

# Scotti-BYTE Enterprise Consulting Services

## The Joys of IPv6 (Part 3)

In part two of this three part series on IPv6 we talked about IPv6 local link addresses (FE:80) and global addresses. We discussed why NAT is no longer needed and how to provide firewall access to an IPv6 application global address vs. the IPv4 port forward rule which translates incoming requests to a NAT address.

A key point about IPv6 is that it is a completely separate protocol from IPv4 and although all modern operating systems speak both IPv4 and IPv6, very few home networks have the IPv6 protocol turned on. By 2011, IPv6 support in all major operating systems has been present, but it has been very slow to adapt for most end users. The best estimate is that IPv6 adoption is at approximately 30% world wide.

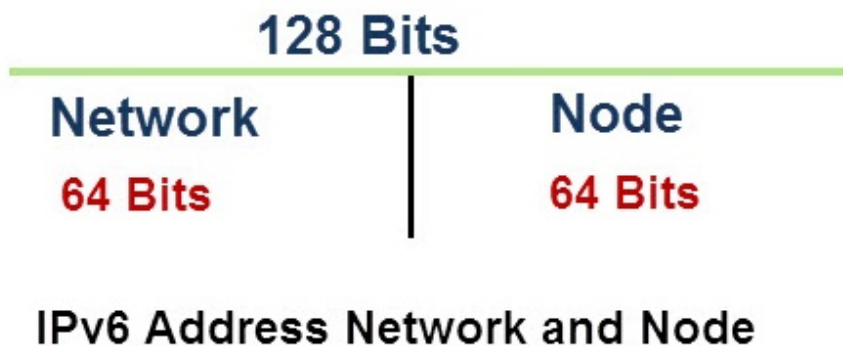
Since IPv6 is a completely different protocol than IPv4, there is no impact to enabling it on your network. Since IPv4 will still be in use years from now, the reason to also run IPv6 is to be able to access systems that inevitably will have only an IPv6 address since nearly all IPv4 addresses have been allocated.

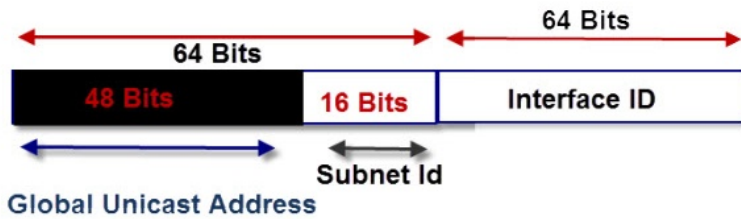
Today, an increasing number of major services offer both addresses. The best option is to run both IPv4 and IPv6 on your home network to be prepared for the future. This will allow you to connect to either address as required. How do you know if you are connecting to an IPv4 address vs an IPv6 address? The short answer is that you don't need to know because we typically use internet names which are translated by Domain Name Servers (DNS) into the number addresses and it does not matter if we are connecting to a 32 bit IPv4 address or a 128 bit IPv6 address.

We talked about the forming of an IPv6 address in the beginning of this series. To review, the 128

bit address space is split into two 64 bit segments. The lower part identifies the interface or node and the upper part is used for routing.

If you look at just the upper network part in more detail. it is further divided, with the upper 48 bits used for the global network address and for routing over the public Internet.





IPv6 addresses have three different types which are the Global Unicast Address, the Unique Local Address, and the Link Local address.

### IPv6 Address Structure

- **Global Unicast Address** –Scope Internet- routed on Internet
- **Unique Local** – Scope Internal Network or VPN internally routable, but **Not routed** on Internet
- **Link Local** – Scope network link- **Not Routed** internally or externally.



### Address Types and Scope

- Global Unicast Address** --Scope Internet- Routed on Internet
- Unique Local** -- Scope Internal Network or VPN -Internally routable but Not routed on Internet
- Link Local** - Scope network link- Not Routed internally or externally.

In IPv4, there are internal network addresses which are not routed on the Internet and are reserved for the local network. These use the reserved ranges 10.0.0.0/8, 172.16.0.0/12 and 192.168.0.0/16 and 169.254.0.0/16.

The IPv6 Link Local addresses are used inside an internal network and never routed on the Internet. Link Local addresses are equivalent to the IPv4 address range 169.254.0.0/16 which is allocated on an IPv4 network when no DHCP server is found. Some people refer to these as the IPv4 autoconfiguration addresses. The IPv6 equivalent is the Link Local addresses and they start with an FE80.

Unique Local are meant to be routed inside an internal network but are not routed on the public Internet. They are equivalent to the IPv4 addresses are 10.0.0.0/8, 172.16.0.0/12 and 192.168.0.0/16. Unique Local address space is divided into two /8 spaces: fc00::/8 for globally assigned addressing, and fd00::/8 for locally assigned addressing. If an organization is using locally assigned addresses, use the FD00 prefix.

On IPv4 networks you can access a network resource using a number:

`http://192.168.1.15/webpage`

On IPv6 addresses contain colons as separators and so they must be contained in square brackets:

`http://[2607:f8b0:4000:837::200e]/webpage`

In IPv4, the loopback address is 127.0.0.1. In IPv6, the loopback address is ::1.

IPv6 Global Addresses (which every client node on your network is assigned when IPv6 is enabled) use Stateless Address AutoConfiguration (SLAAC). SLAAC uses the Extended Unique Identifier (EUI-64) format. EUI-64 takes the client interface MAC address and stuffs the hexadecimal word "0xfffe" in between the OUI (Organizationally Unique Identifier) and the second half of the MAC address, plus setting the "Universal" bit to 1. For example, the MAC address 00.00.5E.00.53.01 would become the interface Identifier 0200:5EFF:FE00:5301 for the lower 64 bits.

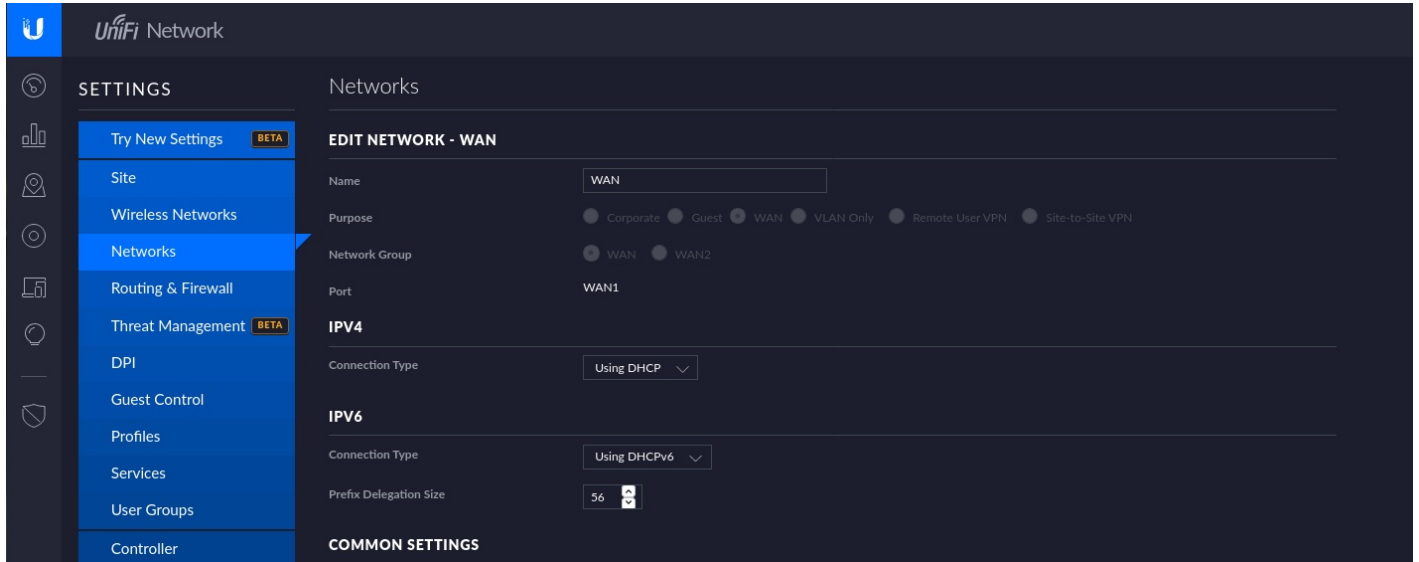
In Part two of this series, I described how to create a router rule to allow Public Internet Access to an application on your network using IPv6. Since, your ISP grants you just ONE IPv4 address for your access to the Internet and you must use NAT to provide a means of having multiple devices communicate on the Internet, you are very limited in the services you can provide for external access.

On the other hand, since your Internet service provider grants you in excess of 18 Quintillion addresses for your personal use, since RFC 6177 recommends home sites are given a /48 subnet assignment. In practice, most ISPs grant either a /64 or a /56 subnet for customer use. It's not likely you will run out of 18 Quintillion addresses on your local network any time soon. By default every device on your local network has a globally unique IPv6 address that can be potentially accessed from anywhere if you create a firewall rule allowing this access.

The RIPE NCC is the Regional Internet Registry of Europe and is one of five Regional Internet Registries in the world. RIPE NCC announced on November 25, 2019 that it has fully run out of IPv4 addresses and called for greater adoption of IPv6. This is a sign that it is time to enable IPv6 on your network.

In conclusion, there is no downside to adding the IPv6 protocol to your local network since IPv4 will run along side IPv6 just fine. Clearly, you will need IPv6 in coming years.

There are two steps to enabling IPv6 on a Ubiquiti Unifi router and the steps are similiar on other brands as well. The first step is to enable IPv6 on your WAN interface and set the Prefix delegation size.



The second step is to enable IP V6 on your LAN Network and any other VLANs on which you want to have IPv6 running. Do this by going into the "Configure IPV6 Network" options while editing your LAN interface and change the Interface type for IPv6 from NONE to Prefix Delegation. That's all that is required, although you can also change the default name servers to the IPv6 addresses for Cloudflare in the DHCPv6 Name Server field. The Cloudflare servers for IPv6 are 2606:4700:4700::1111 and 2606:4700:4700::1001.

