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Welcome to CPSC 441!

Midterm range

The midterm will cover

- Chapter 3
- The part of Chapter 4, which has been discussed on the lecture or tutorial

More depth than breadth!!

Type of Questions

- Similar to last year’s midterm paper
- Will include but not restricted to

✓ Multiple choice

✓ Definitions and Concepts

✓ Discussion

✓ Calculation (calculator is allowed)

Some important knowledge point

Charpter 4:

- Difference between TCP and UDP
- Why different application choose TCP or UDP
- Round-trip time estimation and timeout
- Difference between flow control and congestion control
- How congestion control works

The Network Layer

Chapter 5

- Difference between virtual-circuit networks and datagram networks
- How to do IP subnetting
- Different IP address classes (number of NetworkID bits and HostID bits)
- Why and how to do fragmentation in IP
- How IPv6 do fragmentation
- IPv6

Sample question

(c) (3 marks) "connection-less" and "connection-oriented"

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Connection-oriented: a protocol with explicit phases for setup, data transfer,
and teardown afterwards; involves state information at nodes. Example: TCP.
Connection-less: a protocol with no advance setup or release of resources, and
minimal or no state information involved. Example: UDP.
```

Sample question

What’s the difference between TCP & UDP

TCP	UDP
Reliable	Unreliable
Connection-oriented	Connectionless
Segment retransmission and flow control through windowing	No windowing or retransmission
Segment sequencing	No sequencing
Acknowledge segments	No acknowledgement

Sample Question

What's the difference between flow control and congestion control?

- **Flow Control**: matching the rate at which the sender is sending against the rate at which the receiving application is reading
- **Congestion Control**: preventing a TCP sender overfeed the IP network

Sample Question

(a) (2 marks) What two new TCP sender state variables are used in TCP congestion control? What is the purpose of each of these state variables?

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slow start threshold (ssthresh): remembers a recent estimate of a safe operating
point for the congestion window size
congestion window (cwnd): limits the maximum number of segments transmitted
into the network, based on implicit feedback received from the network
```

Sample Question

(b) (6 marks) What two new algorithms were added to provide TCP congestion control? What is the purpose of each? Give a brief overview of the operation of each.

Slow Start (SS): Start small, with a minimal window size of 1 MSS. Increase cwnd by 1 MSS for each successful ACK received. This results in doubling cwnd every RTT (exponential growth). Continue until ssthresh is reached, or a loss occurs, or done. Provides estimate of good window size.

Congestion Avoidance (CA): Cautious continuous bandwidth probing for additional network capacity. Expand cwnd by 1 MSS for each full window of data exchanged successfully. Linear growth. Upon loss detection, update ssthresh and cwnd.

Sample Question

(c) (2 marks) What is the fundamental underlying control principle during the steady-state operation of TCP congestion control? Why is this principle a good one?

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Additive Increase Multiplicative Decrease (AIMD):
Speed up slowly and cautiously when extra capacity seems to be available.
Slow down quickly when problems occur, to give the network time to clear out.

A safe design principle (from control theory) for stable network operation.
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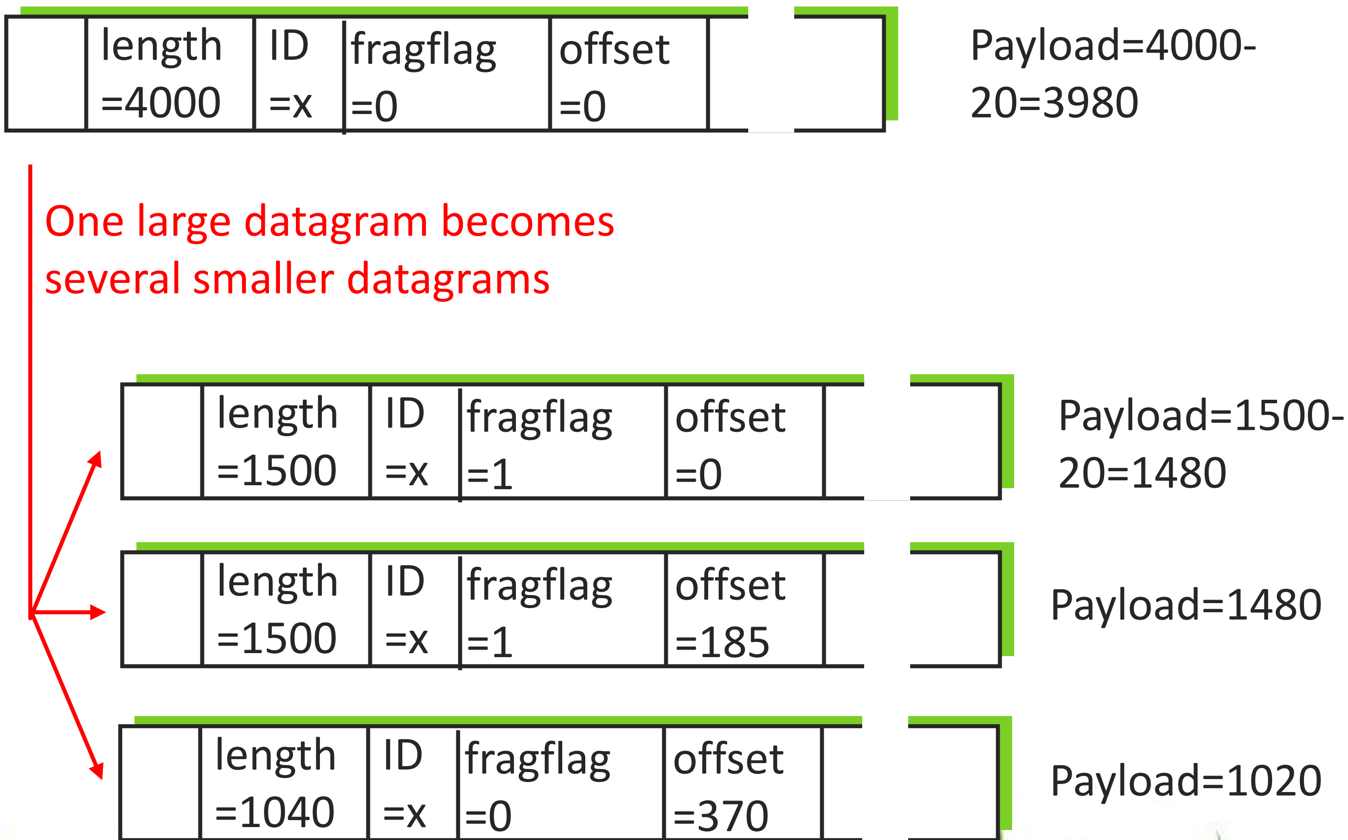
Sample Question

Why need fragmentation?

- Maximum size of IP datagram is 65535, but the data link layer protocol generally imposes a limit that is much smaller
- The limit on the maximum IP datagram size, imposed by the data link protocol is called **maximum transmission unit (MTU)**
- When size of an IP datagram exceeds the MTU, IP datagram is fragmented into smaller units.

How to do fragmentation?

- A datagram of 4000B from a network of 4000 MTU to 1500 MTU



Sample Question

How IPv6 do fragmentation?

- Routers never do fragmentation in IPv6, but drop the packets that are larger than the MTU, for the consideration of security.

Sample Question

IP address classes?

Table 43: IP Address Classes and Class Characteristics and Uses

IP Address Class	Fraction of Total IP Address Space	Number Of Network ID Bits	Number Of Host ID Bits	Intended Use
Class A	1/2	8	24	Unicast addressing for very large organizations with hundreds of thousands or millions of hosts to connect to the Internet.
Class B	1/4	16	16	Unicast addressing for medium-to-large organizations with many hundreds to thousands of hosts to connect to the Internet.
Class C	1/8	24	8	Unicast addressing for smaller organizations with no more than about 250 hosts to connect to the Internet.
Class D	1/16	n/a	n/a	IP multicasting.
Class E	1/16	n/a	n/a	Reserved for "experimental use".

Table 45: IP Address Class Network and Host Capacities

IP Address Class	Total # Of Bits For Network ID / Host ID	First Octet of IP Address	# Of Network ID Bits Used To Identify Class	Usable # Of Network ID Bits	Number of Possible Network IDs	# Of Host IDs Per Network ID
Class A	8 / 24	0xxx xxxx	1	8-1 = 7	2^7-2 = 126	2^{24}-2 = 16,277,214
Class B	16 / 16	10xx xxxx	2	16-2 = 14	2^{14} = 16,384	2^{16}-2 = 65,534
Class C	24 / 8	110x xxxx	3	24-3 = 21	2^{21} = 2,097,152	2^8-2 = 254

Good luck!

Thanks for attending!