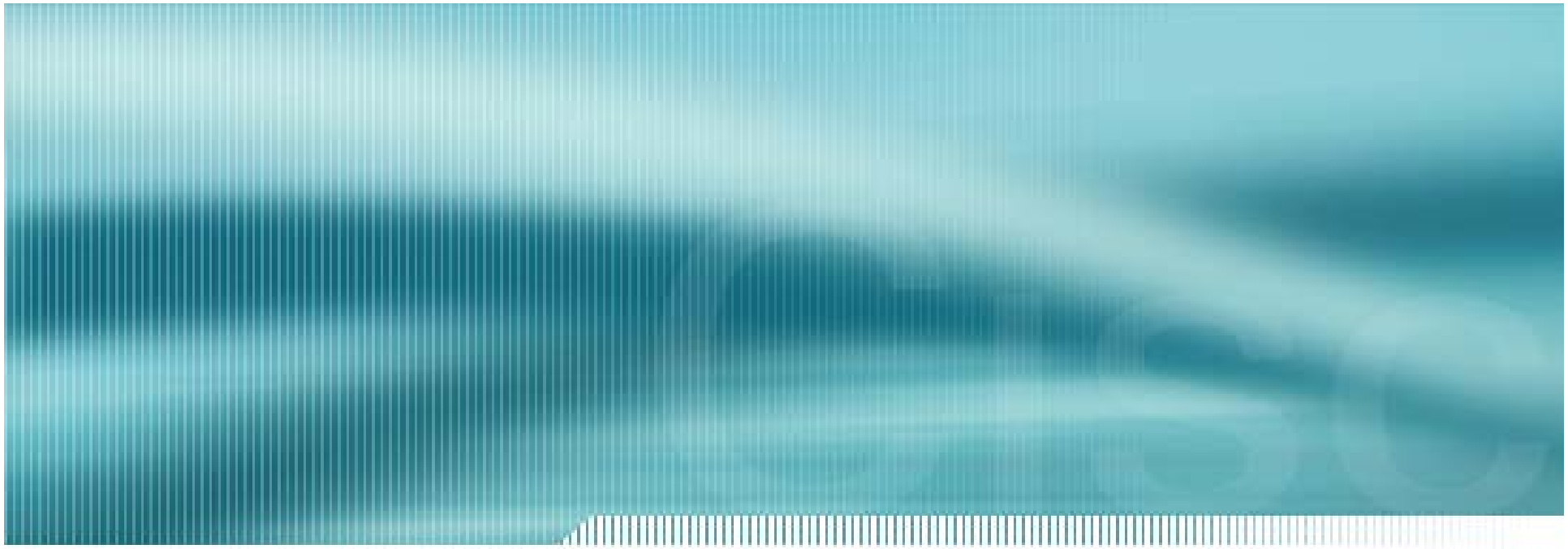

VLSM and CIDR

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Objectives

- **Classless routing**
- **VLSM**
- **Example of a VLSM calculation**

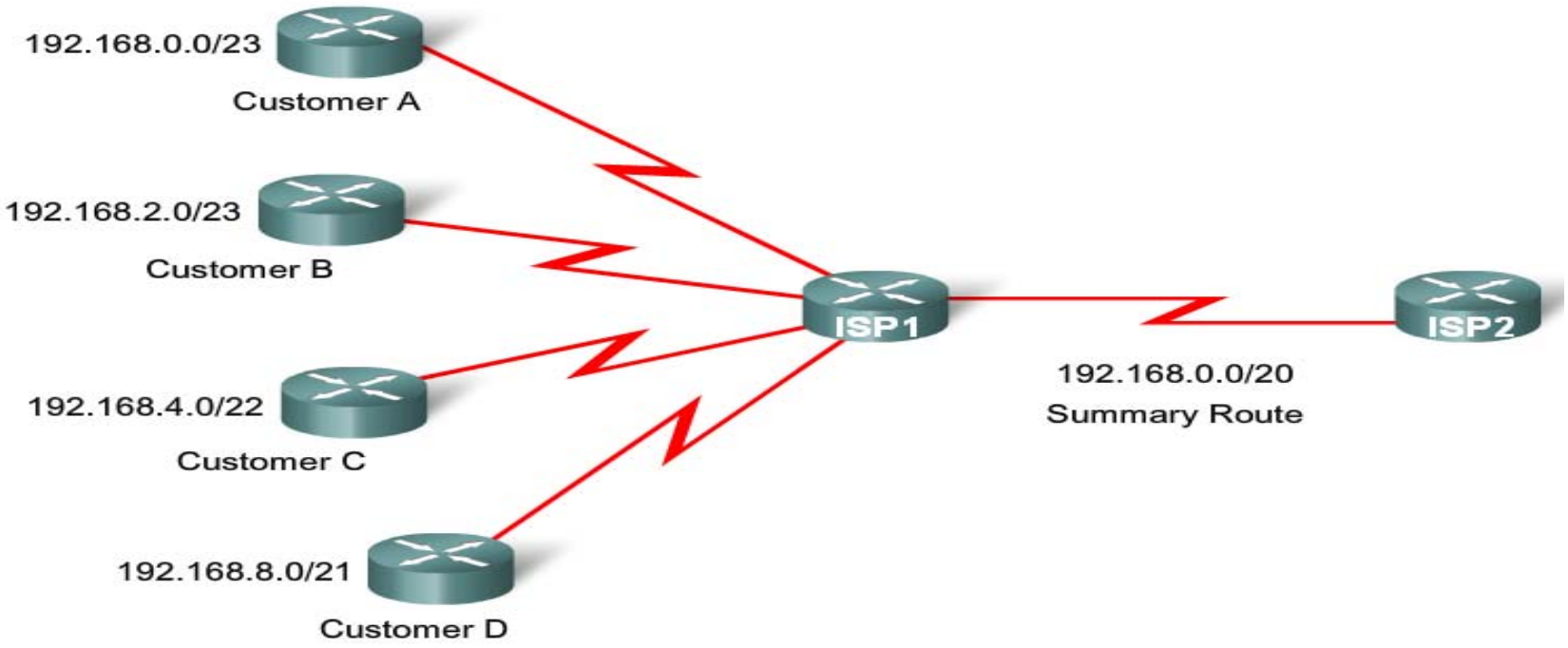
Classless routing

- **CIDR (Classless InterDomain Routing)**
  - **Network not identified based on default classes**
  - **Router uses prefix (/) to describe how many bits are network bits**
  - **More efficient use of IPv4 address space**
  - **Aggregation reduces the size of the routing table**

Classless Routing Protocols

- **Includes the subnet mask in the routing updates**
  - **RIP v2**
  - **EIGRP**
  - **OSPF**
  - **IS-IS**
  - **BGP**

CIDR and Route Summarization



The first 20 bits in all four networks are common, and can be summarized as a single route

Calculating Route Summarization

- **Step 1: List the networks in binary format**

192.168.0.0	**11000000.10101000.00000000.00000000**
192.168.2.0	**11000000.10101000.00000010.00000000**
192.168.4.0	**11000000.10101000.00000100.00000000**
192.168.8.0	**11000000.10101000.00001000.00000000**

Calculating Route Summarization

- **Step 2: Count the number of left-most matching bits to determine the mask**

192.168.0.0	**11000000.10101000.00000000.00000000**
192.168.2.0	**11000000.10101000.00000010.00000000**
192.168.4.0	**11000000.10101000.00000100.00000000**
192.168.8.0	**11000000.10101000.00001000.00000000**

20 matching bits, corresponds to /20 or 255.255.240.0

Calculating Route Summarization

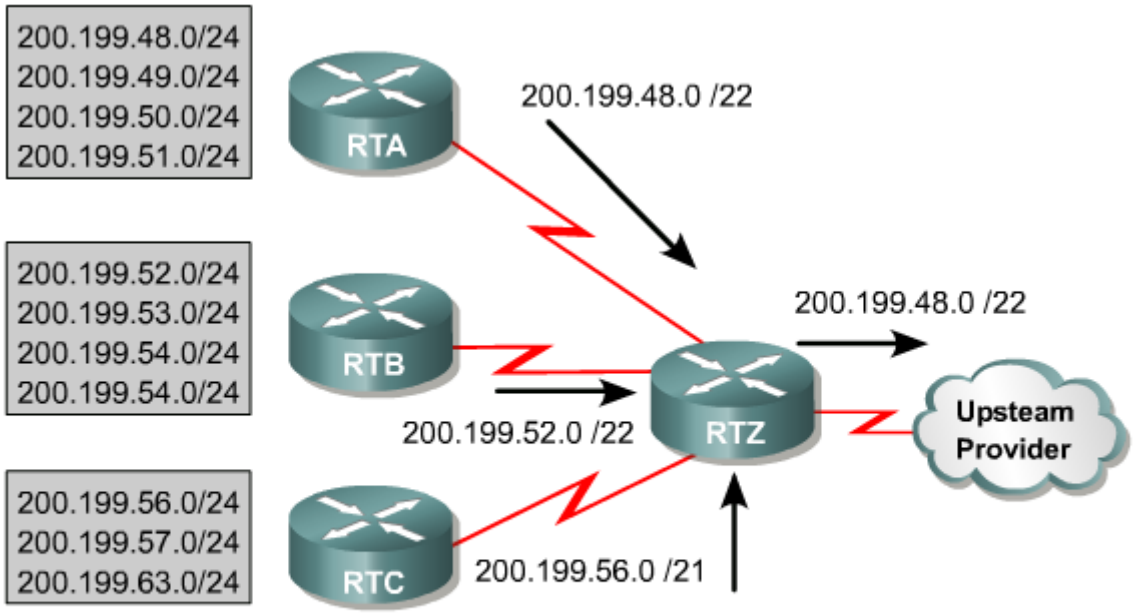
- **Step 3: Copy the matching bits and add zeros to determine the network address**

192.168.0.0 **11000000.10101000.0000**0000.00000000

Copy Add zero bits

All four networks will be summarized as 192.168.0.0 /20

Route Summarization

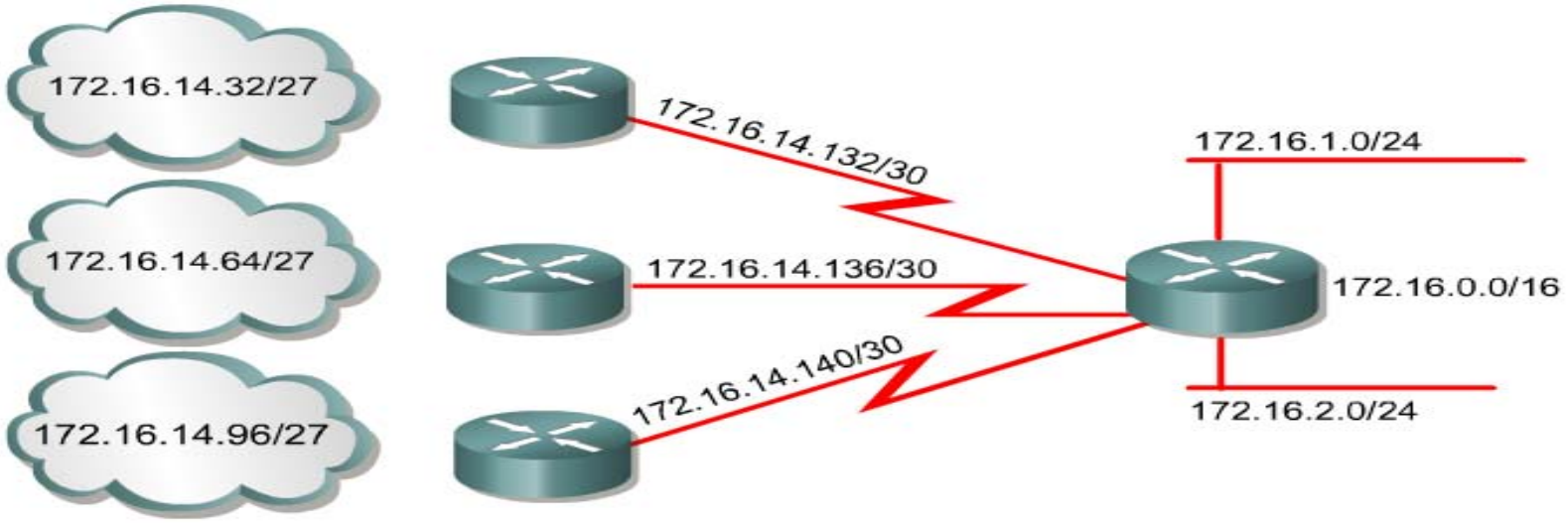


Route summarization reduces routing table size by aggregating routes to multiple networks into one supernet.

What is VLSM?

- **VLSM = Variable Length Subnet Mask**
- **Different subnet masks within the same network address space**
  - **”Sub-subnetting”**
- **Used for efficient and scalable addressing**

Subnet mask



Subnet 172.16.14.0/24 is divided into smaller subnets:

- Subnets with one mask are identified with /27.
- One unused /27 subnet is subdivided into three /30 subnets.

Benefits with VLSM

- **More efficient use of IP addresses**
  - **Variable size of the networks**
- **Greater capability to use route summarization**
  - **Will reduce the entries in the routing table**

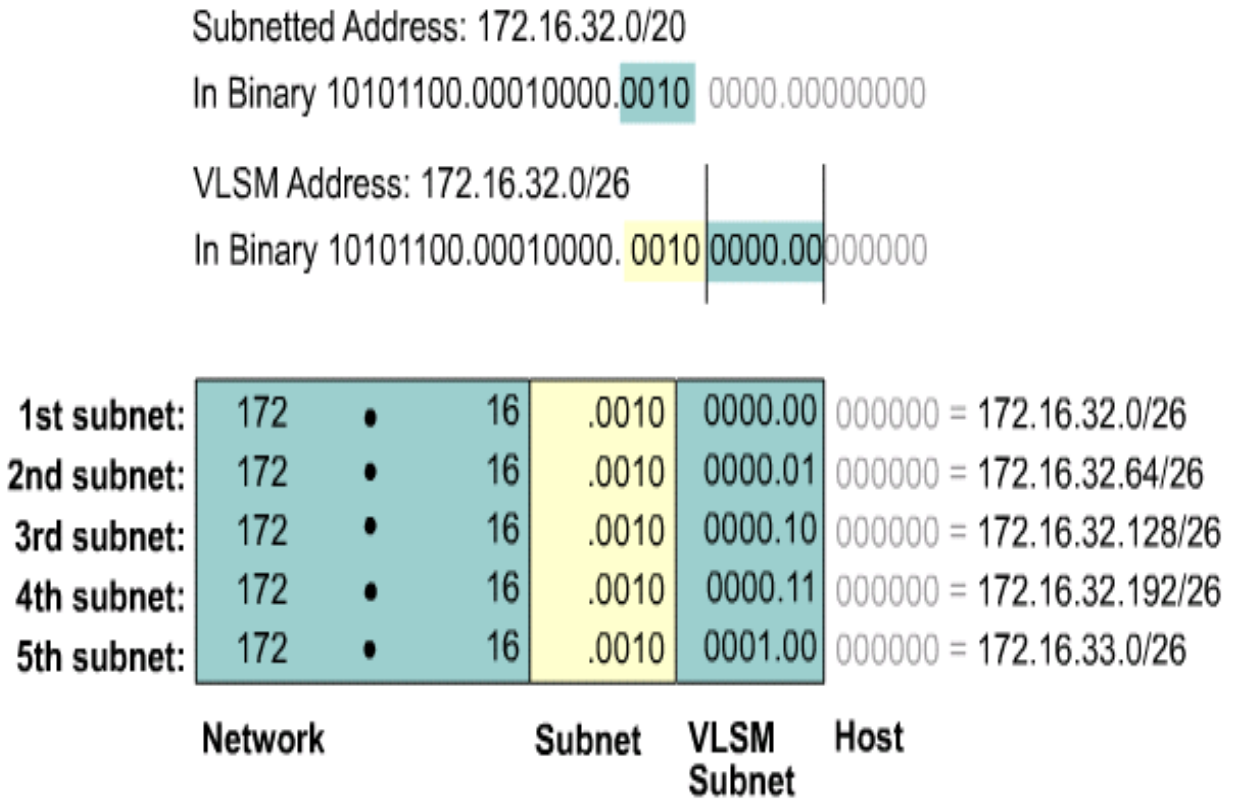
How to calculate VLSM:

- **You have a network that is divided into the subnetwork address 172.16.32.0 /20**
- **This subnetwork is further divided into the VLSM address 172.16.32.0 /26**
- **Calculate the subnet addresses that can be used in the network**

How to calculate VLSM:

- **Use the following steps:**
  - **Write 172.16.32.0 in binary form**
  - **Draw a vertical line between bit 20 and 21, where the original subnet boundary was**
  - **Draw a vertical line between bit 26 and 27, to extend the subnet boundary**
  - **Calculate the 64 subnet addresses with the bits between the two lines**
- **Remember: only unused subnets can be further subnetted**

How to calculate VLSM:



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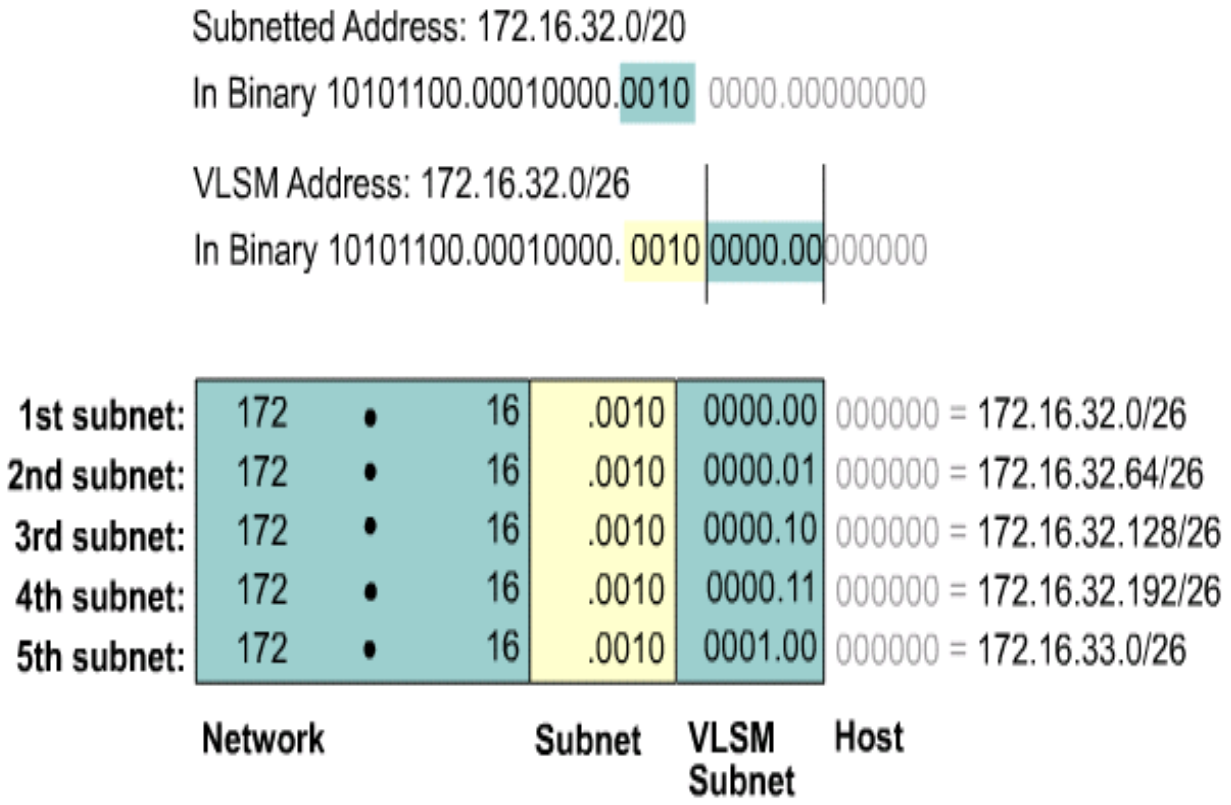

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How to calculate VLSM:

Subnetted Address: 172.16.32.0/20

In Binary 10101100.00010000.0010 0000.00000000

VLSM Address: 172.16.32.0/26

In Binary 10101100.00010000. 0010 0000.00 000000

1st subnet:	172	•	16	.0010	0000.00	000000	= 172.16.32.0/26
2nd subnet:	172	•	16	.0010	0000.01	000000	= 172.16.32.64/26
3rd subnet:	172	•	16	.0010	0000.10	000000	= 172.16.32.128/26
4th subnet:	172	•	16	.0010	0000.11	000000	= 172.16.32.192/26
5th subnet:	172	•	16	.0010	0001.00	000000	= 172.16.33.0/26
	Network			Subnet	VLSM Subnet	Host	

How to calculate VLSM:

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How to calculate VLSM:

Subnetted Address: 172.16.32.0/20

In Binary 10101100.00010000.0010 0000.00000000

VLSM Address: 172.16.32.0/26

In Binary 10101100.00010000. 0010 0000.00 000000

1st subnet:	172	•	16	.0010	0000.00	000000 =	172.16.32.0/26
2nd subnet:	172	•	16	.0010	0000.01	000000 =	172.16.32.64/26
3rd subnet:	172	•	16	.0010	0000.10	000000 =	172.16.32.128/26
4th subnet:	172	•	16	.0010	0000.11	000000 =	172.16.32.192/26
5th subnet:	172	•	16	.0010	0001.00	000000 =	172.16.33.0/26
	Network			Subnet	VLSM Subnet		Host

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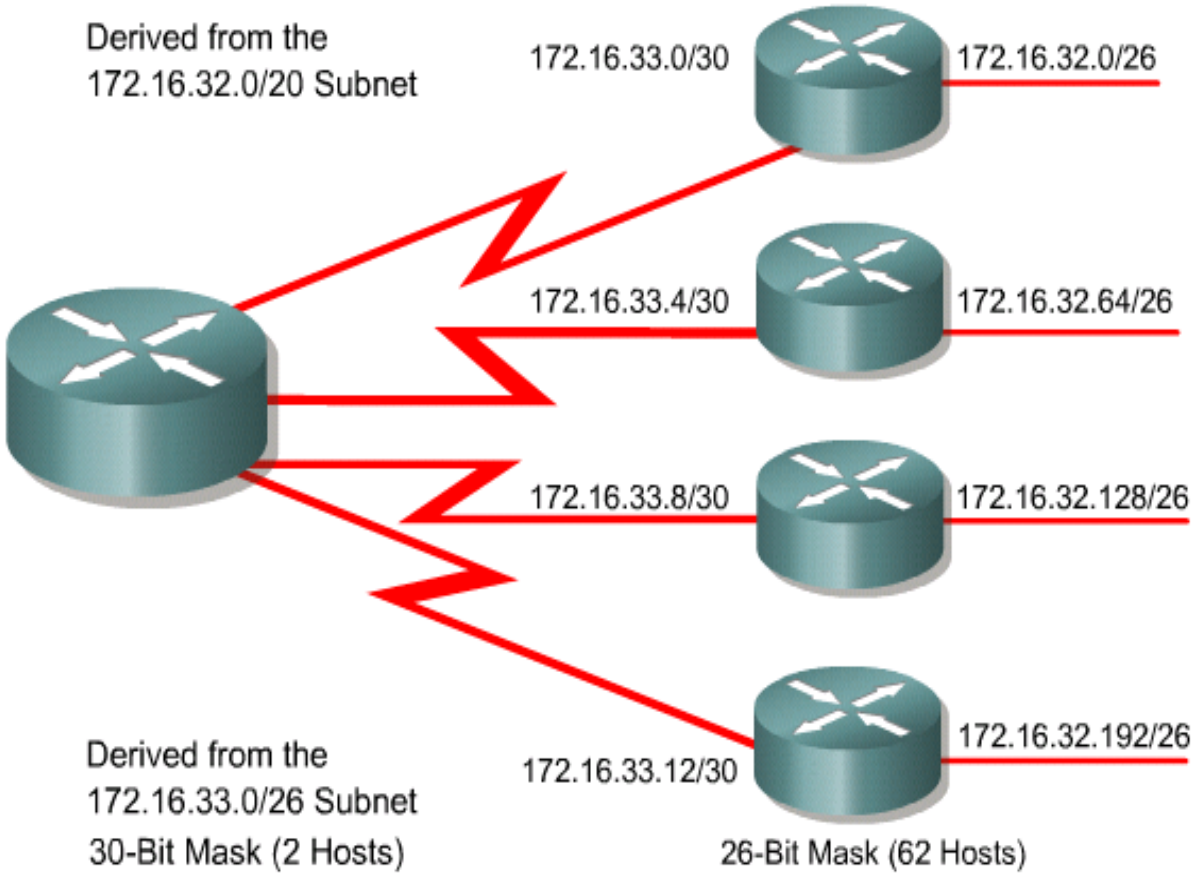
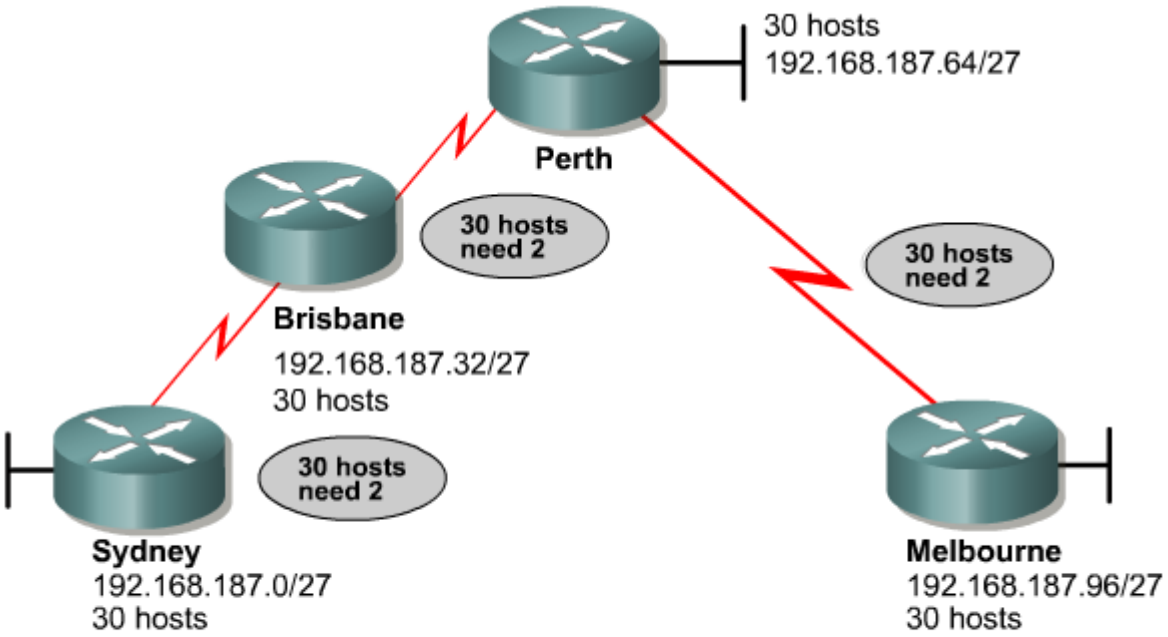
Results



Example: Point-to-Point Links



Use VLSM on the point to point links to use only 2 valid host addresses instead of wasting 30.

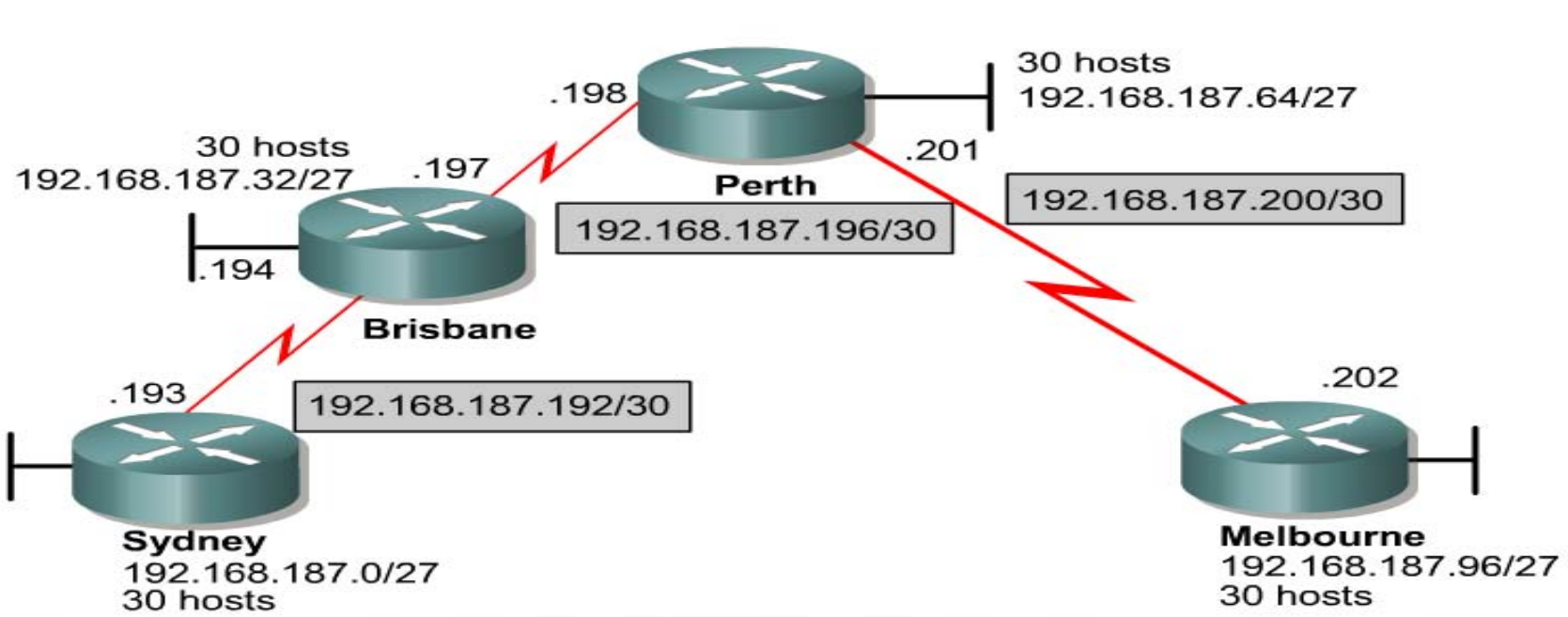
Example: Point-to-Point Links

Subnet Number	Subnet Address	
subnet 0	192.168.187.0	/27
subnet 1	192.168.187.32	/27
subnet 2	192.168.187.64	/27
subnet 3	192.168.187.96	/27
subnet 4	192.168.187.128	/27
subnet 5	192.168.187.160	/27
subnet 6	192.168.187.192	/27
subnet 7	192.168.187.224	/27

Subnet Number	Subnet Address	
sub-subnet 0	192.168.187.192	/30
sub-subnet 1	192.168.187.196	/30
sub-subnet 2	192.168.187.200	/30
sub-subnet 3	192.168.187.204	/30
sub-subnet 4	192.168.187.208	/30
sub-subnet 5	192.168.187.212	/30
sub-subnet 6	192.168.187.216	/30
sub-subnet 7	192.168.187.220	/30

- **Subnet 6 divided to sub-subnets**

Example: Point-to-Point Links



Notice the /27 mask for the LANs and the /30 mask for the serial links.