## Introduction to IPv6



Ross Bagurdes
Network Engineer

@bagurdes



#### Module Goals



**Terms for IPv6** 

**IPv4 Address Size** 

**IPv6 Addresses** 

**IPv6 Address Operation** 

**IPv6 Address Types** 

**IPv6 Address Acquisition** 

**IPv6 Tunneling** 



Bit



0XA

Nibble



## 0xA8

# Byte



## 0xA8C5

## Hextet



#### IPv4 Address Size

32 bits long = 4 octets 192.168.10.10

11000000 1010100 00001010 00001010



#### IPv6 Address Size

128 bits long = 32 nibbles = 8 hextets

2001:0DB8:0002:008D:0000:0000:00A5:52F5



Network Portion 64 Bits

Interface Identifier 64 Bits

2001:0DB8:0002:008D:0000:0000:00A5:52F5

2001:0DB8:0002:008D:0000:0000:00A5:52F5

Eliminate Leading O's





2001:0DB8:0002:008D:0000:000:00A5:52F5

Eliminate Leading O's

2001:0DB8:0002:008D:0000:0000:00A5:52F5

#### Eliminate Leading O's

2001:DB8:2:8D:0:0:A5:52F5

2001:0DB8:0002:008D:0000:0000:00A5:52F5

#### Eliminate Leading O's

2001:DB8:2:8D:0:0:A5:52F5

Eliminate O's with :: (Double Colon)

2001:DB8:2:8D::A5:52F5

Typically at 64 bits

#### IPv6 Addresses Potential Errors



2001:DB8:2:8D::A5:52F5



2001:DB8:8D::A5::52F5

2001:DB8:8D:0:**Q5**A0:0:52F5

### IPv6 Addresses Potential Errors



2001:DB8:2:8D::A5:52F5



2001:DB8:8D::A5::52F5

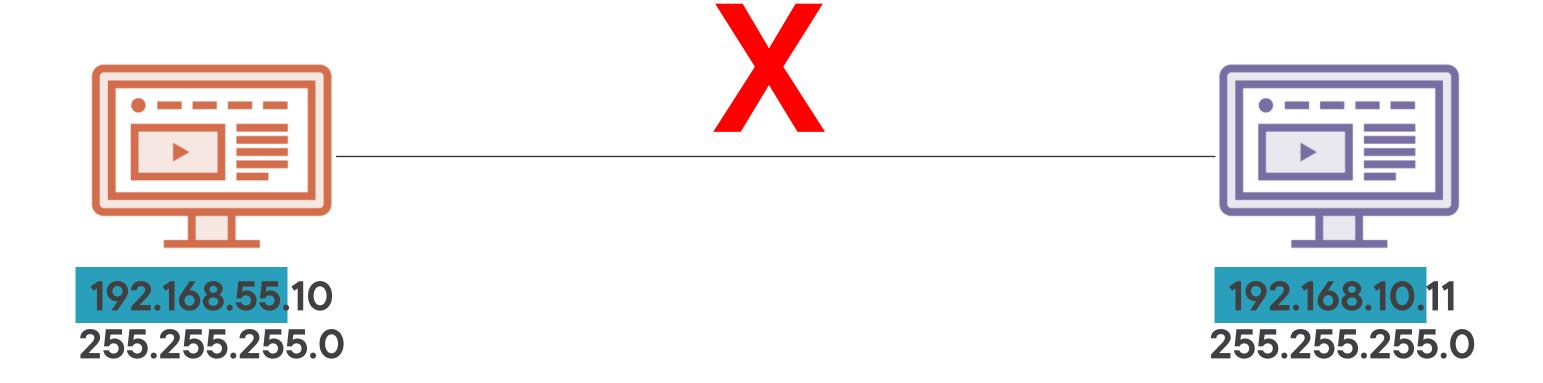


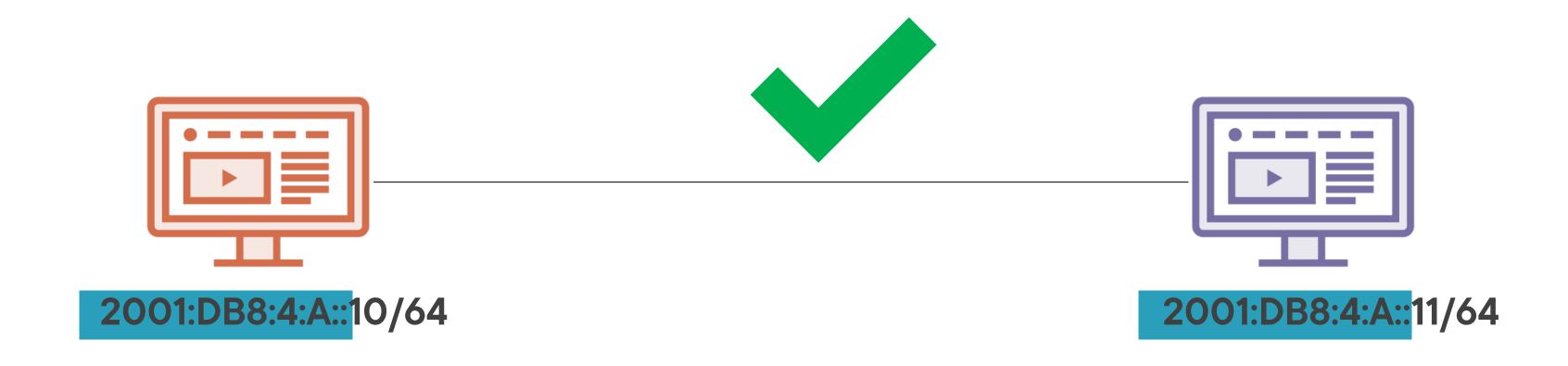
2001:DB8:2:8D:A5:52F5

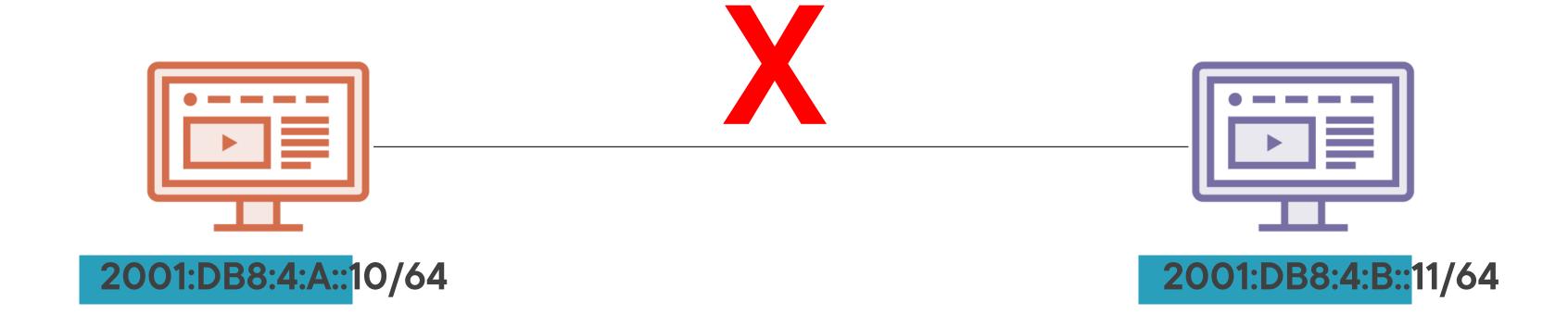
**Not Enough Bits** 

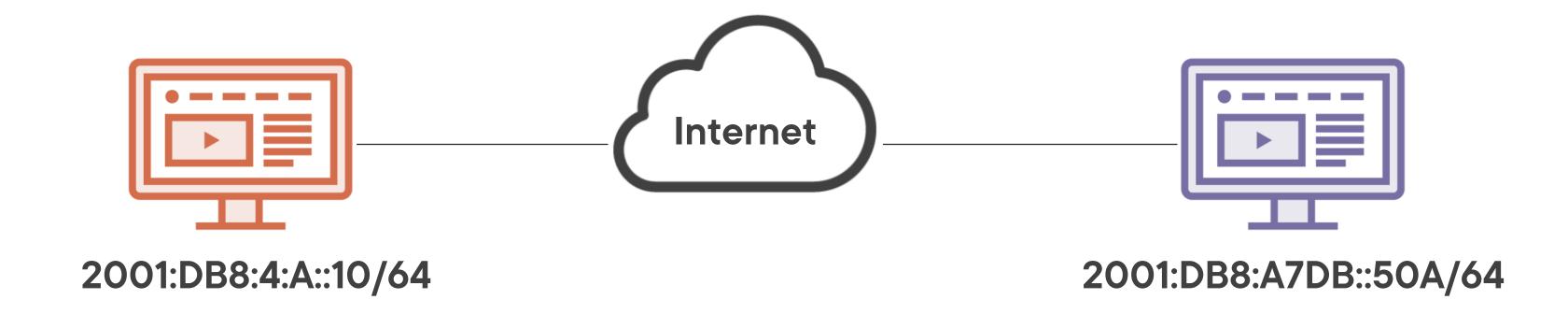






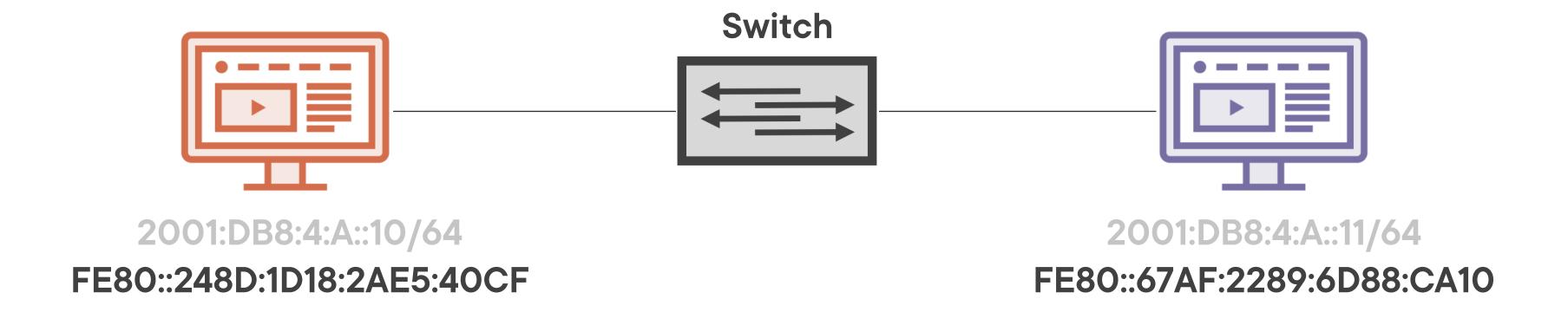






IPv6 Unicast Address
Global Communication





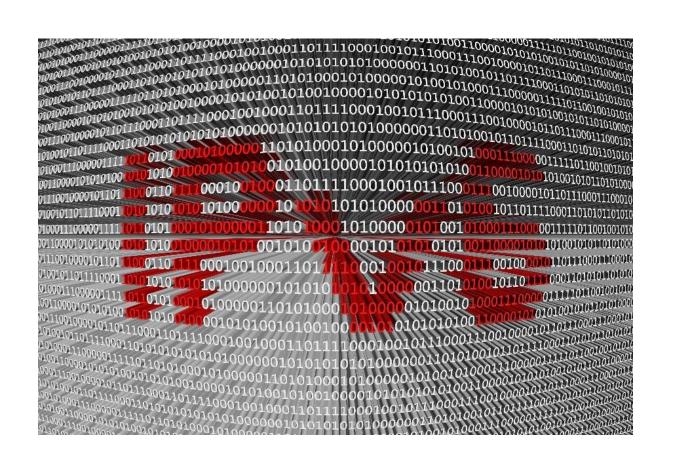
IPv6 Link Local Address Local Communication





#### **Unicast Address**

- Global Unicast Address
- Link Local Address
  - FE80::/10
- Loopback Address
  - · ::1/128



#### **Multicast Address**

- One to many communication

#### **Anycast Address**

- One IPv6 address many devices
- Used for load balancing

Network Portion 64 Bits

Interface Identifier 64 Bits

2001:0DB8:0002:008D:0000:0000:00A5:52F5

Interface Identifier 64 Bits

:0000:0000:00A5:52F5

264

Interface Identifier 64 Bits

:0000:0000:00A5:52F5

264

18,446,744,073,709,600,000



18,446,744,073,709,600,000



18,446,744,073,709,600,000

Each star in the Milky Way would receive 184,000,000 IPv6 addresses/star



18,446,744,073,709,600,000

Each star in the Milky Way would receive 184,000,000 IPv6 addresses/star

Every insect on Earth would receive 2 IPv6 addresses/bug



18,446,744,073,709,600,000

Each star in the Milky Way would receive 184,000,000 IPv6 addresses/star

Every insect on Earth would receive 2 IPv6 addresses/bug

Every grain of sand on Earth would receive 2 IPv6 addresses/grain of sand!

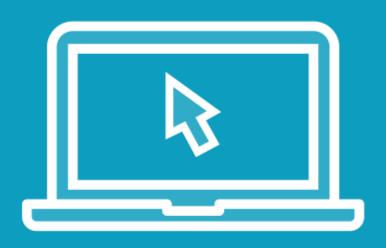


18,446,744,073,709,600,000

#### For EACH IPv6 Network!



#### Demo



**Examine IPv6 information on a PC** 

**Examine Dual Stack on a PC** 



## IPv6 Address Acquisition

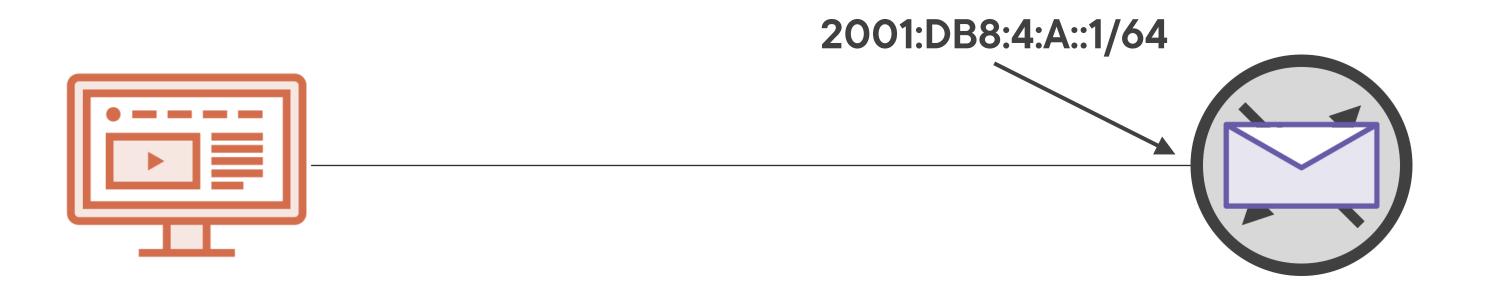


## IPv6 Address Acquisition SLAAC

Stateless Address Auto-configuration

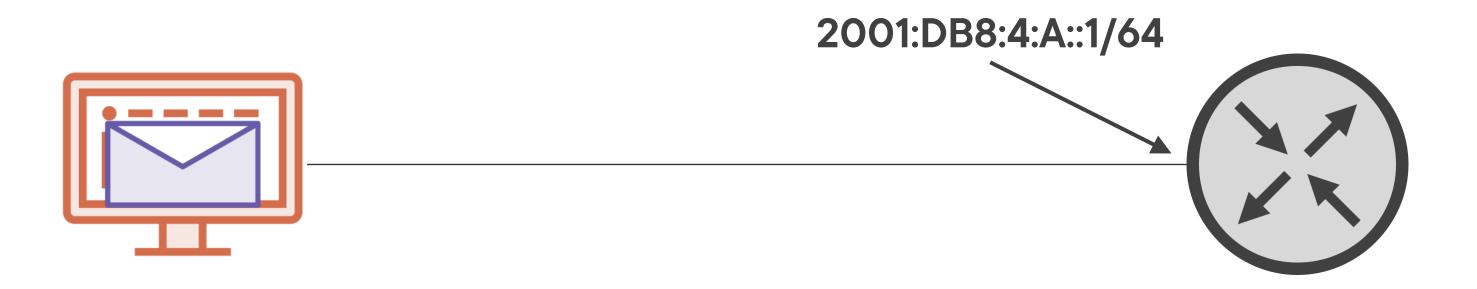


Stateless Address Auto-configuration



Router Advertisement Network 2001:DB8:4:A::/64

Stateless Address Auto-configuration



Router Advertisement Network 2001:DB8:4:A::/64

Stateless Address Auto-configuration



Router Advertisement Network 2001:DB8:4:A::/64

Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64



Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

#### Windows

Random 64 bit Interface Identifier



Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

#### Windows

Random 64 bit Interface Identifier

2001:DB8:4:A

Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

Windows

Random 64 bit Interface Identifier

2001:DB8:4:A:6783:5FA1:7B4C:A42A/64



Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

000C:29 FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

000C:29 FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

000C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

**000C:29 FF:FE FC:70A5** 



Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

**00** OC:29 FF:FE FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

000C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

000C:29 FF:FE FC:70A5





Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

000C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

000C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

020C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

#### Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

020C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

**MAC Address** 

020C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

Unix/Linux/Mac

Modified EUI - 64

2001:DB8:4:A:020C:29 FF:FE FC:70A5



Stateless Address Auto-configuration

Network 2001:DB8:4:A::/64

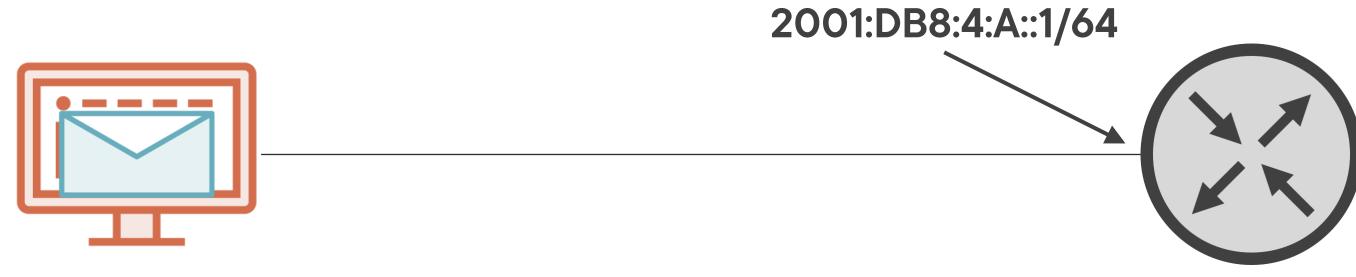
Unix/Linux/Mac

Modified EUI - 64

2001:DB8:4:A:020C:29FF:FEFC:70A5/64

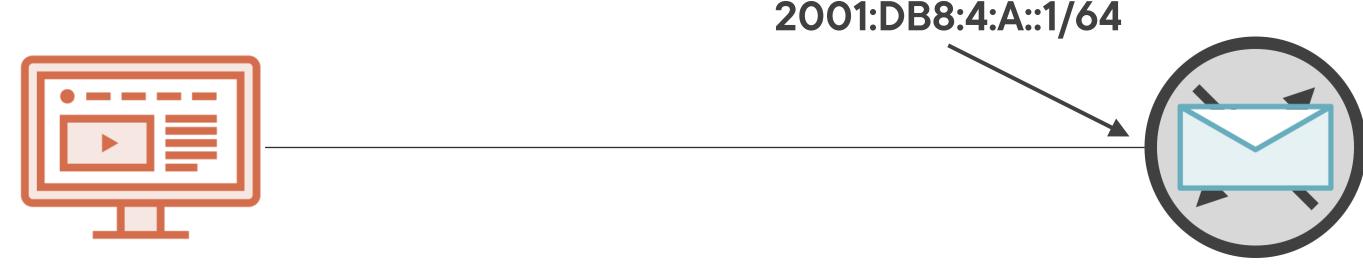


Stateless Address Auto-configuration



2001:DB8:4:A:020C:29FF:FEFC:70A5/64

Stateless Address Auto-configuration



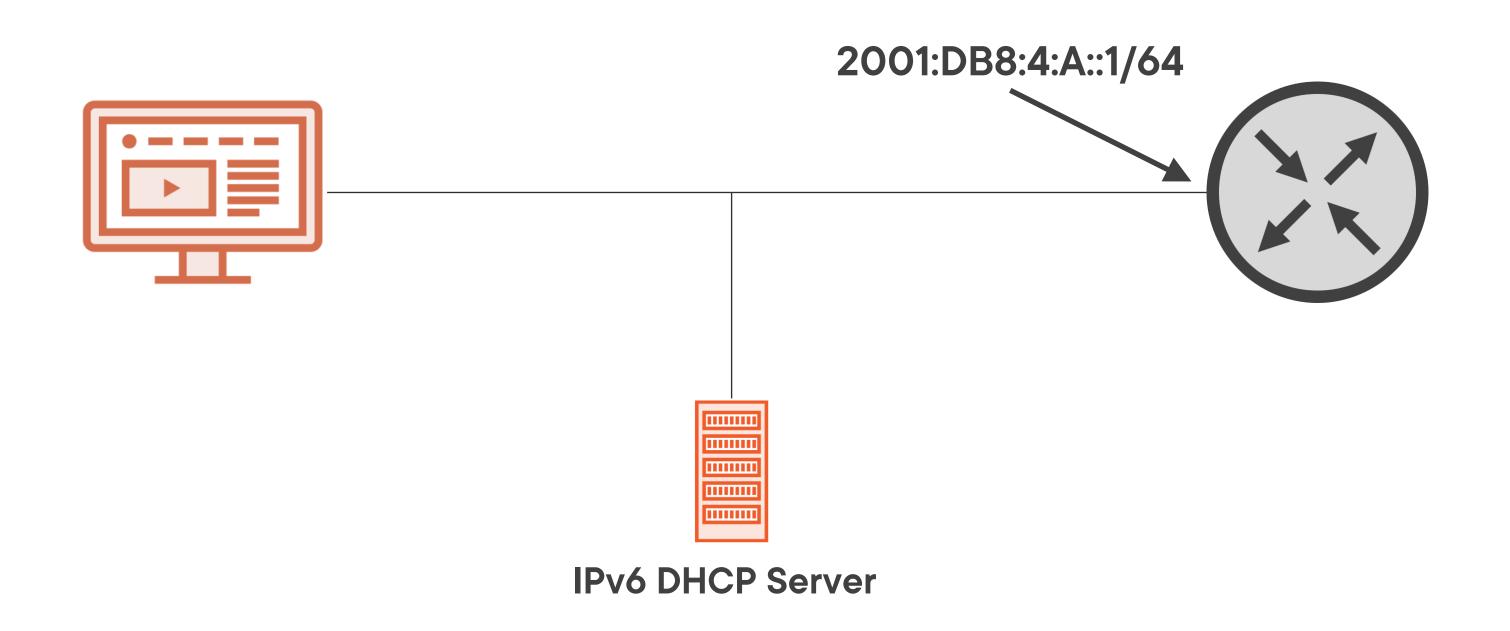
2001:DB8:4:A:020C:29FF:FEFC:70A5/64

Neighbor Advertisement 2001:DB8:4:A:020C:29FF:FEFC:70A5/64

### IPv6 DHCP



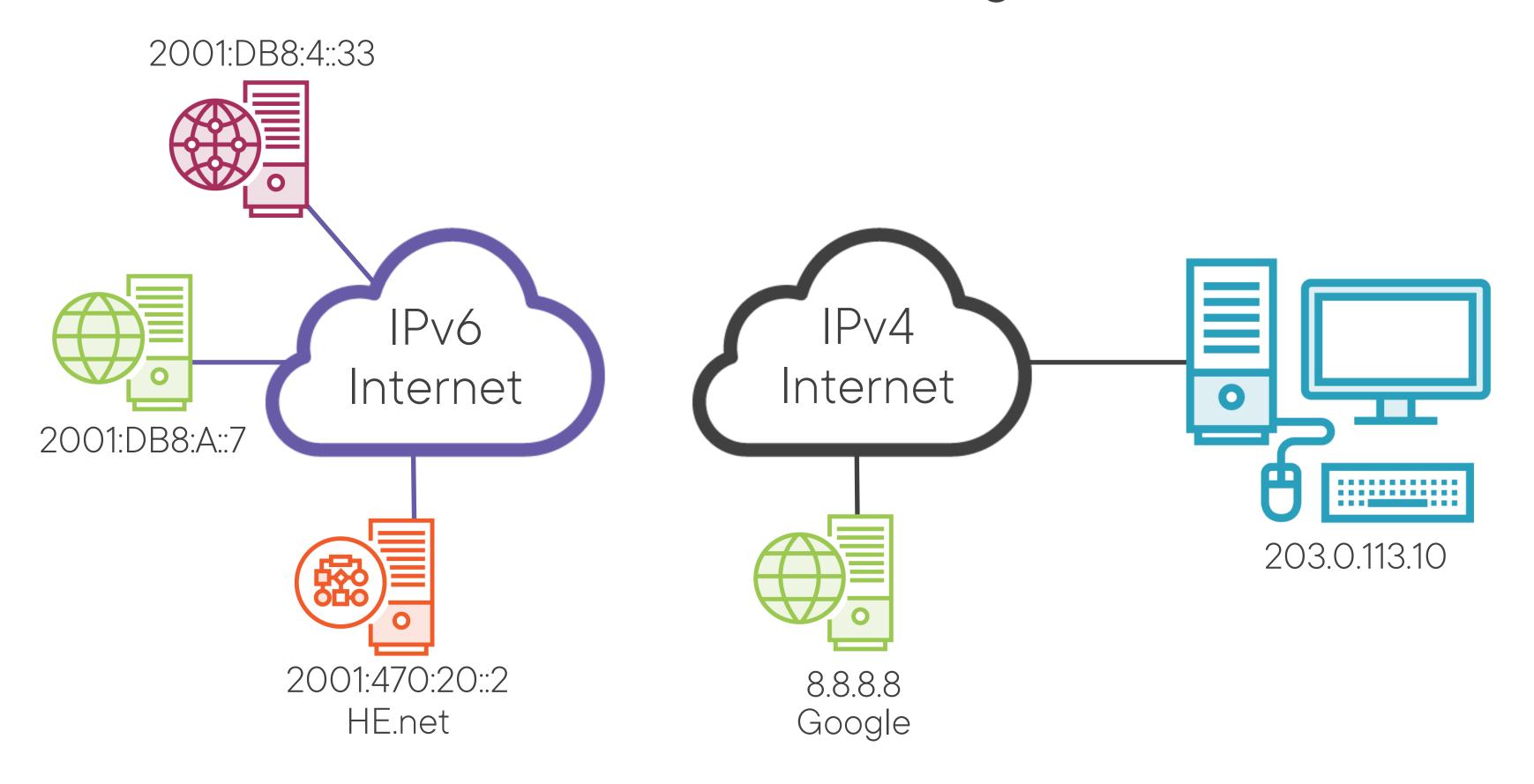
# IPv6 Address Acquisition DHCP



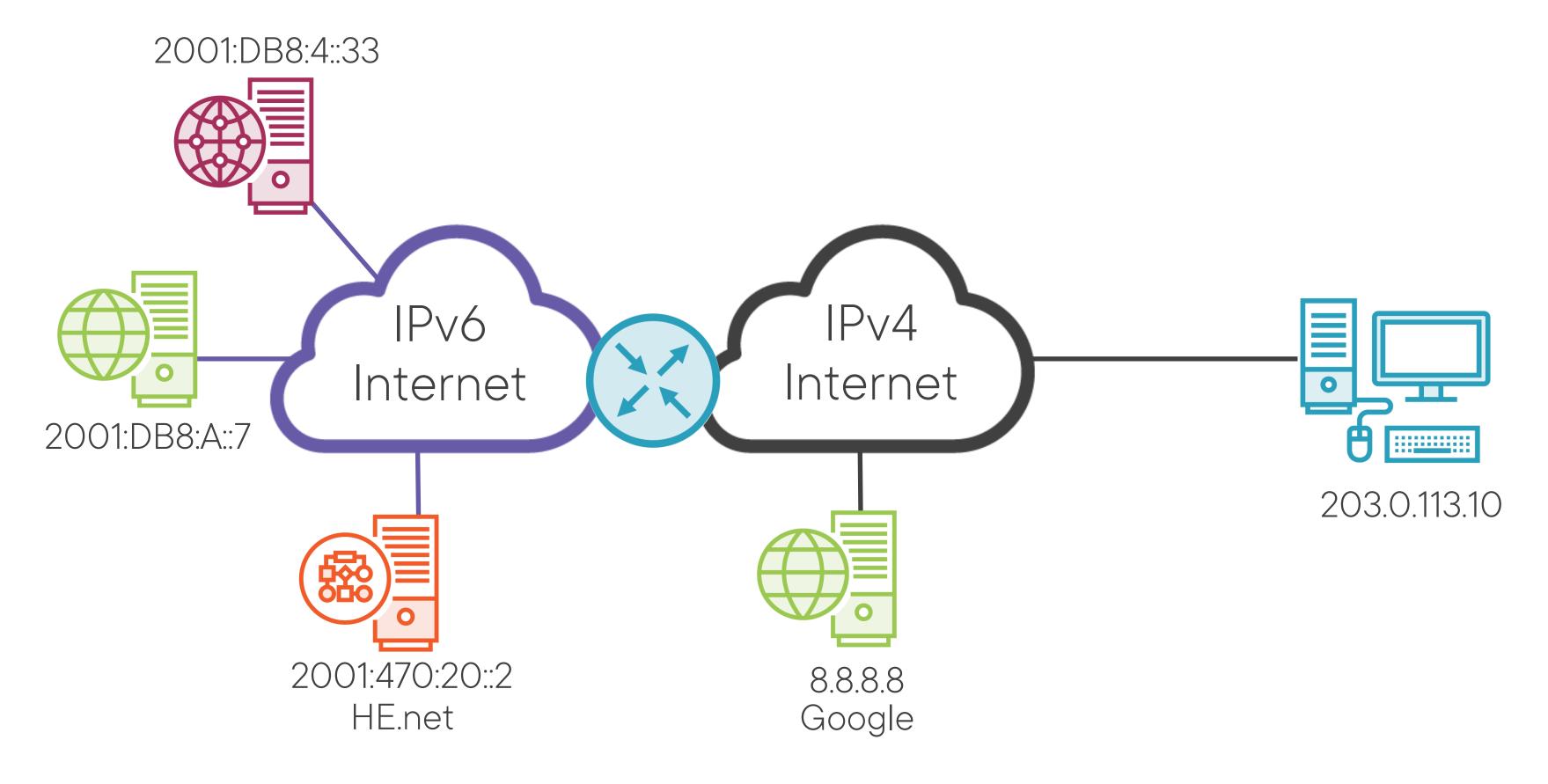


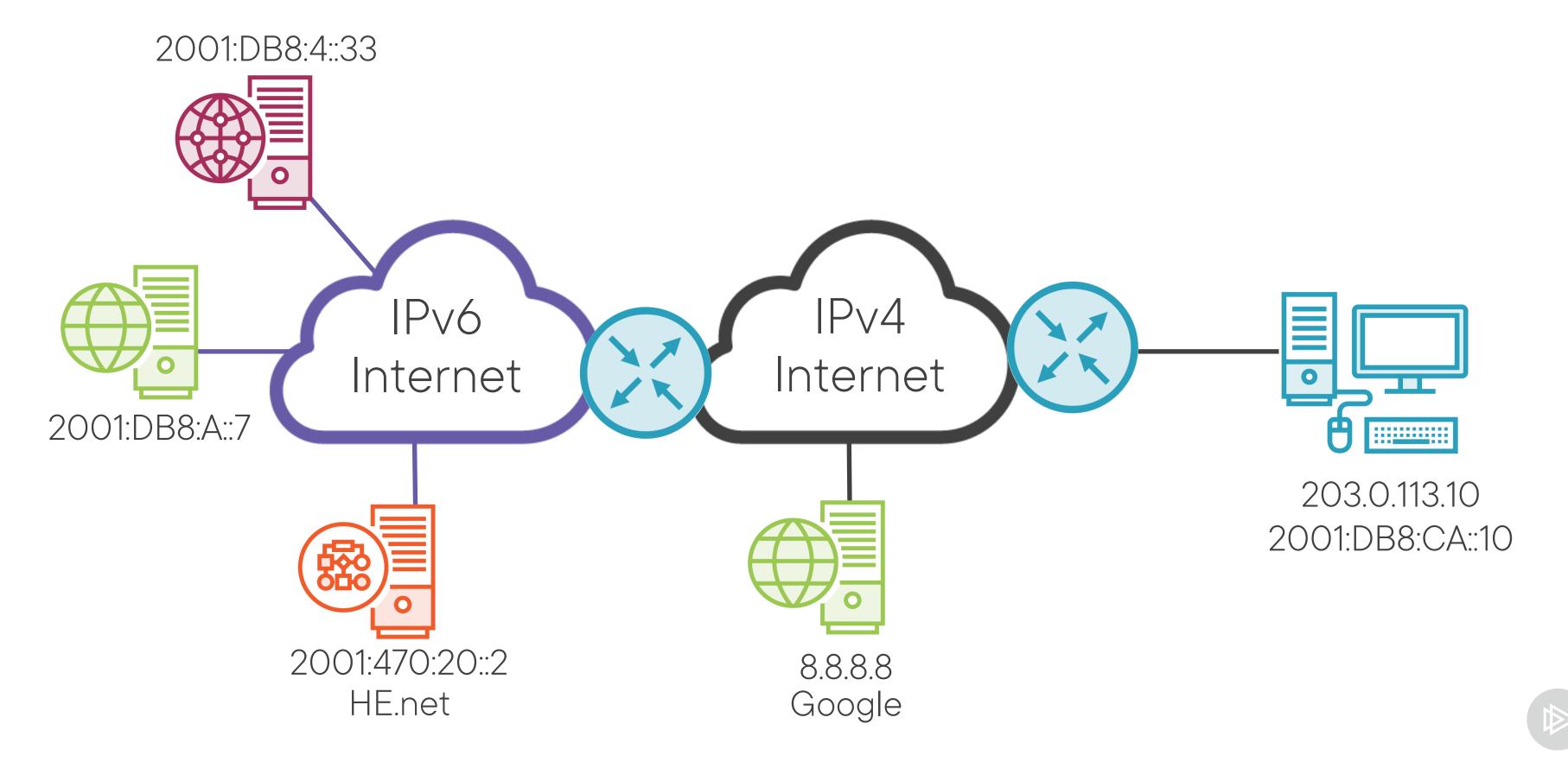
### Tunneling IPv6

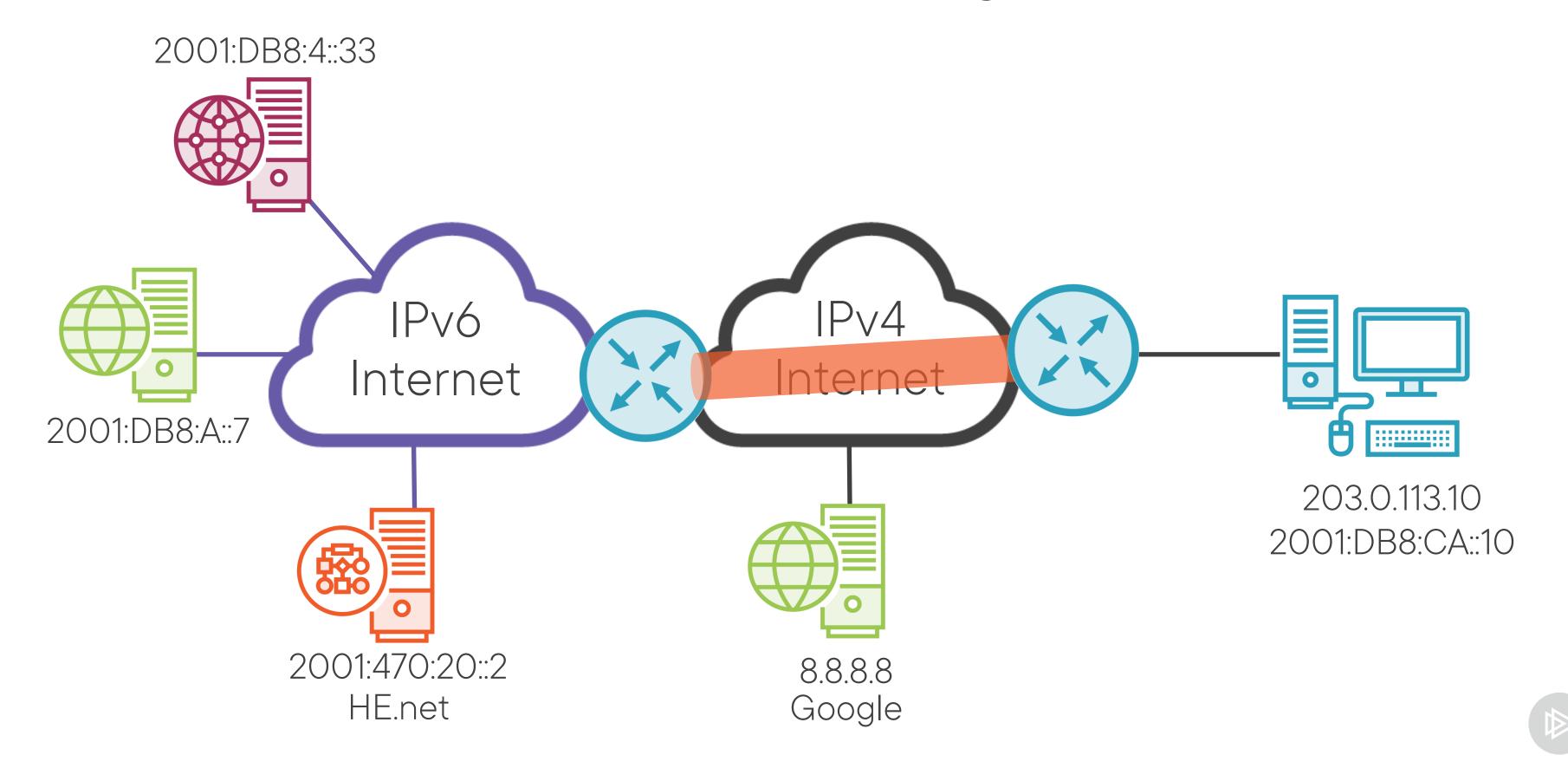


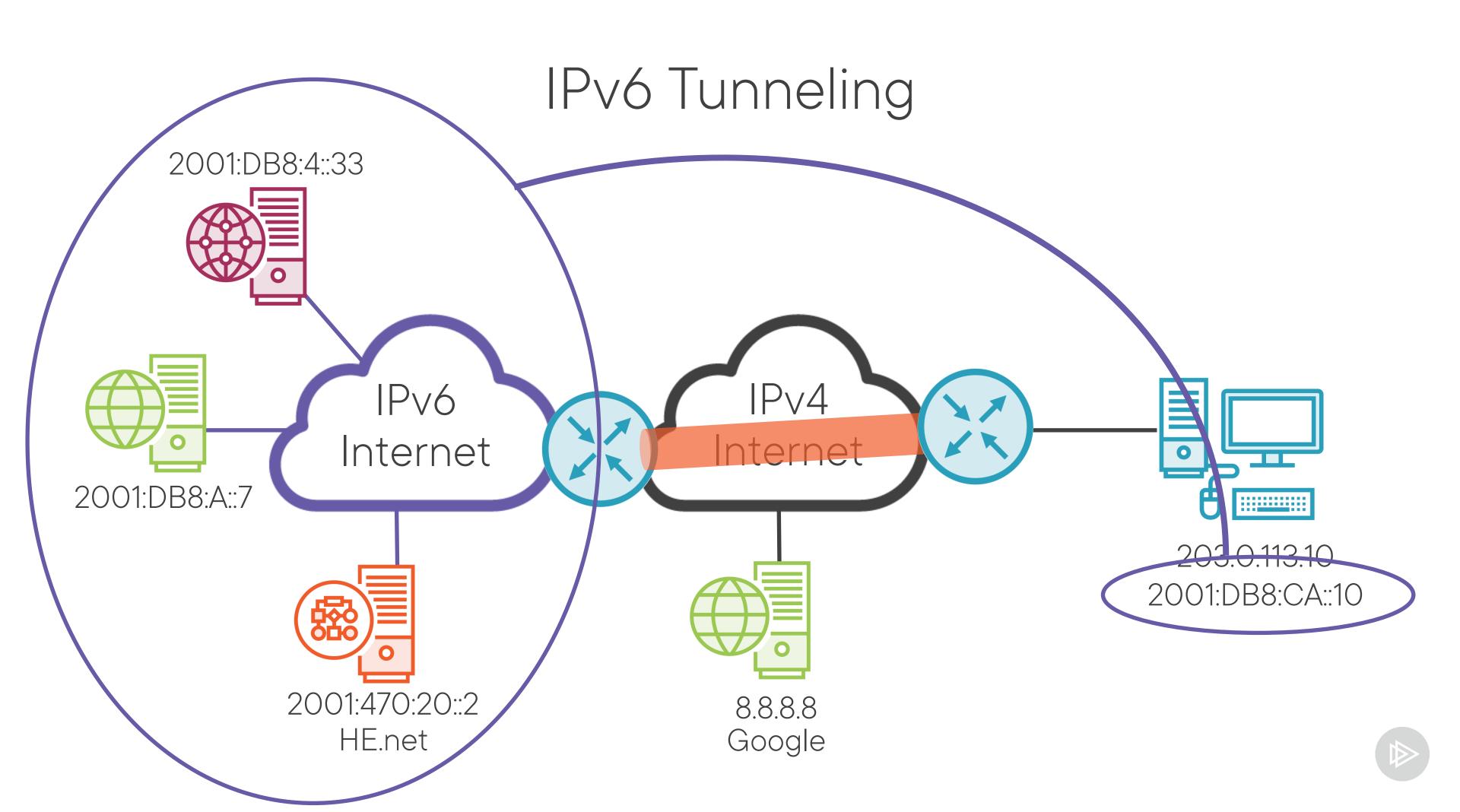












### Summary



**Terms for IPv6** 

**IPv4 Address Size** 

**IPv6 Addresses** 

**IPv6 Address Operation** 

**IPv6 Address Types** 

**IPv6 Address Acquisition** 

