IPv6 Test Service

IPv6-Only Network
Functional Test Plan
Phase 1

Technical Document

Version 1.0

University of New Hampshire
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Table of Contents

Acknowledgements

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Marion Dillon	University of New Hampshire
Michayla Newcombe	University of New Hampshire
Kyle Ouellette	University of New Hampshire
Timothy Winters	QA Café

References

The following documents are referenced in this text:

[NIST IPv6 Profile]   "NIST IPv6 Profile", NIST Special Publication (NIST SP) - 500-267Ar1, November 2020.
https://doi.org/10.6028/NIST.SP.500-267Ar1

[USGv6-R1]   "USGv6 Profile", NIST Special Publication (NIST SP) - 500-267Br1, November 2020.
https://doi.org/10.6028/NIST.SP.500-267Br1

[RFC 5952]   A Recommendation for IPv6 Address Text Representation. S. Kawamura,
M. Kawashima. August 2010.

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 Application properly functions on an IPv6-only network.

Scope:

The following tests verify the general functionality of a product in an IPv6-only network.

The NIST IPv6 Profile (500-267Ar1) defines an **IPv6-Only** product as capable of operating "in environments with no IPv4 capabilities (e.g., either IPv4 is not implemented or is administratively disabled)."

The IPv6-Only capability applies to a product as a whole in its primary role. Additional Application level testing may be warranted for products that serve as a platform to run one or more additional applications or services.

This Test Specification exercises a product to ensure support for the following functions: Installation, Upgrade/Update, Configuration, Management, Instrumentation.

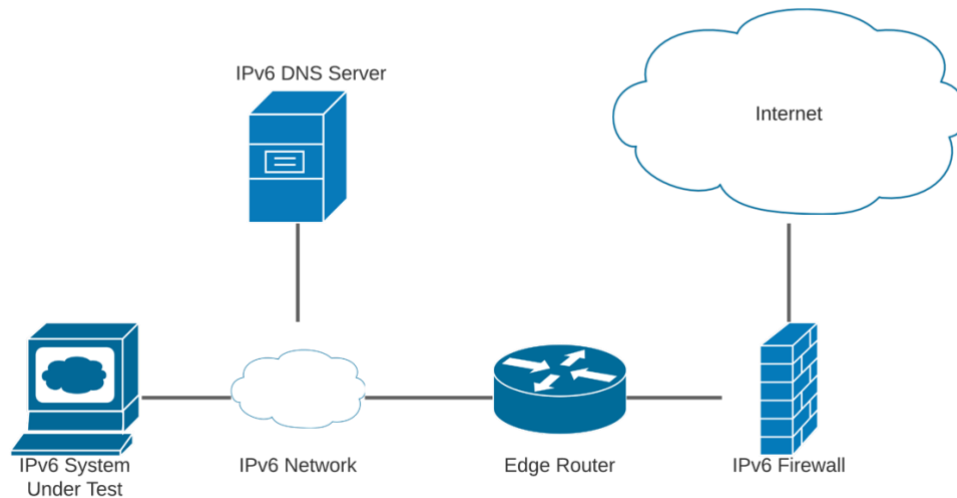**Phase 1:**

This test plan as written is intended to be an initial and minimum approach ("**Phase 1**") to testing and validating the IPv6-Only functionality. As IPv6 adoption and deployment grows, and IPv4 support dwindles, the importance of IPv6-Only functional parity will increase. As appropriate, more extensive and rigorous revisions of this testing in the form of additional Phases is expected.

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:
	    App.A.B
	
	Where each component indicates the following:
	    App – Test Suite Identifier
	    A – Group Number
	    B – Test Number
	
	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. 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 Topology

Test Specification Execution

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

1) The IPv6 Network MUST NOT be provisioned with any IPv4 services (e.g. DHCP).
2) IPv4 Capabilities MUST NOT be configured on any devices used for testing, and may be administratively disabled.
3) DNS Records used for testing have both IPv4 and IPv6 records.
4) The IPv6 DNS Server is configured either manually or automatically.

Section 1: Lifecycle Functionality

Overview

The product must support full product lifecycle functions (defined below) in an IPv6-only context. Note that often the product support functions below are often provided by additional applications or functions distinct from the main function of the product (e.g., installer applications, update applications, management applications for an OS). [Special Publication (NIST SP) - 500-267Ar1, Section 4.1.1]

IPv6-Only.1.1: Online Installation

Purpose: The product or service must be able to be instantiated and installed on nodes and in network environments that do not provide IPv4 services. Initial configuration of the product to a state where other remote services are operational, are part of the installation functions. [Special Publication (NIST SP) - 500-267Ar1, Section 4.1.1]

Applicable Product Types:
- Host, Router, NPP, Switch, Application

Prerequisites:
- Product Supports Online Installation
  - If the product is pre-installed, or comes as a complete software + hardware system, this test may be omitted.
  - If the product can be completely installed via offline means (e.g. ISO), this test may be omitted.

Test Evidence Collected: Collect applicable evidence as described below.
- Description of process and any User Intervention needed for network
- Installation URL, Commands, etc.
- Description of the use, input, or display, of IPv6 addresses.
- Screenshots as needed

Procedure:

Step	Action	Expected Observation
1.	Initiate Installation.	Installation starts successfully.
2.	Monitor Installation progress.	Installation completes successfully and according to supplier description.
3.	Observe use and display or input of network functions or configuration.	Any use of the network must function without error and any input or display of IPv6 Addresses must follow RFC 5952.

Possible Problems:

- None

IPv6-Only.1.2: Online Update

Purpose: All forms of product update functions (e.g., software, BIOS updates), both automated and user initiated, must be fully functional in IPv6-only environments. [Special Publication (NIST SP) - 500-267Ar1, Section 4.1.1]

Applicable Product Types:
- Host, Router, NPP, Switch, Application

Prerequisites:
- Product Supports Online Update
  - If the product can be completely upgrade via offline means (e.g. external storage), or if an upgrade file is provided through an IPv6-Only management interface, this test may be omitted.
  - If the product does not support online update, this test may be omitted.

Test Evidence Collected: Collect applicable evidence as described below.
- Description of process and any User Intervention needed for network
- Update URL, Commands, etc.
- Description of the use, input, or display, of IPv6 addresses.
- Screenshots as needed

Procedure:

Step	Action	Expected Observation
1.	Initiate Update.	Update starts successfully.
2.	Monitor Update progress.	Update completes successfully.
3.	Observe use and display or input of network functions or configuration.	Any use of the network must function without error and any input or display of IPv6 Addresses must follow RFC 5952.

Possible Problems:

- None

IPv6-Only.1.3: User Initiated Management/Monitoring Access

Purpose: All forms of remote management and monitoring functions must be fully functional in IPv6-only environments. [Special Publication (NIST SP) - 500-267Ar1, Section 4.1.1]

Applicable Product Types:
- Host, Router, NPP, Switch, Application

Prerequisites:
- Product Supports Remote Management
  - If the product does not support remote management (i.e. can only be managed via direct access through console, or is unmanaged) this test may be omitted.
  - If supported, Select from at least one of the following functions for remote management and monitoring: **SSH, Telnet, HTTP/HTTPS**.

Test Evidence Collected: Collect applicable evidence as described below.
- Description of Tested Management Method(s)
- Management Method, Commands, etc.
- Description of the use, input, or display, of IPv6 addresses.
- Screenshots as needed

Procedure:

Step	Action	Expected Observation
1.	Connect to the DUT.	Connection is established.
2.	If applicable, perform login function.	Access to the management functions of the device is granted.
3.	Navigate the management interface to confirm functionality. (e.g. Confirm version, IPv6 Address(es), etc.)	The management interface is navigable and responsive.

Possible Problems:

- If the Product does not support any of the specified user-initiated remote management functions, another may be substituted.

IPv6-Only.1.4: Device Initiated Management/Monitoring Functions

Purpose: All forms of remote management and monitoring functions must be fully functional in IPv6-only environments. [Special Publication (NIST SP) - 500-267Ar1, Section 4.1.1]

Applicable Product Types:
- Host, Router, NPP, Switch, Application

Prerequisites:
- Product Supports Remote Management
  - If the product does not support remote management (i.e. can only be managed via direct access through console, or is unmanaged) this test may be omitted.
  - If supported, Select from at least one of the following functions for device-initiated remote management and monitoring: **SNMP, NETCONF, Email**.

Test Evidence Collected: Collect applicable evidence as described below.
- Description of Tested Management Method(s)
- Management Method, Commands, etc.
- Description of the use, input, or display, of IPv6 addresses.
- Screenshots as needed

Procedure:

Step	Action	Expected Observation
1.	Configure the DUT with a target for monitoring.	Configuration is accepted.
2.	Following procedures provided by supplier, initiate action to cause the device to emit an alert.	Device successfully emits alert and the alert is consumed by the target.

Possible Problems:

- If the Product does not support any of the specified device-initiated remote management functions, another may be substituted.

IPv6-Only.1.5: User Interface

Purpose: All forms of interactive access to the product (e.g., web-based interfaces or APIs) must fully support the use of IPv6 and IPv6 addresses of all forms. If the product displays IP addresses, then IPv6 addresses must be displayed according to [RFC5952]. [Special Publication (NIST SP) - 500-267Ar1, Section 4.1.1]

Applicable Product Types:
- Host, Router, NPP, Switch, Application

Prerequisites:
- Product Supports Interactive User Access
  - If the product does not support an interactive method for access, this test may be omitted.

Test Evidence Collected: Collect applicable evidence as described below.
- Description of Tested Interface(s)
- Input/Display Location, Commands, etc.
- Description of the use, input, or display, of IPv6 addresses.
- Screenshots as needed

Procedure:

Part A: IPv6 Address Display

Step	Action	Expected Observation
1.	Navigate to a function for displaying the product's assigned IPv6 Addresses.	
2.	Observe Link-local IPv6 Address.	The observed address is displayed in a text format per RFC 5952, section 4.
3.	Observe Global IPv6 Address.	The observed address is displayed in a text format per RFC 5952, section 4.

Part B: IPv6 Address Input

Step	Action	Expected Observation
4.	Navigate to a function for performing an ICMPv6 Informational Echo Request diagnostic.	
5.	Enter the invalid IPv6 link-local address that is too long: `FE80:0:0:0::1:2:3:4:5:6`	Observe that the address is not accepted.
6.	Enter the invalid IPv6 address that contains characters that are invalid: `FE80::AB:CD:EF:GH`	Observe that the address is not accepted.
7.	Enter the invalid IPv6 address with more "::" than are allowed in RFC 5952: `FE80::1000::2000`	Observe that the address is not accepted.
8.	Enter the invalid IPv6 global address that is too long: `2001:2:0:1:2:3:4:5:6`	Observe that the address is not accepted.
9.	Enter the invalid IPv6 address that contains characters that are invalid: `2001:2:0:AB:CD:EF:G:H`	Observe that the address is not accepted.
10.	Enter the invalid IPv6 address with more "::" than are allowed in RFC 5952: `2001:2::1000::1000`	Observe that the address is not accepted.
11.	Enter a valid link-local IPv6 address assigned to a different device on the IPv6-Only network and perform the diagnostic.	Observe that the application displays the value entered and performs the diagnostic.
12.	Enter a valid global IPv6 address assigned to a different device and perform the diagnostic.	Observe that the application displays the value entered and performs the diagnostic.
13.	Enter a valid FQDN which has a AAAA (IPv6) record assigned to a different device and perform the diagnostic.	Observe that the application displays the value entered and performs the diagnostic.

Possible Problems:

- Part A: If the product does not have a mechanism for displaying the currently assigned IPv6 address(es), this part may be omitted or substituted for another mechanism that displays IPv6 addresses.
- Part B: A device may not accept link-local addresses in some situations, or an interface may need to be specified.
- Part B: A device may not have a diagnostic interface for transmitting ICMPv6 Echo Requests. In this case, a different interface may be utilized as available for this test, or this test may be omitted.

IPv6-Only.1.6: Logging

Purpose: All forms of interactive access to the product (e.g., web-based interfaces or APIs) must fully support the use of IPv6 and IPv6 addresses of all forms. If the product displays IP addresses, then IPv6 addresses must be displayed according to [RFC5952]. [Special Publication (NIST SP) - 500-267Ar1, Section 4.1.1]. Representation of IPv6 Literals in Logs according to [RFC5952] are of particular importance to enable searching and efficient user review.

Applicable Product Types:
- Host, Router, NPP, Switch, Application

Prerequisites:
- Product Supports Logging Functionality
  - If the product does not support logging, or logs are not accessible to end-user/administrator, this test may be omitted.
- Product Supports IP Enabled Remote Logging
  - If the product does not support IP Enabled Remote Logging, Part B may be omitted.

Test Evidence Collected: Collect applicable evidence as described below.
- Description of Logging Function
- Logging Location, Commands, etc.
- Description of the use, input, or display, of IPv6 addresses.
- Screenshots as needed

Procedure:

Part A: Logs viewable locally by User/Administrator

Step	Action	Expected Observation	Evidence Collected
1.	Locate a mechanism for viewing Logs, or where IPv6 addresses are logged.		Description of location and screenshots as needed.
2.	Observe Link-local IPv6 Addresses.	Observed addresses are displayed in a text format per RFC 5952, section 4.	Description of the process and screenshots as needed.
3.	Observe Global IPv6 Addresses.	Observed addresses are displayed in a text format per RFC 5952, section 4.	Description of the process and screenshots as needed.

Part B: IP Enabled Remote Logging

Step	Action	Expected Observation	Evidence Collected
4.	Configure the device for remote logging over IPv6.		Description of location and screenshots as needed.
5.	Enter the valid IPv6 address of a valid IPv6 Destination Server capable of receiving the logs.	Observe that logs are correctly transmitted to the Remote Logging Server.	Description of the process and screenshots as needed.
6.	Observe Link-local IPv6 Addresses in the collected logs on the Remote Logging Server.	Observed addresses are displayed in a text format per RFC 5952, section 4.	Description of the process and screenshots as needed.
7.	Observe Global IPv6 Addresses in the collected logs on the Remote Logging Server.	Observed addresses are displayed in a text format per RFC 5952, section 4.	Description of the process and screenshots as needed.

Possible Problems:

- It may not be possible to cause a device to generate a log that contains an IPv6 address. If no IPv6 addresses are displayed, steps requiring the tester to observe addresses may be omitted.

Modification Record

Version	Date	Editor	Modification
1.0	2022-01-31	Timothy Carlin	• Typos and bug fixes
0.4	2021-12-16	Timothy Carlin	• 1.2 - Specify "offline" exception as with 1.1 • 1.2 – Specify file upload as exception • 1.5B – Add steps to test invalid IPv6 link-local addresses • 1.5B – Clarify that Valid link-local and valid global addresses should be assigned to devices different from the DUT • 1.5B – Add FQDN Diagnostic
0.3	2021-08-30	Timothy Carlin	• Specify functions to be tested
0.2	2021-05-20	Timothy Carlin	• Updates following internal review • Added Logging Tests
0.1	2021-01-20	Timothy Carlin	• Initial Version