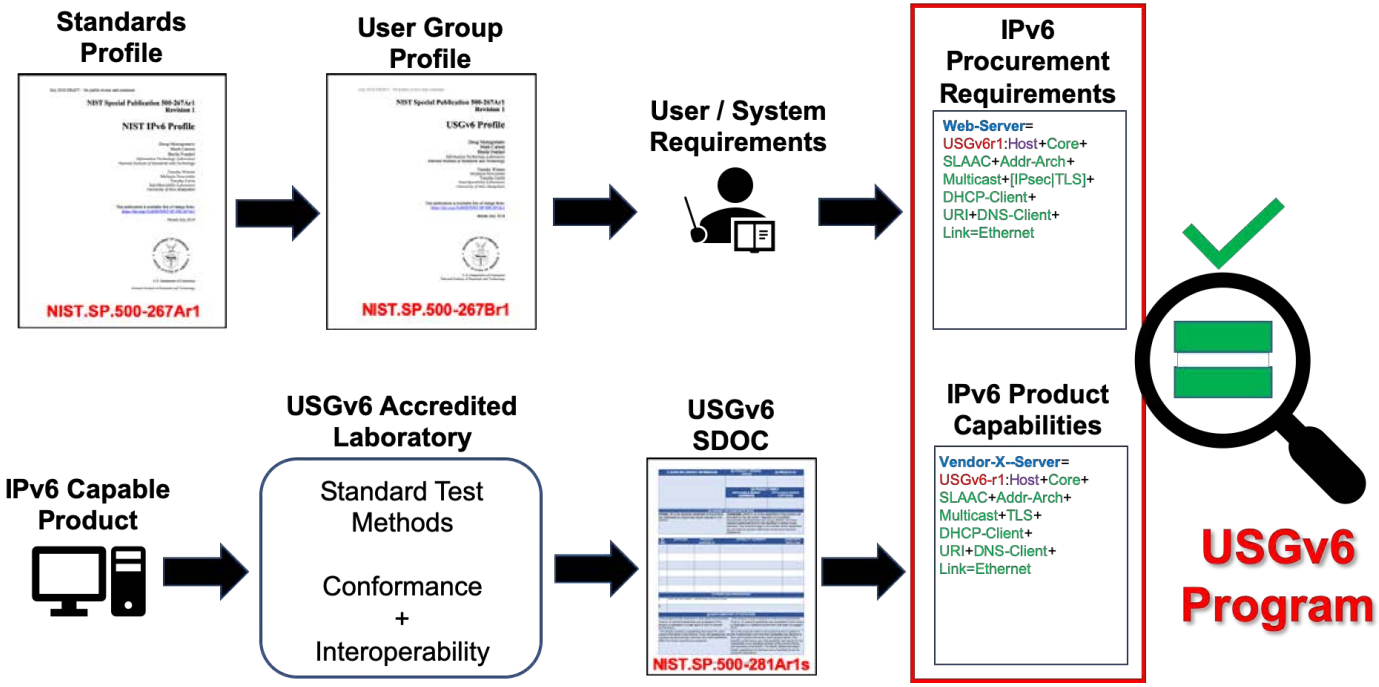
USG IPv6 Initiative

Completing the Transition to IPv6-Only Networks

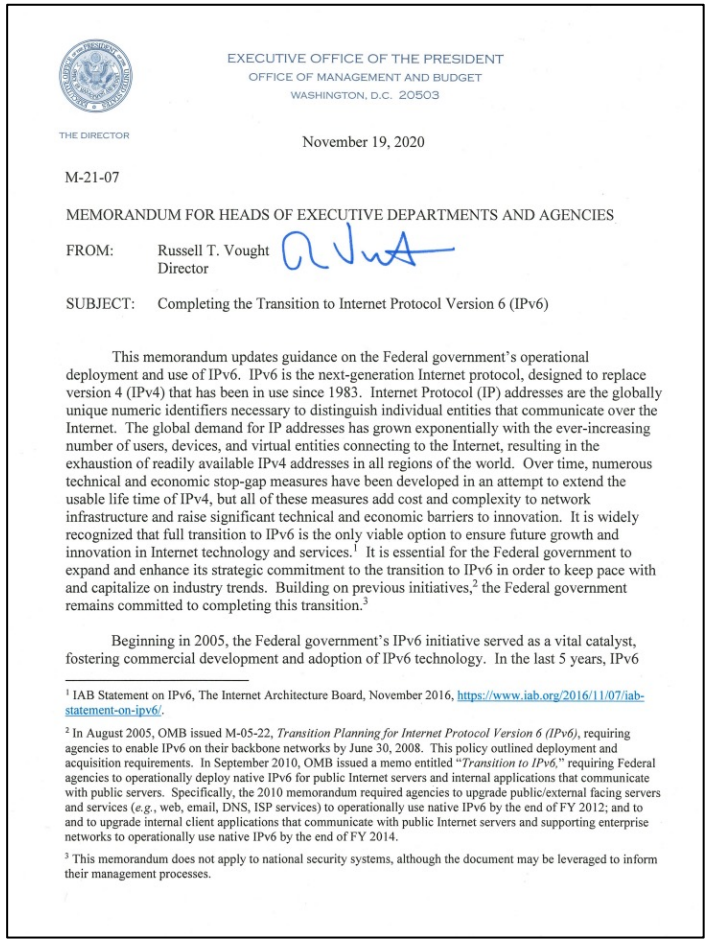


Doug Montgomery / NIST / USGv6 Program Manager. (dougm@nist.gov)

https://www.nist.gov/programs-projects/usgv6-program

USG Transition to IPv6-Only Networks

- **Completing the USG Transition to IPv6**
  - https://www.whitehouse.gov/wp-content/uploads/2020/11/M-21-07.pdf
  - ***"The strategic intent is for the Federal government to deliver its information services, operate its networks, and access the services of others using only IPv6"***
  - *At least 20% IPv6-only by the end of FY 2023*
  - *At least 50% IPv6-only by the end of FY 2024*
  - *At least 80% IPv6-only by the end of FY 2025*
  - *Identify and justify Federal information systems that cannot be converted to use IPv6 and provide a schedule for replacing or retiring these systems;*



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

THE DIRECTOR

November 19, 2020

M-21-07

MEMORANDUM FOR HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Russell T. Vought
Director

SUBJECT: Completing the Transition to Internet Protocol Version 6 (IPv6)

This memorandum updates guidance on the Federal government's operational deployment and use of IPv6. IPv6 is the next-generation Internet protocol, designed to replace version 4 (IPv4) that has been in use since 1983. Internet Protocol (IP) addresses are the globally unique numeric identifiers necessary to distinguish individual entities that communicate over the Internet. The global demand for IP addresses has grown exponentially with the ever-increasing number of users, devices, and virtual entities connecting to the Internet, resulting in the exhaustion of readily available IPv4 addresses in all regions of the world. Over time, numerous technical and economic stop-gap measures have been developed in an attempt to extend the usable life time of IPv4, but all of these measures add cost and complexity to network infrastructure and raise significant technical and economic barriers to innovation. It is widely recognized that full transition to IPv6 is the only viable option to ensure future growth and innovation in Internet technology and services.[1] It is essential for the Federal government to expand and enhance its strategic commitment to the transition to IPv6 in order to keep pace with and capitalize on industry trends. Building on previous initiatives,[2] the Federal government remains committed to completing this transition.[3]

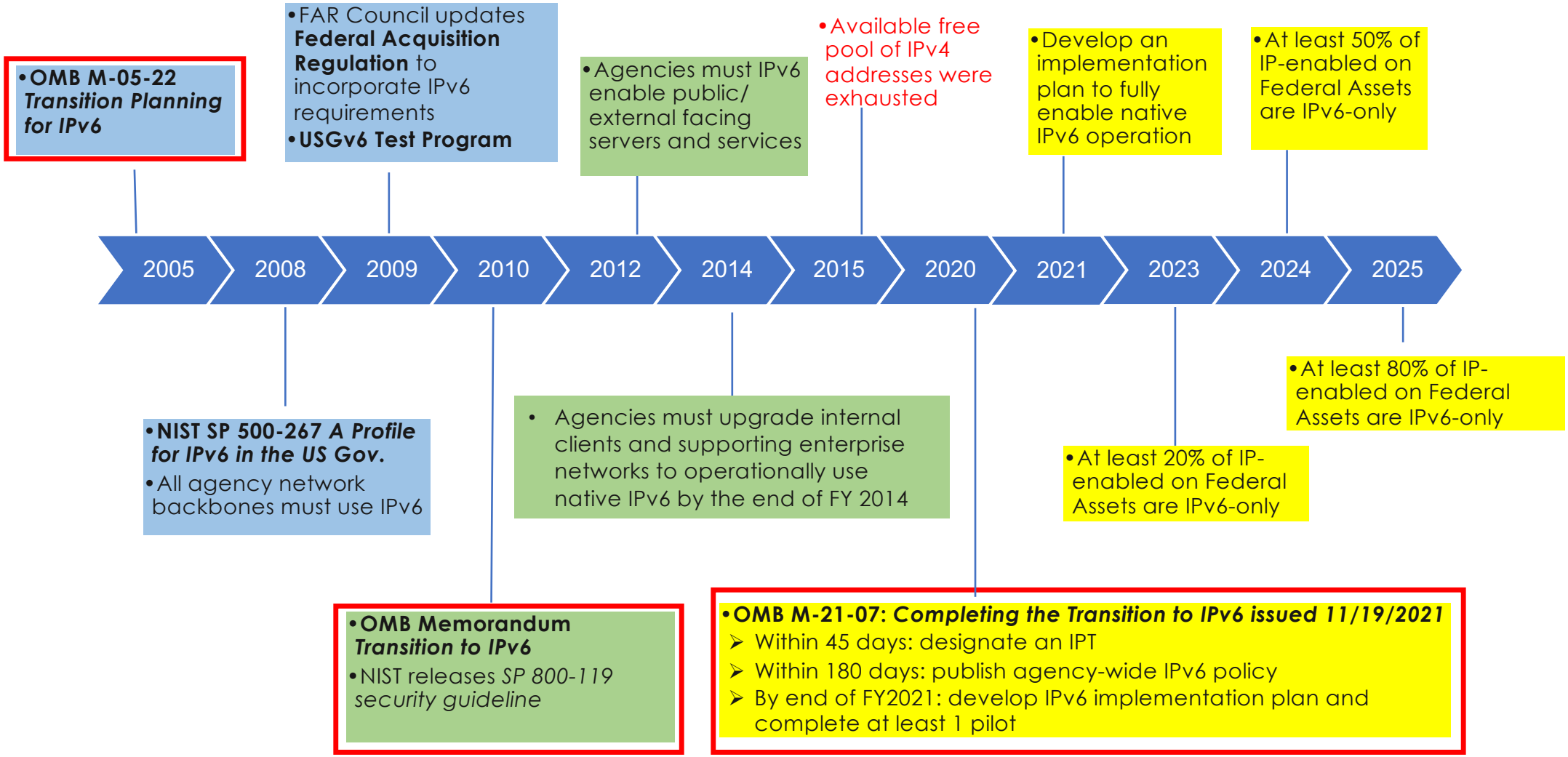
Beginning in 2005, the Federal government's IPv6 initiative served as a vital catalyst, fostering commercial development and adoption of IPv6 technology. In the last 5 years, IPv6

[1] IAB Statement on IPv6, The Internet Architecture Board, November 2016, https://www.iab.org/2016/11/07/iab-statement-on-ipv6/.

[2] In August 2005, OMB issued M-05-22, *Transition Planning for Internet Protocol Version 6 (IPv6)*, requiring agencies to enable IPv6 on their backbone networks by June 30, 2008. This policy outlined deployment and acquisition requirements. In September 2010, OMB issued a memo entitled "*Transition to IPv6*," requiring Federal agencies to operationally deploy native IPv6 for public Internet servers and internal applications that communicate with public servers. Specifically, the 2010 memorandum required agencies to upgrade public/external facing servers and services (*e.g.*, web, email, DNS, ISP services) to operationally use native IPv6 by the end of FY 2012; and to and to upgrade internal client applications that communicate with public Internet servers and supporting enterprise networks to operationally use native IPv6 by the end of FY 2014.

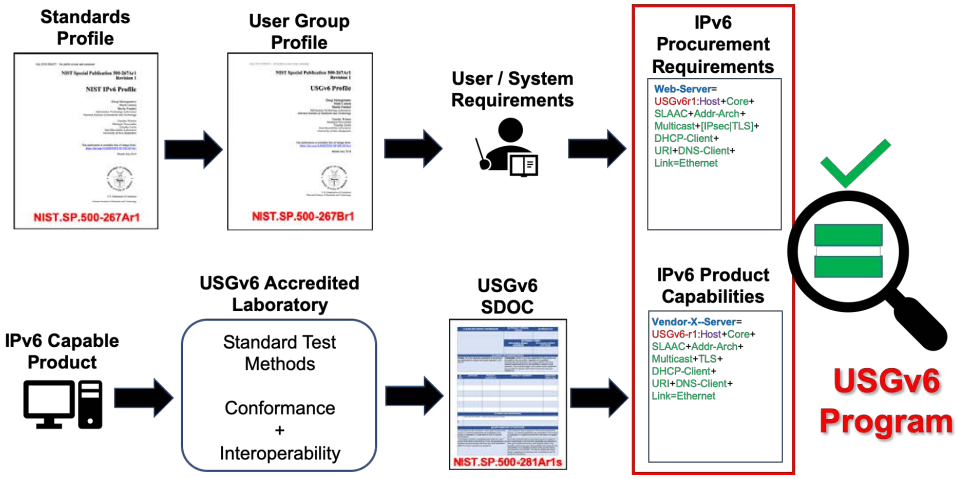
[3] This memorandum does not apply to national security systems, although the document may be leveraged to inform their management processes.

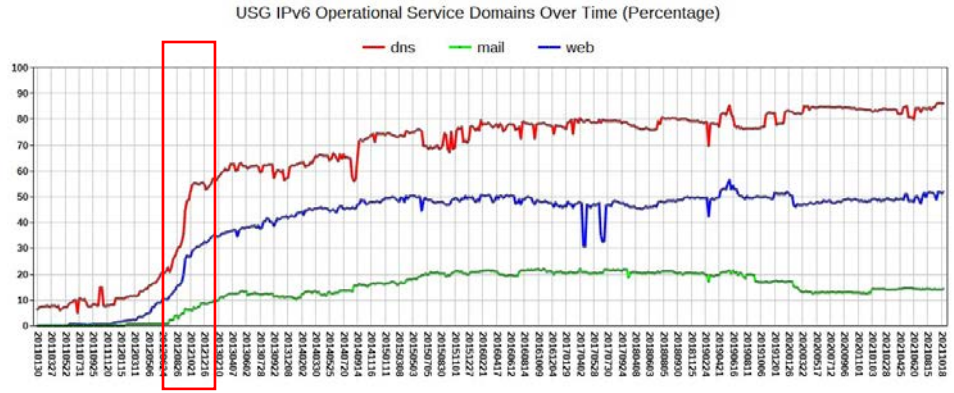
USG IPv6 Policy Timeline



Policy Lessons Learned

- **Common Acquisition Requirements Drive Industry Advancement**
  - Common requirements across large user groups have greater impact.
- **Standards Profiles and Product Testing Protects Investments**
  - Programs must be simple enough to be used in acquisitions while insuring the completeness, correctness and interoperability of IPv6 products.
  - Programs should minimize testing burden on vendors.
- **Specific Milestones and Measurable Metrics Drives Deployment**
  - Continuous test and measurement facilitates deployment.
  - Automated policy metrics motivates progress towards milestones.





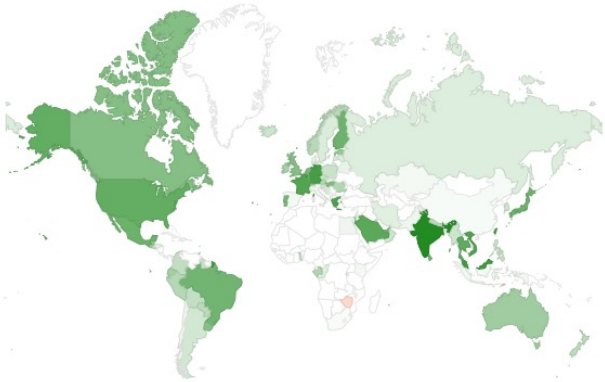
https://fedv6-deployment.antd.nist.gov/

Why Complete the Transition to IPv6?

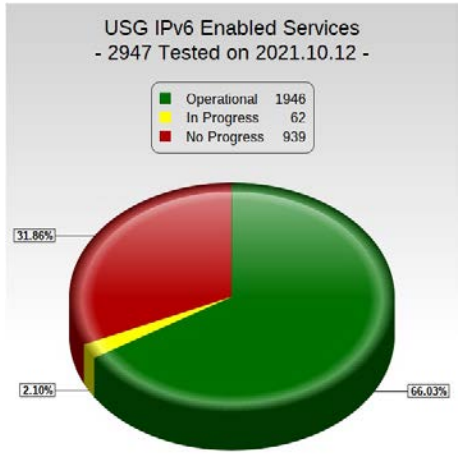
- **Enable Internet growth and innovation.**
  - **Remove technical and economic barriers to innovation.**
  - **Provide a modern network protocol as the global barer service for interoperability.**
- **Ensure Internet security and stability.**
  - The use of globally unique network addresses significantly improves the effectiveness of today's network defense technologies and cyber forensics.
  - IPv6 and its vast address space enables innovation in network security technologies.
- **Reduce cost and complexity in networks.**
  - Engineering around address exhaustion has had a significant impact on protocol design and system architectures for years.

Why Now?

- **In short, it is doable and needs to be done.**
  - Significantly easier than in 2010.
- **Significant advances in both the state of technology and deployment of IPv6 over the last 10 years.**
  - Major operating systems include mature IPv6 implementations.
  - Major ISPs and service providers have IPv6 services.
- **IPv6 deployment and use is growing throughout the Internet.**
  - Various measurement efforts (with differing techniques) show significant growth in IPv6 adoption and use
  - USG agencies have gained operational IPv6 deployment experience over the last 10 years.
- **Industry and Governments aligned on strategic direction.**
  - Numerous large enterprises, service providers, governments / DoD have stated plans to migrate to IPv6-only environments in the next 5-10 years.



https://www.google.com/intl/en/ipv6/



https://fedv6-deployment.antd.nist.gov/

Why IPv6-Only?

- **Ubiquitous dual-stack networking is a necessary transition phase in IPv6 deployment …**
  - … but it is not designed, nor desired, to be a final state.
- **Why would you operate two protocol stacks if you did not have to?**
  - Reduce cost, complexity, and attack surfaces
- **Commercial implementations of scalable transition mechanisms are readily available.**
- **Getting to IPv6-only networks will require work in some areas.**

USG IPv6 Initiative - FAQs

- **How do we define and measure "IPv6-Only"?**
  - M-21-07 is clear about the intent.
  - The technical details still remain a bit uncertain.
    - IPv4 not present in product?
    - IPv4 administratively disabled?
    - IPv4 not provisioned with address?
    - IPv4 native and tunneled blocked by the network?
  - How to will we measure progress against the milestones?
    - Metrics need to be meaningful, automated and scalable
- **IPv6-Only in cloud / shared services?**
  - What does it mean for a cloud service to be IPv6-Capable, IPv6-Enabled, IPv6-Only?
  - How to test could IPv6 capabilities?
- **Interaction with other policies?**
  - Zero trust networks
  - Trusted Internet connections
  - Continuous Diagnostics and Mitigation
  - ….

Summary of USG Initiative Status

75% of CFO Act agencies have chartered an IPv6 Integrated Project Team (IPT)

83% of CFO Act agencies, with chartered IPTs, have a publicly-available IPv6 Policy

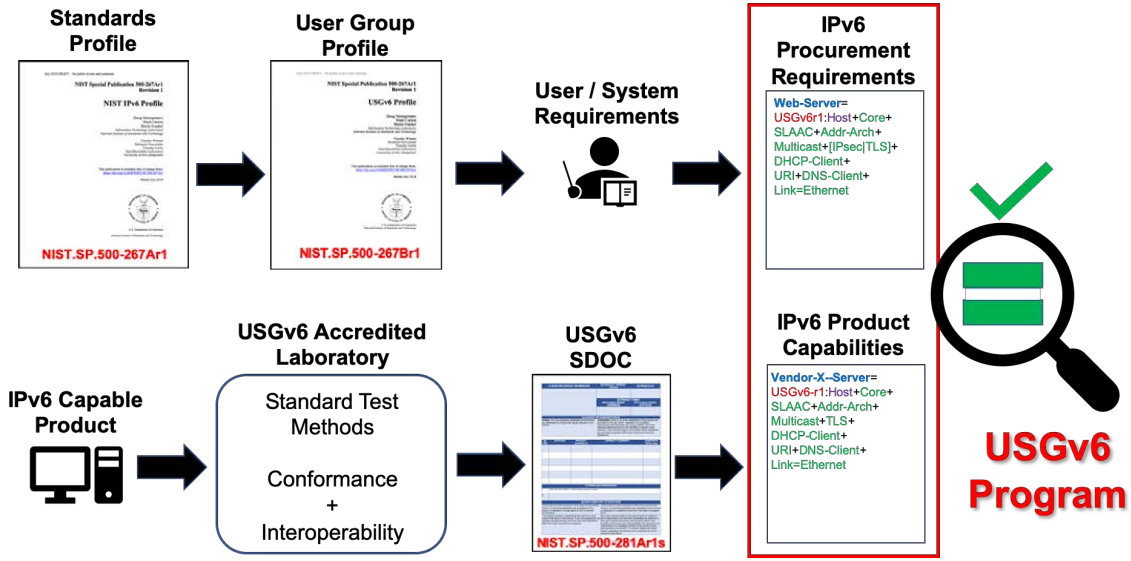
54% of CFO Act agencies have an identified IPv6 Pilot

71% of CFO Act agencies have completed an Implementation Plan

USGv6 Profile & Test Program

USGv6 Profile and Test Program

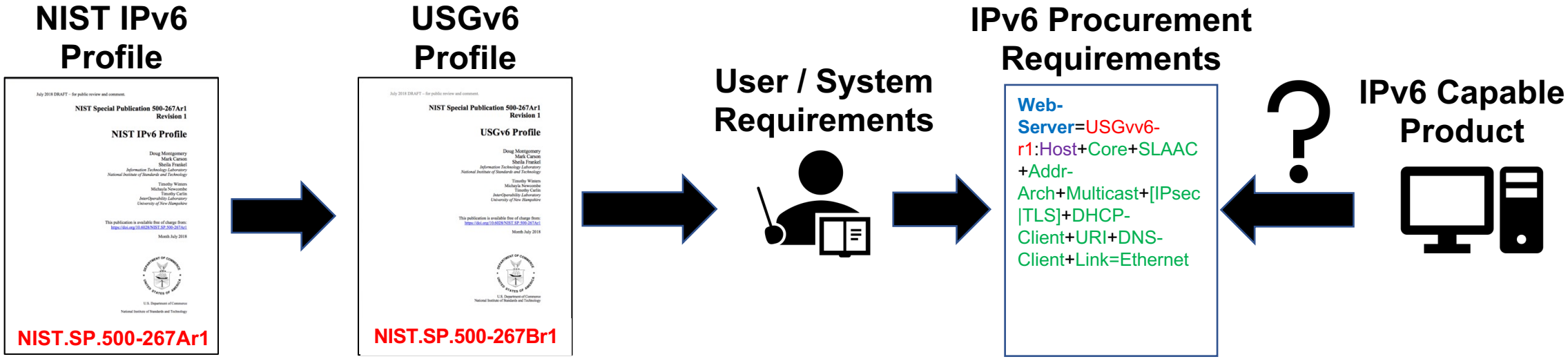
- **How to evolve IT infrastructure?**
  - Establish policies to always buy IPv6-capable products / services.
    - Long term, proactive tech refresh cycles.
- **How to define IPv6-capable?**
  - Establish means for specifying detailed IPv6 capability requirements in individual procurements.
- **How to protect IPv6 investments?**
  - Establish means to test vendor products against requirements statements.
    - Conformance, Interoperability, and Functional tests to insure completeness, correctness and interoperability.



USGv6 Profile: IPv6 Capability Vocabulary

- **<Label>=Profile:<Host|Router|NPP>+<Capabilities>**
  - Capability Summary String (CSS) – Named set of IPv6 requirements for a specific system.
  - Can specify capability choice. e.g. [DHCP-Client|SLAAC]
  - A single product might have multiple capability strings for different stacks / management.

- **Agency-Web-Server**=USGv6-r1:Host+Core+SLAAC+Addr-Arch+Multicast+[IPsec|TLS]+DHCP-Client+URI+DNS-Client+Link=Ethernet



USGv6 Profile – Details

Defines Capability Choices for Products

NISTv6-r1:Host Capabilities Template:

- **IPv6-Only Capabilities** - see section 4.1
  - [O] - **IPv6-Only** - support for full product functionality on an IPv6-only network.
- **Basic Capabilities** - see section 4.2
  - [M] - **Core** - support for IPv6 core functions.
  - [O] - **Extended-ICMP** - support for ICMPv6 extended messages.
  - [O] - **PLPMTUD** - support for Packetization Layer Path MTU Discovery.
  - [O] - **ND-Ext** - support for Neighbor Discovery enhanced DAD and First-Hop Selection.
  - [O] - **ND-WL** - support for packet-loss for router solicitations.
  - [O] - **SEND** - support for neighbor discovery security extensions.
  - [M] - **SLAAC** - support for stateless global address auto-configuration.
  - [O] - **PrivAddr** - support for SLAAC privacy extensions.
  - [O] - **DHCP-Stateless** - support for stateless (DHCP) configuration.
  - [O] - **DHCP-Client** - support for stateful (DHCP) address auto-configuration.
  - [O] - **DHCP-Client-Ext** - support for additional DHCP options including SIP.
  - [O] - **DHCP-Prefix** - support for stateful (DHCP) prefix delegation.
  - [O] - **DHCP-Prefix-Ext** - support for additional DHCP options for prefix exclude using prefix delegation.
  - [O] - **6Lo** - support for IPv6 over low power networks.
  - [O] - **Happy-Eyeballs** - support for Happy Eyeballs algorithm for dual stack environments.
- **Addressing Capabilities** - see section 4.7
  - [M] - **Addr-Arch** - support for address architecture and selection.
  - [O] - **CGA** - support for cryptographically generated addresses.
- **Network Support Capabilities** - see section 4.11
  - [O] - **DNS-Client** - support for DNS client/resolver functions.
  - [O] - **URI** - support for IPv6 uniform resource identifiers.
  - [O] - **NTP-Client** - support for NTP client capabilities.
  - [O] - **NTP-Server** - support for NTP server capabilities.
  - [O] - **DNS-Server** - support for DNS server capabilities.
  - [O] - **DHCP-Server** - support for DHCP server capabilities.
  - [O] - **DHCP-Server-Ext** - support for DHCP server additional DHCP options and Bulk Leasequery.
  - [O] - **DHCP-Relay** - support for DHCP relay capabilities.
- **Security Capabilities** - see section 4.8
  - [O] - **IPsec** - support for the IP security architecture.
  - [O] - **IPsec-IoT** - support for IoT Cryptographic Algorithms.
  - [O] - **IPsec-CHACHA** - support for ChaCha20 Cryptographic Algorithms.
  - [O] - **IPsec-SHA-512** - support for SHA-512 Cryptographic Algorithms.
  - [O] - **SSHV2** - support for SSHv2 over IPv6.
  - [O] - **TLS** - support for Transport Layer Security architecture version 1.2.
  - [O] - **TLS-1.3** - support for Transport Layer Security architecture version 1.3.

Maps Capabilities to Technical Requirements

Basic Capabilities

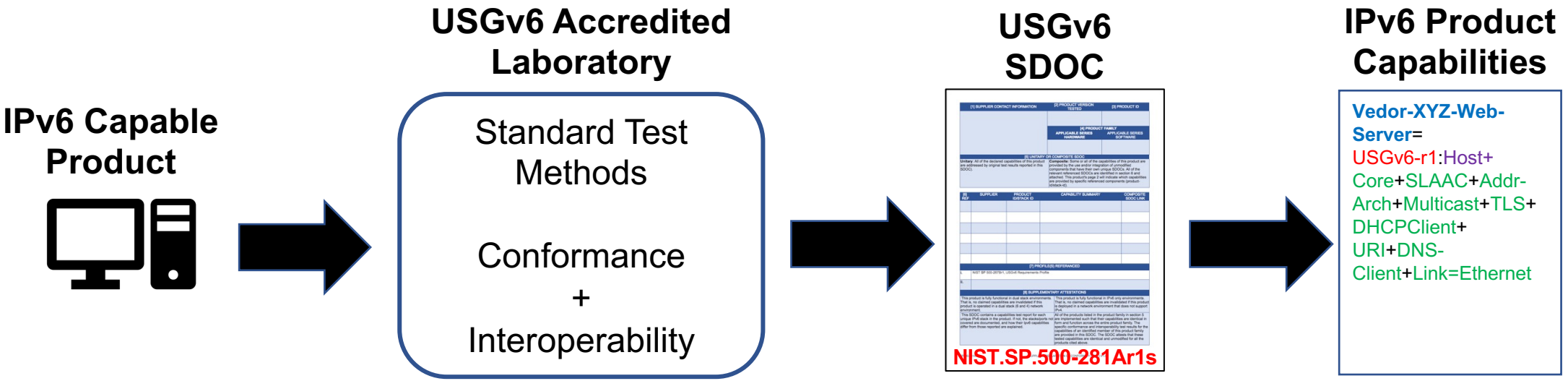
Flag	Host	Router	Other	Capability	Definition
	✓	✓		**Core**	**support for IPv6 core functions.**
U	✓	✓			RFC8200 *Internet Protocol, Version 6 (IPv6) Specification*
	✓	✓			RFC4443 *Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification*
U	✓	✓			RFC8201 *Path MTU Discovery for IP version 6*
	✓	✓			RFC4861 *Neighbor Discovery for IP version 6 (IPv6)*
	✓	✓			RFC4861 Section: 8 Redirect *Neighbor Discovery for IP version 6 (IPv6)*
N	✓	✓			RFC6437 *IPv6 Flow Label Specification*
N	✓	✓			RFC5942 *IPv6 Subnet Model: The Relationship between Links and Subnet Prefixes*
N	✓	✓			RFC6980 *Security Implications of IPv6 Fragmentation with IPv6 Neighbor Discovery*
N		✓			RFC7608 *IPv6 Prefix Length Recommendation for Forwarding*
N	✓	✓			RFC4191 *Default Router Preferences and More-Specific Routes*
	✓	✓			RFC4862 Section: 5.3 Creation of Link Local Addresses *IPv6 Stateless Address Autoconfiguration*
	✓	✓			RFC4862 Section: 5.4 Duplicate Address Detection *IPv6 Stateless Address Autoconfiguration*
	✓	✓		**Extended-ICMP**	**support for ICMPv6 extended messages.**
	✓	✓			RFC4884 *Extended ICMP to Support Multi-Part Messages*

Mandates support for optional feature

Groups requirements in logical / testable sets

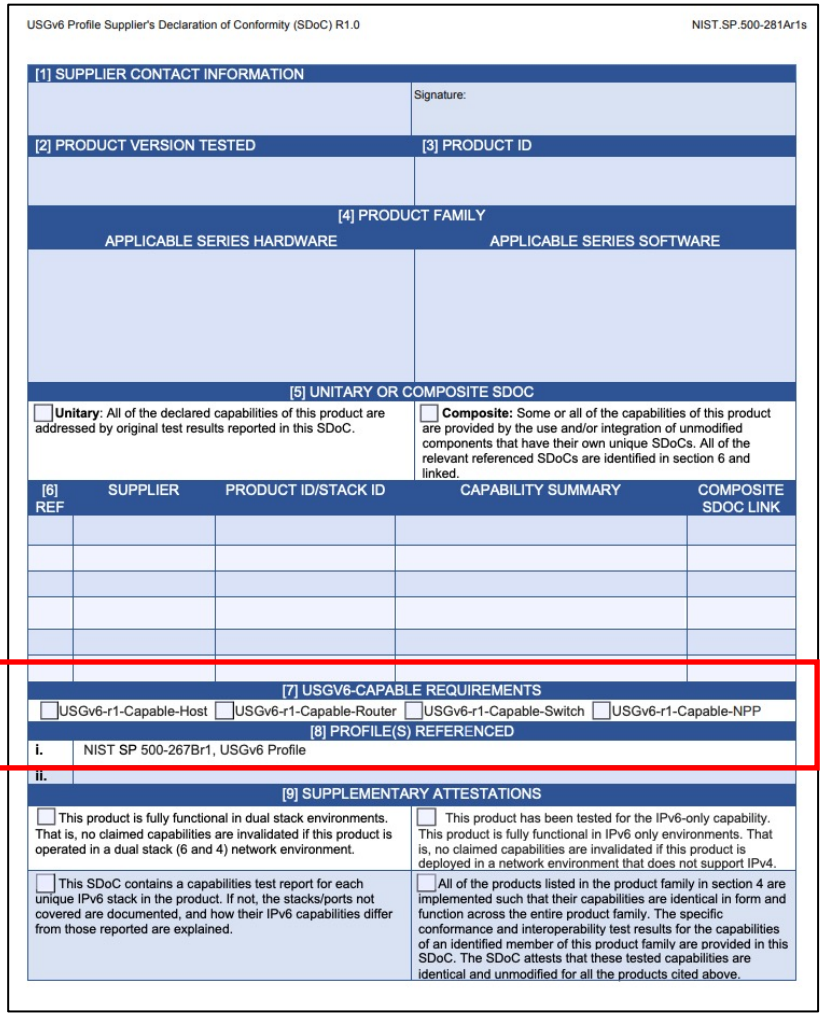
USGv6 Test Program

- **USG defined and managed - operated by independent test laboratories.**
- **USGv6 Test Program committed to converge / harmonize**
  - IPv6 Ready Logo Test Specifications
    - NIST and IPv6 Forum sign MOU
- Claims of compliance documented using Supplier's Declaration of Conformity (SDoC)



Increasing the Usability and Utility of USGv6

- **Example requirement statements**
  - See USGv6 Profile section 5 – Profile Usage Guidance and Examples.
- **Default requirement statements**
  - USGv6 Profile now specifies default definition of "IPv6 Capable" for several product types
    - USGv6-Capable-Host
    - USGv6-Capable-Router
    - USGv6-Capable-Switch
    - USGv6-Capable-NPP
    - USGv6-Capable-Application
  - SDoC now clearly identifies if products meet the above requirements.



USGv6 Profile Supplier's Declaration of Conformity (SDoC) R1.0 — NIST.SP.500-281Ar1s

[1] SUPPLIER CONTACT INFORMATION

Signature:

[2] PRODUCT VERSION TESTED | [3] PRODUCT ID

[4] PRODUCT FAMILY

APPLICABLE SERIES HARDWARE | APPLICABLE SERIES SOFTWARE

[5] UNITARY OR COMPOSITE SDOC

☐ **Unitary**: All of the declared capabilities of this product are addressed by original test results reported in this SDoC.

☐ **Composite:** Some or all of the capabilities of this product are provided by the use and/or integration of unmodified components that have their own unique SDoCs. All of the relevant referenced SDoCs are identified in section 6 and linked.

[6] REF	SUPPLIER	PRODUCT ID/STACK ID	CAPABILITY SUMMARY	COMPOSITE SDOC LINK

[7] USGV6-CAPABLE REQUIREMENTS

☐ USGv6-r1-Capable-Host ☐ USGv6-r1-Capable-Router ☐ USGv6-r1-Capable-Switch ☐ USGv6-r1-Capable-NPP

[8] PROFILE(S) REFERENCED

i. NIST SP 500-267Br1, USGv6 Profile

ii.

[9] SUPPLEMENTARY ATTESTATIONS

☐ This product is fully functional in dual stack environments. That is, no claimed capabilities are invalidated if this product is operated in a dual stack (6 and 4) network environment.

☐ This product has been tested for the IPv6-only capability. This product is fully functional in IPv6 only environments. That is, no claimed capabilities are invalidated if this product is deployed in a network environment that does not support IPv4.

☐ This SDoC contains a capabilities test report for each unique IPv6 stack in the product. If not, the stacks/ports not covered are documented, and how their IPv6 capabilities differ from those reported are explained.

☐ All of the products listed in the product family in section 4 are implemented such that their capabilities are identical in form and function across the entire product family. The specific conformance and interoperability test results for the capabilities of an identified member of this product family are provided in this SDoC. The SDoC attests that these tested capabilities are identical and unmodified for all the products cited above.

USGv6 Revision 1 – Updates

- **USGv6-r1 Profile Published Nov 2020**
  - https://www.nist.gov/programs-projects/usgv6-program/usgv6-revision-1
- **USGv6 Test Program Evolving**
  - Continuing to update test plans for new profile / requirements.
- **Beginning to test products against the new profile.**
  - Nov 2022 – Users should stop accepting the previous version of SDoCs/Profiles.
- **New Test Labs**
  - 2nd Lab is considering becoming an USGv6 accredited lab.

- **Specifications**
  - ***"NIST IPv6 Profile"***, NIST Special Publication (NIST SP) - 500-267Ar1, November 2020.
  - ***"NISTv6 Capabilities Table"***, NIST Special Publication (NIST SP) - 500-267Ar1s, November 2020.
  - ***"USGv6 Profile"***, NIST Special Publication (NIST SP) - 500-267Br1, November 2020.
  - ***"USGv6 Capabilities Table"***, NIST Special Publication (NIST SP) - 500-267Br1s, November 2020.
  - ***"USGv6 Test Program Guide"***, NIST Special Publication (NIST SP) - 500-281Ar1, November 2020.
  - ***"USGv6 Suppliers Declaration of Conformity"***, NIST Special Publication (NIST SP) - 500-281Ar1s, November 2020.
  - ***"USGv6 Test Methods: General Description and Validation"***, NIST Special Publication (NIST SP) - 500-281Br1, November 2020.

Evolving Test Plans

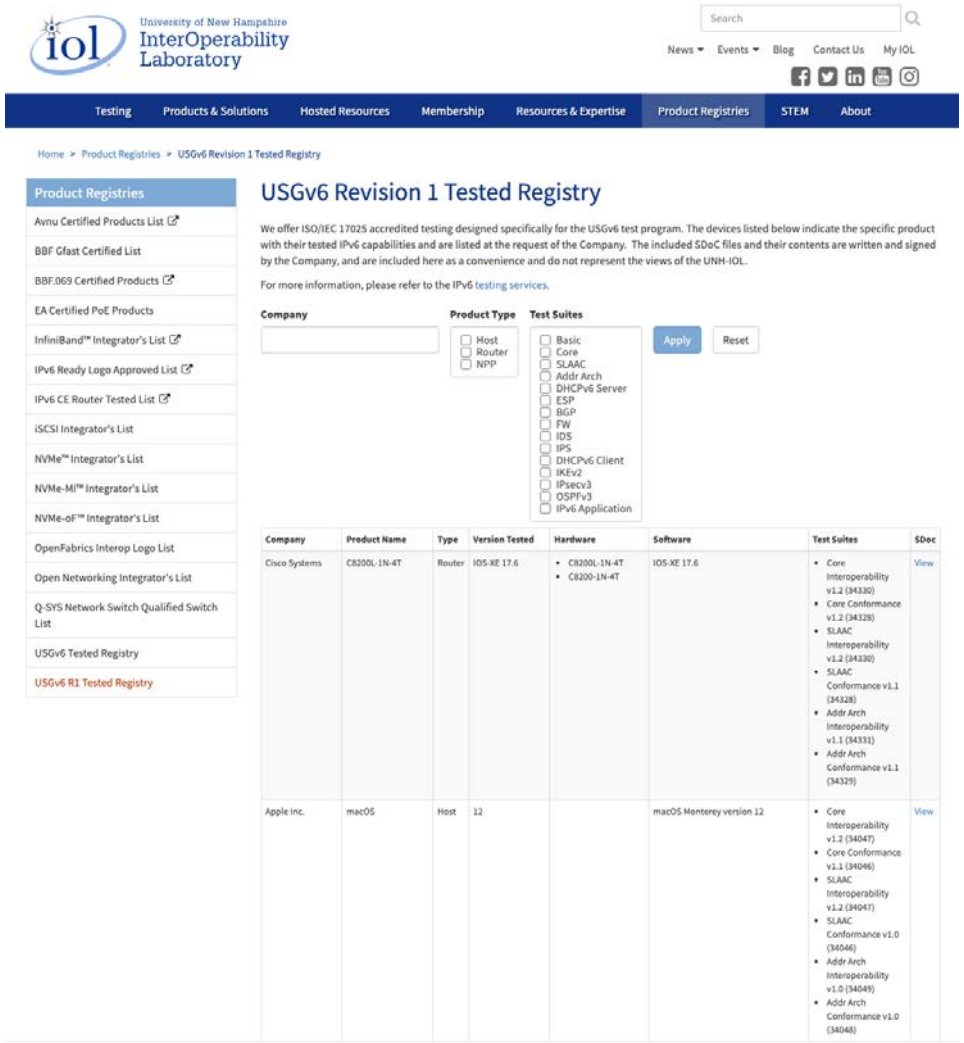
- **Updating Test Plans**
  - To address new / changed USGv6-r1 profile requirements.
  - Adding test plans for new requirements
    - Please review and comment on test plan for the IPv6-Only capability.

USGv6-r1 Test Selection Tables

Capability	Conformance Tests	Interoperability Tests	Functional Tests
IPv6-Only			DRAFT IPv6_Only_F.pdf
Core	Core_v1.2_C.pdf	Core_v1.2_I.pdf	
Addr_Arch	Addr_Arch_v1.1_C.pdf	Addr_Arch_v1.1_I.pdf	
SLAAC	SLAAC_v1.1_C.pdf	SLAAC_v1.2_I.pdf	
DHCP_Client			
DCHP_Server			
IPsecv3			
ESP			
IKEv2			
OSFPv3		OSPFv3_v1.0_I.pdf	
BGP		BGP4_v1.0_I.pdf	
NPP_FW	NPP_FW_v1.0_C.pdf		
NPP_IDS	NPP_IDS_v1.0_C.pdf		
NPP_IPS	NPP_IPS_v1.0_C.pdf		
NPP_APFW			
Application / Service			App_v1.0_F

Testing Against New Profile

- **USGv6-r1 Test Registry**
  - https://www.iol.unh.edu/registry/usgv6r1
- **Vendors testing against new requirements / RFCs.**
  - Most vendors tasking basic capabilities.
- **Need user requirements to drive more complete testing.**
  - Vendors will elect to test more capabilities if they are specified as requirements in RFPs.



New Test Reports (SDoCs)

USGv6 Profile Supplier's Declaration of Conformity (SDoC) R1.0 NIST.SP.500-281Ar1s

[1] SUPPLIER CONTACT INFORMATION

Apple Inc.,
One Apple Park Way,
Cupertino, CA 95014, (408) 996-1010

Signature: Prabhakar Lakhera
Prabhakar Lakhera (Oct 20, 2021 13:36 PDT)

[2] PRODUCT VERSION TESTED	[3] PRODUCT ID
12	macOS

[4] PRODUCT FAMILY

APPLICABLE SERIES HARDWARE	APPLICABLE SERIES SOFTWARE
	macOS Monterey version 12

[5] UNITARY OR COMPOSITE SDOC

☐ **Unitary**: All of the declared capabilities of this product are addressed by original test results reported in this SDoC.

☐ **Composite:** Some or all of the capabilities of this product are provided by the use and/or integration of unmodified components that have their own unique SDoCs. All of the relevant referenced SDoCs are identified in section 6 and linked

[6] REF	SUPPLIER	PRODUCT ID/STACK ID	CAPABILITY SUMMARY	COMPOSITE SDOC LINK
i.	Apple Inc.	macOS/12	USGv6-r1:Host+Core+SLAAC+Addr-Arch+Link=Ethernet	

[7] USGV6-CAPABLE REQUIREMENTS

☐ USGv6-r1-Capable-Host ☐ USGv6-r1-Capable-Router ☐ USGv6-r1-Capable-Switch ☐ USGv6-r1-Capable-NPP

[8] PROFILE(S) REFERENCED

i.	NIST SP 500-267Br1, USGv6 Profile
...	

[9] SUPPLEMENTARY ATTESTATIONS

☑ This product is fully functional in dual stack environments. That is, no claimed capabilities are invalidated if this product is operated in a dual stack (6 and 4) network environment.	☑ This product has been tested for the IPv6-only capability. This product is fully functional in IPv6 only environments. That is, no claimed capabilities are invalidated if this product is deployed in a network environment that does not support IPv4.
☑ This SDoC contains a capabilities test report for each unique IPv6 stack in the product. If not, the stacks/ports not covered are documented, and how their IPv6 capabilities differ from those reported are explained.	☑ All of the products listed in the product family in section 4 are implemented such that their capabilities are identical in form and function across the entire product family. The specific conformance and interoperability test results for the capabilities of an identified member of this product family are provided in this SDoC. The SDoC attests that these tested capabilities are identical and unmodified for all the products cited above.

USGv6 Profile Supplier's Declaration of Conformity (SDoC) R1.0 NIST.SP.500-281Ar1s

Host Capabilities

[10] PRODUCT ID/ STACK ID	CAPABILITY SUMMARY
macOS/12	USGv6-r1:Host+Core+SLAAC+Addr-Arch+Link=Ethernet

[11] SUPPORTED CAPABILITY	CAPABILITY	CONFORMANCE TEST SELECTION	CONFORMANCE RESULT ID	INTEROPERABILITY/FUNCTIONAL TEST SELECTION	INTEROPERABILITY/FUNCTIONAL RESULT ID	NOTES
-	IPv6-ONLY			IPv6-ONLY_R1v1.*_F		
PASS	Core	Core_R1v1.*_C	UNH-IOL/34046	Core_R1v1.*_I	UNH-IOL/34047	
-	Extended-ICMP	Self-Test		Self-Test		
-	PLPMTUD	Self-Test		Self-Test		
-	ND-Ext	Self-Test		Self-Test		
-	ND-WL	Self-Test		Self-Test		
-	SEND	Self-Test		Self-Test		
PASS	SLAAC	SLAAC_R1v1.*_C	UNH-IOL/34046	SLAAC_R1v1.*_I	UNH-IOL/34047	
-	PriAddr					
-	DHCP-Stateless	DHCP-Stateless_R1v1.*_C		DHCP-Stateless_R1v1.*_I		
-	DHCP-Client	DHCP-Client_R1v1.*_C		DHCP-Client_R1v1.*_I		
-	DHCP-Client-Ext	Self-Test		Self-Test		
-	DHCP-Prefix	DHCP-Prefix_R1v1.*_C		DHCP-Prefix_R1v1.*_I		
-	DHCP-Prefix-Ext	Self-Test		Self-Test		
-	6Lo	Self-Test		Self-Test		

Supplemental information for: USGv6 Test Program Guide NIST SP.500-281Ar1 Page 2 of 13

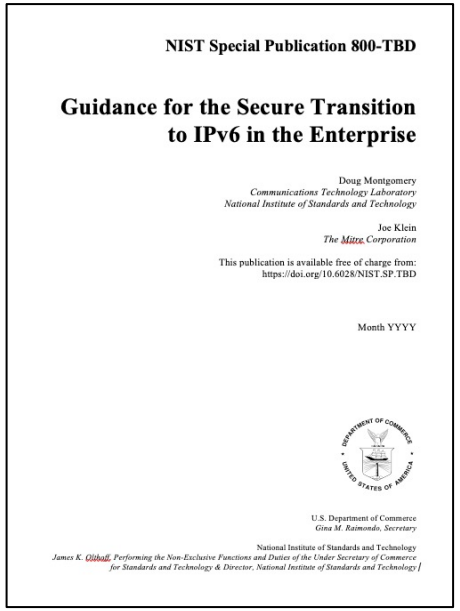
USGv6 Program Next Steps

- **Complete updating of test plans to new profile.**
  - Finalize IPv6-Only test plan and begin to require vendors to test for it.
- **Develop test plans for cloud services**
  - Current conformance and interop plans not well suited for testing IaaS and PaaS cloud services.
- **Develop USGv6 Usage Guidance**
  - Provide simple templates of acquisition language to help users write acquisition requirements that can best leverage the test program.
- **Continue discussion of USGv6 & DoD collaboration**
  - Resume discussions that were left off in Q2 of FY2021

Other IPv6 Activities

Secure IPv6-Only Implementation in the Enterprise

- **New NIST Guidance** on transition to IPv6-only in the enterprise.
  - Playbook as well as traditional technical guidance document.
  - Focus on challenges of transition technologies.
  - Focus on modern use cases – remote work, hybrid cloud & shared services, zero trust security, virtualized network services.



NIST Special Publication 800-TBD

Guidance for the Secure Transition to IPv6 in the Enterprise

Doug Montgomery
Communications Technology Laboratory
National Institute of Standards and Technology

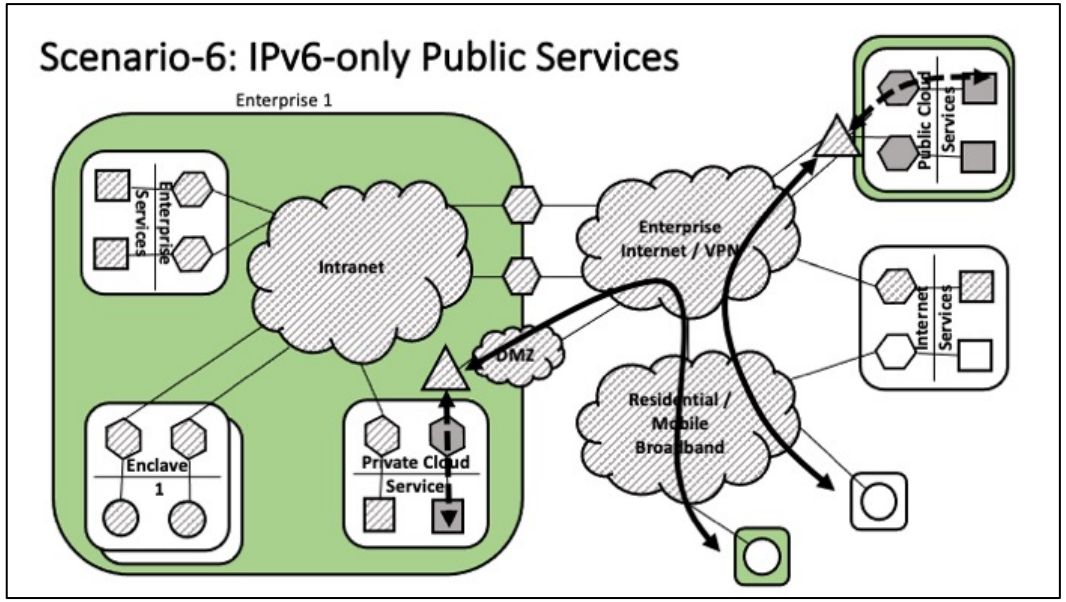
Joe Klein
The Mitre Corporation

This publication is available free of charge from:
https://doi.org/10.6028/NIST.SP.TBD

Month YYYY

U.S. Department of Commerce
Gina M. Raimondo, Secretary

National Institute of Standards and Technology
James K. Olthoff, Performing the Non-Exclusive Functions and Duties of the Under Secretary of Commerce for Standards and Technology & Director, National Institute of Standards and Technology



- **New NCCoE project focused on addressing these issues.**
  - **Focus on typical IPv6 evolution scenarios.**
    - Enabling ubiquitous dual-stack services.
    - Enabling IPv6-only enclaves in dual-stack dominant net.
    - Supporting IPv4-only services in a IPv6-only dominant net.
  - **Focus on impact on security services and technologies.**
  - **Focus on transition mechanisms that must be added to networks.**

Focus on modern enterprise use cases

- Scenario-1: Secure IPv4-Only Enterprise IT Environment
- Scenario-2: Secure IPv6-enabled Public Facing Services
- Scenario-3: Secure IPv6-enabled Enterprise Clients
- Scenario-4: Secure IPv6-enabled Enterprise Services
- Scenario-5: Secure IPv6-only Enterprise Clients
- Scenario-6: Secure IPv6-only Public Services
- Scenario-7: Secure IPv6-only Enterprise Infrastructure

Questions and Discussion

- **For more information:**
  - **Doug Montgomery**
    - douglas.montgomery@nist.gov
  - **USGv6 Program**
    - https://www.nist.gov/programs-projects/usgv6-program
  - **Internet Technologies Research**
    - https://www.nist.gov/itl/antd/internet-scalable-systems-research
  - **Communications Technology Laboratory**
    - https://www.nist.gov/ctl
  - **Information Technology Laboratory**
    - https://www.nist.gov/itl