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USGv6: Technical Basis for IPv6 Adoption.

USGv6:

Establishing a Technical Basis for IPv6 Adoption in the USG.

http://www.antd.nist.gov/usgv6/

usgv6-project@antd.nist.gov.

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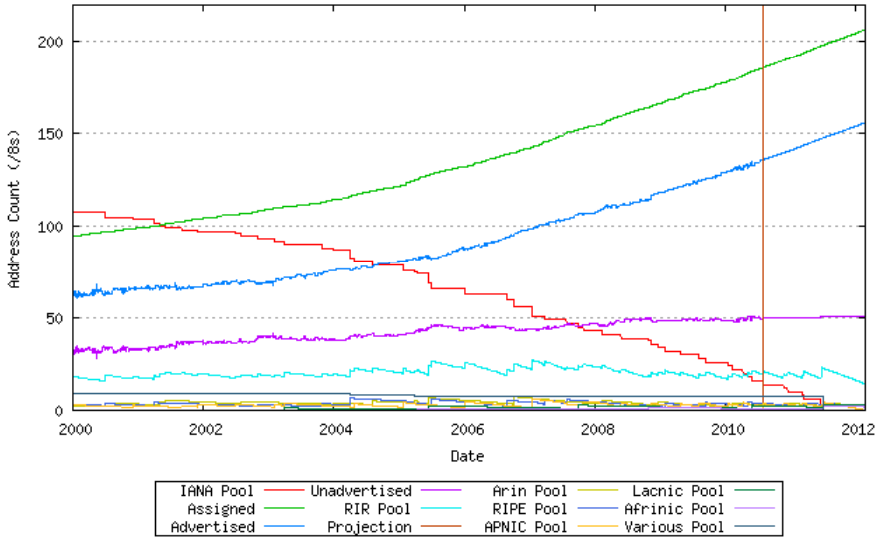
The IPv4 Sky is Falling!..?

- **Are we running out of IPv4 Addresses?**
  - Details depend on the meaning of “we” and “out”….
  - ...but in general, **YES!.**
- **When?**
  - Speculative “science” but things will get “interesting” in the next 1-2 years.
- **What will happen then?**
  - Use IPv6?
  - Deploy big NATs in the sky?
  - Hijack address blocks?
  - New models of IPv4 address management / ownership?
- **How to Expedite IPv6 Adoption?**
  - Vast installed base of IPv4 & 20+ years experience.
  - Mission critical systems.
  - Early adopter costs vs ROI?

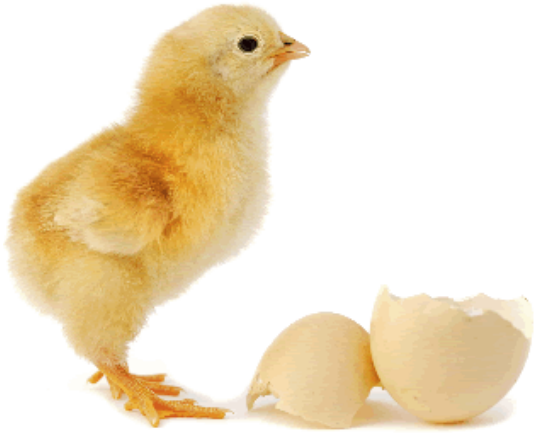


http://www.potaroo.net/tools/ipv4/index.html

Projected IANA Unallocated Address Pool Exhaustion: 20-Jun-2011
Projected RIR Unallocated Address Pool Exhaustion: 23-Feb-2012

Industry Response?

- **IPv4 Exhaustion will happen … what then?**
  - Will constrain economic growth.
  - Will add complexity and brittleness to the network.
  - Will incite address hijacks / black markets.
  - Will undermine trust relationships based upon address ownership.
  - Will cause the network to become more opaque to operators / law enforcement / intelligence.
- **IPv6 Killer Application: Internet Business Continuity!**
  - Enabling the Internet to continue to grow as an economic driver and as a key piece of critical infrastructure.
    - IPv6 was always about the addressing and routing problem …
- **Can we afford not to deploy IPv6?**
  - Starting to be the more interesting question?
- **Some key industry segments get it ….**
  - Cellular providers
  - M2M industries



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USG Response?

- Research and Development of IPng / IPv6
  - NIST and many other USG agencies contributed to the design and evolution of IPv6 standards in the IETF.
- If you *only* standardize it … they won't come.
  - Tragedy of the commons phenomena – "Evolving Core Capabilities of the Internet" - Journal on Telecommunications and High Technology Law, Vol. 3, 2004.
  - **How do you get it deployed?**
- The National Strategy to Secure Cyberspace
  - "The United States must understand the merits of, and obstacles to, moving to IPv6 and, based on that understanding, identify a process for moving to an IPv6 based infrastructure. The federal government can lead in developing this understanding by employing IPv6 on some of its own networks and by coordinating its activities with those in the private sector… The government should play a role when private efforts break down due to a need for coordination or a lack of proper incentives."

IETF®

USGv6 History & Context

- **OMB - Policy M-05-22 & FAQ**
  http://www.whitehouse.gov/omb/memoranda/fy2005/m05-22.pdf
  http://www.whitehouse.gov/omb/egov/documents/IPv6_FAQs.pdf
  - **All Agencies** – Plan for IPv6 adoption. Deploy & use "IPv6 capable/compliant" products in "core" networks by June 2008.
    - Requires agencies to "ensure orderly and secure transition"
    - FAQ: "Agencies should verify …capability through testing …are required to maintain security during and after adoption …"
  - **NIST** – "The National Institute for Standards and Technology (NIST) will develop, as necessary, a standard to address IPv6 compliance for the Federal government."
  - **OMB & GSA** – "Additionally, as necessary, the General Services Administration and the Federal Acquisition Regulation Council will develop a suitable FAR amendment for use by all agencies."
- **NIST Activities**
  - **Surveyed the state of industry**, DoD, and foreign profile / testing efforts.
    - Met with DoD, JITC, IPv6Forum, UNH/IOL, TAHI, ETSI, INRISA, USG IPv6 Working Group, Large users and vendors.
  - **Recommended development of USG IPv6 Profile/Test program**
    - and explicit goal of fostering harmonization across industry/user groups and planning for USG exit as soon as prudent.

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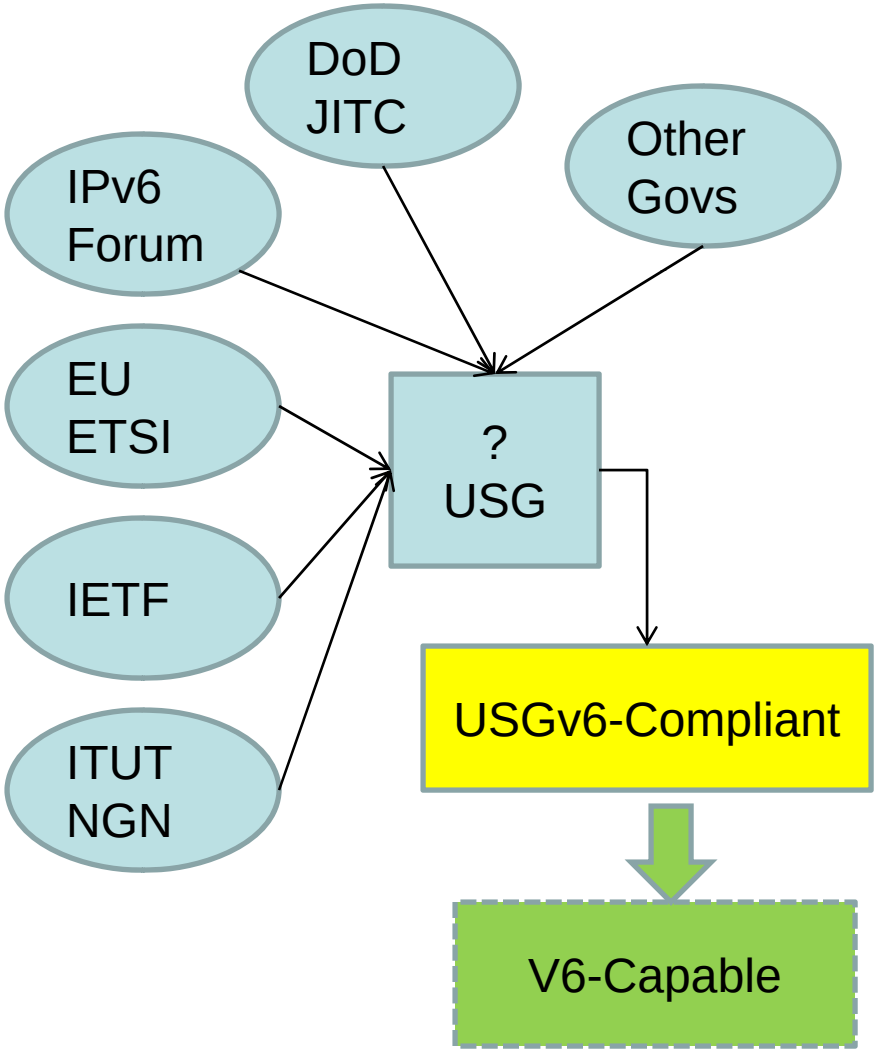
Yet Another IPv6 Program?

- **Goals:**
  - Program to meet USG requirements.
  - Minimize USG centric involvement.
- **Surveyed the State of Industry.**
  - Met with all know players nationally/internationally.
  - Reviewed all profile/test programs.
  - Searching for open/public/international program that could meet USG needs.
- **Result:**
  - Found none that currently could meet goals.
  - Create a new program that others could converge to.
  - Look to transfer profile / test program back to the industry as soon as possible.
  - Retaining only those functions/roles that are inherently governmental.



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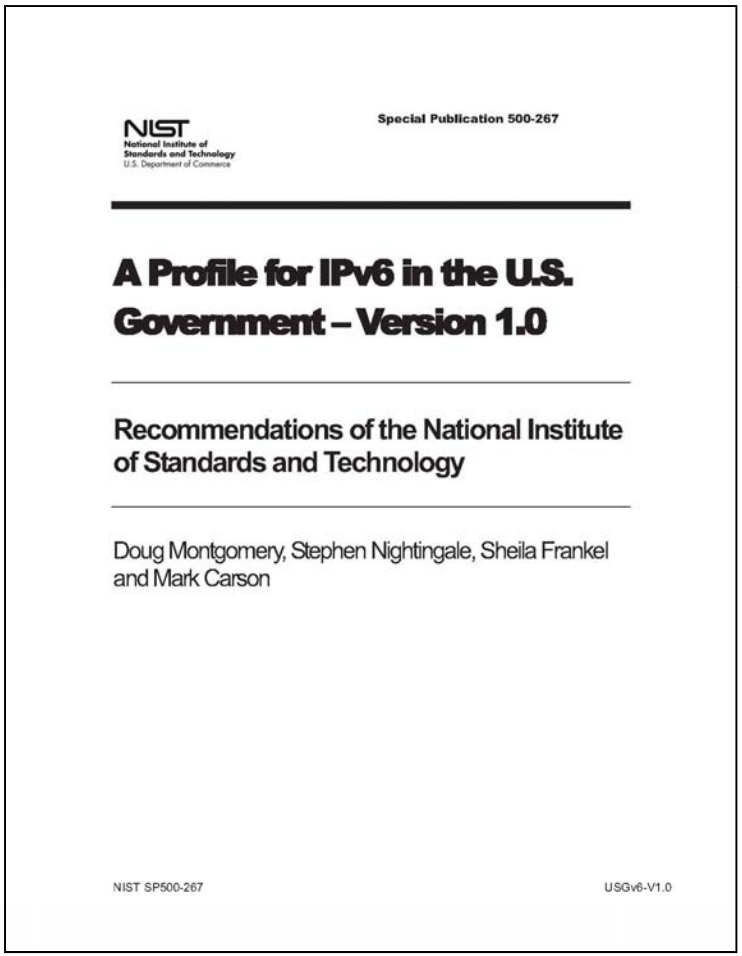
USGv6-V1.0

http://www.antd.nist.gov/usgv6/

USGv6: Technical Basis for IPv6 Adoption.

USGv6 Profile:

- **Defines what "IPv6" means.**
  - Cites 150+ RFCs to define "low bar" requirements for hosts, routers and network protection devices.
  - Establishes a vocabulary to express procurement requirements between users, policy makers and vendors.
  - Policy free as emitted by NIST, but can provide the basis for other USG policies.
- **USG / User / Vendor Collaboration**
  - Two public comment periods, numerous public/vendor meetings and outreach efforts.
  - Highly coordinated and harmonized with DoD / IPv6 Profiling effort.
- **Outlines Test Program.**


NIST National Institute of Standards and Technology U.S. Department of Commerce

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

NIST National Institute of Standards and Technology

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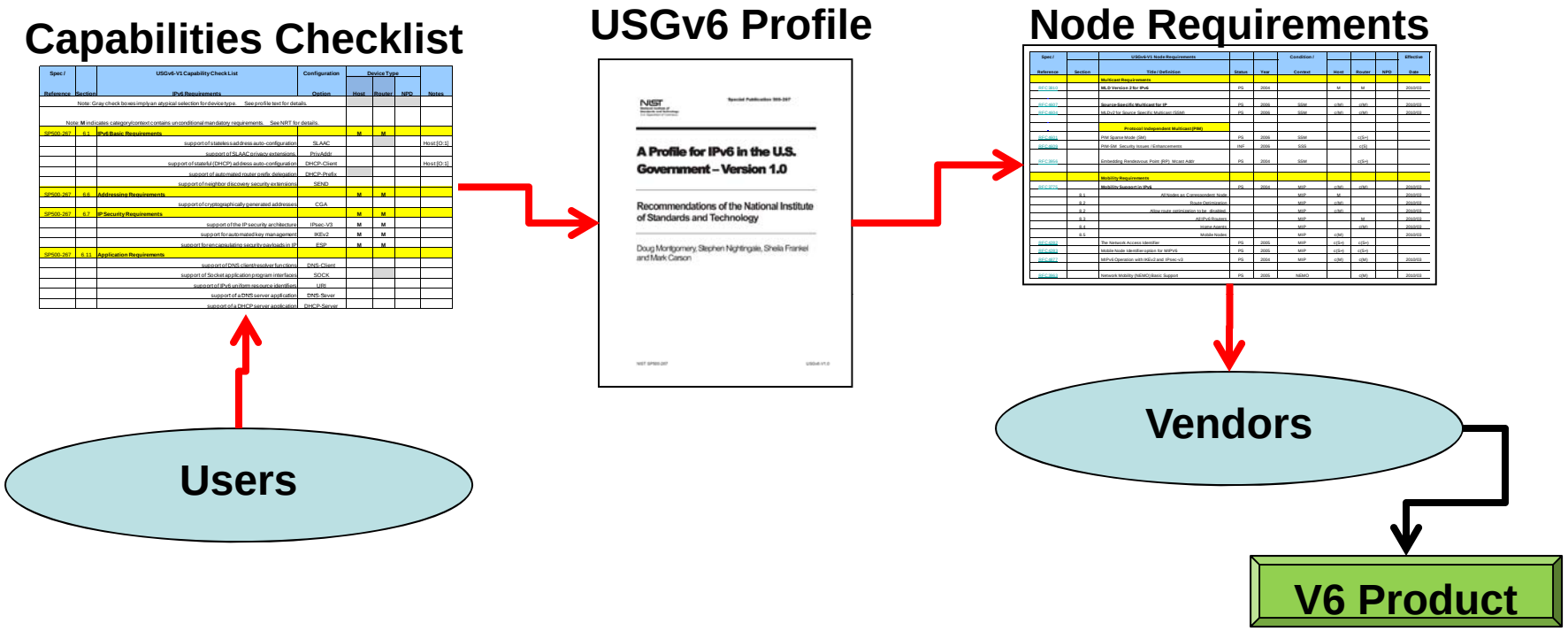
Vocabulary for Requirements



- USGv6 provides the technical infrastructure to enable:
  - precise communication of IPv6 requirements from USG users to vendors; and
  - precise communication of IPv6 capabilities from vendors to USG consumers.

USGv6-V1 Overview

- **Scope and Application**
  - **Recommendation from NIST** – in isolation is **policy free**.
    - Applicable to “non national security Federal IT systems”.
  - **Strategic planning** document to
    - Guide acquisition of IPv6 technologies for Federal IT systems.
    - Establish architectural goals for USG IPv6 network services.
    - Other uses/time-frames are cautioned.
  - Defines **recommended & useful sets of IPv6 requirements** to:
    - Deliver expected functionality
    - Insure interoperability
    - Enable secure operation
    - Protect early investments
  - Defines and **compliance framework** to:
    - Enable products to be tested against requirement sets.
    - Document the results of such tests.
  - **Technical basis** for further refinement and other uses:
    - Agency / mission specific technical requirements.
      - Everything that is not mentioned is optional.
    - Agency / USG acquisition / deployment policies.

What the Profile is Not

- Applicable in the very near term
  - No mandatory requirement should be expected sooner 24 months after final “MUST” is published.
- Deployment or Operations Guide
  - Designed to be a guide to acquisition.
  - Significant additional planning, guidance, reference will be needed to develop operational usage plans and policies.
- Static, Complete, Universally Applicable
  - It is fully expected that users will modify with agency, mission, procurement specific requirements. **In fact it is required.**
  - It is fully expected that some devices, systems, uses will not be easily accommodated by the generalizations of the profile.

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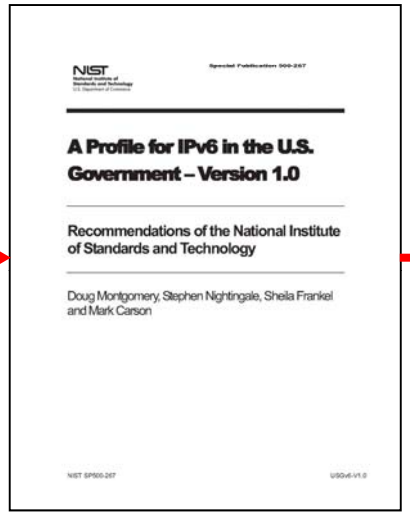
USGv6: Technical Basis for IPv6 Adoption.

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



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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							
RFC3810		**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
RFC4604		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+)		
RFC4609		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
	8.5	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

?

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

V6 Products

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USGv6 Testing Program

USGv6: Technical Basis for IPv6 Adoption.

- **Establish a unified testing program:**
  - Conformance, Interoperability, and Functional testing for Hosts, Routers, NPDs
- **Goal: One-stop Worldwide Testing.**
  - Establish program based upon accredited labs, public test specifications and validated test methods.
  - Establish common means of reporting test results.
  - Establish means of tracing vendor's declarations back to accredited test results.
- **Flexible / Open Program:**
  - Support 1st, 2nd, 3rd party conformance testing.
  - Support 2nd, 3rd party interoperability testing and NPD functional testing.
  - Using commercial labs and accreditors.
  - **Balance the burden / cost of testing with value / protection derived.**
  - **Deal with the complexity of modern products**.
- **Operational 2010:**
  - Includes Accredited Labs, with tested products

NIST

ICSA labs An Independent Division of Verizon Business

IPv6 READY

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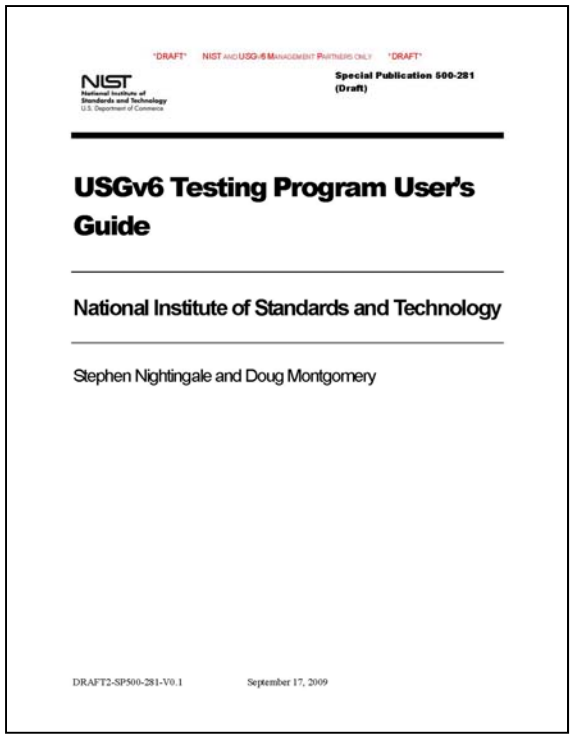
IPv6 FORUM



"DRAFT" NIST AND USGv6 MANAGEMENT PARTNERS ONLY "DRAFT"

NIST National Institute of Standards and Technology U.S. Department of Commerce

Special Publication 500-281 (Draft)

USGv6 Testing Program User's Guide

National Institute of Standards and Technology

Stephen Nightingale and Doug Montgomery

DRAFT2-SP500-281-V0.1 September 17, 2009

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Vocabulary for IPv6 Requirements

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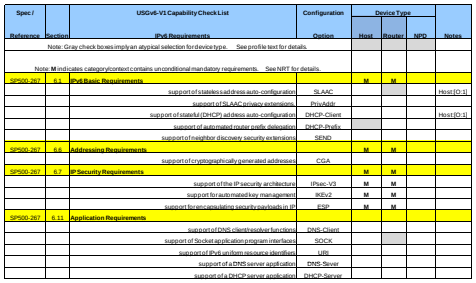

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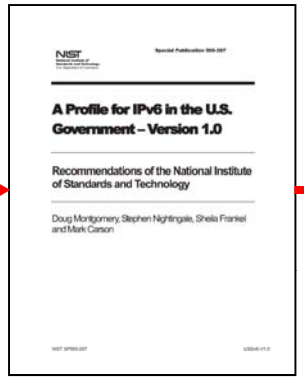
USGv6 Profile



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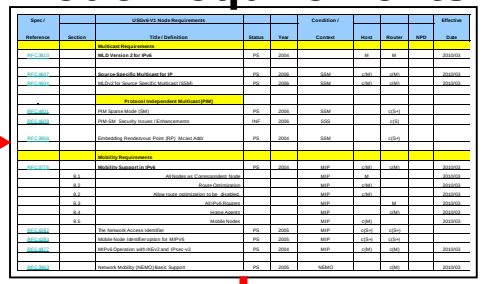

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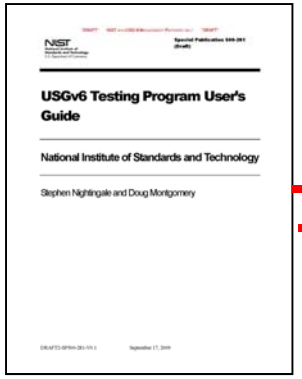
Vendors

Users

Test Program



USGv6 Testing Program User's Guide

National Institute of Standards and Technology

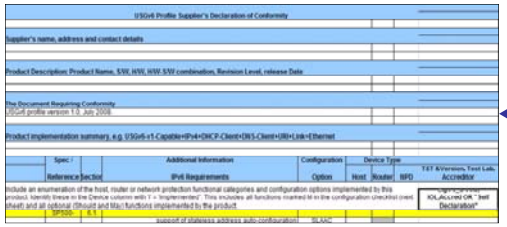
Stephen Nightingale and Doug Montgomery

Test Results

V6 Product

Test Labs

Vendor's SDOC



USGv6 Profile Supplier's Declaration of Conformity

Supplier's name, address and contact details

Product Description: Product Name, S/W, H/W, H/W S/W combination, Revision Level, release Date

The Document Requiring Conformity
USGv6 profile version 1.0, July 2008

Product implementation summary, e.g. USGv6-v1-Capable=IPv4+DHCP-Client+DNS-Client+URI+Link=Ethernet

Spec / Reference	Section	Additional Information IPv6 Requirements	Configuration Option	Device Type Host	Router	NPD	TST &Version, Test Lab, Accreditor
include an enumeration of the host, router or network protection functional categories and configuration options implemented by this product. Identify these in the Device column with 'I = Implemented'. This includes all functions marked M in the configuration checklist (next sheet) and all optional (Should and May) functions implemented by the product.							IOL/ALI/xxx/ OR " Self Declaration"
SP500	6.1.1						
		support of stateless address auto-configuration	SLAAC				

Accreditors

FAR Clause

- http://edocket.access.gpo.gov/2009/pdf/E9-28931.pdf
- **What it says:**

Federal Acquisition Regulation; FAR Case 2005–041, Internet Protocol Version 6 (IPv6) AGENCIES**: Department of Defense (DoD), General Services Administration (GSA), and National Aeronautics and Space Administration (NASA). ACTION: Final rule.**

"Unless the Agency CIO waives the requirement, when acquiring information technology using Internet Protocol, the **requirements documents must include reference to the appropriate technical capabilities** defined in the USGv6 Profile (NIST Special Publication 500-267) and the **corresponding declarations of conformance defined in the USGv6 Testing Program**. The applicability of IPv6 to agency networks, infrastructure and applications specific to individual acquisitions will be in accordance with the agency's Enterprise Architecture (See OMB Memorandum M-05-22 dated August 2, 2005)."

- **What that means:**
- The intent of the new FAR language is to have each acquisition of IP protocol technology express requirements for IPv6 capabilities in terms of the USGv6 Profile (e.g., using the USGv6 Capabilities Check List) and to have vendors document their product's support of the requested capabilities, through USGv6 Test program (e.g., using the USGv6 Suppliers Declaration of Conformity).
- Given that the FAR language references the USGv6 Profile, as noted above, all Profile requirements should be considered as completely optional until July 2010.

USGv6-v1 Clarifications

- What is truly **required** ….
  - The Profile defines terms “USGv6-v1-Capable” and “USGv6-v1-Compliant”.
    - Primarily because we were tasked/asked to.
    - Also to create marketing pressure for recommended capabilities.
  - The FAR Clause does not require you to buy USGv6-v1-Capable / Compliant products!
    - This was purposeful … at least on our part.
    - The FAR requires you to use the USGv6 Profile to express acquisition specific requirements and the USGv6 Testing Program to asses which products meet those requirements.
- The profile doesn’t define product classes
  - It defines requirement classes, users instantiate individual products requirements.

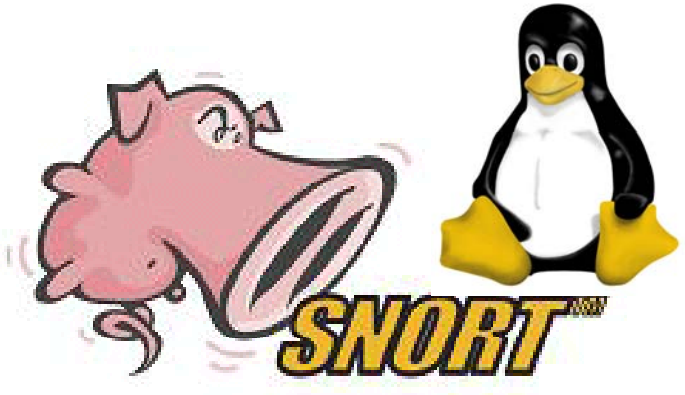
Practical Implications

- How the system is designed to work
  - Profile is used to define sets of requirements.
  - Test Program is used to verify sets of product capabilities.
    - Not “pass/fail” entire products.
    - Output of testing is a list of claimed & tested capabilities.
- User Requirements
  - Some (most?) early users will be using the profile more because of the FAR, than a real desire to acquire IPv6.
    - Likely to effectively just take the default recommendations.
    - Vendors likely to provide / market capability checklists that match their product offerings.
  - Need to insure that reasonable things happen for policy check-box users.

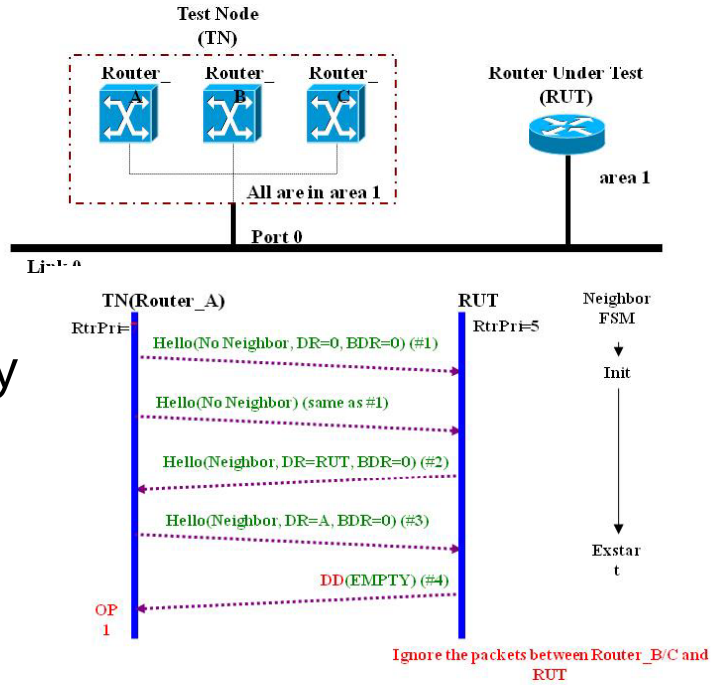
Other NIST IPv6 / USGv6 Activities?

NIST IPv6 R&D

- **NIST Prototype NDP**
  - Lack of fully functional IPv6 firewalls, IDS / IPS system hinder deployment.
  - Developing open source IPv6Tables/SNORT prototype based upon USGv6/NSA requirements.



- **OSPFv3 & SNMP Test System**
  - Collaboration with CHT-TL to develop conformance and interop test capability for OSPFv3 & SNMPv3



USGv6 Program
Questions / Discussion?