

# DHCPv6 Types and Tunneling

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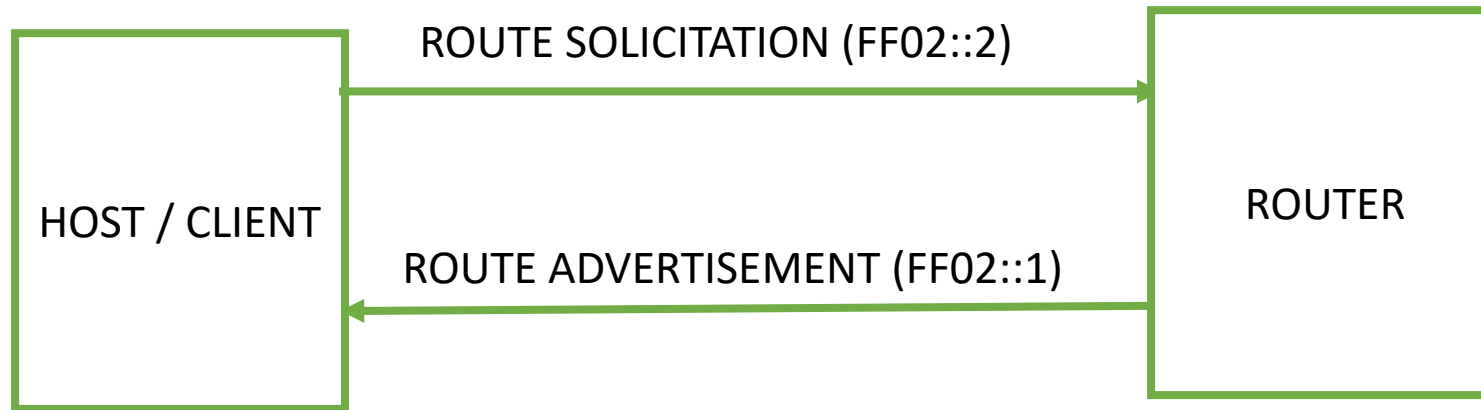
# Address assignment for IPv6

- Static
- Stateless DHCPv6 (SLAAC)
- Stateful DHCPv6
- Prefix delegation

# Stateless DHCPv6 (SLAAC)

- Once router figures out its IPv6 address, it can send a DHCP option for DNS server
- The router advertisement contains option for DHCP
- In the Router advertisement, set the “O” flag
- When the client observes the O flag set, it sends a DHCPv6 request
- The router then sends a DHCPv6 reply with the IP address of DNS server

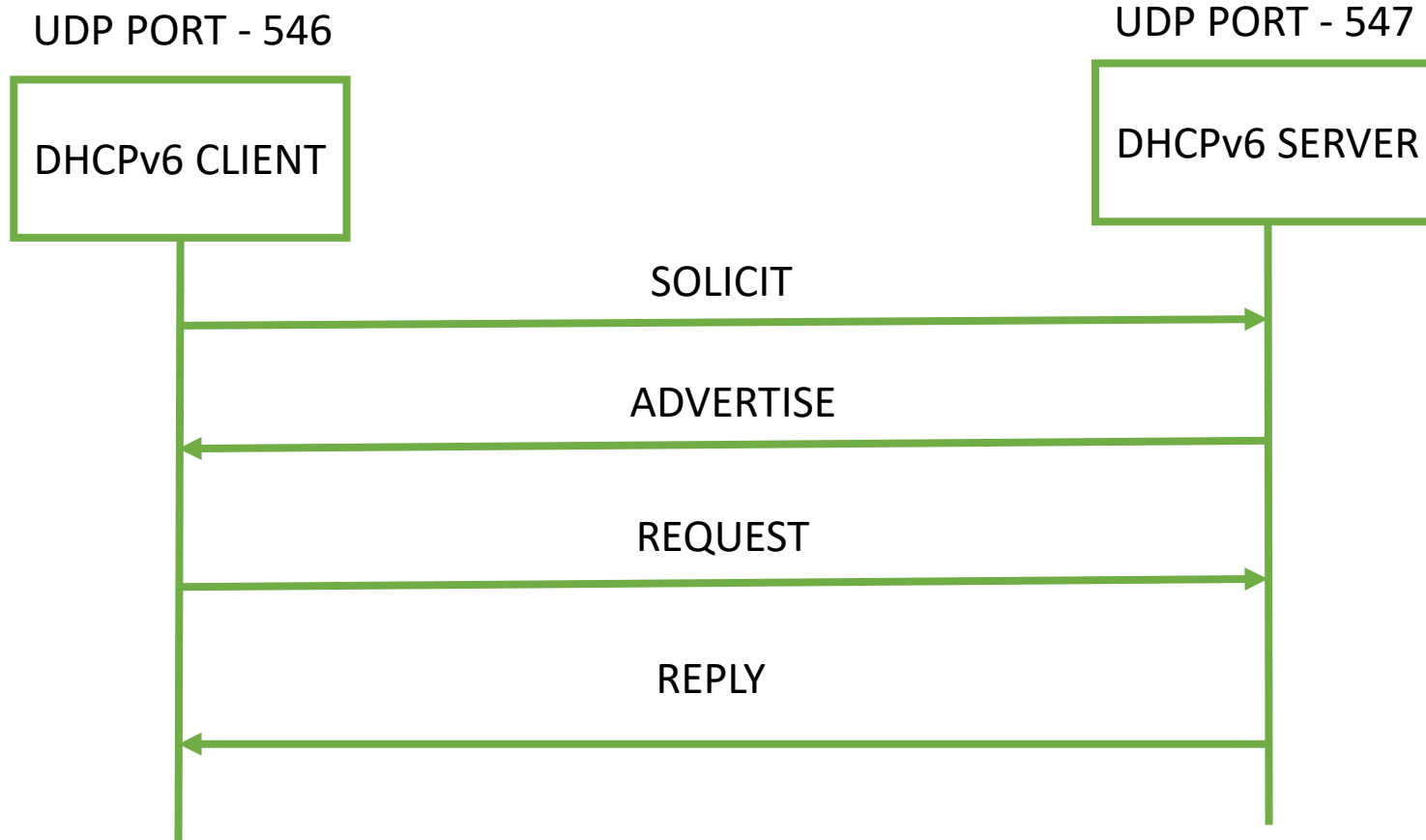
# Stateless DHCPv6 Messages



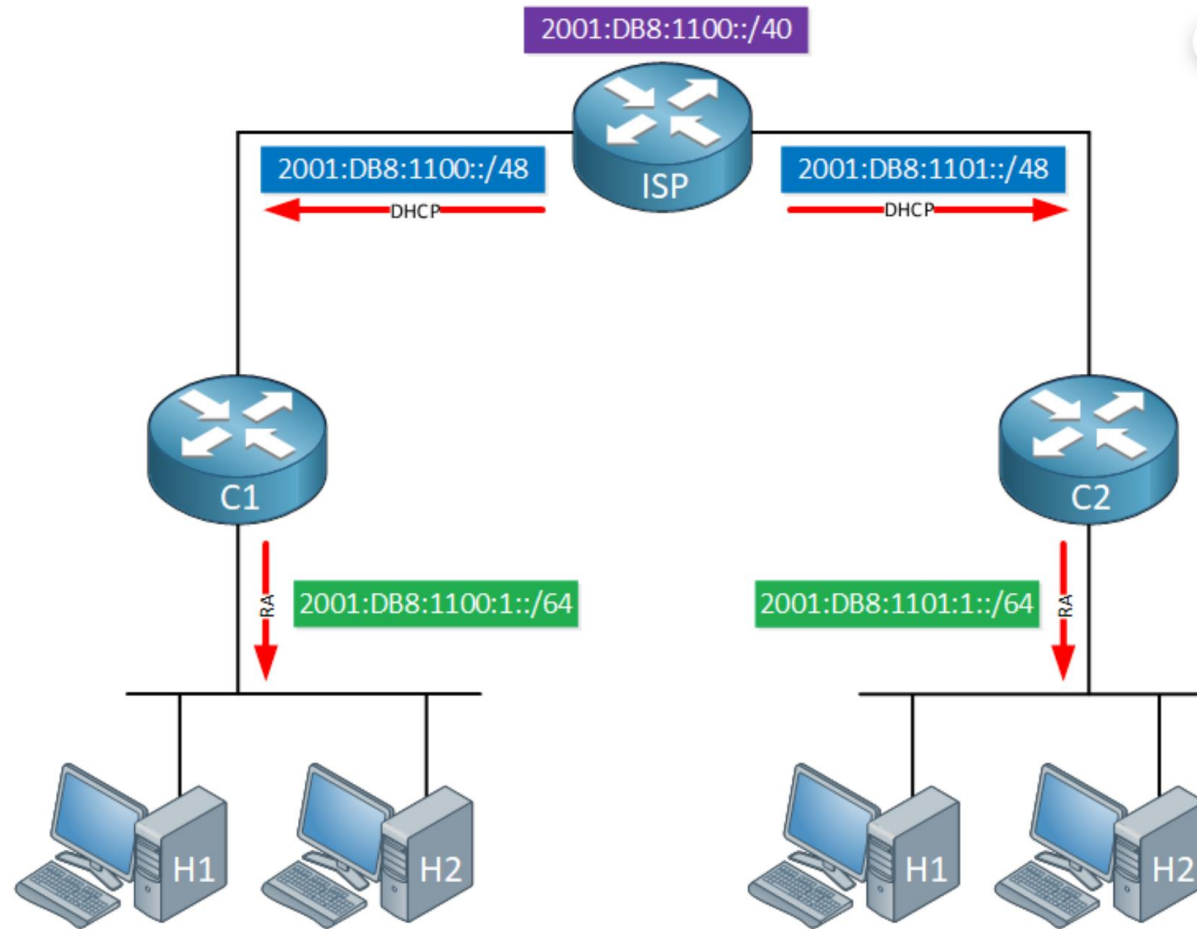
# Stateful DHCPv6

- Stateful version of DHCPv6 is same as the DHCP for IPv4.
- DHCP Server knows exactly what IPv6 address has been assigned to what host.
- Stateful DHCPv6 uses four messages which are Solicit, Advertise, Request and Reply.
- Solicit message enables the use of DHCPv6 by setting the “M” bit to 1.

# SARR Messages (Stateful DHCPv6)



# Prefix Delegation



# Prefix Delegation

- Delegation is done from ISP to the customer.
- Customer router uses general prefix on the LAN interfaces.
- Simple Client End Configuration.
- Scalable way of delegating address blocks.



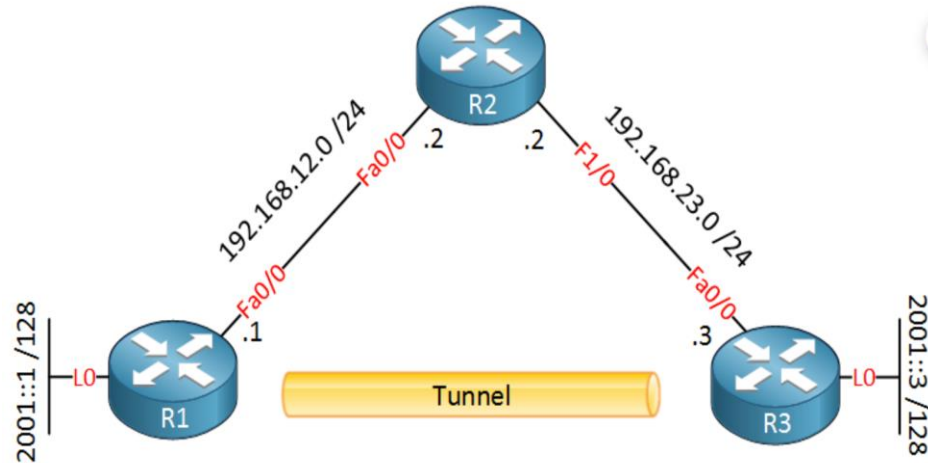
# V4 – V6 communication

- Dual Stack
- Tunneling
  - ISATAP
  - Torpedo
  - 6to4
  - 6 over 4
  - 6 rapid deployment
- Transition
  - NAT 64

# 6 to 4 Tunneling – RFC 4213

- The IPv6 packet is routed out of Tunnel0, it is encapsulated into IPv4.
- The source IPv4 address for the new header is taken from the tunnel source address.
- The encapsulated packet is routed through the IPv4 cloud until it reaches R2. The IPv4 header is stripped upon entering R2's 192.168.12.2 interface.

# 6 to 4 Tunneling (Manual Tunnel)



```
R1(config)#interface loopback 0
R1(config-if)#ipv6 address 2001::1/128
R1(config-if)#exit
R1(config)#interface fastEthernet 0/0
R1(config-if)#ip address 192.168.12.1 255.255.255.0
```

```
R2(config)#interface fastEthernet 0/0
R2(config-if)#ip address 192.168.12.2 255.255.255.0
R2(config-if)#exit
R2(config)#interface fastEthernet 1/0
R2(config-if)#ip address 192.168.23.2 255.255.255.0
```

```
R3(config)#interface fastEthernet 0/0
R3(config-if)#ip address 192.168.23.3 255.255.255.0
R3(config-if)#exit
R3(config)#interface loopback 0
R3(config-if)#ipv6 address 2001::3/128
```

```
R1(config)#interface loopback 1
R1(config-if)#ip address 1.1.1.1 255.255.255.0
R1(config-if)#exit
R1(config)#router eigrp 123
R1(config-router)#no auto-summary
R1(config-router)#network 192.168.12.0
R1(config-router)#network 1.1.1.0
```

```
R2(config)#router eigrp 123
R2(config-router)#no auto-summary
R2(config-router)#network 192.168.12.0
R2(config-router)#network 192.168.23.0
```

```
R3(config)#interface loopback 1
R3(config-if)#ip address 3.3.3.3 255.255.255.0
R3(config-if)#exit
R3(config)#router eigrp 123
R3(config-router)#no auto-summary
R3(config-router)#network 192.168.23.0
R3(config-router)#network 3.3.3.0
```

```
R1(config)#interface tunnel 0
R1(config-if)#tunnel source loopback 1
R1(config-if)#tunnel destination 3.3.3.3
R1(config-if)#tunnel mode ipv6ip
```

```
R3(config)#interface tunnel 0
R3(config-if)#tunnel source loopback 1
R3(config-if)#tunnel destination 1.1.1.1
R3(config-if)#tunnel mode ipv6ip
```

```
R1#show interfaces tunnel 0
```

**Tunnel0 is up, line protocol is up**

Hardware is Tunnel

MTU 1514 bytes, BW 9 Kbit, DLY 500000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

**Encapsulation TUNNEL**, loopback not set

Keepalive not set

Tunnel source 1.1.1.1 (Loopback1), destination 3.3.3.3

**Tunnel protocol/transport IPv6/IP**

```
R3#show interfaces tunnel 0
```

**Tunnel0 is up, line protocol is up**

Hardware is Tunnel

MTU 1514 bytes, BW 9 Kbit, DLY 500000 usec,  
reliability 255/255, txload 1/255, rxload 1/255

**Encapsulation TUNNEL**, loopback not set

Keepalive not set

Tunnel source 3.3.3.3 (Loopback1), destination 1.1.1.1

**Tunnel protocol/transport IPv6/IP**

```
R1#ping 2001::3 source loopback 0
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 2001::2, timeout is 2 seconds:

Packet sent with a source address of 2001::1

!!!!

**Success rate is 100 percent (5/5), round-trip min/avg/max = 8/8/8 ms**

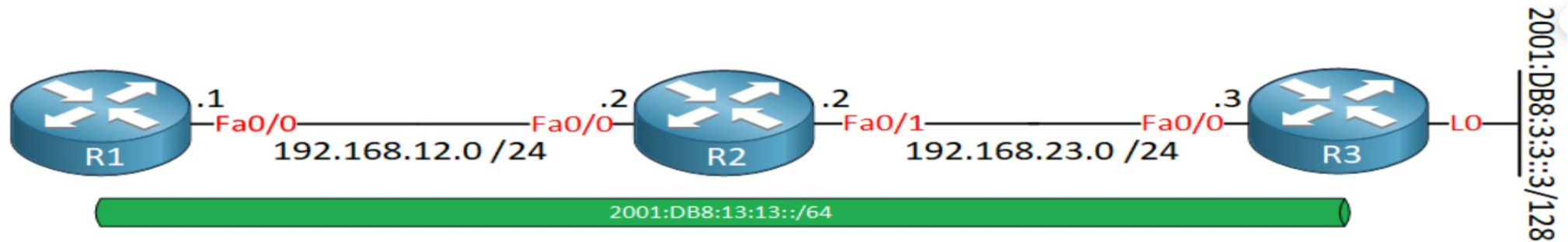
# ISATAP (Intra-Site Automatic Tunnel Addressing Protocol)

- It is a mechanism designed to help IPv4-only hosts communicate to other native IPv6 devices.



- First 64 bits are for the prefix.
- 0000:5EFE: this is a reserved value which indicates that this is an ISATAP address.
- Remaining 32 bits embed the IPv4 address, in hexadecimal.

# ISATAP CONFIGURATION



```
hostname R1
!
ip cef
!
interface Tunnel0
  no ip address
  ipv6 address autoconfig
  tunnel source FastEthernet0/0
  tunnel destination 192.168.23.3
  tunnel mode ipv6ip
!
interface FastEthernet0/0
  ip address 192.168.12.1 255.255.255.0
!
router ospf 1
  router-id 1.1.1.1
  log-adjacency-changes
  network 192.168.12.0 0.0.0.255 area 0
!
end
```

```
hostname R2
!
ip cef
!
interface FastEthernet0/0
  ip address 192.168.12.2 255.255.255.0
!
interface FastEthernet1/0
  ip address 192.168.23.2 255.255.255.0
!
router ospf 1
  router-id 2.2.2.2
  network 192.168.12.0 0.0.0.255 area 0
  network 192.168.23.0 0.0.0.255 area 0
!
end
```

```
hostname R3
!
ip cef
!
ipv6 unicast-routing
!
interface Loopback0
  ipv6 address 2001:DB8:3:3::3/128
!
interface Tunnel0
  ipv6 address 2001:DB8:13:13::/64 eui-64
  no ipv6 nd suppress-ra
  tunnel source FastEthernet0/0
  tunnel mode ipv6ip isatap
!
interface FastEthernet0/0
  ip address 192.168.23.3 255.255.255.0
!
router ospf 1
  router-id 3.3.3.3
  log-adjacency-changes
  network 192.168.23.0 0.0.0.255 area 0
!
end
```

- Verification

## Headend Router

```
R3#show ipv6 interface Tunnel 0
Tunnel0 is up, line protocol is up
IPv6 is enabled, link-local address is FE80::5EFE:C0A8:1703
Global unicast address(es):
  2001:DB8:13:13:0:5EFE:C0A8:1703, subnet is 2001:DB8:13:13::/64 [EUI]
Joined group address(es):
  FF02::1
  FF02::2
  FF02::1:FFA8:1703
MTU is 1480 bytes
ICMP error messages limited to one every 100 milliseconds
ICMP redirects are enabled
ND DAD is not supported
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND router advertisements live for 1800 seconds
Hosts use stateless autoconfig for addresses.
```

## Client

```
R1#show ipv6 interface Tunnel 0
Tunnel0 is up, line protocol is up
IPv6 is enabled, link-local address is FE80::C0A8:C01
Global unicast address(es):
  2001:DB8:13:13::C0A8:C01, subnet is 2001:DB8:13:13::/64 [PRE]
  valid lifetime 2591842 preferred lifetime 604642
Joined group address(es):
  FF02::1
  FF02::2
  FF02::1:FFA8:C01
MTU is 1480 bytes
ICMP error messages limited to one every 100 milliseconds
ICMP redirects are enabled
ND DAD is enabled, number of DAD attempts: 1
ND reachable time is 30000 milliseconds
Default router is FE80::5EFE:C0A8:1703 on Tunnel0
```

## Connectivity

```
R1#ping 2001:db8:3:3::3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:DB8:3:3::3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/40/40 ms
```