

AUTOMOTIVE ETHERNET TESTING—IXIA AND ELECTROBIT

TECHNICAL GUIDE

Highlights

- Leveraging automotive and IT/telecom network test expertise
- Testing methodologies
- Conformance testing
- Integration testing
- Results and outlook

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Automotive Ethernet Testing

Challenges and what can be learned from the IT and telecom networking domains

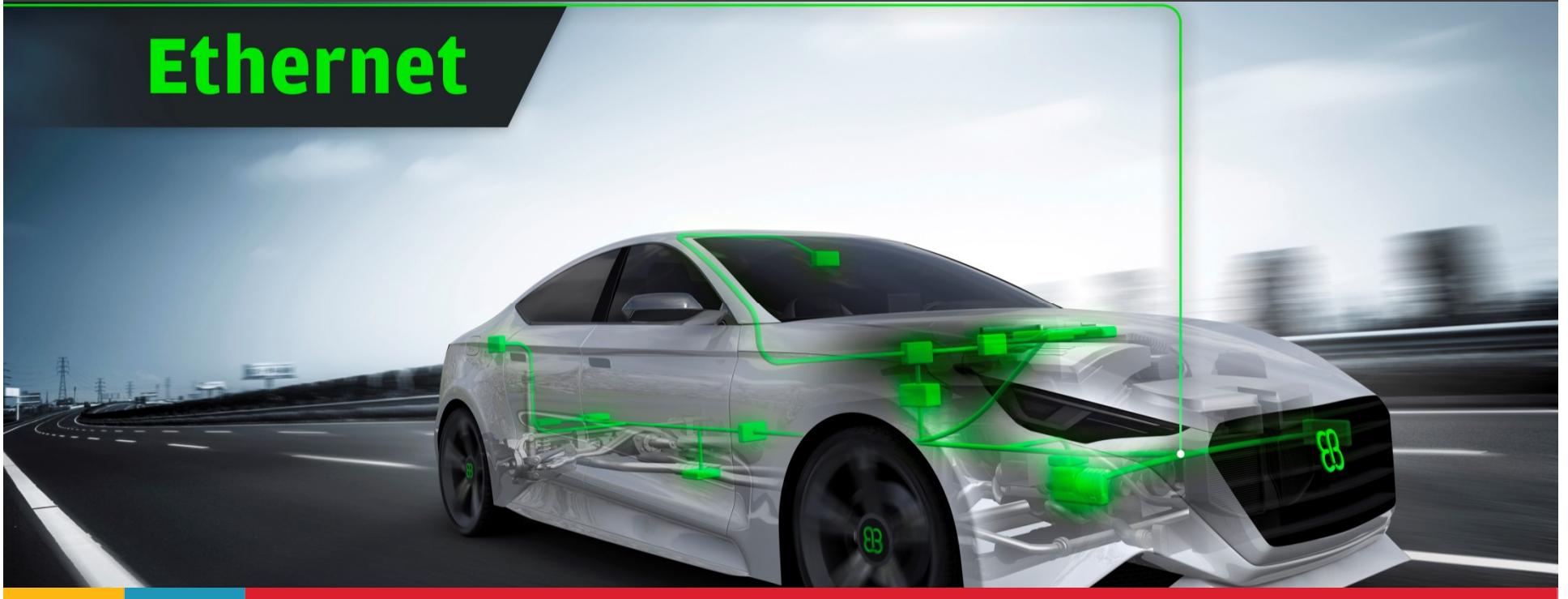
Alon Regev, Roman Pallierer
24th Oct 2014



Elektrobit



Ethernet



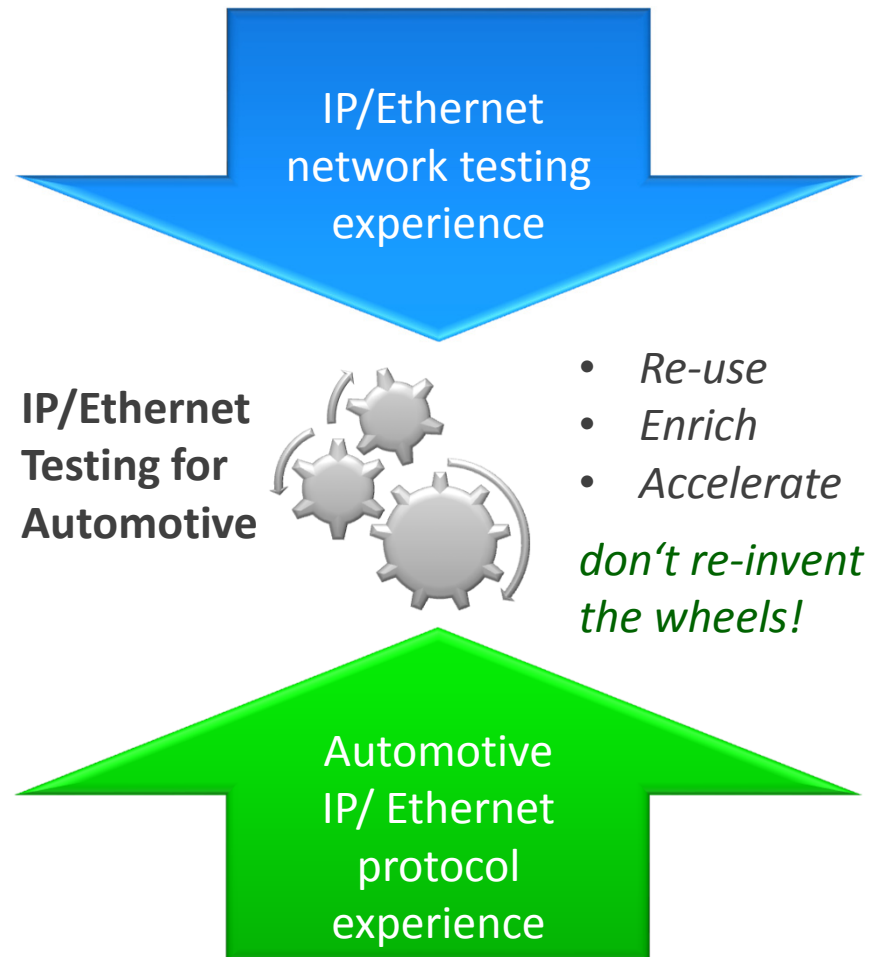
Leveraging automotive and IT/telecom network test expertise

- **Ixia**

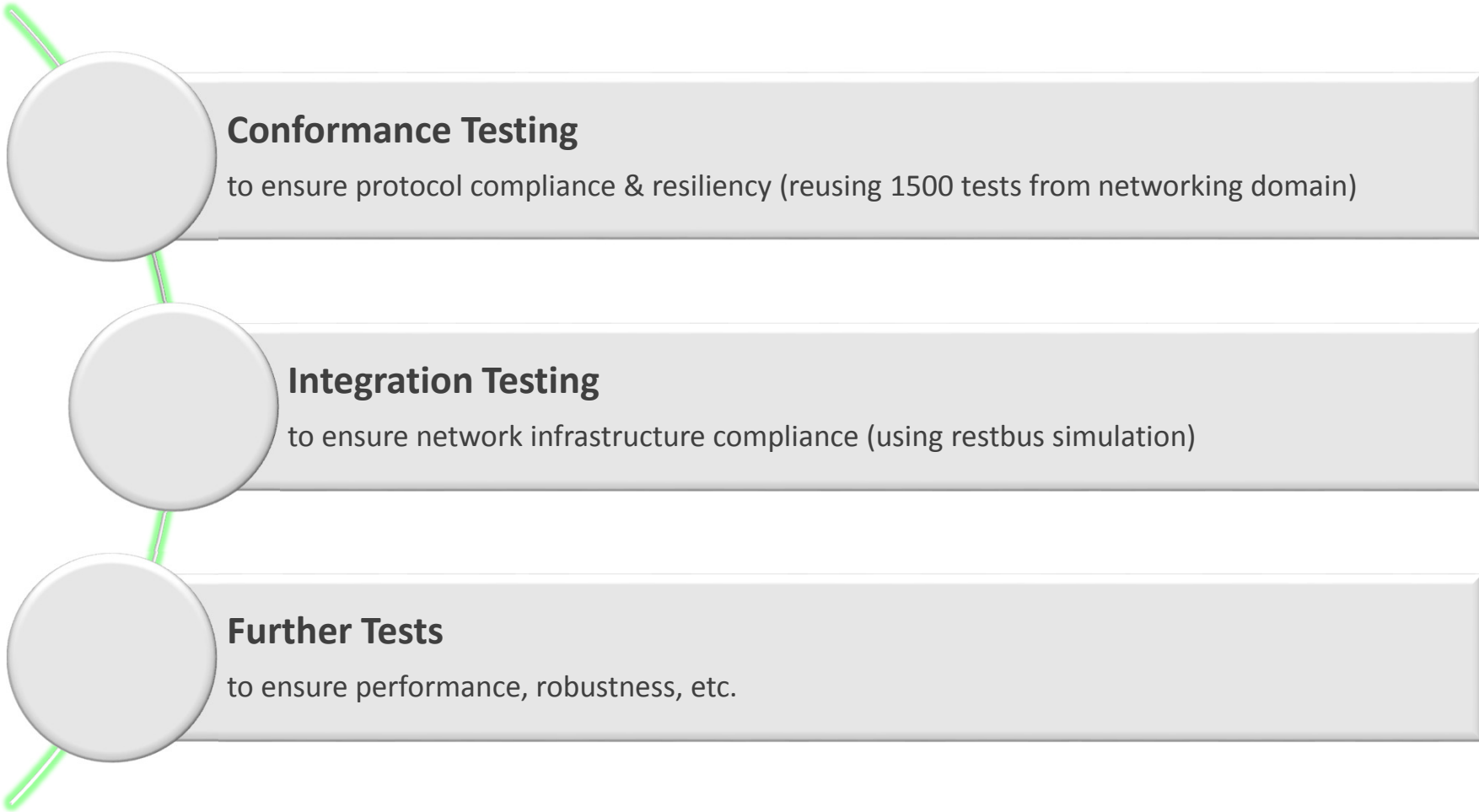
- 20+ years of IP/Ethernet network testing experience
- TCP/IP, security, voice/video, routing & switching, WiFi, Wireless (3G/4G/LTE), virtualization, etc.

- **Elektrobit**

- 25+ years of automotive experience
- OSEK/VDX, AUTOSAR, OEM basic software solutions
- Automotive ECU testing
- CAN, FlexRay, LIN, IP/Ethernet



Testing Methodologies



Conformance Testing

to ensure protocol compliance & resiliency (reusing 1500 tests from networking domain)

Integration Testing

to ensure network infrastructure compliance (using restbus simulation)

Further Tests

to ensure performance, robustness, etc.

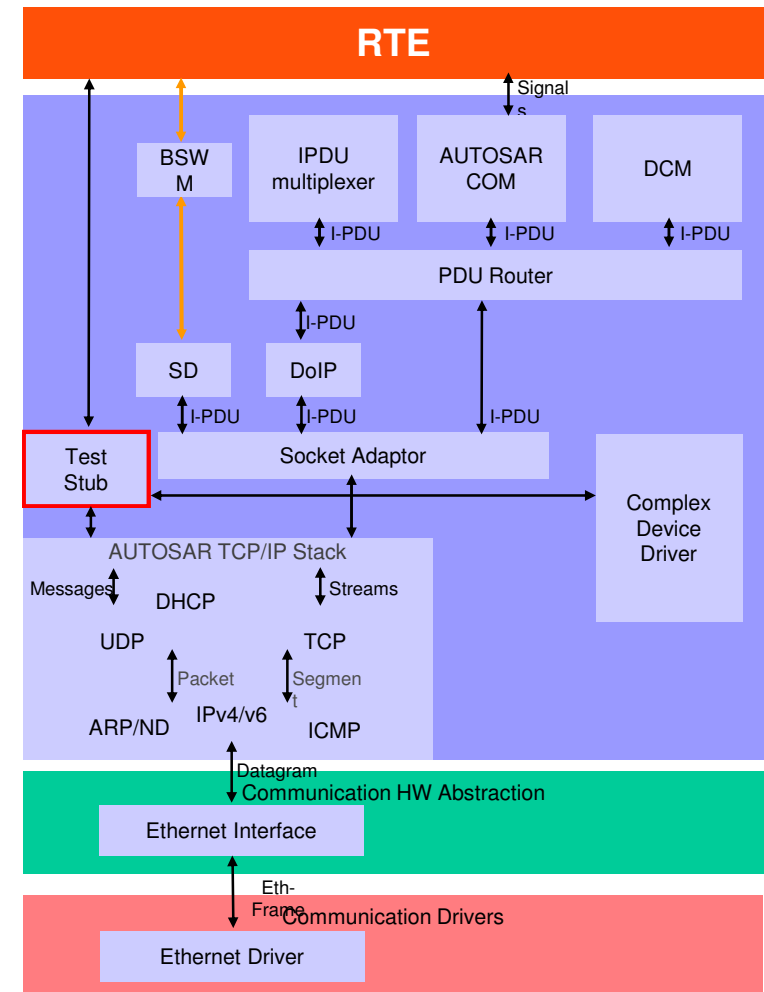
Conformance Testing

• Challenge

- Protocols such as TCP are stateful
- Black box testing is not sufficient

• Solution

- A 'test stub' is being proposed in AUTOSAR
 - Provides granular control over the socket adapter calls
 - Drives protocol state transitions
 - Can Initiate actions upon state transitions
 - Can be used for positive & negative testing
 - Strengthening protocol layer security
 - Can be leveraged to test the TCP stack during both development & production stages



Source: AUTOSAR WP-T1 proposal presentation

Conformance Testing

- **Challenge**

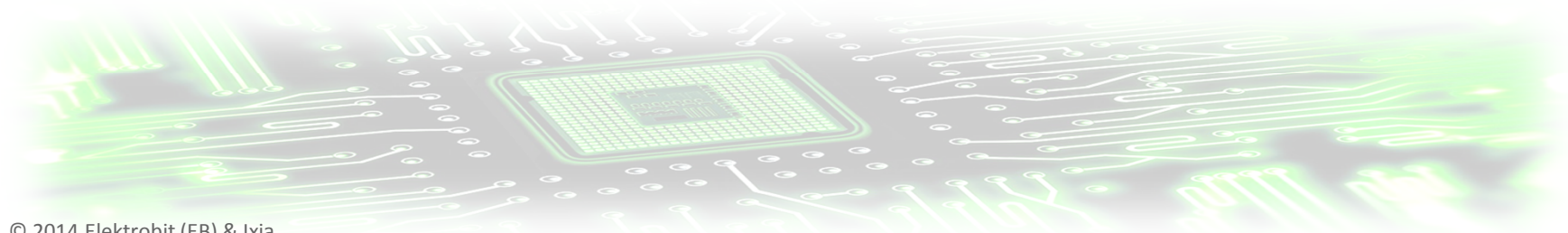
- Some tests in the networking domain utilize features and/or protocols not used in the automotive domain
 - Automotive networks do not typically use configuration protocols.
 - ECUs only implement protocols & features required for ECU operation

- **Solution**

- Consider automotive requirements when reusing IP conformance tests
- Identify functions that require changes and make minor modifications to affected test cases

- **Example:** use the ECU configuration instead of dynamic configuration

- Path MTU (Maximum Transmission Unit) Discovery detects the largest frame size supported
- In the automotive world, MTU is pre-configured so there is no need for MTU discovery



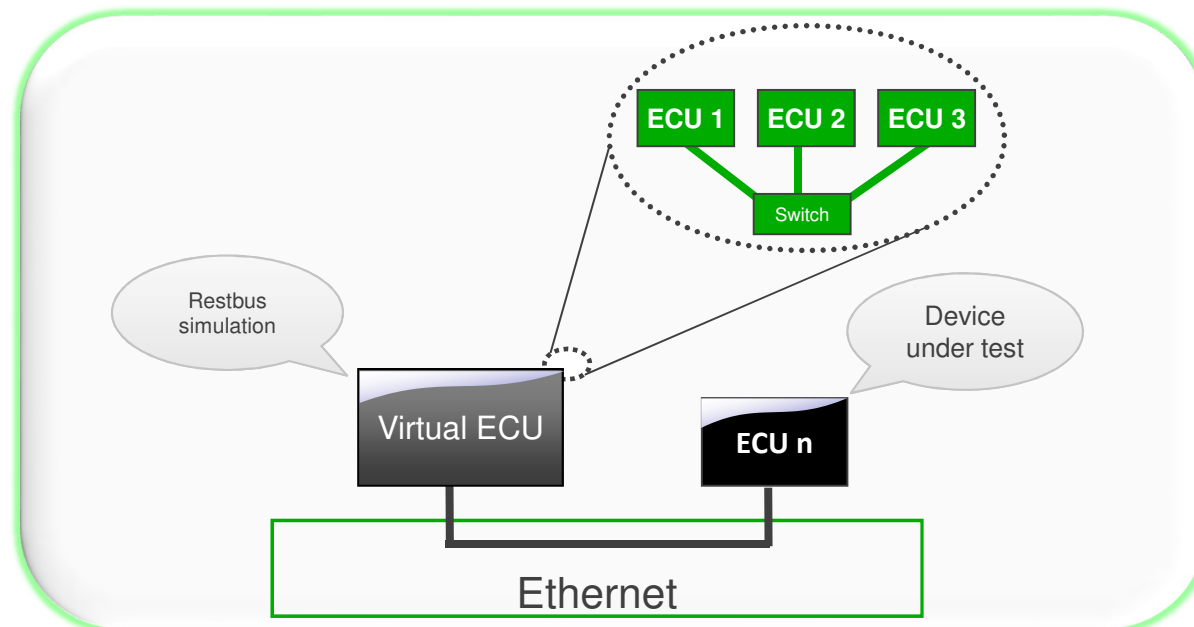
Integration Testing

Tasks

- Restbus simulation tests a single ECU
- Emulating the communication with all related ECUs
 - System requests (network management, **service discovery**)
 - Application requests (**events, notifications, remote procedure calls**)
 - Gateway functionality (CAN, FlexRay, LIN).

New with
Ethernet

Extended
with
Ethernet



Integration Testing

- **Challenges**

- Emulation of the communication behavior of multiple ECUs (e.g. MAC addresses) in one test device
- Emulation of the AUTOSAR functionality on the communication network layer
- Service based communication requires a more complex restbus simulation
 - Data is transmitted on specific requests or subscription, only.
 - Service availability has to be emulated since services of the ECU under test may require them

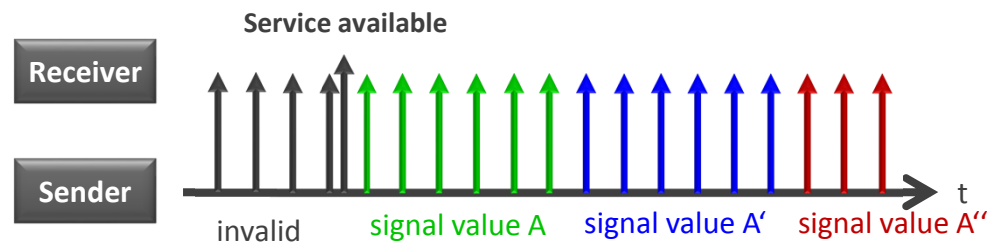
- **Solutions**

- Create one virtual ECU out of the configuration of the ECUs to be emulated
 - Using the AUTOSAR BSW implementation and configuration tool
 - Virtual ECU also emulates network components functionalities including gateways & switches
- Provide interfaces to easily include test application models
 - ECU integrator can easily choose which test „suites“ are needed
- Scalable emulation of service availability
 - static configuration of all services vs. dynamic control of service offers and subscriptions

Integration Testing – Example Services

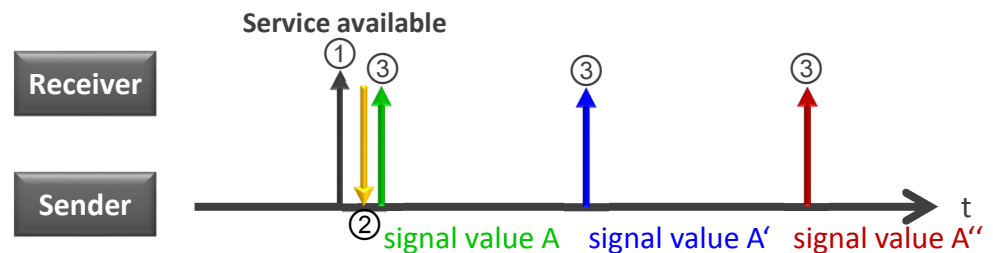
- **Signal based**

- Sender
 - Just transmit
 - Don't care who is receiving
- Receiver
 - Just Listen
 - Don't care who is sending



- **Service Based**

- Sender (= Service Provider)
 - Offer service & maintain subscriber ①
 - Send message to subscriber
- Receiver (= Client)
 - Find service & subscribe to service ②
 - Receive message ③



Results & Outlook

- **Conformance testing**
 - Ixia is contributing 1500+ test cases to AUTOSAR, OPEN Alliance, and other standards organization
 - EB uses Ixia conformance tools to test EB's implementation of IP / Ethernet
- **Integration testing**
 - Expanding restbus simulation for IP/Ethernet communication services
- **Further testing**
 - *Reuse of automotive & IT expertise is also useful for other test methodologies*
 - *Tests such as network infrastructure tests, stress tests, degraded performance tests, Quality of Service, Quality of Experience, and security tests can leverage the best practices from both domains*



Thank you!

More @

www.automotive.elektrobit.com/ethernet

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