Client IPv6 Addressing

ISP Workshops



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Acknowledgements

- This material originated from the Cisco ISP/IXP Workshop Programme developed by Philip Smith & Barry Greene
- Use of these materials is encouraged as long as the source is fully acknowledged and this notice remains in place
- Bug fixes and improvements are welcomed
 - Please email workshop (at) bgp4all.com

Philip Smith

Client IPv6 Addressing

IPv6 Addressing on LANs (fixed & wireless)

StateLess Address AutoConfiguration (SLAAC)

 Client learns IPv6 address, default gateway, and DNS resolver, from the router on the LAN

Stateful DHCPv6

- Client learns IPv6 address, default gateway, and DNS resolver, from a DHCP server
 - Can be on the same LAN (not advised)
 - Can be the router (usually limited feature set)
 - Standalone, via DHCP relay on the router (most common)

Stateless DHCPv6

SLAAC for address information, DHCPv6 for everything else

SLAAC: Router side

Router does not need any specific configuration

- But there are some good practice suggestions to improve general behaviour
 - Setting router preference high (default is medium)
 - Make the RA interval 30 seconds
 - If supported, also supply DNS resolver using RA
 - Set Multicast Listener Discovery query interval to 30 seconds

```
interface FastEthernet0/0
ipv6 address 2001:DB8:100::1/64
ipv6 nd router-preference high
ipv6 nd ra interval 30
ipv6 nd ra dns server 2001:DB8:100:F::53
ipv6 mld query-interval 30
!
```

SLAAC: Client side

□ IPv6 client learns address "from the LAN"

- IPv6 is enabled on most end-user devices today
 Laptop, PC, tablet, smartphone
- Device sends out "router solicit"
- Router responds with "router advertisement" containing subnet and default gateway
- Initial client state (eg macOS laptop):

```
Client:
en3: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
ether 68:5b:35:7d:3b:bd
inet6 fe80::6a5b:35ff:fe7d:3bbd%en3 prefixlen 64 scopeid 0x8
```

SLAAC

On receiving response from the router:

en3: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
 ether 68:5b:35:7d:3b:bd
 inet6 fe80::6a5b:35ff:fe7d:3bbd%en3 prefixlen 64 scopeid 0x8
 inet6 2001:db8:100::6a5b:35ff:fe7d:3bbd prefixlen 64 autoconf
 inet6 2001:db8:100::18eb:2861:458e:862b prefixlen 64 autoconf temporary
 nd6 options=1<PERFORMNUD>

Internet6:

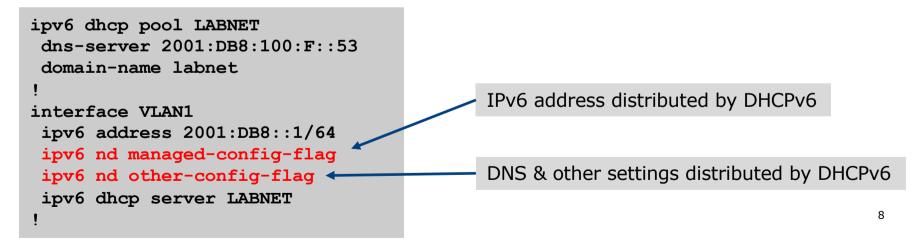
Destination	Gateway	Flags	Netif Expire
default	fe80::219:30ff:fee	UGC	en3

 Note the temporary address – this is the one used for all IPv6 connectivity, and has a lifetime determined by the client's operating system

Stateful DHCPv6

Behaves like DHCP on IPv4 infrastructure:

- DHCPv6 server distributes host address from a pool on request from client
- DHCPv6 client configures IPv6 address, default gateway, and DNS resolver
- Sample server configuration (Cisco IOS)



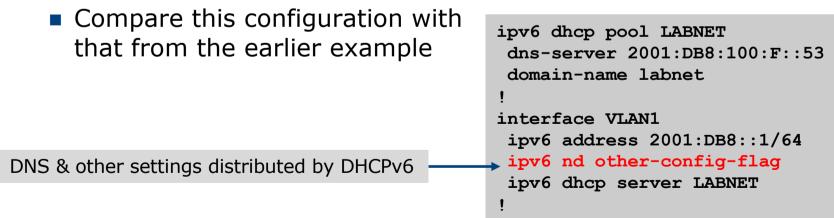
Stateless DHCPv6

Where DHCPv6 is used to distribute other information

- But not IPv6 addresses (usually done by SLAAC)
- Documented in RFC3736

■ For example:

- SLAAC is used to distribute IPv6 address and default gateway
- DHCPv6 is used to provide DNS resolver and other network information



Distributing subnets to End-Users

Static assignment (as in IPv4)

- Tell the customer what subnet they have
 - Not dynamic!
 - Usually with Internet service documentation

DHCPv6-PD

 Use DHCPv6 Prefix Delegation feature to distribute subnets automatically

Prefix delegated can optionally be made persistent if desired

DHCPv6-PD

□ New for IPv6, is Prefix-Delegation (PD)

- Allows DHCP server to delegate subnets to clients
- Especially useful for Broadband deployments
 Also can be used for enterprise
- Server example on BRAS (Cisco IOS)
 - Distribute /56 to client network out of /40 pool

```
ipv6 dhcp pool BB-CUST-1
  prefix-delegation pool BBCUST1 lifetime 1800 600
!
ipv6 local pool BBCUST1 2001:DB8:F00::/40 56
!
interface FastEthernet0/0
ipv6 enable
ipv6 dhcp server BB-CUST-1
!
```

DHCPv6-PD

- Client receives IPv6 subnet from the server
- Client then automatically assigns a /64 to each active interface on the router
- This means that the network operator can prepare a standard configuration for each client
 - No IPv6 address dependencies
 - Flexibility to change delegated prefix as required
- Many client side routers (CPE) support DHCPv6-PD

DHCPv6-PD – Cisco IOS example

Cisco IOS uses a "general prefix" concept

- The received subnet is stored in a user defined "variable"
- This variable is then used on internal interfaces to give each a /64 subnet
- For example:
 - Prefix received is 2001:DB8:C:80::/56 -> General Prefix
 - Final 72 bits are set by the user, taking the form ::<subnet>:0:0:1
 - Interfaces will be addressed 2001:DB8:C:80::1/64, 2001:DB8:C:81::1/64, 2001:DB8:C:82::1/64 etc, in sequence
- Receiving interface also configured automatically as the default gateway

DHCPv6-PD – Client Configuration

Cisco IOS client configuration example:

```
interface Dialer0
description ADSL link to MY ISP
                                                              Signifies default interface, for
 ipv6 address autoconfig default
                                                              default route
 ipv6 dhcp client pd ADSL-PD rapid-commit
interface Vlan1
                                                              Speeds up DHCP configuration
description Home Network
                                                              between client and server,
 ipv6 address ADSL-PD ::0:0:0:0:1/64
                                                              using 2 messages rather than 4
interface Vlan2
description Home IP/TV Network
 ipv6 address ADSL-PD ::1:0:0:0:1/64
interface Vlan3
description Home Wireless Network
 ipv6 address ADSL-PD ::2:0:0:0:1/64
!
```

DHCPv6-PD – Client Configuration

Cisco IOS client interface status example:

```
router# sh ipv6 interface brief
Vlan1 [up/up]
    FE80::C800:E7FF:FE22:8
    2001:DB8:F00:3100::1
Vlan2 [up/up]
    FE80::C800:E7FF:FE22:6
    2001:DB8:F00:3101::1
Vlan3 [up/up]
    FE80::C800:E7FF:FE22:4
    2001:DB8:F00:3102::1
...etc...
```

DHCPv6-PD Servers ?

Many vendor hardware products

Routers, firewalls, etc

Example of standalone software (like IPv4 DHCP):

- ISC's DHCP server
- ISC's KEA (replaces ISC's DHCP server)
 - http://kea.isc.org
- Jagornet DHCP server
 - http://www.jagornet.com

Persistent address delegation

Available using DHCP Option 37 "remote hardware ID"
 The client gets the same address block delegated each time

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