Problem 1

Suppose two packets arrive to two different input ports of a router at exactly the same time. Also suppose there are no other packets anywhere in the router.

(a) Suppose the two packets are to be forwarded to two different output ports. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses a shared bus?

(b) Suppose the two packets are to be forwarded to two different output ports. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses switching via memory?

(c) Suppose the two packets are to be forwarded to two different output ports. Is it possible to forward the two packets through the switch fabric at the same time when the fabric uses a crossbar?

Write your solution to Problem 1 in this box

a)
No. Only one packet can be transmitted at a time over a shared bus.

b)
No. Only one packet can be transmitted due to only one memory read/write can be done at a time over the shared system bus.

c)
Yes.
Two packets can be forwarded in parallel as long as the two packets use different input buses and different output buses.

Problem 2 Chap 4.3

Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 123.15.68.0/24. Also suppose that Subnet 1 is required to support at least 36 interfaces (i.e. unique IP addresses), Subnet 2 is to support at least 100 interfaces, and Subnet 3 is to support at least 16 interfaces. Provide three subnet addresses (of the form a.b.c.d/x) that satisfy the constraints. You may use the following link to help verify your result: http://jodies.de/ipcalc.

Write your solution to Problem 2 in this box

Subnet 1: 36 interfaces -> 6 bits
Subnet 2: 100 interfaces -> 7 bits
Subnet 3: 16 interfaces -> 5 bits

123.15.68.0/24 (Network ID)	01111011 00001111 01000100 xxxxxxxx
Subnet1	01111011 00001111 01000100 10xxxxxx
Subnet2	01111011 00001111 01000100 0xxxxxxx
Subnet3	01111011 00001111 01000100 110xxxxx

Allocate,
Subnet 1: 123.15.68.128/26
Subnet 2: 123.15.68.0/25
Subnet 3: 123.15.68.192 /27

Problem 3 ✓

Consider sending a datagram with total length 3600 B into a link that has an MTU (maximum transmission unit) of 1200 B. Suppose the original datagram is stamped with the identification number 475 and all IP headers are 20 bytes.

(a) How many fragments are generated?

(b) What are the values in the various fields (header length, total length, identification, MF flag, and fragment offset) in the IP datagram(s) generated related to fragmentation?

Write your solution to Problem 3 in this box

a) The maximum size of data field in each fragment: 1176 (20 bytes IP header, 1200-20 ->1180, and it should be divisible by 8 -> 1176)
Thus the number of required fragments = (3600-20)/1176 = 4

b)
Then each fragment have identification 475.

Fragment	Header Length	Total length	ID	MF Flag	fragment offset
1	20	1176 + 20 = 1196	475	1	0
2	20	1176 + 20 = 1196	475	1	147
3	20	1176+20 = 1196	475	1	294
4	20	72 + 20 = 92	475	0	441

3600 − 1176 × 3 = 72 → payload length for last fragment

offset = 1176/8 = 147

Problem 4

Please answer the following questions IP datagram header.

(a) Since it is possible to support IPv4 and IPv6 on a single link at the same time, and they need different processing. How does the nodes (hosts and routers) tell whether a datagram is IPv4 or IPv6?

(b) Suppose a TCP segment is sent while encapsulated in an IPv4 datagram. When the destination host gets it, how does the host know that it should pass the segment (i.e. the payload of the datagram) to TCP rather than to UDP or some other upper-layer protocol?

(c) Does the IP header checksum in IPv4 need recalculation at every router? Why or why not?

Write your solution to Problem 4 in this box

a) In IP datagram, the version field would tell if the datagram is IPv4 or IPv6. Note that datagram which does not need to compute the header checksum is IPv6. Otherwise, it is IPv4.

b)
In the 8-bit "Upper-layer protocol" field in the IP datagram, the value of this field indicates that the specific transport-layer protocol to which the data portion of the IP datagram should be passed. For example, a value of 6 indicates that the data portion is passed to TCP.

c)
Yes.
The checksum must be recomputed and stored again at each router, since the TTL field, and possibly the options field as well, will change.

Problem 5

Suppose an application generates chunks of 40 bytes of data every 20 msec, and each chunk gets encapsulated in a TCP segment and then an IP datagram. Suppose the smallest possible headers are used, i.e. there is no TCP options or IP options involved. What percentage of each datagram will be overhead if IPv4 is used? What about IPv6?

Write your solution to Problem 5 in this box

IPv4：

As suppose the smallest possible headers are used, the the length of the TCP header is 20 bytes, as well as the minimum IP header.

Hence the total header size is 40 bytes.

Then the total segment size = size of chunks generated + size of header = 80 bytes

Therefore, the percentage of each datagram will be overhead is 50%.

IPv6:

The IPv6 header is always present and is a fixed size of 40 bytes.

Overhead 20 bytes of TCP.

Then the total header size is 60 bytes.

Similarly, the total segment size = size of chunks generated + size of header = 100 bytes

Therefore, the percentage of each datagram will be overhead is 60%.