

The background of the slide features a stylized world map composed of a grid of small dots. Overlaid on this map are several large, semi-transparent circles of varying sizes, some containing clusters of smaller white dots, resembling a network or data visualization. The overall aesthetic is technical and digital.

US Govt. / Dept of Defense IPv6 Requirements: Linux Readiness

Venkata Jagana
(jagana@us.ibm.com)
Linux Technology Center, IBM

Leader – IPv6 Initiative/Linux Foundation

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Agenda (June 15th, 2007)

- 9.00 AM - 9.15 AM Introductions
- 9.15 AM - 9.30 AM DoD IPv6 mandate and Linux Problem scope
- 9.30 AM - 10.30 AM DoD IPv6 Profiles and Linux IPv6 Gap Analysis
- 10.30 AM - 10.45 AM BREAK
- 10.45 AM - 11.30 AM User-level Packages; Distros Enablement
- 11.30 AM - 1.00 PM Lunch
- 1.00 PM - 2.00 PM DoD Certification Process
(by Capt Jeremy Duncan of JITC/DoD)
- 2.00 PM - 3.00 PM Open Discussion: IPv6 Gaps, Resource needs and who can help

Introductions (9.00-9.15AM)

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US Govt. / Dept. of Defense: IPv6 Mandate

- On behalf of US Federal Gov't, Office of Management and Budget (OMB) issued a policy mandating all Federal Govt Agencies to upgrade their network infrastructure to IPv6, and interface each agency network with this infrastructure by June, 2008.
 - ▶ Operating in either dual IPv4/IPv6 mode or IPv6 only.
- DoD has its own requirement to upgrade its networks to IPv6 by 2008.

Linux IPv6 – Is it Ready?

➤ Problem

- ▶ Ongoing IPv6 development effort within the current Linux community is minimal, with only a few developer resources actively contributing.
- ▶ Even though Linux IPv6 is enterprise ready but lags behind in meeting the US Govt/DoD IPv6 June/2008 mandate.
- ▶ Not being able to meet IPv6 mandate is the Linux-industry problem.

➤ What needs to be done?

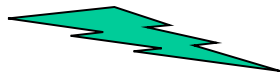
- ▶ Not too late to address the identified gaps.
- ▶ The Linux industry must get its act together quickly and address the gaps.
- ▶ Vendor companies must come forward, by providing developer resources, to take the ownership of some of the identified gaps and address them soon.

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Federal Govt. / DoD Milestones

Milestone	Description	Target Date	Linux (2.6.21)
Milestone Objective 1 (MO1)	Demonstrate basic Ipv6 functional capability and preparation for transition....	Oct 1, 2005	Green
Milestone Objective 2 (MO2)	Permit applications to test IPv6 specific end-to-end capabilities ...	Oct 1, 2006	Green
Milestone Objective 3 (MO3)	Core IPv6 infrastructures shall accept, route, and process IPv6 protocol traffic ..	Jun, 2008	Yellow



Info in this gap analysis is based on DoD functional Spec, 22 Nov 2005

Red “Reqd function minimally or not available”, **Yellow** “Reqd function partially available”, **Green** “Reqd function fully available”

US Govt. / DoD: Product Selection Criteria

- Interoperate with both IPv6 and IPv4 systems and products.
- If not initially compliant, provide a migration path and commitment to upgrade to IPv6 for all application and product features by June 2008.
- Have available contractor/vendor IPv6 technical support for development and implementation.

US Govt/DoD Agencies: Stakeholders

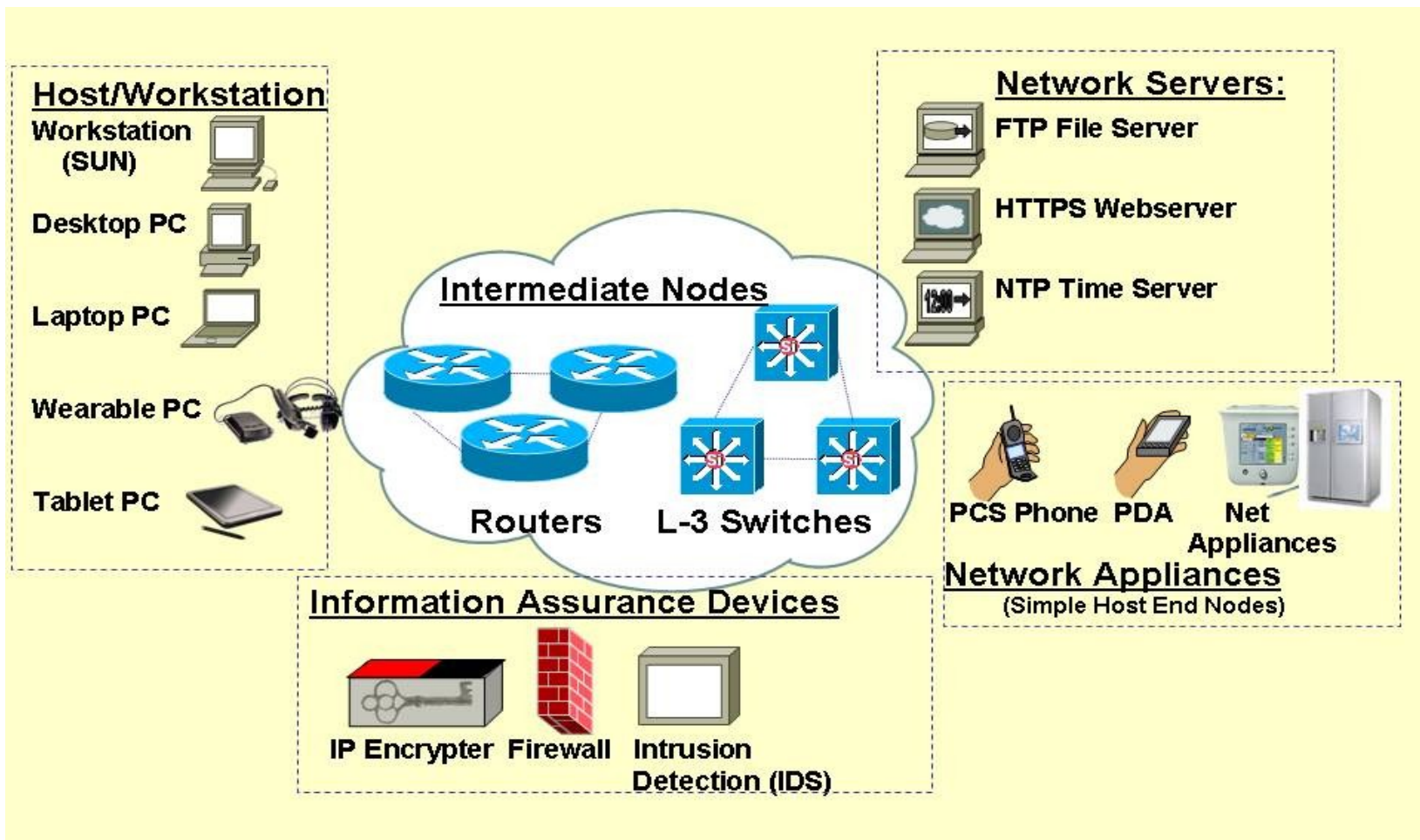
- **Federal Agency**
 - ▶ Must ensure the use of IPv6 network backbone infrastructure, and must interface its network with this infrastructure (June 2008).
- **NIST (National Inst for Standards & Technology):**
 - ▶ Responsible for developing IPv6 test compliance / conformance / interoperability standard for all Federal agencies.
- **GAO/FARC**
 - ▶ Amend acquisition regulations as necessary for use by all Federal agencies.
- **CIO Council**
 - ▶ Responsible for developing any additional transition guidance as necessary for the agencies.
- **JITC (Joint Interoperability Test Command Center)/DISA**
 - ▶ Responsible for assessing the IPv6 capabilities of the products used by DoD using Generic Test Plan.

IPv6 Capable Product: Definition

- A product must meet the IPv6 “base requirements” and support requirements for one (or more) product categories such as
 - ▶ Host/Workstation (**End nodes for users**)
 - ▶ Network Appliance (**Simple end nodes for users such as PDAs, PCS phones, simple sensors, home automation, Internet appliances**)
 - ▶ Router (**Intermediate nodes for packet routing**)
 - ▶ L-3 Switch (**Intermediate nodes for packet switching**)
 - ▶ Information Assurance Device (**Provides some Information Assurance (IA) service function**)
 - ▶ Network server (**Provides some type of IPv6 Network Service**)
 - ▶ In addition to meeting the categories mentioned above, a product must support the IPv6 version of any IPv6 protocol functional categories required for its function within the DoD Global Information Grid (GIG).

Source: https://www.aiptl.nit.disa.mil/documents/DISR_IPv6_Product_Profile__v1.doc

IPv6 Product Categories



Source: https://www.aiptl.nit.disa.mil/documents/DISR_IPv6_Product_Profile__v1.doc

IPv6 Capable Product: Base Requirements

- RFC 1981, Path MTU Discovery for IPv6
- RFC 2460, Internet Protocol v6 (IPv6) Specification
- RFC 2461, Neighbor Discovery for IPv6
- RFC 2462, IPv6 Stateless Address Auto-configuration
- RFC 2464, Transmission of IPv6 packets over Ethernet
- RFC 3810, MLDv2
- RFC 4443, Internet Control Message Protocol (ICMPv6)
- RFC 4301, Security Architecture for the Internet Protocol: All end nodes and intermediate nodes *requiring security* MUST have an upgrade path to full IPsec by 2007.
- IPv6 Addressing Architecture:
 - ▶ RFC 4291, IPv6 Addressing Architecture
 - ▶ RFC 4007, Scoped Address Architecture
- RFC 4193, Unique Local IPv6 Unicast Addresses

Source: https://www.aiptl.nit.disa.mil/documents/DISR_IPv6_Product_Profile_v2.0%20final%2015Jun07.doc

IPv6 Capable Product: Protocol Functional Categories

➤ **Transition Mechanisms (TM)**

- ▶ All IPv6 nodes that must interoperate with IPv4 MUST support one or more transition mechanisms for interoperability.

➤ **Connection Technology (CT)**

- ▶ Link layer connection technology definitions for all nodes (Ex: Ethernet, PPP).

➤ **IPv6 Security Profile (IPsec)**

- ▶ Protocols to achieve basic IP Security (IPsec) for IPv6.

➤ **Quality of Service (QoS)**

- ▶ IPv6 protocols related to QoS signaling and services.

➤ **Mobility (MOB)**

- ▶ Requirements to achieve IPv6 Mobility (MIPv6) and Network Mobility (NEMO) for IPv6.

➤ **Wireless Systems (Wireless)**

- ▶ IPv6 support for wireless systems including header compression and MANET routing.

➤ **Network Management (NM)**

- ▶ Protocols for network management in IPv6 networks.

Source: https://www.aiptl.nit.disa.mil/documents/DISR_IPv6_Product_Profile_v2.0%20final%2015Jun07.doc

IPv6 Capable Product: Certification Process

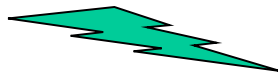
- The IPv6 product vendor must first get all product(s) scheduled for testing to obtain interoperability certification.
 - ▶ <http://vt.fhu.disa.mil/calendar/default.asp>
- The IPv6 product vendor must follow the process defined at (<https://www.aiptl.nit.disa.mil/documents/IPv6%20APL%20Process%20v%200.9.pdf>) to get it tested.
- JITC will assess IPv6 product compliance and interoperability based on Generic Test Plan (<https://www.aiptl.nit.disa.mil/documents/IPv6-GTPv2.pdf>)
 - ▶ Issues compliance certification letter based on the results.
- The product will be placed in Approved Products List (APL) if IPv6 capable product requirements are met.
 - ▶ APL listing of product is critical for DoD procurement

Source: http://jitc.fhu.disa.mil/adv_ip/register/register.html#server

Federal/DoD Reqts: Linux Gaps Summary

	Linux (2.6.21)
IPv6 Base Area	Green
IPv6 Transition Area	Yellow
IPv6 Network Management & Ops	Yellow
IPv6 Applications and Services	Green
IPv6 Security	Yellow
IPv6 Mobility	Yellow

- Bottom line: Linux community must ramp up its resources to meet 2008 federal mandate.
- The detailed gaps listed in follow-on slides are for Linux as advanced server, but there may be additional gaps that need to be addressed for Linux as router, Network Appliance or Information Assurance Device.



Per DOD reqts version 2.0, and functional Spec 22 Nov 2005

Red "Reqd function minimally or not available", **Yellow** "Reqd function partially available", **Green** "Reqd function fully available"

Federal/DoD Reqts: IPv6 Core

IPv6 Base/Core Area	Linux (2.6.21)
1981 Path MTU discovery for IPv6	Green
2373 IPv6 Addressing Architecture	Green
2374 IPv6 Aggregatable Global Unicast Address Format	Green
2460 IPv6 Specification	Green
2461 Neighbor discovery for IPv6	Green
2462 IPv6 Stateless Autoconfiguration	Green
2463 Internet Control Message Protocol for IPv6	Green
2464 Transmission of IPv6 packets over Ethernet networks	Green
2472 IPv6 over PPP	Green
2491, 2492, 2684 IPv6 over NBMA (ATM)	Green
2553 Basic Socket Interface extensions for IPv6	Green
2710 Multicast listener discovery (MLD) for IPv6; 3810 MLDv2	Green
2711 IPv6 Router Alert option (host only)	Green
3484 Default Address Selection	Yellow
3493 Basic Socket Interface Extensions for IPv6	Green
3513 IPv6 Addressing Architecture	Green
3542 Advanced Socket API for IPv6	Green
4429 Optimistic DAD for IPv6	Green
4443 ICMPv6 for IPv6	Yellow
4193 Unique Local IPv6 Unicast, 4007 scoped address arch 4291 IPv6 addr arch	Yellow

Red indicates “function not available”, Yellow indicates “function partially available”, Green indicates “function fully available”

Federal/DoD Reqts: Transition Mechanisms

Transition Mechanisms Area	Linux (2.6.21)
1993 Transition mechanisms for IPv6 hosts and routers	Green
2784 Generic Routing Encapsulation	Green
2893 Transition mechanisms for IPv6 hosts and routers (Dual Stack)	Green
3056 Connection of IPv6 domains via IPv4 clouds (Tunnels)	Green
4213 Basic Transition mechanisms for IPv6 hosts and routers (dual stack & configured tunnelling)	Green
3053 IPv6 Tunnel Broker	Yellow

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Federal/DoD Reqts: Network Management & Operations

Network Management Area	Linux (2.6.21)
2452 IPv6 MIB for TCP	Green
2454 IPv6 MIB for UDP	Green
2465 Management Information Base for IPv6: Tex convs & Gen Group	Green
2466 Management Information Base for IPv6: ICMPv6	Green
4022 MIB for TCP	Yellow
4113 MIB for UDP	Yellow
4087 IP Tunnel MIB	Yellow
4293 MIB for Internet Protocol	Yellow
4292 IP forwarding MIB	Yellow
Standard 62/RFC 3411, An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks	Yellow
Standard 62/RFC 3412, Message Processing and Dispatching for the SNMP	Yellow
Standard 62/RFC 3413, SNMP Applications	Yellow

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Federal/DoD Reqts: Security

Security Area	Linux(2.6.21)
2401 Security Architecture for the Internet Protocol	Green
2402 IP Authentication Header	Green
2403 The Use of HMAC-MD5-96 within ESP and AH	Green
2404 The Use of HMAC-SHA-1-96 within ESP and AH	Green
2406 IP Encapsulating Security Payload (ESP)	Green
2409 The Internet Key Exchange (IKE)	Green
2410 The NULL Encryption Algorithm and Its Use With IPsec	Green
3041 Privacy extns for stateless address autoconfiguration in IPv6	Green
3971 SEND	Red
4306 IKEv2 Protocol	Red
4307 Cryptographic Algorithms for use in IKEv2	Red
4302 IPSec AH	Yellow
4303 IPsec ESP	Yellow
4305 Cryptographic Algo Implementation reqts for ESP	Yellow
4308 Cryptographic Suites for IPSec	Yellow
4309 Using AES CCM mode IPSec ESP	Yellow

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Federal/DoD Reqts: Applications & Services

Applications Area	Linux (2.6.21)
3596 DNS extensions to support IPv6	Green
2428 FTP Extensions for IPv6 and NATs	Green
3315 DHCPv6	Yellow
2732 Format for literal IPv6 addresses in URL	Green
2821 SMTP	Green
854 Telnet	Green

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Federal/DoD Reqts : Mobility

Mobility Area	Linux(2.6.21)
3775 Mobility support in IPv6	Yellow
3776 Using IPSec for MIPv6 signalling between MN/HA	Red
4068 Fast Handovers for Mobile IPv6	Red
4295 Mobile IPv6 MIB	Red
3963 NEMO Basic Support Protocol	Red
4282, Network Access Identifier	Red
4283, Mobile Node identifier option for MIPv6	Red

Red indicates “function not available”, **Yellow** indicates “function partially available”, **Green** indicates “function fully available”

Closing Gaps in Linux: A Snapshot

Core Areas	2.6.16	2.6.17	2.6.18	2.6.21
IPv6 Core: Overall	Yellow	Yellow	Yellow	Yellow
- Default address selection	Red	Red	Yellow	Yellow
- Various MIBS	Yellow	Yellow	Yellow	Light Green
- ICMPv6 for IPv6 (new RFC)	Yellow	Yellow	Yellow	Yellow
- Optimistic DAD for IPv6 (new RFC)	Red	Red	Red	Green
IPSecv6: Overall	Yellow	Yellow	Yellow	Yellow
- IPSec AH and ESP (new RFCs)	Yellow	Yellow	Yellow	Yellow
- Opportunistic encryption, SEND	Red	Red	Red	Red
- Cryptographic suites for IPSec	Red	Red	Red	Red
- Using AES CCS mode for IPSec ESP	Red	Red	Red	Red
Mobile IPv6: Overall	Red	Red	Yellow	Yellow
- Mobility support for Ipv6	Red	Red	Yellow	Yellow
- Using IPSec AH	Red	Red	Red	Red
- Fast handoff optimization	Red	Red	Red	Red
- MIB	Red	Red	Red	Red

Red indicates “not available”, Yellow indicates “partially available”, Green indicates “fully available”

Existing Linux IPv6 Gaps: Satisfying DoD Requirements (v2.0)

Gaps

IPv6 Core: RFC 3484 (Policy Table only), 4443, 4007, 4193, 4291

Security: RFC 4301,4303,4305,4306,4307, 4308,4309, 3971

Network Mgmt: RFC 4022, 4113, 4087, 4292, 4293, 3411, 3412, 3413

Mobility: RFC 3775,3276,4295,3963,4282,4283

Tunnel Broker: RFC 3053

DHCPv6: RFC 3315 (Full support of DHCPv6 protocol for server & relay agent)

SNTP: RFC 4330

Various User Level Packages for IPv6 enablement

Call to the Linux Industry

- The Linux industry must help in closing the required IPv6 gaps. Without this help, Linux won't be able to meet the required certification criteria.
 - ▶ Must take the ownership of the identified gaps and help close them through dedicated developer resources.
- Linux developer community must also come forward to address these gaps.
- If your product is using Linux as one of the listed product categories, then identify the corresponding IPv6 gaps for the IPv6 capable product and then contribute developer resources to address those gaps.

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User Level Packages

- Packages Classification
 - ▶ Set of Packages do not require IPv6 enablement
 - ▶ Set of Packages already enabled for IPv6
 - ▶ **Set of Packages requiring IPv6 enablement**

- A sample set of most commonly used packages: 300
 - ▶ Set of Packages do not require IPv6 enablement: 200
 - ▶ Set of Packages already enabled for IPv6: 40
 - ▶ **Set of Packages requiring IPv6 enablement: 60**

User Level Packages (A Sample Set): Not enabled for IPv6

Package	Comments
autofs	Dependency on NFS/IPv6
nfs-utils	Dependency on NFS/IPv6; patches available but require integration
openhpi	Does it require IPv6 enablement?
openIPMI	Does it require IPv6 enablement?
openslp	How critical is its support? Need to find out applications dependency
openssl	Use by multiple apps
snort	Seems like there are multiple usages; other than Intrusion detection
perl	
pam	
Samba, sudo, syslinux	

User Level Packages

- Need some dedicated developers to go off and assess the packages for IPv6 readiness.
 - ▶ Work with the corresponding Open Source community by influencing them to enable for IPv6 or
 - ▶ Go ahead and Develop the IPv6 support for those packages that require the support.
- Add the list supported IPv6 RFCs in readme or some related documentation for the IPv6 enabled packages.

User Level Packages: Distro dependencies

- There may be some packages that are specific Linux distribution dependent
 - ▶ Distros might want to look at and identify those specific packages and request for assistance of the corresponding community.
- Any input from distros?

IPv6 Dependencies : Others

- Linux Standards Base (LSB)
- Any Other opensource middleware?

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Switch to Capt. Jeremy Duncan Slides

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Open Discussion: Resource needs (Companies/Developers who can help)

- Please sign-up on IPv6 Wiki or contact jagana@us.ibm.com to help with this effort