First insights to compliance verification of Automotive Ethernet Switches based on OPEN TC11

Fabian Nikolaus & Avik Bhattacharya

C&S group GmbH & Keysight Technologies 2018.10.10
OPEN TC11?
OPEN Alliance TC11

SCOPE AND GOALS

• Started in January 2016
• Align and identifying a minimum set of common switch features of automotive applications
  • Non-availability of certain functions could be irrelevant for one OEM, while it is essential for others
• Defining requirements out of this minimum set
• Definition of an automotive switch conformance test specification
OPEN Alliance TC11

REASONS

• A minimum set of switch features required
  • To cover all network characteristics of each OEM
  • Generate economies of scale without limiting to a specific network architecture

• Compliance testing of switch semiconductor product
  • Helpful already in the creation phase creating a common understanding of requirements of the automotive industry
  • Guarantees a certain required functionality
  • Reduce effort and costs when changing a key switch semiconductor

R E A S O N S
Requirements
Requirements to switch semiconductor

OVERVIEW

• Requirement specification released on September 28, 2016
• 86 requirements defined in 9 different areas
Requirements to switch semiconductor

**GEN-005**
“The Ethernet Switch shall operate as store and forward switch”

**FILT-007**
“The Ethernet Switch shall support filtering on L2 fields.”

**QOS-004**
“The Ethernet Switch shall support strict priority scheduling for each egress port.”

**TIME-002**
“The Ethernet Switch shall support time synchronization on all ports.”

**VLAN-001**
“The Ethernet Switch shall support VLAN handling according to IEEE 802.1Q.”

**ADDR-004**
“It shall be possible to read and write entries to the address table(s) by the host processor.”
Test Specification
*Defined** 166 test cases overall

*Categories aligned with requirement specification*
  - GEN, ADDR, VLAN, QOS, TIME, FILT, DIAG, INTF, CONF

*Covered 95% of the initial TC11 requirements*

*Only 4 uncovered requirements, because:*
  - Already covered in others test specifications (3)
  - Not testable due to vague specification (1)
Test Specification

**CONTENT**

**General (GEN, 23 test cases)**
- Startup performance
- Queue/Frame buffer size
- Port Mirroring

**Address Resolution (ADDR, 17)**
- Tagged/untagged Frames
- Aging time
- Read/write address table

**Virtual LAN (VLAN, 75)**
- Handling according to IEEE 802.1Q
- Freely configure VLAN IDs
- Overwrite VLAN IDs at ingress port

**Time Synchronization (TIME, 4)**
- PTP 1-step-clk
- PTP 2-step-clk

**Quality of Service (QOS, 12)**
- Priority based QoS
- Support of WRR and CBS
- Overwrite priority

**Configuration (CONF, 5)**
- Reconfiguration without interruption
- Starting in „dont forward“ mode

**Filtering (FILT, 17)**
- Filtering based in L2/L3 information
- Rate limitation

**Diagnostics (DIAG, 11)**
- MIB counter support (RFC 2819)
- Port_Based_Counters

**Interfaces (INTF, 2)**
- Configuration via SPI
- AUTO-MDI-X for 100BASE-TX
Test Specification

- Test tool is connected to Device Under Test via host board (Ixia hardware used)
- Various test topologies are simulated for testing different scenarios from VLAN, ARP, TSN, FILT, etc.
- Test execution fully automated
- Same DUT that was used for PHY interoperability testing (OPEN TC1 IOPT)
Experience & Outlook
Experience

- Extensive upper layer interface (Upper Tester) required
  - Configuration of switch features/parameters
- Vendor specific implementation
- Comparison between functionality required for IOPT and TC11
  - IOPT requires about a dozen driver functions
    - GetLinkStatus, GetSQI, GetCableDiagnostic, etc.
  - TC11 requires about a hundred driver functions / service primitives
    - CreateVLAN, DeleteVLAN, SetPVID, etc.
Experience

TEST IMPLEMENTER

- Requires Hardware Capability
- Availability of a singleton implementation
- Absence of standard method of accessing Device data
# Test System

## Development Status

<table>
<thead>
<tr>
<th>Test Scope</th>
<th>Test Cases</th>
<th>Test Implementer</th>
<th>Test House</th>
<th>Test House / Vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDR</td>
<td>17</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>VLAN</td>
<td>75</td>
<td>100%</td>
<td>100%</td>
<td>80%</td>
</tr>
</tbody>
</table>

## Test Scopes

- GEN (23)
- ADDR (17)
- VLAN (75)
- TIME (4)
- QOS (12)
- CONF (5)
- FILT (17)
- DIAG (11)
- INTF (2)
Test System

Phase 1 Completed

Phase 2
Oct 2018

Phase 3
Nov 2018

- Implementation of the remaining Test Suites is expected to be finished by November 2018
Targeted publish date of TC11 Test Specification

October 2018

We are ready to test Now
Outlook

FUTURE TOPICS

• Security testing, especially in security-critical applications and systems an awareness for security must be created

• 802.11AE MAC Security (MACSec) standard offers MAC-level encryption and message authentication for Ethernet using 802.1x for secure key exchange.
Questions?