COMP30040
Subnetting

Thanks to Cristian Olariu

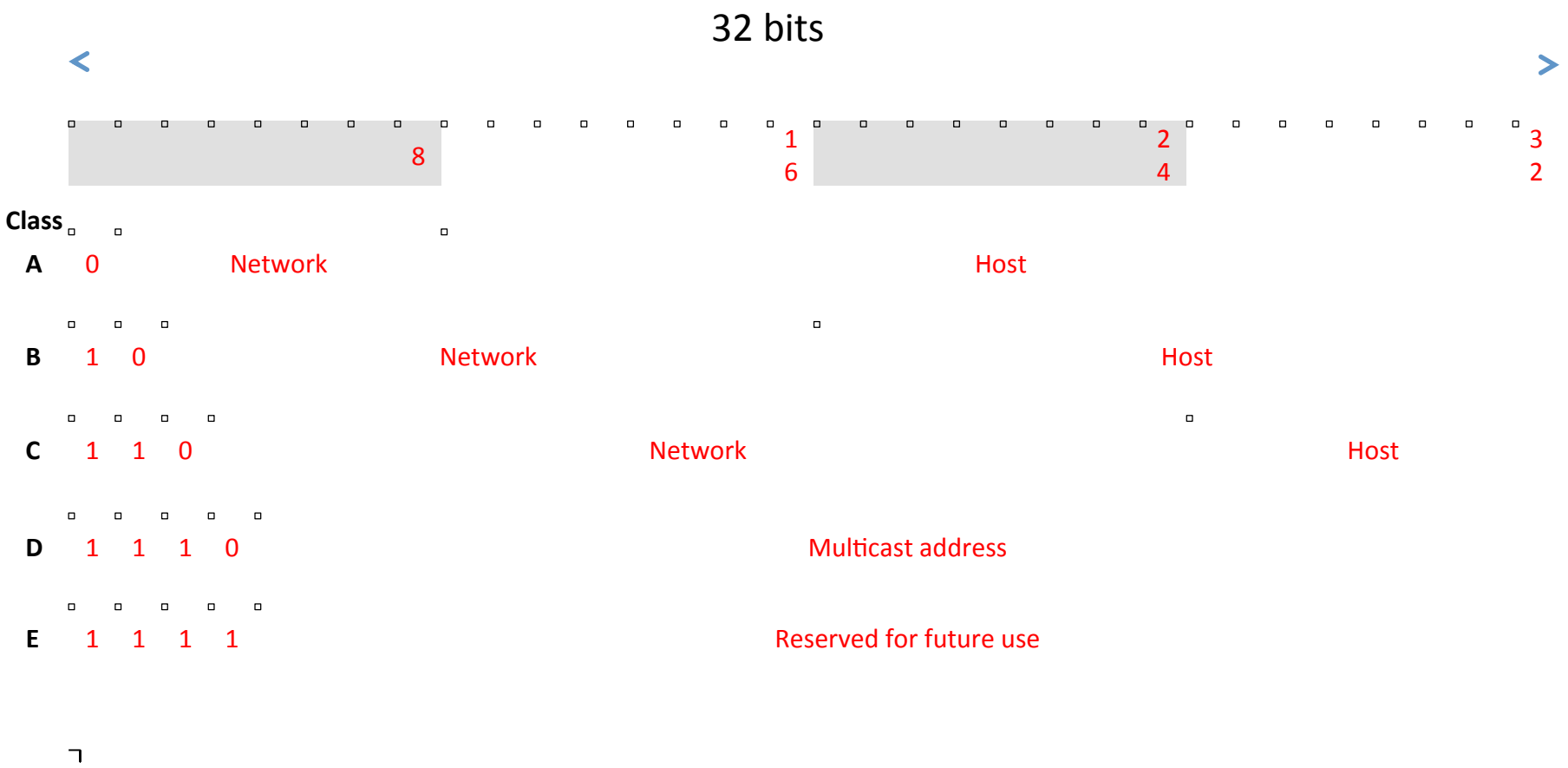
IPv4 address space

- 32 bits (4 bytes) addresses

- Total number of addresses:
- 2^{32}= 4,294,967,296 IPv4 addresses

- Lower than Earth's population (approx. 7b)

History – Class-based subnets (used before 1993 and is now deprecated)



All a router had to do, is look at the first 4 bits of an incoming IP packet.

Subnetting

- Divides a network into sub-networks, i.e UCD has one network, but many schools (sub-nets)

- The Netmask splits the IP Address into:
  - network-prefix (Network ID)
  - and host-number (Host ID)

CIDR – Classless Inter-Domain Routing

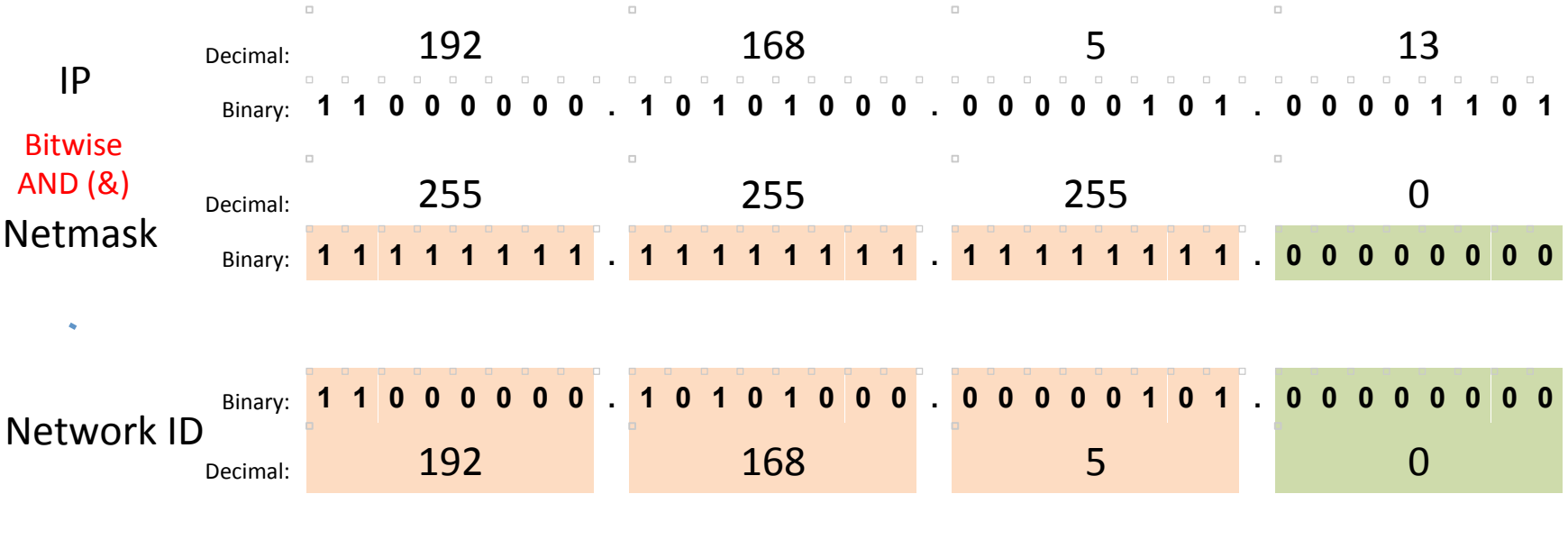
- Why it exists:
  - The 8 bit address boundary had lack of vision
  - E.g.: Class B networks are too big, i.e. 65536 hosts
  - In CIDR, the address space can be allocated to Internet Providers and end-users on any address bit boundary, using netmasks
- Netmask (network mask):
  - 32 bits long
  - Used to specify
    - how many bits from an IP address define the Network ID,
    - and how many bits define the Hosts IDs
- Netmask e.g.:

255 255 255 240

1 1 1 1 1 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

In this example, there are 28 bits of "1" and 4 bits of "0". So, it is said that this is a /28 network.

Example:
What network do I belong to?



This is the fixed part of any IP address in this network.
This is a /24 network, specifically: 192.168.5.0/28

This is the free part, where bits can take any value, resulting in host IP addresses.

How many hosts does this network have?

Example: 192.168.5.0/24

In network 192.168.5.0/24,
there are 254 hosts:
$2^{(32-24)} - 2 = 2^8 - 2 = 256 - 2 = 254$ hosts,
And the broadcast address is 192.168.5.255

Network ID	Binary:	1 1 0 0 0 0 0 0	1 0 1 0 1 0 0 0	0 0 0 0 0 1 0 1	0 0 0 0 0 0 0 0
	Decimal:	192	168	5	0
First host's address	Binary:	1 1 0 0 0 0 0 0	1 0 1 0 1 0 0 0	0 0 0 0 0 1 0 1	0 0 0 0 0 0 0 1
	Decimal:	192	168	5	1
Other hosts	Binary:	1 1 0 0 0 0 0 0	1 0 1 0 1 0 0 0	0 0 0 0 0 1 0 1	x x x x x x x x
	Decimal:	192	168	5	2 to 253
Last host's address	Binary:	1 1 0 0 0 0 0 0	1 0 1 0 1 0 0 0	0 0 0 0 0 1 0 1	1 1 1 1 1 1 1 0
	Decimal:	192	168	5	254
Broadcast address	Binary:	1 1 0 0 0 0 0 0	1 0 1 0 1 0 0 0	0 0 0 0 0 1 0 1	1 1 1 1 1 1 1 1
	Decimal:	192	168	5	255

Subnetting: number of hosts

- If your network has a /n netmask,
- then, there are:

$2^{(32-n)} - 2$ hosts (a.k.a. usable IP addresses)

Reserved ranges,
can not be used over the Internet

10.0.0.0 – 10.255.255.255	
127.0.0.0 – 127.255.255.255	Localhost
172.16.0.0 – 172.31.255.255	
192.168.0.0 – 192.168.255.255	

IPv6

- Solution to the scarce IPv4 address domain
- Addresses are on 128 bits
- Total number of IPv6 addresses:

  2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456
- More than enough for anybody on Earth to own multiple IP addresses
- IoT will use a lot of these IPv6 addresses

Practice on your own!
Use: 192.168.153.33/21

There are 21 of “1”s in this netmask!