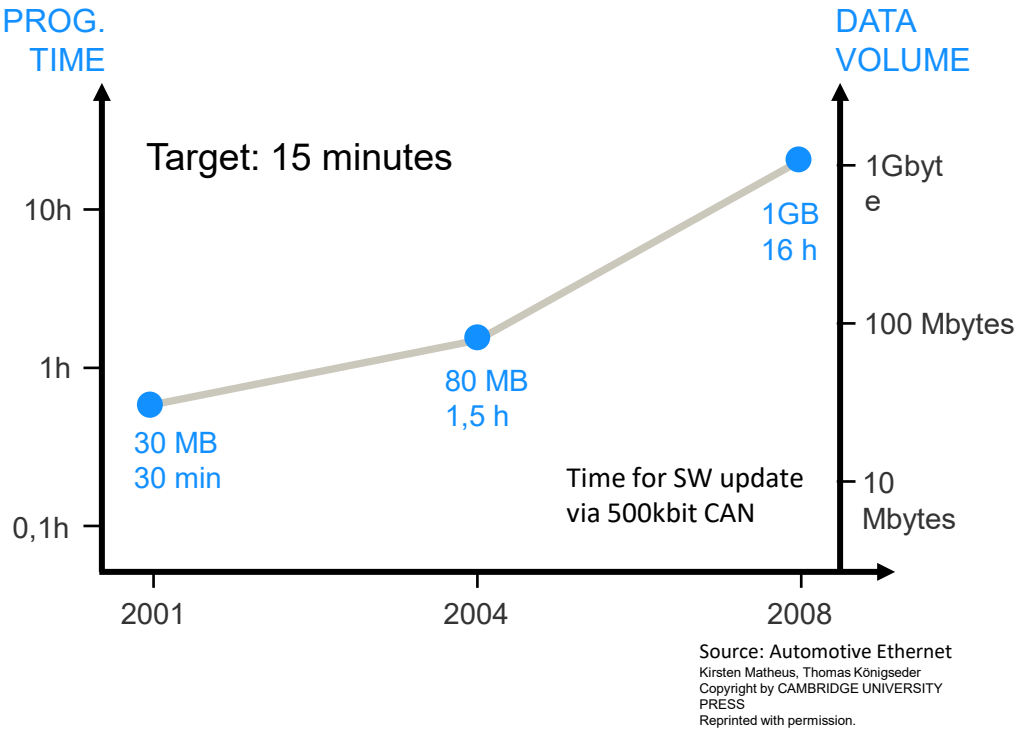
HISTORY & BACKGROUND

HISTORY
BACKGROUND
OBD
CONNECTION

HISTORY

DIAGNOSTICS & ETHERNET



Source: Automotive Ethernet
Kirsten Matheus, Thomas Königseder
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Available solution space in 2004:
MOST, USB, FIREWIRE, Ethernet etc.

The advantages of Ethernet 100BASE-TX:

- No DC coupling
- Every PC has an Ethernet connection
- Cheap, robust
- USE of standard OBD connector
- Effective software stacks

Only with Ethernet 100BASE-TX the SW-update of a modern CAR via the diagnostic interface was possible!

BACKGROUND

DIAGNOSTICS & ETHERNET 100BASE-TX

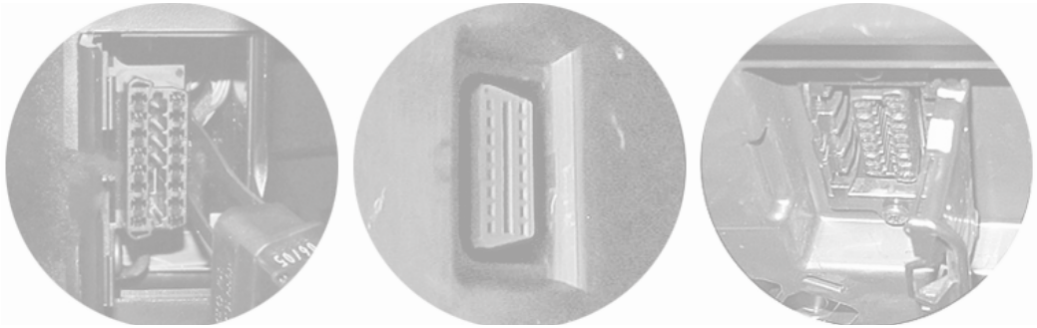
Why was it possible to use a non-standard conform solution with 100Base-TX with enormous efficiency for the diagnostic and programming use cases.

Thanks to a clear analysis for the needs of this use cases and a clever combination it was possible
to achieve a solution that became a
new worldwide standard. (DoIP)

The following lecture explains the background and the thought process which led to today’s solution.

USE OF STANDARD DIAGNOSTIC CONNECTOR

DIAGNOSTICS & ETHERNET
100BASE-TX

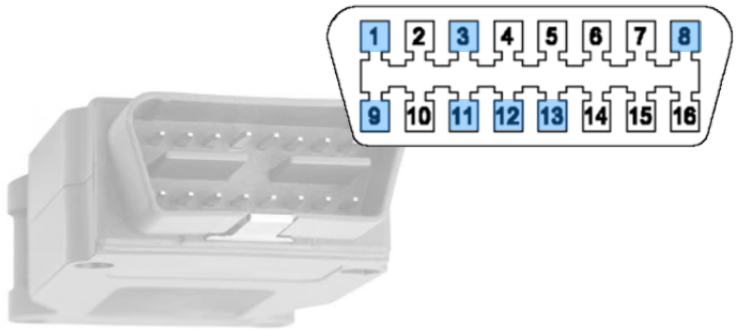


- Using a standard diagnostic connector for high-speed diagnostic access means having to **make compromises**.
- With a **clever combination**, these compromises do not become a problem and the result is an ideal
  and **cost-optimized solution.**
- An essential aspect is the correct **understanding of EMC requirements**.
- The availability of the diagnosis functionality **must be considered as a system** not only just restricted to vehicle access.

USE OF STANDARD DIAGNOSTIC CONNECTOR

DIAGNOSTICS & ETHERNET

100BASE-TX



Pin1: OEM specific
Pin2: SAE-J1850 bus +
Pin3: OEM specific
Pin4: GND CAR
Pin5: GND cable
Pin6: D-CAN +
Pin7: ISO 9141-2 (K-Line)
Pin8: OEM specific
Pin9: OEM specific
Pin10: SAE-J1850 bus –
Pin11: OEM specific
Pin12: OEM specific
Pin13: OEM specific
Pin14: D-CAN –
Pin15: ISO9141-2 (L-line 2. K-Line)
Pin16: V bat

100BASE-TX (DOIP VEHICLE ACCESS)

Option1:	**Option2:**
Pin3: TX +	Pin1: TX +
Pin11: TX –	Pin9: TX –
Pin12: RX +	Pin12: RX +
Pin13: RX -	Pin13: RX -
Pin8: Activation Line	Pin8: Activation Line

EMC & NEEDS

EMC EMISSIONS
EMC IMMUNITY
CONCLUSION

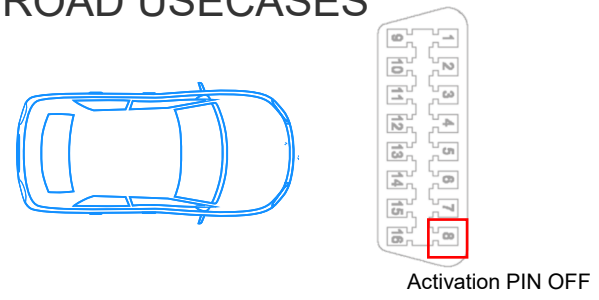
EMC EMISSIONS

DIAGNOSTICS & ETHERNET 100BASE-TX

No EMC emission impact

Ethernet diagnostic phy is deactivated without test equipment connected to the car.

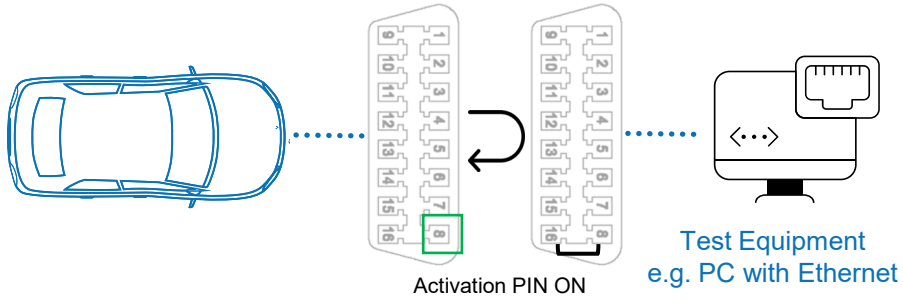
USE CASE CAR
ROAD USECASES



Emissions Lower than CE-Limits

Ethernet diagnostic phy is activated only when tester is connected. EMC emissions are higher, but car is not in the standard use case.
But the diagnostic system has to be CE-compliant.

USE CASE CAR
CAR DIAGNOSTICS

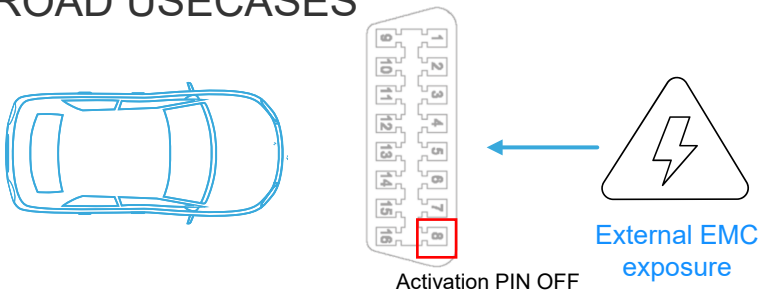


EMC IMMUNITY

DIAGNOSTICS & ETHERNET 100BASE-TX

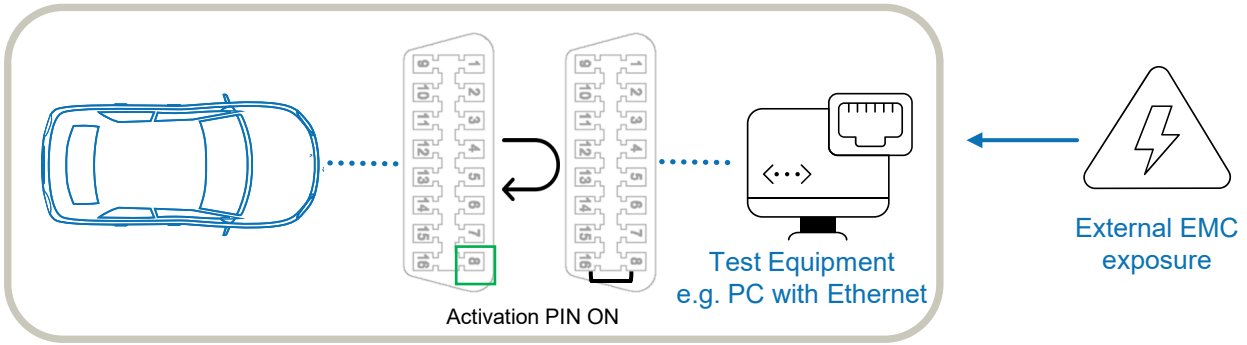
The vehicle must not have any safety-critical malfunctions.

USE CASE CAR
ROAD USECASES



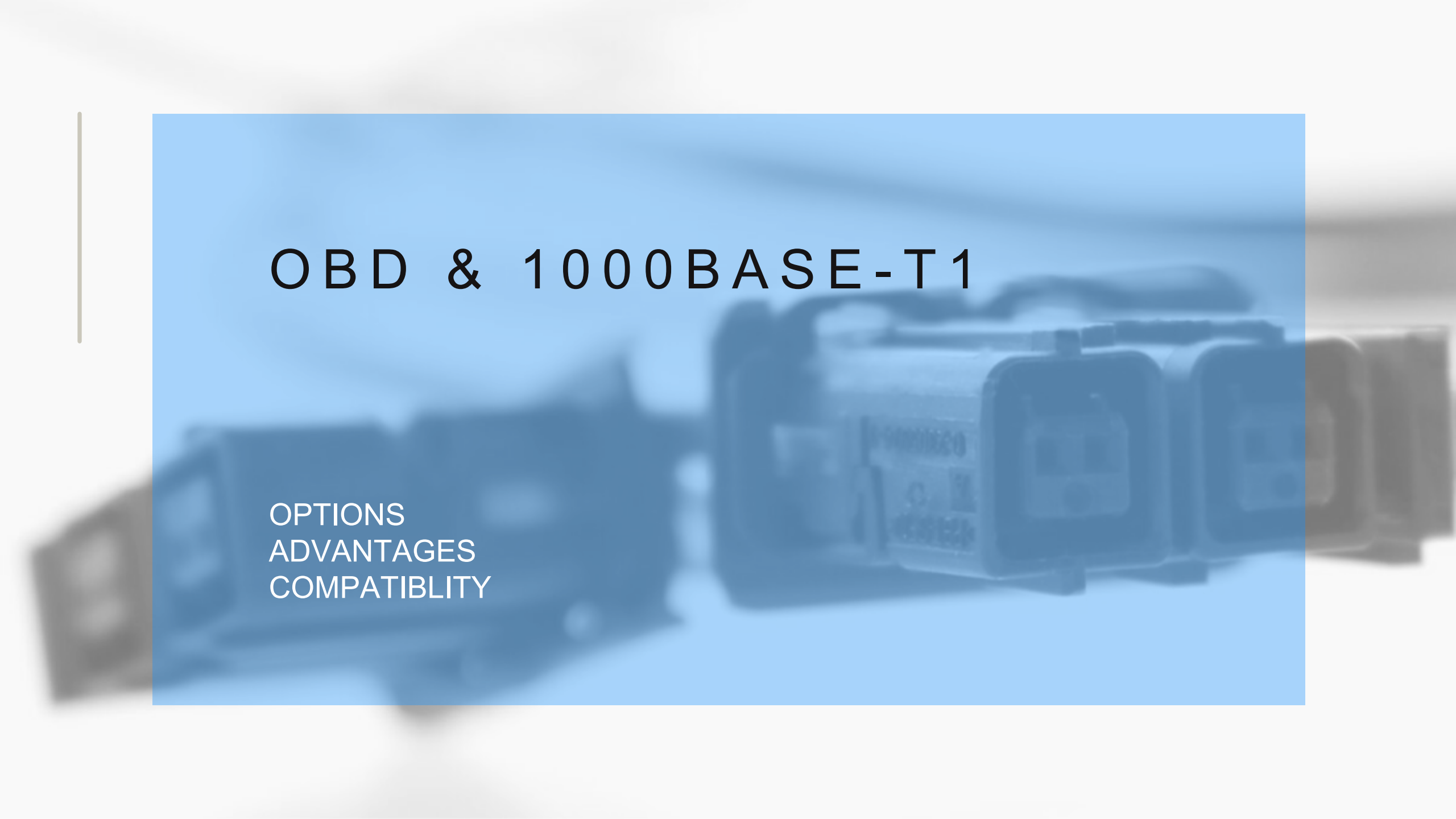
The vehicle must not have any safety-critical malfunctions.
The availability of the diagnosis is not relevant to safety.
The diagnostic system has to meet the CE-requirements

USE CASE CAR
CAR DIAGNOSTICS



OBD & 1000BASE-T1

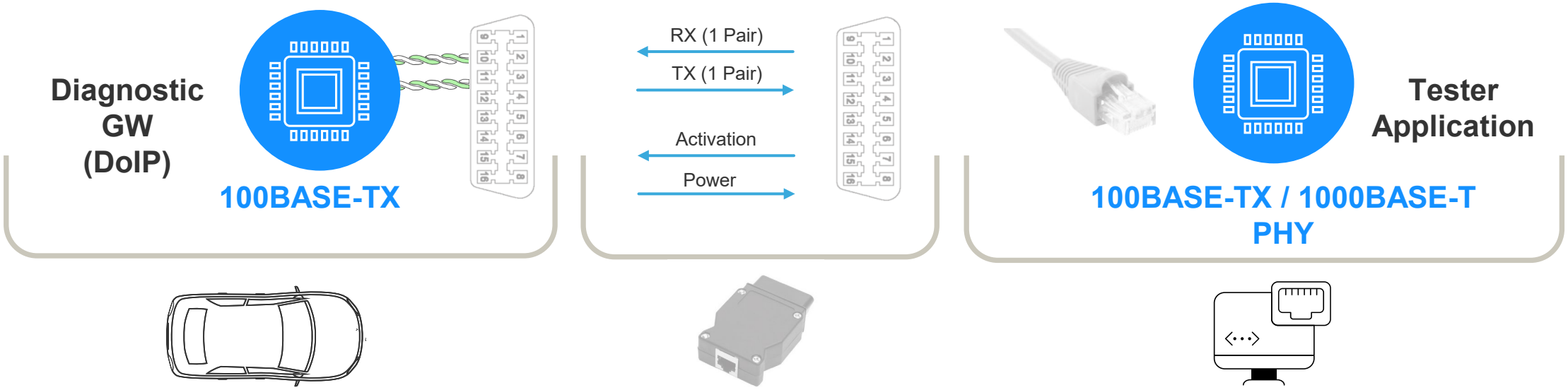
OPTIONS
ADVANTAGES
COMPATIBLITY



WHAT ARE THE OPTIONS FOR GBIT?

DIAGNOSTICS & ETHERNET
1000BASE-T1

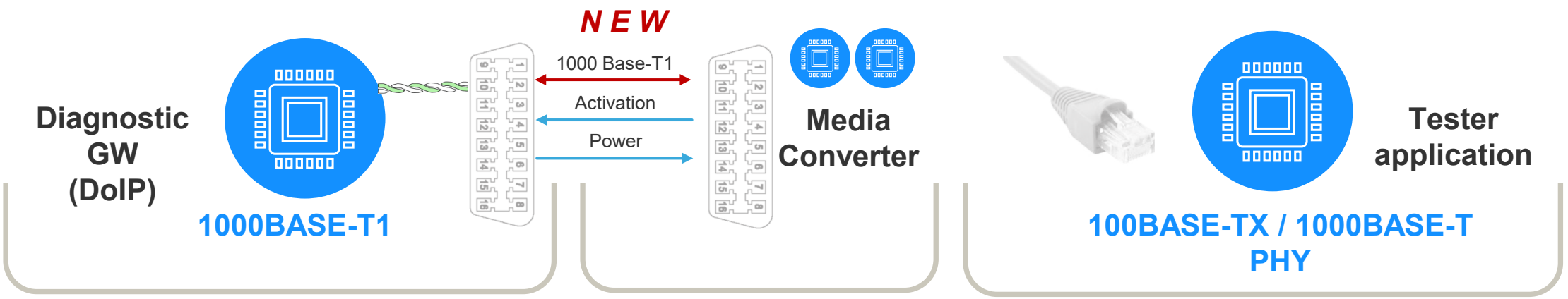
State of the art for 100Mbit with 100BASE-TX



WHAT ARE THE OPTIONS FOR GBIT?

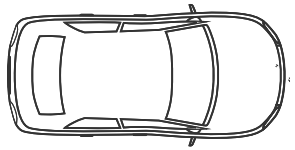
DIAGNOSTICS & ETHERNET
1000BASE-T1

Use the same strategy as 100BASE-TX for 1000BASE-T1 OBD Connection

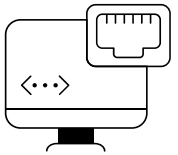


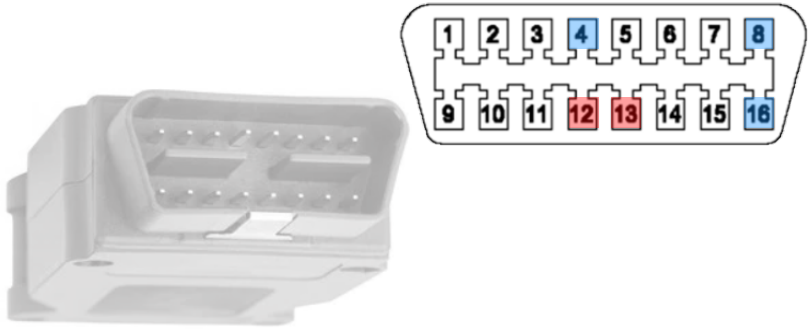
WHAT ARE THE OPTIONS FOR GBIT?

DIAGNOSTICS & ETHERNET 1000B-T1

#01 

#02 

#03 



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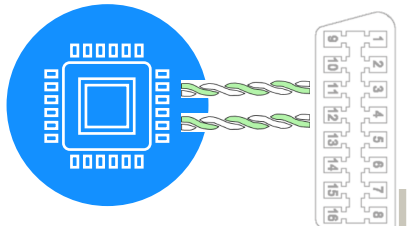
Pin5: GND Cable
Pin6: D-CAN +
Pin7: ISO 9141-2 (K-Line)
Pin8: Ethernet Activation

PinPin9: OEM specific
Pin10: SAE-J1850 bus –
Pin11: OEM specific
Pin12: 1000BASE-T1 +
Pin13: 1000BASE-T1 -
14: D-CAN –
Pin15: ISO9141-2 (L-line 2. K-Line)
Pin16: V Bat

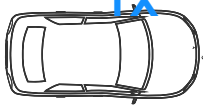
100BASE-TX OR 1000BASE-T1?

DIAGNOSTICS & ETHERNET 1000B-T1

Diagnostic GW (DoIP)

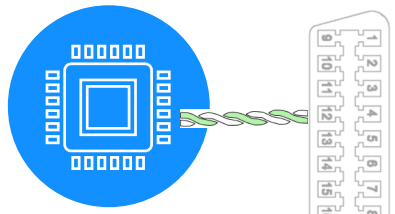


100BASE-TX

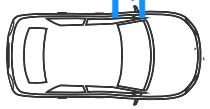


OR

Diagnostic GW (DoIP)



1000BASE-T1



Intelligent diagnostic adapter automode

BOTH SOLUTIONS CAN BE SUPPORTED BY ONE TESTER APPLICATION !

COST COMPARISON:

For 1000BASE-T1:

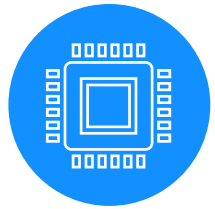
in-vehicle solution:

- ✓ Phy: identical, due to switches with multi speed phy features
- ✓ Cable: One UTP cable instead of two
- ✓ Rest of BOM: comparable

Cost adder for off-vehicle:

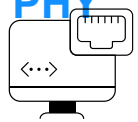
+ Cost for special Media-Converter

(Only needed per test system not per car)



Tester application

100BASE-TX / 1000BASE-T PHY

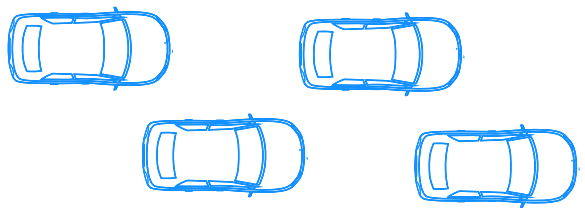


100BASE-TX OR 1000BASE-T1?

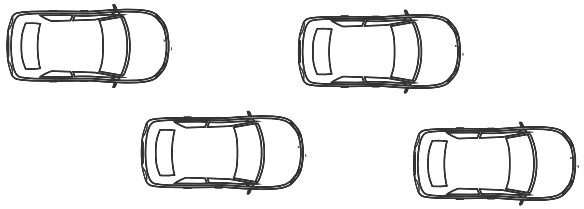
DIAGNOSTICS & ETHERNET 1000B-T1

FUTURE
CAR FLEETS

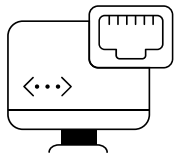
1000BASE-T1



100BASE-TX



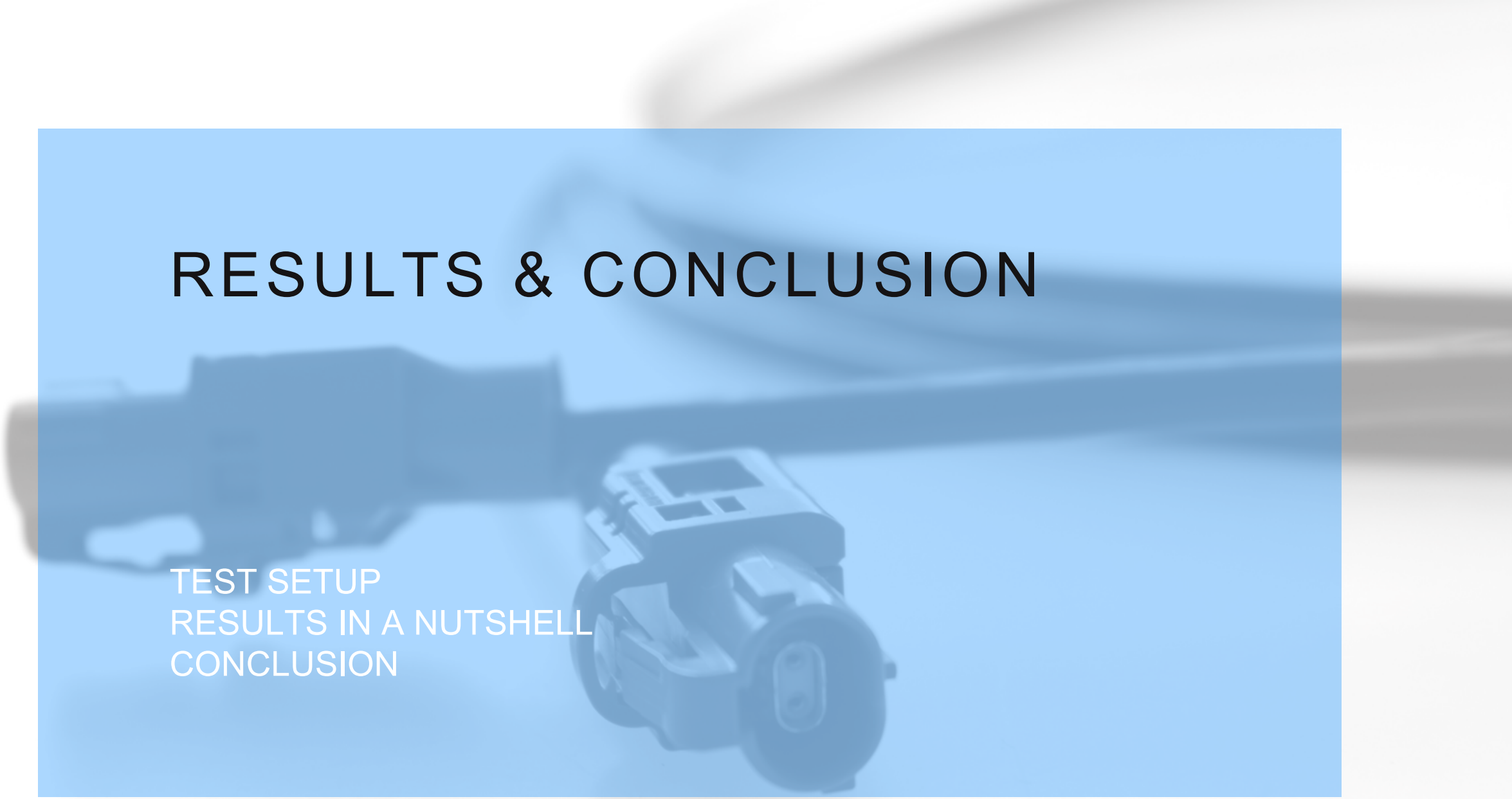
CAR EXTERNAL
COMBO INTERFACE



First prototypes are available

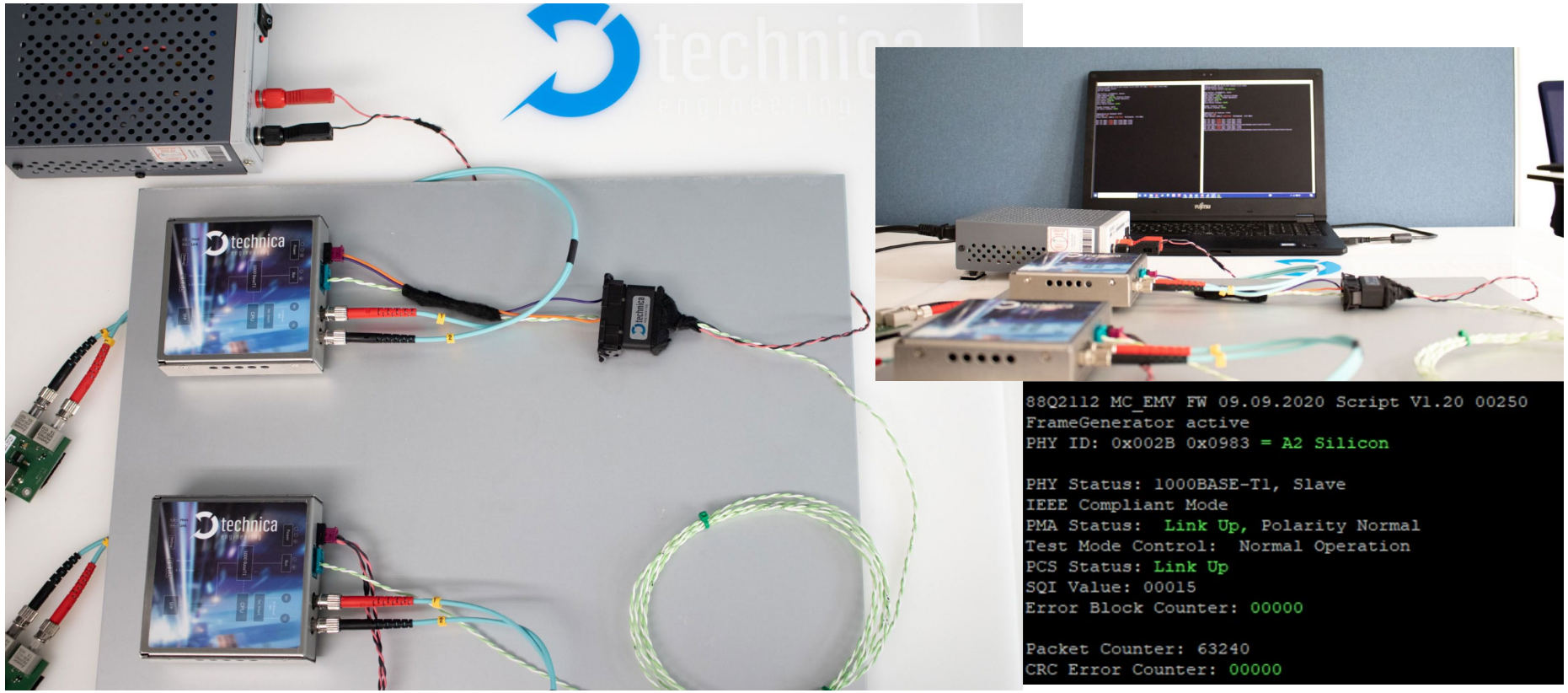
- No direct cost impact on board (cars)
- No change in off-vehicle solutions
- Combo interface possible
- No need to adapt „old cars“
- Off-vehicle “Media-Converter” needed

RESULTS & CONCLUSION



TEST SETUP
RESULTS IN A NUTSHELL
CONCLUSION

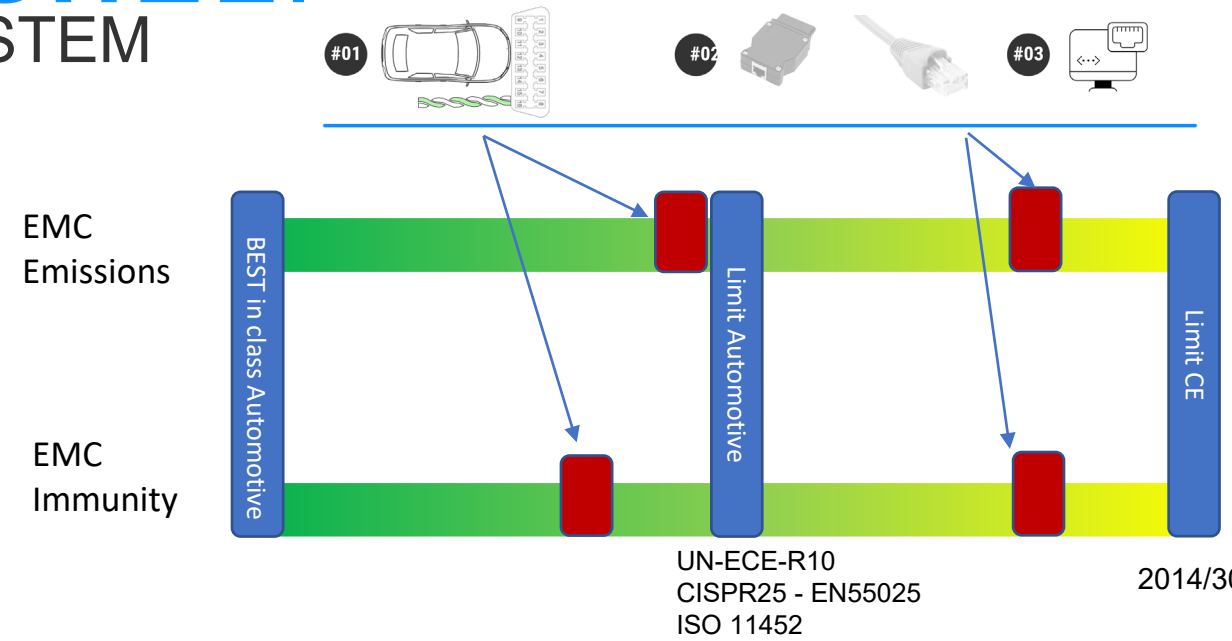
TEST SETUP

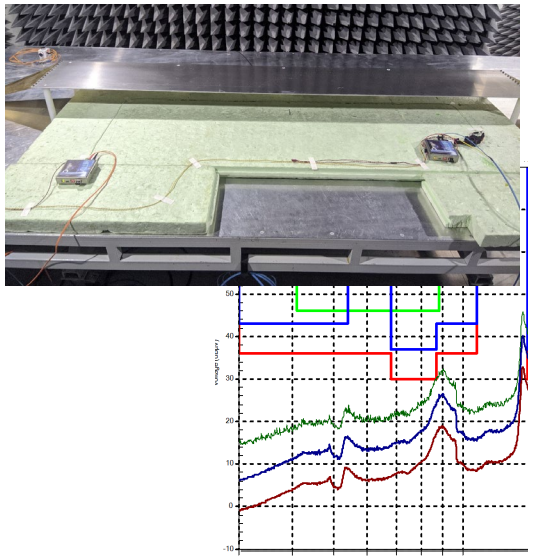


- Data communication is very robust.
- SQI Value is excellent.
- The Bit Error Rate is as expected (<10^{-14}). Bit Error Rate is more than good enough (TCP for diagnosis).

RESULTS IN A NUTSHELL

DIAGNOSTIC SYSTEM: ON BORD INTERFACE + OFF BOARD TESTSYSTEM





- A EMC certification of a DIAGNOSTIC SYSTEM with this type of interface is possible.
- The Bit Error Rate is very low and the system is robust enough.

CONCLUSION

Diagnostics & Ethernet 1000Base-T1

- Multi-Gigabit networks need a high performance diagnostic interface
- 1000BASE-T1 will work over a standard OBD interface
- The EMC issues are under control
- The availability and the robustness of the interface is good
- Cost savings in comparison to 100BASE-TX solution possible
- First test setups already exists

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