



THE SIX MINUTE GUIDE TO IPv6

GETTING STARTED WITH THE INTERNET PROTOCOL VERSION 6

TCP/IP Version 6

Introduction

Introduction

If you need to learn about IPv6 or just want a bit more information on how it may affect your business then this is the place to start. Spend six minutes and get up to speed!

Address Exhaustion ...

The current addressing scheme used for the Internet (IP version 4) is almost exhausted and it is time to replace it with a numbering scheme that can cater for future growth. The Internet Protocol version 6 (IPv6) has a much larger address space that will provide an addressing scheme for the future.

Improved Security ...

IPv6 includes IP Security (IPsec) as an integrated component that is required in an IPv6 implementation, rather than an add-on feature like it was in IPv4. IPsec provides end-to-end security between two devices connected over the Internet.

Eliminate NAT ...

Network Address Translation (NAT) is widely implemented in IPv4 networks. It translates between a single IPv4 address on the outside of a network and a private address range on the inside, conserving the scarce IPv4 addresses. Unfortunately, NAT breaks some applications by changing the contents of packets as they traverse the NAT router. This violates the rules of security protocols that insist that all packets remain unmodified from source to destination. IPv6 has a huge address space, eliminating the need for NAT.

Improved Mobility ...

There is massive growth in mobile devices including smart phones and tablet computers. In some markets, tablets are starting to outsell laptop/notebook computers. The challenge these mobile devices place on networks is more complex than the issues of mobility for mobile (cell) phones. Not only do these mobile devices roam between towers on mobile (cell) networks, they also roam to Wi-Fi and other data networks with the user expecting a seamless network connection. IPv4 has been patched and amended to try to provide this support – something it was never originally designed to do. IPv6 however has been designed to cater for this mobility.

Education

Education is the starting point for IPv6. Start here...

Education is a key component of any IPv6 project. Without knowing how the protocols work, how they are different from IPv4, best practices in implementing them and pitfalls to avoid; the risks to an organization are too high. Start now and get your team up to speed.

did you know that an IPv6 address is 128 bits long (compared to 32 bits for IPv4)? This allows for a total of **340,282,366,920,938,463,463,374,607,431,768,211,456** addresses or 340 undecillion!

use the resources of the Internet to identify suitable training and implementation resources in your area and find information on best practice from organizations similar to yours.

Creating complex **variable length subnet masks** is now a thing of the past. With IPv6, we have a larger address space and can do simple sub-netting based on our network prefix. We will have plenty of subnet addresses available to meet our needs without resorting to complex address saving schemes.

a key technical decision that you need to consider is the transition method you will use. The choices are **Tunneling** (run IPv6 over IPv4) and **Dual-Stack** (run both on each device). Research and understand the implications of each method. IPv4 will still be with us for a long time.

to write the larger IPv6 addresses, we use the digits 0-9 and the letters a-f (hexadecimal numbering). Instead of the dot or period character, ‘.’ we use the colon ‘:’ to separate the hexadecimal digits. An IPv6 address can be quite long like this: **2001:0db8:0123:4567:890a:bcde:f012:3456**

invoke all staff to become involved the education process. Managers and executives need to be included in the training so they can make informed decisions about projects that involve IPv6.

One way we can simplify writing IPv6 addresses is to use **zero suppression** – this means that we can drop all the leading zeros. **2001:0db8:0123:0001:0023:0345:0006:0007** is reduced to: **2001:db8:123:1:23:345:6:7**. (Note: We use lower case letters a-f so that B and 8, D and 0 are not confused).

now there is a second way to shorten IPv6 addresses: **zero compression** allowing us to replace groups of zeros with the double colon ‘::’. (Note: We can only use this method once per address.) **2001:0db8:0000:0000:0000:0000:0001** can be reduced to **2001:0db8::0001**. We can further reduce this to **2001:db8::1** by using zero suppression.

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Planning

In planning your IPv6 project, clearly define the deliverables, scope, costs and resources required.

Expectations: Your project expectations must include those of the end users and management. The expectations for your end users may be that they do not experience any changes at all. Everything will work as normal, all web sites will be accessible, and email will flow normally. Managers will be looking for disruption to the business, costs/savings and any enhancements or improvements to normal business processes.

Inventory: *You need to identify all network equipment, web based applications, security systems, content management systems and any other device or system that uses an IP address on your network or other networks that your business uses. The next step is to identify which of these systems support IPv6. If they don't - do you plan to upgrade, replace or isolate them? Isolating them may mean they remain on an IPv4 segment of the network, reachable by tunneling or a dual-stacked¹ host.*

Inclusions and Exclusions: Which **deliverables** are you including and what is specifically excluded? Deliverables must be clearly defined so that you do not fall victim to **scope creep** - where the project is seen as a vehicle to fix all the ICT problems in the organization.

By failing to prepare, you are preparing to fail.
(Benjamin Franklin)

Time Frame: *Exactly when do you plan to start and finish your IPv6 Project? Fortunately, with any IPv6 implementation, there is no critical date by when you must implement (unlike the Y2K bug). Take care to include the availability of all internal and external resources that you plan to use and include a significant **contingency** factor to cater for Murphy's Laws of Technology².*

Cost & Resources: Don't forget to include resources from your hardware, software and application suppliers. They may even provide some resources at reduced cost so they can be part of the experience of a new IPv6 implementation – that is if you are a pioneer in your region or industry. You may need to convince them of the benefit of this experience to get their cooperation.

Approval: *It is critical that the planning phase includes formal approval by management to commence the pilot phase. This approval should be in writing and it should summarize the aims of the pilot phase and describe the final project objectives and estimated costs (subject to future review).*

¹ Dual-Stacked refers to a host or device that is running both IPv4 and IPv6 protocols.

² Murphy's Laws of Technology: "Anything that can go wrong will go wrong"

Design

Designing your IPv6 project includes the technical detail of what you want to achieve. Your design should also include a trial project that will test your design on a small scale.

Review your existing network design, look at the current and future challenges facing your network, in particular expansion to other offices, possible mergers and acquisitions and your mobile users/devices. Consider your transition method (tunneling or dual-stack).



*With such a large address space and no need to implement NAT, changing ISPs can mean complete network renumbering for IPv6 networks. If yours is a large organization then apply to your **Regional Internet Registry** for a “Provider Independent” network prefix. This will allow your network address to be completely independent from your ISP. This is useful if you want to change ISP in the future and is mandatory if you have multiple Internet connections via different ISPs.*

Document your design in detail. In particular, explain why you made each design decision. With IPv6 being relatively new, there is bound to be many revisions of your design in the future. Having this detail in your design will help future designers avoid mistakes that your design was intended to solve or avoid.

Firewalls, Intrusion Detection and Content Filters require special consideration. You will most likely need to run both IPv4 and IPv6 versions of these services. The rules will be similar but you can exclude NAT for IPv6.

Conduct a **critical review of your design** to ensure that you have not overlooked any important issues. Invite internal and external experts to suggest alternatives or features that you may have not considered. Find examples of *best practice* and see if your design meets or exceeds them. The design is a critical part of your IPv6 implementation so don't be afraid to consult widely.

Your **Pilot Project** is a trial of not only your detailed design and a test of the accuracy of your inventory but will test your staff – users, support and technical staff. In theory, your pilot project should provide a seamless experience where the users experience NO adverse effects to the business. Hopefully, there will be some improvements noticed too – like the ease of making external connections without NAT, improved support for mobile applications and more secure applications. Ensure you document the success and improvements from your pilot project as these will be helpful in getting your final project approved.

Pilot

Your pilot project is a small-scale test of what you expect to achieve in your full IPv6 project. It should be of similar complexity but have less users or applications.



Carefully select the users that you want to participate in the pilot project. These people need to be ‘early adopters’ who can:

- provide accurate reports of problems
- supply fair and unbiased opinions
- be tolerant and adaptable if problems occur
- report to their peers on the success of the pilot

Review

Review your pilot project to see what worked and what didn't. Make sure the opinion of all members of the team is included. User and management perceptions are important, as they will be critical in your final project.

- **Emphasize and celebrate** the good experiences.
- **Investigate and resolve** the bad experiences.
- **Update** your project plan based on the experiences from your pilot project.
- **Submit** your project plan to management for final approval

Implement

With the benefit of the experience from your pilot project, you are now ready to implement your IPv6 project.

It is most likely that your implementation project will include retaining IPv4 and adding IPv6 to most of the hosts and devices on your network. This implementation is known as **Dual Stack** – meaning both the IPv4 and IPv6 protocol stacks will be running on each device. During your planning phase, check the additional memory and CPU requirements for routers with two sets of routing tables (*IPv4 and IPv6 routes*).

Conclusion

Check that your project achieved its objectives. Report on your success to management and users.

Document your lessons learned (for the next project).

- What was successful?
- What did not work and why?
- What would you have done differently?

Get Started Now with IPv6!

How to start with IPv6 in your organization right now:

- Change your purchasing policy to ensure all new ICT purchases support IPv6. Advise your major suppliers of this requirement and request they produce certification to prove their IPv6 product support.
- Start an IPv6 education project for your organization, using some of the resources on the following page.
- Raise awareness in your organization about IPv6, discuss with colleagues, managers and executives.
- Circulate this document both within and outside your organization. You are permitted to circulate this document freely as long as it remains complete with its copyright notice.

Resources

The following resources will be useful in your IPv6 project:

Request for Comments (RFCs) – are the standards that define the protocols and services for the Internet, making it accessible from a wide range of vendor hardware and software. The Internet Engineering Task Force www.ietf.org is the organization responsible for the development, management and publication of these standards. Some of the main IPv6 standards include:

RFC Number	Topic
RFC 2460	Internet Protocol, Version 6 Specification (IPv6)
RFC 4301	Security Architecture for the Internet Protocol (IPsec)
RFC 3596	Domain Name System for IPv6 (DNSv6)
RFC 3315	Dynamic Host Control Protocol for IPv6 (DHCPv6)
RFC 4862	IPv6 Stateless Address AutoConfiguration (SLAAC)
RFC 4861	Neighbor Discovery for IP version 6 (ND)

IPv6 Forum

- www.ipv6forum.com - The IPv6 Forum is a worldwide consortium of leading Internet vendors, industry subject matter experts, and research & education networks. (*This is where the experts on IPv6 communicate.*)

Websites

- www.IPv6Train.com has a huge collection of IPv6 resources including tutorials, news, training courses, books, hardware support, operating system support, best practice and sites to test IPv6 clients.
- Need some help with your business case for IPv6? Hurricane Electric operates the largest IPv6 backbone network in the world. Read their business case document here: www.businessv6.he.net
- If you are not ready to go native IPv6 (or still only have an IPv4 ISP) try www.tunnelbroker.net where you can get free IPv6 tunnels and training/certification through actually deploying IPv6.
- Wikipedia has a helpful reference document on IPv6 with links to the major standards and many other useful background references: www.wikipedia.org/wiki/IPv6