

Lecture 12

SUBNET ADDRESSING

Topics Covered

- Benefits of subnetting
- Subnetting
- Subnet Mask
- Examples
- Applications

INTRODUCTION

- In sub netting, a **network is divided into smaller subnets** with each subnet having its own subnet address.

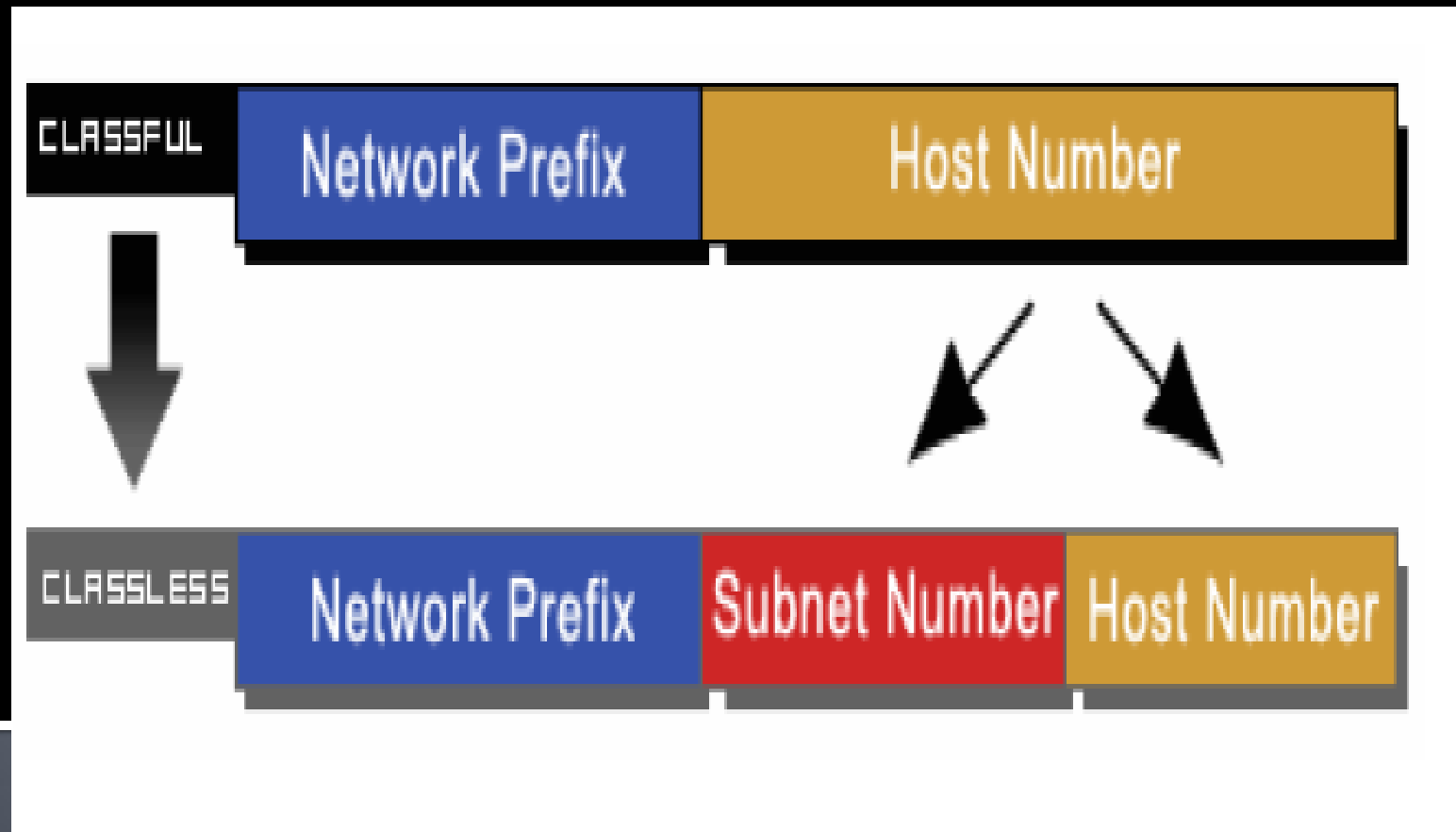
Reasons for Sub netting

- Most IP address assignments were not used very efficiently.
- Broadcast problem.
- Many sites were requesting multiple network numbers due to variable amounts of networks at their sites.

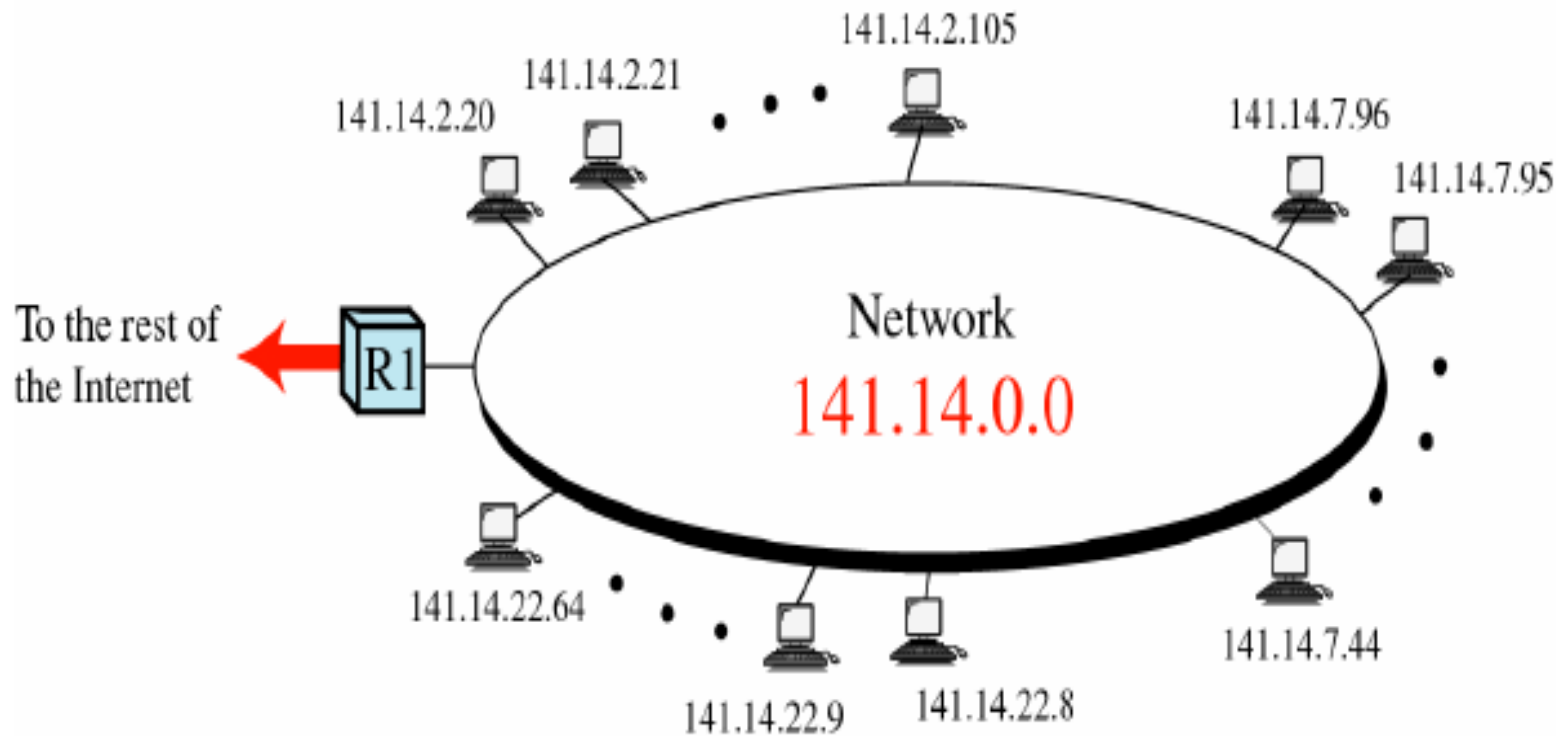
Benefits of subnetting

- Reduced network traffic
- Simplified management
- Smaller broadcast domains

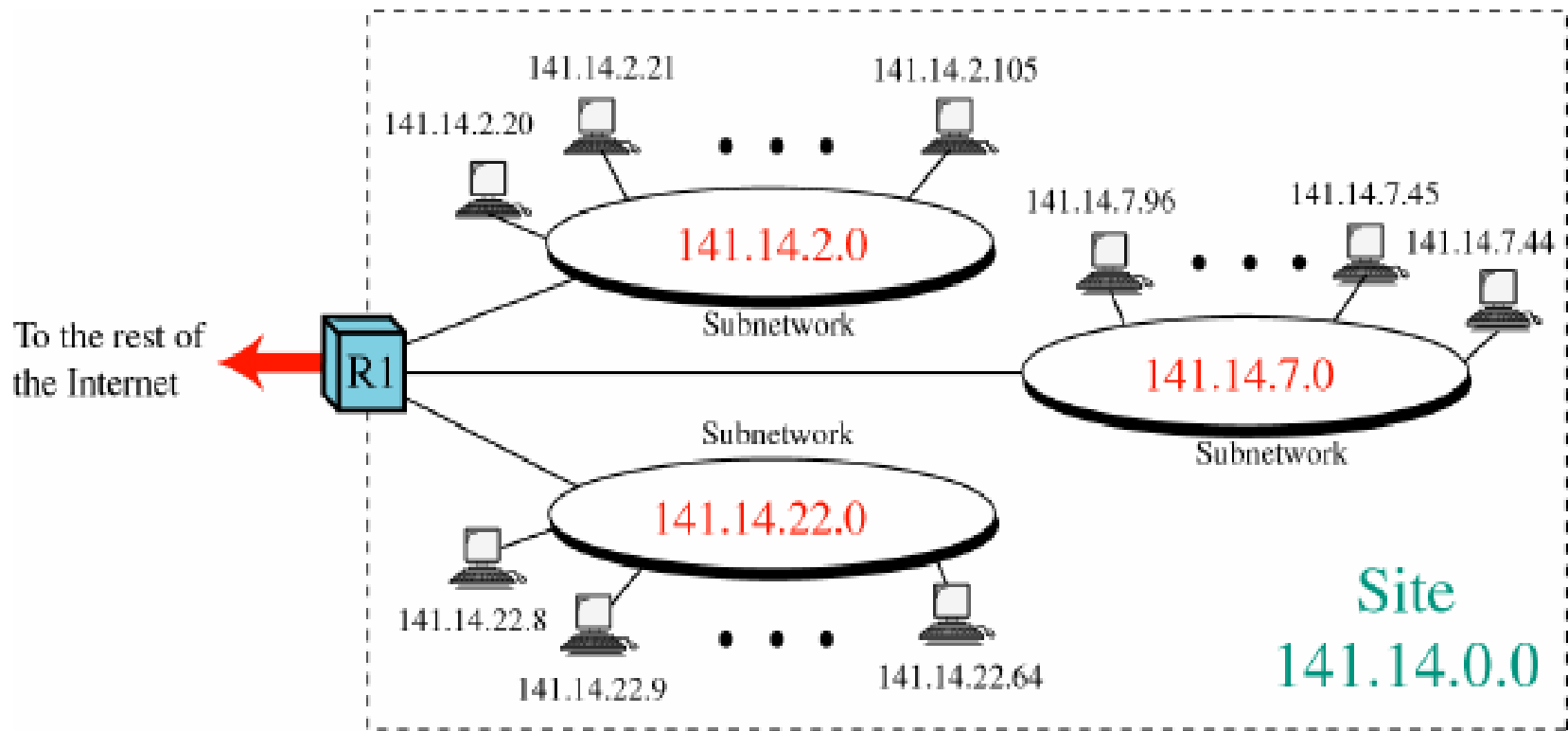
Subnetting



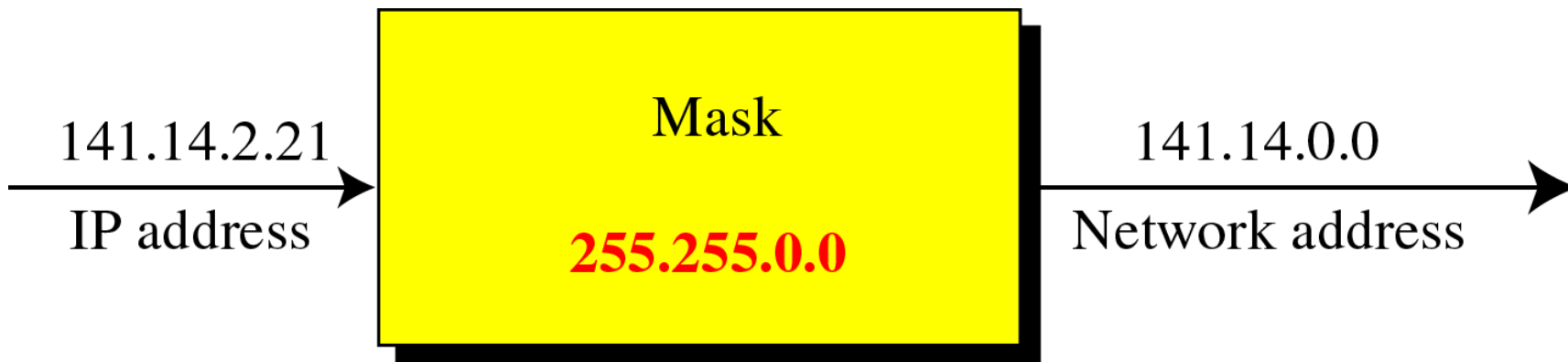
Network Before Subnetting



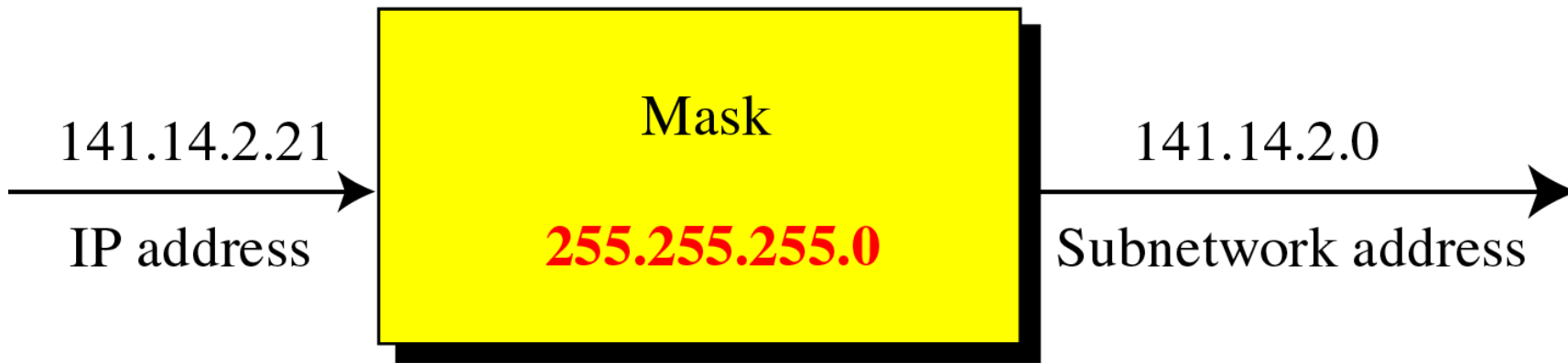
Network After Subnetting



Masking



a. Without subnetting



b. With subnetting

Subnet Mask

How do we determine the entire subnets inside our network?

Subnet mask is used to distinguish the network ID from the host ID

Example

	Dot-decimal Address	Binary
Full Network Address	192.168.5.10	11000000.10101000.00000101.00001010
Subnet Mask	255.255.255.0	11111111.11111111.11111111.00000000
Network Portion	192.168.5.0	11000000.10101000.00000101.00000000
Host Portion	0.0.0.10	00000000.00000000.00000000.00001010

How to know network is sub netted

Address Class	Bits for Subnet Mask	Network Prefix
Class A	11111111 00000000 00000000 00000000	/8
Class B	11111111 11111111 00000000 00000000	/16
Class C	11111111 11111111 11111111 00000000	/24

IP Address: 192.168.2.1

Subnet Mask: 255.255.255.0

With Prefix Notation: 192.168.2.1/24

Prefix Notation

IP Address: 132.168.64.3/18

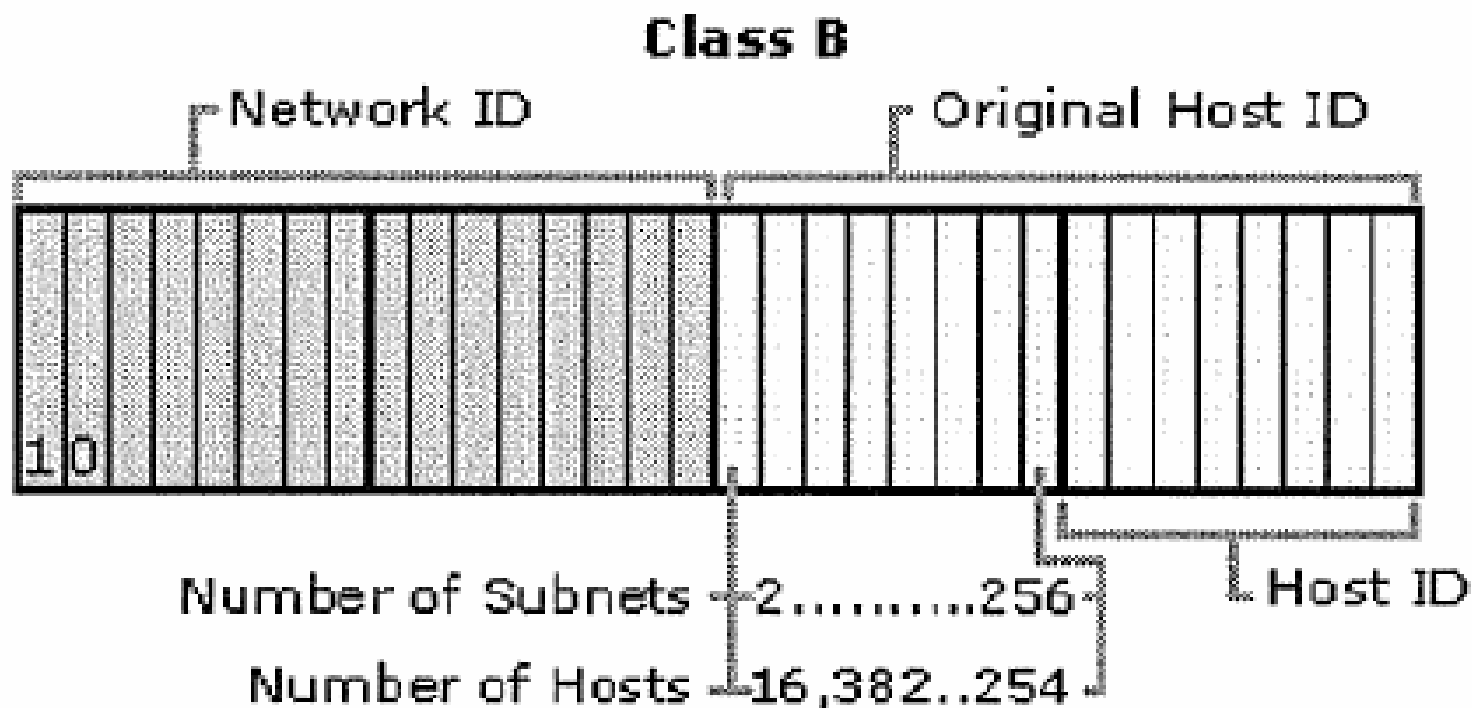
Subnet Mask: 255.255.192.0

Subnetting: how to?

- Number of host bits used for subnetting
- What are the sub netted Network IDs
- What are the IP Addresses for each new subnet?

Number of host bits used for subnetting

- How many subnets I will have in the future
- Use more bits to overcome the change overhead.



Example

Network	Network (binary)	Broadcast address
192.168.5.0/26	11000000.10101000.00000101.00000000	192.168.5.63
192.168.5.64/26	11000000.10101000.00000101.01000000	192.168.5.127
192.168.5.128/26	11000000.10101000.00000101.10000000	192.168.5.191
192.168.5.192/26	11000000.10101000.00000101.11000000	192.168.5.255

Possible subnets for a /24 prefix (traditional Class C)

CIDR notation	Network Mask	Available Networks	Available Hosts per network	Total usable hosts
/24	255.255.255.0	1	254	254
/25	255.255.255.128	2	126	252
/26	255.255.255.192	4	62	248
/27	255.255.255.224	8	30	240
/28	255.255.255.240	16	14	224
/29	255.255.255.248	32	6	192
/30	255.255.255.252	64	2	128
/31	255.255.255.254	128	2 *	256

Another Example

Network ID: 191.168.0.0

Use 3 bits

Subnet Mask: 255.255.224.0

	Subnet Binary Representation	Subnetted Network ID
1	10111111.10101000. <u>000</u> 00000.00000000	191.168.0.0/19
2	10111111.10101000. <u>001</u> 00000.00000000	191.168.32.0/19
3	10111111.10101000. <u>010</u> 00000.00000000	191.168.64.0/19
4	10111111.10101000. <u>011</u> 00000.00000000	191.168.96.0/19
5	10111111.10101000. <u>100</u> 00000.00000000	191.168.128.0/19
6	10111111.10101000. <u>101</u> 00000.00000000	191.168.160.0/19
7	10111111.10101000. <u>110</u> 00000.00000000	191.168.192.0/19
8	10111111.10101000. <u>111</u> 00000.00000000	191.168.224.0/19

How many hosts allowed for each subnet of the previous example?

	Subnet Binary Representation	Range of IP Addresses
1	10111111.10101000. <u>00000000</u> .00000001 10111111.10101000. <u>000</u> 11111.11111110	191.168.0.1 - 191.168.31.254
2	10111111.10101000. <u>00100000</u> .00000001 10111111.10101000. <u>001</u> 11111.11111110	191.168.32.1 - 191.168.63.254
3	10111111.10101000. <u>01000000</u> .00000001 10111111.10101000. <u>010</u> 11111.11111110	191.168.64.1 - 191.168.95.254
4	10111111.10101000. <u>01100000</u> .00000001 10111111.10101000. <u>011</u> 11111.11111110	191.168.96.1 - 191.168.127.254
5	10111111.10101000. <u>10000000</u> .00000001 10111111.10101000. <u>100</u> 11111.11111110	191.168.128.1 - 191.168.159.254
6	10111111.10101000. <u>10100000</u> .00000001 10111111.10101000. <u>101</u> 11111.11111110	191.168.160.1 - 191.168.191.254
7	10111111.10101000. <u>11000000</u> .00000001 10111111.10101000. <u>110</u> 11111.11111110	191.168.192.1 - 191.168.223.254
8	10111111.10101000. <u>11100000</u> .00000001 10111111.10101000. <u>111</u> 11111.11111110	191.168.224.1 - 191.168.255.254

Static Subnetting

- All subnets in the subnetted network use the same subnet mask
- Easy to implement
- Waste IP Addresses

Variable Subnetting

- Subnets use different subnet masks
- Real world environments
- No wasting of IP addresses

Variable Subnetting Example

Network ID: 135.41.0.0/16

24 subnets are required as follows:

- One subnet with up to 32000 hosts
- 15 subnets with up to 2000 hosts
- 8 subnets with up to 250 hosts

One subnet with up to 32000 hosts

- I need one bit only to subnet
- Subnet ID options:

Subnet ID (Decimal)	Subnet ID (Binary)	Subnet Mask
135.41.0.0/17	10000111.00101001.00000000.00000000	255.255.128.0
135.41.128.0/17	10000111.00101001.10000000.00000000	255.255.128.0

15 subnets with up to 2000 hosts

I need 4 bits to subnet

Subnet ID options:

Subnet ID (Decimal)	Subnet ID (Binary)	Subnet Mask
135.41.128.0/21	10000111.00101001.10000000.00000000	255.255.248.0
135.41.136.0/21	10000111.00101001.10001000.00000000	255.255.248.0
135.41.144.0/21	10000111.00101001.10010000.00000000	255.255.248.0
-	-	-
-	-	-
-	-	-
135.41.240.0/21	10000111.00101001.11110000.00000000	255.255.248.0

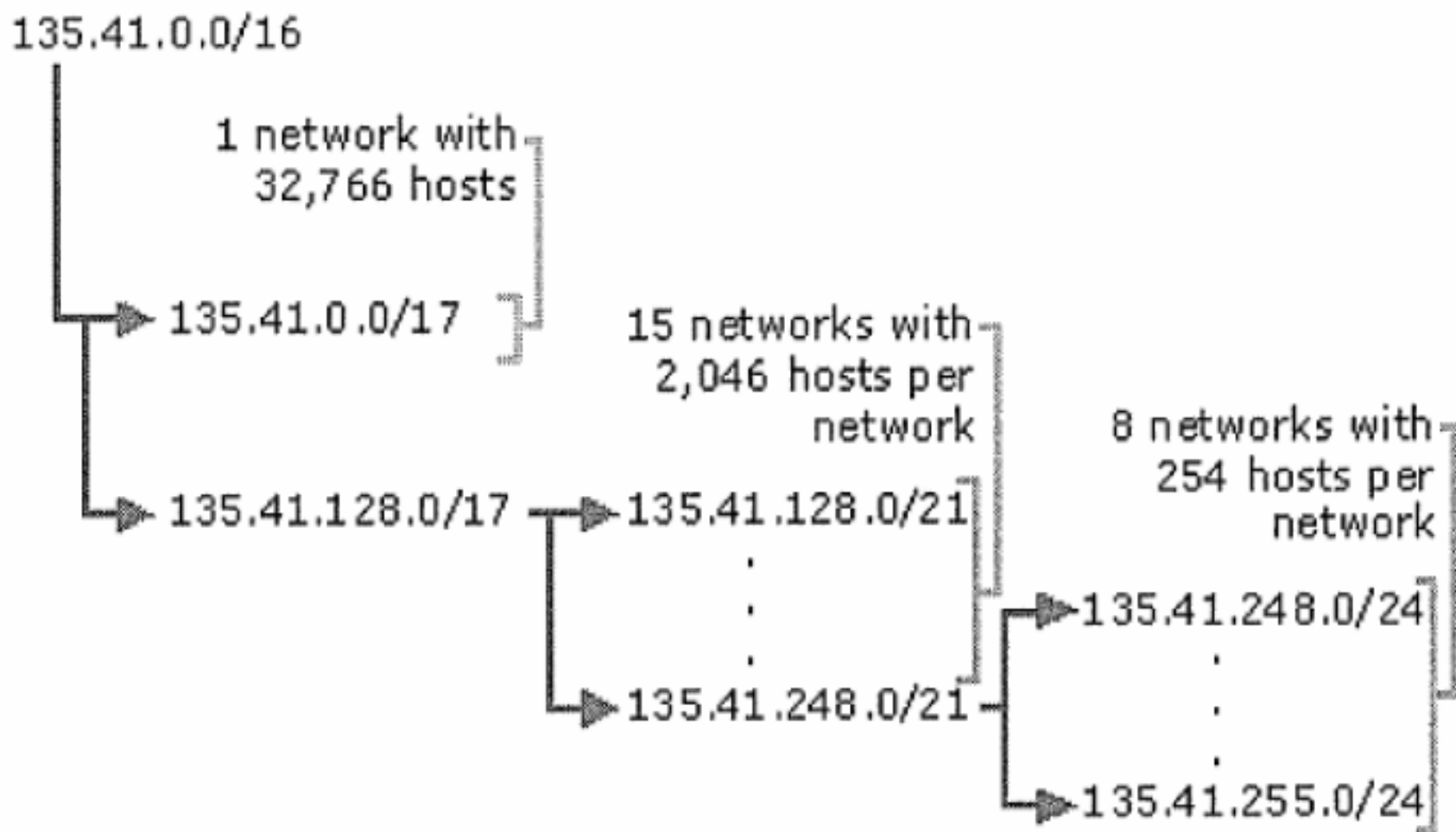
8 subnets with up to 250 hosts

I need 3 bits to subnet

Subnet ID options:

Subnet ID (Decimal)	Subnet ID (Binary)	Subnet Mask
135.41.248.0/24	10000111.00101001.11111000.00000000	255.255.255.0
135.41.249.0/24	10000111.00101001.11111001.00000000	255.255.255.0
135.41.250.0/24	10000111.00101001.11111010.00000000	255.255.255.0
135.41.251.0/24	10000111.00101001.11111011.00000000	255.255.255.0
-	-	-
-	-	-
-	-	-
135.41.255.0/24	10000111.00101001.11111111.00000000	255.255.255.0

Variable Subnetting of 135.41.0.0/16



APPLICATIONS

- NETWORK MANAGEMENT
- BROADCASTING MESSAGES

SCOPE OF RESEARCH

- SUBNET ADDRESSING IN IPv10 and further versions of IP Protocol