

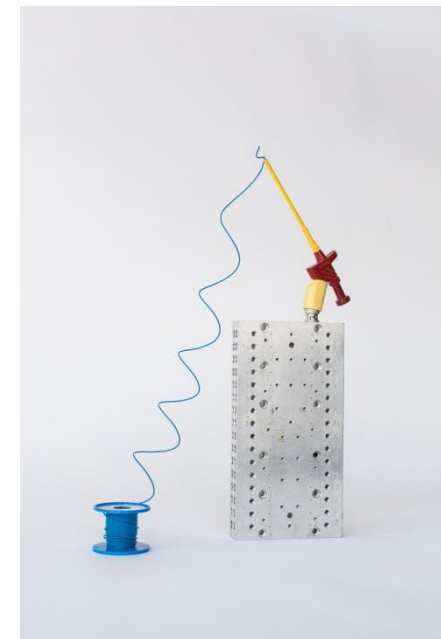
Compliance Verification and Qualification for Automotive Switch Chips

Ethernet & IP @ Automotive Technology Day

Paris, 21-SEP-2016

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CTO



Agenda

1. Motivation
2. The Compliance Verification Process
3. Test Purposes for Switch Chips
4. Conclusion

Motivation

Semiconductors are Fundamental!

Automotive is Different!

- Semiconductors are the key components for automotive data communication and are therefore designed to follow specific automotive requirements.
- Design of automotive components means to maximize performance at minimum cost.
- New trends like autonomous driving are being designed now. This triggers additional efforts and dynamics for semiconductor designs.
- Standardization of requirements and compliance verification are fundamental for a successful automotive ethernet technology.

Motivation

Goals:

- Definition of comprehensive requirements for switch chips for all car manufacturers
- Reliable and standardized Compliance Verification of all requirements
- Benchmarking for typical automotive use cases
- Maintenance of the Compliance Verification

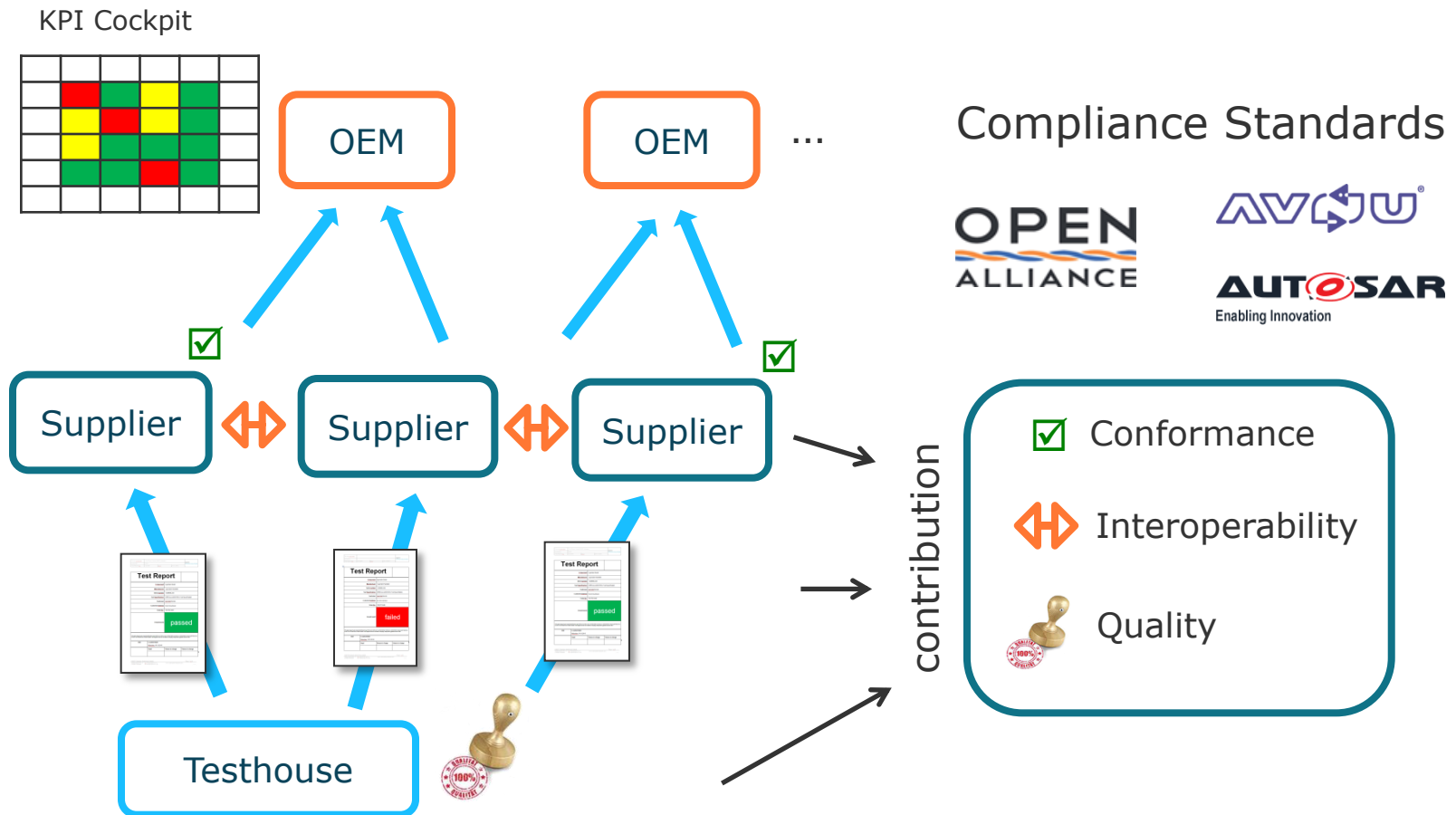


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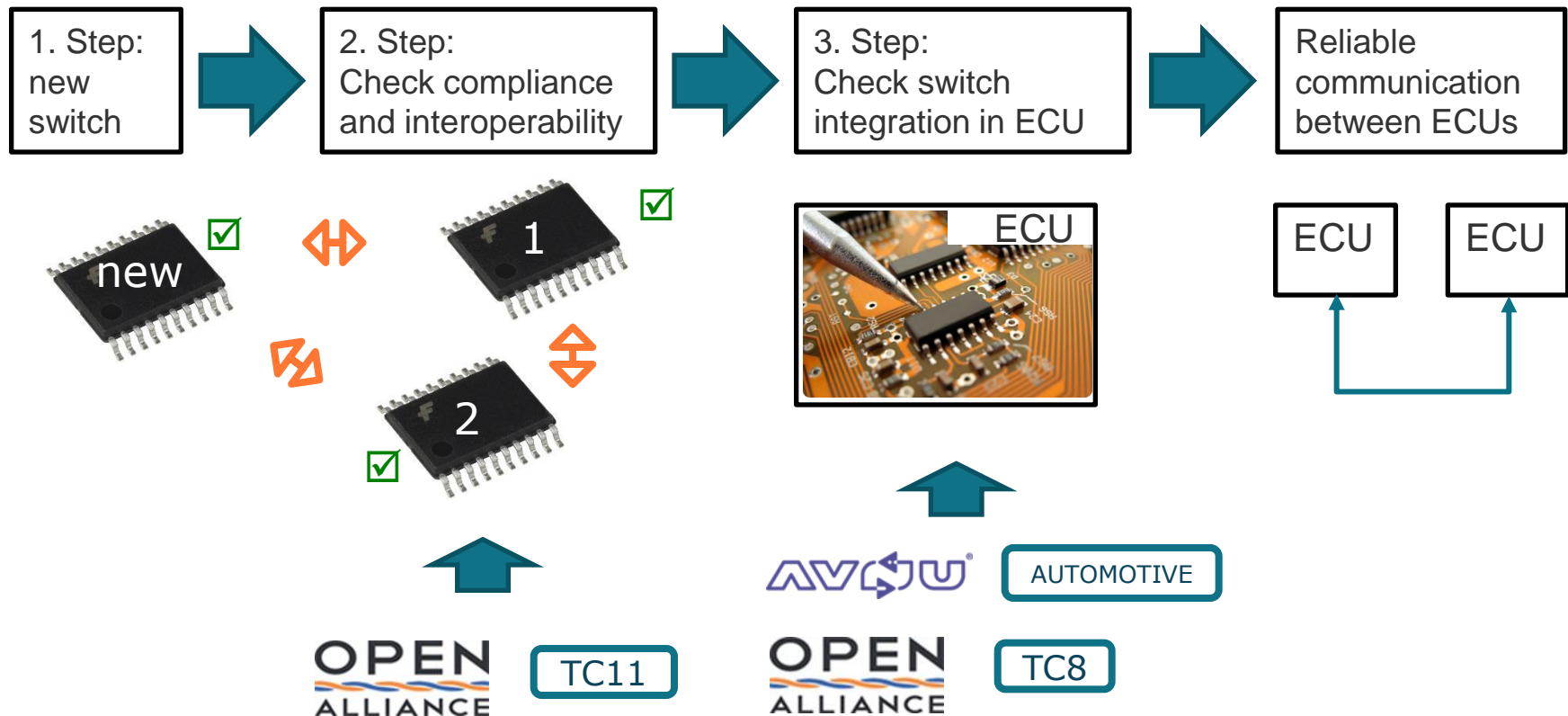
The Compliance Verification Process

An Overview



The Compliance Verification Process

Test and Validation Process for Layer 2




RUETZ SYSTEM SOLUTIONS

Certificate of Conformance

This is to certify that the
Automotive Ethernet Switch Semiconductor XY from Manufacturer Z
has been assessed by
RUETZ SYSTEM SOLUTIONS GmbH
and found to comply with the requirements of
**Test Specification Automotive Ethernet SWITCH Compliance
Version 34**

RS-P010XXX
Certificate Number


Jörg Angstenberger
Technical Head of Test Laboratory
Issue Date: February 29th, 2016

Scope of Assessment:

- Benchmarking RFC2544 /RFC 2889
- Switching
- Configuration
- TSN IEEE1588/IEEE802.1AS/IEEE802.1QAV
- Automotive Ethernet Use Cases



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Test Purposes for Switch Chips

Overview

1. General

- Operating and forwarding
- Start-up performance
- IEEE 802.1X Port-based security
- IEEE 802.1AE MACsec support
- Port mirroring
- Port disabling
- Handling of jumbo frames
- Chip identification
- Frame buffer size

2. Address Resolution

3. Virtual LAN (VLAN)

4. Time Sensitive Networking (TSN)

- Time synchronization
- Audio / Video Bridging

5. Configuration

6. Filtering of incoming frames

7. Diagnostic

8. Interface

- MDIO
- SPI

Test Purposes for Switch Chips

Examples of Automotive Use Cases

Multi-Switch Setup

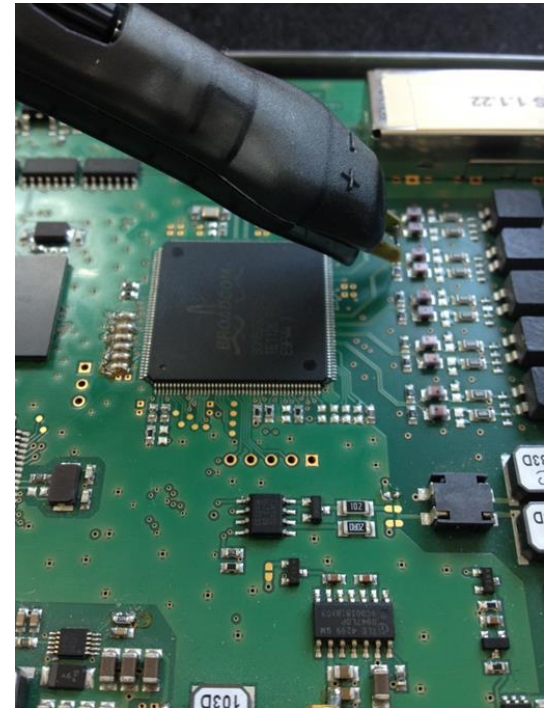
- Cascading/Daisy chain
- Performance benchmarking
- Combination of different vendors
- Handling of hash conflicts
- Robustness to failure injection

AVB/TSN in Multi Switch Setup

- Time synchronization with host application
- Traffic shaping of AVB content

Mirroring in Multi Switch Setup

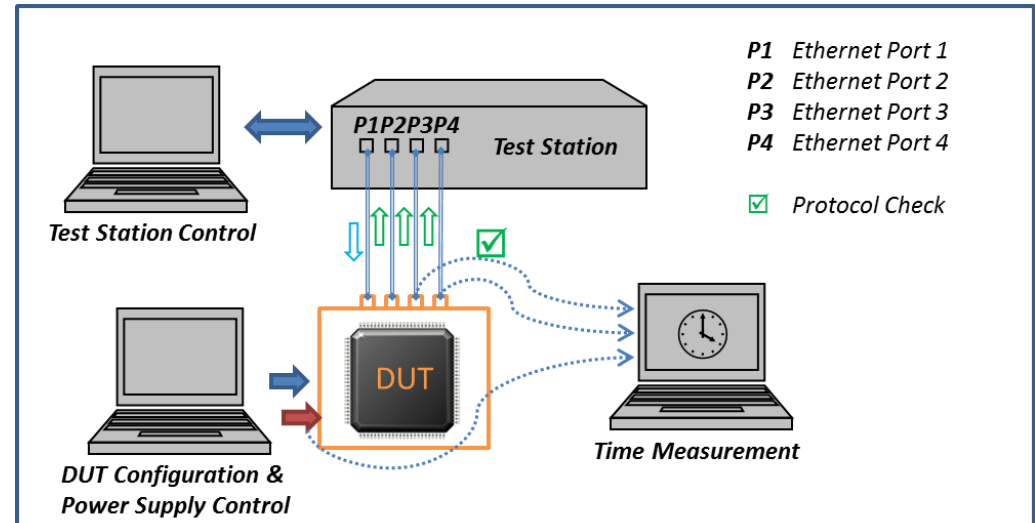
- Remote mirroring
- Handling of duplicated frames



Startup Performance – Boot Time

Synopsis:

Check if the startup of the switch including PHYs takes no more than a defined period of time.



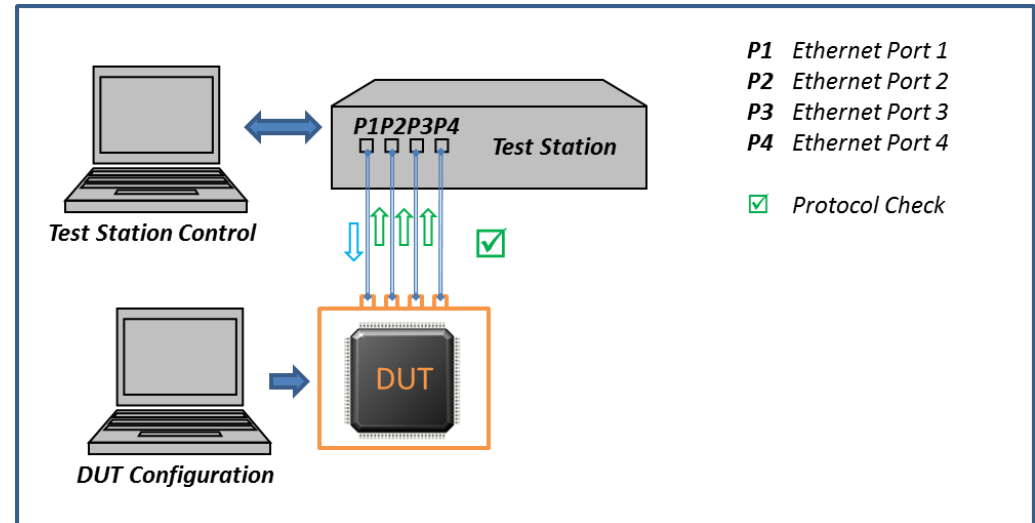
Test Flow

1. Test station sends frames to one egress port
2. Power on DUT
3. Receive all traffic from egress port
4. Test station measures period of time from power-on to the first bit of the first received frame on the destination port

Security – IEEE 802.1X Drop Frames with Unknown Source Address

Synopsis:

Check if the required function is implemented to drop traffic with unknown MAC source address on a specific port



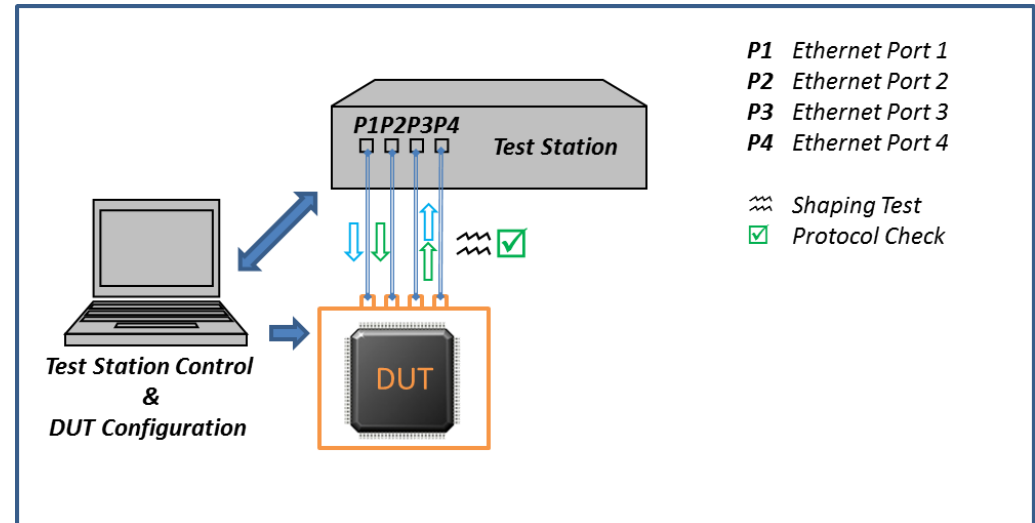
Test Flow

1. Send frames from test station to configured DUT ingress port
2. Check if frames are being forwarded to other DUT egress ports
3. Configure DUT ingress port to drop frames with unknown MAC source address
4. Send frames with unknown MAC source addresses to configured DUT ingress port
5. Check if frames are being forwarded to DUT egress ports

Time Sensitive Networking – Test Traffic Shaping Algorithm

Synopsis:

Check if switch supports a specific configured credit-based shaper algorithm used for the SR classes.



Test Flow

1. DUT is configured for required shaping behavior
2. Test station sends traffic stream to designated ports
3. Test station receives shaped traffic stream on designated port
4. Test station analyzes traffic for function and performance

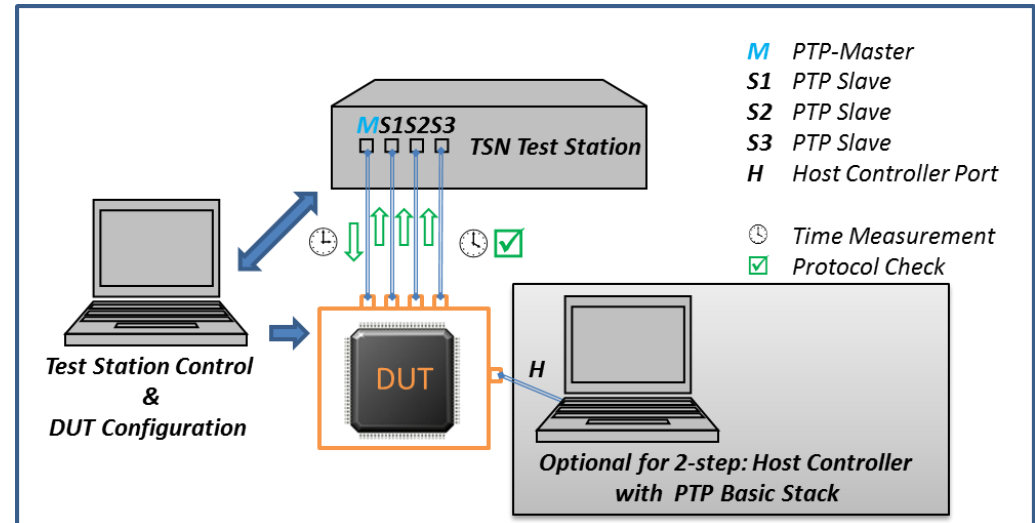
Time Sensitive Networking – gPTP Time Synchronization

Synopsis:

Checking the 1- and 2-step gPTP frame forwarding mechanism including correct implementation of residence time measurement.

Test Flow

1. DUT is configured to handle gPTP behavior
2. TSN Test station sends gPTP traffic to ingress port and records timestamps
3. TSN Test station receives gPTP traffic on egress ports and records timestamps
4. TSN Test station analyzes gPTP traffic and timestamp information



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Automotive Switch Semiconductors are Unique!

- Requirements for Automotive Applications :
 - ... are distinct from other domains of Ethernet and IP
 - ... have variants. It is important to have a portfolio.
 - ... are now precisely defined in the OPEN TC11.
- Layer 2 plays a key role for future solutions (AVB / TSN / Autonomous Driving).

It is important to care about requirements and quality in the implementations!
- The Compliance Process supports the development of switch semiconductors and assures that requirements are implemented in conformity to the needs of the OEM

Conclusion

Benefits

- Car manufacturer is able to
 - define the criteria for switch chips precisely
 - nominate chip vendors when compliant to requirements
- Automotive expertise gives chip vendors an important guide to car manufacturers' and TIER1s' needs
- Chip vendors have an independent and reliable statement to convince their customers about quality and performance

Thank you for your attention!

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