Internet Protocols EBU5403

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	Week 1	Week 2	Week 3	Week 4
Telecom	Adnan Kiani		Michael Chai	
E-Commerce	Richard Clegg			

Week 1: IP networks introduction

our goal:

- get "feel" and terminology
- more depth, detail *later* in course
- approach:
  - use Internet as example

overview:

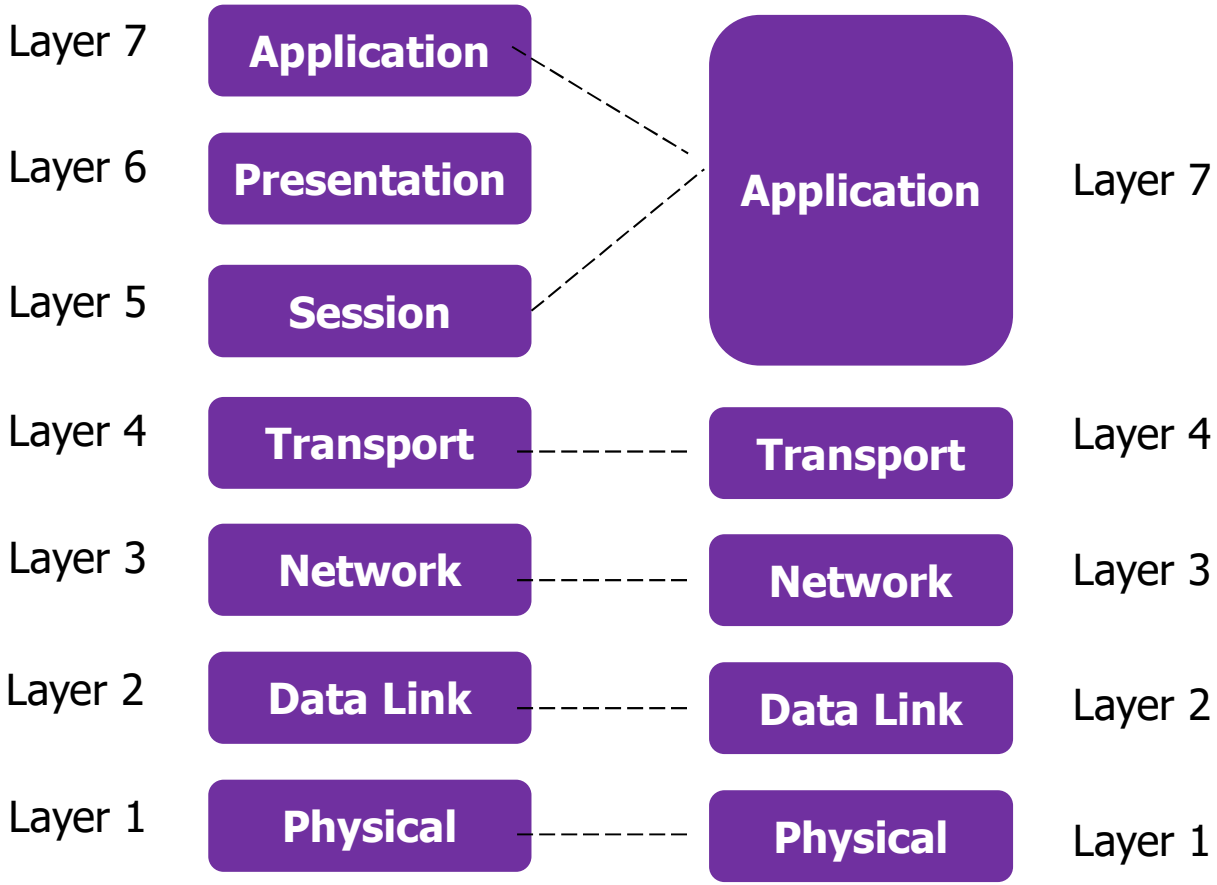
- what's the Internet?
- what's a protocol?
- network edge; hosts, access net, physical media
- network core: packet/circuit switching, Internet structure
- performance: loss, delay, throughput
- protocol layers, service models
- history

Week 1: Transport Layer (part 1)

our goals:

- understand principles behind transport layer services:
  - multiplexing, demultiplexing
  - reliable data transfer
  - flow control
  - congestion control
- learn about Internet transport layer protocols:
  - UDP: connectionless transport
  - TCP: connection-oriented reliable transport
  - TCP congestion control

ISO/OSI (left) vs TCP/IP (right)



Do the quiz on your mobile phone?

Add URL and QR code here

About this quiz

- This quiz is not assessed. You do not need to do well.
- This quiz is to let us (teachers) know how well you understand the material.
- It is very easy to cheat on this quiz.
- If you do that we do not know which questions are easy and which are hard.
- Please answer honestly so we can improve the course.
- Please press submit at the end of the quiz.

Question 1

- A **coaxial cable** is most associated with which layer of the ISO/OSI model:
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 2

- An IP (Internet protocol) address (such as 127.0.0.1) is most associated with which layer of the ISO/OSI model:
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 3

- An MAC (Media Access Control) address (such as 54-8c-a0-df-90-81) is most associated with which layer of the ISO/OSI model:
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 4

- A **router** is most associated with which layer of the ISO/OSI model:
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 5

- A **switch** is most associated with which layer of the ISO/OSI model:
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 6

- A **web browser** is most associated with which layer of the ISO/OSI model:
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 7

- Which layer of the ISO/OSI model is responsible for ensuring that data is reliably delivered to an end host without loss?
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 8

- Which layer of the ISO/OSI model is responsible for ensuring that packets are delivered between two computers that are "directly" connected.
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 9

- Which level of the ISO/OSI model ensures that data is sent to the correct host wherever it might be in the world?
  - Physical (layer 1)
  - Data Link (layer 2)
  - Network (layer 3)
  - Transport (layer 4)
  - Application (layer 7)

Question 10

- Which of these statements about UDP (User Datagram Protocol) is FALSE?
  - Packets transmitted by UDP are not "reliable" (they may be lost and not resent).
  - Packets transmitted by UDP may be "out of order" (the third packet may arrive before the first).
  - Packets transmitted by UDP have no check for "corruption" (bits being transmitted incorrectly).
  - UDP transmissions are "connectionless" (they don't need a connection to be set up before data is sent).

Question 11

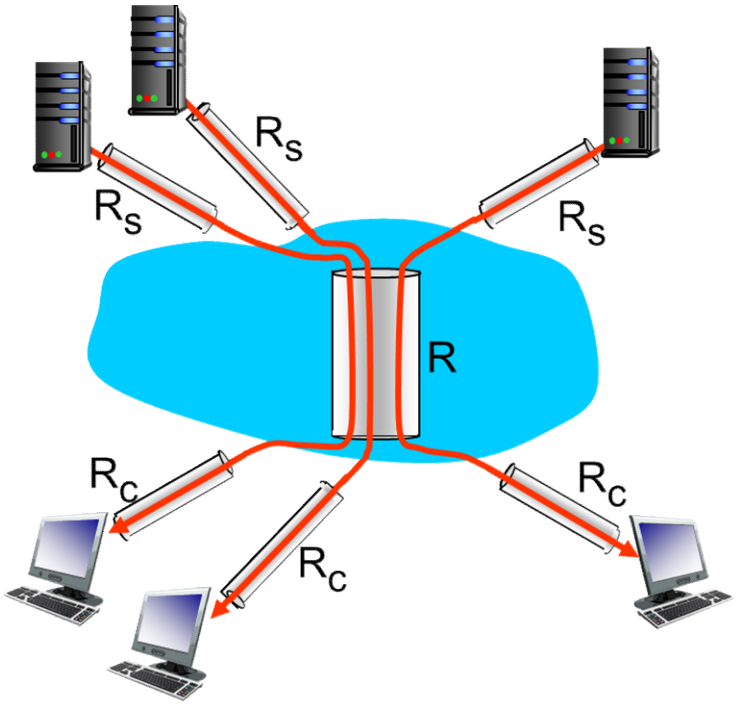
- A packet is 1500B. It is being send down an Ethernet link with a bandwidth of 1Mb/s. How long does it take to transmit?
  - 1.5 seconds
  - 1.5 milliseconds
  - 12 seconds
  - 12 milliseconds

Answer

- 1500B = 1500x8 bits = 12000bits
- (Remember 1 byte = 8 bits).
- 1Mb/s = 1000000b/s
- 12000bits/1000000b/s=0.012s = 12ms
- Answer is12 milliseconds

Question 12

- If R (the backbone link) is 5Mb/s how much bandwidth does each connection get over the backbone:
  - 50Kb/s
  - 2.5 Mb/s
  - 25 Kb/s
  - 500Kb/s



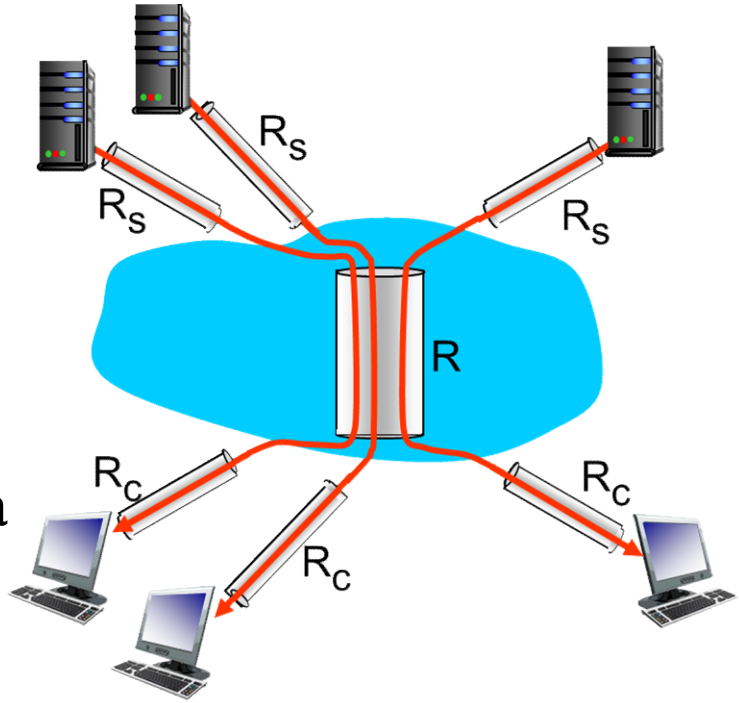
10 connections (fairly) share backbone bottleneck link *R* bits/sec

Answer

- The link is shared fairly so the bandwidth is 5Mb/s divided by 10.
- = 0.5 Mb/s
- = 500Kb/s
- (1Mb/s = 1000Kb/s = 1000000b/s)

Question 13

- If
  R = 5Mb/s
  Rs = 1Mb/s
  Rc = 250Kb/s
  what is the mean throughput for a connection?
  - 5Mb/s
  - 500Kb/s
  - 1Mb/s
  - 250Kb/s



10 connections (fairly) share backbone bottleneck link *R* bits/sec

Answer

- The link is shared fairly so the bandwidth is 5Mb/s divided by 10.
- = 0.5 Mb/s
- = 500Kb/s (as before)
- But the throughput is limited to the minimum of all links
- So it is the smallest from 5Mb/s, 500Kb/s and 250Kb/s
- Answer is 250Kb/s

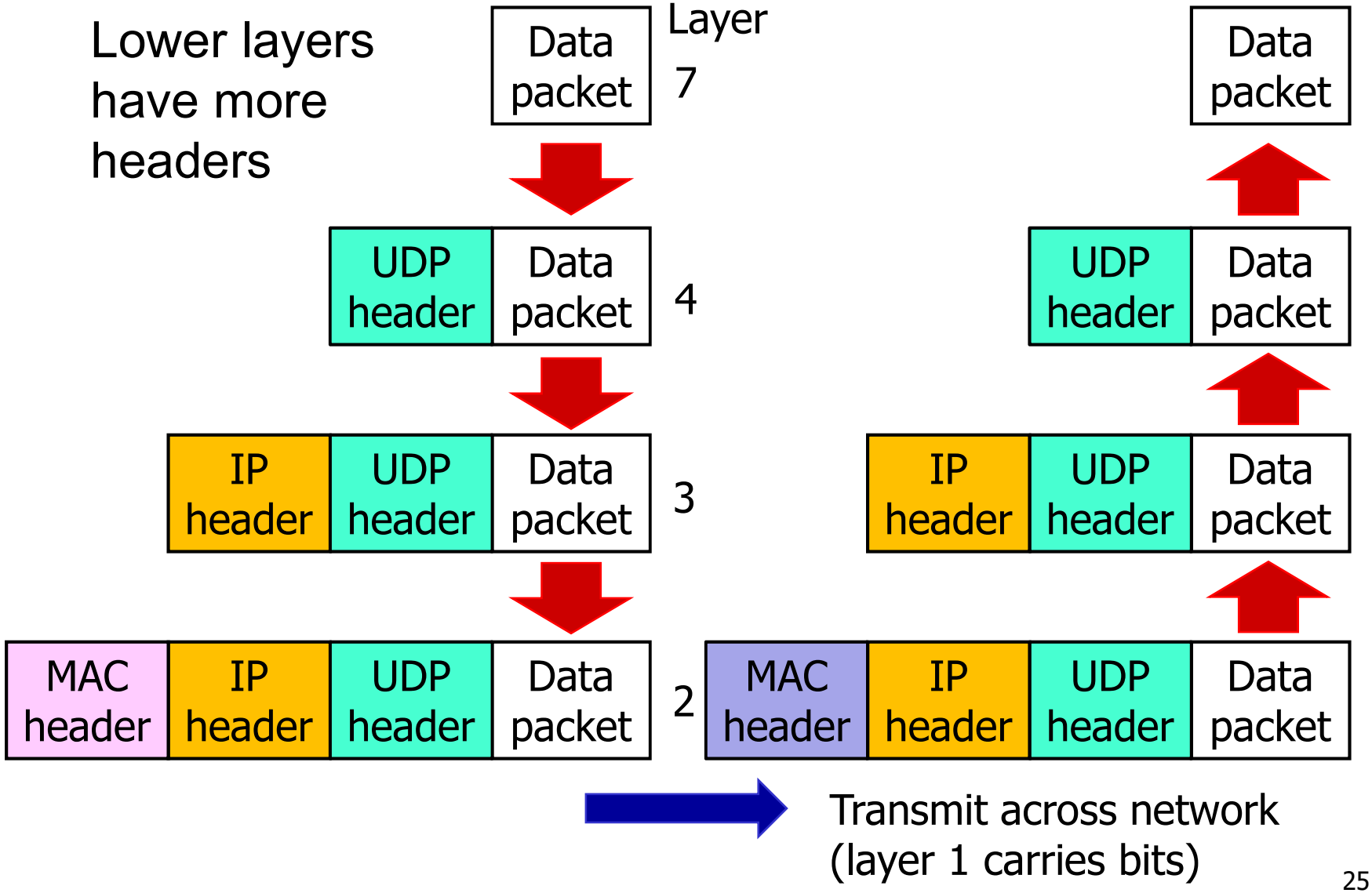
Question 14

- Combining several connections into a single connection is called:
  - Packetisation
  - Demultiplexing (demux)
  - Multiplexing (mux)
  - Transport

Question 15

- When the layer 2 header has been removed from a packet sent over UDP then the remaining part of the data contains:
  - Physical layer header and data
  - Layer 3 header and data
  - Layer 4 header and data
  - Layer 3 header, layer 4 header and data

UDP Encapsulation/decapsulation



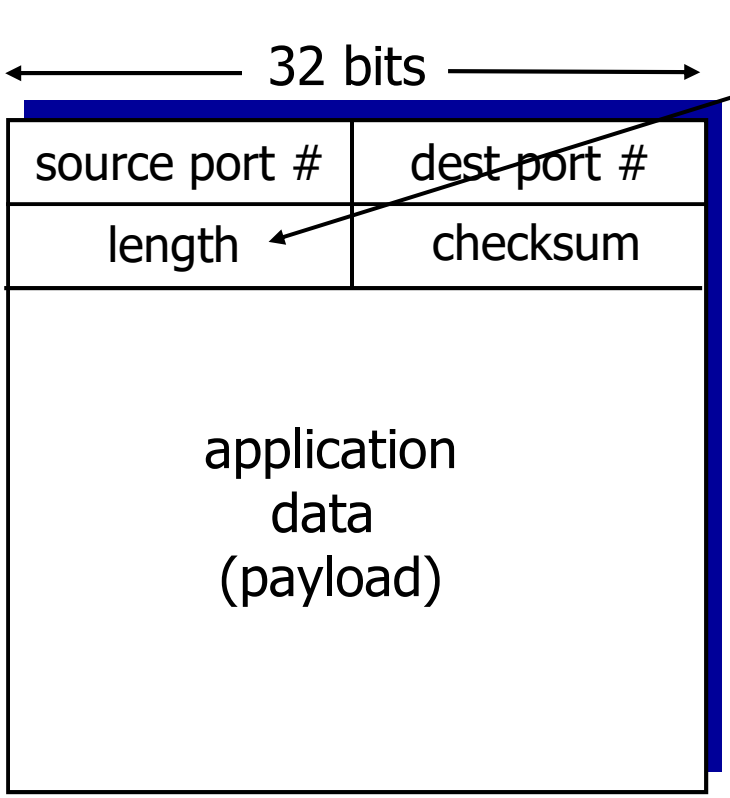
Question 16

- In rdt 2.0 we send an ACK to say we received data and a NAK to say we did not. If we receive two packets correctly then one with an error we send:
  - ACK NAK
  - NAK NAK ACK
  - ACK ACK ACK
  - ACK ACK NAK

Question 17

- A UDP header contains
  - A checksum
  - A source port
  - A destination port
  - All three of the above

UDP: segment header



length, in bytes of UDP segment, including header

UDP segment format

why is there a UDP?

- no connection establishment (which can add delay)
- simple: no connection state at sender, receiver
- small header size
- no congestion control: UDP can blast away as fast as desired

Question 18

- A UDP application receives a packet and wants to send data in reply. Which fields from the packet would it use as the destination for its data?
  - Destination IP and destination port
  - Destination IP and source port
  - Source IP and source port
  - Source IP and destination port

Connectionless demux: example