



IP NETWORK

How Will the Change in Internet Addresses Affect Your Business?

The Internet has become indispensable for business and government world-wide not to mention the estimated 2 billion individuals who connect to it every day. This enormous popularity has led to near depletion of Internet Protocol (IP) addresses needed to uniquely identify each device using the Internet. Running out of Internet addresses would have disastrous worldwide consequences, as the ability to add and connect new devices would come to a halt. A new and much larger type of address known as IPv6 avoids this issue. But the IPv6 address is not compatible with the current address type. Further, it's not possible or economically desirable to replace all networking equipment and all devices to IPv6 all at once. What's needed are solutions that allow IPv6 to co-exist with the existing IP address type, IPv4, and for electronic information using one address type to be delivered to devices using the other. This paper will help you better understand what IPv6 is, why address exhaustion does not impact all businesses and regions the same, and what the options are for peaceful co-existence of IPv6 with IPv4 on the internet.

GROWTH OF THE INTERNET AND ADDRESS EXHAUSTION

You may have seen news reports, analyst articles, and blogs about the dwindling number of Internet addresses and how a new type of address, called IP version 6 (IPv6), overcomes this problem. Every device that uses the Internet has an “IP” address defined by a standard called the Internet Protocol (IP). These addresses are used much the way we use postal addresses when mailing a letter; we put a letter inside an envelope, add the recipient’s address and our return address on the outside, and put it in a drop box for delivery. On the Internet, an electronic device (a computer, smart phone, even a cable set top box) places information in an electronic envelope, adds the recipient and sender IP addresses, and forwards it on its way over the Internet.

Clearly, every device using the Internet needs a unique address. In 2010, it is estimated that the Internet was used by almost two billion individuals to connect and communicate. In 2008 it was estimated that the total number of personal computers in the world reached 1 billion and is projected to double by 2014. Just about every enterprise depends on the Internet to quickly and reliably conduct business in real time with suppliers and customers around the world. Running out of Internet addresses would have disastrous worldwide consequences, as the ability to add and connect new devices would come to a halt. IPv6 avoids this issue by introducing a new address format and an enormous new address supply.

Business problem solved, right? Well, while IPv6 adds plenty of new addresses, the new address format (IPv6) is not backward compatible with the earlier format, IP version 4 (IPv4). This affects Internet service providers and enterprises alike, as it impacts how they are adding and supporting new customers, optimizing current and future computer and network infrastructure investments, providing seamless employee communication, and fulfilling government mandates.

Networking equipment, called routers, can forward electronic information only when the sender and receiver use the same address type. Routers work like regional mail forwarding centers that send letters to the forwarding center closest to you so your mailman can deliver it to your mailbox. Adding a new IPv6 address format means the Internet operates as if there are two different postal services with incompatible addresses and mail forwarding centers. So, how would you send a letter using one service to a recipient who is using another? As you will learn later, the lack of backward compatibility between IP address formats can be overcome through different solution options and cost-effective planning.

Many articles take an alarming view, suggesting that everyone needs to replace the existing IP addressing method with the new one as soon as possible. But this is not practical, as it is impossible to replace all the devices and routers that use the earlier address type all at once. It will take a long time for devices that use the earlier address type to be retired. Clearly, migration to IPv6 is not like the Y2K event that required all computing systems to be upgraded by January 1, 2000. It is not possible or necessary to replace your entire network with IPv6 equipment all at once. The Internet is using both IPv4 and IPv6 addresses and will continue to do so for many years. In turn, your company networks will transition to IPv6 in phases, supporting both addresses types for some time. But you do need to plan for how you will migrate to IPv6 and build a business case based on your unique requirements.

Before reviewing the options for peaceful coexistence between these two address types, let’s quickly review the other capabilities of IPv6 and its impact in different parts of the world and on different industries.

IPv6 PROVIDES MORE THAN ADDRESSES

IPv6 was primarily designed to increase the number of unique addresses from approximately 4.3 billion in IPv4 to an astounding 340 billion, billion, billion, billion addresses. In addition, it provides other capabilities that may be valuable to your business:

- IPv6 has more efficient methods of addressing, so routers can handle the growth in Internet traffic.

- Servers and devices can automatically configure themselves when they connect to an IPv6 network, which simplifies administration via “plug and play” connectivity.
- An IP security protocol, known as IP Security or IPsec, is now integrated into IPv6, so communications are always secure (encrypted) from sender to receiver.
- Mobile devices such as cell phones use IP addresses, and when they move between mobile service access points they can drop calls, as the IP address is changed. IPv6 will reduce this.

The Impact of IPv4 Address Exhaustion is not Uniform

The degree and impact of IPv4 address exhaustion depends on location and industry. For example, in the United States there are still a large number of unassigned IPv4 addresses available, but in China and Japan there are not very many. The addition of IPv6 traffic will proceed at different rates in different parts of the world.

The U.S. government has been a proponent of IPv6, and federal agencies have mandates to support IPv6 in their computing systems and networks by specific dates. Note that several agencies provide information about IPv6 standards and have IPv6 certification programs for vendors who supply computing and network equipment. This information may help you with your planning. See the Useful References section.

Companies that build, operate, and provide Internet services, such as Internet Service Providers (ISPs), Internet Exchange Carriers (IXCs), telephone companies, cable companies, and internet content providers, must handle traffic from all parts of the world sent by all kinds of devices using both address types. Many of these already support a separate IPv6 network alongside their existing IPv4 network. Many also provide a way to move information between the two networks, called network address translation (NAT), so electronic data flows transparently between sender and recipient regardless of which address type they use.

Some industries, (for instance, utilities deploying smart grids of utility meters, the auto industry with IP addresses in every car, and so forth) will find it important to directly add IPv6 traffic to their own networks and will invest in migrating to IPv6 sooner rather than later. They will need a way to transparently move electronic data between the separate IPv4 and IPv6 networks they are operating, just as the Internet companies do.

IMPORTANT OPTIONS WHEN MIGRATING TO IPV6

As mentioned earlier, it is not possible, or even desirable, to replace all computing and networking equipment with IPv6 equipment at the same time. Instead, when buying new IT equipment during regular technology upgrades or to satisfy growth, you can specify that equipment be IPv6-ready. See the Useful References section for information on specifying IPv6 support by vendors.

For any company, deciding when and how to migrate to IPv6 should start with a business analysis and business case. As part of the technical analysis, it is important to understand the options and evaluate which ones would work well for your business. Companies may decide to use more than one option in their environment, as appropriate.

ISP-Provided IPv6 Network Address Translation Services

Many companies can communicate with customers and suppliers without converting their existing IPv4 routers to IPv6 right away. Instead, they can rely on ISPs that offer network address translation (NAT) services to keep them connected to IPv6 devices outside their own network. NAT is described in a separate section, but it can be thought of as a special forwarding service that can read one type of IP address and figure out what the corresponding address is for the other type. Since the applications that many companies rely on to run their business are using IPv4 in the data center and campus/LAN, there is no pressing need to migrate, as long as they can continue to connect to their customers and suppliers over the Internet via an ISP-supplied NAT service.

Dual-Stack Routers

When purchasing new network routers, you can specify that this equipment be capable of operating with both IPv4 and IPv6 address types. This is called “dual stack,” as networking protocols are layered in a stack like a cake. At the routing layer, the equipment can handle IPv4 or IPv6 address types and traffic, hence they are dual-stack routers. This does not mean that the routers translate IPv4 addresses into IPv6, or vice versa. It only means that the equipment can connect to independent IPv4 and IPv6 networks simultaneously. An important consideration is that the amount of work done by dual-stack routers increases substantially. Therefore, higher performance equipment should be specified to ensure it can keep up with the combined workload of IPv4 and IPv6 traffic.

Tunneling

Tunneling allows an envelope using one address type to be put inside another that uses a different address type. For example, an envelope using IPv6 addresses can be put inside an envelope that uses IPv4. This envelope can then be routed over an existing IPv4 network. At the destination router, the outside IPv4 envelope is discarded, and the IPv6 envelope is used to forward the electronic information to an IPv6 device. This can work the other way, by putting IPv4 envelopes inside IPv6 envelopes. Although tunneling can be used to move incompatible envelopes across dissimilar networks, this approach complicates network design and management and can create unexpected security holes in the network, so it has to be carefully designed.

Network Address Translation (NAT)

A third method involves address translation between the IPv4 and IPv6 address types. This is an excellent approach, as many Web applications and IP telephone signaling protocols do not support IPv6 addresses. Companies who leverage the Internet heavily, or have a large investment in IP telephone systems, will likely need to maintain the IPv4 information used by these applications and devices to ensure that existing monitoring and management tools do not break. Investing in NAT at the application layer, instead of just a dual-stack router, preserves the substantial investment in monitoring, business intelligence, and management tools that many applications use and that companies depend on for their competitive advantage. With NAT, they can communicate with customers and suppliers regardless of which IP protocol is used and can better manage the cost and risk of rebuilding a large part of their business applications and existing IPv4 networks.

THE NEXT STEP

The next step is to develop the business case for investing in and migrating to IPv6. To start, conduct a network evaluation and identify which equipment can support only IPv4 and which equipment is “IPv6-ready”. Next, talk with your ISP about their ability to support IPv6 and about any NAT options they provide. Finally, develop a plan, schedule, budget, and business case for migrating to IPv6 in phases. Keep in mind that migration will not happen all at once. To help you, the table below shows a prioritized, phased approach for migration to IPv6.

	Phase 1: IPv6 Presence	Phase 2: Dual Stack Core	Phase 3: IPv4/IPv6 Interoperability	Phase 4: IPv4 to Dual Stack
Focus	Internet facing IPv6 connection for your company from service providers	Your core/backbone routers can directly forward v4 to v4 & v6 to v6 traffic	Any v4 devices can connect to IPv6 network and vice versa	Normal refresh for campus/LAN clients & data center servers to IPv6
Priority	Highest	High	Medium	Low
Complexity	N/A	Medium	High	High
Options	NAT, Dual Stack	Dual Stack	NAT, Dual Stack	NAT, Dual Stack

HOW BROCADE CAN HELP

Brocade® provides networking equipment for data centers, campus/LAN networks and service providers (ISP, IXP, Internet content providers, telcos, cable companies, and so forth) that support IPv4 and IPv6 with the needed routing horsepower. Brocade actively participates in U.S. federal government programs that certify vendor equipment compliance with IPv6 standards. Brocade also supplies products that provide IPv4-IPv6 NAT for some of the largest service providers in the world and companies who are heavily dependent on the Internet for their profitability. The Useful References section has links to government information on IPv6 certification programs and links to Brocade products and resources for IPv6.

USEFUL REFERENCES

“Technical and Economic Assessment of Internet Protocol Version 6 (IPv6)”, U.S. Department of Commerce, National Institute of Standards and Technology, National Telecommunications and Information Administration, January 2006.

<http://www.ntia.doc.gov/ntiahome/ntiageneral/ipv6/final/ipv6final.pdf>

“A Profile for IPv6 in the U.S. Government – Version 1.0,” Special Publication 500-267, Recommendations of the National Institute of Standards and Technology, by Doug Montgomery, Stephen Nightingale, Sheila Frankel, and Mark Carson, July 2008.

<http://www.antd.nist.gov/usgv6/usgv6-v1.pdf>

Wikipedia web page on IPv6

<http://en.wikipedia.org/wiki/IPv6>

Brocade IPv6 resources, products for IPv6-IPv4 translation and IPv6-capable routers

<http://www.brocade.com/solutions-technology/technology/ethernet-technology/ipv6.page>

<http://www.brocade.com/products/all/application-delivery-controllers/index.page>

<http://www.brocade.com/products/all/routers/index.page>

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