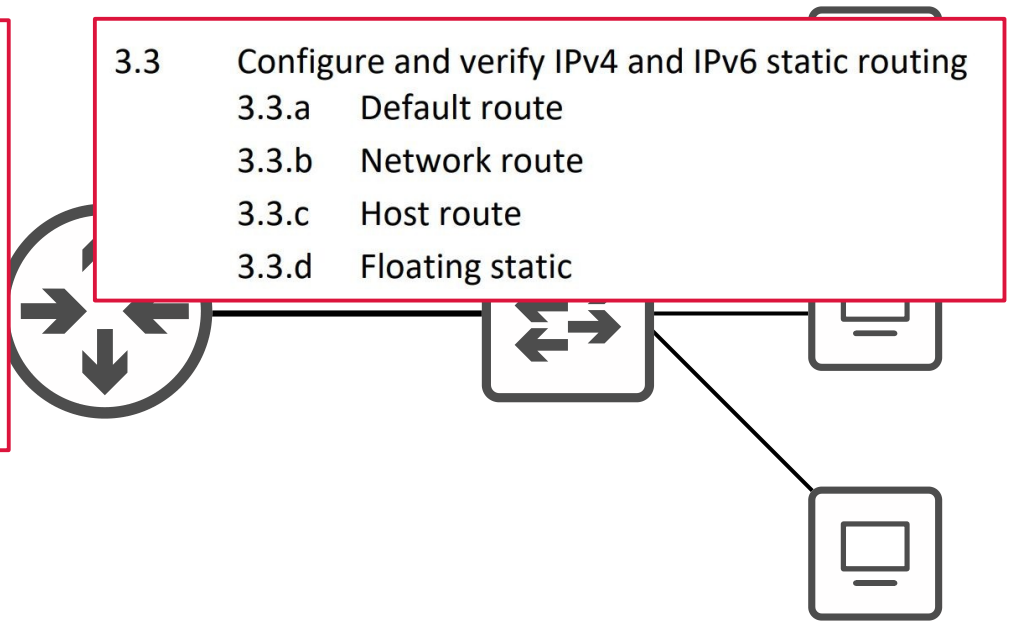
CCNA 200-301 Day 31

IPv6 Part 1

1.8 Configure and verify IPv6 addressing and prefix

1.9 Compare IPv6 address types
- 1.9.a Global unicast
- 1.9.b Unique local
- 1.9.c Link local
- 1.9.d Anycast
- 1.9.e Multicast
- 1.9.f Modified EUI 64

3.3 Configure and verify IPv4 and IPv6 static routing
- 3.3.a Default route
- 3.3.b Network route
- 3.3.c Host route
- 3.3.d Floating static



Things we'll cover

- Hexadecimal (review)
- Why IPv6?
- Basics of IPv6
- Configuring IPv6 addresses

What about IPv5?

- ‘Internet Stream Protocol’ was developed in the late 1970s, but never actually introduced for public use.
- It was never called ‘IPv5’, but it used a value of 5 in the Version field of the IP header.
- So, when the successor to IPv4 was being developed, it was named IPv6.

Hexadecimal

- Binary / Base 2 / 0b
  0, 1

10 ◄

0b10

Is that decimal 10?
Or binary 10 (=decimal 2)?
Or hexadecimal 10 (=decimal 16)?

- Decimal / Base 10 / 0d
  0, 1, 2, 3, 4, 5, 6, 7, 8, 9

- Hexadecimal / Base 16 / 0x
  0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

Hexadecimal

Decimal	Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9

Decimal	Binary	Hexadecimal
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

Binary → Hexadecimal 1

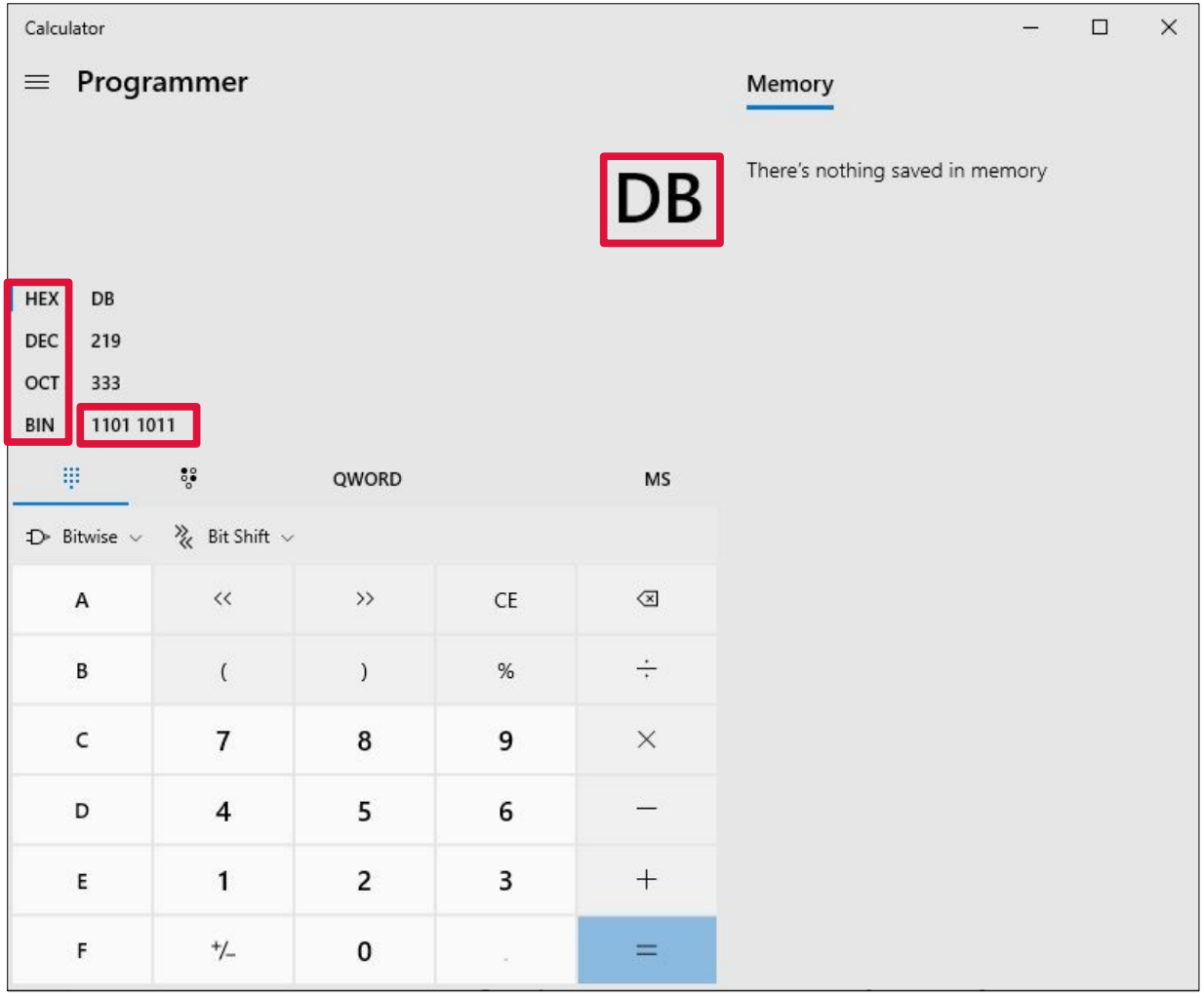
0b11011011 = 0x??

0b1101 0b1011

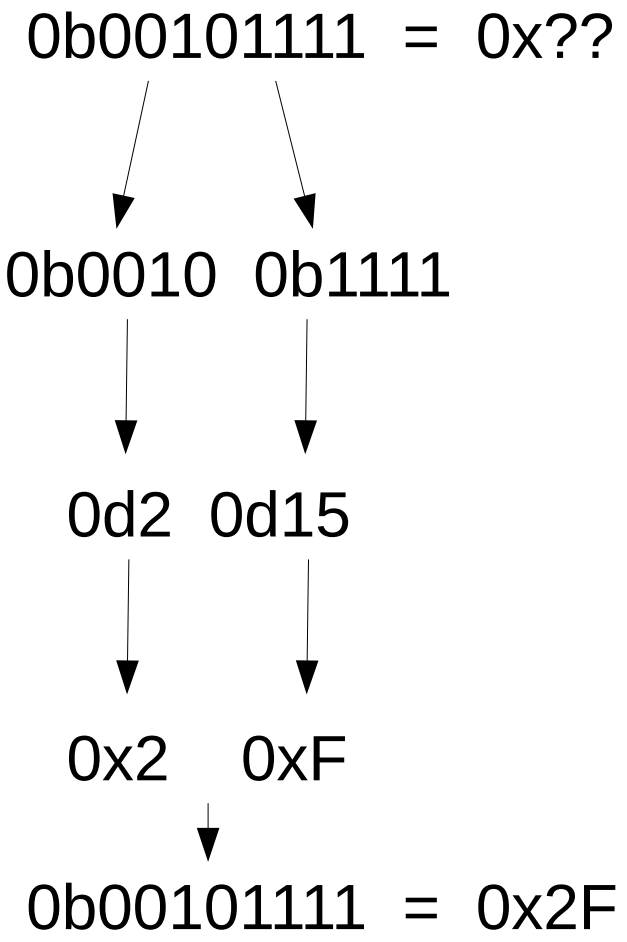
0d13 0d11

0xD 0xB

0b11011011 = 0xDB



Binary → Hexadecimal 2



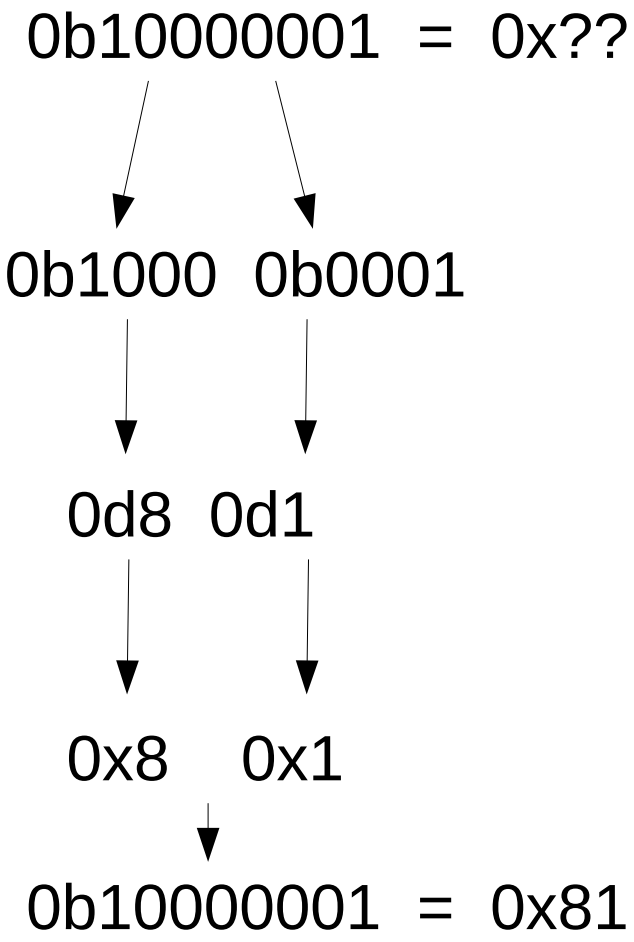
Split the number into 4-bit groups

Convert each 4-bit group to decimal

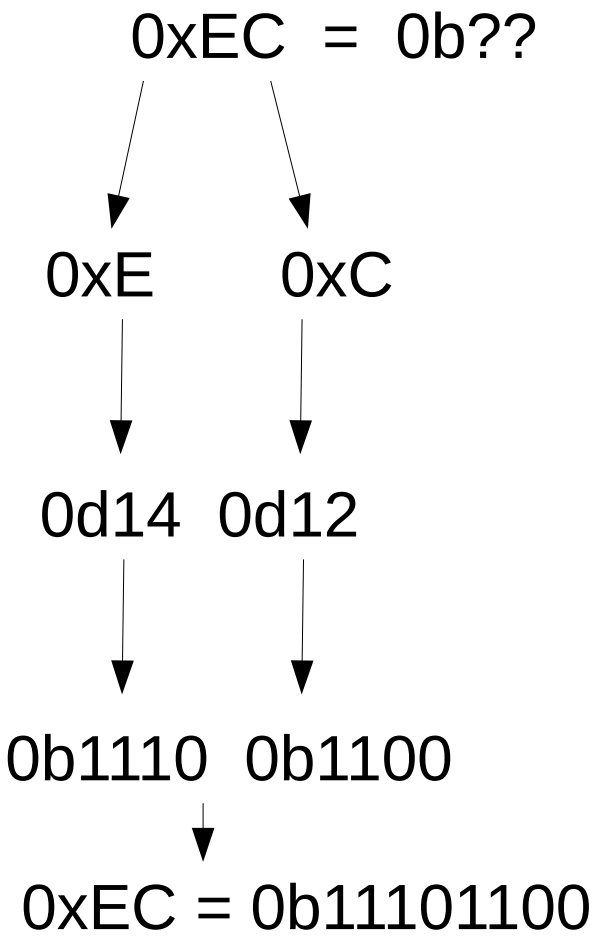
Convert each decimal number to hexadecimal

That’s the answer

Binary → Hexadecimal 3



Hexadecimal → Binary 1



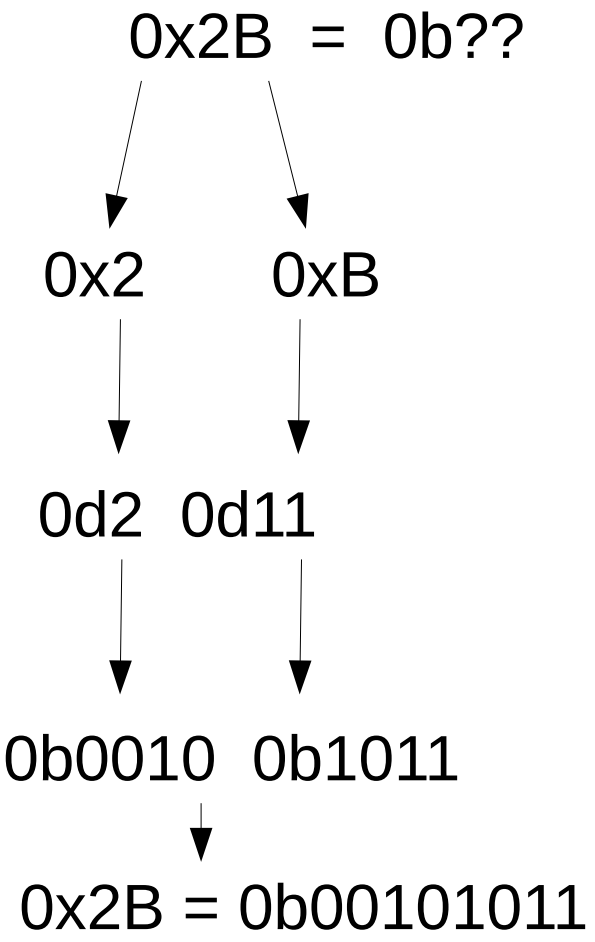
Split up the hexadecimal digits

Convert each hexadecimal digit to decimal

Convert each decimal number to binary

That's the answer

Hexadecimal → Binary 2



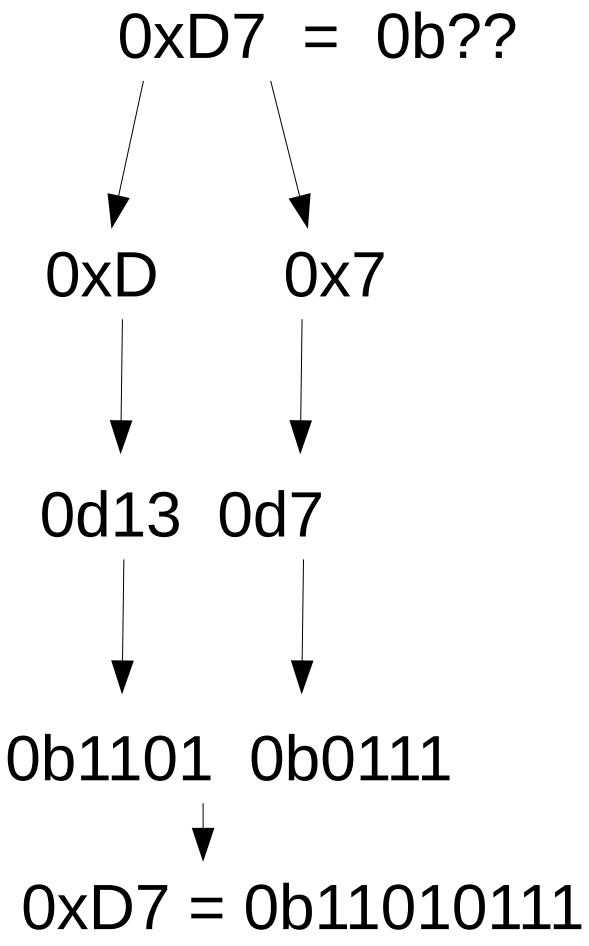
Split up the hexadecimal digits

Convert each hexadecimal digit to decimal

Convert each decimal number to binary

That's the answer

Hexadecimal → Binary 3



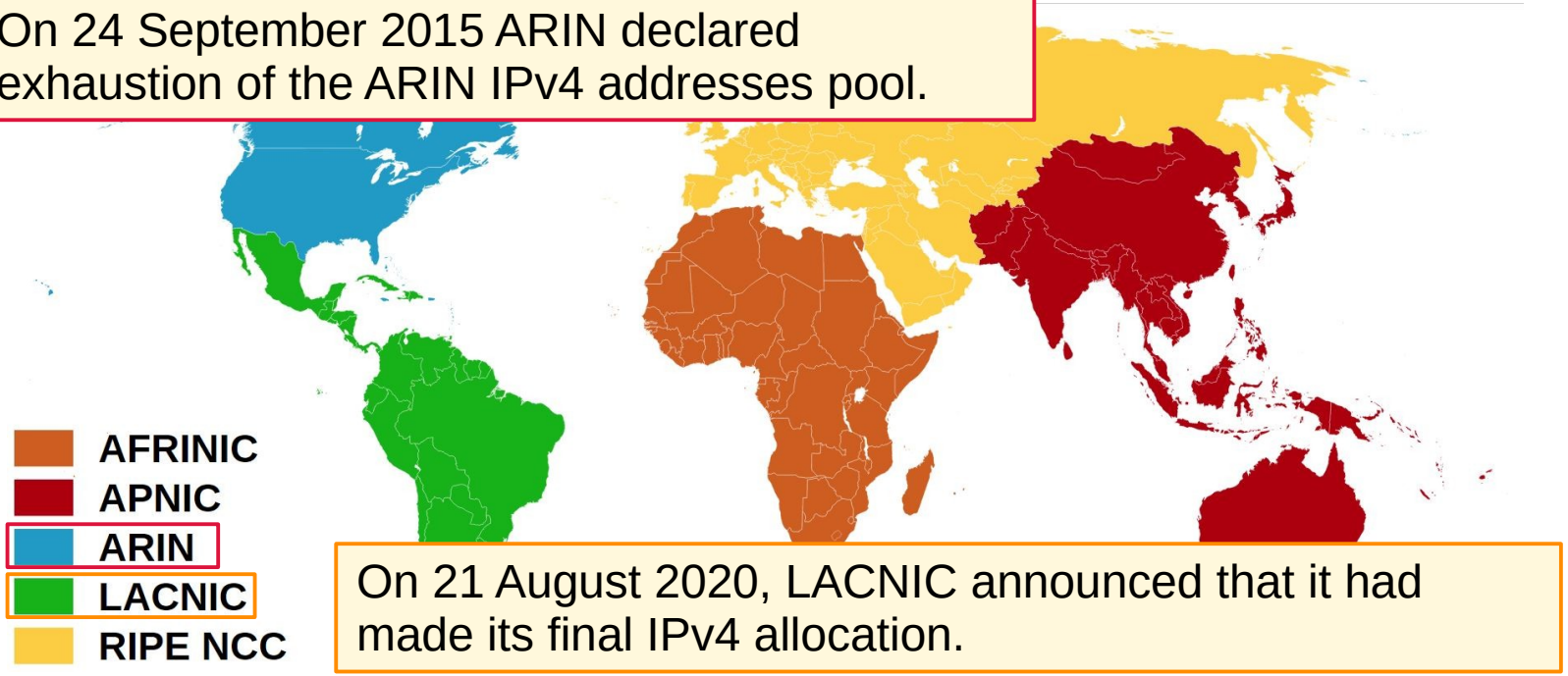
Why IPv6?

- The main reason is that **there simply aren't enough IPv4 address available!**
- There are 4,294,967,296 (2^{32}) IPv4 addresses available.
- When IPv4 was being designed 30 years ago, the creators had no idea the Internet would be as large as it is today.
- VLSM, private IPv4 addresses, and NAT have been used to conserve the use of IPv4 address space.
- Those are short-term solutions.
- The long-term solution is IPv6.

Why IPv6?

- IPv4 address assignments are controlled by IANA (Internet Assigned Numbers Authority)
- IANA distributes IPv4 address space to various RIRs (Regional Internet Registries), which then assign them to companies that need them.

On 24 September 2015 ARIN declared exhaustion of the ARIN IPv4 addresses pool.



On 21 August 2020, LACNIC announced that it had made its final IPv4 allocation.

IPv6

- An IPv6 address is **128 bits**.
- 4*the bits of an IPv4 address = 4*the number of possible addresses? NO
- Every additional bit **doubles** the number of possible addresses.
- There are 340,282,366,920,938,463,463,374,607,431,768,211,456 IPv6 addresses.
  There are ……..4,294,967,296 IPv4 addresses.
- Example IPv6 address in binary:
  `00100000000000010000110110111000010110010001011111101010101111010110010101100010000101111110101011001001001011010101100110111101`

  ↳~~`32.1.13.184.89.23.234.189.101.98.23.234.201.45.89.189`~~

  ↳`2001:0DB8:5917:EABD:6562:17EA:C92D:59BD` /64

  1 2 3 4 5 6 7 8

Shortening (abbreviating) IPv6 addresses

- **Leading 0s** can be removed

  2001:0DB8:000A:001B:20A1:0020:0080:34BD

  2001:DB8:A:1B:20A1:20:80:34BD

- **Consecutive quartets of all 0s** can be replaced with a double colon (::)

  2001:0DB8:0000:0000:0000:0000:0080:34BD

  2001:0DB8::0080:34BD

  Combine both methods

  2001:DB8::80:34BD

Shortening (abbreviating) IPv6 addresses

- Consecutive quartets of 0s can only be abbreviated once in an IPv6 address.

2001:0000:0000:0000:20A1:0000:0000:34BD

~~2001::20A1::34BD~~

How many quartets of 0 are here?

How many quartets of 0 are here?

2001::20A1:0:0:34BD

Shortening (abbreviating) IPv6 addresses

Full IPv6 Address	Shortened IPv6 Address
2000:AB78:0020:01BF:ED89:0000:0000:0001	2000:AB78:20:1BF:ED89::1
FE80:0000:0000:0000:0002:0000:0000:FBE8	FE80::2:0:0:FBE8
AE89:2100:01AC:00F0:0000:0000:0000:020F	AE89:2100:1AC:F0::20F
2001:0DB8:8B00:1000:0002:0BC0:0D07:0099	2001:DB8:8B00:1000:2:BC0:D07:99
2001:0DB8:0000:0000:0000:0000:0000:1000	2001:DB8::1000

Expanding shortened IPv6 addresses

- Put leading 0s where needed (all quartets should have 4 hexadecimal characters)

FE80::2:0:0:FBE8

FE80::0002:0000:0000:FBE8

- If a double colon is used, replace it with all-0 quartets. Make sure there are 8 quartets in total.

FE80::0002:0000:0000:FBE8 5 quartets (8 quartets, but only 5 are written)

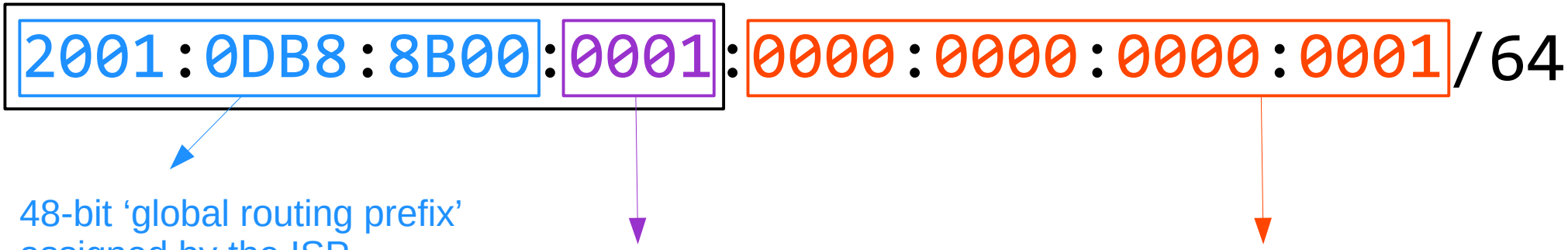
FE80:0000:0000:0000:0002:0000:0000:FBE8 8 quartets

Expanding shortened IPv6 addresses

Full IPv6 Address	Shortened IPv6 Address
FE80:0000:0000:0000:1010:02FC:0000:0009	FE80::1010:2FC:0:9
2001:0DB8:0001:0B23:2309:0000:0000:00C1	2001:DB8:1:B23:2309::C1
FD00:0000:0000:0000:1000:0689:9000:0CDF	FD00::1000:689:9000:CDF
FF02:0000:0000:0000:0000:0000:0000:0002	FF02::2
0000:0000:0000:0000:0000:0000:0000:0001	::1

Finding the IPv6 prefix (global unicast addresses)

- Typically, an enterprise requesting IPv6 addresses from their ISP will receive a /48 block.
- Typically, IPv6 subnets use a /64 prefix length.
- That means an enterprise has 16 bits to use to make subnets.
- The remaining 64 bits can be used for hosts.

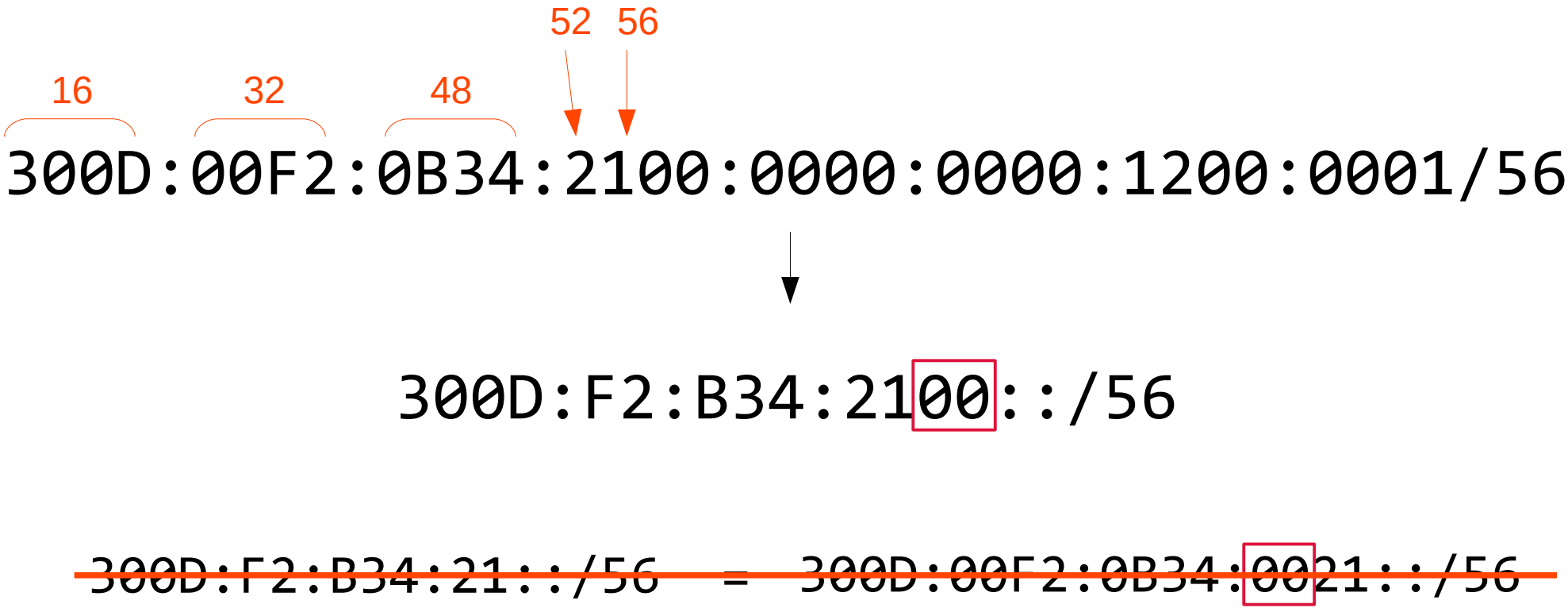


Finding the IPv6 prefix

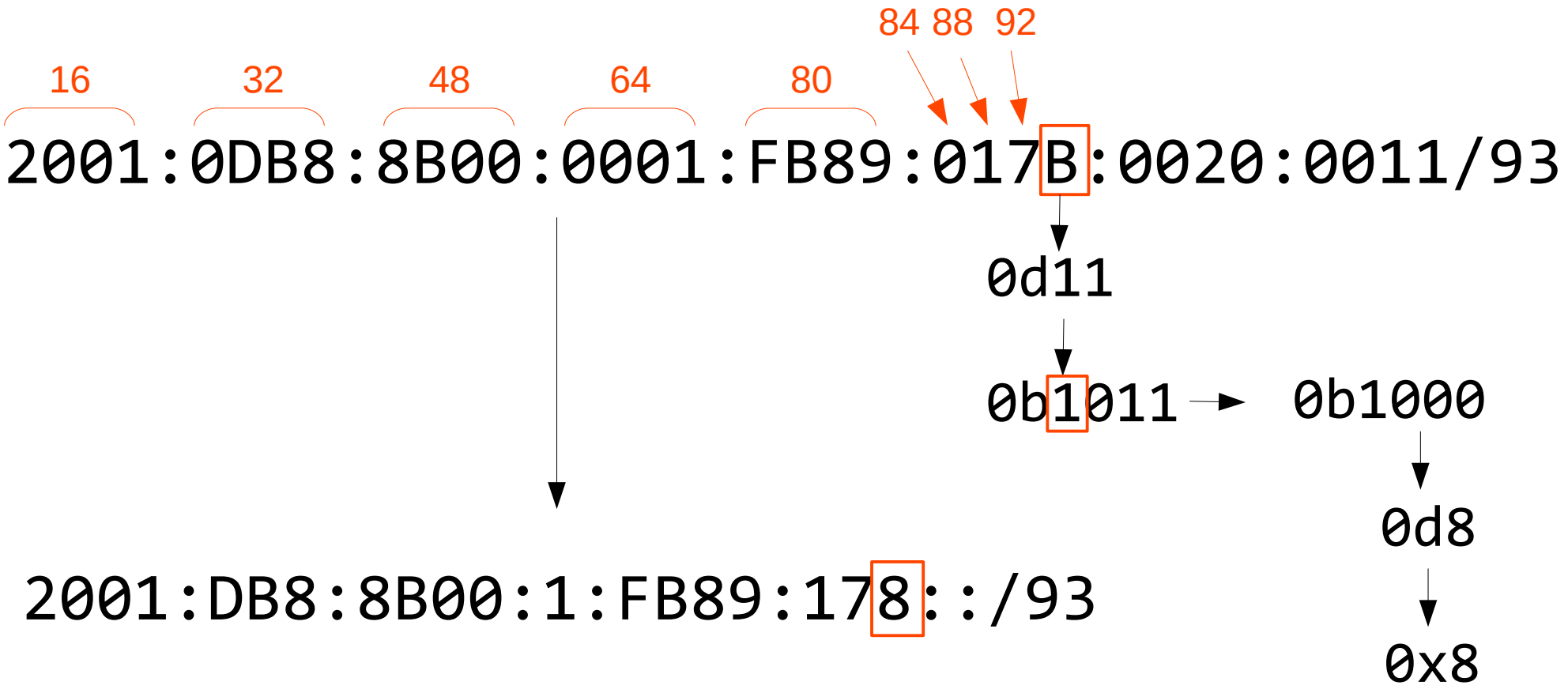
2001:0DB8:8B00:0001:0000:0000:0000:0001/64

2001:DB8:8B00:1::/64

Finding the IPv6 prefix



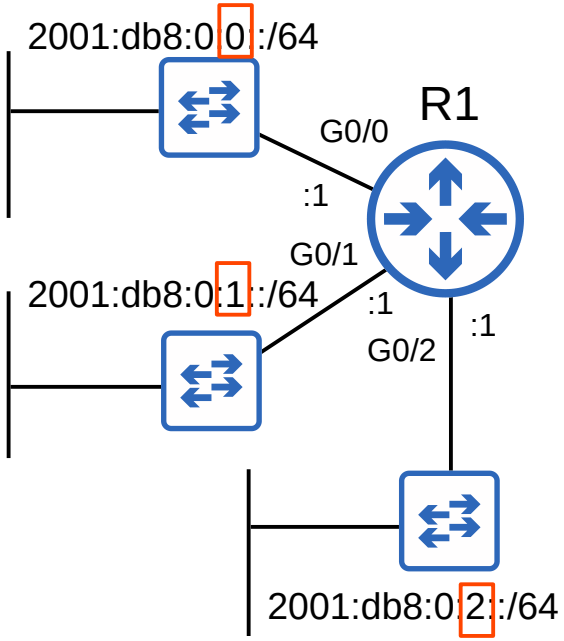
Finding the IPv6 prefix



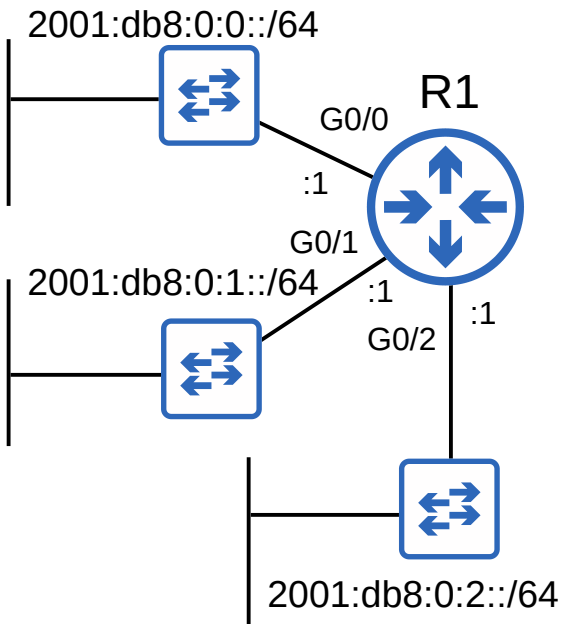
Finding the IPv6 prefix

Host Address	Prefix
FE80:0000:0000:0000:4c2c:e2ed:6a89:2a27/9	FE80::/9
2001:0DB8:0001:0B23:BA89:0020:0000:00C1/64	2001:DB8:1:B23::/64
2001:0DB8:0BAD:CAFE:1300:0689:9000:0CDF/71	2001:DB8:BAD:CAFE:1200::/71
2001:0DB8:0000:FEED:0DAD:018F:6001:0DA3/62	2001:DB8:0:FEEC::/62
2001:0DB8:9BAD:BABE:0DE8:AB78:2301:0010/63	2001:DB8:9BAD:BABE::/63

Configuring IPv6 addresses



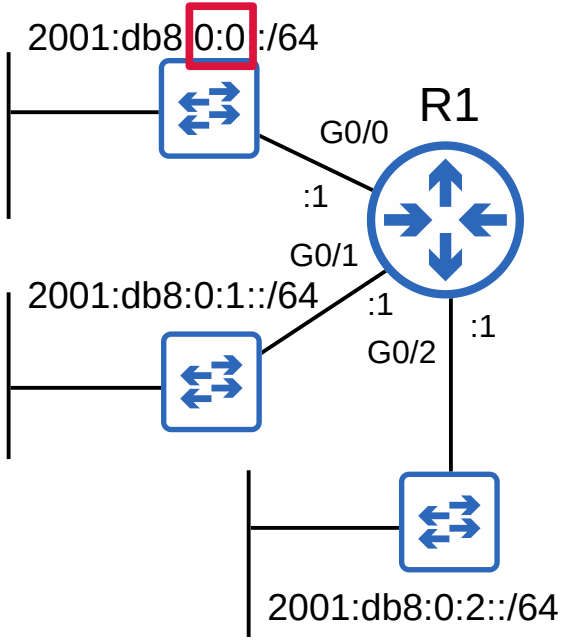
Configuring IPv6 addresses



Allows the router to perform IPv6 routing.

```
R1(config)#
R1(config)#ipv6 unicast-routing
R1(config)#
R1(config)#int g0/0
R1(config-if)#ipv6 address 2001:db8:0:0::1/64
R1(config-if)#no shutdown
R1(config-if)#
R1(config-if)#int g0/1
R1(config-if)#ipv6 address 2001:db8:0:1::1/64
R1(config-if)#no shutdown
R1(config-if)#
R1(config-if)#int g0/2
R1(config-if)#ipv6 address 2001:0db8:0000:0002:0000:0000:0000:0001/64
R1(config-if)#no shutdown
R1(config-if)#
```

Configuring IPv6 addresses




```
R1#show ipv6 interface brief
GigabitEthernet0/0     [up/up]
    FE80::EF8:22FF:FE36:8500
    2001:DB8::1
GigabitEthernet0/1     [up/up]
    FE80::EF8:22FF:FE36:8501
    2001:DB8:0:1::1
GigabitEthernet0/2     [up/up]
    FE80::EF8:22FF:FE36:8502
    2001:DB8:0:2::1
GigabitEthernet0/3     [administratively down/down]
    unassigned
R1#
```

Link-Local Addresses

https://en.wikipedia.org/wiki/Link-local_address

Things we covered

- Hexadecimal (review)
- Why IPv6?
- Basics of IPv6
- Configuring IPv6 addresses

Quiz 1

Which of the following are valid IPv6 addresses? (select three)

a) `2000:AB78:20:1BF:ED89::1`

b) `FE80:0000:0000:0000:0002:0000:0000:FBE8`

c) `AE89:2100:1AC:00G0::20F`

d) `2001:DB8:8B00:1000:2:BC0:D07:99:1`

e) `2001:0DB8::1000`

f) `2001::0002::0099`

Quiz 2

Which of the following is a correctly-abbreviated version of the IPv6 address below?
↪2001:0DB8:0101:0B23:BA89:0020:0AB0:00C1

a) 2001:0DB8:0101:0B23:BA89:002:0AB:00C1

b) 2001:DB8:101:B23:BA89:2:0AB:C1

c) 21:DB8:11:B23:BA89:2:AB:C1

d) 2001:DB8:101:B23:BA89:20:AB0:C1

Quiz 3

Which of the following commands must be used to enable a router to perform IPv6 routing?

a) `R1(config-if)# ipv6 unicast-routing`

b) `R1(config)# ipv6 unicast-routing`

c) `R1(config)# ipv6 routing`

d) `R1(config-if)# ipv6 routing`