Device Conformance Testing

Hamza Choudhry
ODVA

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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

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Conformance Testing Process

Conformance Testing Process

Conformance Testing Purpose

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

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Obtain/Maintain DOC

Vendor Development Process

New Product

Update Product (Amend DOC)

Describe Changes to ODVA Conformance Authority (CA)

CA Decision

Conformance Test

Order Extra Hours or Full Re-Test

Pass?

Yes

No

Fix Defects

Test By Vendor Conformance Test

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Changes and additions to Conformance Testing

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

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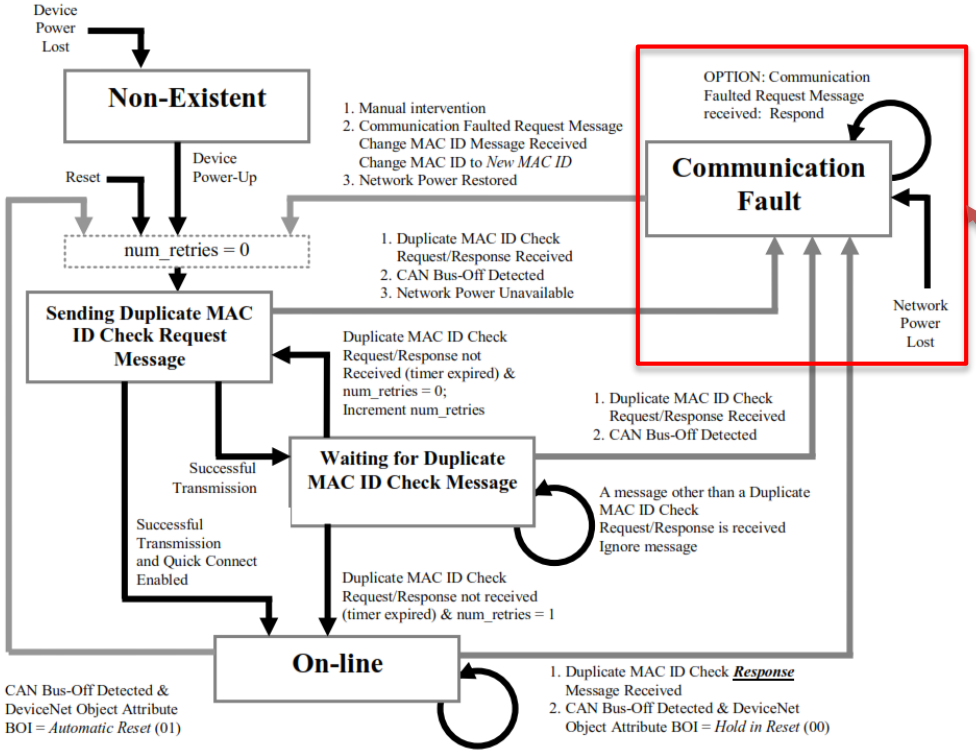
New Tests in DeviceNet™ CT29/CT30



- **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.

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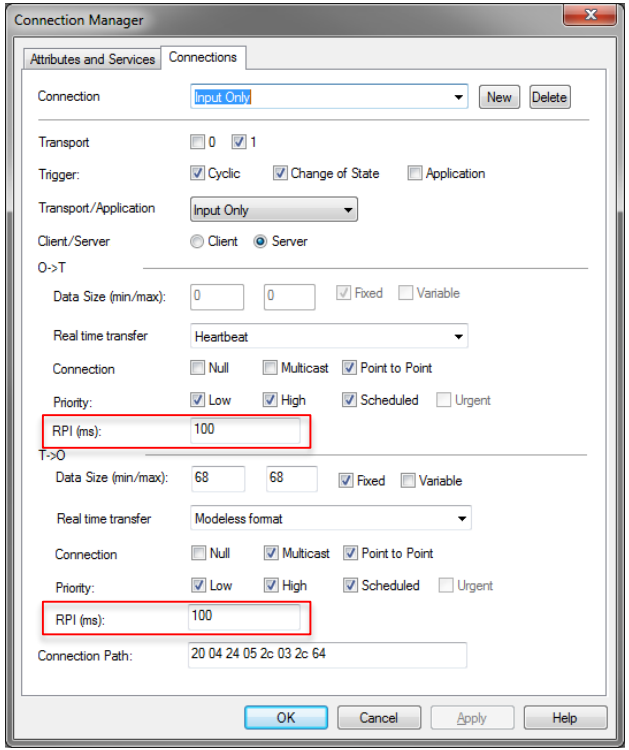
New Tests in EtherNet/IP™ CT15

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



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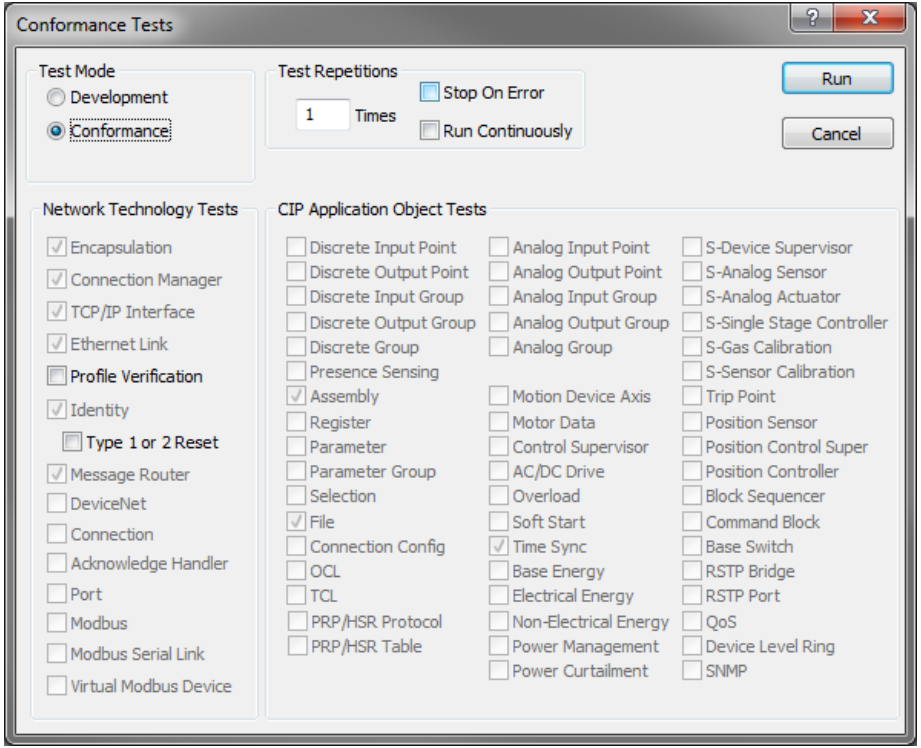
New Tests in EtherNet/IP™ CT15

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



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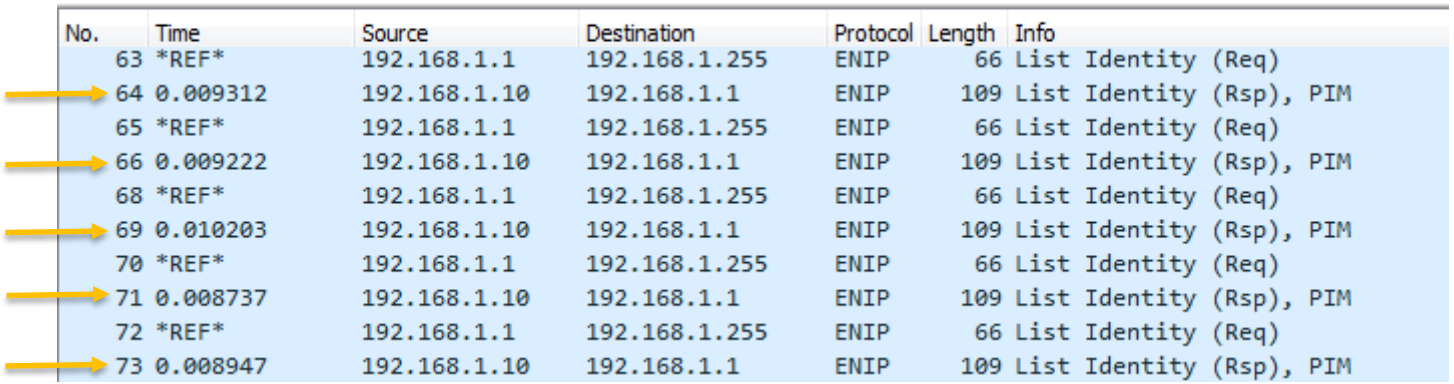
New Tests in EtherNet/IP™ CT15

- **Broadcast ListIdenty 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

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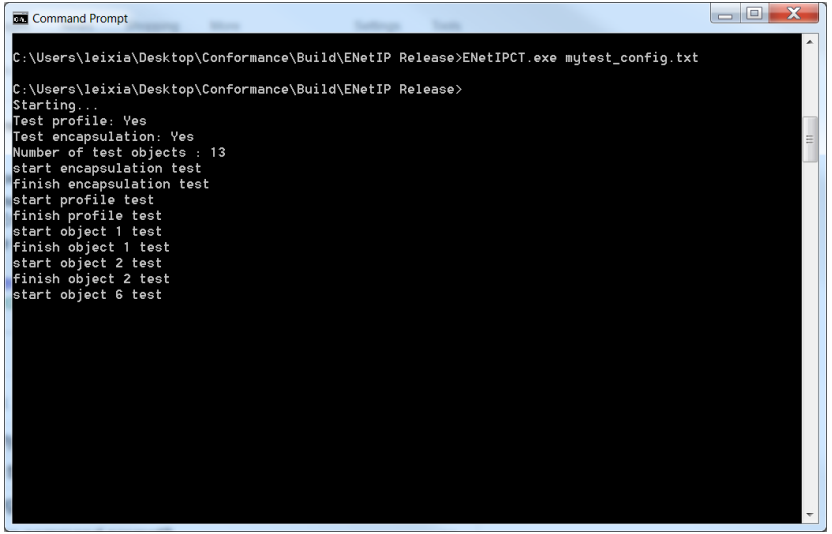
New Tests in EtherNet/IP™ CT16

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



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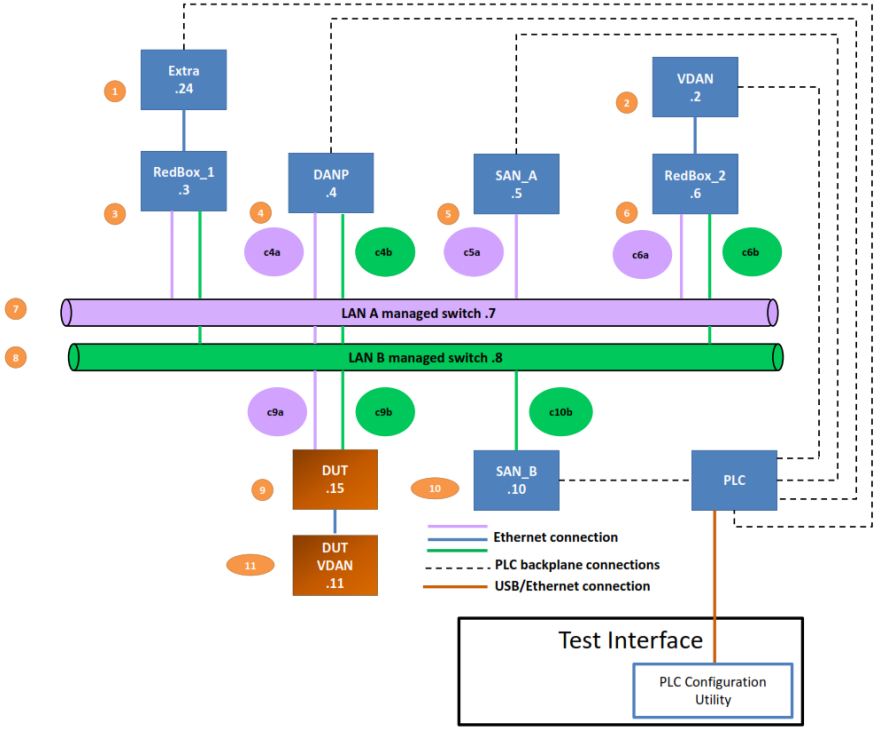
Manual Test additions - EtherNet/IP™ CT15/CT16

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).”



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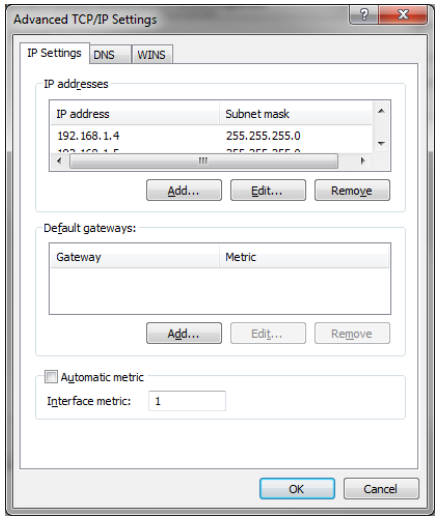
Manual Test additions - EtherNet/IP™ CT15/CT16

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)

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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=0000000000
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=0000000001
65	1.546667	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=0000000001
66	1.646657	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=0000000002
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=0000000003
69	1.747898	192.168.2.100	192.168.1.10	ENIP		Connection: ID=0x001A4024, SEQ=0000000002
70	1.846652	192.168.1.10	192.168.2.100	ENIP		Connection: ID=0x00000000, SEQ=0000000004

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

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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

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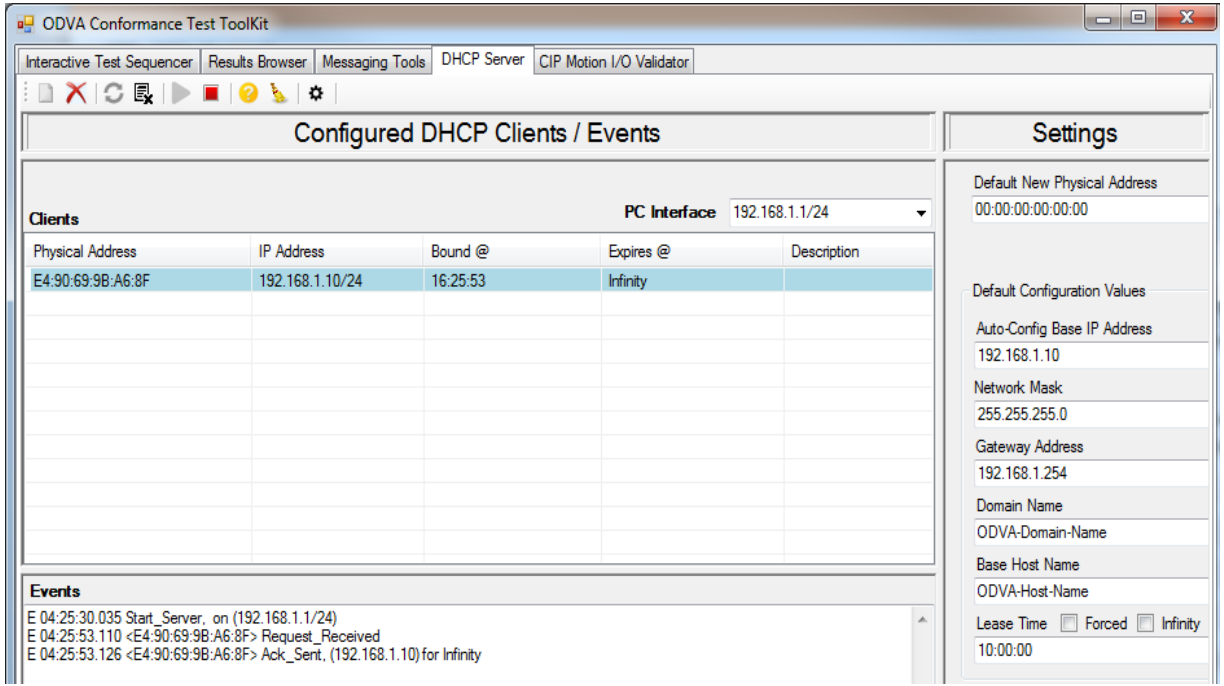
Conformance Test ToolKit – Content Highlights

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



- Fully functional DHCP Server.

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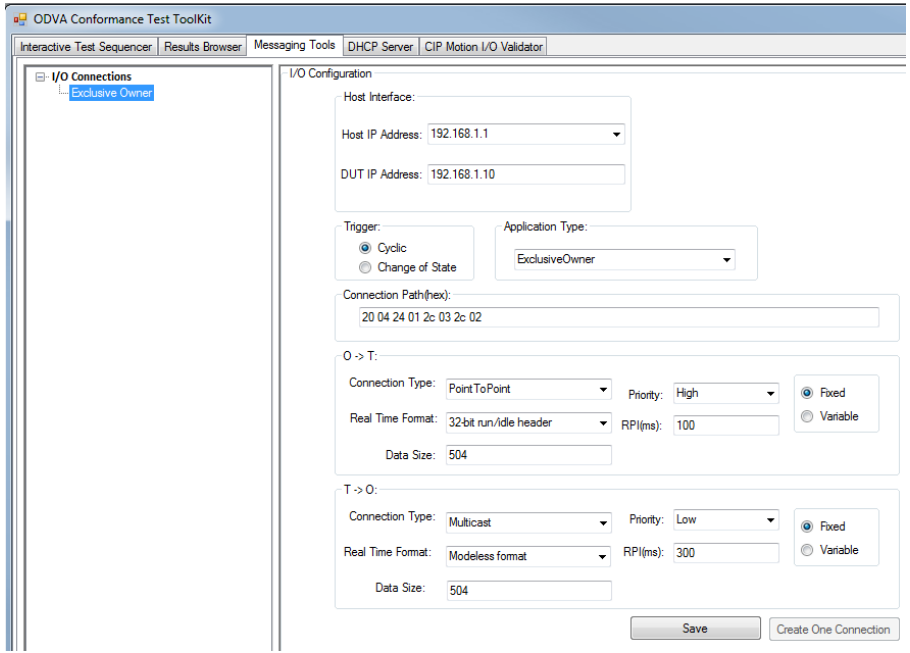
Conformance Test ToolKit – Connections Tool



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

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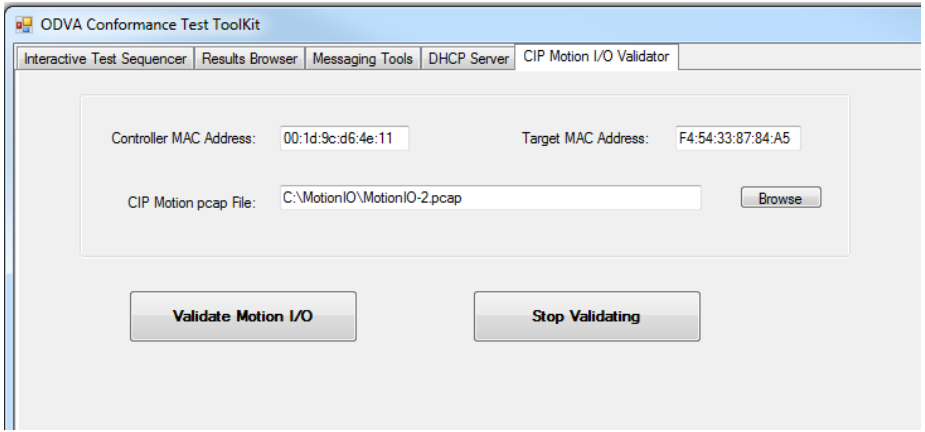
Conformance Test ToolKit – Motion I/O Validator



- Utility to validate CIP Motion I/O messages

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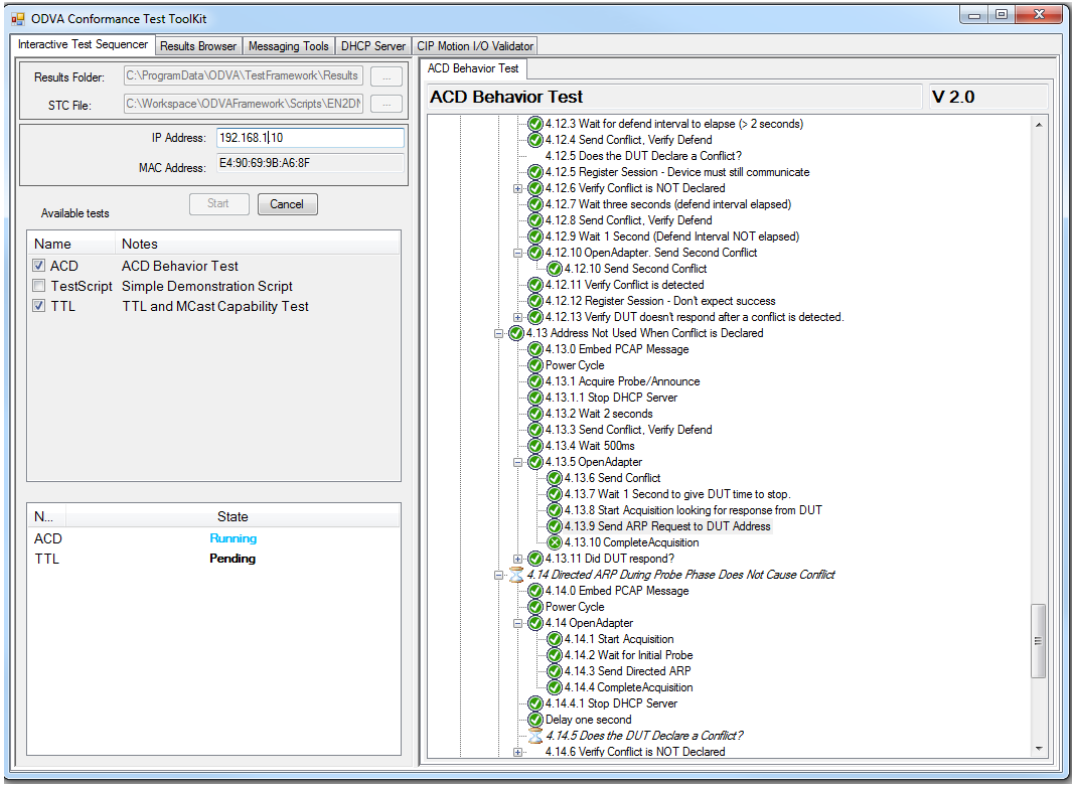
Conformance Test ToolKit – Script Sequencer



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

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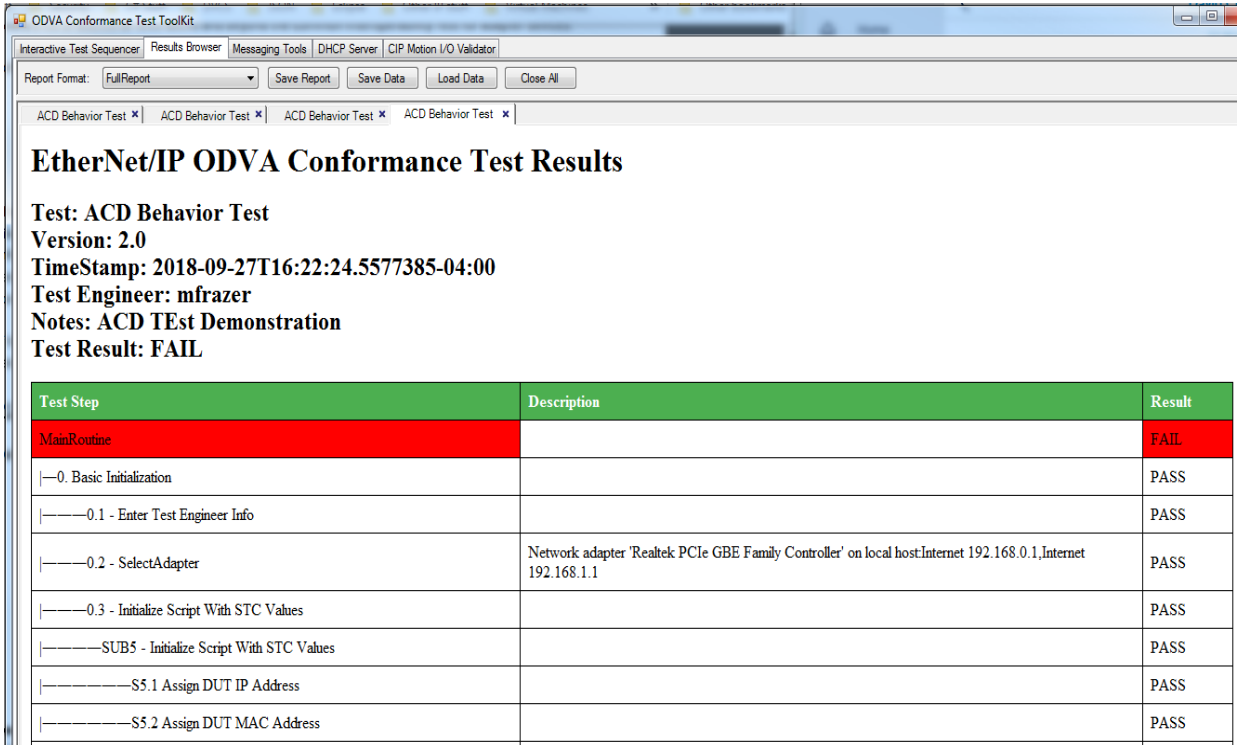
Conformance Test ToolKit – Results Viewer



EtherNet/IP ODVA Conformance Test Results

Test: ACD Behavior Test
Version: 2.0
TimeStamp: 2018-09-27T16:22:24.5577385-04:00
Test Engineer: mfrazer
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

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Getting ready for a Conformance Test

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

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THANK YOU