Date
Page No.

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BCSE 308L

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Digital Assignment - I

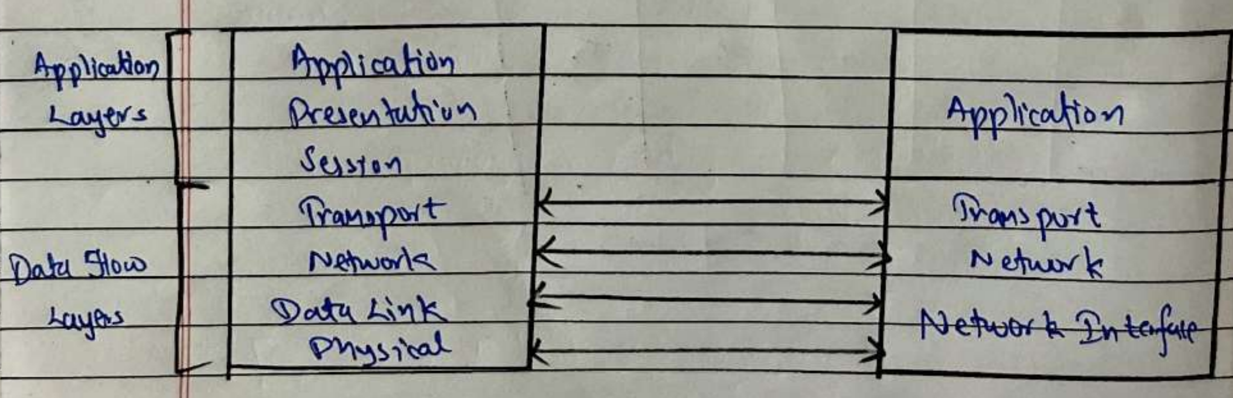
1. Give some advantages and disadvantages of combining the session presentation, and application layer of OSI Model into one single application layer in the Internet model

Answer:
when the session, presentation and the application layer of the OSI models are combined into a single application layer, ~~the~~ they create the TCP/IP model.

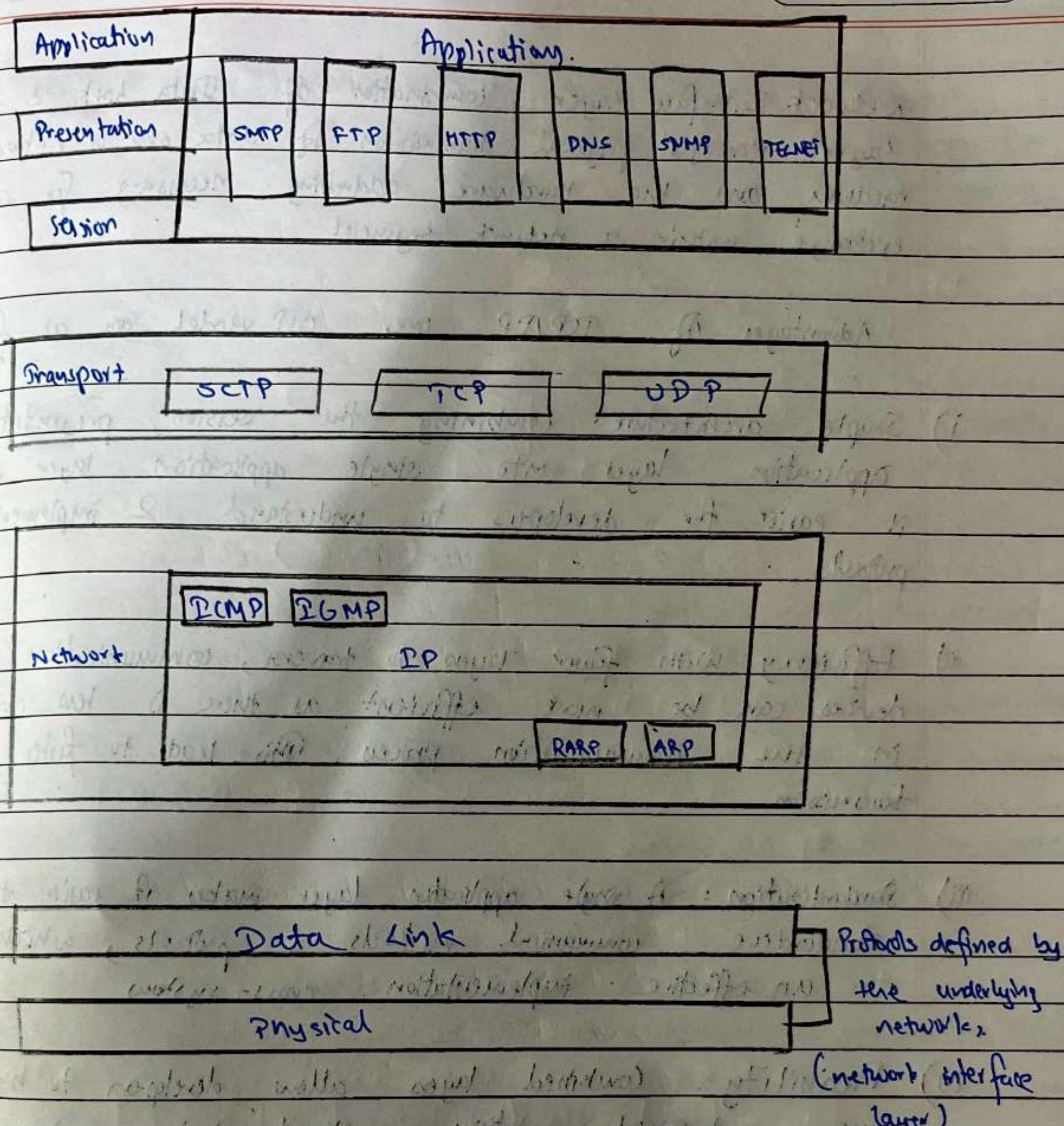
The TCP/IP protocol suite is made of five layers: physical, data link, network transport & application.
The application layer, as previously stated, is a combination of the three topmost OSI layers.

Diagramatically representing.

OSI Model TCP/IP layers



FABER-CASTELL
Date
Page No.



Application Layer: Handles high level protocols used by applications to communicate over a network. Protocols like HTTP & FTP allow for web browsing & file transfers, respectively.

Transport Layer: Responsible for end-to-end communication, providing reliable data transfer through TCP protocol or UDP.

Network Layer: Responsible for logical addressing & routing with IP being the primary protocol for addressing & routing packets of data between source & destination across networks.

Network Interface Layer: Combination of Data Link & Physical Layer. Manages physical transmission of data over a network medium and the hardware addressing necessary for data exchange within a network segment.

Advantages of TCP/IP over OSI model are as follows:

i) Simple architecture: Combining the session, presentation & application layer into single application layer makes it easier for developers to understand & implement protocols.

ii) Efficiency: With fewer layers to traverse, communication between devices can be more efficient as there is less overhead in the communication process. This leads to faster data transmission.

iii) Standardization: A single application layer makes it easier to standardize communical methods & protocols, which leads to an effective implementation cross-systems.

iv) Flexibility: Combined layers allow developers to build more customized solutions without being constrained by the strict boundaries of seperate layers.

Disadvantages of TCP/IP when compared to OSI model are as follows:

i) Loss of Modularity: The OSI model's layered approach allows for clear seperation of concerns, making it easier to troubleshoot, update, and replace specific functionalities. Combining these layers into one can make it harder to isolate & fix issues, as everything is bundled together.

ii) Increased Complexity in the Application Layer: Complexity increases in the application layer as a single application layer now has to handle task that were previously handled by three seperate layers.

~~iii) Reduced~~

iii) Higher Maintenance Costs: Combined application layer is more costly & time consuming as updating or changing on funtion might affect others within the same layer.

iv) Potential for Security Issues: Security features that were previously handled by separate layers might be less robust when combined into a single layer. This can create vulnerabilities that are harder to detect & mitigate.

2. For each of the following four networks, discuss the consequences if a connection fails.

a) Five devices arranged in a mesh topology.
b) Five devices arranged in a star topology (not counting the hub).
c) Five devices arranged in a bus topology.
d) Five devices arranged in a ring topology.

a)

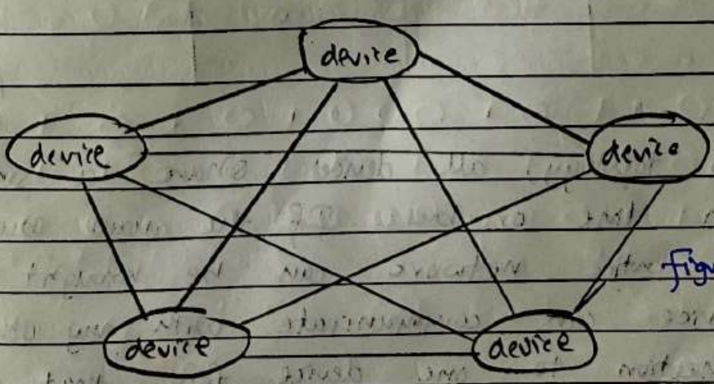


Figure: Mesh topology

In mesh topology, all devices are connected to each other. A single connection failure has minimal impact because data can still travel through alternative paths.

This topology is highly fault-tolerant, ensuring that the network remains operational even if one or more connections fail.

b) Five Devices arranged in a Star Topology (Not Counting the hub).

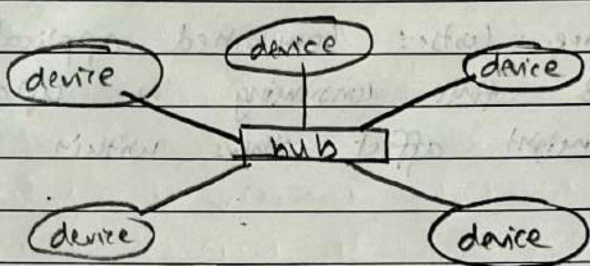
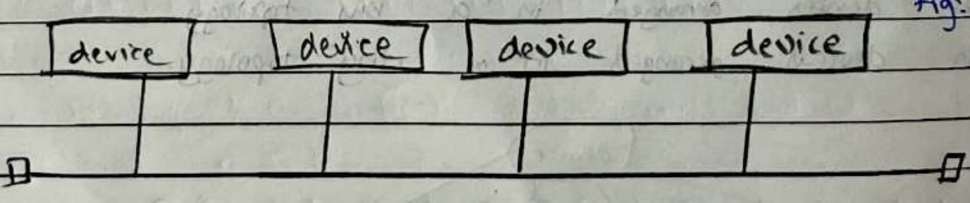


Fig: Star topology

In a star topology, all devices are connected to the central hub. If a connection between a device and the hub fails, only that particular device loses connectivity, while the rest of the network remains unaffected.

c. Five Device Arranged in a Bus Topology.

Fig: bus topology



In a bus topology, all devices share a single communication line or bus. If the main bus cable fails, the entire network can be brought down, as no device can communicate with any other. Additionally, if a connection to one device fails, that device is isolated, but the rest of the network may still function.

d. Five Devices Arranged in a Ring Topology.

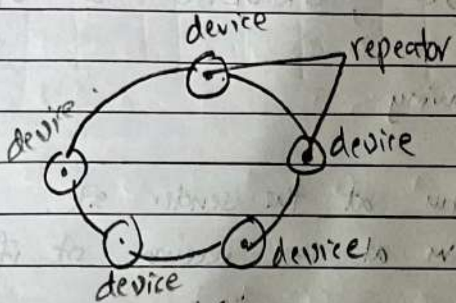
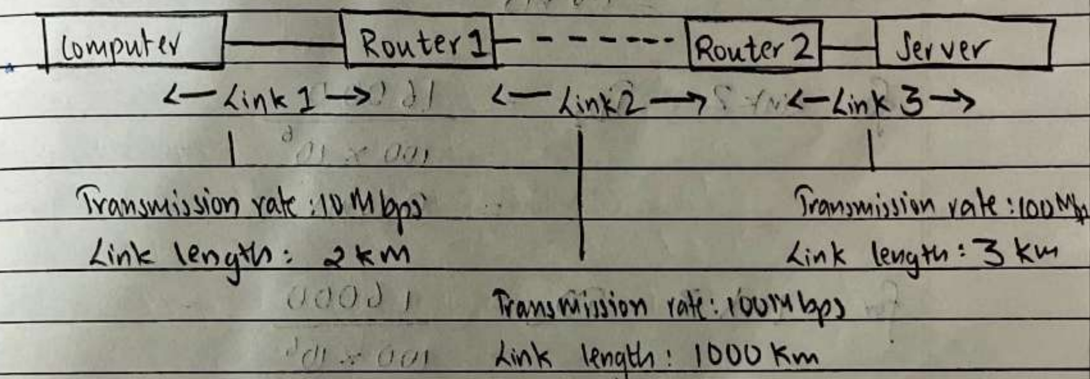


fig: ring topology

In a ring topology, each device is connected to two others, forming a closed loop. If a single connection in the ring fails, it breaks the loop, disrupting communication for the entire network. The network can potentially continue to function if there is a mechanism in place to reroute the data in the opposite direction, but without such a mechanism, the network becomes inoperable

FABER-CASTELL
Date
Page No.

3. Find the end-to-end delay (including transmission delays and propagation delays on each of the three links, but ignoring queueing delays and processing delays) from when the last bit of that packet is received at the server at the right. The speed of light propagation delay on each link ~~distances are~~ is 3×10^8 m/sec. Note that the transmission rates are in Mbps and the link distances are in Km. Assume a packet length of 16000 bits. Give your answer in milliseconds.



Solution:

Given,

size/length of packet = 16000 bits

propagation speed = 3×10^8 m/sec

Link 1) distance between computer and router 1,
(link length 1) = 2 km
Bandwidth 1 (Transmission rate 1) = 10 Mbps.

Link 2) distance between Router 1 & Router 2,
(link length 2) = 1000 Km
Bandwidth 2 (Transmission rate 2) = 100 Mbps

Link 3) distance between Router 2 & Server,
(link length 3) = 3 km
Bandwidth 3 (Transmission rate 3) = 100 Mbps

we know,

transmission delay $(T_D) = \frac{\text{size/ length of packet}}{\text{Bandwidth}}$

for Link 1 $T_{D_1} = \frac{16000}{10 \times 10^{6}}$

$= 1.6 \times 10^{-3}$

$= 1.6$ ms

for Link 2 $T_{D_2} = \frac{16000}{100 \times 10^6}$

$= 0.16$ ms

for Link 3 $T_{D_3} = \frac{16000}{100 \times 10^6}$

$= 0.16$ ms

$T_D = 1.6 + 0.16 + 0.16$

$= 1.92$ ms

again,

we know,

propagation delay $= \frac{\text{Link length}}{\text{propagation speed}}$

for Link 1 $(P_D) = \frac{2 \times 10^3}{3 \times 10^8}$

$= 6.67 \times 10^{-3}$ ms.

for Link 2 $(PD_2) = \frac{1000 \times 10^3}{3 \times 10^8}$

$= 3.33 ms.$

for Link 3 $(PD_3) = \frac{3 \times 10^3}{3 \times 10^8}$

$= 0.01 ms$

$PD = 6.67 \times 10^{-3} + 3.33 + 0.01$

$= 3.34667 \approx 3.35$

now,

we know,

Total End to End Delay $= \Sigma (PD)_i + \Sigma (TD)_i$

$= 1.92 + 3.35$

$= 5.27 ms$

4. A sender needs to send the four data items 0x 3456, 0xABCC, 0x02BC & 0xEEEE.

Answer the following:

a. Find the checksum at the sender site.
b. Find the checksum at the receiver site if there is no error.
c. Find the checksum at the receiver site if the second data item is changed to 0x ABCE.
d. Find the checksum at the receiver site if the ~~dat~~ second data item is changed to 0x ABCF & the third data item is changed to 0x 02BA.

Solution;

First,

Converting the data items to binary;

0x3456: 0011010001010110
0x ABCC: 1010101111001100
0x 02BC = 0000001010111100
0x EEEE = 1110111011101110

Taking the first & second bit

```
     1 1 1 1 1   1 1 1   1   1 1
   0 0 1 1 0 1 0 0 0 1 0 1 0 1 1 0
 + 1 0 1 0 1 0 1 1 1 1 0 0 1 1 0 0
 ---------------------------------
   1 1 1 0 0 0 0 0 0 0 1 0 0 0 1 0
```

Taking the third bit and the previous sum

```
                     1
   1 1 1 0 0 0 0 0 0 0 1 0 0 0 1 0
 + 0 0 0 0 0 0 1 0 1 0 1 1 1 1 0 0
 ---------------------------------
   1 1 1 0 0 0 1 0 1 1 0 1 1 1 1 0
```

$$
\begin{array}{r}
1\,1\,1\,0\;\;0\,0\,1\,0\;\;1\,1\,0\,1\;\;1\,1\,1\,0 \\
+\;1\,1\,1\,0\;\;1\,1\,1\,0\;\;1\,1\,1\,0\;\;1\,1\,1\,0 \\
\hline
1\,1\,0\,1\;\;0\,0\,0\,1\;\;1\,1\,0\,0\;\;1\,1\,0\,0 \\
+\;1 \\
\hline
1\,1\,0\,1\;\;0\,0\,0\,1\;\;1\,1\,0\,0\;\;1\,1\,0\,1
\end{array}
$$

Taking 1's complement of the final sum,

0010 1110 0011 0010

the 1's complemented bit sum is sent to the receiver side with the data items.

b) then the addition part is repeated.
Adding the final sum with the checksum.

$$
\begin{array}{r}
1\,1\,0\,1\;\;0\,0\,0\,1\;\;1\,1\,0\,0\;\;1\,1\,0\,1 \\
+\;0\,0\,1\,0\;\;1\,1\,1\,0\;\;0\,0\,1\,1\;\;0\,0\,1\,0 \\
\hline
\end{array}
$$

complementing: 0000 0000 0000 0000
meaning there is no error.

c) 0xABCE = 1010 1011 1100 1110

again,
sum of first and second bit

$$
\begin{array}{r}
0\,0\,1\,1\;\;0\,1\,0\,0\;\;0\,1\,0\,1\;\;0\,1\,1\,0 \\
+\;1\,0\,1\,0\;\;1\,0\,1\,1\;\;1\,1\,0\,0\;\;1\,1\,1\,0 \\
\hline
1\,1\,1\,0\;\;0\,0\,0\,0\;\;0\,0\,1\,0\;\;0\,1\,0\,0
\end{array}
$$

sum and the third bit,

```
  1 1 1 0 0 0 0 0 0 0 1 0 0 1 0 0
+ 0 0 0 0 0 0 1 0 1 0 1 1 1 1 0 0
----------------------------------
  1 1 1 0 0 0 1 0 1 1 1 0 0 0 0 0
```

now, with the 4th bit

```
  1 1 1 0 0 0 1 0 1 1 1 0 0 0 0 0
+ 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0
----------------------------------
  1 1 0 1 0 0 0 1 1 1 0 0 1 1 1 0
                              + 1
----------------------------------
  1 1 0 1 0 0 0 1 1 1 0 0 1 1 1 1
```

Adding the check sum bit

```
  1 1 0 1 0 0 0 1 1 1 0 0 1 1 1 1
+ 0 0 1 0 1 1 1 0 0 0 1 1 0 0 1 0
----------------------------------
  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
```

complementing: 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 # checksum

as the final output is not 0, the error is detected.

d) changing third item to '0x02BA'

0x02BA = 0000001010111010

we know,

from the previous question,

sum of first & second bit is,

1 1 1 0 0 0 0 0 0 0 1 0 0 1 0 0

with the third bit

```
   1 1 1 0 0 0 0 0 0 0 1 0 0 1 0 0
 + 0 0 0 0 0 0 1 0 1 0 1 1 1 0 1 0
 ---------------------------------
   1 0 1 0 1 0 0 0 1 0 1 1 0 1 1 1 1 0
```

now, adding the ~~thre~~ fourth bit with the sum,

```
   1 1   1 1 1   1 1 1 1 1 1 1
   1 1 1 0 0 0 1 0 1 1 0 1 1 1 1 0
 + 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0
 ---------------------------------
   1 1 0 1 0 0 0 1 1 1 0 0 1 1 0 0
                                + 1
 ---------------------------------
   1 1 0 1 0 0 0 1 1 1 0 0 1 1 0 1
```

adding the checksum to the final sum

```
   1 1 0 1 0 0 0 1 1 1 0 0 1 1 0 1
 + 0 0 1 0 1 1 1 0 0 0 1 1 0 0 1 0
 ---------------------------------
   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

complementing: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 # check sum

as 0 is the output, error is not detected.