School of Computing and Communications

SCC.130 Information Systems (2021-2022)

Home Work 4: Networking, Switching, Protocols & layering, TCP/IP protocol suite,

Q1: Compare the telephone network and the Internet. What are the similarities? What are the differences?

Solutions:

Similarities: The two networks are similar in the fact that both are made of interconnections of small networks.

Differences: The public switch telephone network was originally designed for voice communication; the Internet was originally designed for data communication.

The public switch telephone network is a circuit-switched network. Mobile wireless voice communications also uses circuit-switched communication.

Of course, it is possible nowadays to use the data network and make voice calls over a packet switched data connection through the inter-network; rather than the traditional circuit-switched voice network such as is the case for many applications e.g. Whatsapp, Messenger, etc. but it is expected that packets might be dropped.

The Internet is a packet-switched network.

Q2: When communicating between two networks, two switched network strategies are used: circuit switching and packet switching:

- Explain their principles of operations.
- Identify the advantage of one with respect to the other.
- State, with justification, the type of switched network connection the information system in Figure 2 should use when data is being exchanged.

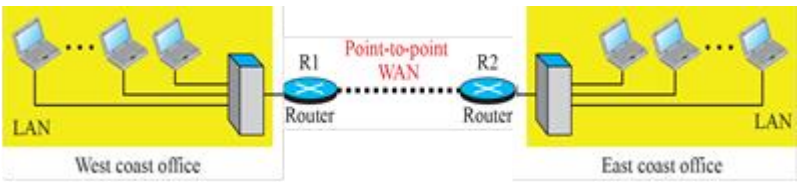


Figure 1: An inter-network communication link

Solutions:

Principles of operations

Circuit switching:

- A connection is a dedicated path established across a sequence of links between two parties.
- The process of creating a connection (the establishment of the dedicated circuit or path) and communication involves three phases: setup phase e.g. resource allocation, data transfer phase and tear down phase.
- In a circuit-switched network, data are not packetized; data flow is a continuation of bits that travel the same path (circuit) during the data transfer phase.
- Once a connection is set-up, the path (circuit) between both ends (parties) exists until the call is finished.

Packet switching:

- The data is divided into discrete "blocks" or packets.
- Each packet is sent separately into the network.
- Packets have a header containing information about their intended destination
- Packets may follow different paths from source to destination.
- Link capacity is shared between data streams.

Advantage of one with respect to the other:

Efficiency: *Packet switching* is *more efficient* than circuit switching since *resources* (for circuit switching) are allocated during the entire duration of the connection. Though a fixed amount of link resource (bandwidth) and (capacity) is allocated and reserved (for as long as the connection lasts) when using circuit switching, if a path (circuit) goes unused (e.g. silent telephone conversation), link capacity is *wasted*. For example, for voice or data communications:

- Voice to voice needs to terminate to release resources to the system: bandwidth.
- Computer to computer connection may mean other computers are deprived if both are not exchanging data for a period of time.

Further, if link capacity has been reached, new paths (circuits) cannot be established.

In packet switching, link capacity is shared between data streams, and resource allocation is performed only when there are packets to be transmitted. Resources can be relocated for some packets if not processed in time.

Delay: Circuit switching experiences *minimal delay* compared with packet switching. The delay is based on the time needed to: create the connection (as mentioned already): setup phase e.g. resource allocation, data transfer phase, and tear down phase.

Though there is no "setup phase" in packet switching, each packet may experience a wait at a switch (router) before being forwarded. Routers must deal with congestion (too many packets arriving at a given time), packets may get dropped if buffer space is not available, packets may be lost, delayed,

re-ordered or corrupted. Since different packets do not necessarily travel through the same router, the delay is not uniform for each packet of a message resulting in jitter.

Q3: Why are protocols needed?

Solutions:

Protocols are needed because they define what is communicated, in what way and when. This provides accurate and timely transfer of information between different devices on the network.

Q4: What are the two principles of protocol layering that need to be considered when communicating across a network?

Solutions:

Principle 1: for bidirectional communication, each layer needs to perform two opposite tasks: one in each direction.

Principle 2: Two objects associated with each layer at both sites should be identical.

Q5: Consider Figure 2 below with the direction of transmission taking place from Maria to Ann (from left to right):

a. What is the service provided by Layer 1 to Layer 2 at Maria's site?
b. What is the service provided by Layer 1 to Layer 2 at Ann's site?
c. What is the service provided by Layer 2 to Layer 3 at Maria's site?
d. What is the service provided by Layer 2 to Layer 3 at Ann's site?

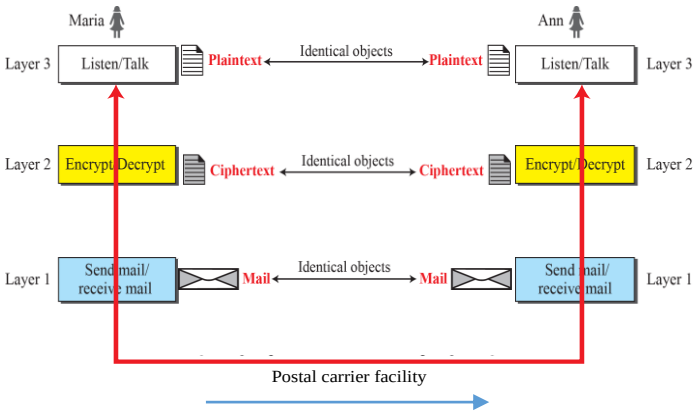


Figure 1: Communication using three layers between Maria and Ann

Solutions:

a. What is the service provided by Layer 1 to Layer 2 at Maria's site?

Layer 1 takes the ciphertext from layer 2, encapsulates it in an envelope and sends it.

b. What is the service provided by Layer 1 to Layer 2 at Ann's site?

Layer 1 receives the mail, removes (decapsulates) the ciphertext from the envelope and passes it to layer 2.

c. What is the service provided by Layer 2 to Layer 3 at Maria's site?

Layer 2 takes the plain text from layer 3, encrypts it, and passes it to layer 1.

d. What is the service provided by Layer 2 to Layer 3 at Ann's site?

Layer 2 takes the ciphertext from layer 1, decrypts it, and passes it to layer3.

Q6: Which layers of the TCP/IP protocol suite are involved in a link-layer switch?

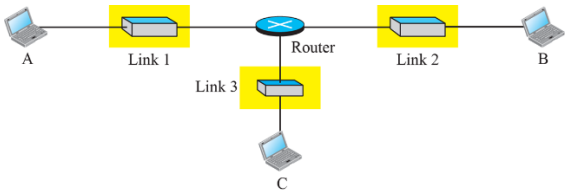
Solutions:

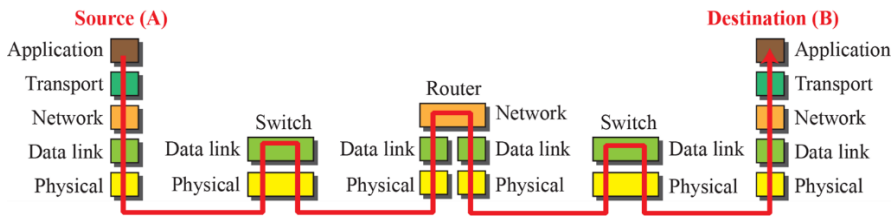
The link layer switch is involved with the first two layers of the TCP/IP protocol suite: The Physical and Data Link Layers.

Q7: Suppose in an Inter-network we change the LAN technology to a new one, which layers in the TCP/IP protocol suite need to be changed?

Solutions:

The only two layers that need to be changed are the data-link layer and the physical layer. The new hardware and software need to be installed in all hosts, routers, and link-layer switches. As long as the routers are able to understand the changes required in the Physical and Data link layers, there is no need to change any protocol in the upper three layers. This is one of the characteristics of the protocol layering.





Q8: Using the internet in Figure 1 below, show the layers of the TCP/IP protocol suite and the flow of data when two hosts, one on the east coast and the other on the west coast exchange messages.

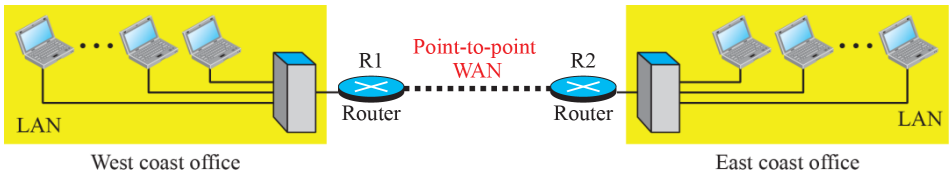


Figure 2: An inter-network communication link

Solutions: