The next generation of IP - IPng

With a current monthly growth rate from 10 to 15%, the Internet was doomed to reach pretty soon the limits of the addressing scheme allowed by its protocol. In order to avoid this, the IETF ("Internet Engineering Task Force"); the body supervising the technological evolution of the net; has approved a new protocol called IPv6, or IPng ("ng" stands for "Next Generation"). The current protocol IPv4 consists of a 4 byte addressing, which theoretically could withstand 4 billion computers connected to the net. IPv6 features a 16 byte addressing and will therefore allow each citizen in our planet to connect several dozen terminals and peripherals to the Internet (computers, telephones, TV sets). Several specifications of IPv6 have already been made public.

Ipv6 Capabilities

✍ Expanded routing and addressing capabilities made possible by an increase in IP address size from 32 bits to 128 bits. IPv6 will incorporate hierarchical addressing as a fundamental capability to facilitate routing.

✍ Automatic configuration of IP addresses by network devices.

? Global "addresses for a lifetime" that enable an organization to move to a different Internet Service Provider (ISP) without

changing IP addresses. The address assignment scheme of IPv4 is based on defined sets of addresses that are allocated to each provider.

? Simplification of the IP header format to expedite packet forwarding.

? Class-of-service definitions based on traffic flows that will improve performance for delay-sensitive applications such as real-time multimedia.

? Highly integrated capabilities for user authentication and security, including encryption and continued use of firewalls.

Before we go into details let us find out what the older version IPv4 looks like.

IPv4 uses a 32-bit address to identify a machine on a network and the network to which it is attached. IP addresses identify a machine's connection to the network, not the machine itself- an important distinction. Whenever a machine's location on the network changes, the IP address must be changed too. Each IP address consists of 4 bytes; or 32 bits; that is unique across a TCP/IP network.

An IP address looks like this: a.b.c.d. Where, a, b, c & d take the form of one-byte strings of whole numbers, each one situated in a range from 1 and 254 and separated by a period. This addressing scheme indicates the host network and its own unique number within the network. Depending on the size of the network, one, two, or even three bytes can be used to identify the network. The remaining bytes are used to identify the machine on the network. Example of an IP address 130.131.89.44.

IPv6 Address: Here, the address consists of 128 bitsthat identify an interface or a set of interfaces. The address consists of two parts: an address prefix and an IPv6 interface ID. The first 3 bits of the address

indicate the type of address that follows -- a unicast address, for example.

Figure shows the basic parts of an IPv6 address:

TYPE	ADDRESS PREFIX	INTERFACE ID (OR TOKEN)

Address Prefix: The address prefix consists of one or more *aggregator addresses*. These addresses are listed in the hierarchical order of the organizations that issue them.

? At the top of the hierarchy, international registries assign blocks of addresses to *top-level aggregators* (TLAs). TLA addresses provide the public transit points where long-haul service providers establish peer connections.

? TLAs allocate blocks of address to the next *level aggregators* (NLAs), the large Internet service providers and global corporate networks.

? An NLA that is a service provider further allocates its addresses to its subscribers, the lowest-level aggregators, the *site-level aggregators* (SLAs).

TLA and NLA addresses are part of the public Internet topology. SLA addresses are part of private site-level topologies.

Interface ID: The interface ID or token is a unique number identifying an IPv6 node (a host or a router).

Address Formats: The format for representing an IPv6 address is *n*:*n*:*n*:*n*:*n*:*n*:*n*:*n* (*n* is the hex representation of 16 bits in the address) For example: FF01:0:0:0:0:0:0:43

Each nonzero field must contain at least one numeral. Within a given hexadecimal field, however, leading 0s are not required.

Certain classes of IPv6 addresses commonly include multiple contiguous fields containing hexadecimal 0. Our sample address includes five contiguous fields containing 0. These fields can be represented by double colons (::). For example: **FF01::43**

A double colon can appear once in an address.

IPv4-Compatible Address: The IPv4-compatible address, which includes an IPv4 address in the low-order 32 bits, is intended for IPv6 nodes that need to inter-operate with IPv4 nodes.

An IPv6-compatible address combines hexadecimal and decimal values as follows: x.x.x.x.x.x.d.d.d.d

x:x:x:x:x:x is a hexadecimal representation of the six high-order 16-bit pieces of the address and *d.d.d.d* is a decimal representation of the four 8-bit pieces of the address.

For example: 0:0:0:0:0:0:13.1.68.3 or ::13.1.68.3

Ipng Header Layout: The version number in the IP datagram header is 4 bits long and holds the release number (which is 6 with Ipng).

The priority field is 4 bits long and holds a value indicating the datagram's priority. The priority is used to define the order of transmission.

The Flow Label is 24 bits long and is still in the development stage. It is likely to be used in combination with the source machine IP

<table>
<tr><td>Version Number</td><td>Priority</td><td colspan="2">Flow Label</td></tr>
<tr><td colspan="2">Payload Length</td><td>Next Header</td><td>Hop Limit</td></tr>
<tr><td colspan="4">Sending IP Address</td></tr>
<tr><td colspan="4">Destination IP Address</td></tr>
</table>

Address to provide flow identification for the network.

The Payload Length field is a 16-bit field used to specify the total length of the IP datagram, given in bytes. The total length is exclusive of the IP header itself. The use of a 16-bit field limits the maximum value in this field to 65,535, but by using an extension header we can send large datagrams.

The Next Header field is used to indicate which header follows the IP header when other applications want to piggyback on the IP header.

The Hop Limit field determines the number of hops the datagram can travel. With each forwarding, the number is decremented by 1. When the Hop Limit field reaches 0, the datagram is discarded, just as with IP version 4.

Finally, the Sending and Destination IP Addresses in 128-bit format are placed in the header.

IPv6 Automatic Configuration: There are two mechanism of Automatic Configuration.

Stateless configuration will enable a device or host to configure its own address without using DHCP. Stateful addresses will be implemented in an IPv6 version of DHCP for autoconfiguration of intelligent hosts that contain DHCP clients. (DHCP i.e. Dynamic Host Configuration Protocol was available in IPv4. Instead of configuring an IP address on every machineon the network which is unique, DHCP allows

machines to obtain the IP address from a DHCP server. This simplifies administration of IP addresses). The stateless address autoconfiguration eliminates the need to maintain DHCP servers. With stateless autoconfiguration, a host is expected to construct its IPv6 address by joining its IEEE Media Access Control(MAC) address to the subnet prefix that the host learns by using neighbor discovery from the routers that are on the same subnetwork as the host.

The Transition: The IPv6 standards are expected to be supported by networking vendors on both new and existing equipment. However, a significant amount of work must be completed to test interoperability and implement transition strategies before IPv6 will become widely available. This work includes developing IPv6 stacks on computers,

gateways between IPv4 and IPv6 networks, and routers that implement services such as Domain Name Service (DNS) and Dynamic Host Configuration Protocol (DHCP) for operation with IPv6.

To allow a smooth transition, every computer running the new protocol will have two Internet addresses: a 32-bit address for Ipv4 and a 128-bit address for Ipv6, hoping that the fact to maintain both will not cause problems of its own. But everything seems to be forecasted to avoid rupture caused by IPv6 installation.