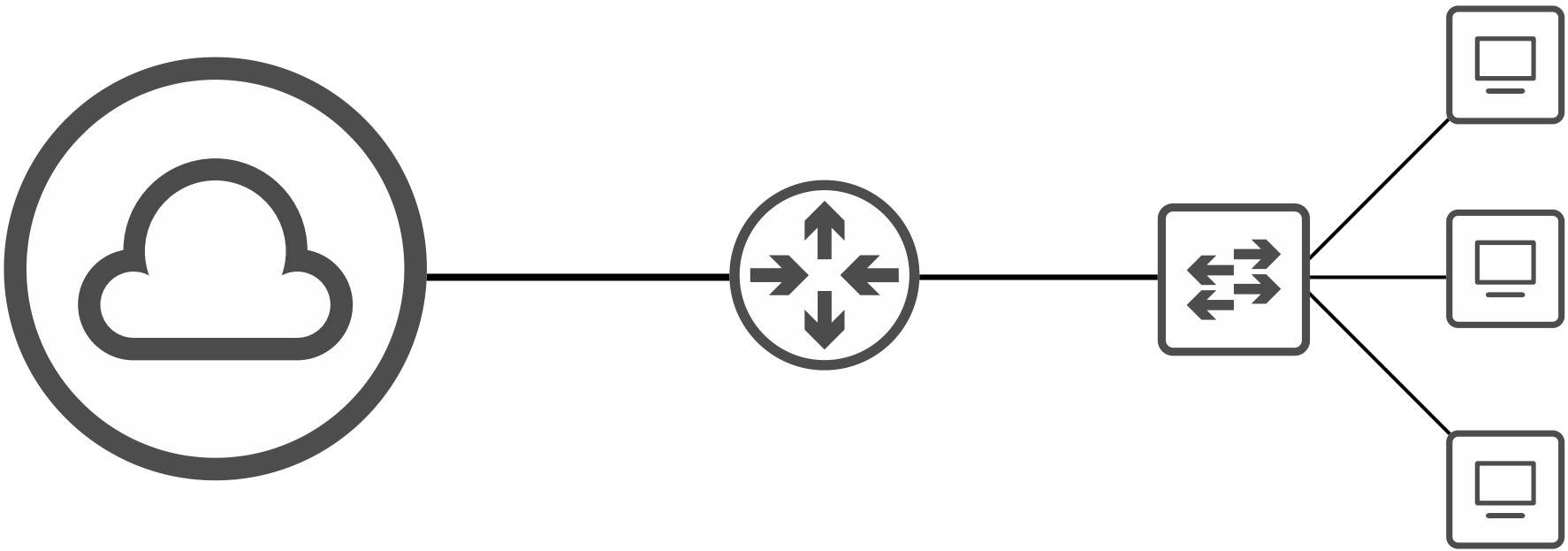
Jeremy's IT Lab

CCNA 200-301 Day 15

Subnetting (Part 3)



Things we'll cover

- Answers to Day 14's quiz questions
- Subnetting Class A networks
- VLSM (Variable-Length Subnet Masks)
- Extra subnetting practice resources

QUIZ QUESTION 1

You have been given the 172.30.0.0/16 network. Your company requires 100 subnets with at least 500 hosts per subnet. What prefix length should you use?

Borrowed bits:	1	2	3	4	5	6	7
Num. of subnets:	2	4	8	16	32	64	128

QUIZ QUESTION 1

1 0 1 0 1 1 0 0 . 0 0 0 1 1 1 1 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

172 . 30 . 0 . 0

9 host bits = 2^9 - 2 = 510 usable addresses

Subnet mask:

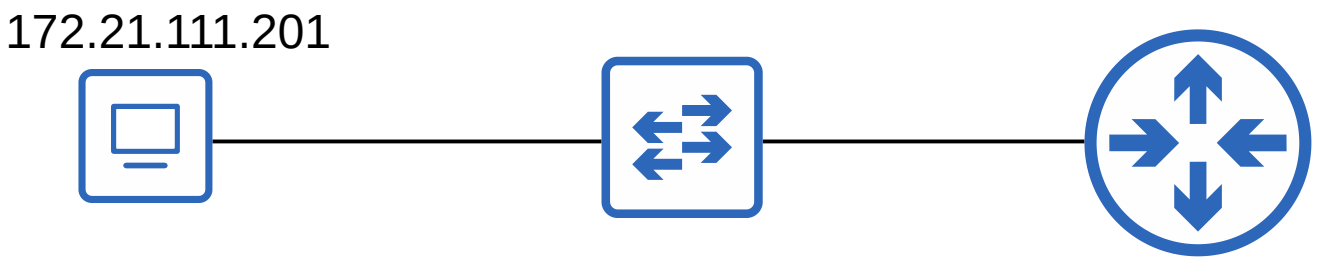
1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 0 . 0 0 0 0 0 0 0 0

255 . 255 . 254 . 0

QUIZ QUESTION 2

What subnet does host **172.21.111.201/20** belong to?

Subnet ID: _____/20



QUIZ QUESTION 2

/20

1 0 1 0 1 1 0 0 . 0 0 0 1 0 1 0 1 . 0 1 1 0 1 1 1 1 . 1 1 0 0 1 0 0 1

172 . 21 . 111 . 201

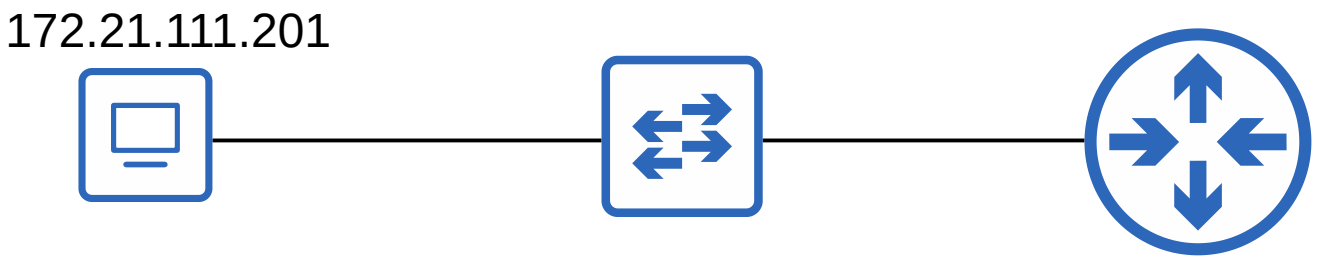
1 0 1 0 1 1 0 0 . 0 0 0 1 0 1 0 1 . 0 1 1 0 0 0 0 0 . 0 0 0 0 0 0 0 0

172 . 21 . 96 . 0

QUIZ QUESTION 2

What subnet does host **172.21.111.201/20** belong to?

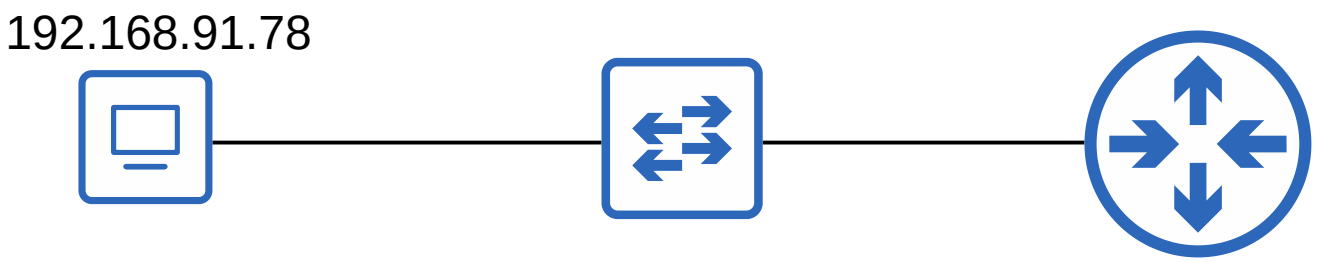
Subnet ID: _172.21.96.0_/20



QUIZ QUESTION 3

What is the **broadcast address** of the network **192.168.91.78/26** belongs to?

Broadcast address: _____/26



QUIZ QUESTION 3

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 1 0 1 1 0 1 1 . 0 1 0 0 1 1 1 0

192 . 168 . 91 . 78

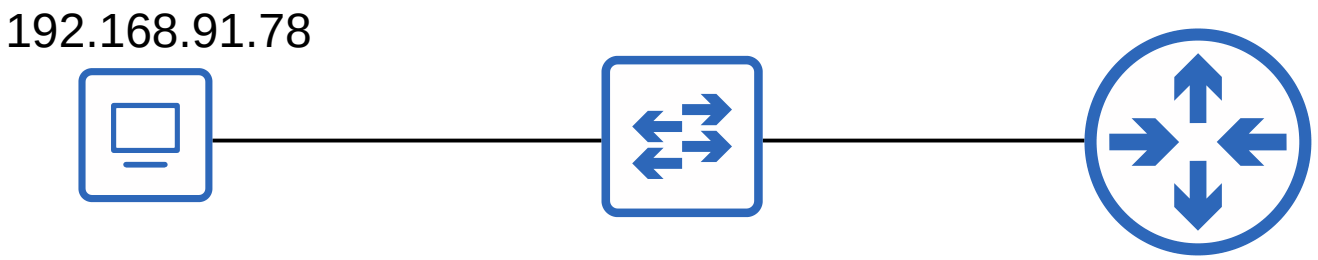
1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 1 0 1 1 0 1 1 . 0 1 1 1 1 1 1 1

192 . 168 . 91 . 127

QUIZ QUESTION 3

What is the **broadcast address** of the network **192.168.91.78/26** belongs to?

Broadcast address: 192.168.91.127 /26



QUIZ QUESTION 4

You divide the 172.16.0.0/16 network into 4 subnets of equal size. Identify the **network** and **broadcast** addresses of the second subnet.

Borrow 2 bits = 2^2 = 4 subnets

QUIZ QUESTION 4

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

172 . 16 . 0 . 0

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 1 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

172 . 16 . 64 . 0

= Network address of the second subnet.

QUIZ QUESTION 4

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 1 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

172 . 16 . 64 . 0

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1

172 . 16 . 127 . 255

= Broadcast address of the second subnet.

QUIZ QUESTION 5

You divide the 172.30.0.0/16 network into subnets of 1000 hosts each. How many subnets are you able to make?

10 host bits = 2^{10} - 2 = 1022 hosts

QUIZ QUESTION 5

1 0 1 0 1 1 0 0 . 0 0 0 1 1 1 1 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

172 . 30 . 0 . 0

6 borrowed bits = 2^6 = 64 subnets

Subnetting Class A Networks

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)

The process of subnetting Class A, Class B, and Class C networks is EXACTLY THE SAME!

Subnetting Class A Networks

You have been given the 10.0.0.0/8 network. You must create 2000 subnets which will be distributed to various enterprises.

What prefix length must you use?

How many host addresses (usable addresses) will be in each subnet?

Subnetting Class B Networks

0 0 0 0 1 0 1 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

10 . 0 . 0 . 0

Borrowing 0 bits = can't make any subnets

Subnet mask:

1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

255 . 0 . 0 . 0

Subnetting Class A Networks

$2^{what?}$ = at least 2000

$2^{11} = 2048$

Subnetting Class B Networks

0 0 0 0 1 0 1 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

10 . 0 . 0 . 0

13 host bits = 2^{13} - 2 = 8190 hosts per subnet

Subnet mask:

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 0 0 0 0 0 . 0 0 0 0 0 0 0 0

255 . 255 . 224 . 0

Subnetting Class A Networks

You have been given the 10.0.0.0/8 network. You must create 2000 subnets which will be distributed to various enterprises.

What prefix length must you use? /19

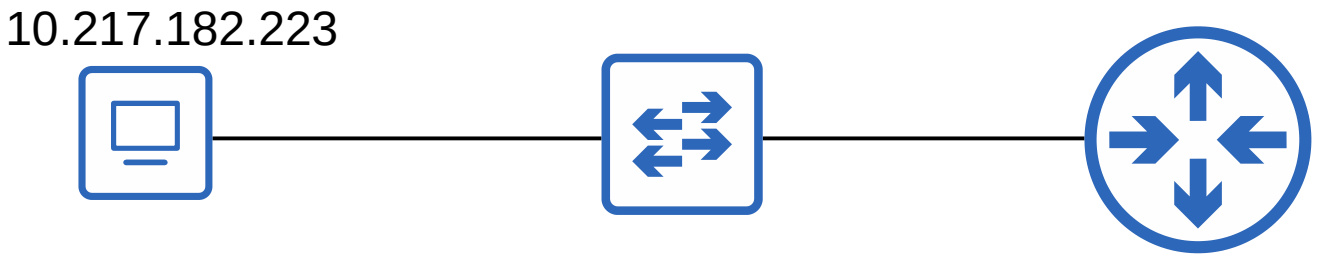
How many host addresses (usable addresses) will be in each subnet? 8190

Subnetting Class A Networks

PC1 has an IP address of **10.217.182.223/11.**

Identify the following for PC1's subnet:

1) Network address:
2) Broadcast address:
3) First usable address:
4) Last usable address:
5) Number of host (usable) addresses:



Subnetting Class A Networks

0 0 0 0 1 0 1 0 . 1 1 0 1 1 0 0 1 . 1 0 1 1 0 1 1 0 . 1 1 0 1 1 1 1 1

10 . 217 . 182 . 223

Network Address

0 0 0 0 1 0 1 0 . 1 1 0 1 1 0 0 1 . 1 0 1 1 0 1 1 0 . 1 1 0 1 1 1 1 1

10 . 217 . 182 . 223

0 0 0 0 1 0 1 0 . 1 1 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

10 . 192 . 0 . 0

First usable address

0 0 0 0 1 0 1 0 . 1 1 0 1 1 0 0 1 . 1 0 1 1 0 1 1 0 . 1 1 0 1 1 1 1 1

10 . 217 . 182 . 223

0 0 0 0 1 0 1 0 . 1 1 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 1

10 . 192 . 0 . 1

Broadcast address

0 0 0 0 1 0 1 0 . 1 1 0 1 1 0 0 1 . 1 0 1 1 0 1 1 0 . 1 1 0 1 1 1 1 1

10 . 217 . 182 . 223

0 0 0 0 1 0 1 0 . 1 1 0 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1

10 . 223 . 255 . 255

Last usable address

0 0 0 0 1 0 1 0 . 1 1 0 1 1 0 0 1 . 1 0 1 1 0 1 1 0 . 1 1 0 1 1 1 1 1

10 . 217 . 182 . 223

0 0 0 0 1 0 1 0 . 1 1 0 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 0

10 . 223 . 255 . 254

Number of host addresses

0 0 0 0 1 0 1 0 . 1 1 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

10 . 192 . 0 . 0

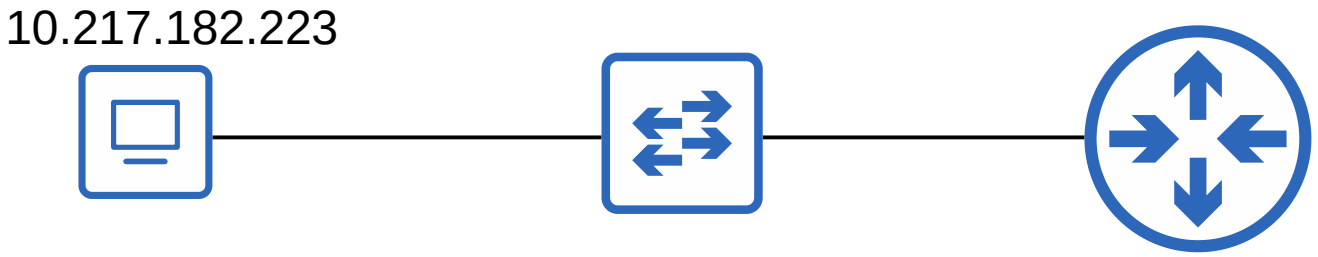
21 host bits = 2^{21}- 2 = 2,097,150 hosts per subnet

Subnetting Class A Networks

PC1 has an IP address of **10.217.182.223/11.**

Identify the following for PC1's subnet:

1) Network address: 10.192.0.0/11
2) Broadcast address: 10.223.255.255/11
3) First usable address: 10.192.0.1/11
4) Last usable address: 10.223.255.254/11
5) Number of host (usable) addresses: 2,097,150



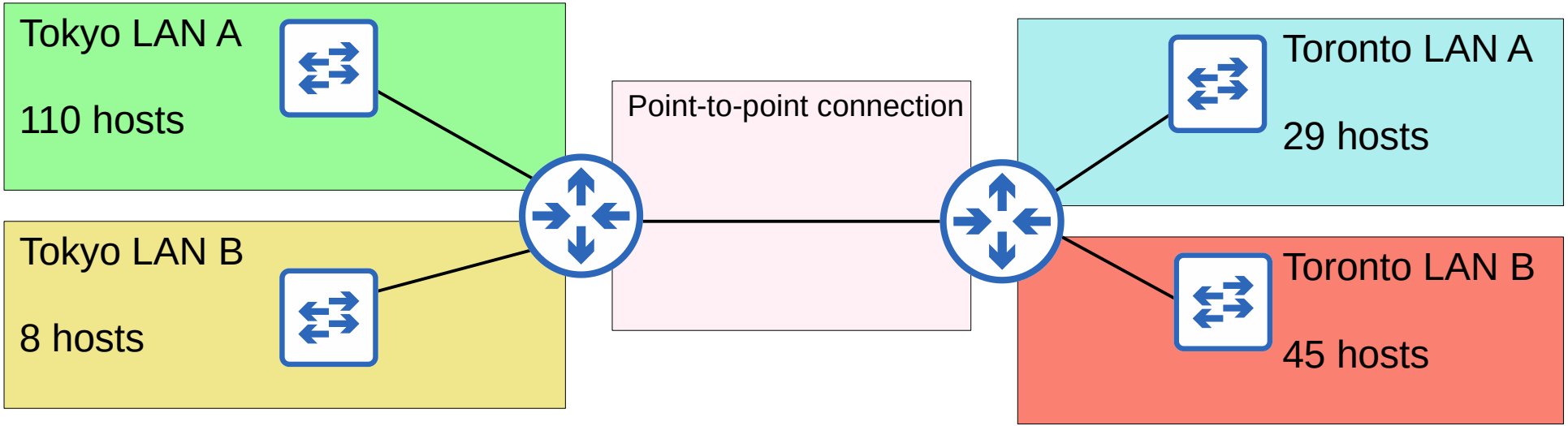
Variable-Length Subnet Masks

- Until now, we have practiced subnetting used FLSM (Fixed-Length Subnet Masks).
- This means that all of the subnets use the same prefix length (ie. subnetting a class C network into 4 subnets using /26).

- VLSM (Variable-Length Subnet Masks) is the process of creating subnets of different sizes, to make your use of network addresses more efficient.

- VLSM is more complicated than FLSM, but it’s easy if you follow the steps correctly.

VLSM



192.168.1.0/24

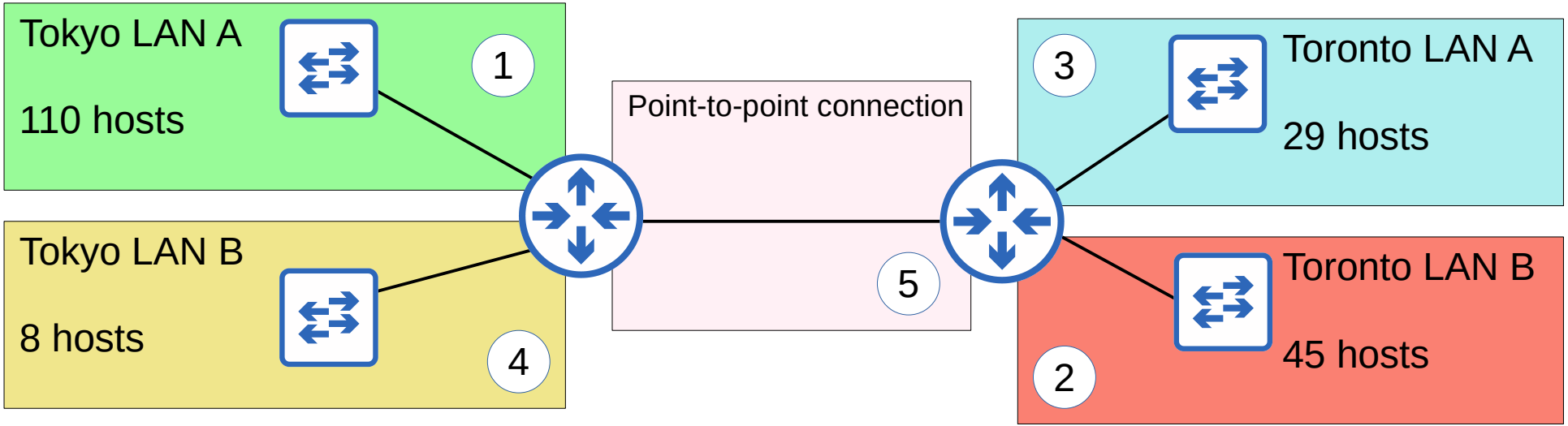
VLSM - Steps

1) Assign the largest subnet at the start of the address space.

2) Assign the second-largest subnet after it.

3) Repeat the process until all subnets have been assigned.

VLSM



192.168.1.0/24

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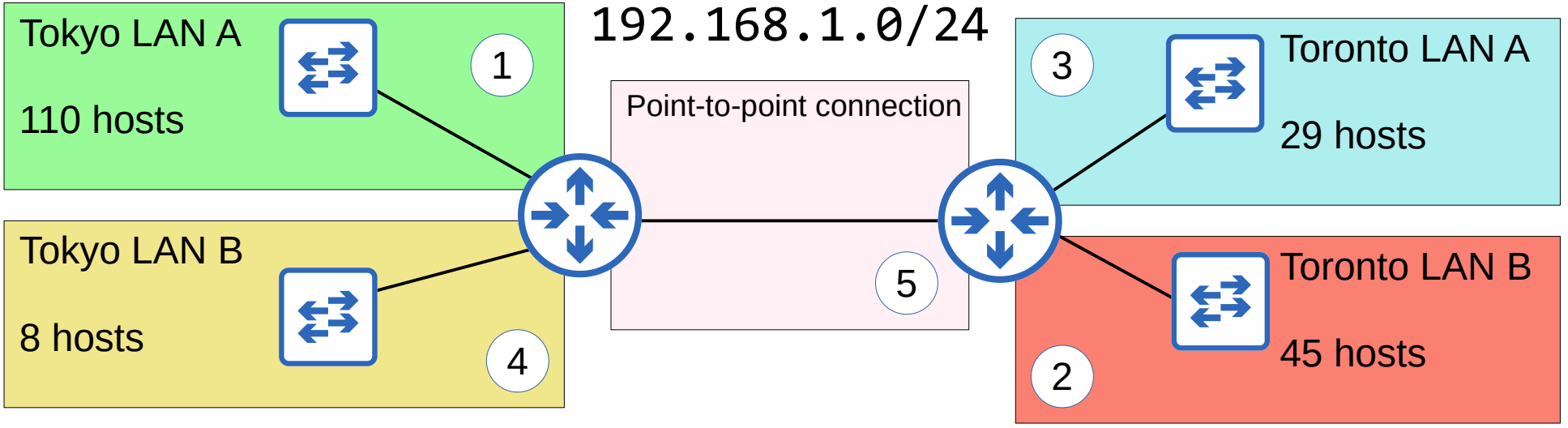
Tokyo LAN A



Network address:

Broadcast address:

First usable address:

Last usable address:

Total number of usable host addresses:

Tokyo LAN A

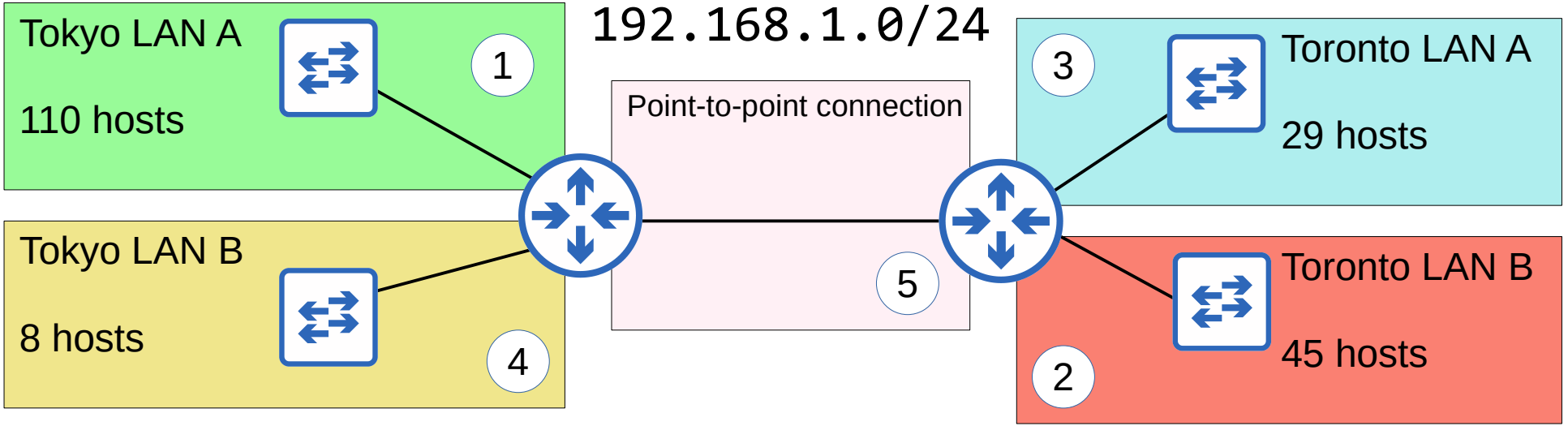
1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 0 0 0 0 0 0 0 0

192 . 168 . 1 . 0

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 0 1 1 1 1 1 1 1

192 . 168 . 1 . 127

Tokyo LAN A



Network address: 192.168.1.0/25

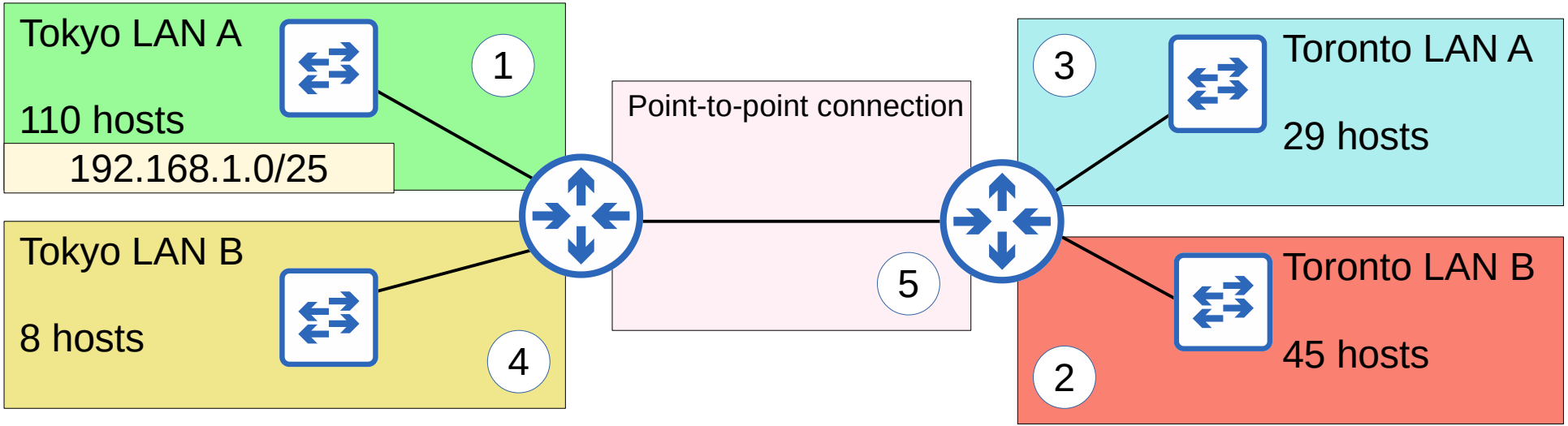
Broadcast address: 192.168.1.127/25

First usable address: 192.168.1.1/25

Last usable address: 192.168.1.126/25

Total number of usable host addresses: 126

VLSM



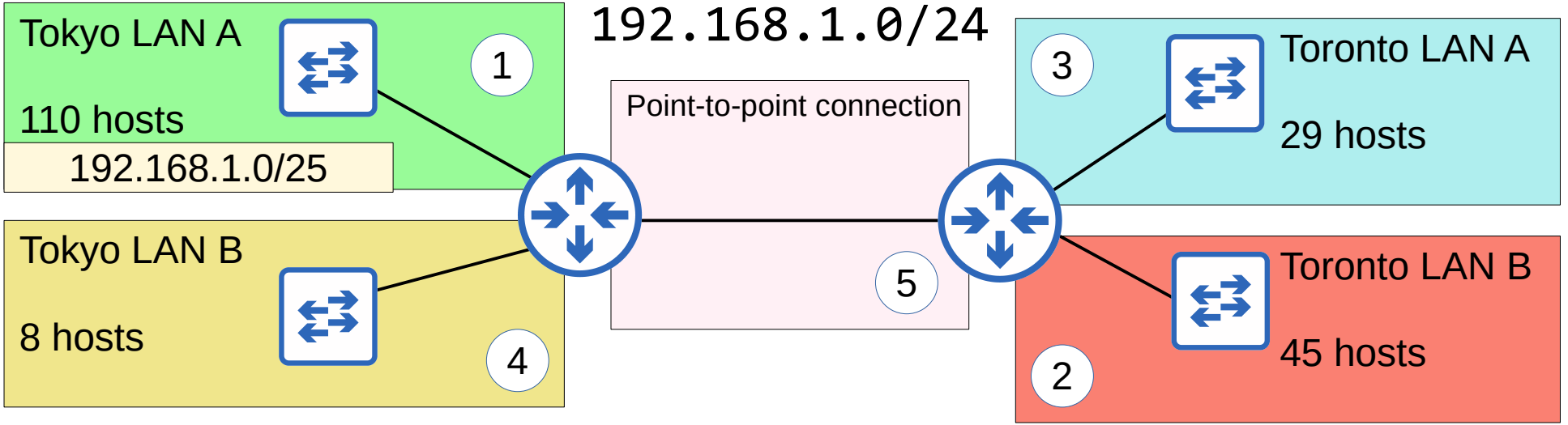
192.168.1.0/24

192.168.1.127 = broadcast address of Tokyo LAN A

192.168.1.128 = network address of Toronto LAN B

What prefix length?

Toronto LAN B



Network address: 192.168.1.128/??

Broadcast address:

First usable address:

Last usable address:

Total number of usable host addresses:

Toronto LAN B

/26

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 0 0 0 0 0 0 0

192 . 168 . 1 . 128

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 0 1 1 1 1 1 1

192 . 168 . 1 . 191

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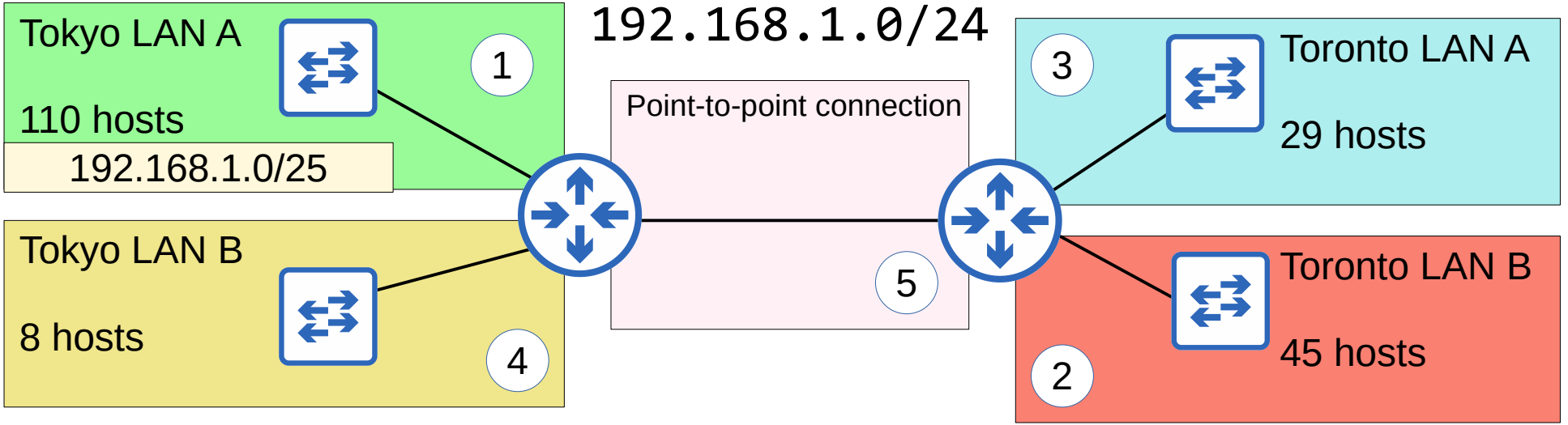
Toronto LAN B



Network address: 192.168.1.128/26

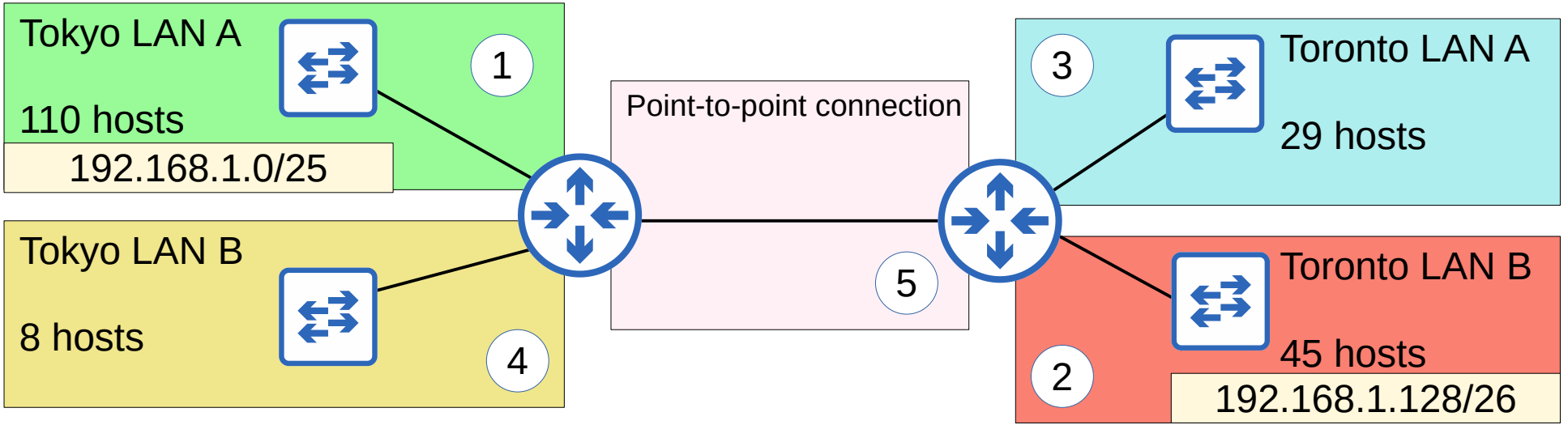
Broadcast address: 192.168.1.191/26

First usable address: 192.168.1.129/26

Last usable address: 192.168.1.190/26

Total number of usable host addresses: 62

VLSM



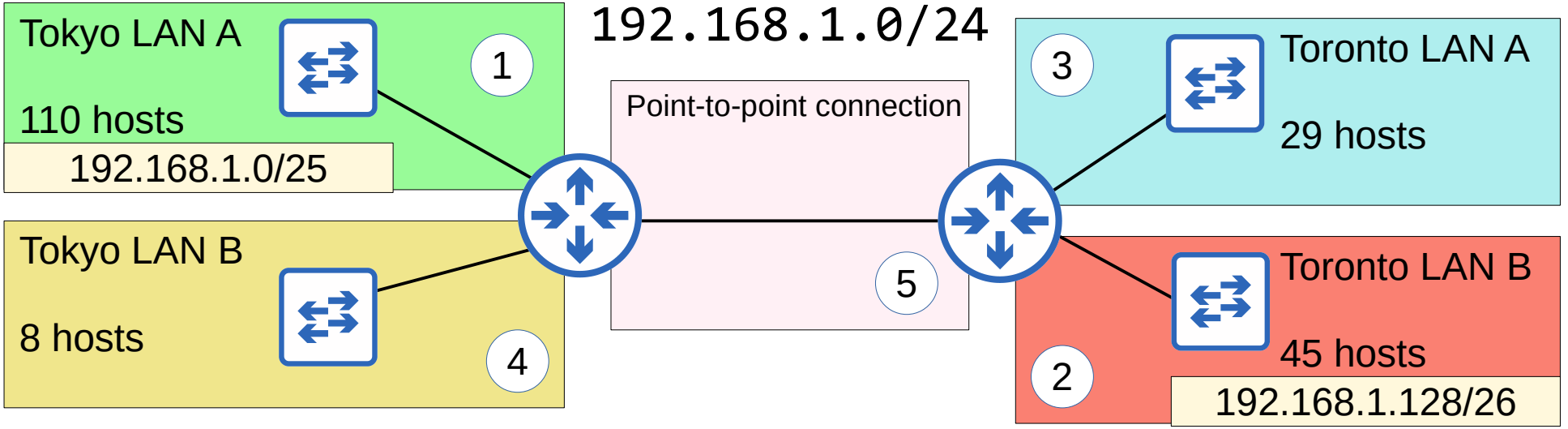
192.168.1.0/24

192.168.1.191 = broadcast address of Toronto LAN B

192.168.1.192 = network address of Toronto LAN A

What prefix length?

Toronto LAN A



Network address: 192.168.1.192/??

Broadcast address:

First usable address:

Last usable address:

Total number of usable host addresses:

Toronto LAN A

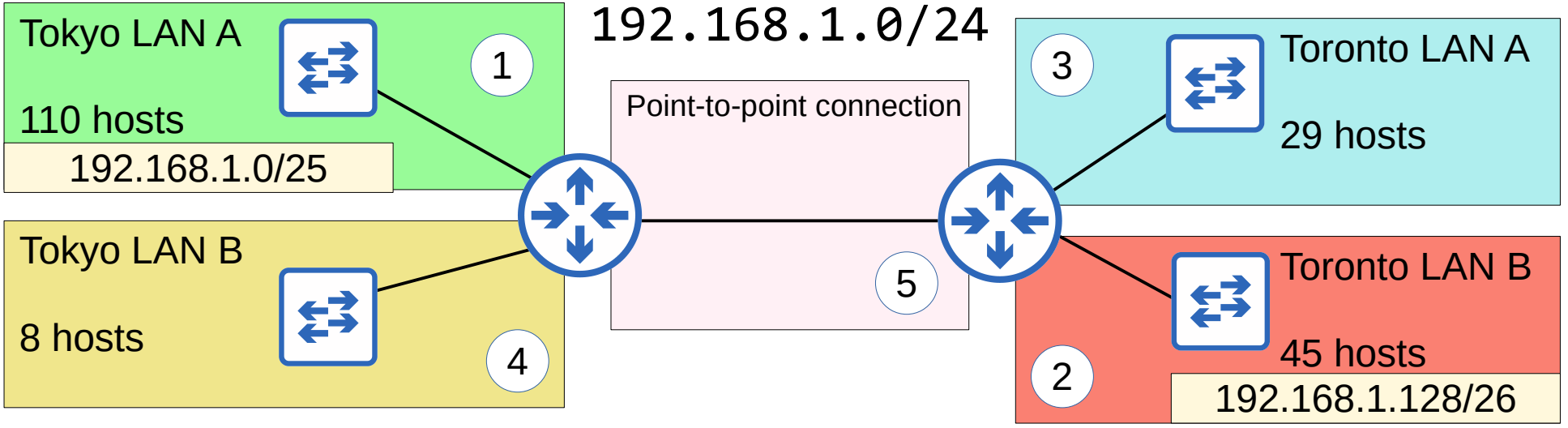
1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 0 0 0 0 0 0

192 . 168 . 1 . 192

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 0 1 1 1 1 1

192 . 168 . 1 . 223

Toronto LAN A



Network address: 192.168.1.192/27

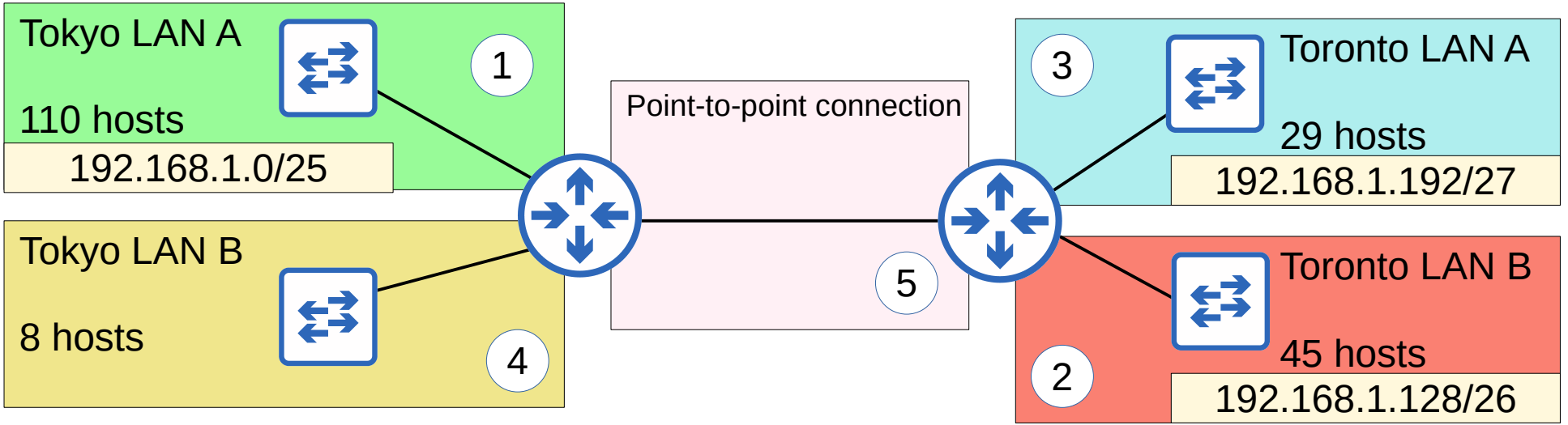
Broadcast address: 192.168.1.223/27

First usable address: 192.168.1.193/27

Last usable address: 192.168.1.222/27

Total number of usable host addresses: 30

VLSM



192.168.1.0/24

192.168.1.223 = broadcast address of Toronto LAN A

192.168.1.224 = network address of Tokyo LAN B

What prefix length?

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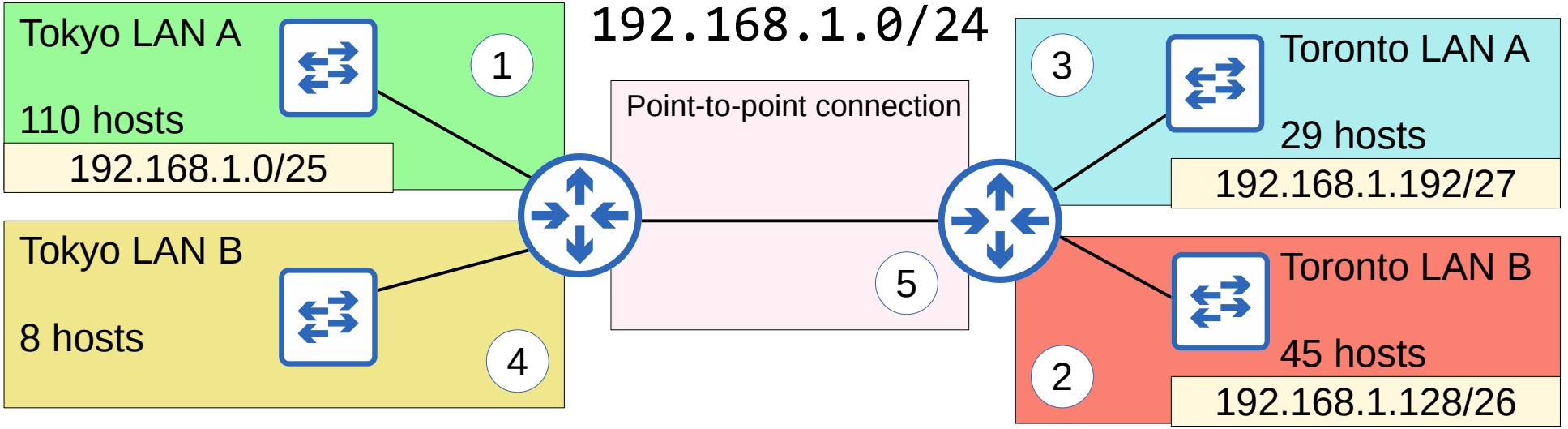
Tokyo LAN B



Network address: 192.168.1.224/??

Broadcast address:

First usable address:

Last usable address:

Total number of usable host addresses:

Tokyo LAN B

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 1 0 0 0 0 0

192 . 168 . 1 . 224

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 1 0 1 1 1 1

192 . 168 . 1 . 239

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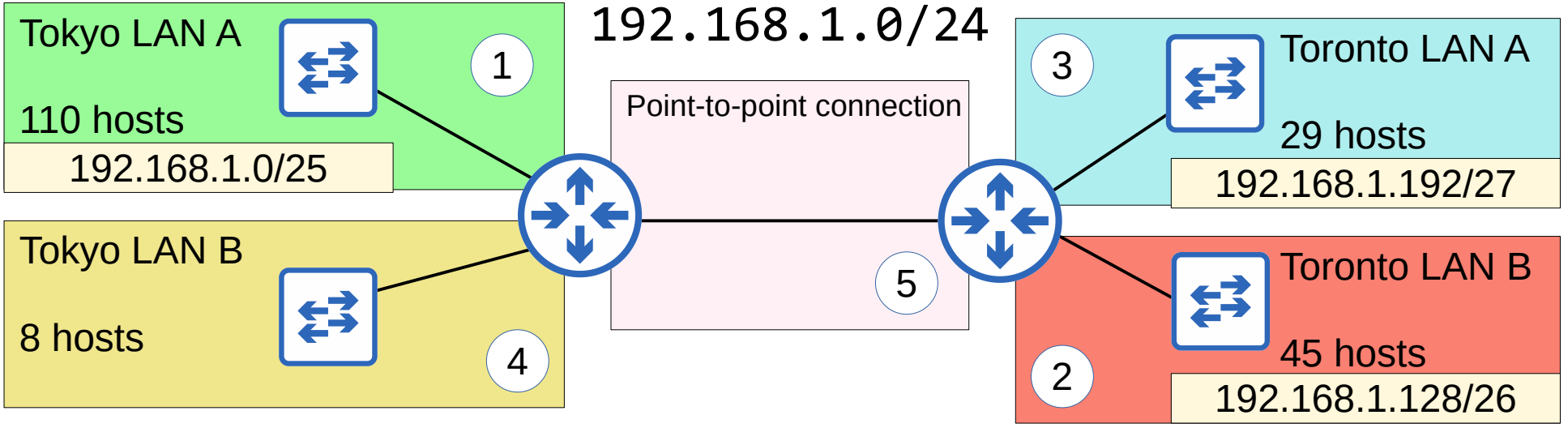
Tokyo LAN B



Network address: 192.168.1.224/28

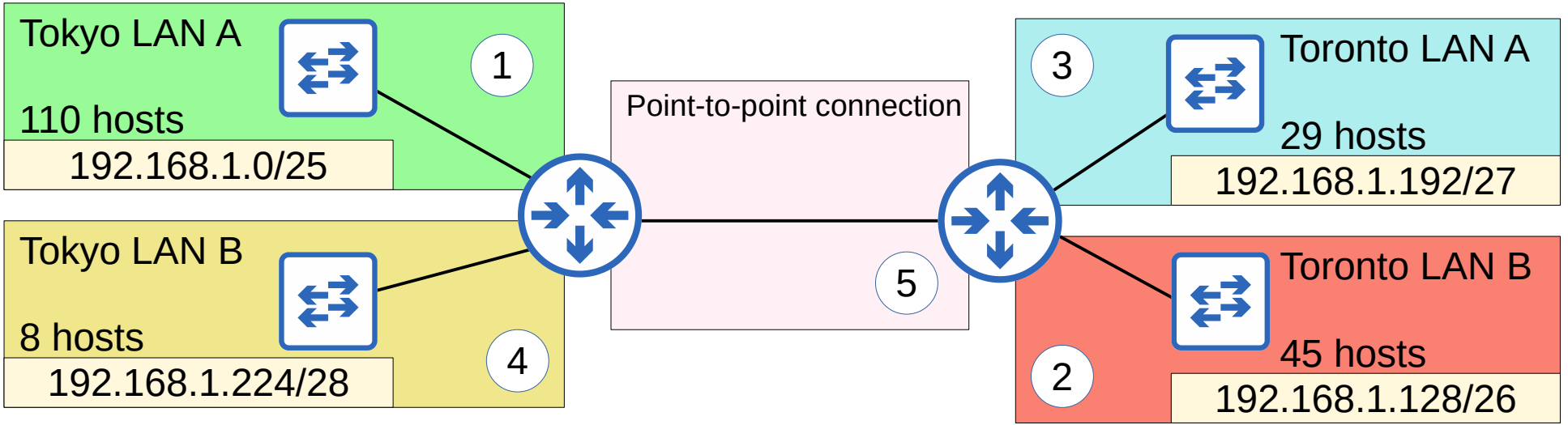
Broadcast address: 192.168.1.239/28

First usable address: 192.168.1.225/28

Last usable address: 192.168.1.238/28

Total number of usable host addresses: 14

VLSM



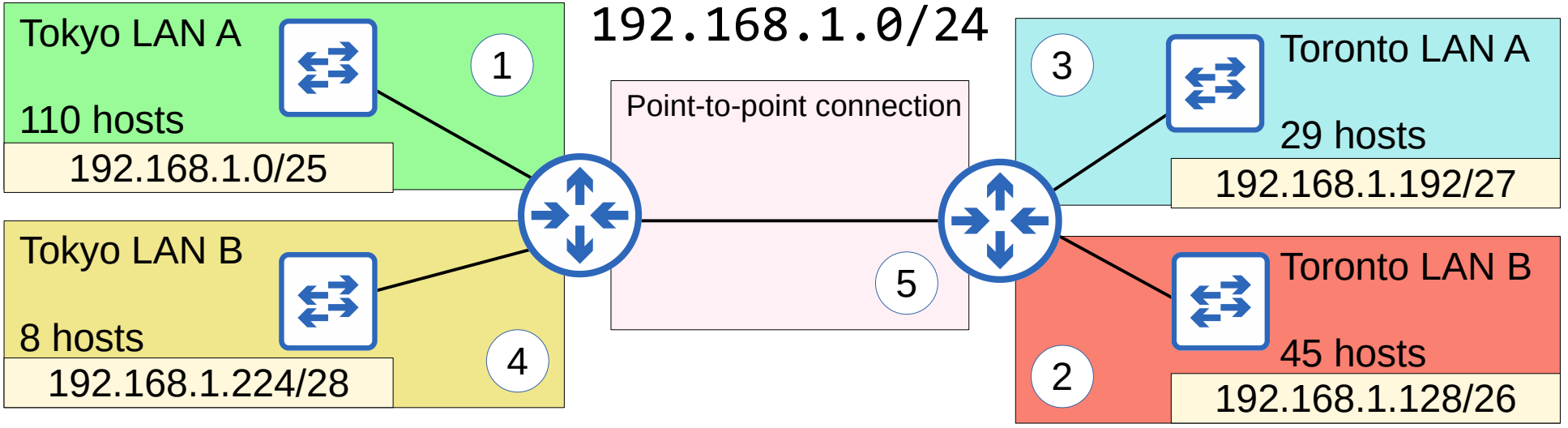
192.168.1.0/24

192.168.1.239 = broadcast address of Tokyo LAN B

192.168.1.240 = network address of point-to-point connection

What prefix length?

Point-to-point connection



Network address: 192.168.1.240/??

Broadcast address:

First usable address:

Last usable address:

Total number of usable host addresses:

Point-to-point connection

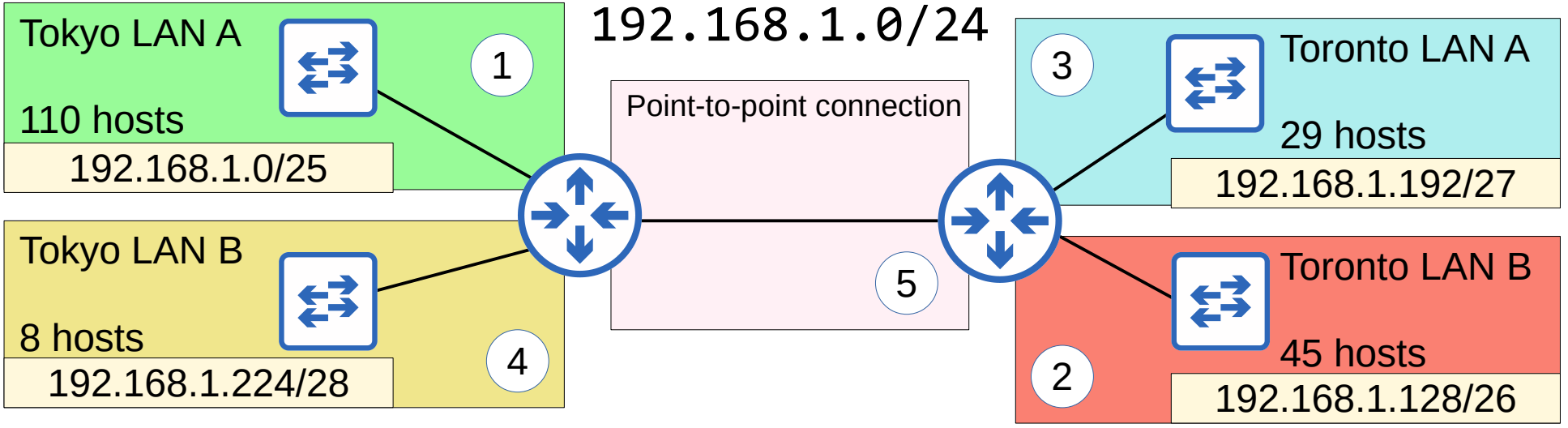
1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 1 1 0 0 0 0

192 . 168 . 1 . 240

1 1 0 0 0 0 0 0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 1 1 0 0 1 1

192 . 168 . 1 . 243

Point-to-point connection



Network address: 192.168.1.240/30

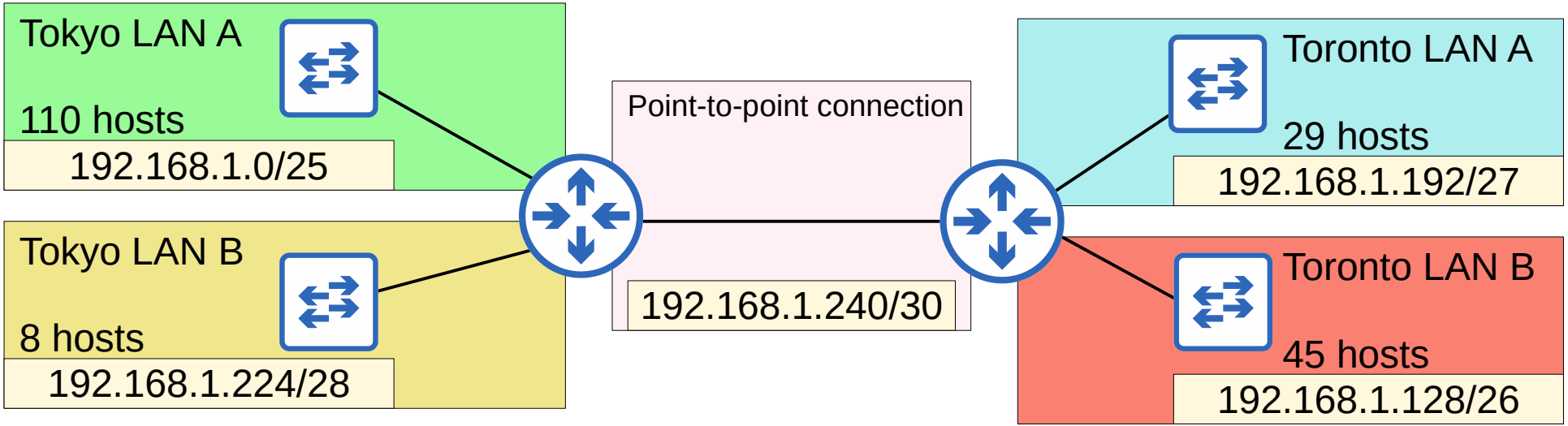
Broadcast address: 192.168.1.243/30

First usable address: 192.168.1.241/30

Last usable address: 192.168.1.242/30

Total number of usable host addresses: 2

VLSM



192.168.1.0/24

VLSM - Steps

1) Assign the largest subnet at the start of the address space.

2) Assign the second-largest subnet after it.

3) Repeat the process until all subnets have been assigned.

Additional Practice

- http://www.subnettingquestions.com/
- http://subnetting.org/
- https://subnettingpractice.com/

IPv4 subnetting - random question generator v1.6

Question: *What subnet does host 192.168.5.57/27 belong to?*

Reveal answer

Question: *How many subnets and hosts per subnet can you get from the network 172.28.0.0/22?*

Reveal answer

Questions are configured for internal IP address ranges only. Subnet zero is allowed as per Cisco standard practice. If you have learnt subnetting from organisations other than Cisco your answers may differ by up to two subnets per network (see explanation).

Visit our partner sites for advise on networking: Networking Boards, Networksinc Cisco Training

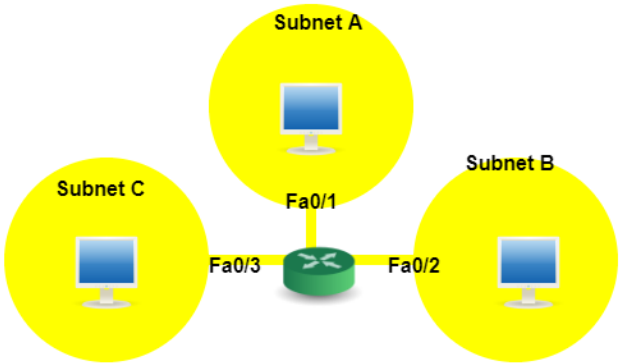
Digg This! Delicio.us Website built by and copyright © Kim Nobay (Telemark Media Ltd) 2008.

SubnettingPractice.com The most extensive subnetting practice site on the web!

Subnetting Questions

Given the network diagram below, and the results of the **sh ip route** command, on which interface will the destination IP address 34.134.17.52 be found? For your answer simply enter the corresponding letter (i.e. A).
A) Fa0/1
B) Fa0/2
C) Fa0/3

```
router# sh ip route
Codes: L - local, C - connected
[output cut]

C       34.134.16.0/25 is directly connected, FastEthernet0/1

L       34.134.16.1/32 is directly connected, FastEthernet0/1

C       34.134.16.128/25 is directly connected, FastEthernet0/2

L       34.134.16.129/32 is directly connected, FastEthernet0/2

C       34.134.17.0/25 is directly connected, FastEthernet0/3

L       34.134.17.1/32 is directly connected, FastEthernet0/3
```

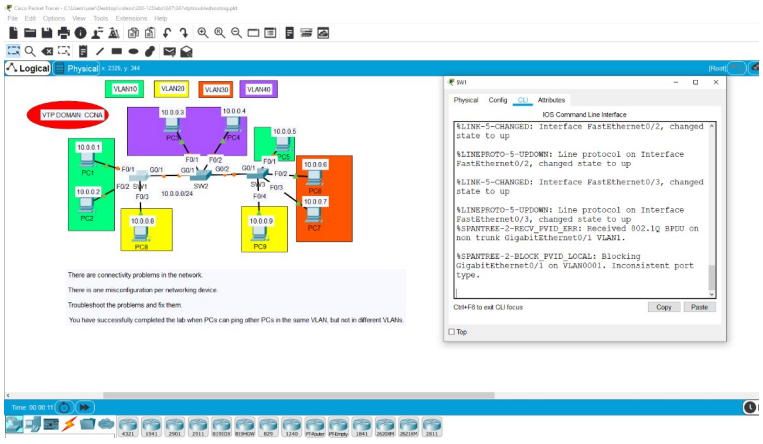


QUIZ

- There is NO QUIZ for this video
- Instead, here is some homework: do at least ONE practice question from EACH of those practice websites every day for at least one week.

Supplementary Materials

- Packet Tracer lab



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