

Best Practices to Accelerate IPv6 Migration Testing

With the inevitable exhaustion of IPv4 addresses sometime over the next 1-2 years and after more than a decade of pilots, trials and test runs, IPv6 is finally here.

The “killer app” for IPv6 is the Internet. IP technology is pervasive; it has spread into every conceivable network environment, including Internet backbones, mobile carrier networks, enterprise networks, smart grids, industrial control systems, and cloud computing. Without IPv6, the Internet’s growth will stop next year. IPv6 provides expanded addressing capability, enhanced network security, and mobile routing support, but at the end of the day, what it really does is provide a foundation for the continuing growth of the Internet.

The U.S. government has taken a proactive role in moving the adoption of IPv6 forward. From July 1st 2010, all networking infrastructure procurements must be in compliance with the requirements of the NIST USGv6 Test Program. In order to do that, equipment manufacturers need to get their respective products certified as “IPv6 Ready”, which means they are certified for IPv6 conformance, interoperability and network protection testing. The NIST USGv6 Test Program defines the mandatory IPv6 capabilities and configuration options for hosts, routers and network protection devices. Achieving USGv6 certification is no easy task. It means passing more than 450 tests that vet core IPv6 functionality as well as specific tested capabilities for IPsec, including IKEv2, DHCPv6, and other key protocols.

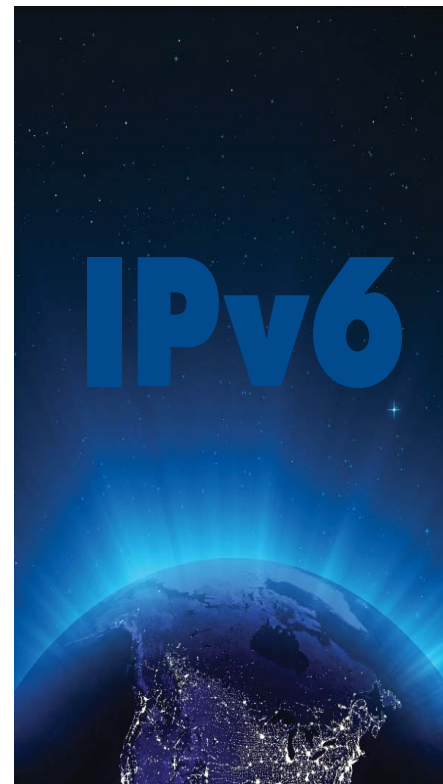
IPv6 Migration Testing Challenges

Since IPv6 introduces a completely new way of addressing endpoints in a network, IPv6 migration has ramifications from the network layer all the way up through the application layer.

- Applications using protocols such as HTTP and SIP that embed IP addresses must be thoroughly tested since they will be impacted by IPv6.
- Interoperability testing is needed to ensure that new and existing applications and services can support both IP versions and all the numerous permutations.
- Networking infrastructure, such as security gateways and deep packet inspection systems, must be tested for security and resilience to ensure attacks over IPv6 are detected and handled.
- Back-end databases and other systems that allow networks to be managed and provisioned must be updated to handle IPv6 addresses. It is critical to test these systems prior to the first IPv6-related change to the live network.

Furthermore, organizations will find that testing needs are ongoing, as IPv4 and IPv6 will likely coexist for many years to come.

Developing internal test cases or relying on static tests tools will not be sufficient because of the extensive time and labor requirements – a luxury few organizations have in today’s highly competitive market. Network equipment manufacturers (NEMs) and service providers must effectively manage the IPv6 testing and certification process with limited resources.



Best Practices to Accelerate IPv6 Migration Testing

- 1. Implement a testing strategy that leverages your IPv4 Packet Captures to speed up migration validation.*
- 2. Utilize automation to simplify and accelerate interoperability testing.*
- 3. Be proactive in IPv6 security and resilience testing.*
- 4. Crowd-source and tap into greater testing community.*

Mu Dynamics Best Practices for IPv6 Migration Testing

In working with closely with customers and partners, Mu Dynamics developed four best practices for IPv6 migration testing. By following these recommendations, NEMs and service providers can release products and services with the highest quality, as quickly as possible and at the lowest cost, which allows them to achieve their time-to-market and business goals. They can also improve the likelihood of achieving compliance with the USGv6 Test Program.

Here are four best practices for IPv6 migration testing.

1

Implement a Testing Strategy that Leverages Your IPv4 Packet Captures to Speed up Migration Validation

Challenge

It's not sufficient to count support for IPv6 at the transport layer as "ready," because IP addresses are embedded across many layers and protocols such as SIP, HTTP and SMTP. Therefore, applications must be re-tested over IPv6 to verify that they will work completely in native IPv6 and dual-stack environments.

For example, a VoIP call will fail if IPv6 is supported only at the transport layer. Many IPv4 products and services require new code to support IPv6, and this new software must be tested thoroughly to verify that it will work correctly in native IPv6 and dual-stack environments. Also, the variety of operating systems that might connect to the network will all behave differently when operating in both IPv4 and IPv6 environments. Key elements such as domain name resolution need to be thoroughly tested as all applications depend on this service working flawlessly.

Mu Dynamics Recommendation

Vendors and operators should take full advantage of their existing IPv4 test assets and IPv4 packet capture (pcap) library to reduce the time to test and improve test coverage during IPv6 migration testing. Without the ability to reuse existing assets, IPv6 testing literally doubles the workload.

The Mu Test Suite for IPv6 leverages customers' own traffic captures that represent their own properly functioning IPv4 services, which makes it straightforward for test engineers to extend their IPv4 test cases to test IPv6. For example, engineers who are testing the functionality of SIP phones in an IPv6 network can use Mu to emulate IPv4 and IPv6 traffic flows to call manager servers running on IPv4 and IPv6 segments. By leveraging their existing IPv6 test assets in an IPv6 network, they can identify application-level failures and improper or illegal translations that could impact functionality prior to product release or service deployment.

Taking a data-driven testing approach allows testers to rapidly generate thousands of test cases that comprehensively test the complex interactions of a unique IP product or service. The ability to leverage test assets from other teams allows engineers to test rapidly and more thoroughly, thereby improving test coverage.

Mu makes it easy to reuse existing test assets. In fact, test teams can migrate IPv4 test cases to IPv6 with a simple drop-down selection on the Mu software. Testers can also tap into millions of packets and hundreds of protocols on www.pcapr.net, thus leveraging the power of the NGN testing community.

2

Utilize Automation to Simplify and Accelerate Interoperability Testing

Challenge

IPv6 products and services rely on dozens of IETF RFCs. Implementing products and services predicated on such a large and complex number of standards is fertile ground for interoperability issues and implementation errors. Manufacturers and operators

Challenges of IPv6 Migration Testing

- *Current applications and services must be re-tested in both native IPv6 and dual-stack environments to verify that they continue to function as expected.*
- *Applications and services must be tested to ensure interoperability across multiple IP versions.*
- *Networking infrastructures must be secure and resilient, ensuring that IPv4-based attacks cannot bypass their defenses by delivering the IPv4-based attacks over IPv6.*

must ensure that their applications and services will interoperate in IPv6 and with the multiple IPv4 to IPv6 transition strategies. For instance, a service provider must verify that its IPv6 routers will work flawlessly in both IPv6 segments as well as tunneled environments.

Mu Dynamics Recommendation

Operators and vendors should take advantage of automated testing to simplify the massive challenge of interoperability testing in native and mixed networks. A manual approach to testing simply won't scale to the requirements.

The ideal way to accurately and rapidly test network components in native and dual-stack environments is to use realistic, stateful recreations of IPv4 and IPv6 flows. Testing teams can use the Mu solution to emulate routers, intrusion detection systems (IDS), firewalls, hosts, clients, and many other network elements, which saves significant time and money because technical staff doesn't need to set up and run large, multivendor test labs. The Mu solution emulates complex network configurations, including 6over4, ISATAP, 6to4, and Teredo tunneling, in a stateful manner. With its multi-host simulation ability, Mu can act as client, client and server, or even multiple clients and servers to test intermediate devices.

NEMs and service providers should take advantage of automation capabilities to significantly minimize manual setup of third-party client devices and versions in interoperability labs. By automating as much as possible during regression runs, large numbers of clients can be tested efficiently. To seamlessly integrate Mu into your existing test harness, Mu provides a powerful remote automation API. We also recommend mastering the usage of Mu Scenario Templates, because they can be shared and reused across different teams within the organization, which helps you scale test efforts with diminishing resources.

3 Be Proactive in IPv6 Security and Resilience Testing

Challenge

While IPv6 is more secure by design (in theory, since it mandates that IPsec be incorporated in IPv6 implementations), security and resilience nevertheless must be proven in the real world. IPv6 security is very different than IPv4, especially for security devices such as firewalls and IDS. During the migration phase, not all firewalls or IDS may be IPv6-capable, which creates additional security risks from unwanted traffic from the Internet. It is imperative that vendors and operators thoroughly test their solutions for weaknesses to mitigate the impact of IPv4 attacks in an IPv6 environment and to protect against emerging IPv6 attacks and exploits.

Mu Dynamics Recommendation

NEMs and service providers can comprehensively test for weaknesses that may lead to security or reliability issues by taking a unified approach to all phases of testing. For example, reusing the assets from functional testing for security testing will deliver greater test coverage with higher accuracy. By launching known vulnerabilities over either IPv4 or IPv6, testers can understand the impact of known exploits and vulnerabilities over IPv6 and IPv6-over-IPv4 tunnels. Auto-generating fuzz tests using malformed packets and unexpected responses helps pinpoint weaknesses in the IPv6 service or product prior to release.

NEMs and operators can improve the security and resilience of native IPv6 and transitional systems with the Mu Test Suite. With Mu, any IP protocol can be fuzz-tested over IPv6 to determine the resilience of the protocol in the new environment. Development and QA engineers can test error-handling routines and the behavior of products in the face of unexpected inputs. Mu auto-generates stateful fuzz tests cases from actual pcaps from production environment or by following the protocol standards. Leveraging the Mu solution, testers can drive their application logic in a stateful manner, and then use Mu's mutation library to test the product's resilience in the face of malformed packets and proactively expose any hidden weaknesses in IPv6 code.



As an accredited laboratory in delivering IPv6 testing for the USGv6 Test Program, and leveraging our extensive experience in managing the IPv6 Ready Logo program, the University of New Hampshire InterOperability Lab is using Mu's Test Suite to deliver automated testing for network protection devices.

“With an impending deadline of July 1 that requires all government agencies to acquire networking equipment that is USGv6 certified, the Mu Test Suite helps us automate tests that otherwise would have needed to be performed manually, saving us precious time.”

Erica Johnson, Director of InterOperability Lab, University of New Hampshire

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Crowd-source and Tap into Greater Testing Community

Challenge

Learning network analysis can be a tedious process and even skilled network technicians run into time-consuming problems. Leveraging the collective knowledge of the NGN service testing community reduces the time needed to test and accelerates the time to market.

Mu Dynamics Recommendation

Unleash the power of your packets and leverage the community of IP service testing experts with Mu Dynamics [pcapr](#) and [xtractr](#). pcapr is the largest crowd-sourced packet capture repository in the world, with more than 59 million packets and over 400 protocols. At this open site, network engineers and testers have access to a wealth of useful tools and utilities, including an IPv4-to-IPv6 packet converter. With the vast resources of pcapr at their fingertips, testers can build customized, open source test cases for the Mu Test Suite in hours.

The pcaps have powerful manipulation capabilities that lead to significant efficiencies and customizations. The pcaps are fully decoded and editable. Testers can identify, isolate or decode streams. They can remove extraneous packets from protocols that they're interested in, reorder packets, and save a subset or modify pcaps. They can also upload their own local pcaps for analysis.

xtractr is a collaborative cloud application that provides test engineers with the ability to index, search, extract and report on packet captures. With xtractr, testers can take huge packet captures and classify them into smaller parts, while also sharing their troubleshooting queries with the community. Using xtractr reduces the effort needed to troubleshoot network problems, isolate network problems and conduct network forensics.

Getting Started

Avoid IPv6 migration nightmares and integration challenges and gain control of skyrocketing costs by following best practices for IPv6 migration testing and taking a unified approach to testing with Mu Dynamics' IPv6 testing solution. Mu reduces the time required to test by making it easy to create and execute IPv6 migration tests, simplifies interoperability testing through intelligent automation, and improves the resilience and security of native IPv6 and transitional systems.

About Mu Dynamics

Mu Dynamics' adaptive approach to testing Next-Generation Network (NGN) services enables customers to dramatically reduce the time to test and deliver higher quality IP services. Mu's unique approach uses service traffic from a customer's environment as the basis for the testing solution, enabling the rapid generation of test cases that accurately and thoroughly test customer's services as a single system - both at the application and infrastructure level. Since its inception, Mu's focus has been to drive the complexity out of NGN services testing for its customers.

Founded in 2005, Mu today has over 100 deployments including within the top five global service providers, the top five networking technology companies, and numerous government agencies. The Mu Test Suite has received many industry awards for product innovation and is quickly becoming the test solution of choice at leading IP services labs worldwide.

Headquartered in Sunnyvale, California, more information on Mu's products, solutions, and customers are online at <http://www.mudynamics.com>.



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