21520 30th Drive SE #110
Bothell, WA 98021
Tel: (425) 951-8086
Fax: (425) 951-8094
sales@datalight.com
support@datalight.com
www.datalight.com

IPv4 versus IPv6

TECHNICAL OVERVIEW

What are IPv4 and IPv6?

IP stands for Internet Protocol. The current version of this protocol is 4 (IPv4). A revised and updated protocol has been created to address some of the limitations and problems with the aging IPv4 standard.

Feature	IPv4	IPv6
Address Space	32-bit	128-bit
Management	Host identifiers assigned manually which adds to administrative workload.	Auto-configuration of IP addresses using host identifier derived from MAC addresses.
Performance	Unused fields in header and header variances slow performance.	Predictable header sizes and 64-bit header alignment mean better performance from routers and bridges/switches
Multicast/Multimedia	Minimal multicast functionality that is not supported on every router or host.	Built-in features for multicast and new "anycast" groups.
Mobile IP	Some support for MobileIP protocol available, but requires setup and configuration.	Built-in, streamlined support for MobileIP protocol allowing easy roaming between different networks
Virtual Private Networks	Support for ESP/AH protocols are add-ons for IPv4.	Built-in and required support for ESP/AH encrypted/authenticated virtual private network protocols will result in more secure networks.

As listed in the chart, IPv4 uses a 32-bit addressing scheme. In theory, this allows 2^32 (roughly 4 billion) connections to the Internet. Although that seems like enough to go around, with the proliferation of PDA's, cell phones, IP phones, and other internet appliances, the available addresses are dwindling rapidly. The the limited address space is thought to be the most troublesome of the drawbacks found in IPv4.

A new version of IP has been developed to overcome this addressing crunch as well as offer other enhancements over the older IPv4. The new version, IPv6 (also referred to as IPng – IP next generation) uses 128 bit addressing which allows for 2^128 unique addresses.

Addressing

The most noticeable difference to the casual user will be the change in IP address format. With IPv4, the IP address is a 32-bit binary number that is broken into four 8 bit binary numbers, or octets. For easier use, we typically work with IP addresses in a decimal notation that uses periods to separate each octet. For example, the IP address

00001010 00000000 00000000 00000001

usually appears in the equivalent **dotted decimal** representation

10.0.0.1

Because each byte is 8 bits in length, each octet in an IP address ranges in value from a minimum of 0 to a maximum of 255. Therefore, the full range of IP addresses is from 0.0.0.0 through 255.255.255.255. That represents a total of 4,294,967,296 possible IP addresses.

With IPv6, the IP address is a 128-bit binary number (16 bytes vs. only 4 bytes with IPv4). This represents more than

300,000,000,000,000,000,000,000,000,000,000,000,000

possible addresses – a significant enhancement over IPv4.

IPv6 addresses are generally written in the following form:

hhhh:hhhh:hhhh:hhhh:hhhh:hhhh:hhhh:hhhh

In this notation, pairs of IPv6 bytes are separated by a colon and each byte in turn is represented as an equivalent pair of **hexadecimal** rather than decimal numbers, for example:

E3D7:0000:0000:0000:51F4:9BC8:C0A8:6420

IPv6 addresses often contain many bytes with a zero value. Addresses can be shortened by removing these values from the text representation. The bytes are still present in the actual network address though. The shortened version of the above example would be:

E3D7::51F4:9BC8:C0A8:6420

Other Advantages of IPv6

With the increase in address space, ISP's will be able to have enough IP addresses to allocate to every customer so that every IP device has a unique address, even if behind a firewall. This will help reduce or eliminate the need for NAT (network address translation) which is cumbersome and doesn't work well with some internet applications. Removing NAT should allow for improved reliablility, connectivity and flexibility. It is also hoped that having additional address space will help reduce the size and complexity of the global routing tables on the internet. The new addressing format also can allow for easier or even automated assignment of IP addresses for users, which reduces administrative overhead for service providers.

IPv6 also will help streamline network communications. The IPv6 packet header has been changed to be more standardized which will help in moving the data across the internet. This will also make it simper to add new IP options in the future.

Another benefit of IPv6 is in the arena of high band width multimedia. This type of application often takes advantage of multicast – the transmission of a single datagram to multiple recipients. Although IPv4 had some capabilities for multicast, with IPv6, this feature is fully available. IPv6 also has a new capability called "anycast" which delivers the data to a single member of an anycast group rather than all members.

IPv6 also makes standard several of the enhanced features of version 4's VPN (virtual private network) services. Several of the security and authentication protocols that were considered add-ons with IPv4 are required in IPv6 which will mean it is easier to build more secure networks.

Resources used for this document:

http://www.more.net/technical/research/ipv6

http://www.onlamp.com/lpt/a/877

http://www.opus1.com/ipv6/whatisipv6.html

http://compnetworking.about.com/library/weekly/aa042400a.htm

http://www.mosaicd.com/fan/students/IPv4.asp