COMP90007 Internet Technologies Workshop

Week 6

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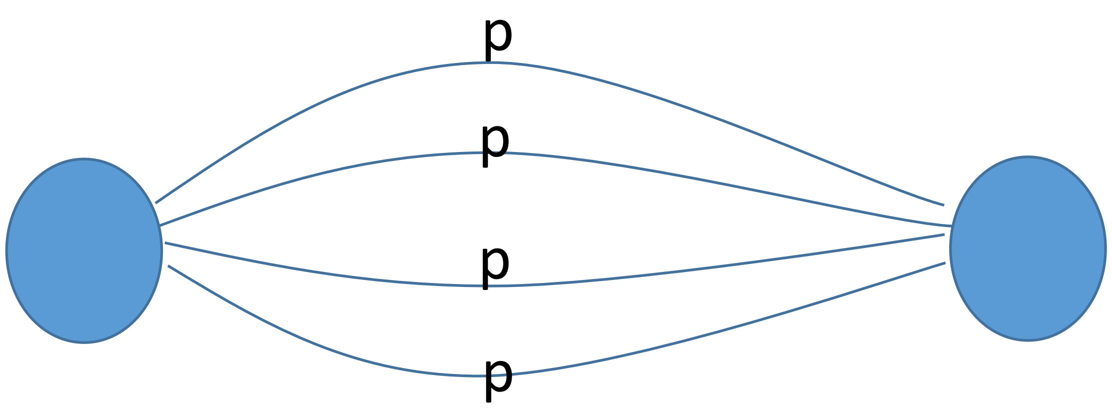
Question 1

If there are *n* independent paths between two nodes in a network, and the probability that an individual path is working is *p*, what is the probability of these two nodes being connected? Assume path failures are independent.

Hint: first try to calculate what is the probability that all paths have failed



Answer:

P(nodes connected)
= 1 − P(all n paths failed)
= $1 - (1 - p)^n$

Question 2

Give two example computer applications for which connection-oriented service is appropriate, and two examples for which connectionless service is best.

Network Layer Provide services to the Transport Layer

2 Types of Services

1. Connectionless: Packets (datagrams) injected into subnet independently and packets individually routed to destination
   - Internet: move packets in a potentially unreliable subnet - QoS is not easily implemented
   - Flow and error control done by the hosts
2. Connection-oriented: Packets travelling between destinations all use the same route
   - Telco: guarantee reliability of subnet - QoS is important

Question 2

Give two example computer applications for which connection-oriented service is appropriate, and two examples for which connectionless service is best.

Answer:

***Connection-oriented* service:**

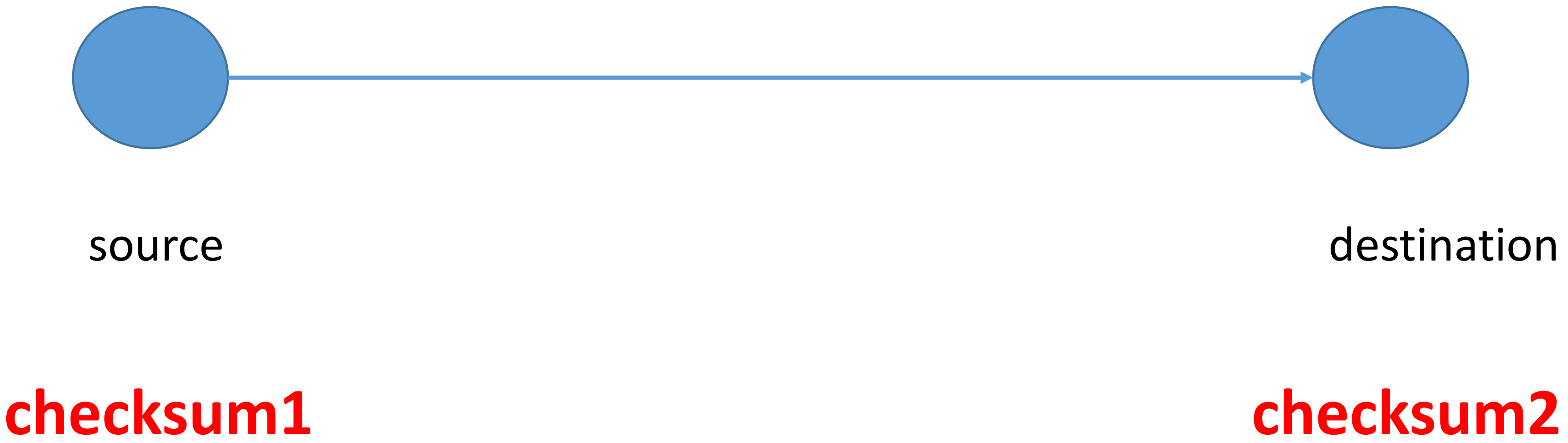
File transfer (FTP), remote login (SSH/telnet), web surfing (HTTP) and email (SMTP/IMAP/POP) need *connection-oriented* service. Lost packets are unacceptable.

Connectionless service:

On the other hand, point-of-sale terminals and many forms of remote database access are inherently *connectionless*, with a query going one way and a reply and coming back the other way. Other examples include P2P, VPN, video/audio streaming and some online games, where we don't care too much about lost packets.

Question 3

Assuming that all routers and hosts are working properly and that all software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination?


source
destination
checksum1
checksum2

Question 3

Assuming that all routers and hosts are working properly and that all software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination?

Answer:

Yes. A large noise burst could garble a packet badly

If the destination field, or equivalently, virtual circuit number is changed, the packet will be delivered to the wrong destination and accepted as genuine.

Put in other words, an occasional noise burst could change a perfectly legal packet for one destination into a perfectly legal packet for another destination.

Question 4

Is fragmentation needed in concatenated virtual-circuit internet or only in datagram systems?

Answer:
It is needed in both. Even in a concatenated virtual circuit network, some networks along the path might accept 1024-byte packets, and others might only accept 48-byte packets. Fragmentation is still needed.

Question 5

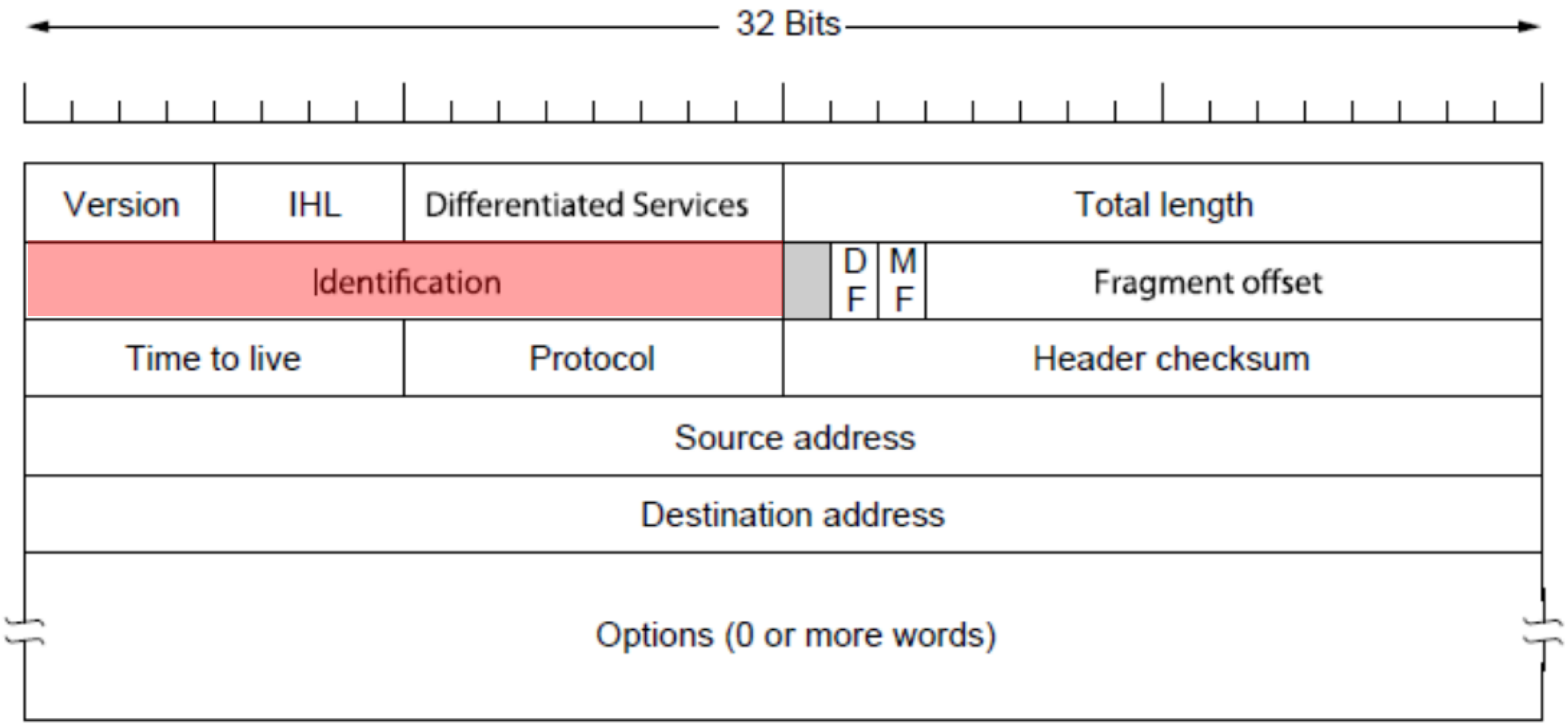
A router blasting out IP packets whose total length (header plus data) is 1024 bytes. Assuming that packets live for 10 sec, what is the maximum line speed the router can operate at without danger of cycling through the IP datagram ID number space (*identification* field – 16 bits)?

IPv4 Frame Structure Illustrated

- IPv4 (Internet Protocol) header is carried on all packets and has fields for the key parts of the protocol

16 bits

2^{16} bits



Question 5

A router blasting out IP packets whose total length (header plus data) is 1024 bytes. Assuming that packets live for 10 sec, what is the maximum line speed the router can operate at without danger of cycling through the IP datagram ID number space (*identification* field – 16 bits)?

The IP datagram ID number space: 2^{16} = 65536 packets

Each packet lifetime = 10 seconds

Therefore, a maximum of 65536 packets are allowed to send in 10 seconds. If any more packets were to be sent within the 10 seconds, there would be multiple live packets with the same ID.

Time for sending each packet = 10/65536 seconds

Terminology

IP Address (32bits) has two components,
the network address and the host address.

A **subnet mask** separates the IP address into the network and host addresses, by setting network bits to all "1"s and setting host bits to all "0"s

If additional subnetwork is needed. **Subnetting** can further divide the host part of an IP address into a **subnet and host address**

2 ways to represent IP addresses

1. Classful Network Address
2. CIDR (Classless Inter-Domain Routing)

1. Classful Network Address

Such as **192.168.2.0**

- Part of history now-old addresses came in blocks of fixed size (A, B, C)
  - Carries size as part of address, but lacks flexibility
  - Called classful (vs. classless) addressing

32 Bits

Class				Range of host addresses	Default subnet mask
A	0	Network	Host	1.0.0.0 to 127.255.255.255	255.0.0.0
B	10	Network	Host	128.0.0.0 to 191.255.255.255	255.255.0.0
C	110	Network	Host	192.0.0.0 to 223.255.255.255	255.255.255.0
D	1110	Multicast address		224.0.0.0 to 239.255.255.255	
E	1111	Reserved for future use		240.0.0.0 to 255.255.255.255	

2. CIDR (Classless Inter-Domain Routing)

CIDR introduced a new method of representation for IP addresses (known as CIDR notation)

Address or routing prefix is written with a suffix **indicating the number of bits for network of the prefix**.

Such as 192.168.5.130/24

24 bits for network address

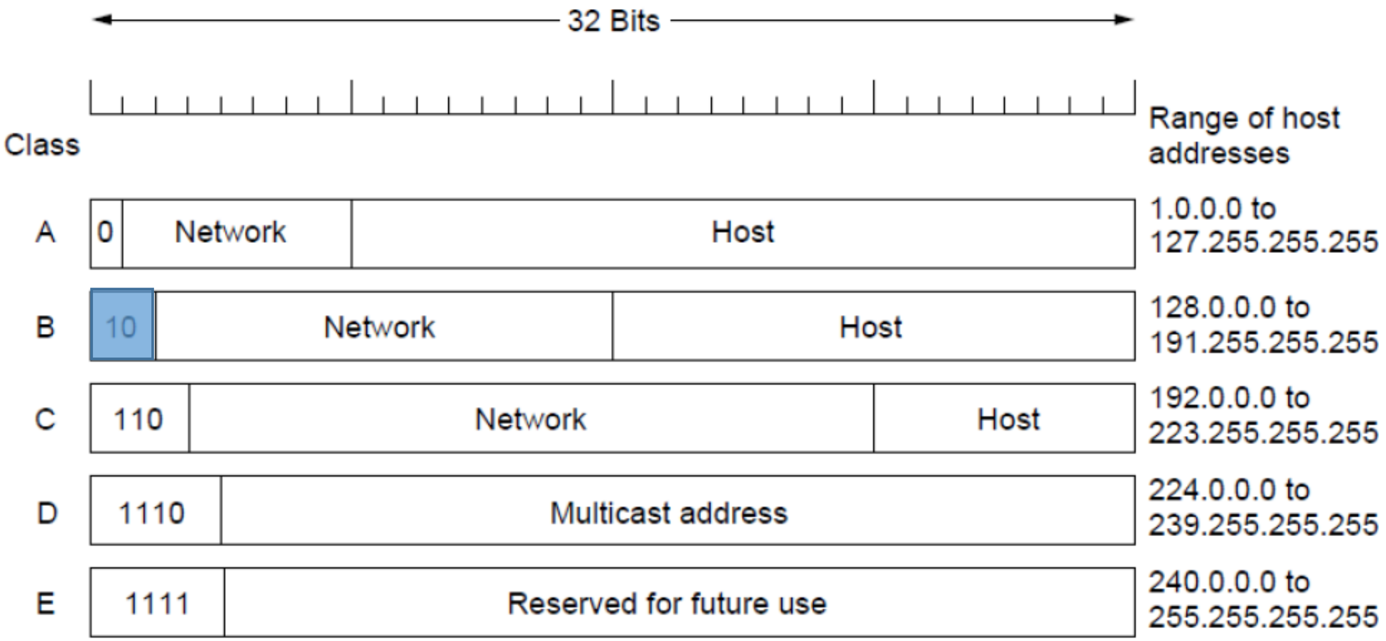
A **subnet mask** separates the IP address into the network and host addresses, by setting network bits to all "1"s and setting host bits to all "0"s

Subnet mask 11111111. 11111111.11111111.00000000

	Binary form	Dot-Decimal notation
IP address	11000000.10101000.00000101.10000010	192.168.5.130/24
Subnet mask	11111111. 11111111.11111111.00000000	255.255.255.0
Network Address	11000000.10101000.00000101.00000000	192.168.5.0/24
Host Address	00000000. 00000000.00000000. 10000010	0.0.0.130

Question 6

Suppose that instead of using 16 bits for the network part of a class B address originally, 20 bits had been used. How many class B networks would there have been?



Answer:

With a 2-bit prefix, there would have been 18 bits left over to indicate the network. Consequently, the number of networks would have been 2^{18} or 262,144.

Question 9

A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts that it can handle?

Answer:

255.255.240.0 in binary is

11111111 11111111 11110000 0000000

The mask is 20 bits long, so the network part is 20 bits.

The remaining 12 bits are for the host, so $2^{12} = 4096$ host addresses exist.

You can also say there are 4096-2 = 4094 hosts.

Because the all 0s and all 1s are for special use.

Question 7

Convert the IP address

11000001, 01010010, 11010010, 00001111

to dotted decimal notation.

Ans. 193.82.210.15

10000000	2^7	128
01000000	2^6	64
00100000	2^5	32
00010000	2^4	16
00001000	2^3	8
00000100	2^2	4
00000010	2^1	2
00000001	2^0	1

Question 8

Convert the IP address 240.68.10.10 to binary format

Use the following key:

10000000	2^7	128
01000000	2^6	64
00100000	2^5	32
00010000	2^4	16
00001000	2^3	8
00000100	2^2	4
00000010	2^1	2
00000001	2^0	1

Ans. 1111 0000 . 0100 0100 . 0000 1010 . 0000 1010

Subnetting

Subnetting allows the block of addresses to be split into several parts for internal use as multiple networks(organizations), while still acting like a single network to the outside world.

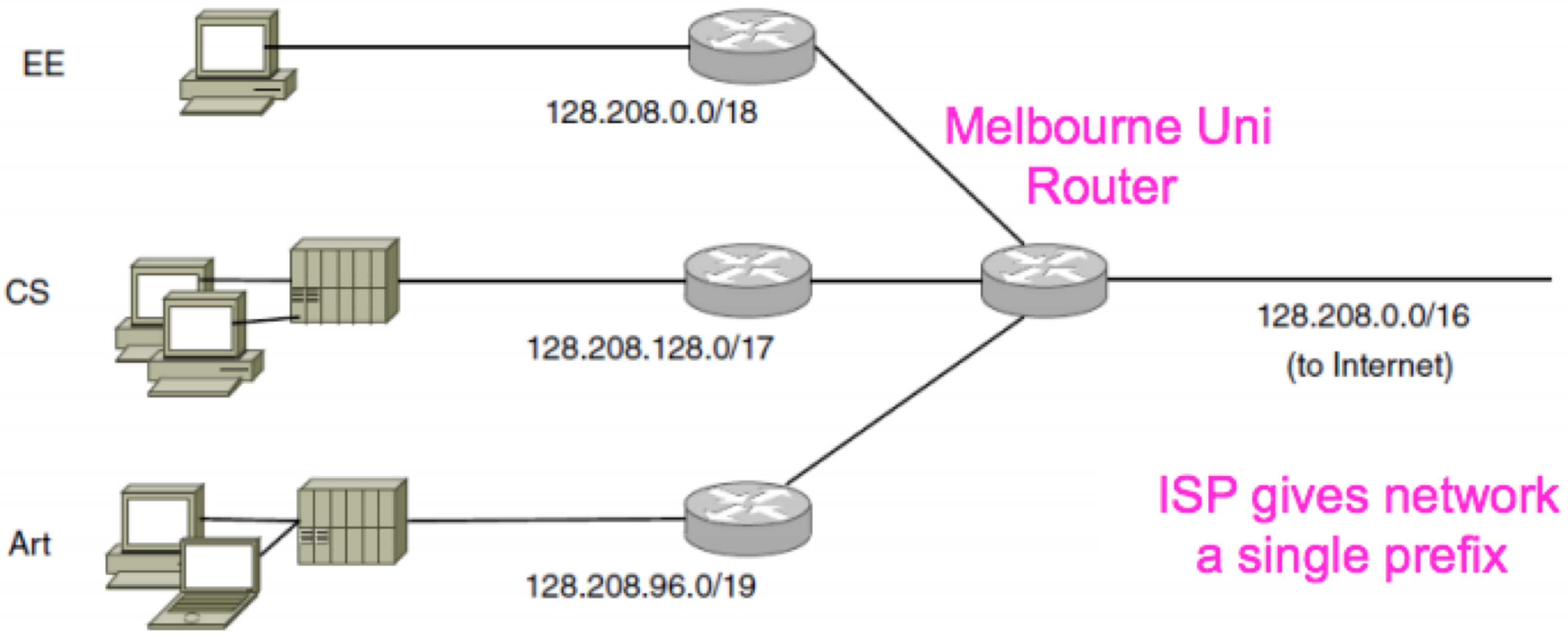
Host addresses must be consecutive

If additional subnetwork is needed. Subnetting can further divide the host part of an IP address into a **subnet and host address**

Network	**Subnet**	**Host**

Subnets

- Subnetting allows networks to be split into several parts for internal uses whilst acting like a single network for external use
  - Looks like a single prefix outside the network



Network divides it into subnets internally

How to do subnetting?

Textbook Fig 5-50

Consider an example in which a block of 8192 (2^{13}) addresses is available starting from 194.24.0.0

Order of the organizations: Cambridge(2048 = 2^{11}), Oxford(4096 = 2^{12}) and Edinburgh(2048)

Cambridge:

Decimal notation	Binary format
194.24.0.0	11000010.00011000.00000000.00000000
194.24.7.255	11000010.00011000.00000111.11111111

21

How to do subnetting?

Textbook Fig 5-50

Consider an example in which a block of 8192 (2^{13}) addresses is available starting from 194.24.0.0

Order of the organizations: Cambridge($2048 = 2^{11}$), Oxford($4096 = 2^{12}$) and Edinburgh(2048)

Oxford:

Decimal notation	Binary format
194.24.8.0	11000010.00011000.00001000.00000000
194.24.15.255	11000010.00011000.00001111.11111111

$$2^{11} < 2^{12}$$

How to do subnetting?

Textbook Fig 5-50

Consider an example in which a block of 8192 (2^{13}) addresses is available starting from 194.24.0.0

Order of the organizations: Cambridge(2048), Oxford(4096) and Edinburgh(2048)

University	First address	Last address	How many	Prefix
Cambridge	194.24.0.0	194.24.7.255	2048	194.24.0.0/21
Edinburgh	194.24.8.0	194.24.11.255	1024	194.24.8.0/22
(Available)	194.24.12.0	194.24.15.255	1024	194.24.12.0/22
Oxford	194.24.16.0	194.24.31.255	4096	194.24.16.0/20

If class C uses the subnet mask is
11111111.11111111.11111111.11100000,
How many subnets are allowed?

$$2^3 = 8$$

If additional subnetwork is needed. Subnetting can further divide the host part of an IP address into a **subnet and host address**

Network	**Subnet**	**Host**