CIP Network Conformance Testing

ODVA Conformance Authority
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Today’s Topics:

- Conformance Testing Process
- New Conformance Test Changes
- Common Conformance Testing Errors
- Questions
Conformance Testing Process

Conformance Testing Purpose

- Because You Have To (TOU)
- Better Products at Release
- Benefits Your Customers and Ultimately You
Conformance Testing Process

Updates to ODVA Test Guidelines

- Read the ODVA Test Guidelines in the *Conformance Test Details Form*
  - Updates to the DUT firmware testing will require repeating all tests
  - Order extra hours in advance
  - Send in the required documents on time
New Tests in EtherNet/IP™ CT14
MS/NS LED Behavior

- Vendor specific LED behavior must be documented.
- MS/NS LEDs not required for Industrial Performance Level
  - But if implemented must conform to requirements or documented
- Special LED behavior before DHCP / BOOTP server configuration.
  - MS = flashing green, NS = dark
New Tests in EtherNet/IP™ CT14

- **TCP/IP Interface Object Test**
  - Multiple Instances Test
    - CT tool probes all instances of TCP/IP Object
    - Need as many STC files as instances
      - unless some or all instances configured same
  - IANA Port Admin attribute test
    - At minimum, all EtherNet/IP-related ports supported by the DUT shall be exposed.
New Tests in EtherNet/IP™ CT14

- Point-to-Point I/O on non-default port
  - Point-to-Point **consumer** can specify alternate port number
  - Default UDP port is 2222. **Sockaddr Info** item specifies other UDP port.
  - Forward_Open Request - T->O Item – Originator as Consumer, **determines the port**
  - Forward_Open Reply - O->T Item – Target as Consumer, **determines the port**
New Tests in EtherNet/IP™ CT14

- **T->O multicast matching rules test (return error code)**

  Test for the rule "For multicast, if an established T->O producer exists on the same port*, the T->O parameters listed in the Table 3-6.4 below shall match. If not, the device shall return the indicated error.”

* Same port means same UDP port 2222 and same T->O path

<table>
<thead>
<tr>
<th>T→O Parameter</th>
<th>General Status</th>
<th>Extended Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>T→O RPI</td>
<td>0x01</td>
<td>0x0112</td>
</tr>
<tr>
<td>T→O Network Connection Parameters – Size</td>
<td>0x01</td>
<td>0x0134</td>
</tr>
<tr>
<td>T→O Network Connection Parameters – Fixed/Variable</td>
<td>0x01</td>
<td>0x0135</td>
</tr>
<tr>
<td>T→O Network Connection Parameters – Priority</td>
<td>0x01</td>
<td>0x0136</td>
</tr>
<tr>
<td>Transport Class</td>
<td>0x01</td>
<td>0x0137</td>
</tr>
<tr>
<td>T→O Production Trigger</td>
<td>0x01</td>
<td>0x0138</td>
</tr>
<tr>
<td>T→O Production Inhibit Time</td>
<td>0x01</td>
<td>0x0139</td>
</tr>
</tbody>
</table>
New Tests in EtherNet/IP™ CT14

- **T->O multicast matching rules, test cases in CT tool software**
  - Transport Class mismatch
  - T->O Production Trigger mismatch
  - T->O Production Inhibit Time mismatch
  - T->O Network Connection Parameters Size mismatch
  - T->O Network Connection Parameters Fixed/Variable mismatch
  - T->O Network Connection Parameters Priority mismatch
  - T->O parameters totally match
  - See also CIP PCTS PUB 166 for details of these tests
Run CT

- for each supported Configuration Method: Hardware, DHCP, Static IP Mode...
- again for Large_Forward_Open if supported. Set Connection Size to > 511
  For Class 3 Connection (Explicit Messages)
New Tests in EtherNet/IP™ CT14

- Large_Forward_Open (LFO)
  - Class 1 Connection
    - Tested by Connection Manager Size Max
    - Either T->O or O->T now generates LFO when Max Size > 511
ACD Behavior Test of WaitLinkIntegrity

1. DUT Initialization ➔ OngoingDetection
2. DUT LinkDown (only port)
3. Transition to Probelpv4Address (LinkUp)
4. Reference Node creates Conflict
   • DUT shall not defend
New Tests in EtherNet/IP™ CT14

- DLR
  - AutoMDIX in Auto-Negotiation and *Forced Mode*.
    - Use appropriate PHY
  - Neighbor_Status on Ring Fault (notifies Supervisor)
    - 0x01 Port 1 Active (bit 0)
    - 0x02 Port 2 Active (bit 1)
    - 0x80 Neighbor Status (bit 7)
    - Indicates Unresponsive Neighbor
New Tests in EtherNet/IP™ CT14

- DLR

  - Multiple Instances (DLR Switch)
    - Manual verification, each instance operates independently
    - CT tool probes each instance
    - Ring Port 1 and 2 Ethernet Link Object Instance Attributes
      - Allow Ethernet Link Object Instances to be mapped to DLR instance
    - DLR Enable
      - Allows the DLR instance to be disabled
Common Conformance Testing Errors
Common Conformance Testing Errors

- TCP/IP Interface Object Test
  - Report correct status or value during **mode switch** for following attributes:
    - Attribute 1 (Status) accurately reports Configuration Status
    - Attribute 2 (Configuration Capability) reflects correct DUT capabilities
Common Conformance Testing Errors

- TCP/IP Interface Object Test – Cont’d

  - Attribute 3 (Configuration Control) shows current mode of DUT

  - Attribute 5 (Interface Configuration) maintains proper values

  - In DHCP mode, attributes 5 & 6 should get the Domain Name and Host Name from the DHCP server if they are in the DHCPOFFER*. 


![Configuration Control (attr. 3)](image)

![Interface Configuration (attr 5)](image)
Common Conformance Testing Errors

- **Ethernet Link Object Test**
  - Attribute 2 (Interface Flags) shall report correct status and configuration about the physical interface.
  - Attribute 9 (Admin State) should not allow you to disable the last port*. 

*Note: The diagram shows various negotiation statuses and manual setting options, emphasizing the importance of correct interface flags and admin state settings.
Common Conformance Testing Errors

Ethernet Link Object Test

- Attribute 11 (Interface Capability) shall indicate the exact capabilities of that instance.
  - Ensure this matches the capabilities reported in other Ethernet link object attributes (attribute 2)

<table>
<thead>
<tr>
<th>Attribute 11- Interface Capabilities Verification</th>
<th>DUT Reports</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute 11 Get_AttributeSingle Value (Hex):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0A 00 00 00 04 0A 00 00 01 64 00 00</td>
<td>1010</td>
<td></td>
</tr>
<tr>
<td>Verify - DUT requires reset to apply changes made to Interface Control (Attr 6):</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Verify - DUT supports link Auto-Negotiate:</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Verify - DUT supports Auto MDIX operation:</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Verify - DUT is capable of Manual Speed/Duplex Via Interface Control (Attr 6):</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Verify - Number of elements:</td>
<td>04</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Formated Hex Value: 0A00000040A00000A000164000640001       |             |        |</p>
<table>
<thead>
<tr>
<th>Speed</th>
<th>Duplex</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element Pair #1:</td>
<td>10</td>
<td>Half</td>
</tr>
</tbody>
</table>
Common Conformance Testing Errors

- **DLR Object Test**
  - Sign_On Frame is received and transmitted upon power up. Test with all Configurations (BOOTP, DHCP, Static)
  - Be sure to check for consistent results on LinkDown (Ring Fault) at least three times, for all DLR Frames.

![Diagram of DLR Ring Node Conformance Test Setup](image-url)
Common Conformance Testing Errors

- NV (Non-Volatile) Attributes Behavior
  - NV attribute values shall be persistent after a power cycle or a Type 0 Reset.
  - NV attribute values shall be restored to factory default values after a Type 1 Reset.
Common Conformance Testing Errors

- NV (Non-Volatile) Attributes Behavior
  - Take effect immediately. e.g. *PTPEnable in Time Sync Object*
  - Take effect after power cycle or a Type 0 Reset. e.g. *QoS Object attributes. ACD Enable*
  - Take effect immediately or after a reset. Tend to have a pending reset bit. e.g. *Interface Configuration, TTL/Mcast attributes*
Common Conformance Testing Errors

- Honorable Mentions
  - DUT unable to acquire Interface Configuration after ACD conflict, upon link up.
  - DUT only able to pass CT with a single TCP/IP configuration.
  - DUT having Memory leak/buffer issues.
QUESTIONS?
THANK YOU