

# CS538 Take-home Submission

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October 6, 2014

## 1 Problem 1: Data Transmission in Internet

### 1.1 part 1

Advantages of Packet Switching v.s. Circuit Switching Transmission are:

- Packet switching is able to achieve higher utility in terms of bandwidth. The key feature of circuit switching is that it reserves a connection/channel between a pair of hosts for a certain period of time, with and without actual data or messages being transmitted. In other words, there are times the connection sends nothing while keeping other hosts connected to each other.

However, packet switching allows packets between various hosts to use the same connection at the same time. It increases the utility by allowing messages sent between various hosts to take advantage of the idle time when the connection is not being used by others.

- Packet switching is able to resend only damaged or lost packets while circuit switching has to resend the entire message. Packets in packet switching have sequence numbers which help to identify which packet got damaged or lost, so the specific packet could be resent. However, circuit switching does not keep such sequence numbers. So when a piece of message gets lost, the entire data or file needs to be resent.

Disadvantages of packet switching are:

- Packet switching cannot guarantee a bandwidth while the circuit switching can. The delivery under packet switching is best-effort delivery.
- The forwarding in circuit switching would be much simpler compared to packet switching. Because a channel is reserved in circuit switching, routers visited by the transmitted messages are forwarding messages to the same destination. Therefore, as long as a channel is alive, the routers can forward the messages to the same outgoing link. However, in packet switching, packets are being forwarded to multiple destinations which requires the routers to decide which outgoing links to send these packets. So more effort is cost when forwarding packets in packet switching.

## **1.2 part 2**

### **1.2.1 part a**

NCP was not sufficient because it had no end-to-end host error control. To be more clear, NCP was designed only to serve ARPANET – the only existing network which was so reliable that no error control was needed, so NCP had no end-to-end host error control. However, when network enlarged, network reliability became one critical issue which NCP could not resolve. Therefore, NCP was not sufficient anymore.

One missing feature of NCP to address the scale of Internet growth is error detection. When Internet dramatically grows, the reliability of Internet decreases which introduces corrupted packets. NCP does not provide the service to identify these corrupted packets. Another missing feature of NCP is congestion control. Since growing number of computers are trying to send data packets to the network, it is easy to forecast that there will be a high potential of traffic congestion. Therefore, having some protocol to restrict the amount of data being sent into the network is critical, which NCP did not have.

### **1.2.2 part b**

TCP/IP is a replacement protocol for NCP. The new features are:

1. TCP/IP provides reliable transmission by including a sequence number in its header. The sequence number is used to identify the order of received data packets and reconstruct the original message/file regardless of any disordering or packet loss.
2. TCP/IP provides error detection since it has a checksum field in its header. After receiving a data packet, a checksum procedure will be performed by the receiver to ensure the correctness of the received data.
3. TCP/IP provides sliding window flow control protocol to avoid letting senders sending data so fast that receivers cannot properly receive and process the received packets. The flow control protocol lets receivers specify restricts the maximum amount of data a sender could send, and the sender could only move forward to sending more data after it received an acknowledgement from the receiver.
4. TCP/IP provides congestion control by adjusting the speed senders send data into the network. Generally speaking, if a potential traffic congestion is detected, senders decrease their sending rates to less the traffic goes into the network. If no sign of traffic congestion is detected, senders are allowed to increase their sending rates to take full advantage of the network.

## **1.3 part 3**

1. Domain Name System (DNS) was introduced to address the naming and addressing issue with the development of scale of Internet. The early stage network has a limited

number of hosts and their names and addresses are able to be stored in a single table. However, with the increasing number of hosts in network, the single table is not suitable anymore. Therefore, the hierarchical distributed naming system, DNS, was developed to solve this issue by associating various information with domain names assigned to each of entities and it translates easily domain names to the numerical IP addresses to locate computers.

2. A hierarchical model of routing using an Interior Gateway Protocol (IGP) and an Exterior Gateway Protocol (EGP) was developed to connect the networks and regions together. Each region can run their selected IGP to deliver packets inside their region, while use EGP to route packets among different regions.