# IoT IP Consortium

IoT IP Interoperability Test Specification

## Technical Document

Version 1.3

**University of New Hampshire**           **21 Madbury Road, Suite 100**
**InterOperability Laboratory**                      **Durham, NH 03824**
**Home Networking Consortium**           **Phone: +1-603-862-3941**
**http://www.iol.unh.edu**                      **Fax: +1-603-862-4181**

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## Modification Record

| Version | Date | Editor | Modification |
|---|---|---|---|
| 1.3 | 2016-9-30 | Marion Dillon | • Fixed test case numbering |
| 1.2 | 2016-8-02 | Timothy Winters | • Added IPv6<br>• Updated to new Test Specification Format |
| 1.1 | 2013-3-22 | Timothy Sheehan | • Basic edits and cleanup, additional wireless test cases added. |
| 1.0 | 2013-2-28 | Timothy Sheehan | • Completed Details of all the test cases. |

## Acknowledgements

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# Introduction

The University of New Hampshire's InterOperability Laboratory (UNH-IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard.  This suite of tests validates that an IP IoT device properly interoperates with Customer Edge Routers.

**Scope:**

The following tests verify the general operation between constraing IP device and CE Router.
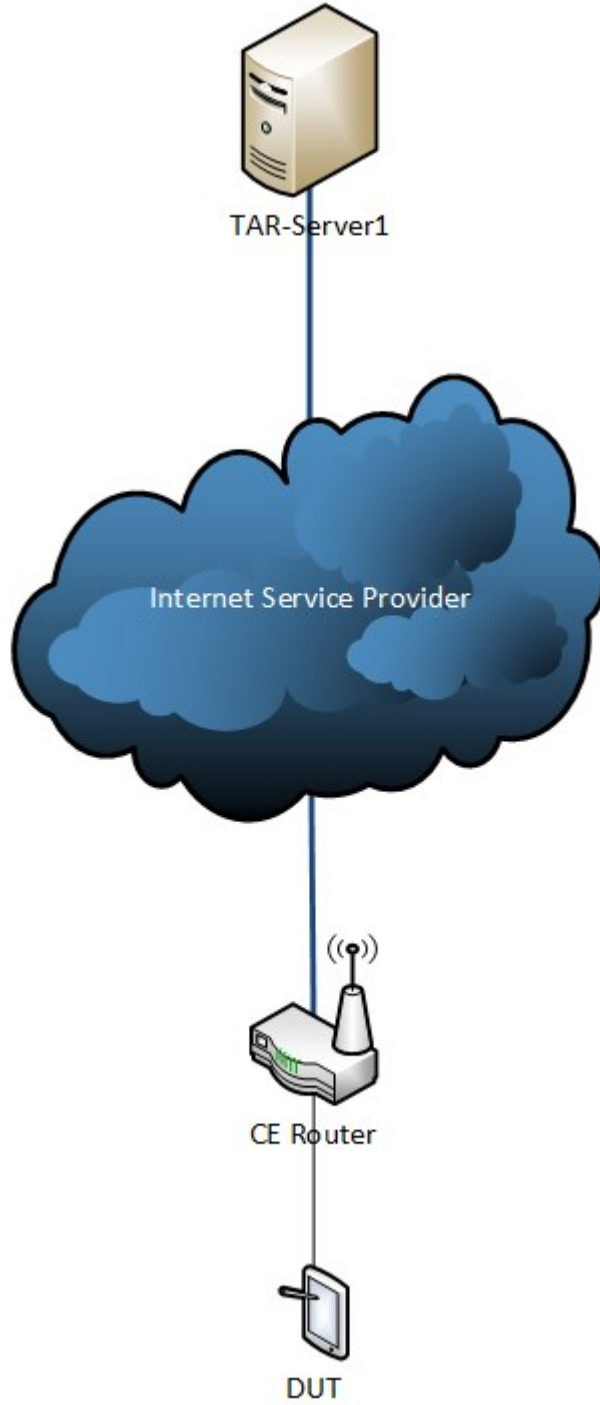
## Definitions

| IoT Device | Constrained IP enabled device (Device Under Test) |
|---|---|
| CE LAN | CE Router LAN Interface, connects to the DUT. |
| CE WAN | CE Router WAN Interface, typically connects to a ISP. |
| TAR-Server1 | A Server on the Internet that will respond to the Application traffic generated by the DUT. |

## Test Organization

This document organizes tests by group based on related test methodology or goals. Each group begins with a brief set of comments pertaining to all tests within that group. This is followed by a series of description blocks; each block describes a single test. The format of the description block is as follows:

| | |
|---|---|
| **Test Label** | The **Test Label** is the first line of the test page. It will have the following form:<br>    IP.IOP.A.B<br><br>Where each component indicates the following:<br>    IP – Test Suite Identifier<br>    IOP – Interoperability Test Suite<br>    A – Group Number<br>    B – Test Number<br><br>Scripts implementing this test suite should follow this convention, and may also append a character in the set [a-z] indicating a particular test part. |
| **Purpose** | The **Purpose** is a short statement describing what the test attempts to achieve. It is usually phrased as a simple assertion of the feature or capability to be tested. |
| **Test Setup** | The **Test Setup** section describes the configuration of all devices prior to the start of the test. Different parts of the procedure may involve configuration steps that deviate from what is given in the test setup. If a value is not provided for a protocol parameter, then the protocol's default is used for that parameter. |
| **Procedure and Expected Behavior** | The **Procedure and Expected Behavior** table contains the step-by-step instructions for carrying out the test. These steps include such things as enabling interfaces, unplugging devices from the network, or sending packets from a test station. The test procedure also cues the tester to make observations of expected behavior, as needed, as not all steps require observation of results. If any behavior is expected for a procedure, it is to be observed prior to continuing to the next step. Failure to observe any behavior prior to continuing constitutes a failed test.<br><br>Note, that while test numbers continue between test parts, each test part is to be executed independently (Following Common Test Setup and Cleanup as indicated), and are not cascaded from the previous part. |
| **Possible Problems** | The **Possible Problems** section contains a description of known issues with the test procedure, which may affect test results in certain situations. |

## Common Interoperability Topology

TAR-Server1

Internet Service Provider

CE Router

DUT

## Test Specification Execution

When executing the test cases in this document, use the following steps:

1) Configure the CE Router to the default values unless the individual test case overrides the configuration.
2) During test execution use different CE Routers for interoperability partners. Use one CE Router for all the test cases in the document, calling this a round of interop. Then change CE Routers and execute all the test cases again, this would be Round 2.
3) CE Routers Interoperability partners should have multiple WAN access technologies such as DSL, DOCSIS, GPON, and Ethernet.
4) 10 Rounds of interop are recommended.

# Section 1: Physical

**Overview:** The tests in this group verify that the DUT properly supports protocols necessary to access the internet via the default settings on the CE Router.  This group is not specific to any particular hard wired connectivity media.

## Test IP.IOP.1.1: Ethernet Wired Connectivity

**Purpose:** Verify that the DUT achieves internet connectivity through a CE Router Ethernet interface.

**Test Setup:** The devices are setup according to Common Interoperability Topology.

**Procedure:**

### Part A: Establish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router Wireless LAN interface. | |
| 2. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

### Part B: Reestablish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 3. | Connect DUT to the CE Router LAN interface. | |
| 4. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |
| 5. | Disable the CE Router LAN interface. | |
| 6. | Enable the CE Router LAN interface. | |
| 7. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None

## Test IP.IOP.1.2: Wireless using No Security

**Purpose:** Verify that the DUT achieves internet connectivity through a CE Router Wireless LAN interface.

**Test Setup:** The devices are setup according to [Common Interoperability Topology](#).
Configure the Wireless LAN interface with the following settings.
   a. SSID = interop-none
   b. Channel = 11
   c. BeaconType = Basic
   d. BasicEncryptionMode = None
   e. BasicAuthenticationMode = None

**Procedure:**

### Part A: Establish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 2. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

### Part B: Reestablish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 8. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 9. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |
| 10. | Disable the CE Router Wireless LAN interface. | |
| 11. | Enable the CE Router Wireless LAN interface. | |
| 12. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None

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## Test IP.IOP.1.3: Wireless using WEP-64

**Purpose:** Verify that the DUT achieves internet connectivity through a CE Router Wireless LAN interface that is using WEP.

**Test Setup:** The devices are setup according to [Common Interoperability Topology](#).
Configure the Wireless LAN interface with the following settings.
- a. SSID – interop-wep-64
- b. Channel = 11
- c. WEPKeyIndex = 1
- d. BasicEncryptionModes = WEPEncryption
- e. BeaconType = Basic
- f. WEP key = 10-digit hexadecimal key to match on DUT and CPE.

**Procedure:**

### Part A: Establish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 2. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

### Part B: Reestablish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 3. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 4. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |
| 5. | Disable the CE Router Wireless LAN interface. | |
| 6. | Enable the CE Router Wireless LAN interface. | |
| 7. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None

## Test IP.IOP.1.4: Wireless using WEP-128

**Purpose:** Verify that the DUT achieves internet connectivity through a CE Router Wireless LAN interface that is using WEP.

**Test Setup:** The devices are setup according to <u>Common Interoperability Topology</u>. Configure the Wireless LAN interface with the following settings.

g. SSID – interop-wep-128
h. Channel = 11
i. WEPKeyIndex = 1
j. BasicEncryptionModes = WEPEncryption
k. BeaconType = Basic
l. WEP key = 13-digit hexadecimal key to match on DUT and CPE.

**Procedure:**

*Part A: Establish Connection*

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 8. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 9. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

*Part B: Reestablish Connection*

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 10. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 11. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |
| 12. | Disable the CE Router Wireless LAN interface. | |
| 13. | Enable the CE Router Wireless LAN interface. | |
| 14. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None

## Test IP.IOP.1.5: Wireless using WPA

**Purpose:** Verify that the DUT achieves internet connectivity through a CE Router Wireless LAN interface that is using WPA.

**Test Setup:** The devices are setup according to Common Interoperability Topology.
Configure the Wireless LAN interface with the following settings.
   a. SSID – interop-wpa
   b. Channel = 11
   c. WPAAuthenticationMode = PSKAuthentication
   d. BeaconType = WPA
   e. WPAEncryptionModes = TKIPEncryption
   f. WPAkey = to match on DUT and CPE.
**Procedure:**

*Part A: Establish Connection*

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 2. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

*Part B: Reestablish Connection*

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 3. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 4. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |
| 5. | Disable the CE Router Wireless LAN interface. | |
| 6. | Enable the CE Router Wireless LAN interface. | |
| 7. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None

## Test IP.IOP.1.6: Wireless using WPA2

**Purpose:** Verify that the DUT achieves internet connectivity through a CE Router Wireless LAN interface that is using WPA.

**Test Setup:** The devices are setup according to Common Interoperability Topology.
Configure the Wireless LAN interface with the following settings.

       g.   SSID – interop-wpa2
       h.   Channel = 11
       i.   WEPKeyIndex = 1
       j.   IEEE11iAuthenticationMode = PSKAuthentication
       k.   BeaconType = 11i
       l.   WPAEncryptionModes = AESEncryption

**Procedure:**

### Part A: Establish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 8. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 9. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

### Part B: Reestablish Connection

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 10. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 11. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |
| 12. | Disable the CE Router Wireless LAN interface. | |
| 13. | Enable the CE Router Wireless LAN interface. | |
| 14. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None

## Test IP.IOP.1.7: Wireless using Wi-Fi Protected Setup

**Purpose:** Verify that the DUT achieves internet connectivity through a CE Router Wireless LAN interface that is using Wi-Fi Protected Setup.

**Test Setup:** The devices are setup according to [Common Interoperability Topology](). Configure the Wireless LAN interface using the WPS button wireless authentication parameters.

**Procedure:**

### Part A: Establish Connection

| Step | Action | Expected Behavior |
|---|---|---|
| 1. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 2. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

### Part B: Reestablish Connection

| Step | Action | Expected Behavior |
|---|---|---|
| 3. | Connect DUT to the CE Router Wireless LAN interface using the settings in setup. | |
| 4. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |
| 5. | Disable the CE Router Wireless LAN interface. | |
| 6. | Enable the CE Router Wireless LAN interface. | |
| 7. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None

## Section 2: DHCP

**Overview:** The tests in this group verify that the DUT properly supports DHCP protocols necessary to access the internet via the default settings on the CE Router.

## Test IP.IOP.2.1: DHCP Lifetime

**Purpose:** Verify that the DUT achieves internet connectivity after a DHCP Renew event.

**Test Setup:** The devices are setup according to Common Interoperability Topology. Configure the Wireless LAN interface using the WPS button wireless authentication parameters.

**Procedure:**

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router LAN interface, acquire an address. | |
| 2. | Wait the address lifetime from Step 1. | |
| 3. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None.

## Test IP.IOP.2.2: DHCP Release

**Purpose:**  Verify that the DUT achieves internet connectivity after a DHCP Release event.

**Test Setup:**  The devices are setup according to Common Interoperability Topology.

**Procedure:**

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router LAN interface, acquire an address. | |
| 2. | Configure the DUT to perform a DHCP Release. | |
| 3. | Wait for the DUT to acquire an address. | |
| 4. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface.  Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:**  None.

## Test IP.IOP.2.3: DNS

**Purpose:** Verify that the DUT properly receives DNS thru DHCP.

**Test Setup:** The devices are setup according to Common Interoperability Topology.

**Procedure:**

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router LAN interface, acquire an address and a DNS server. | |
| 2. | Resolve the address of the TAR-Server1. | |
| 3. | Send application traffic from DUT to the address resolved in Step 2 on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None.

## Section 3: IPv6

**Overview:** The tests in this group verify that the DUT properly supports IPv6 protocols necessary to access the internet via the default settings on the CE Router.

## Test IP.IOP.3.1: IPv6

**Purpose:** Verify that the DUT achieves internet connectivity using IPv6.

**Test Setup:** The devices are setup according to [Common Interoperability Topology](). TAR-Server1 has both a A and AAAA record in DNS.

**Procedure:**

### Part A: Dual Stack

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router LAN network provisioned with both IPv4 and IPv6. | |
| 2. | Resolve the address of the TAR-Server1. | |
| 3. | Send application traffic from DUT to TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

### Part B: IPv6-only

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 4. | Connect DUT to the CE Router LAN network provisioned with IPv6-only. | |
| 5. | Resolve the address of the TAR-Server1. | |
| 6. | Send application traffic from DUT to TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None.

## Test IP.IOP.3.2: DHCPv6

**Purpose:** Verify that the DUT achieves internet connectivity after a DHCP Release event.

**Test Setup:** The devices are setup according to Common Interoperability Topology.

**Procedure:**

### Part A: DHCPv6 Lifetime

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 1. | Connect DUT to the CE Router LAN interface, acquire an IPv6 address using DHCPv6 | |
| 2. | Wait the address lifetime from Step 1. | |
| 3. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

### Part B: DHCPv6 Release

| Step | Action | Expected Behavior |
|------|--------|-------------------|
| 5. | Connect DUT to the CE Router LAN interface, acquire an address. | |
| 6. | Configure the DUT to perform a DHCP Release. | |
| 7. | Wait for the DUT to acquire an address. | |
| 8. | Send application traffic from DUT to a specified URL address on TAR-Server1. | Observe the traffic on the CE Router LAN interface. Verify the the DUT establishes a connection to TAR-Server1. |

**Possible Problems:** None.