Migration Technologies.
Dual Stack and Tunneling Using GRE, 6to4, and 6in4.

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Why Not Dual Stack?

- Dual Stack is very important in our migration plane.
- Dual stack device must have both address types running correctly.
- Dual Stack devices can talk to both IPv4 and IPv6 devices.
- But with dual stack you have to run your services twice, one in IPv4 and the other in IPv6 i.e.:
  - Your domain controller must be dual stack to support both kinds of clients.
  - You have to run DHCPv4 and another DHCPv6.
  - Also for DNS services.
  - And so on for every service and software you have to have it in dual stack machine.
**Dual Stack**

- Dual Stack is the best migration strategy, because it will support both IPv6 & IPv4 communications.
- IPv4 internet will not disappear soon, so we have to keep communicate and connected to it.
- Dual Stack insures the most flexible and smoothest migration process.
- In your migration plane consider dual stack where ever possible.
- Also some software programs are not IPv6 ready until now, and those machines (servers) have to still use IPv4, until we upgrade our software or change it, and that needs time.
- In our migration plane to IPv6 we have to set a place for legacy machines and software prepared with IPv4 to support those for a while.

**Dual Stack Limitation**

- Most important your core network devices if they are not dual stack, your dual stack design can’t be fully completed.
- If any of your routers or layer 3 switches (Core Network Devices) is not dual stack you must consider tunneling.
- Firewalls and Proxy servers must be Dual stack or you must use tunneling.
- So tunneling seems to be very important part in the migration process for the next years (as there will be still IPv4 addresses and devices in some core devices and network infrastructure).
Who Support Dual Stack?

- Linux all new distributions support it (depends mostly on the kernel version).
- Cisco IOS and all cisco products support it, if you have a very old one just update your firmware or IOS.
- Many others but you have to check every system you have and try to test it before real production deployment.

Tunneling

- Tunneling is a technique where we encapsulate a packet of some type in another packet type, from specific source to a specific destinations.
- The tunnel source do the encapsulation, the destination do the decapsulation.
- There are many standers to create IPv6 tunnels.
- GRE, automatic 6to4, and 6in4 are examples of tunneling protocols that are used to tunnel IPv6 packets over IPv4 packets.
- Using these tunneling protocols we can transport our IPv6 traffic over IPv4 infrastructure or IPv4 services.
Why We Have To Consider Tunneling?

- Not all ISPs support native IPv6 networks until now (but there is a fast change now).
- In the same Enterprise not all core devices support IPv6, and we need to change the enterprise and our networks in phases.
- If we have branches and we migrate to IPv6 inside the sites or branches, but we don’t have direct IPv6 connections between sites, we have to use tunneling to connect them.

Tunneling Protocols for IPv6

- Generic Routing Encapsulation (GRE).
- GRE is old and used in IPv4 to tunnel networks (protocols that need direct connections while we don’t have direct connections, VPNs, etc...).
- GRE is useful to tunnel also IPv6 packets inside IPv4 packets.
- GRE uses protocol number 47.
- 6to4 tunneling uses protocol number 41.
- 6in4 tunneling also uses protocol number 41.
- The main difference between 6to4 and 6in4 is that 6to4 uses a special IPv6 destination addresses that embed in them the IPv4 address of the tunnel destination, so tunnels can be automatically setup and not static as in 6in4.
Cisco Tunneling

- The tunneling accomplished using a tunnel interface (it’s a virtual interface).
- The default encapsulation of cisco IOS tunnel interface is GRE.
- If you would like to use Auto 6to4 tunneling you have to change the tunneling encapsulation in the tunnel interface to 6to4.
- In GRE tunnel you have to specify the tunnel source and destination.
- In 6to4 tunnels you have to specify only the source but not the destination.
- In 6in4 tunnels you have to specify the tunnel source, destination, and changing the tunnel encapsulation to 6in4.

6to4 embed the IPv4 destination address in the IPv6 destination address.

Thus if using 6to4 you have to plan your IPv6 addressing before using it.

6to4 address format is 2002:XXXX:XXXX:YYYY::/48 - 64

X = IPv4 address of the router creating the tunnel for your network.

Y = used if you would like to subnet.

The last 64bits for the hosts.

6to4 range is 2002:IPv4 32bit mapped in hex::/48
6to4 Address Example

- If you have a router that will create a 6to4 tunnel, the router IPv4 address is **195.189.210.1**
- Your 6to4 scope will be **2002:C3BD::D201::/48**
- 6to4 benefit is you can setup one tunnel interface to do all your tunneling automatically, to multiple destinations
- In GRE and 6in4 you have to setup a tunnel to each peer (static tunneling).
- But in 6to4 you have still need to create routes to the destinations as in GRE or 6in4 so the router will not drop the packets.

Cisco GRE Tunnel Configuration

- Config t
- Interface tunnel #
- Tunnel source (interface or ip)
- Tunnel destination (ip)
- Ipv6 address (global address)
- Ipv6 address (fe80) link-local
- Exit
- Both tunnel sides must be on the same subnet.
- Both tunnel sides must have routes to each other on the IPv6 addresses of the tunnel and the IPv4 (using static or dynamic routes).
Cisco 6to4 Tunnel Configuration

- Config
- Interface tunnel #
- Tunnel source (interface or ip)
- Tunnel mode ipv6ip 6to4
- Ipv6 address (global address)
- Ipv6 address (fe80) link-local
- Exit
- Both tunnel sides must have routes to each other on the IPv6 address of the tunnel and the IPv4 (using static or dynamic routing).
- For 6to4 tunnel a static route to 2002::/16 to tunnel interface as destination will be excellent.

To use 6to4 you have to design your site addressing in IPv6 so you use the range of 2002:your site router IPv4 address::/48, inside your site.

To overcome this limitation and use global IPv6 addressing of any other range, a static route for each site must be configured to forward the traffic to a 6to4 engineered address.

To accomplish this, In each site enter:
- Ipv6 route (global range of other site)/48 (2002:XXXX:XXXX:: of the remote site)
- i.e. ipv6 route 2001:db8:1::/48 2002:C3BD:D201::
- This will forward traffic going to 2001:db8:1::/48 to the tunnel interface of 6to4 and use the 2002:C3BD:D201:: address to get the IPv4 destination of 195.189.210.1
Cisco 6in4 Tunnel Configuration

- Config t
- Interface tunnel #
- Tunnel source (interface or ip)
- Tunnel destination (ip)
- Tunnel mode ipv6ip
- Ipv6 address (global address)
- Ipv6 address (fe80) link-local
- Exit
- Both tunnel sides must be on the same subnet.
- Both tunnel sides must have routes to each other on the IPv6 addresses of the tunnel and the IPv4 (using static or dynamic routes).