IPV6 introduction

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.

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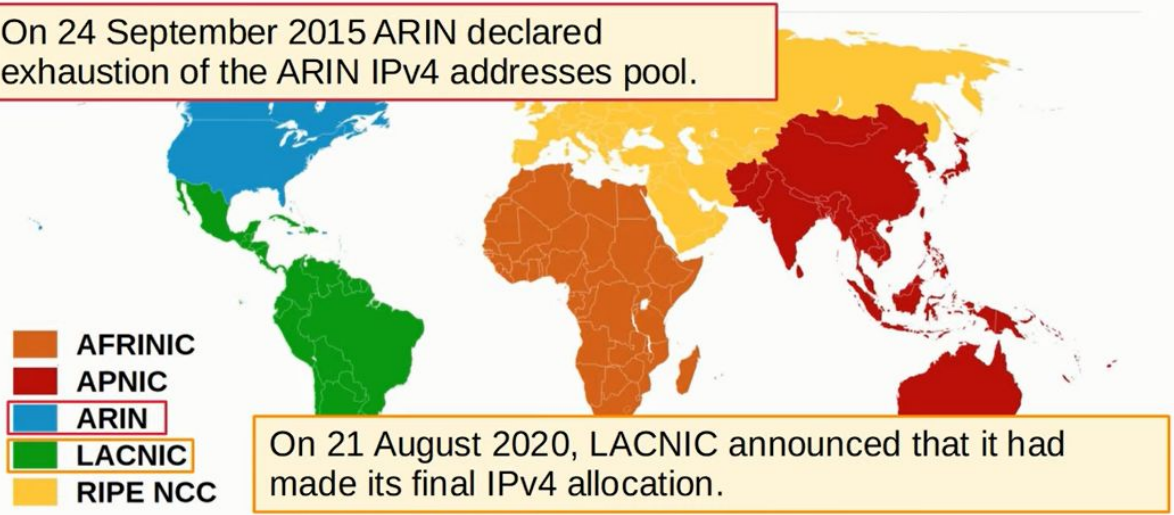
On 24 September 2015 ARIN declared exhaustion of the ARIN IPv4 addresses pool.



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:
  `0010000000000001000011011011100001011001000101111110101010111101011001010110001000010111111010101100100100101101010110011011110 1`

  ↳~~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	
FE80:0000:0000:0000:0002:0000:0000:FBE8	
AE89:2100:01AC:00F0:0000:0000:0000:020F	
2001:0DB8:8B00:1000:0002:0BC0:0D07:0099	
2001:0DB8:0000:0000:0000:0000:0000:1000	

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::1010:2FC:0:9
	2001:DB8:1:B23:2309::C1
	FD00::1000:689:9000:CDF
	FF02::2
	::1

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.

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

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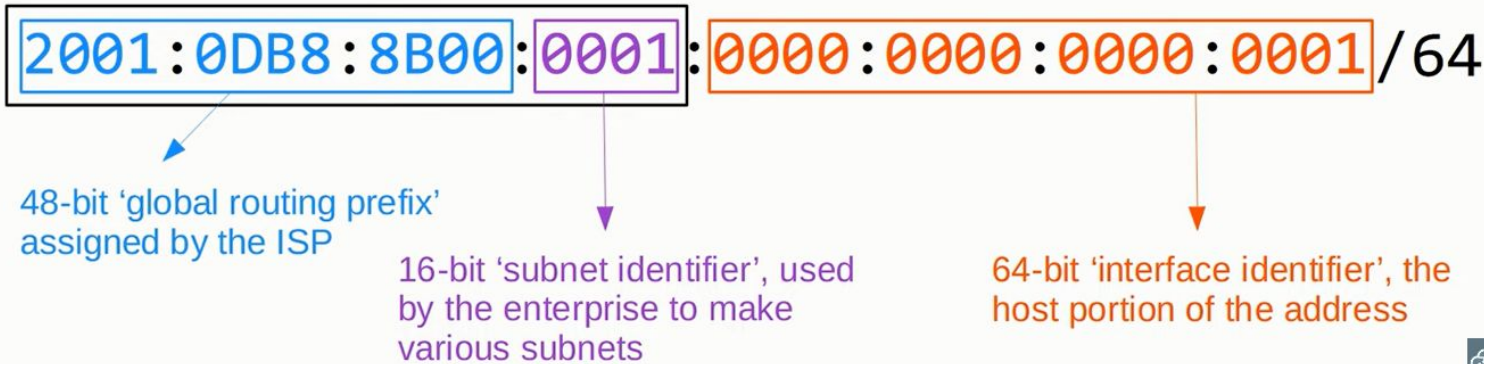
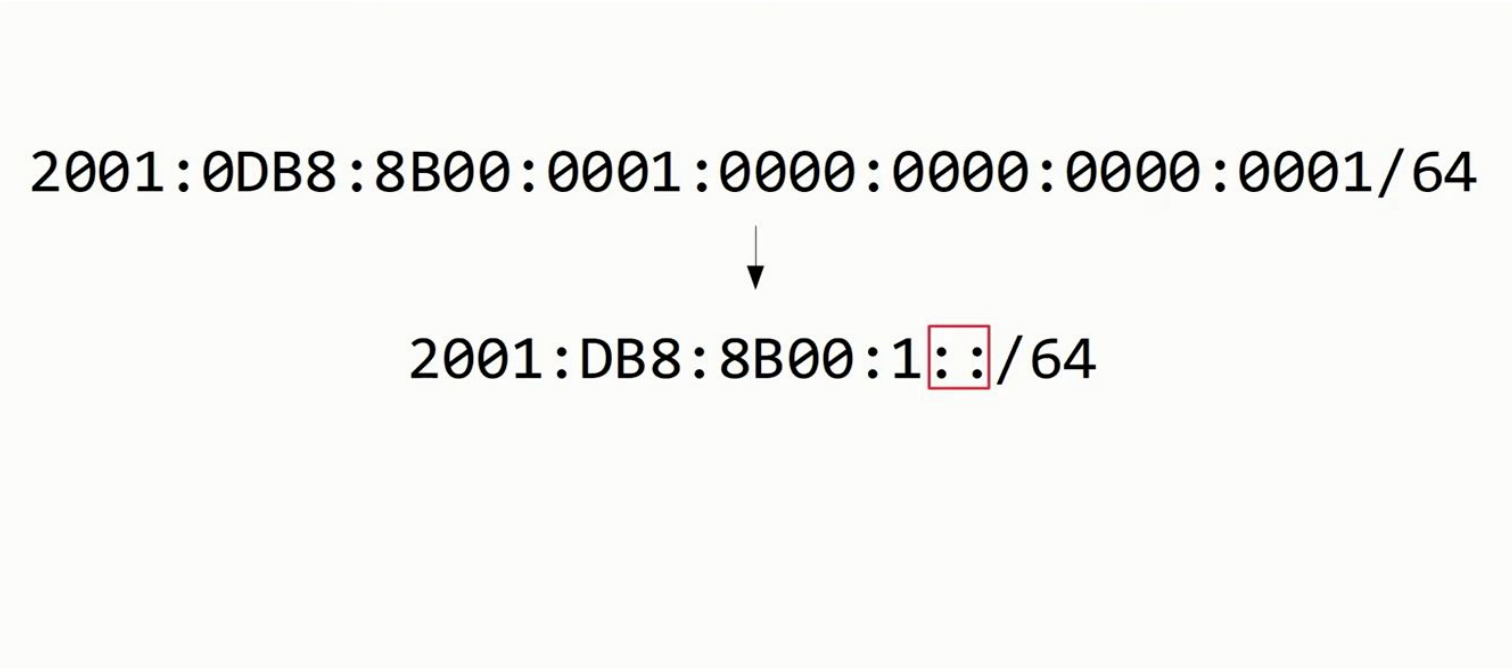


Finding the IPV6 prefix



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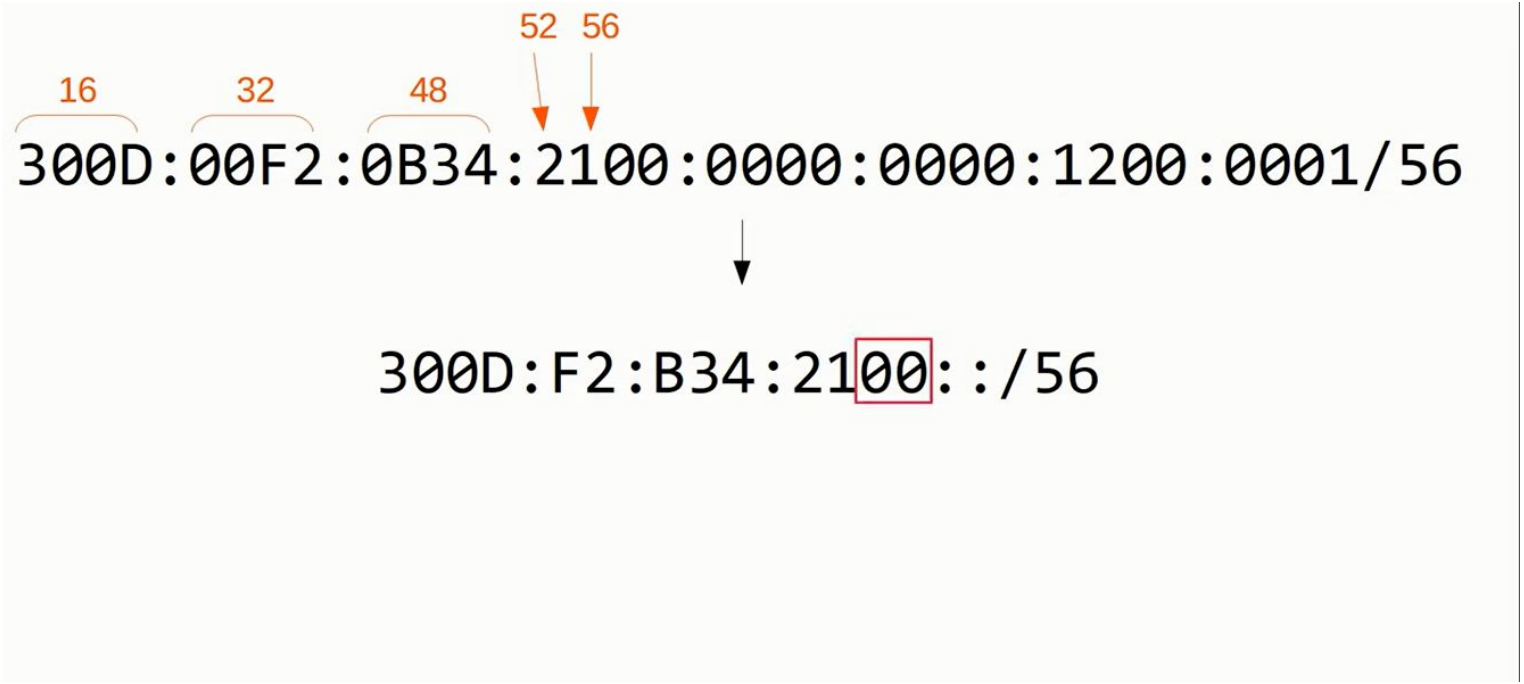
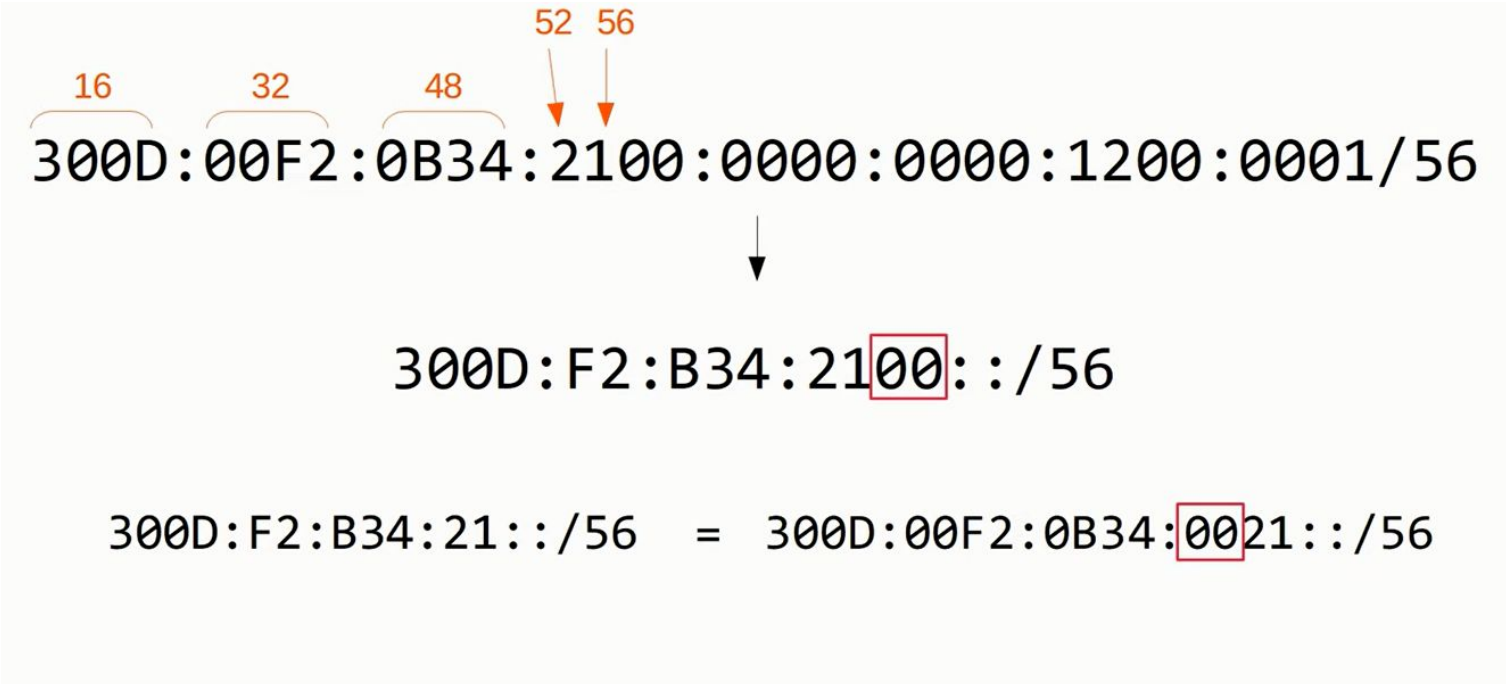
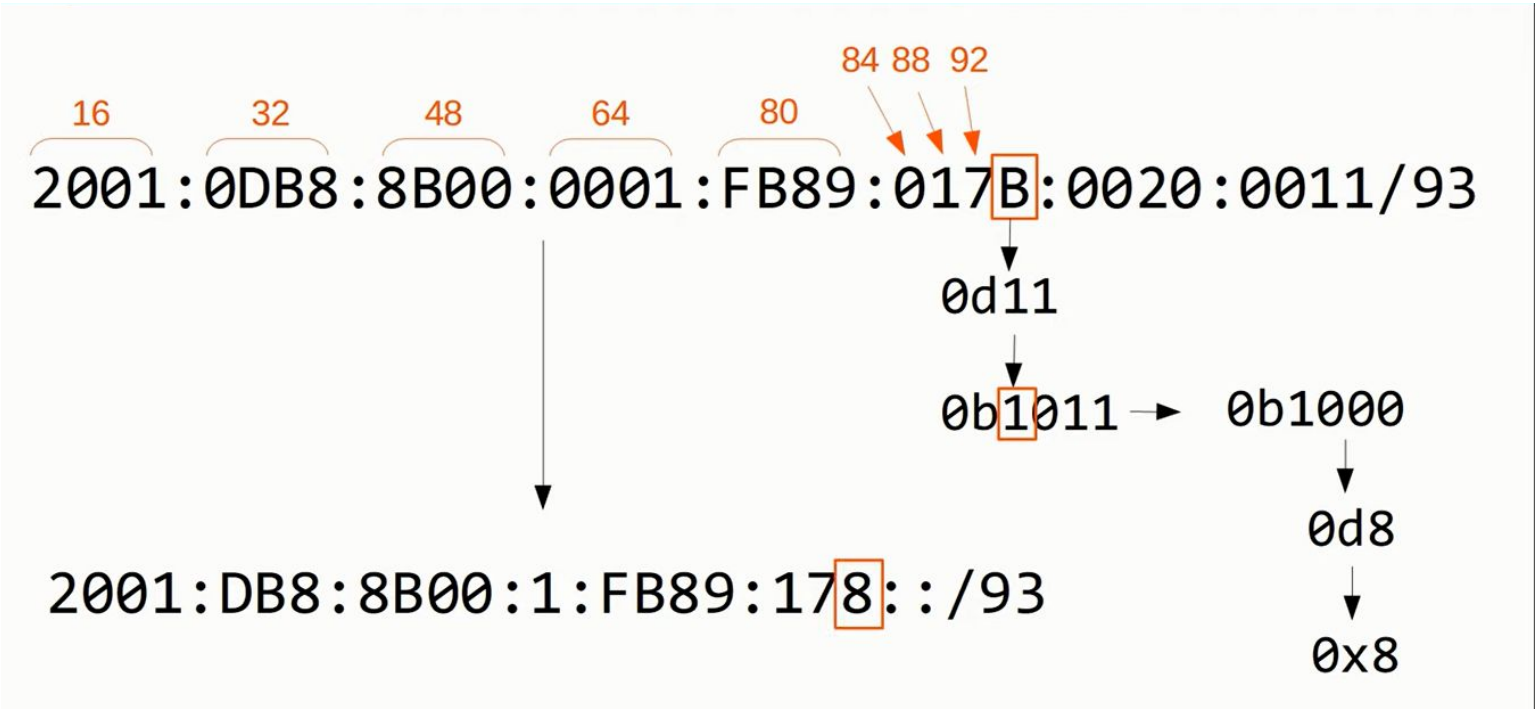


Finding the IPV6 prefix



Finding the IPV6 prefix



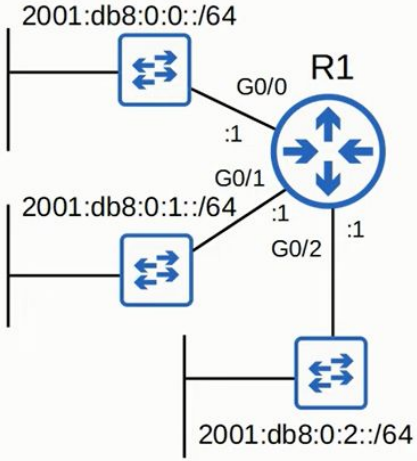
Finding the IPV6 prefix

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

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

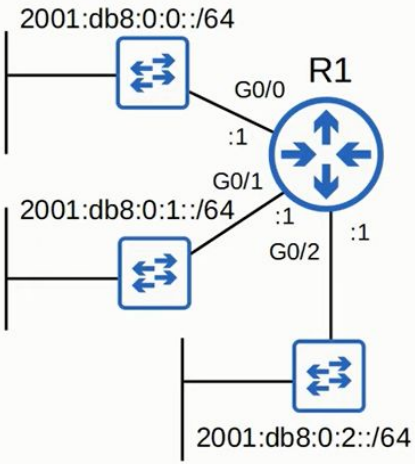
Finding the IPV6 prefix



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)#
```

Finding the IPV6 prefix




```
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

Quiz

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

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

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

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