U.S. DEPARTMENT OF ENERGY | Office of the Chief Information Officer

IPv6 Best Practices

Denise Hill, Senior Technical Advisor

DOE IPv6 Transition Initiative

April 17, 2012

The DOE enterprise is dynamic with diverse mission and business objectives that drive organizational IPv6 strategic planning.

Panel of Subject Matter Experts

- **Pamela Wise-Martinez – NNSA**
- **Denise Hill – IM-40; DOE Sr. Technical Advisor**
- **Michael Sinatra – Energy Sciences Network**
- **Seth Hall – BRO**
- **Laura Hobgood – IM-40, Project Mgr. (moderator)**

NOTE: Back up slides can be found at the end of the deck

Best Practices

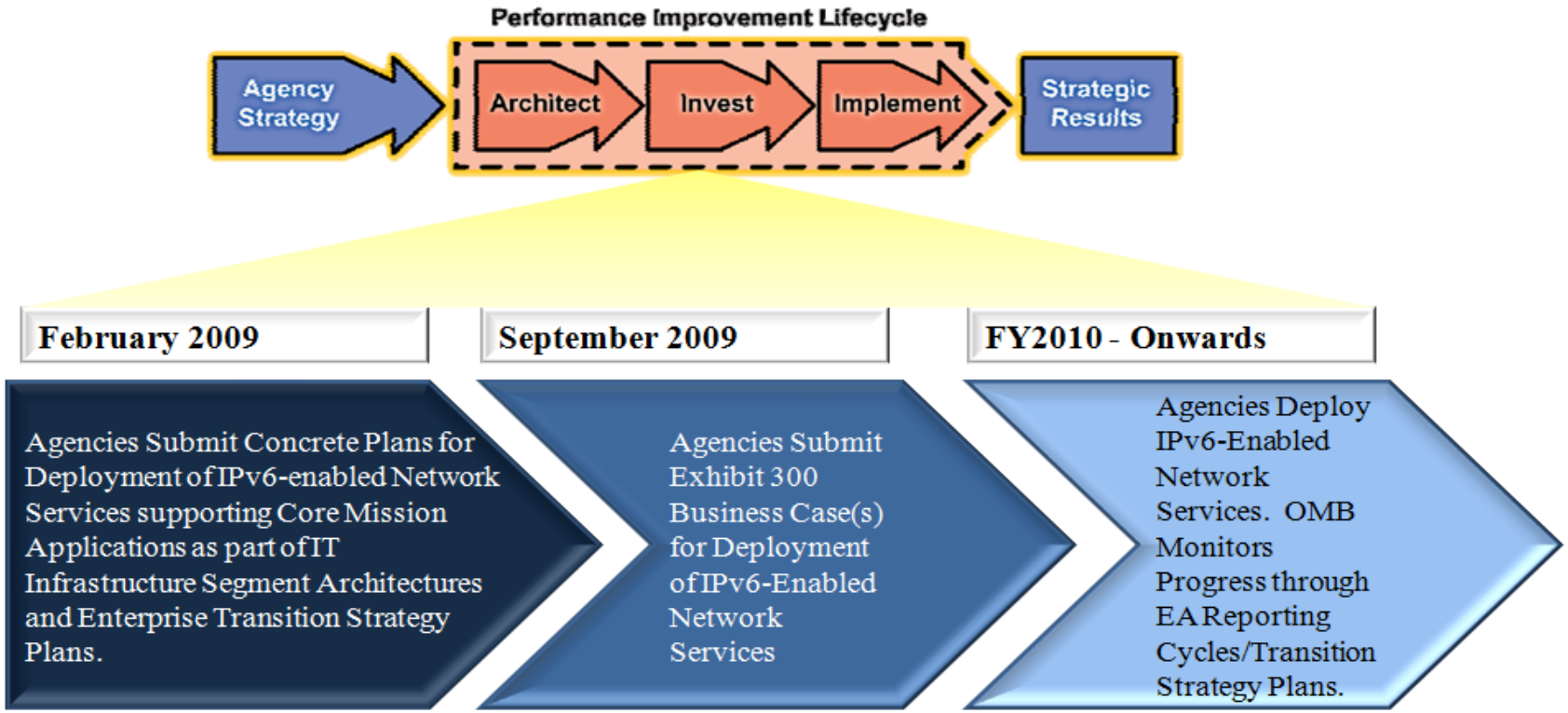
IPv6 Transition Planning

- Mission and Business Driven Objectives
- Enterprise Architecture / Capital Planning and Investment Planning
- Acquisition and Procurement Planning
- Governance and Reporting
- Enterprise Infrastructure
- Security
- Application Hosting Environment and Applications
- Testing and Certification
- Training
- Documentation Updates

Best Practices

Agency Mission/Strategic Goals

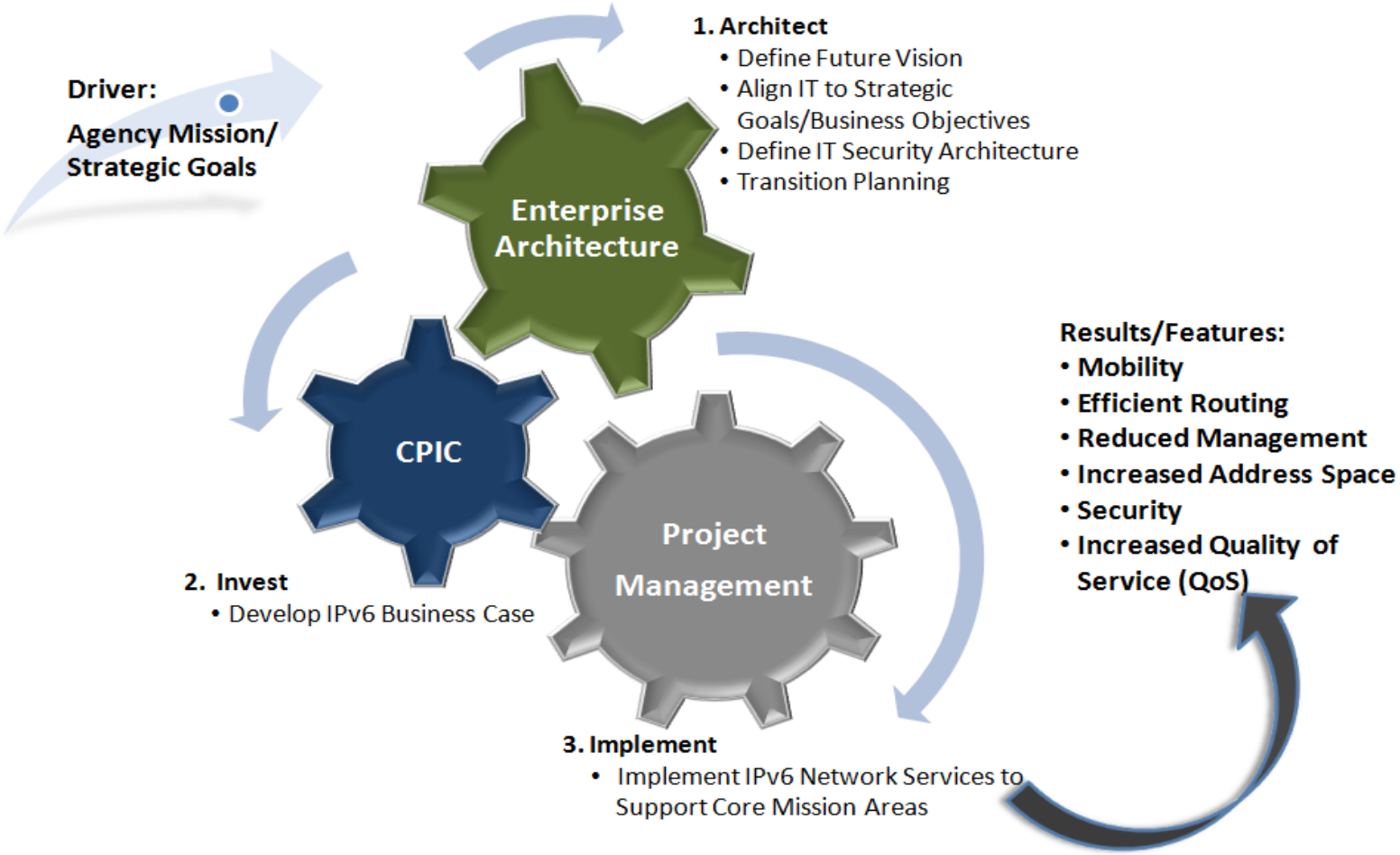
Enterprise Architecture & Capital Planning
IPv6 Roadmap (Federal CIO Roadmap)



Best Practices

Agency Mission/Strategic Goals

IPv6 Transition Concept of Operations
(Federal CIO Roadmap)



U.S. DEPARTMENT OF ENERGY
Office of the Chief Information Officer

IPv6 Agency Mission/Strategic Goals

	Business	Operational
Management	Alignment with Business Objectives Preserve existing IT investments where possible Agency Objectives OMB Milestones	Next generation applications and services Part of lifecycle and Refresh updates Optimize Opportunities OMB Milestones
Procurement	Acquisition and FAR Regulations Compatibility Functional Procurement Reviews	Requirements Development Infrastructure to Applications Collaboration with other organizations for success
Execution	Internal and External stakeholders considerations Gradual Deployment (Phased) – stable, manageable, and secure roll-out	Continuity of critical day-to-day business operations Phased transition used to gain invaluable operational experience
Reporting	Agency Reporting NIST Monitor Reporting Documentation and Updates	Cross-organizational Tracking NIST Monitor Reporting Integrate Lessons Learned and Best Practices

Best Practices

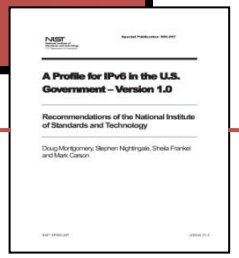
Acquisition

- IPv6 Acquisition Planning as a Requirement
- Acquisition planning benefits – Mission/Budget/Buy-in
- Incorporate applicable processes and procedures
- Relationships and Coordination between Teams
- Acquisition role in IPv6 Transition Risk Mitigation

Best Practices

Acquisition

USGv6-v1.0 Testing Program



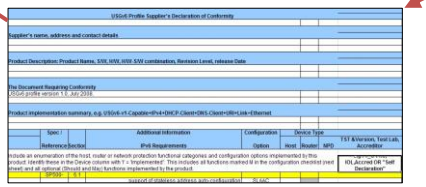
USGv6 Profile

Users

Acquisition

RFP

Vendors



Vendor's SDOC

Test Results

V6 Product

Corroboration

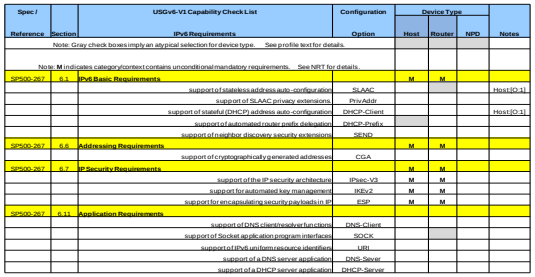
Test Labs

USGv6-v1.0 Testing Website: http://www.antd.nist.gov/usgv6/testing.html.

Acquisition

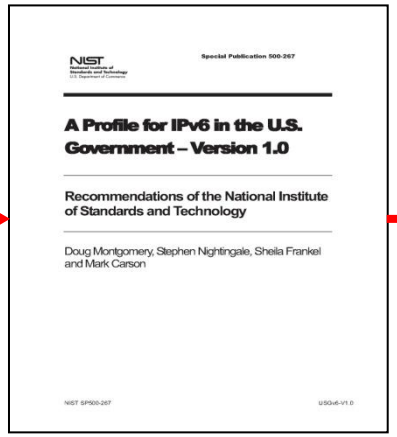
Protecting Early IPv6 Investments

Capabilities Checklist



Spec / Reference	Section	USGv6-V1 Capability Check List / IPv6 Requirements	Configuration Option	Device Type: Host	Router	NPD	Notes
Note: Gray check boxes imply an atypical selection for device type. See profile text for details.							
Note: M indicates category/context contains unconditional/mandatory requirements. See NRT for details.							
SP500-267	6.1	**IPv6 Basic Requirements**		M	M		
		support of stateless address auto -configuration	SLAAC				Host [O.1]
		support of SLAAC privacy extensions	PrivAddr				
		support of stateful (DHCP) address auto -configuration	DHCP-Client				Host [O.1]
		support of automated router prefix delegation	DHCP-Prefix				
		support of neighbor discovery security extensions	SEND				
SP500-267	6.6	**Addressing Requirements**		M	M		
		support of cryptographically generated addresses	CGA				
SP500-267	6.7	**IP Security Requirements**		M	M		
		support of the IP security architecture	IPsec-V3	M	M		
		support for automated key management	IKEv2	M	M		
		support for encapsulating security payloads in IP	ESP	M	M		
SP500-267	6.11	**Application Requirements**					
		support of DNS client/resolver functions	DNS-Client				
		support of Socket application program interfaces	SOCK				
		support of IPv6 uniform resource identifiers	URI				
		support of a DNS server application	DNS-Sever				
		support of a DHCP server application	DHCP-Server				

USGv6 Profile



NIST Special Publication 500-267

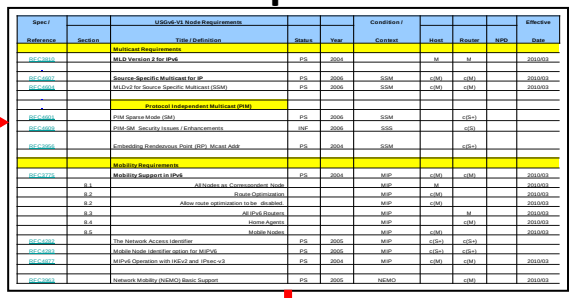
A Profile for IPv6 in the U.S. Government – Version 1.0

Recommendations of the National Institute of Standards and Technology

Doug Montgomery, Stephen Nightingale, Sheila Frankel and Mark Carson

NIST SP500-267 USGv6-V1.0

Node Requirements



Spec / Reference	Section	USGv6-V1 Node Requirements / Title / Definition	Status	Year	Condition / Context	Host	Router	NPD	Effective Date
		Multicast Requirements							
RFC2710		**MLD Version 2 for IPv6**	PS	2004		M	M		2010/03
RFC4607		**Source-Specific Multicast for IP**	PS	2006	SSM	c(M)	c(M)		2010/03
RFC3810		MLDv2 for Source Specific Multicast (SSM)	PS	2006	SSM	c(M)	c(M)		2010/03
		Protocol Independent Multicast (PIM)							
RFC4601		PIM Sparse Mode (SM)	PS	2006	SSM		c(S+)		
RFC4605		PIM-SM Security Issues / Enhancements	INF	2006	SSS		c(S)		
RFC3956		Embedding Rendezvous Point (RP) Mcast Addr	PS	2004	SSM		c(S+)		
		Mobility Requirements							
RFC3775		**Mobility Support in IPv6**	PS	2004	MIP	c(M)	c(M)		2010/03
	8.1	All Nodes as Correspondent Node			MIP	M			2010/03
	8.2	Route Optimization			MIP	c(M)			2010/03
	8.2	Allow route optimization to be disabled			MIP	c(M)			2010/03
	8.3	All IPv6 Routers			MIP		M		2010/03
	8.4	Home Agents			MIP		c(M)		2010/03
	8.4	Mobile Nodes			MIP	c(M)			2010/03
RFC4283		The Network Access Identifier	PS	2005	MIP	c(S+)	c(S+)		
RFC4283		Mobile Node Identifier option for MIPv6	PS	2005	MIP	c(S+)	c(S+)		
RFC4877		MIPv6 Operation with IKEv2 and IPsec v3	PS	2004	MIP	c(M)	c(M)		2010/03
RFC3963		Network Mobility (NEMO) Basic Support	PS	2005	NEMO		c(M)		2010/03

Users

Vendors

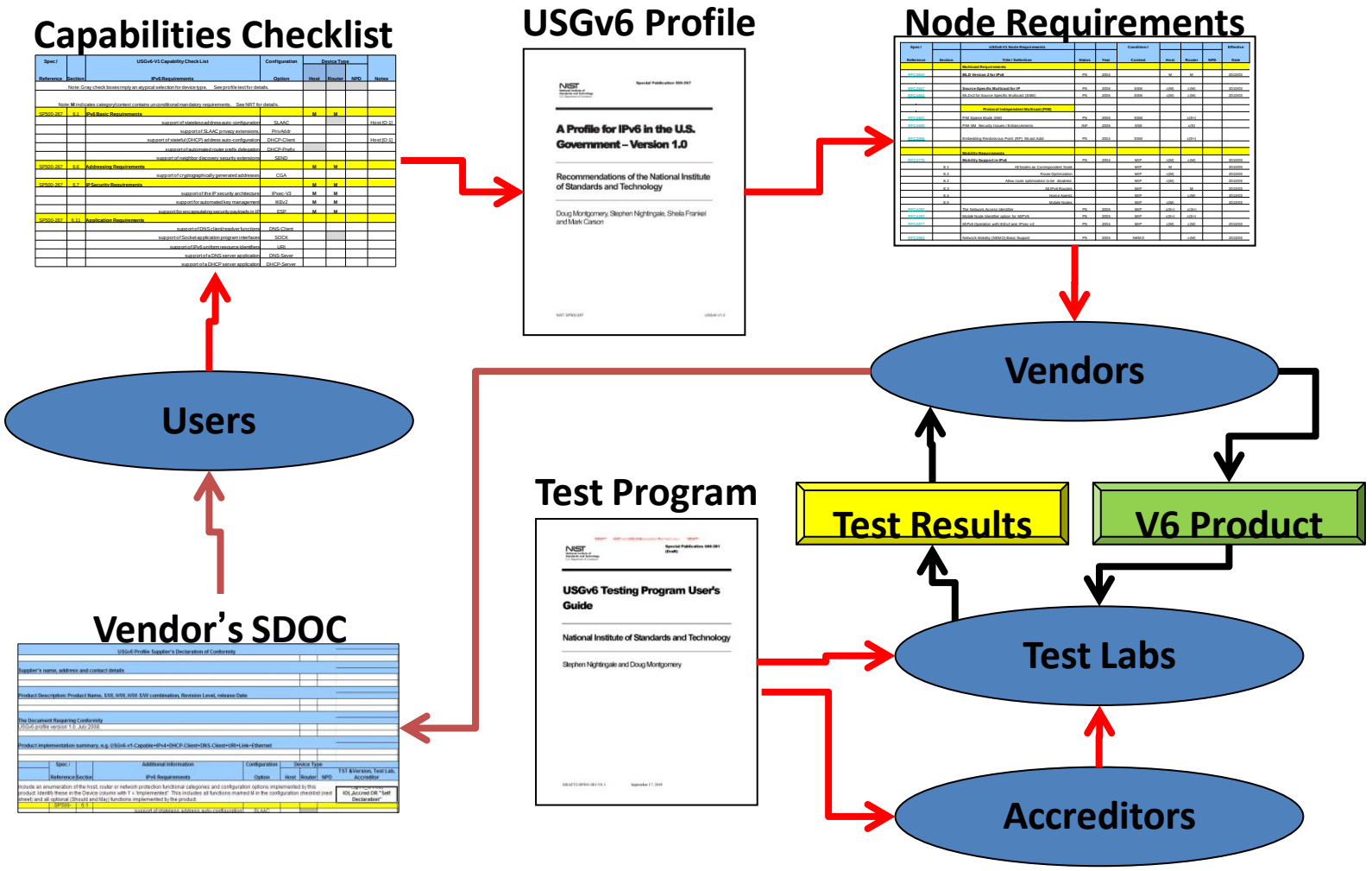
V6 Products

?

How do we verify the completeness, correctness and safety of early implementations?

Acquisition

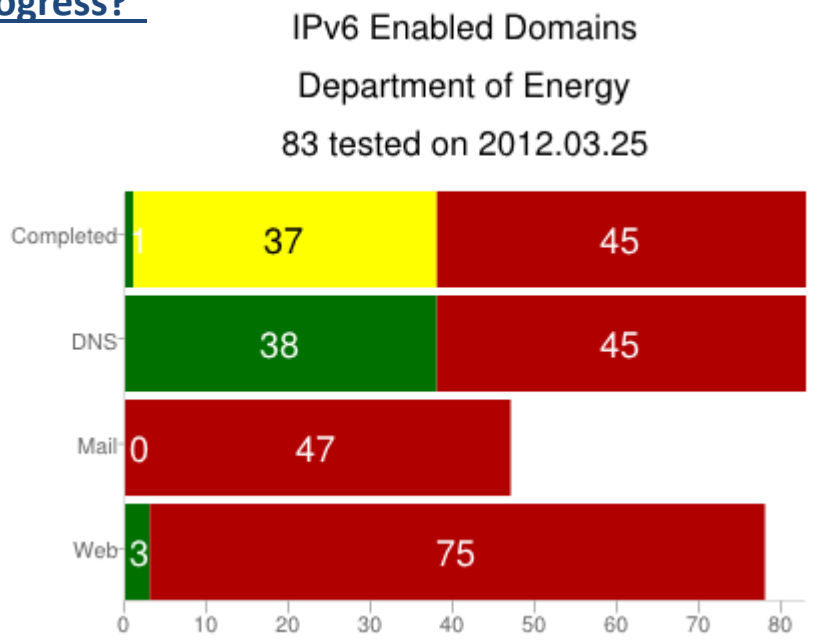
Vocabulary for IPv6 Requirements



Estimating IPv6 & DNSSEC External Service Deployment Status Department of Energy

"Where are we now?" and "Are we making progress?"

- Tool examines IPv6 and IPv4 status of DNS, Mail and Web Services Weekly
- Tool is unrelated to the USGv6 profile and the USGv6 Testing Program
- Monitored domain and service; report estimated number of IPv4 interfaces for that services/and number of interfaces that:
- Includes a heuristic indication of whether the service in question seems to be operating within the domain in question or if it's provided elsewhere.
- Monitor relies on the DATA.gov list of agency domains [augmented].



http://usgv6-deploymon.antd.nist.gov/cgi-bin/cfo?agency=energy

Federal Initiatives

- **Align activities**
- **Optimize costs**
- **Increase effectiveness**
- **Cross reference documentation**

Best Practices

Security

- Gain internal deployment experience to **minimize risk**
- **Simplify management** [remove NAT/VPN layers of complexity] and avoid outages
- Policy-based versus topology based **security model**
- Efficient **identification** and **authorization** of people, information, devices, and services centralized within the enterprise network
- Network sniffing architecture
- **Traffic analysis**, especially with Bro
- Intrusion **detection** and incident **response**

Best Practices

Addressing, Testing, and Applications

- **Simplified** addressing – avoid complicated workarounds
- **Hybrid approach** to Network addressing
- Subnet capabilities create more **efficient network** and **systems**
- Device identification and **controls**
- Application **testing in lab** environment **before production** and roll out
- Testing as a **critical element** of the transition to an IPv6 Enterprise Environment
- **Validation** of applications and **certification** process **changes**
- **Align** IPv6 testing for **compatibility** and **certification** with timing of other programs
- **Dual compatibility** (IPv4/IPv6)

Best Practices

Maximize Benefits

- Implementation costs far less than **anticipated benefits**
- Built in **Multi-casting capability** (messaging multiple networks simultaneously)
- **Improved security** – IPsec, etc.
- Better **performance** and operational **efficiency**
- Easier management - **auto configuration** of hosts, **auto discovery** of devices and users on the network.
- IPv6 specific features inherit in **new devices and software** allow for **operational enhancements**; Peer-to-Peer collaboration, plug/play identification and security capabilities
- Device and network **controls support** overarching **DOE mission** and **business objectives**.
- Supports **Mobility** and **tele-work** – implementation on carrier networks..

Best Practices

Training is critical

- Segment **employee** training and **involvement** in transition planning is critical
- Transition provides invaluable **Operational experience**
- **One step ahead** of customer requirements

Alignment with Federal Initiatives

PANEL DISCUSSION

Q&A's

Alignment with Federal Initiatives

Back-up Slides

Best Practices

Considerations

- Integrate IPv6 into your organizational IT refresh cycles
- Assess the existing infrastructure and HW/SW inventory (baseline)
- Specify IPv6 compliance in all IT RFP's and purchases (capable/enabled/ready)
- Determine transition technology and decision strategy (dual stack/tunnels, etc.)
- Integrate IPv6 specialized training into IT Budget
- Prioritize financial strategy for IPv6 transition (milestones, business function, etc.)

Best Practices

Acquisition

IPv6 Acquisition Planning as a Requirement

- Proactive planning for today and tomorrow
- Ensure IPv6 is considered in all IT related purchases
- Consider agency level mission and ongoing initiatives
- Leverage IPv6 enterprise-wide impact

Acquisition planning benefits

- Align with program level missions and objectives
- Coordinate purchases across initiatives
- Small increase in investment today saves money long term
- Result is cost efficient spending
- Senior management buy-in

Best Practices

Acquisition

Incorporate applicable processes and procedures

- Enterprise Architecture (EA)
- Capital Planning and Investment Control (CPIC)
- Change and risk management
- Integrated Project Teams (IPT)

Relationships and Coordination between Teams

- Translation of requirements for better understanding
- IT mgt, network, security, application hosting, procurement
- Communicate technical requirements to procurement
  - Infrastructure, transport, equipment (routers, switches, firewalls, servers), software, security, etc.
- Coordination of process and procedural timelines

Acquisition

Acquisition role in IPv6 Transition Risk Mitigation

- Requirements checklist (for development)
- Supplier Declaration Of Conformity (SDOC) - details on Specs
- Mitigate potential impact on project schedule, cost, and resources:
  - Equipment replacement or upgrade (cost/timeline)
  - IPv6 performance impact on network and applications
  - Risk to availability of resources when needed
  - Delay of implementation activities

Best Practices

Acquisition

SDOC: Page 1

Product identification

- Includes attestations for Composite Products, Original/Derived testing, IPv6 only, Tested/ Untested stacks, Product Families

Suppliers Declaration of Conformity for USGv6 Products					USGv6-v1 SDOC-v1.1 Page 1
1	**The Document Requiring Conformity:**				**USGv6 Profile Version 1.0, July 2008. (NIST SP500-267)**
2	**Product Identifier:**				
3	**Supplier's Name, Address and SDOC Contact Details**				
4	**Product as Tested/Declared:** *Product Identifier, version/revision information, details of configuration tested.*				
5	**Product Family** (other products using same IPv6 stack(s) to which these results are declared to apply). ***Check Product Family attestation below.***				
6	**USGv6 Capability summary.** (For each distinct IPv6 stack in the product provide a summary of its USGv6 capabilities below and include a detailed test result summary). *e.g. example-prod-id/stack-1: USGv6-v1-Host: IPv6-Base+Addr-Arch+IPsec-v3+IKEv2+SLAC+Link=Ethernet.*				
7	**Self Contained or Composite SDOC?** (Must indicate one).				
	All of the declared USGv6 capabilities of this product are addressed by orginal test results reported in this SDOC.		*Some or all of the USGv6 capabilities of this product are provided by the use and/or integration of umodified components that have their own unique USGv6 SDOCs. All of the relevant referenced SDOCs are identified in section 8 and attached. This product's page 2 will indicate which capabilities are provided by specific referenced components (product-id/stack-id).*		
8	**Additional Declarations / Attachments:** *(List supplier & product-id/stack-id for referenced and attached test results in the case of composite products).*				
	Component Supplier	**Product ID:**	**Stack ID:**	**Notes:**	
[1]					
[2]					
[3]					
[4]					
9	**Supplementary Attestations** *(Answer all).*				
	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, please document which stacks/ports are not covered, and how their IPv6 capabilities differ from those reported in this SDOC.*		*All of the products listed in the product family in section 5 are implemented such that their USGv6 capabilities are identical in form and function across the entire product family. The specific conformance and interoperability test results for the USGv6 capabilities of an identified member of this product family are provided in this SDOC. The SDOC attests to the fact that these tested USGv6 capabilities are identical and unmodified for all the products cited above.*
10	**Signature**			**Date**	
	Print Name / Title				

Best Practices

Acquisition

SDOC: Page 2

Testing details

- Where tests run and passed
- Self Test when no public test spec available

11	Suppliers Declaration of Conformity for USGv6 Products: Declared Capabilities and Test Results Summary								USGv6-v1 SDOC-v1.1	Page 2
Product Id:				Stack Id:						
			Context /	Supported Capabilities			USGv6 Testing Program Results			
Spec / Reference	Section	USGv6-v1 Profile Requirements	Configuration Option	Host	Router	NPD	Test Suite Conformance/NPD	Test Lab / Result ID, Note #, or Component Ref	Test Suite Interopoperability	Test Lab / Result ID, Note #, or Component Ref
SP500-267	6.1	**IPv6 Basic Requirements**								
		support of IPv6 base (IPv6,ICMPv6,PMTU,ND)	IPv6-Base				**Basic_v1.*_C**		**Basic_V1.*_I**	
		support of stateless address auto-configuration	SLAAC				**SLAAC-V1.*_C**		**SLAAC-V1.0_I**	
		support of SLAAC privacy extensions.	PrivAddr				*Self Test*		*Self Test*	
		support of stateful (DHCP) address auto-	DHCP-Client				*Self Test*		**DHCP_Client_v1.*_I**	
		support of automated router prefix delegation	DHCP-Prefix				*Self Test*		*Self Test*	
		support of neighbor discovery security extensions	SEND				*Self Test*		*Self Test*	
SP500-267	6.6	**Addressing Requirements**								
		support of addressing architecture reqts	Addr-Arch				**Addr_Arch_v1.*_C**		**Addr_Arch_v1.*_I**	
		support of cryptographically generated addresses	CGA				*Self Test*		*Self Test*	
SP500-267	6.7	**IP Security Requirements**								
		support of the IP security architecture	IPsecv3				**IPsecv3_v1.*_C**		**IPsecv3_v1.*_I**	
		support for automated key management	IKEv2				**IKEv2_v1.*_C**		**IKEv2v1.0_I**	
		support for encapsulating security payloads in IP	ESP				**ESPv3_v1.*_C**		**ESP_v1.*_I**	
SP500-267	6.11	**Application Requirements**								
		support of DNS client/resolver functions	DNS-Client				*Self Test*		*Self Test*	
		support of Socket application program interfaces	SOCK				*Self Test*		*Self Test*	
		support of IPv6 uniform resource identifiers	URI				*Self Test*		*Self Test*	
		support of a DNS server application	DNS-Server				*Self Test*		*Self Test*	
		support of a DHCP server application	DHCP-Server				*Self Test*		**DHCP_Serv_v1.*_I**	
SP500-267	6.2	**Routing Protocol Requirements**								
		support of the intra-domain (interior) routing	IGW				*Self Test*		**OSPFv3_v1.*_I**	
		support for inter-domain (exterior) routing	EGW				*Self Test*		**BGP_v1.*_I**	
SP500-267	6.4	**Transition Mechanism Requirements**								
		support of interoperation with IPv4-only systems	IPv4				*Self Test*		*Self Test*	
		support of tunneling IPv6 over IPv4 MPLS services	6PE				*Self Test*		*Self Test*	
SP500-267	6.8	**Network Management Requirements**							**Self Test**	
		support of network management services	SNMP				*Self Test*		Self Test	
SP500-267	6.9	**Multicast Requirements**								
		support of basic multicast	Mcast				*Self Test*			
		full support of multicast communications	SSM				*Self Test*		*Self Test*	
SP500-267	6.10	**Mobility Requirements**								
		support of mobile IP capability.	MIP				*Self Test*		*Self Test*	
		support of mobile network capabilities	NEMO				*Self Test*		*Self Test*	
SP500-267	6.3	**Quality of Service Requirements**								
		support of Differentiated Services capabilities	DS				*Self Test*		*Self Test*	
		PHB Id					*Self Test*			
SP500-267	6.12	**Network Protection Device Requirements**								
		support of common NPD reqts	NPD				**N1|N2|N3|N4**			
		support of basic firewall capabilities	FW				**N1_FW**			
		support of application firewall capabilities	APFW				**N2_App_FW**			
		support of intrusion detection capabilities	IDS				**N3_IDS**			
		support of intrusion protection capabilities	IPS				**N4_IPS**			
SP500-267	6.5	**Link Specific Technologies**								
		support of robust packet compression services	ROHC				Self Test		Self Test	
		support of link technology [O:1]	Link=				Self Test		Self Test	
		(repeat as needed) support of link technology	Link=							
12		**< Check HERE if this stack's DOC includes additional information about tested capabilities and options on an attached page 3 of notes.**								

Level	Level of support for USGv6-v1 Requirements for capability.	Color	Indication of USGv6-v1 Recommended Level of Support for device type / stack role.
	Blank - SDOC makes no declaration for this capability.		Indicates capability that is recommendend as mandatory (unconditional MUST) in the USGv6-v1 Profile.
P	Passed required tests of USGv6-V1 requirements for these capabilities.		Indicates cabability that is unusal for a given device type / stack role. Do not select without careful analysis.
N	See notes page for details on the level of support of USGv6-v1 reequirements for this capability		Indicates capability that is left optional / ocnditional by the recommedations of the USGv6-v1 Profile.
X	USGv6 capability not supported in product.		

Test Suite - Specific USGv6 Test suite used for test. See: http://www.antd.nist.gov/usgv6/test-specifications.html
Test Lab / Result ID - Abbreviation of accredited laboratory and its local identifier for this test result.
Note # - reference to a detailed note about this capability or result on attached page.
Component Ref - Supplier / Product / Stack ID of distinctly tested component that provides this capability.

Best Practices

Acquisition

SDOC: Page 3

Vendor variations and reasoning

Note #	Product Id:			Stack Id:							
	Spec / Reference	Section	USGv6-v1 Profile Requirements	Context / Configuration Option	Supported Capabilities			Notes about USGv6-v1 Capabilities.			
					Host	Router	NPD	Test Suite Conformance/NPD	Test Lab / Result ID, Note	Test Suite Interopoperability	Test Lab / Result ID, Note
1											
Discussion:											
2											
Discussion:											
3											
Discussion:											
4											
Discussion:											
5											
Discussion:											
6											
Discussion:											
7											
Discussion:											
8											
Discussion:											
9											
Discussion:											
10											
Discussion:											

Best Practices

Acquisition

SDOC: Page 4

Instructions

Suppliers Declaration of Conformity for USGv6 Description and Instructions Page 3

General: This document describes network product from the identified supplier that claims support of USGv6 capabilities. General product and supplier identification is given on Page 1. Overall results of testing USGv6 capabilities for conformance, interoperability and network protection are given on Page 2. Detailed instructions for completing and interpreting each numbered field are given below. Note USGv6 Testing website at: http://www.antd.nist.gov/usgv6/testing.html. Contact: usgv6-project@antd.nist.gov.

Field	Description and Instructions	Field	Description and Instructions
1	**The Document Requiring Conformity**: Identifies the profile version implemented. Not a user completeable field.		
2	**Product Identifier**: Supplier's concise name for the product declared.	11	**Summary of Results**: The format of this table mirrors the USGv6-v1.0 capabilities checklist (USGv6 Profile, Appendix A). The 12 categories of USGv6 capabilities are listed as subheadings, with subsidiary functions as line items. Configuration options related to conditional implementation of selected capabilities.
3	**Suppliers Name, Address and Contact Details**: Company name and point of contact for SDOC questions, street address, phone and email.		
4	**Product as Tested/Declared**: Product Identifier and detailed version information. If this SDOC reports oringal test results (page 2), include information about the specific product configuration(s) that was actually tested (e.g., hardware configuration, operating system, etc).		**Product Id/Stack Id**: The identification line of this page includes space for Product Id and Stack Id labels. Product Id is the same as given on Page 1. As there may be more than one unique IPv6 stack implemented in the product, the Stack Id field identifies the particular stack described. One Results Summary page per stack is required.
5	**Product Family**: A list of other products that use the same, unmodified IPv6 stacks such that their USGv6 capabilities are identical in form and function to the specific product configuration above. Test labs are only required to affirm the results for specific products tested. Test labs optionally may affirm recognized product families.		**Host, Router and Network Protection (NPD)** columns identify 'preferred' options: cells in green represent the NIST recommendations. Cells in grey denote atypical options, very unlikely to be implemented. The procuring Agency may additionally tailor these fields to indicate requirements for this acquisition.
6	**USGv6 Capability Summary**: The USGv6 stack implementation summary as identified by the '+' notation described in the USGv6 profile, Appendix A. For each IPv6 stack implementation in the product, a distinct Stack Id and reference to the attached Results Summary page (Page 2).		**Test Suite Conformance and Interoperability** columns identify capability sets for which a public test suite exists, and the versions applicable to USGv6-v1.0 test results. Major version v1 and all its minor versions are deemed acceptable. Over time, new versions will be added and older ones retired. There may be periods when more than one major version is acceptable concurrently.
7	**Self Contained or Composite SDOC**: If this SDOC relies on the test results of other disinct products, list the Supplier & Product ID/Stack IDs referenced and attach those original SDOCs to this one.		The supplier completes the adjacent **Test Lab and Result Id** column with the test lab acronym and unique result identifier (See Test Lab and Accreditor page on the Website). The buyer may opt to query results with the test laboratory using the specified Result Id(s). The supplier may opt to provide particular explanation of some results (partial results, additional options) in which case reference to note on an attached page 3. (*e.g. "See Note# N"*). See the USGv6 testing website to identify the test lab, and find contact details.
8	**Additional Declarations / Attachements:** List the supplier / product ID / Stack ID of any test results of composite components referenced by this SDOC.		Cells marked ***Self Test*** have no associated public test suite. If implemented by the supplier, the required adjacent annotation is "*Self Declaration*". Note that vendors declaring support for such a capability are declaring support for the associated specific requirements in the USGv6 Profile.
9	**Supplementary Attestations**: Suppliers disclosure of IPv6 only capabilities; multiple stacks present; product family applicabilities. These are not included to qualify or disqualify a product from purchase considerations, but to inform network administrators of potential configuration options relevant to USGv6 interoperability. Check all that apply.	12	**Additional Options Tested**: Vendor checks if it is desired to record tested options not part of the 'Musts' in the profile. Explanations on the page following the results summary.
			Headings and Special Notations: as described.
10	**Signature Block**: Wet ink signature of the responsible product manager, dated. Printed name and position title on the line below.		**Options for Test Lab and Result Id**: Currently 3 cases: (1) the test lab acronym and alphanumeric Id of the result set as assigned by the test laboratory; (2) 'Self declaration' denoting the supplier attests to adequate QA testing of the capability; (3) See attachment or note 'N', where the supplier explains variations in greater detail.

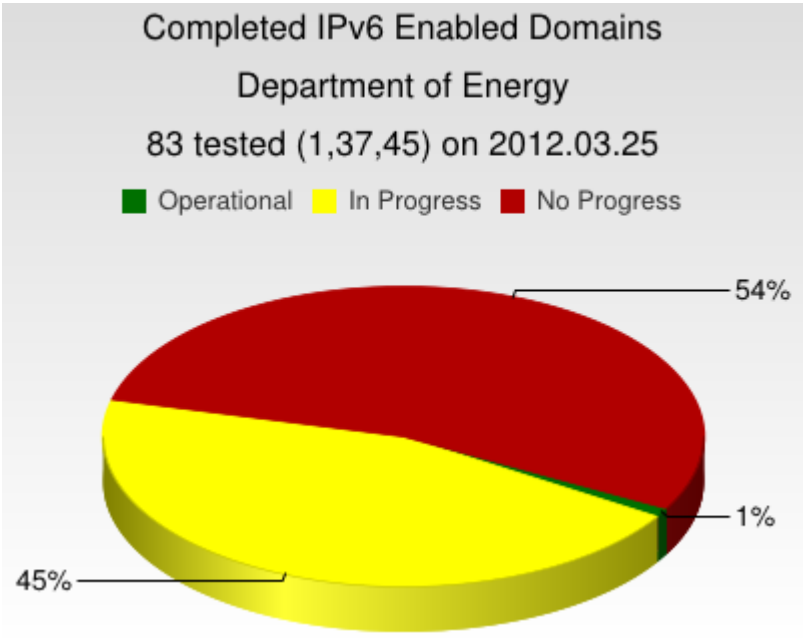
Further Description: http://www.antd.nist.gov/usgv6/testing.html, and NIST SP 500-267 USGv6 Testing Program Users Guide available at the website.

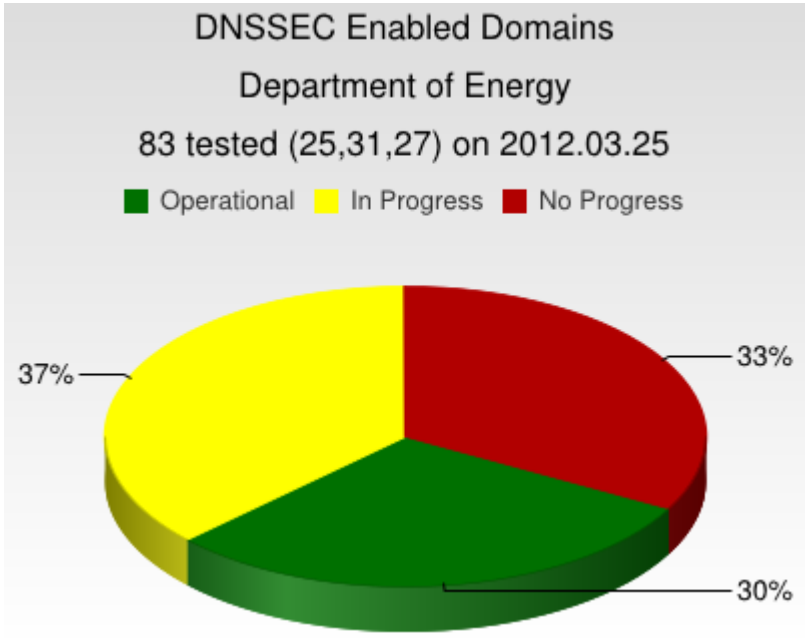
Related Resources

USGv6-v1.0 Testing Website

- The USGv6 testing website identifies accredited test labs: http://www.antd.nist.gov/usgv6/testing.html.
  - https://www.icsalabs.com/
  - http://www.iol.unh.edu/services/testing/ipv6/USGv6.php
- And the functions and RFCs for which public tests exist:
  - http://www-i.antd.nist.gov/accounts/night/test-specifications.html

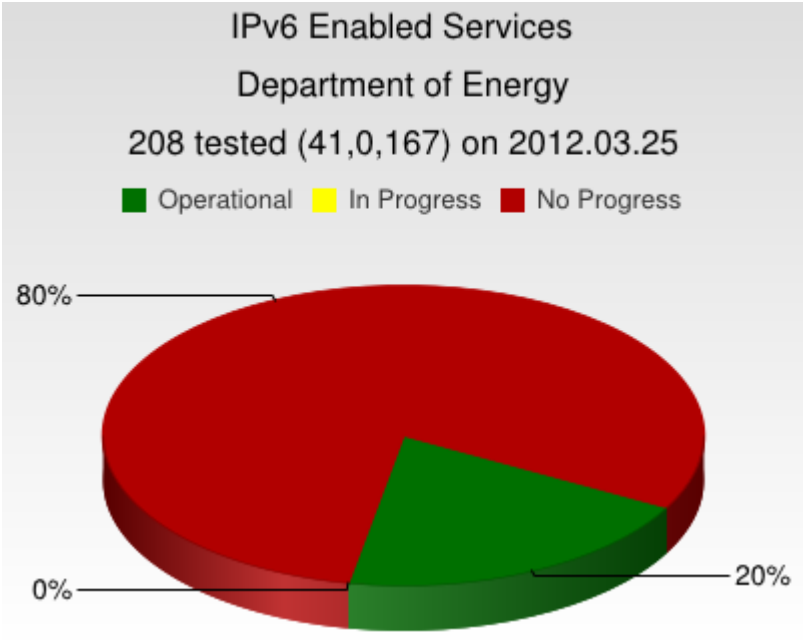
Estimating IPv6 & DNSSEC External Service Deployment Status Department of Energy

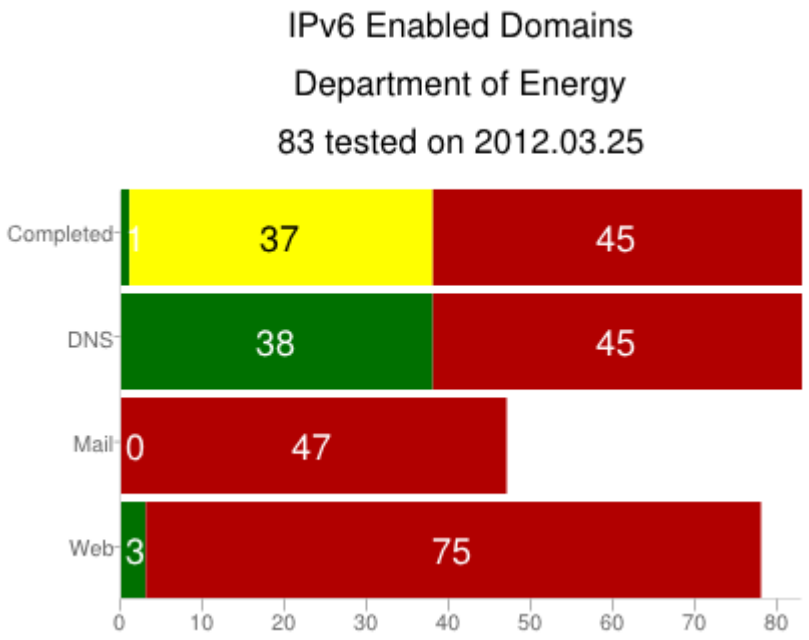




http://usgv6-deploymon.antd.nist.gov/cgi-bin/cfo?agency=energy

Estimating IPv6 & DNSSEC External Service Deployment Status Department of Energy





Services went from 255 to 208; Mail and Web went from 85 to 47 and 85 to 75 respectively based on corrected baseline data

"Where are we now?" and "are we making progress?"

- Tool examines IPv6 and IPv4 status of DNS, Mail and Web Services Weekly
- Tool is unrelated to the USGv6 profile and the USGv6 Testing Program
  - No assessment on compliance to USGv6 Profile
  - Services not monitored whether they are running over IPv6 stacks
- Monitored domain and service; report estimated number of IPv4 interfaces for that services/and number of interfaces that:
  a) have an Ipv6 address configured,
  b) Of those, the number of interfaces whose IPv6 addresses are reachable to our monitor,
  c) the number of those interfaces actually running the service over Ipv6 (e.g. answering DS queries)
- Includes a heuristic indication of whether the service in question seems to be operating within the domain in question or if it's provided elsewhere.
- Monitor relies on the DATA.gov list of agency domains [augmented].

Best Practices

Addressing, Testing, and Applications

- **Check with your Web Developers to determine if:**
  - **Upgrades** are needed for *reachability and webcode*
    - Most of the work needed is on reachability only
  - **Webcode** update needed if
    - IPv4 addresses are hard coded in website, and/or
      - Address fields for IPv4, i.e. 32 bits wide
      - 127.0.0.1 loopback address
      - Data-structures and functions that are unusable in a dual-stack environment
    - IPv4 functions being used in scripts (PHP, CGI, Java, etc.)
- **Testing and certification guidelines** mentioned on http://www.ipv6forum.org/ipv6_enabled
- If listed on IPv6 Forum as an approved site
  - Place the IPv6 Forum WWW logo on your web site
  - IPv6 Forum *only needs reachability check before approval*

DOE IPv6 Dashboard

High Level Implementation Checklist

Sample Agency Ipv6 Execution Timeline 2012 Public Facing Execution	Key Stakeholders (External)	Milestone 1 Jun-11	2 Dec-11	3 Jun-12	4 Dec-12	5 Jun-13	6 Dec-13	7 Jun-14	8 Dec-14
Network Connectivity									
Internet Gateway 1 IPv6 Enabled	Networx or other Carriers (ISP)	Complete							
Internet Gateway 2 IPv6 Enabled		In Progress	Complete						
Internet Gateway 3 IPv6 Enabled		In Progress	Complete						
Internet Gateway 4 IPv6 Enabled		In Progress	Complete						
Addressing									
ISP Provided Ipv6 Addresses	Networx or other Carriers (ISP) ARIN	Complete							
Announce Agency IPv6 Addresses		In Progress	Complete						
Routing									
Basic IPv6 Routing	Networx or other Carriers (ISP) Routing Vendors	Complete							
IPv6 BGP Routing Gateway 1		In Progress	Complete						
IPv6 BGP Routing Gateway 2		In Progress	Complete						
IPv6 BGP Routing Gateway 3		In Progress	Complete						
IPv6 BGP Routing Gateway 4		In Progress	Complete						
IPv6 Multi-home Routing			In Progress	Complete					
Domain Name Services (DNS)									
ns1 IPv6 enabled	GSA (.gov) DNS Providers	Complete							
ns2 IPv6 enabled		In Progress	Complete						
ns3 IPv6 enabled		In Progress	Complete						
ns4 IPv6 enabled		In Progress	Complete						
Primary Agency Domain (www.energy.gov)									
Phase 1	Cloud/Hosting Providers Web Vendors	Complete							
Phase 2		In Progress	Complete						
Mail									
Inbound SMTP IPv6 Enabled	Cloud/Hosting Providers SMTP/Mail Security Vendors	In Progress	Complete						
Outbound SMTP IPv6 Enabled			In Progress	Complete					
Security									
DMZ Basic Ipv6 Security	MTIPS/TICAP Providers Security Vendors Security Service Providers	Complete							
DMZ Comparable Ipv6 Security		In Progress	In Progress	Complete					
Full Ipv6 Security			In Progress	In Progress	Complete				
Network Management									
Basic Ipv6 Network Management	Network Management Vendors	Complete							
Comparable Ipv6 Network Management		In Progress	In Progress	Complete					
Full IPv6 Network Management			In Progress	In Progress	Complete				
Public Facing Domains									
1 Public Facing Domain IPv6 Enabled	Cloud/Hosting Providers Web Vendors	Complete							
35% Public Facing Domains IPv6 Enabled		In Progress	Complete						
100% Public Facing Domains IPv6 Enabled		In Progress	In Progress	Complete					
Pilots									
Mission Pilots	Impacted Vendors/Providers	In Progress	In Progress	Complete					

Legend
In Progress
Complete

Sample Agency Ipv6 Execution Timeline 2014 Enterprise Network Execution	Key Stakeholders (External)	Milestone 1 Jun-11	2 Dec-11	3 Jun-12	4 Dec-12	5 Jun-13	6 Dec-13	7 Jun-14	8 Dec-14
Network Connectivity									
Core/Backbone Network	Networx or other Carriers Router Vendors	In Progress	In Progress	Complete					
Infrastructure Routers 25%				In Progress	Complete				
Infrastructure Routers 50%				In Progress	In Progress	Complete			
Infrastructure Routers 100%				In Progress	In Progress	In Progress	Complete		
Addressing									
Internal Ipv6 Addresses Allocated	ARIN DCHPv6 Vendors		In Progress	Complete					
DHCPv6 Enabled 25%				In Progress	Complete				
DHCPv6 Enabled 50%					In Progress	Complete			
DHCPv6 Enabled 100%					In Progress	In Progress	Complete		
Routing									
Core/Backbone Network Routing	Networx or other Carriers Router Vendors		In Progress	Complete					
Infrastructure Routing 25%				In Progress	Complete				
Infrastructure Routing 50%					In Progress	Complete			
Infrastructure Routing 100%						In Progress	Complete		
Domain Name Services (DNS)									
Internal DNS Ipv6 Enabled	DNS Vendors		In Progress	Complete					
Data Centers									
Data Center 1 IPv6 Enabled	Networx or other Carriers Router Vendors IT Vendors Service Providers	In Progress	In Progress	Complete					
Data Center 2 IPv6 Enabled				In Progress	Complete				
Data Center 3 IPv6 Enabled					In Progress	Complete			
Data Center 4 IPv6 Enabled					In Progress	Complete			
Mail									
Exchange Ipv6 Enabled	Mail Vendors			In Progress	In Progress	Complete			
Internal Applications & Services									
Internal Applications & Services 25%	Application Vendors Service Providers IT Vendors		In Progress	In Progress	Complete				
Internal Applications & Services 50%				In Progress	In Progress	Complete			
Internal Applications & Services 75%					In Progress	In Progress	Complete		
Internal Applications & Services 100%					In Progress	In Progress	In Progress	Complete	
End Device Transition									
Internal Servers IPv6 Enabled 25%	Server & OS Vendors Virtualization Vendors IT Vendors			In Progress	Complete				
Internal Servers IPv6 Enabled 50%				In Progress	In Progress	Complete			
Internal Servers IPv6 Enabled 75%				In Progress	In Progress	In Progress	Complete		
Internal Servers IPv6 Enabled 100%				In Progress	In Progress	In Progress	In Progress	Complete	
User Computers IPv6 Enabled 25%	Laptop/Desktop & OS Vendors		In Progress	Complete					
User Computers IPv6 Enabled 50%			In Progress	In Progress	Complete				
User Computers IPv6 Enabled 75%			In Progress	In Progress	In Progress	Complete			
User Computers IPv6 Enabled 100%			In Progress	In Progress	In Progress	In Progress	Complete		
PDA/Mobile Devices Ipv6 Enabled 25%	PDA Vendors			In Progress	Complete				
PDA/Mobile Devices Ipv6 Enabled 50%				In Progress	In Progress	Complete			
PDA/Mobile Devices Ipv6 Enabled 75%				In Progress	In Progress	In Progress	Complete		
PDA/Mobile Devices Ipv6 Enabled 100%				In Progress	In Progress	In Progress	In Progress	Complete	
Mission Devices IPv6 Enabled 25%	IT Vendors Device Vendors			In Progress	Complete				
Mission Devices IPv6 Enabled 50%				In Progress	In Progress	Complete			
Mission Devices IPv6 Enabled 75%				In Progress	In Progress	In Progress	Complete		
Mission Devices IPv6 Enabled 100%				In Progress	In Progress	In Progress	In Progress	Complete	
Pilots									
Enclave Pilot Phase 1	IT Vendors	In Progress	Complete						
Enclave Pilot Phase 2			In Progress	Complete					
Enclave Pilot Phase 3				In Progress	Complete				

Legend
In Progress
Complete