

System Integration and its compliance testing necessities

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Georg Janker
CTO

Agenda

1. Motivation
2. Positioning
3. Measures
4. Compliance Test Scopes
5. Benefits

Status Quo

- Qualification means are defined and verified for the individual components.
(Phy, IP Stack, SomeIP Protocol, ...)
→ Not always suitable for ECU,
as comparatively very complex and cost intensive
- First suppliers are entrusted with the task of realizing new architecture.
 - Evaluations serve as reference for the development.

Motivation

Status Quo

- Design requirements for control units are often verified only by reviews, not by executing tests.
- Suppliers are not capable of verifying successful implementation, as protective solutions with adequate test depth are missing.

Objective: Introduction of Compliance Verification

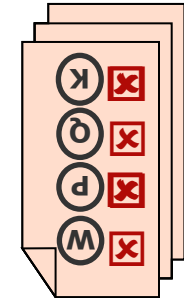
- Optimization of the system integration process
 - Meaningful and cost competitive verification for the developmental stages
 - Make ECU suppliers discharge their duties
 - Maximize level of standardization
- Early quality increase at the suppliers
 - Identification of typical (critical) implementation errors
 - Support with troubleshooting
- Reduction of the validation efforts at OEM and supplier
 - Customer functions instead of network or Phy
- Definition of appropriate test solutions for ECU verification
 - Difference with respect to qualification of components

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Realize causes for failures at an early stage

Test Report



Hard and Software components

Phy

IP Stack

Connector

Cable

Control Units

Gateway

Camera System

Internet Connectivity

Infotainment

Driver Assistance

...

System Integration

Subsystem

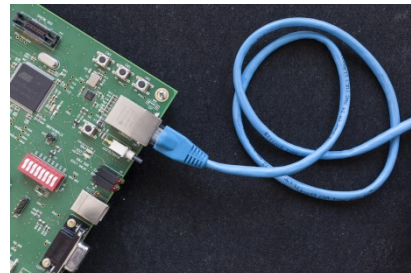
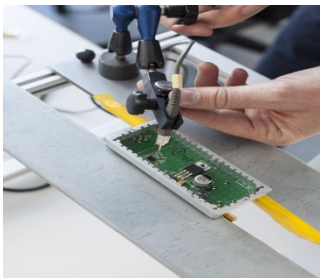
Vehicle Integration

Vehicle Testing

MODEL A

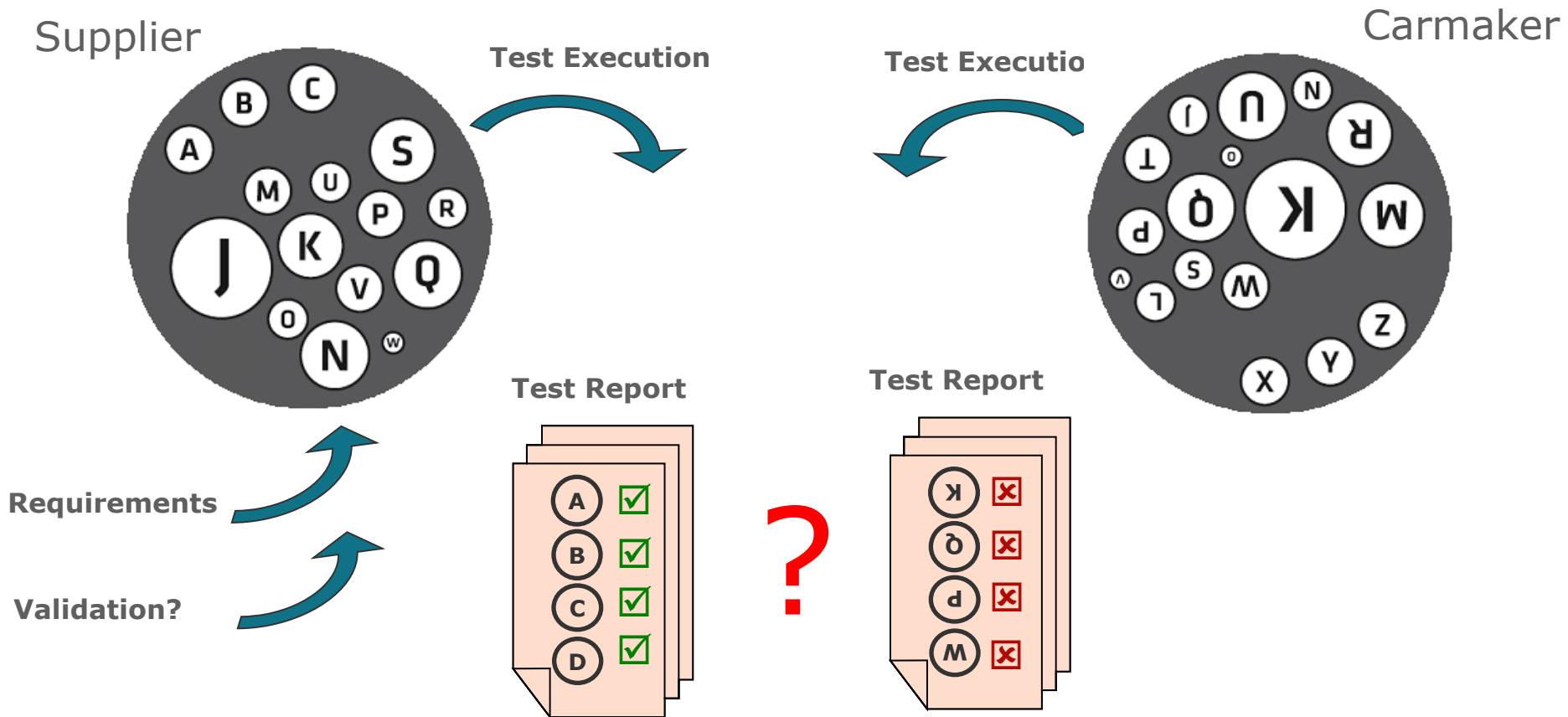
MODEL B

MODEL T



Source: Google

Typical Situation of TIER1 Suppliers



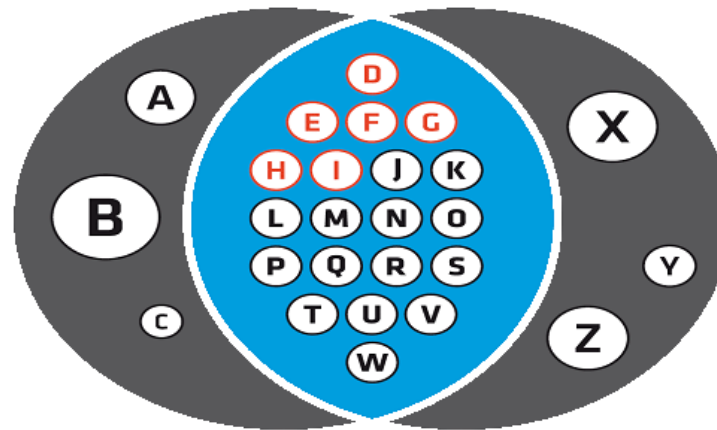
Role Allocation

Control Unit Supplier

develops control units,
not test processes and tools

OEM

specifies functionalities and verifies
the successful implementation

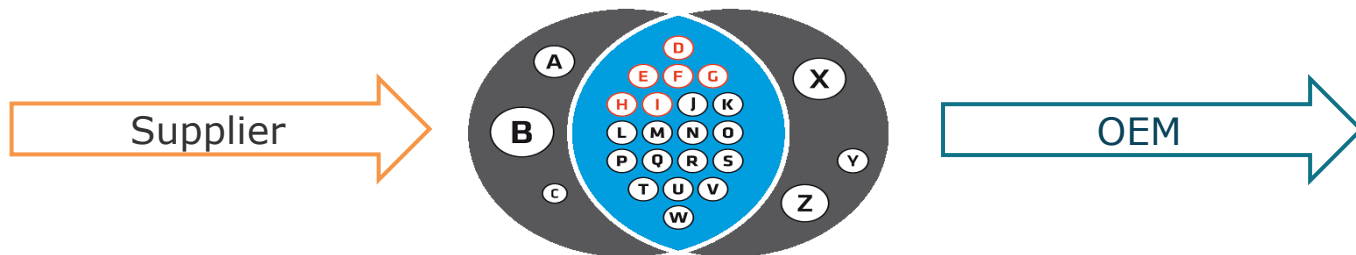
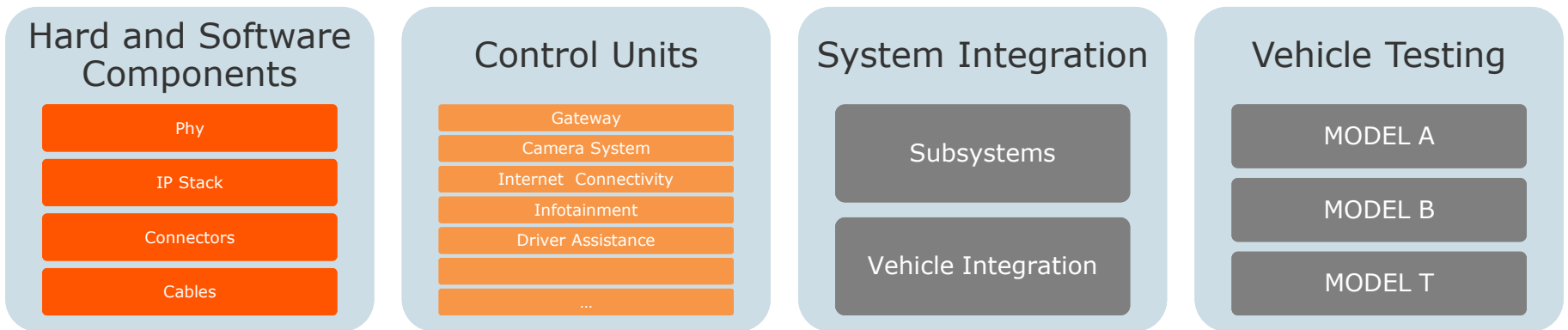


Compliance Test House

concentrates on detection of implementation errors and
supports OEMs and suppliers with the integration

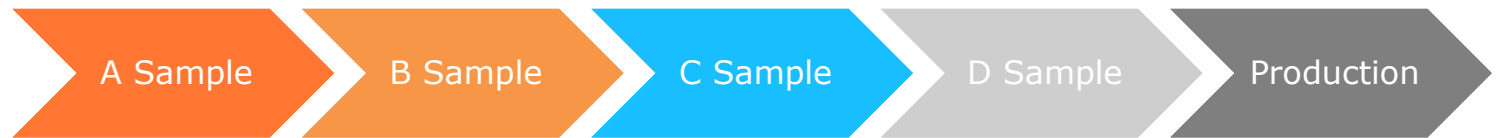
Positioning

Classification of the Compliance Verification into the Development Process



Compliance Test Report
as Part of Admission Tickets

Compliance as Part of the System Integration

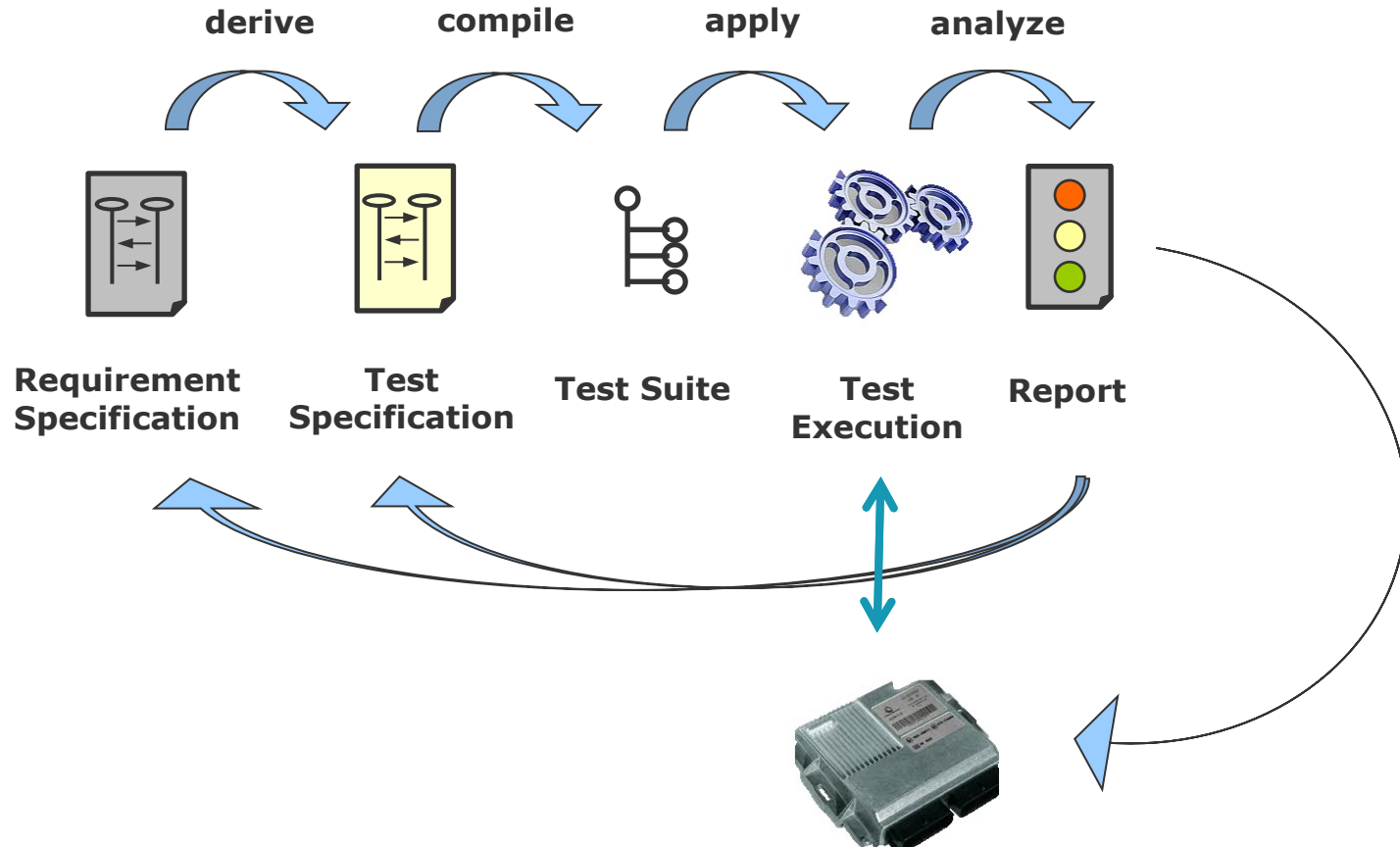


Application		•	○	○
Middleware	•	○	○	○
Physical Layer	○	○	○	

→ Pre-testing at the earliest stage!

- Pre-test
- Compliance

Quality Through Improvement Cycles!



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General Approach (1/2)

- Review of the Specifications
 - Identification of the requirements, decisive for the control unit tests
 - Identification of typical implementation mistakes
 - > Reduction to the essential
- Securing Testability of Control Units
 - Early identification of required test parameters → new requirements
 - Important: no modification of the ECU for the test!
- Harmonization of Test Setups
 - Use of already existing approaches and solutions
 - Components tests -> ECU tests
 - > Reduction to the essential

General Approach (2/2)

- Fast improvement cycles
 - In time increase quality of specifications and test processes
- Conversion of test runs into ISO 17025 test processes
 - Resilient results → reliable figures
 - World wide reproducibility
 - Improved informational value in respect to robustness of an implementation
- Definition of a Compliance Standard for Ethernet ECUs
 - Know-how from system integration is incorporated in new projects
 - Preparation of operating figures for early evaluation of supplier quality

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Compliance Test Scopes

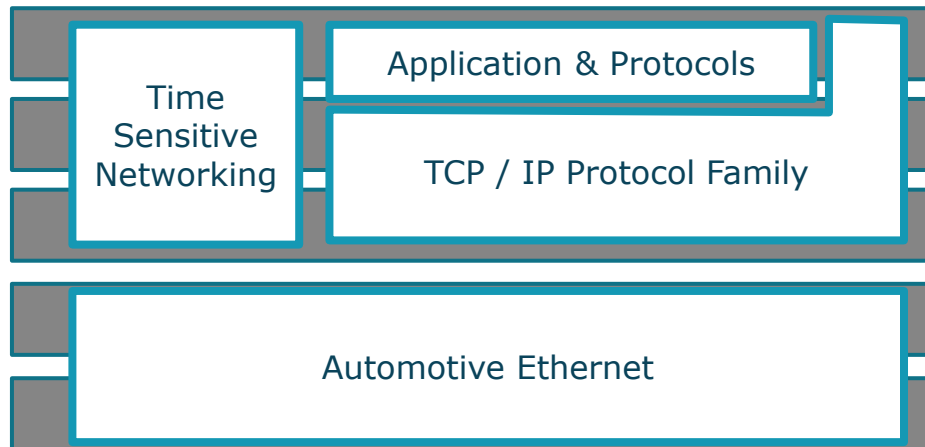
Definition of Test Scopes

For ECUs:

- Automotive Ethernet compliance test
- TCP/IP protocol family compliance test
- Application & protocols compliance test
- TSN compliance test

For components:

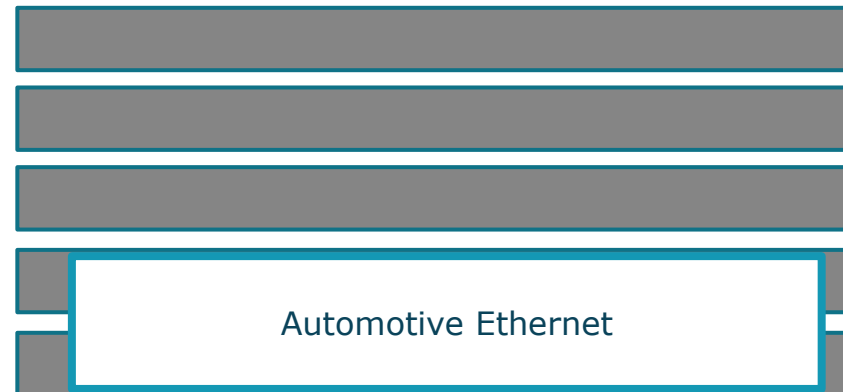
- OABR® PHY compliance test
- SWITCH compliance test



Compliance Test Scopes

Automotive Ethernet Compliance Test

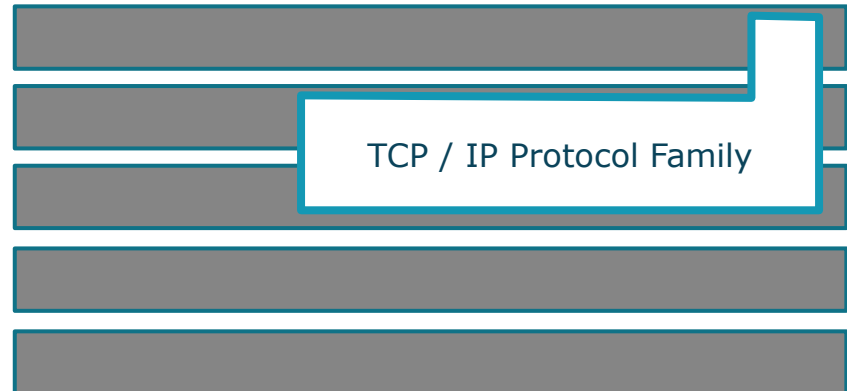
- Validation of existing solutions / up-to-date solution proposals
 - Phy tests
 - Switch tests
- Identification of test parameters
(e.g. OABR register values, debug headers, test modes)
- Worst case test scenarios:
 - Worst case channel (cable)
 - Definition of tolerable value ranges
- Harmonization of test equipment
Cost reduction!



Compliance Test Scopes

TCP/IP Protocol Family Compliance Test

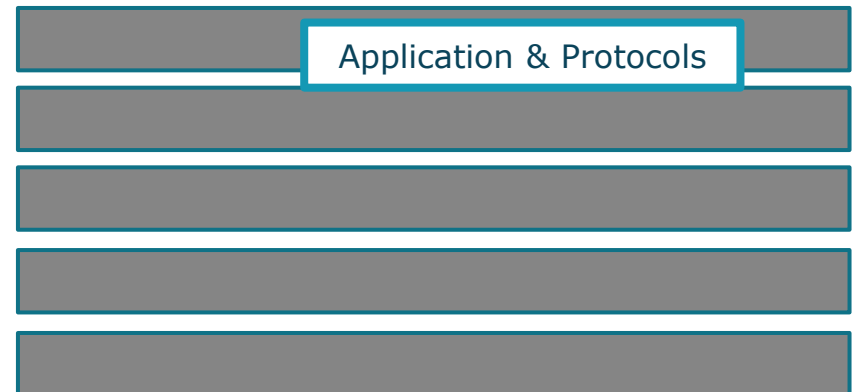
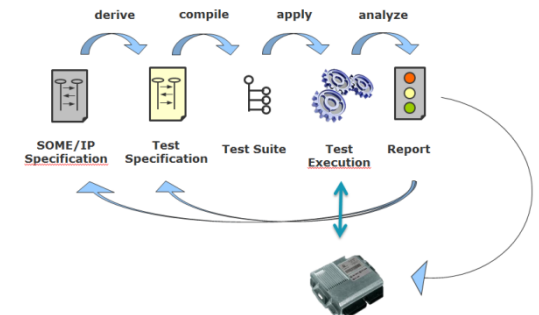
- Quality review of existing IP stacks
- Validation of existing test solutions (IP stack tester)
 - Appropriate for the automotive application?
- Definition of an adequate subset for ECU validation
 - What are the potential implementation errors?
 - What are the relevant performance figures?
- Definition of an optimized test stub for control units
- Creation of a test suite



TCP / IP Protocol Family

Application & Protocols Compliance Test

- Introduction of a work flow for standardized test specifications
- TTCN-3 as test language
- Test suites for:
SOME / IP, service discovery, DoIP, UDP-NM
- Intensive support for suppliers
- Consecutive practical improvement cycles



Application & Protocols

Compliance Test Scopes

TSN Compliance Test

- AVB with focus on:
 - IEEE 802.1AS
 - IEEE 802.1Qat
 - IEEE 802.1Qav
 - IEEE 1722
- Time Sensitive Networking:
 - Protocols for control data transmission in real time
 - Specification in design



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Introduction of a Compliance Process Allows:

- Distinct and comparable test results
 - Allows more competition at increased quality
- Transparency during design process
 - Early recognition of critical courses during ECU design process
 - Test results are reliable (as from independent source and ISO 17025)
- Separation of component qualification and control unit verification
 - reduces cost for ECU design and certification

Introduction of a Compliance Process Allows:

- Reduction of the complexities at OEMs during system integration
 - Tests cover basic functionalities (Phy, network, protocols)
 - OEMs may concentrate on customer functions
- Pre-condition for world wide standardization
- Easy entry for new suppliers
 - Ecosystem for components and validation
 - Standardized test methods
 - Supplier can access independent support

Thank you for your attention!

Georg Janker

RUETZ
SYSTEM SOLUTIONS

Walter-Gropius-Straße 17
80807 München
Germany

T +49 / 89 / 200 04 13-0
F +49 / 89 / 200 04 13-99
info@ruetz-system-solutions.com