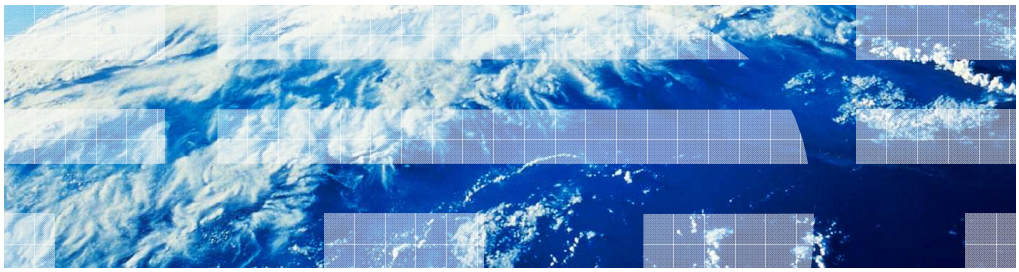
z/OS Communications Server

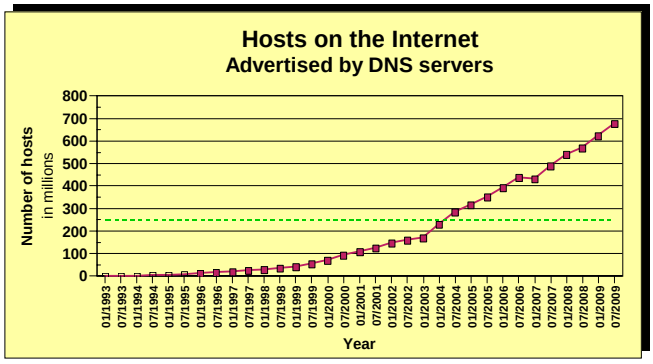
Next generation internet: IPv6 – Business case



This presentation describes the reasons why IPv6 will become much more important in the next few years because IPv4 addresses are running out. In the last few decades, the industry has come up with several technologies to extend the life of the IPv4 addressing scheme yet another few years. These technologies include NAT (network address translation) firewalls, SOCKS servers, and others during 1990s and early 2000s. However, there are no more new technologies in the pipeline, and IPv4 addresses are likely to run out in 2012.

IPv4 address usage since early 1993

- Projected Internet Assigned Numbers Authority (IANA) Unallocated Address Pool Exhaustion
  - July 2011
- Projected Regional Internet Registries (RIR) Unallocated Address Pool Exhaustion
  - April 2012
- z/OS® Communications Server continues to focus on IPv6 standards currency
  - US DoD/NIST
  - IPv6 Forum



- What is the upper practical limit (the ultimate pain threshold) for number of assigned IPv4 addresses? Some predictions said 250,000,000 (250 million), others go up to 1,000,000,000 (one billion or one milliard).
- Source: https://www.isc.org/solutions/survey
- Source: http://www.potaroo.net/tools/ipv4/index.html
- Source: http://penrose.uk6x.com/

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There are many unknowns around IPv6, but one thing is well known and that is that IPv4 addresses are running out. Various internet-related organizations keep track of the number of assigned IPv4 addresses. They all indicate that by 2012 to 2014, the internet will run out of IPv4 addresses.

First, the Internet Assigned Numbers Authority (IANA) will run out of IPv4 address blocks that can be assigned to the Regional Internet Registries (RIRs).

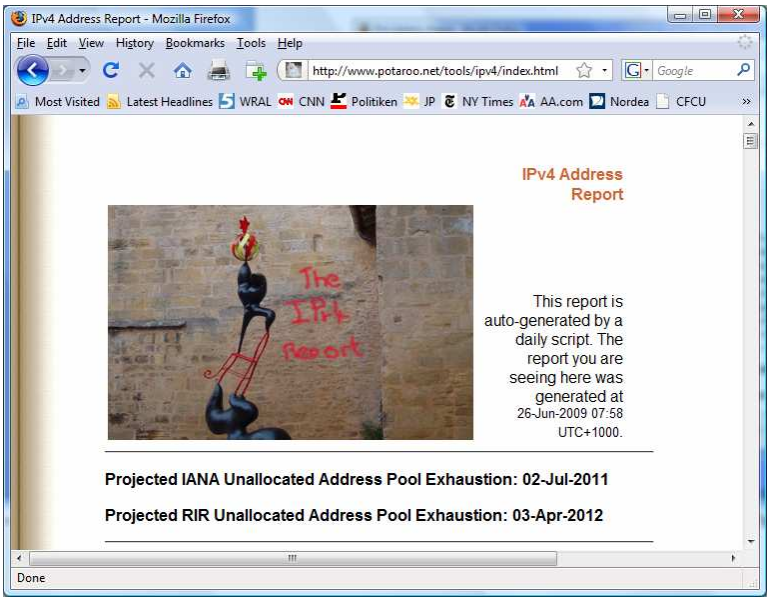
Shortly thereafter (one to two years), the regional registries are expected to run out of IPv4 addresses.

At that point, no more IPv4 addresses can be assigned to ISPs or private companies that need internet accessible IPv4 addresses. Remember that even NAT-based internet connectivity technologies require a certain number of public IPv4 addresses.

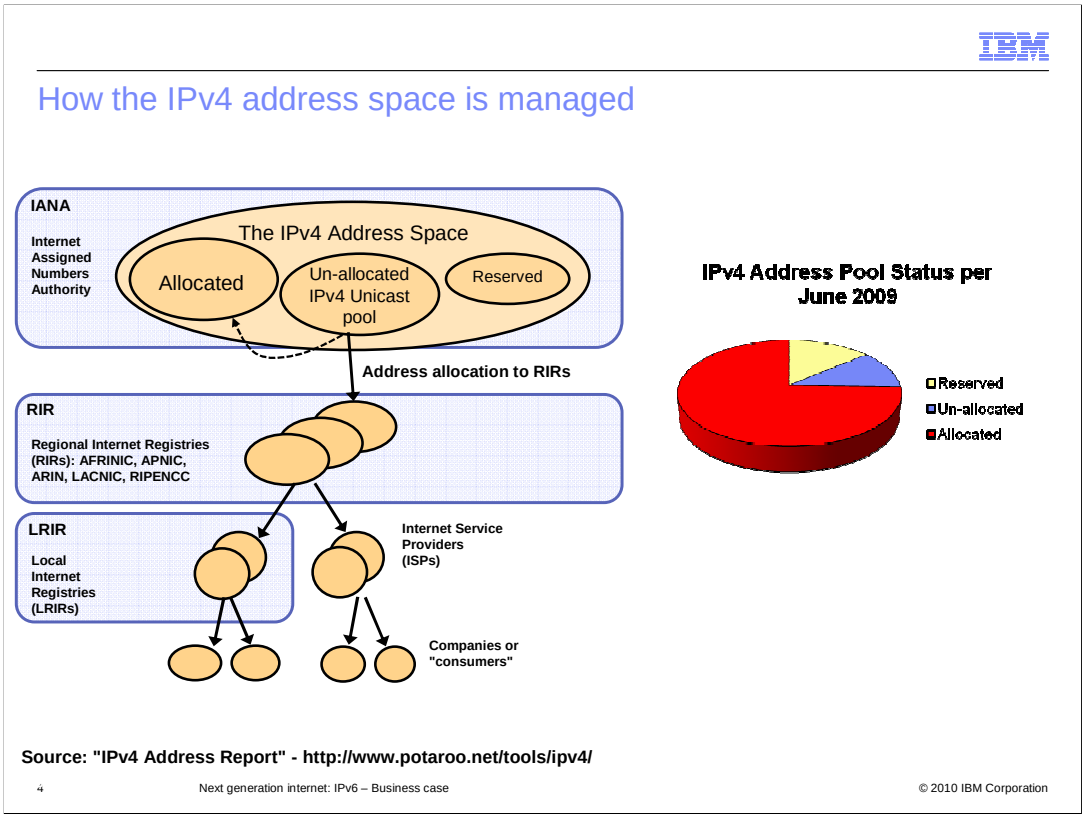
Various government organizations have begun to plan for deployment of IPv6 connectivity. Best known are the US Department of Defense (DoD) and National Institute of Standards and Technology (NIST). Both organizations have defined IPv6 compliance requirements that IT solutions must meet. z/OS is tracking these compliance requirements carefully. z/OS V1R10 has achieved the “Special Interoperability Test Certification of the IBM z/OS Version 1.10 Operating System for IBM Mainframe Computer Systems for Internet Protocol Version 6 Capability” of the US Department of Defense - http://jitc.fhu.disa.mil/adv_ip/register/certs/ibmzosv110_dec08.pdf

If you want to stay in business after 2011 or 2012, you need to start planning for IPv6. IPv4 and IPv6 will coexist for many years to come. Your applications need to be able to use both. If you write directly to the TCP/IP sockets layer, you need to start changing those applications.

Is Doomsday approaching?



Go to http://www.potaroo.net/tools/ipv4/index.html for a daily status of when IPv4 addresses will run out. The site is updated daily based on the latest statistics and as predicted date approaches, the fluctuations are getting smaller.



The role of the IANA is to manage the unallocated IPv4 unicast address pool. IANA does not perform user or ISP address assignments. It allocates units of address blocks to RIRs. The specific address block allocated to the RIR is an IANA decision. The block is allocated to the RIR when the RIR's available space falls below the working space required for nine months of allocations. The allocation made by IANA is a minimum of one block, and enough to restore the RIR's address pool to encompass a further 18 months of allocations.

The five Regional Internet Registries are AfriNIC, APNIC, ARIN, RIPE_NCC, and LACNIC.

AfriNIC covers Africa and portions of the Indian Ocean.

APNIC covers portions of Asia and portions of Oceania (which includes Australia, China, and India).

ARIN covers Canada, the United States, and islands in the Caribbean Sea and North Atlantic Ocean.

RIPE_NCC covers Europe, the Middle East, and Central Asia.

LACNIC covers Latin America and portions of the Caribbean.

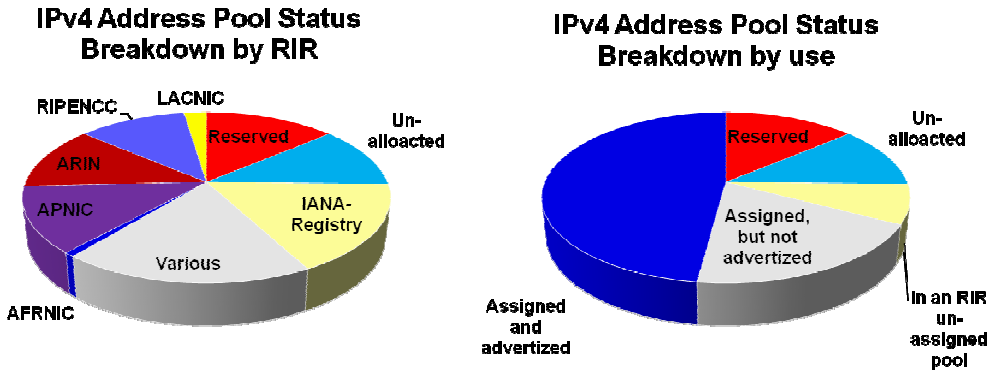
The RIRs operate as self-regulatory bodies with strong regional industry support and participation.

One role of the RIRs is to host open policy for that, among other functions, set address allocation policies within the region. The RIRs manage the address distribution function, assigning addresses to ISPs and various forms of Local Internet Registries (LIRs) in a manner that conforms to these regional policies.

IANA divides the IPv4 address space into three groups.

> The first group is the address space allocated and assigned to a regional registry or a user (ISP, large company, and so on).
>
> The second group is reserved addresses (various IPv4 addresses have special meaning, such as loopback, multicast, and so on).
>
> The third group is the unallocated pool, which is the pool of available IPv4 addresses that can be assigned to one of the RIRs.
>
> Current predictions estimate that the un-allocated pool is to be drained by mid 2011. Some of the assigned but not advertised space might potentially be re-used to prolong the life of IPv4.

IPv4 address space data as of June 2009



Reserved:	Reserved by the IETF
Un-allocated:	Available to be allocated to the RIRs
IANA-Registry:	Addresses assigned directly by the IANA from before the time of regional registries
Various:	Space allocated to various registries (before regional registries were introduced)
AFRINIC:	Africa, portions of the Indian Ocean
APNIC:	Portions of Asia, portions of Oceania (includes Australia, China, India)
ARIN:	Canada, United States, islands in the Caribbean Sea and North Atlantic Ocean
RIPENCC:	Europe, the Middle East, Central Asia
LACNIC:	Latin America, portions of the Caribbean

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The allocated number pool is managed by the Regional Internet Registries (RIRs). The breakdown of IANA allocated address blocks to each of the RIRs is shown in this slide. The address block allocated to "VARIOUS" refers to the IANA IPv4 address registry where several blocks were assigned before the commencement of today's RIR system, and are listed as assigned to "Various Registries". Address blocks that are assigned from these blocks are typically managed by multiple registries. The figure also includes 40 blocks listed against an IANA registry. This refers again to the IANA IPv4 address registry where, before the RIR system, assignments were made directly by the IANA.

An individual IPv4 address can be in any one of five states:

(1) reserved for special use,

(2) part of the IANA unallocated address pool,

(3) part of the unassigned pool held by an RIR,

(4) assigned to a user entity but not advertised in the routing system, or

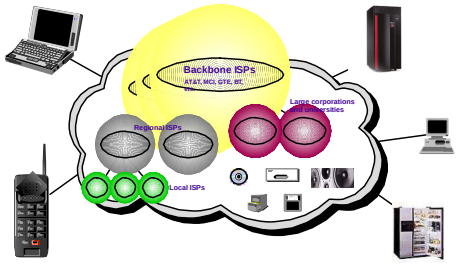
(5) assigned and advertised in the BGP (border gateway protocol).

The current total of IP addresses in each state is shown in the right pie chart on the slide.

It's this simple: IPv4 addresses are running short!

- Forget about fancy IPv6 features as a reason for moving to IPv6
- IPv6 deployment is inevitable
  - Literally running out of IPv4 addresses
    - To minimize disruption, IPv6 needs to be in place and in actual use before exhaustion occurs
  - No other credible alternative to IPv6
    - Only alternative is IPv4 with significant increase in NAT
- All major vendors have maturing IPv6 product lines
  - All IBM operating systems support IPv6, with middleware and application support starting to ship as well
  - Router vendors (such as Cisco) have supported IPv6 for several years
  - Microsoft® VISTA

The Internet - a worldwide digital utility.



Connectivity for ***anyone*** from ***anywhere*** (car, plane, home, office) to ***anything***!
More and more "push" applications being deployed in the wireless market space.

IPv6 promises true end-to-end connectivity for peer-based collaborative solutions

Why is IPv6 so important? Because IPv4 addresses are literally running out! Currently there isn't another "good" alternative to IPv6.

You COULD use IPv4 with significant increases in network address translation, but using more private addresses increases the chances for address collisions. Using NAT means that you lose globally unique addressing. Using NAT also means that the NAT firewall bordering the public internet must have a workable pool of public IPv4 addresses.

Everything these days seems to have an internet connection! There are not enough IPv4 addresses to support this growth. One case in point:

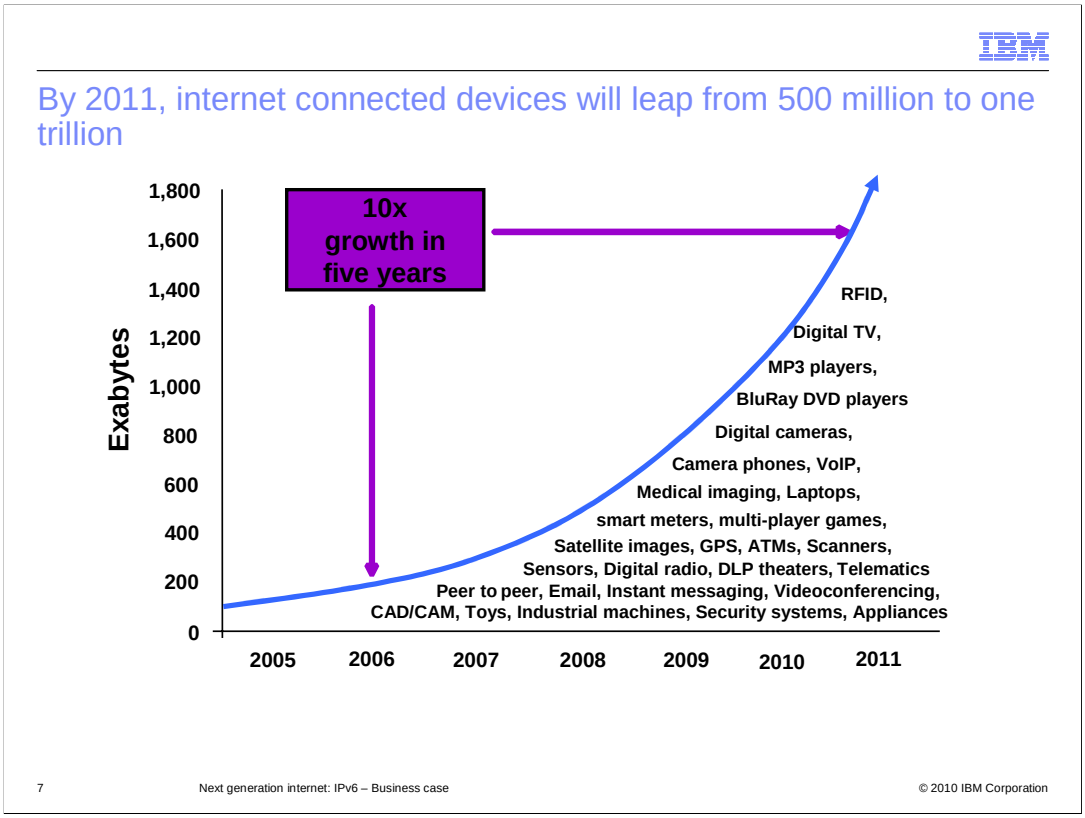
> The Third Generation Partnership Project (3GPP) is responsible for the standardization of the third-generation mobile networks. It has designated the session initiation protocol (SIP) as the call control protocol and IPv6 as the only network protocol for 3G IP-based wireless networks.

Push applications mean that servers connect out to clients when they have data to which the client subscribes. Servers connecting out to clients mean that clients must have public addresses – which breaks the typical model for NAT technologies where clients are behind a NAT firewall. Only IPv6 can deliver enough public IP addresses to support this type of application. This is the reason why 3G and 4G networks use IPv6 technologies.

The good news is that all major vendors have maturing IPv6 product lines in place. All IBM operating systems support IPv6.

Middleware and application support is continuing to grow. Routing vendors like CISCO have supported IPv6 for several years.

Microsoft VISTA is IPv6 enabled.



The proliferation of sensors, digital communications and other forms of digital data collection has led to a projected tenfold growth in digital data between 2007 and 2011. All of this data has the potential to provide an enterprise with valuable insights for running your business more effectively and efficiently.

Business analysts need to adapt from an environment in which the challenge was in gaining insights from limited data to one in which the challenge is in managing and extracting useful information from massive data sets. As you can imagine, finding the relevant data, and quickly, amid the 'mountain' of available data can be like finding a needle in a haystack. Moreover, of the growth in digital data, approximately 80% of it is expected to comprise semi-structured and unstructured data (email, blogs, medical images, videos, audio files, and pictures). With unstructured data, considerable effort is required to 'understand' the data, before further analysis can be performed to intelligently influence decision making.

The number of semantically tagged documents and data sets is growing, as a result of five developments.

(1) “Linked Data” guidelines, published in 2006, make it easier to share data on the web. The Linking Open Data community project has the goal of making large numbers of open data sets more available by complying with the Linked Data guidelines. RDF (Resource Description Framework) triples are a key component of the Linked Data guidelines.

(2) Technologies to convert many legacy sources, especially relational data, into RDF triples, became available as open source in 2006 (and IBM Research has improved versions of these).

(3) Technologies are appearing that can automatically find associations between subjects and objects from one “data graph” with subjects and objects in other “data graphs”.

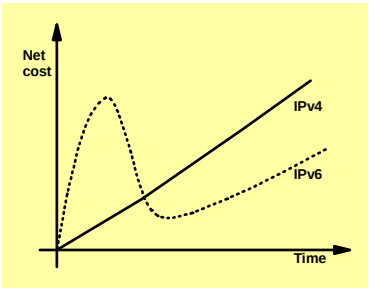
(4) Several important reference information suppliers, most notably Thomson Reuters, entered into this space (through their OpenCalais effort).

(5) Several efforts have developed technology to mine the essential information about people, places, materials, governments, businesses, works of literature and so on from Wikipedia. The information is put into a semantically tagged form (notably DBPedia and Freebase) so that as Wikipedia extends to cover more of the world’s knowledge, more of that becomes part of the web of semantic data.

The net result is that both the number of facts, and the rich interconnecting of different classes of facts, have been growing at an accelerating rate.

What are the business reasons to get serious about IPv6?

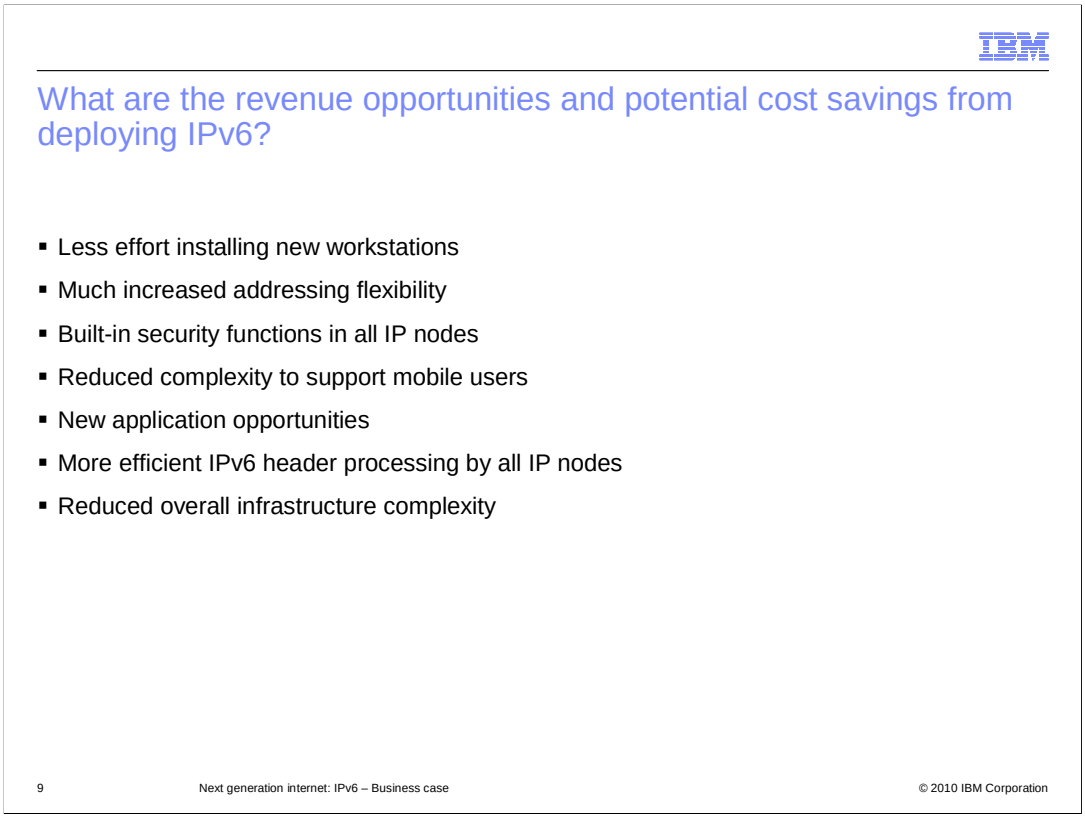
- Staying on IPv4
  - Cost will gradually increase due to the gradually increasing complexity of maintaining an IPv4 infrastructure
- Moving to IPv6
  - Costs more initially due to a phase of new investments
  - Costs less eventually due to the increased flexibility and operational aspects of an IPv6 network infrastructure



There are several reasons to get started with IPv6. If you stay on IPv4, the cost will increase due to the gradually increasing complexity of maintaining an IPv4 infrastructure. Consider also the cost of missed opportunities by postponing IPv6 deployment.

There are costs associated with moving to an IPv6 deployment. You need to analyze and understand the current environment and subsequent business needs. You need to develop appropriate IPv6 skills. You need to design your IPv6 topology and develop a deployment plan. You need to purchase and deploy hardware and software upgrades to networking infrastructure. You need to implement the IPv6 infrastructure. And you need to consider operation costs.

After the initial cost of moving to IPv6, it will eventually be cheaper to maintain due to the increased flexibility and operational aspects of an IPv6 network infrastructure.



Deploying IPv6 can increase revenue opportunities and potentially save costs. With IPv6, you will expend less effort installing new workstations due to improved auto-configuration capabilities. IPv6 has better addressing flexibility, including the ability to easily move from one ISP (one prefix) to another (using a different prefix) through renumbering.

IPv6 has built-in security functions in all IP nodes (through IPSec). IPv6 is less complex for supporting mobile users. You might have new application opportunities with IPv6 as a result of restoring the original true end-to-end communications model. You should see higher throughput and reduced latency in the network due to the more efficient IPv6 header processing by all IP nodes. And IPv6 reduces overall infrastructure complexity due to less dependency on network address translation functions.

Who is currently taking the lead on IPv6 deployment?

- US Department of Defense (DoD)
- National Institute of Standards and Technologies (NIST)
- IPv6-Ready Phase 1 and Phase 2 logo certification
  - z/OS V1R5 is IPv6-Ready Logo Phase 1 certified
  - z/OS V1R8 and V1R11 are IPv6-Ready Logo Phase 2 certified
  - z/OS V1R10 is IPv6 certified according to the US DoD IPv6 requirements
- Other countries
  - Russia
  - European Union
  - Japan and China

There are several leaders in IPv6 deployment. The US Department of Defense (DoD) has detailed IPv6 compliance requirements. All platforms offered to DoD must meet very specific IPv6 capabilities.

Other US government institutions use the National Institute of Standards and Technologies (NIST). NIST has also published detailed IPv6 compliance requirements. Generally platforms offered to any US government institution must meet these very specific IPv6 requirements.

Worldwide, other organizations are closely looking at the IPv6 compliance testing – the IPv6-Ready Phase 1 and Phase 2 logo certifications. Note that z/OS V1R5 is IPv6-Ready Logo Phase 1 certified. z/OS V1R8 and V1R11 are IPv6-Ready Logo Phase 2 certified. And z/OS V1R10 is IPv6 certified according to the US DoD IPv6 requirements.

Russia has begun developing similar IPv6 compliance requirements. The European Union is trying to jump-start IPv6 deployment within the European Union. Japan and China have had operational IPv6 networks for a few years.

What can you do today? Start planning and testing!

- Develop a multi-step plan
- Choose a target date for being IPv6-enabled
- Develop a detailed plan for each sub-step
- Begin planning today!
- Plan for distributing and managing IPv6 addresses
- Understand your ISPs IPv6 plans
- Inventory all systems
- Plan to ensure all components are IPv6-enabled according to a workable timeline
- Determine how users will use IPv6 services
- Plan for IPv6 training, education and consulting

You can start planning and testing today.

(1) Develop a multi-step plan. Your eventual goal is a fully IPv6-enabled dual-stack operating environment.

(2) Choose a target date for being IPv6-enabled. Work backwards in developing a timeline on when key steps need to be completed.

(3) Develop a detailed plan for each sub-step to resolve critical dependencies in the necessary timeframe.

(4) It's not too early to begin planning today. The need for IPv6 can occur quickly and with little advanced warning. People are rapidly realizing that IPv6 is needed. It takes several years to actually get IPv6 deployed. You need to have IPv6 already in use (and tested) before it becomes a requirement that it be used operationally.

(5) Develop an internal addressing plan for distributing and managing IPv6 addresses. Determine how IPv6 addresses are obtained, either from your ISP or from a Regional Internet Registry (RIR). Consider whether Unique Local Addresses are appropriate.

(6) Understand your ISPs IPv6 plans.

(7) Perform a detailed inventory of all systems. Determine what is involved in IPv6-enabling them. Include all network hardware and software, all client and server hardware, software and applications.

(8) Develop plans to ensure all components are IPv6-enabled according to a workable timeline. Work with vendors to understand their plans for adding IPv6 support for all critical components.
(9) Determine how users will use IPv6 services. This will likely involve tunneling initially but you will need IPv6-capable routers on the edge links where clients connect. You will need to provide remote IPv6 access.

Finally, develop plans for IPv6 training, education and consulting.

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