



Device Conformance Testing

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CIP Network Conformance Testing

Today's Topics:

- Conformance Testing process
- Changes and additions to Conformance Testing
- How to be ready for a Conformance Test
- Questions



Conformance Testing Process

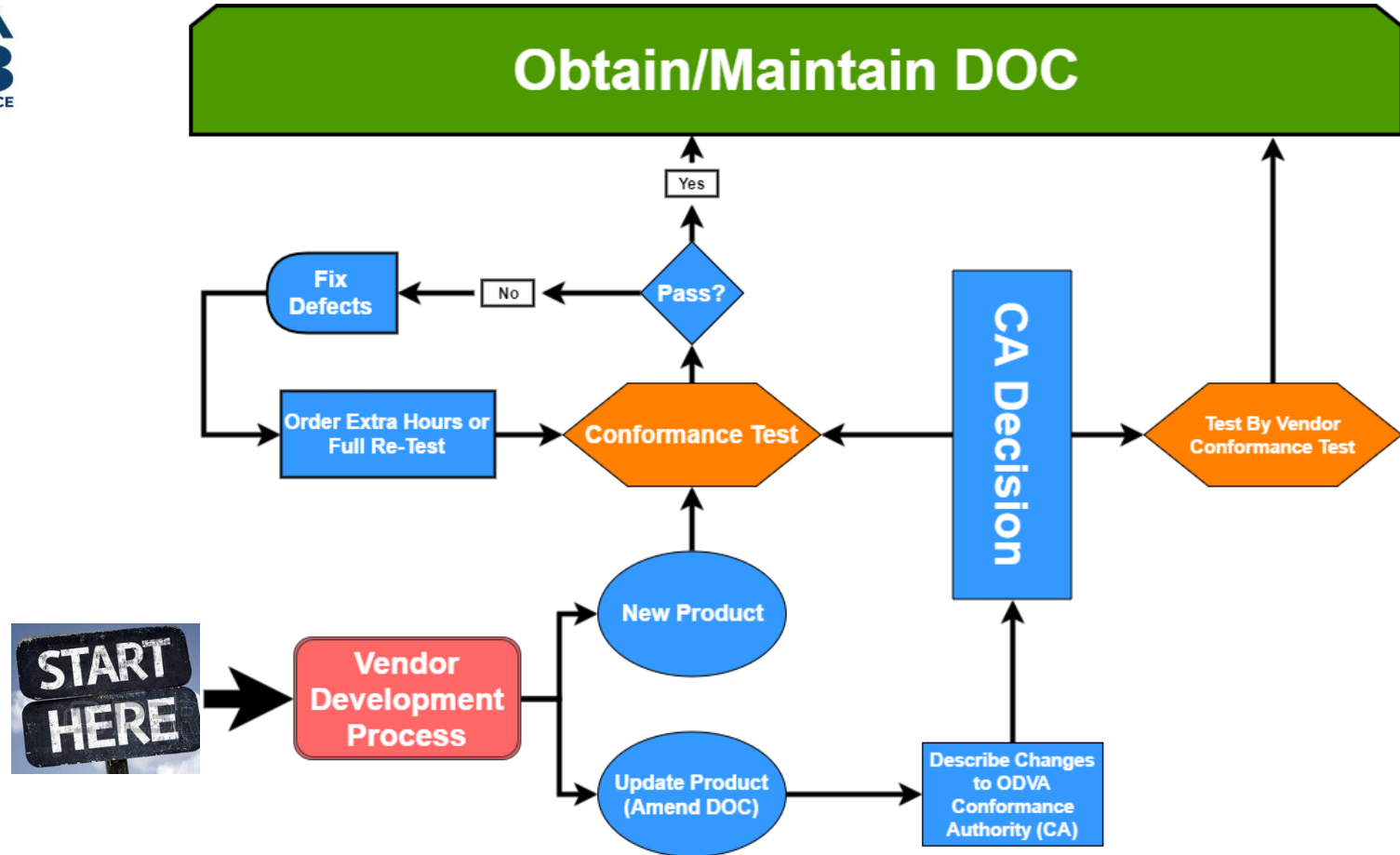
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Conformance Testing Process

Conformance Testing Purpose

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





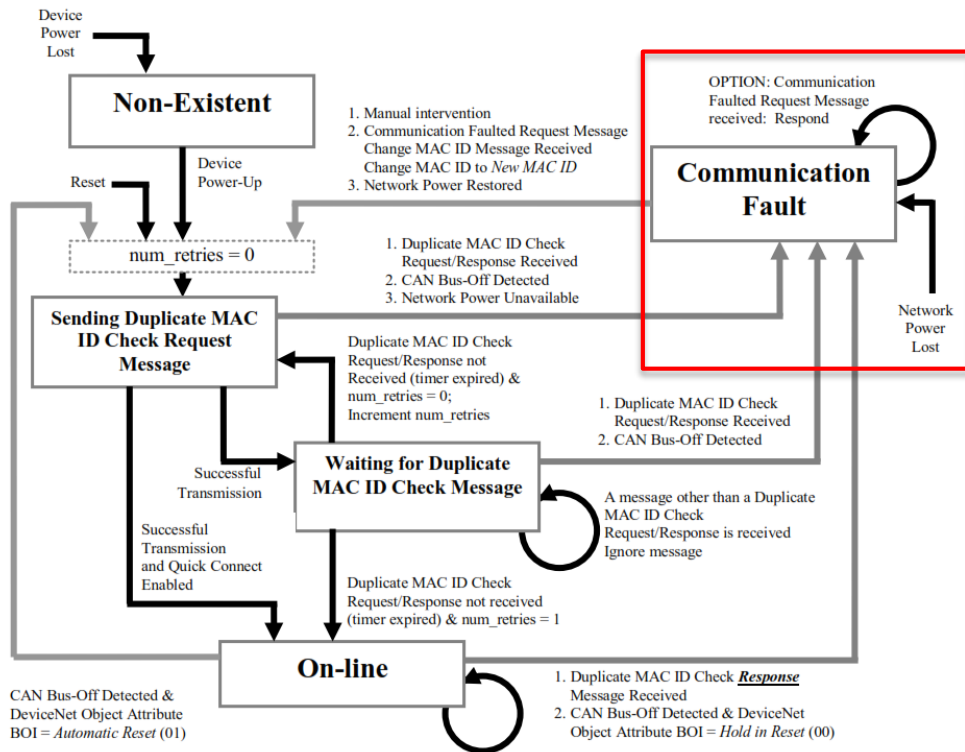
Changes and additions to Conformance Testing

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New Tests in DeviceNet™ CT29/CT30

- New Common Service Test:
 - Get_Member Service Test for Basic and Extended Format
 - Get_Attribute_List / Set_Attribute_List Test
 - Set_Attributes_All for some CIP objects
- Port Object Test update (Associated Communication Objects attribute)
- Time Sync Object test update
- File Object Test update
- Circuit Breaker Profile and Circuit Breaker objects test
- Identity Object Test (new attributes)
- Support Parameter Group Object revision 2

New Tests in DeviceNet™ CT29/CT30

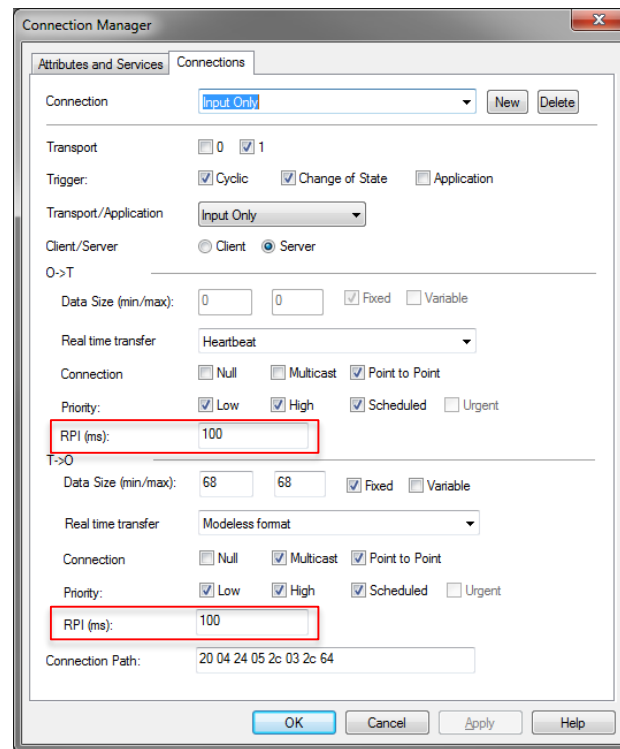


• DUP Mac Test on Network Power cycle

Expectation: A device needs to execute Duplicate MAC ID detection process after a reset of the device or after a power cycle of the network power.

Automated Test Enhancements

- New Common Service Test
- Connection Manager Object test enhancements
 - Updated Class 3 Duplicate 16-bit Sequence Count Test
 - Production Inhibit Time Network Segment in Milliseconds / Microseconds
 - I/O RPI configurable via stc interface
 - Speed up I/O tests when DUT supports multiple Priority levels



New Tests in EtherNet/IP™ CT15

Automated Test Enhancements

- CIP Modbus Device and CIP Modbus Translator Device Profiles Test
- CIP Motion Test for Motion Controllers and Motion Devices
- SNMP Object Test
- File Object Test update
- Port Object Test update for Associated Communication Objects attribute

Conformance Tests

Test Mode
☐ Development
☒ Conformance

Test Repetitions
 1 Times
☒ Stop On Error
☐ Run Continuously

Network Technology Tests

- ☒ Encapsulation
- ☒ Connection Manager
- ☒ TCP/IP Interface
- ☒ Ethernet Link
- ☐ Profile Verification
- ☒ Identity
- ☐ Type 1 or 2 Reset
- ☒ Message Router
- ☐ DeviceNet
- ☐ Connection
- ☐ Acknowledge Handler
- ☐ Port
- ☐ Modbus
- ☐ Modbus Serial Link
- ☐ Virtual Modbus Device

CIP Application Object Tests

- ☐ Discrete Input Point
- ☐ Discrete Output Point
- ☐ Discrete Input Group
- ☐ Discrete Output Group
- ☐ Discrete Group
- ☐ Presence Sensing
- ☒ Assembly
- ☐ Register
- ☐ Parameter
- ☐ Parameter Group
- ☐ Selection
- ☒ File
- ☐ Connection Config
- ☐ OCL
- ☐ TCL
- ☐ PRP/HSR Protocol
- ☐ PRP/HSR Table
- ☐ Analog Input Point
- ☐ Analog Output Point
- ☐ Analog Input Group
- ☐ Analog Output Group
- ☐ Analog Group
- ☐ Motion Device Axis
- ☐ Motor Data
- ☐ Control Supervisor
- ☐ AC/DC Drive
- ☐ Overload
- ☐ Soft Start
- ☒ Time Sync
- ☐ Base Energy
- ☐ Electrical Energy
- ☐ Non-Electrical Energy
- ☐ Power Management
- ☐ Power Curtailment
- ☐ S-Device Supervisor
- ☐ S-Analog Sensor
- ☐ S-Analog Actuator
- ☐ S-Single Stage Controller
- ☐ S-Gas Calibration
- ☐ S-Sensor Calibration
- ☐ Trip Point
- ☐ Position Sensor
- ☐ Position Control Super
- ☐ Position Controller
- ☐ Block Sequencer
- ☐ Command Block
- ☐ Base Switch
- ☐ RSTP Bridge
- ☐ RSTP Port
- ☐ QoS
- ☐ Device Level Ring
- ☐ SNMP

Run **Cancel**

New Tests in EtherNet/IP™ CT15

- Broadcast ListIdentity MaxResponseDelay Test**

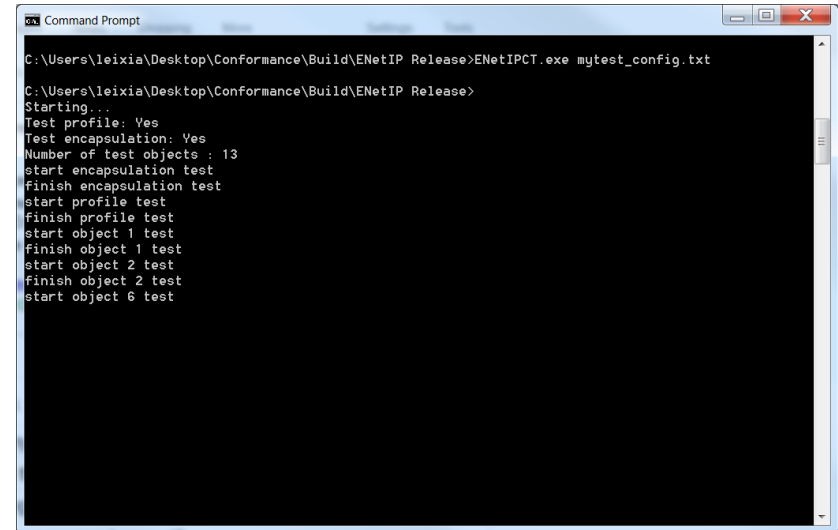
“The receiver’s delay shall be a random value, in milliseconds, between 0 and the MaxResponseDelay specified in the ListIdentity request” *[Vol2, Chapter 2, Section 2-4.2.3]*

No.	Time	Source	Destination	Protocol	Length	Info
63	*REF*	192.168.1.1	192.168.1.255	ENIP	66	List Identity (Req)
64	0.009312	192.168.1.10	192.168.1.1	ENIP	109	List Identity (Rsp), PIM
65	*REF*	192.168.1.1	192.168.1.255	ENIP	66	List Identity (Req)
66	0.009222	192.168.1.10	192.168.1.1	ENIP	109	List Identity (Rsp), PIM
68	*REF*	192.168.1.1	192.168.1.255	ENIP	66	List Identity (Req)
69	0.010203	192.168.1.10	192.168.1.1	ENIP	109	List Identity (Rsp), PIM
70	*REF*	192.168.1.1	192.168.1.255	ENIP	66	List Identity (Req)
71	0.008737	192.168.1.10	192.168.1.1	ENIP	109	List Identity (Rsp), PIM
72	*REF*	192.168.1.1	192.168.1.255	ENIP	66	List Identity (Req)
73	0.008947	192.168.1.10	192.168.1.1	ENIP	109	List Identity (Rsp), PIM

New Tests in EtherNet/IP™ CT16

Enhancements in CT16

- CT can be run from GUI or Command Line
- Circuit Breaker Profile and Circuit Breaker objects test
- Identity Object Test (new attributes)
- Support Parameter Group Object revision 2
- MDAO and Motion I/O test for new SEs



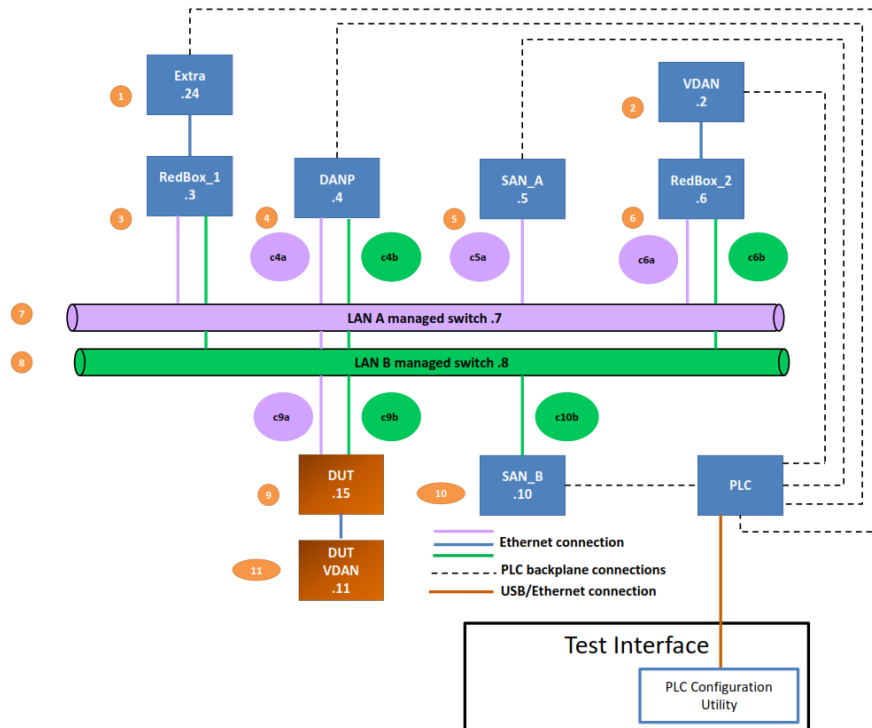
```
Command Prompt
C:\Users\leixia\Desktop\Conformance\Build\ENetIP Release>ENetIPCT.exe mytest_config.txt
C:\Users\leixia\Desktop\Conformance\Build\ENetIP Release>
Starting...
Test profile: Yes
Test encapsulation: Yes
Number of test objects : 13
start encapsulation test
finish encapsulation test
start profile test
finish profile test
start object 1 test
finish object 1 test
start object 2 test
finish object 2 test
start object 6 test
```

Manual Test additions - EtherNet/IP™ CT15/CT16

PRP Behavior Test

“Parallel Redundancy Protocol (PRP) is a network protocol standard for Ethernet that provides seamless failover against failure of any network component. This redundancy is invisible to the application.

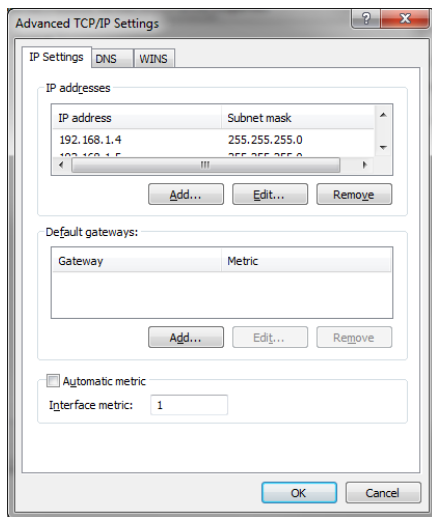
“The PRP/HSR Protocol Object provides the CIP application-level interface to these protocols (PRP/HSR).”



Manual Test additions - EtherNet/IP™ CT15/CT16

Off-Link Routing Test

“If the destination is on a connected network, the datagram is sent directly to the destination host; otherwise, it has to be routed to a gateway on a connected network” [RFC 1122, Section 3.3.1]



Configure the PC's physical Ethernet interface so that it has three logical TCP/IP interfaces as follows:

- IP address 192.168.2.100 with subnet mask 255.255.0.0 (note /16 subnet mask)
- IP address 192.168.1.4 with subnet mask 255.255.255.0 (note /24 subnet mask)
- IP address 192.168.1.5 with subnet mask 255.255.255.0 (note /24 subnet mask)

Manual Test additions EtherNet/IP™ CT15/CT16

Multicast I/O Forward Open Request

No.	Time	Source	Destination	Protocol	Extended Status	Info
48	1.438274	192.168.2.100	192.168.1.10	CIP CM		Connection Manager - Forward Open (Class (0xa7))
49	1.438651	192.168.1.10	192.168.2.100	TCP		44818 → 62112 [ACK] Seq=751 Ack=1135 Win=8082 Len=0
50	1.438982	192.168.1.10	192.168.2.100	CIP CM	Not configured for off-subnet multicast	Connection failure: Connection Manager - Forward Open
51	1.440274	192.168.2.100	192.168.1.10	CIP CM		Connection Manager - Forward Open (Class (0xa7))
52	1.440642	192.168.1.10	192.168.2.100	TCP		44818 → 62112 [ACK] Seq=807 Ack=1245 Win=8082 Len=0
53	1.440958	192.168.1.10	192.168.2.100	CIP CM	Not configured for off-subnet multicast	Connection failure: Connection Manager - Forward Open
54	1.442276	192.168.2.100	192.168.1.10	CIP CM		Connection Manager - Forward Open (Class (0xa7))
55	1.442639	192.168.1.10	192.168.2.100	TCP		44818 → 62112 [ACK] Seq=863 Ack=1355 Win=8082 Len=0
56	1.442959	192.168.1.10	192.168.2.100	CIP CM	Not configured for off-subnet multicast	Connection failure: Connection Manager - Forward Open
57	1.444256	192.168.2.100	192.168.1.10	CIP CM		Connection Manager - Forward Open (Class (0xa7))
58	1.444608	192.168.1.10	192.168.2.100	TCP		44818 → 62112 [ACK] Seq=919 Ack=1465 Win=8082 Len=0
60	1.446318	192.168.2.100	192.168.1.10	CIP CM		Connection Manager - Forward Open (Class (0xa7))
61	1.446703	192.168.1.10	192.168.2.100	TCP		44818 → 62112 [ACK] Seq=975 Ack=1575 Win=8082 Len=0
62	1.447268	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=000000000
63	1.447269	192.168.1.10	192.168.2.100	CIP CM		Success: Connection Manager - Forward Open
64	1.448292	192.168.2.100	192.168.1.10	ENIP		Connection: ID=0x001A4024, SEQ=000000001
65	1.546667	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=000000001
66	1.646657	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=000000002
67	1.652895	192.168.2.100	192.168.1.10	TCP		62112 → 44818 [ACK] Seq=1575 Ack=1067 Win=64632 Len=0
68	1.746658	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=000000003
69	1.747898	192.168.2.100	192.168.1.10	ENIP		Connection: ID=0x001A4024, SEQ=000000002
70	1.846652	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=000000004

Unsuccessful off-subset multicast I/O request

Successful off-subset unicast I/O request and I/O packets

Default TTL Value of DUT = 1
Default Gateway Assigned to DUT

Unicast I/O Forward Open Request

New Tests in EtherNet/IP™ CT16

CIP Security Test: (in a separate app for CT16)

- I/O Test via DTLS session
- CIP security objects test via TLS session
- Configure and use PSK test
- Use default and non-default certificates test
- NULL ciphers and non-NULL ciphers test

Conformance Test ToolKit – Content Highlights

ODVA Test Framework

- To be released as part of CT-16 (but a separate installation package)
- Tools to aid in conformance testing:
 - Connections Tool
 - DHCP Server
 - CIP Motion I/O Validator
- Scripts to provide some automation for manual test processes
 - ACD
 - TTL/MCast

Conformance Test ToolKit – DHCP Server Tool

Configured DHCP Clients / Events

Clients

Physical Address	IP Address	Bound @	Expires @	Description
E4:90:69:9B:A6:8F	192.168.1.10/24	16:25:53	Infinity	

Events

```

E 04:25:30.035 Start_Server, on (192.168.1.1/24)
E 04:25:53.110 <E4:90:69:9B:A6:8F> Request_Received
E 04:25:53.126 <E4:90:69:9B:A6:8F> Ack_Sent, (192.168.1.10) for Infinity
    
```

Settings

Default New Physical Address
00:00:00:00:00:00

Default Configuration Values

Auto-Config Base IP Address
192.168.1.10

Network Mask
255.255.255.0

Gateway Address
192.168.1.254

Domain Name
ODVA-Domain-Name

Base Host Name
ODVA-Host-Name

Lease Time ☐ Forced ☐ Infinity
10:00:00

- Fully functional DHCP Server.

Conformance Test ToolKit – Connections Tool

ODVA Conformance Test ToolKit

Interactive Test Sequencer | Results Browser | Messaging Tools | DHCP Server | CIP Motion I/O Validator

I/O Connections

Exclusive Owner

I/O Configuration

Host Interface:

Host IP Address: 192.168.1.1

DUT IP Address: 192.168.1.10

Trigger:

☒ Cyclic

☐ Change of State

Application Type:

ExclusiveOwner

Connection Path(hex):

20 04 24 01 2c 03 2c 02

O -> T:

Connection Type: PointToPoint

Priority: High

☒ Fixed

☐ Variable

Real Time Format: 32-bit run/idle header

RPI(ms): 100

Data Size: 504

T -> O:

Connection Type: Multicast

Priority: Low

☒ Fixed

☐ Variable

Real Time Format: Modeless format

RPI(ms): 300

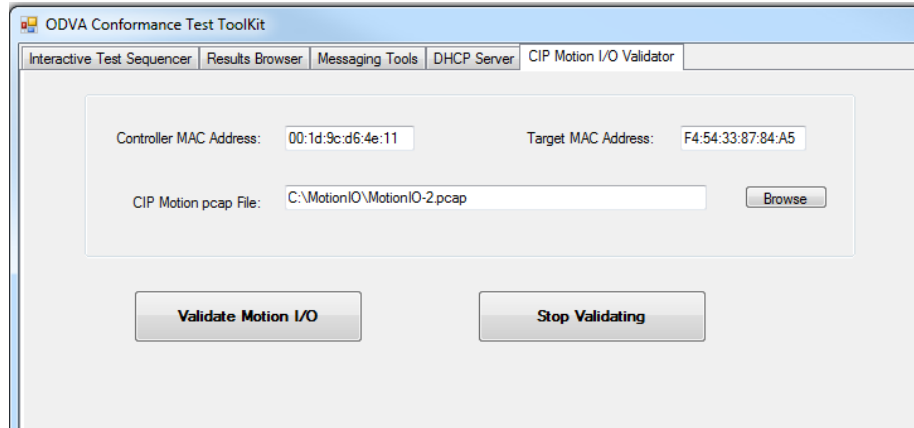
Data Size: 504

Save

Create One Connection

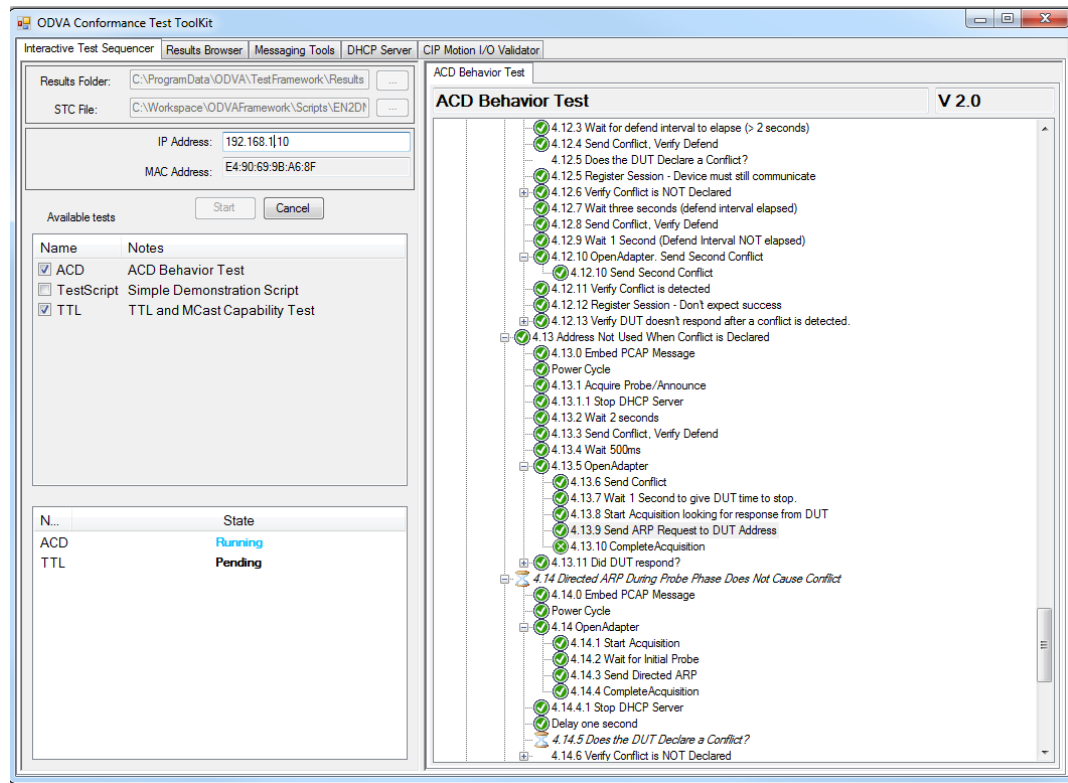
- Encapsulation commands
- Explicit messaging
 - Connected
 - UCMM
- I/O Connections
 - Multiple connections

Conformance Test ToolKit – Motion I/O Validator



- Utility to validate CIP Motion I/O messages

Conformance Test ToolKit – Script Sequencer



Scripting Engine front end provides:

- Selection of installed scripts to be run
- Selection of DUT information (.STC)
- Visual feedback during test execution
- Automatic archiving of result data

Conformance Test ToolKit – Results Viewer

ODVA Conformance Test Toolkit

Interactive Test Sequencer | Results Browser | Messaging Tools | DHCP Server | CIF Motion I/O Validator

Report Format: FullReport | Save Report | Save Data | Load Data | Close All

ACD Behavior Test x | ACD Behavior Test x | ACD Behavior Test x | ACD Behavior Test x

EtherNet/IP ODVA Conformance Test Results

Test: ACD Behavior Test
Version: 2.0
TimeStamp: 2018-09-27T16:22:24.5577385-04:00
Test Engineer: mfrazier
Notes: ACD TEST Demonstration
Test Result: FAIL

Test Step	Description	Result
MainRoutine		FAIL
—0. Basic Initialization		PASS
—0.1 - Enter Test Engineer Info		PASS
—0.2 - SelectAdapter	Network adapter 'Realtek PCIe GBE Family Controller' on local host:Internet 192.168.0.1,Internet 192.168.1.1	PASS
—0.3 - Initialize Script With STC Values		PASS
—SUB5 - Initialize Script With STC Values		PASS
—S5.1 Assign DUT IP Address		PASS
—S5.2 Assign DUT MAC Address		PASS

- Report shows result of each script step, as well as final result of test.
- Test data is stored as XML format.
- Report is generated as HTML for viewing

Getting ready for a
Conformance Test

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Getting ready for a Conformance Test

- Start early – submit your conformance test well in advance
- Read the ODVA Test Guidelines in the Conformance Test Details Form
- Review and run the manual tests
- First timers – encouraged to attend the test
- Ask Questions! – conformance@odva.org





QUESTIONS?



THANK YOU