

# Introduction to IPv6

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# Module Goals

**IPv4 Address Size**

**IPv6 Addresses**

- Shorten address

**IPv6 Address Acquisition**

**IPv6 Tunneling**

## Bit

- 1 or 0

## Nibble - 4 bits

- 1010
- Hex - 0xA

## Byte - 8 bits

- 11001001
- Hex - 0xC9

## Hextet - 16 bits

- 10101010 01000110
- Hex - 0xAA46

# IPv4 Address Size

1.3

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

0010	0000	0000	0001	0000	1101	1011	1000
0000	0000	0000	0010	0000	0000	1000	1101
0000	0000	0000	0000	0000	0000	0000	0000
0000	0000	1010	0101	0101	0010	1111	0101

# IPv6 Addresses

1.3

**Network Portion**  
**64 Bits**

**Interface Identifier**  
**64 Bits**

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

# IPv6 Addresses

1.3

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

**Eliminate Leading 0's**

# IPv6 Addresses

1.3

## Leading 0's

X

US\$ 1  
US\$ 01  
US\$ 0001

= US\$ 1



# IPv6 Addresses

1.3

## Leading 0's

X

US\$ 1	≠	US\$ 1
US\$ 10		
US\$ 1000		

# IPv6 Addresses

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

**Eliminate Leading 0's**

# IPv6 Addresses

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

## Eliminate Leading 0's

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

# IPv6 Addresses

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

## Eliminate Leading 0's

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

## Eliminate 0'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:0:0:0:0:52F5

# IPv6 Addresses Potential Errors



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



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



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

Not Enough Bits

# How Many IPv6 Addresses?

**Network Portion**  
**64 Bits**

**Interface Identifier**  
**64 Bits**

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

# How Many IPv6 Addresses?

**Interface Identifier**  
**64 Bits**

:0000:0000:00A5:52F5

**$2^{64}$**



# How Many IPv6 Addresses?

**Interface Identifier**  
**64 Bits**

**:0000:0000:00A5:52F5**

**$2^{64}$**

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

# How Many IPv6 Addresses?

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Each star in the Milky Way would receive  
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Every insect on Earth would receive  
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# How Many IPv6 Addresses?

# 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!

How Many IPv6 Addresses?

**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



# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration



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

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration



Router Advertisement  
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# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration



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

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

# IPv6 Address Acquisition SLAAC Stateless Address Auto-configuration

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

## **Windows**

Random 64 bit Interface Identifier

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

### **Windows**

Random 64 bit Interface Identifier

**2001:DB8:4:A:**

# IPv6 Address Acquisition SLAAC

## 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**



# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

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

# IPv6 Address Acquisition SLAAC Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**000C:29**

**FC:70A5**

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

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

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**000C:29FF:FEFC:70A5**

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**000C:29FF:FEFC:70A5**

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**000C:29FF:FEFC:70A5**

0000 00 0

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**000C:29FF:FEFC:70A5**

0000 0000



# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**000C:29FF:FEFC:70A5**

0000 00**1**0

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**000C:29FF:FEFC:70A5**

0000 0010

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**02**0C:29FF:FEFC:70A5

0000 0010

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**02**0C:29FF:FEFC:70A5

0000 0010

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

**MAC Address**

**020C:29FF:FEFC:70A5**

0000 0010

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

Modified EUI - 64

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

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

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

**Unix/Linux/Mac**

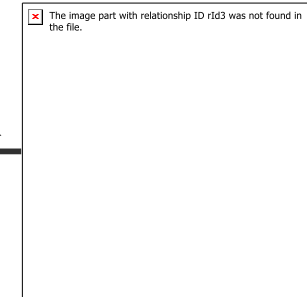
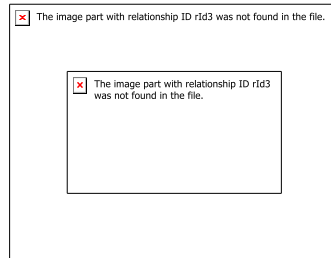
Modified EUI - 64

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

# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

2001:DB8:4:A::1/64



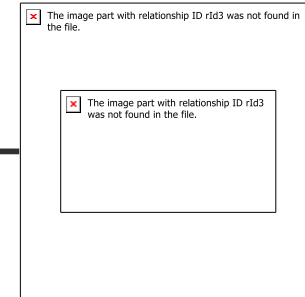
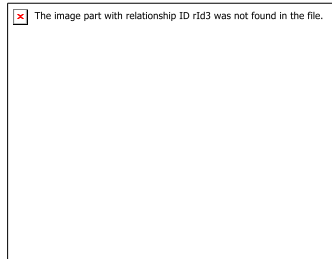
2001:DB8:4:A:020C:29FF:FEFC:70A5/64



# IPv6 Address Acquisition SLAAC

## Stateless Address Auto-configuration

2001:DB8:4:A::1/64



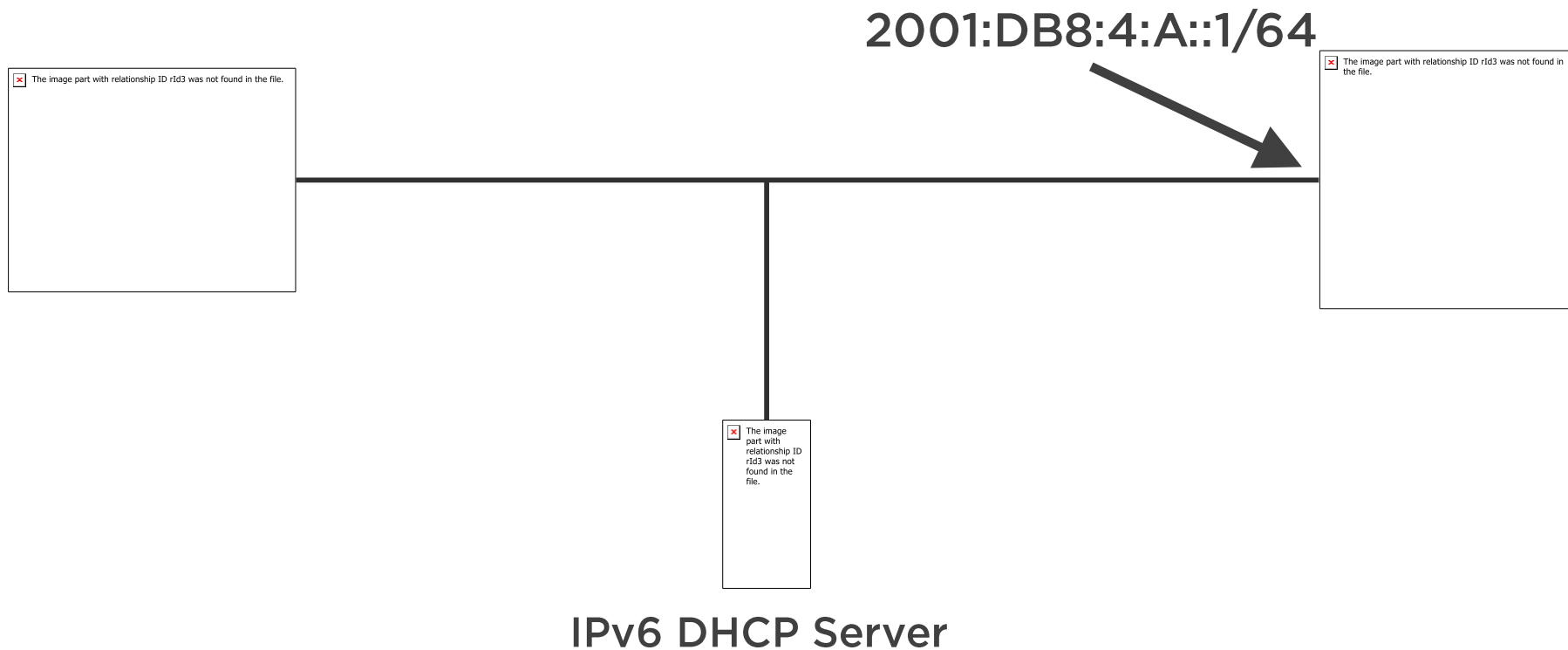
2001:DB8:4:A:020C:29FF:FEFC:70A5/64

Neighbor Advertisement

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

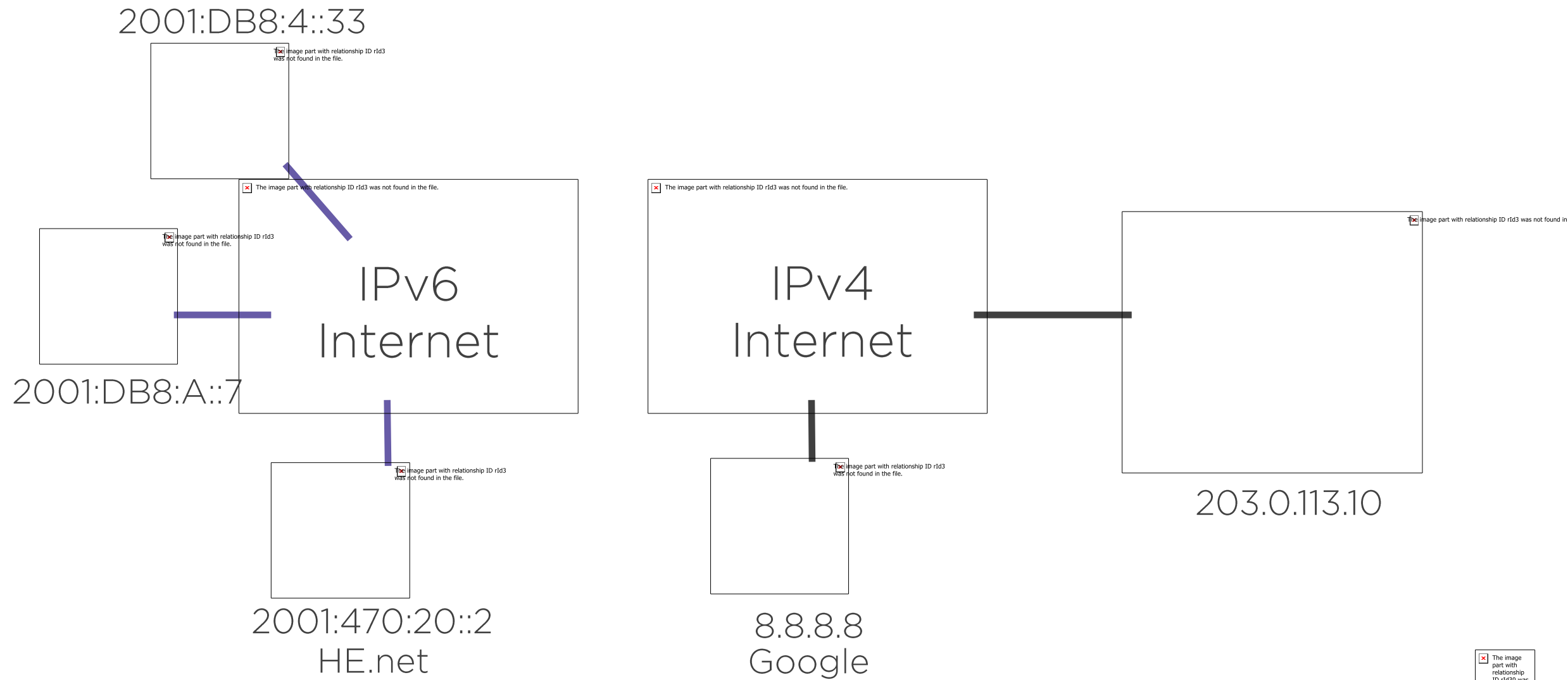
# IPv6 DHCP

# IPv6 Address Acquisition DHCP

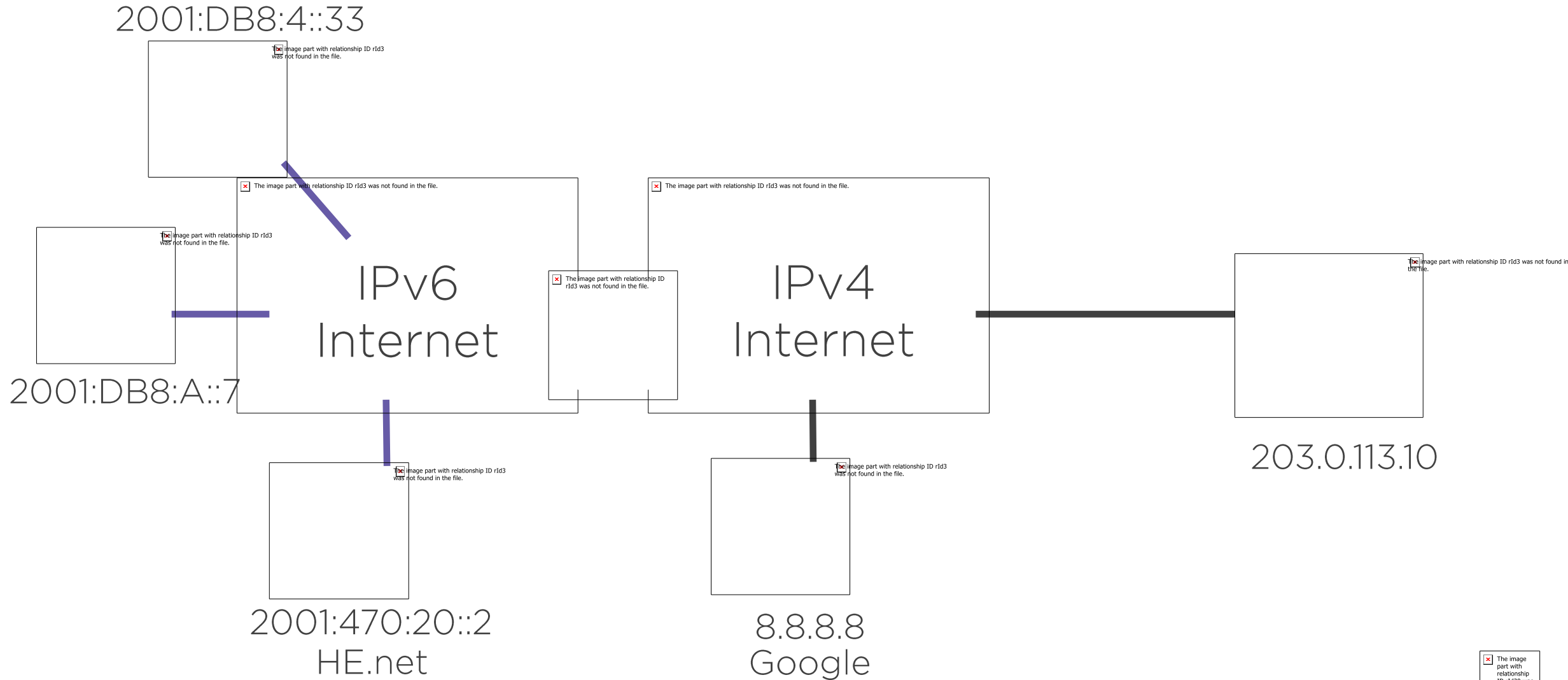


# Tunneling IPv6

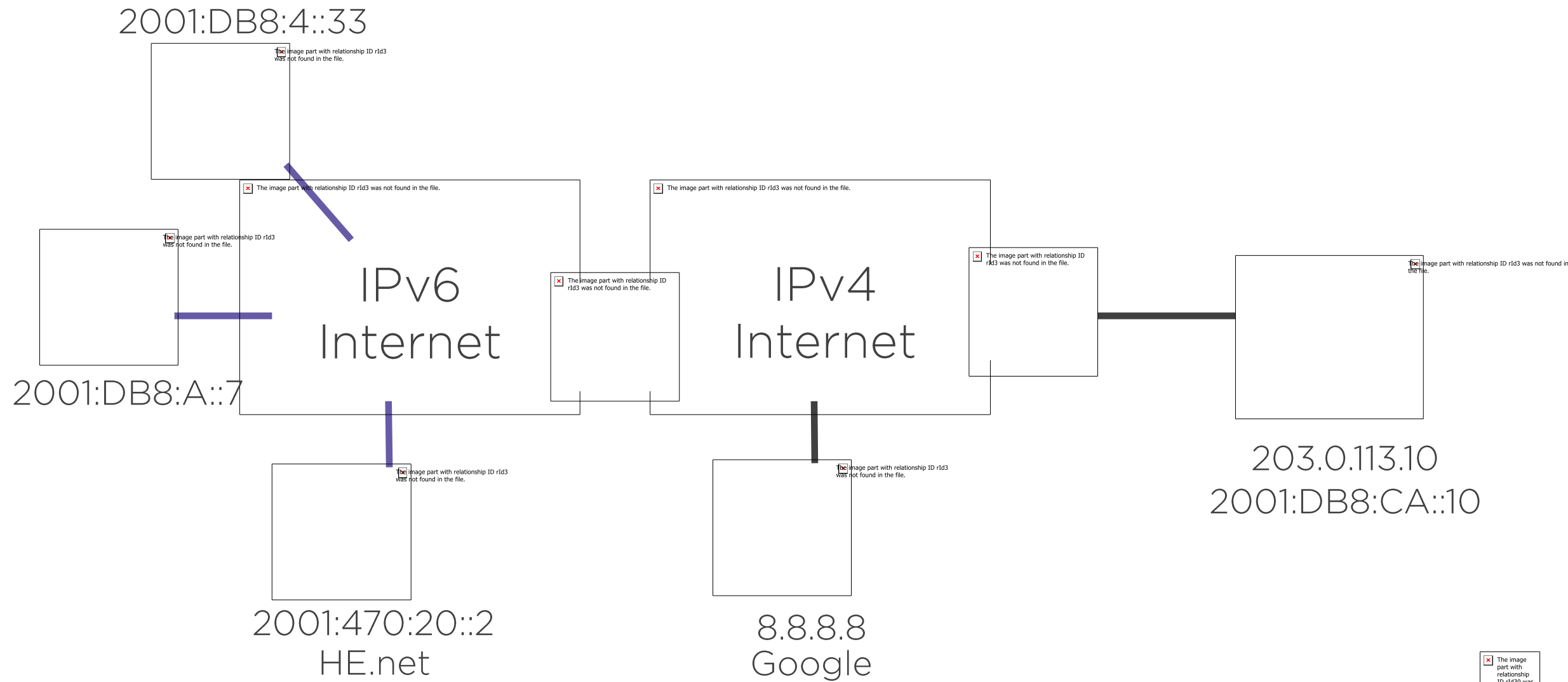
# IPv6 Tunneling



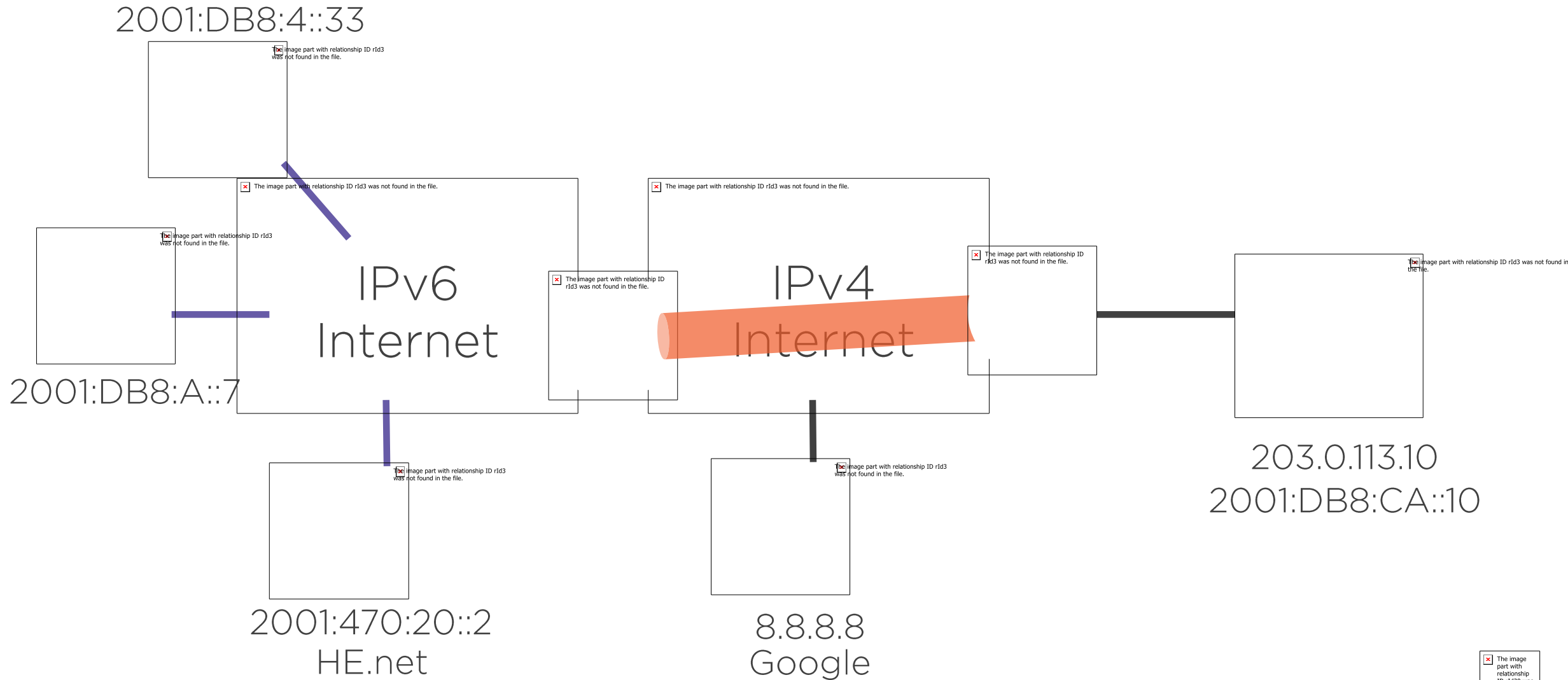
# IPv6 Tunneling



# IPv6 Tunneling

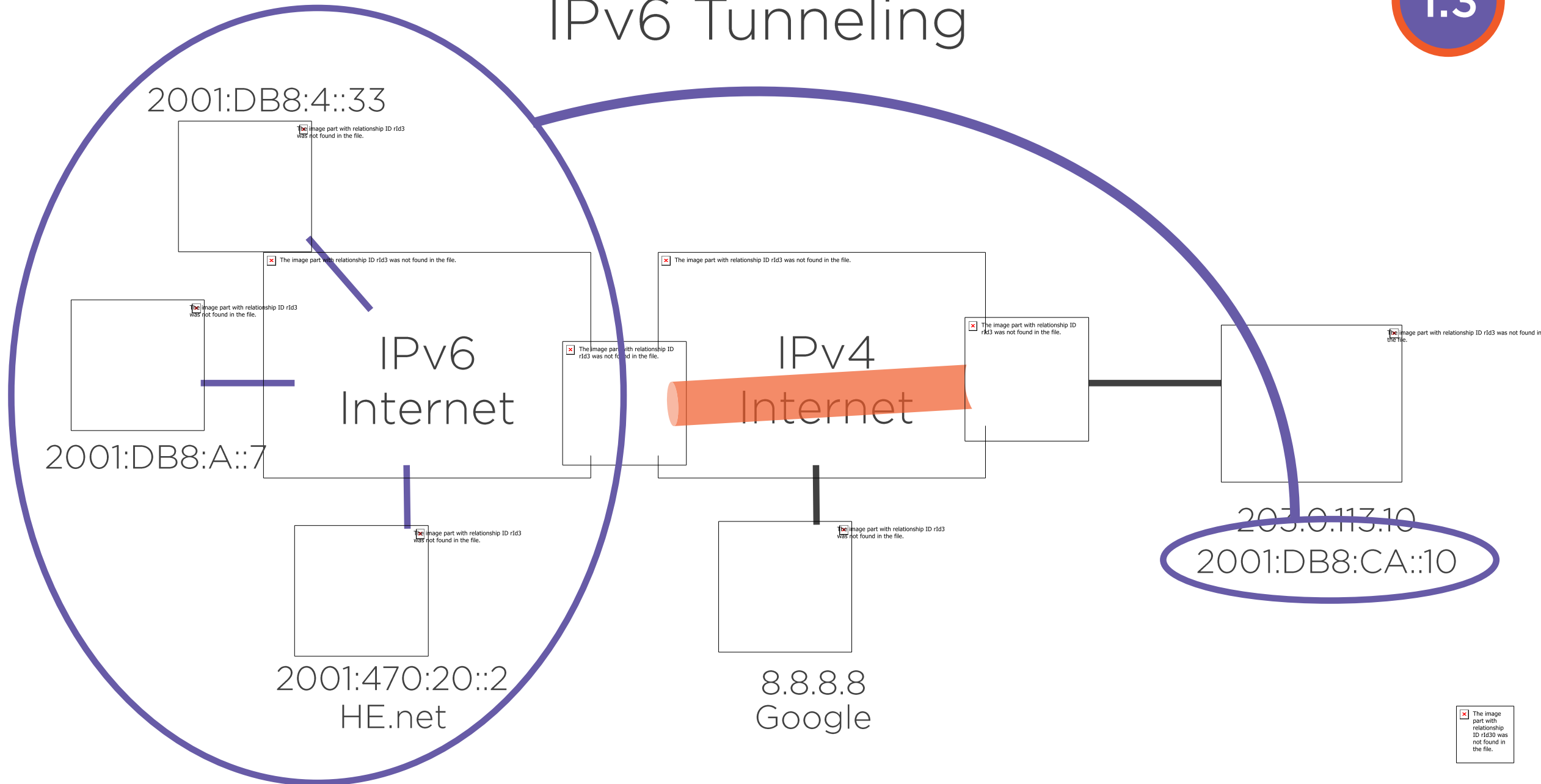


# IPv6 Tunneling





# IPv6 Tunneling



# Summary

**IPv4 Address Size**

**IPv6 Addresses**

- Shorten address

**IPv6 Address Acquisition**

**IPv6 Tunneling**