This is the best assignment solution uploaded with some modification of the following student:

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Question No. 1:

a) An ATM network uses a token bucket scheme for traffic shaping. A new token is put into the bucket every 5 μ sec. Each token is good for one cell, which contains 48 bytes of data. What is the maximum sustainable data rate?

b) Consider the following design problem concerning implementation of virtual-circuit service. If virtual circuits are used internal to the subnet, each data packet must have a 3-byte header and each router must tie up 8 bytes of storage for circuit identification. If datagrams are used internally, 15-byte headers are needed but no router table space is required. Transmission capacity costs 1 cent per 10^6 bytes, per hop. Very fast router memory can be purchased for 1 cent per byte and is depreciated over two years, assuming a 40-hour business week. The statistically average session runs for 1000 sec, in which time 200 packets are transmitted. The mean packet requires four hops. Which implementation is cheaper, and by how much?

c) For the network given in the following Figure, give the datagram forwarding table for each node. The links are labeled with relative costs; your tables should forward each packet via the lowest-cost path to its destination.

d) Suppose a 100-Mbps delayed-release token ring has 10 stations, a ring latency of 30 μs, and an agreed-on token rotation time (TRT) of 350 μs. (i) How many synchronous frame bytes could each station send, assuming all are allocated the same amount? (ii) Assume stations A, B, C are in increasing order on the ring. Due to uniform synchronous traffic, the TRT without asynchronous data is 300 μs. B

sends a 200-µs (2.5-Kb) asynchronous frame. What TRT will A, B, and C then sees on their next measurement? Who may transmit such a frame next?

Solution:

a) An ATM network uses a token bucket scheme for traffic shaping. A new token is put into the bucket every 5 µ sec. Each token is good for one cell, which contains 48 bytes of data. What is the maximum sustainable data rate?

Given Data:
Size of the bucket = Token Bucket Size = 48 bytes = 48×8 bits = 384 bits
Time taken to fill the bucket = 5 µ sec = 5×10^{-6} sec

To Find:
Maximum Sustainable data Rate = Token Bucket Rate = ?

Solution:
The Maximum Sustainable data rate or the Token Bucket rate can be calculated by the following formula as follows:

$$Token\ Bucket\ Rate = \frac{Token\ Bucket\ Size}{Time\ taken\ to\ fill\ the\ bucket}$$

Putting the given values, we get;

$$Token\ Bucket\ Rate = \frac{48\times8}{5\times10^{-6}} = \frac{384}{5\times10^{-6}} = 76.8\times10^{6}\,bits/\sec$$

$$Token\ Bucket\ Rate = 76.8\times10^{6}\,bits/\sec = 76.8\ Mbps$$

$$Maximum\ Sustainable\ Data\ Rate = 76.8\ Mbps$$

Hence, the maximum sustainable data rate is found to be 76.8 Mbps.

b) Consider the following design problem concerning implementation of virtual-circuit service. If virtual circuits are used internal to the subnet, each data packet must have a 3-byte header and each router must tie up 8 bytes of storage for circuit identification. If datagrams are used internally, 15-byte headers are needed but no router table space is required. Transmission capacity costs 1 cent per 10^6 bytes, per hop. Very fast router memory can be purchased for 1 cent per byte and is depreciated over two years, assuming a 40-hour business week. The statistically average session runs for 1000 sec, in which time 200 packets are transmitted. The mean packet requires four hops. Which implementation is cheaper, and by how much?

Hops required by a mean packet = 4 hops
Number of Routers Involved = 5

Virtual Circuit Implementation

Number of Routers = 5
Router Table Space for Circuit Identification = 8 bytes
Memory required for 1000 sec by virtual circuit Implementation = 5 × 8 = 40 bytes
Hence, 40 bytes of circuit identification are needed for 1000 seconds for each session.
Since, memory is depreciated over 2 years; there are 52 weeks in a year, 40 hours in a business week (given) and 3600 sec in an hour.

Time over which memory is depreciated = $2\times52\times40\times3600 = 1.49\times10^{7} \simeq 1.5\times10^{7}$ sec

Cost of 1 byte-sec = 6.7×10^{-8} cents
It follows that
Cost of 40,000 byte-sec = 2.6×10^{-3} cents

Datagram Implementation

Number of Routers = 5
Hops required by a mean packet = 4 hops
Number of Packets to be transmitted = 200
Size of header needed by Datagram Implementation = 15 bytes
Size of header needed by Virtual Circuit Implementation = 3 bytes
Memory required for 1000 s by Datagram Implementation = $(15-3)\times4\times200 = 9600$ bytes
Hence, the datagram implementation requires 9600 more byte-hops to transmit each session.
Cost of 1 byte-hop = 10^{-6} cents
Cost of 9600 byte-hops = 9600×10^{-6} cents
Cost of 9600 byte-hops = 9.6×10^{-3} cents

Hence, after comparing the costs of both implementations, we see that Virtual Circuit implementation is Cheaper.

c) For the network given in the following Figure, give the datagram forwarding table for each node. The links are labeled with relative costs; your tables should forward each packet via the lowest-cost path to its destination.

Node A

Destination	Next Hop
B	C
C	C
D	C
E	C
F	C

Node B

Destination	Next Hop
A	E
C	E
D	E
E	E
F	E

Node C

Destination	Next Hop
A	A
B	E
D	E
E	E
F	F

Node D

Destination	Next Hop
A	E
B	E
C	E

E	E
F	E

Node E

Destination	Next Hop
A	C
B	B
C	C
D	D
F	C

Node F

Destination	Next Hop
A	C
B	C
C	C
D	C
E	C

d) Suppose a 100-Mbps delayed-release token ring has 10 stations, a ring latency of 30 µs, and an agreed-on token rotation time (TRT) of 350 µs. (i) How many synchronous frame bytes could each station send, assuming all are allocated the same amount? (ii) Assume stations A, B, C are in increasing order on the ring. Due to uniform synchronous traffic, the TRT without asynchronous data is 300 µs. B sends a 200-µs (2.5-Kb) asynchronous frame. What TRT will A, B, and C then sees on their next measurement? Who may transmit such a frame next?

Ring Latency = 30 µs
Token Rotation Time (TRT) = 350 µs
(i) How many synchronous frame bytes could each station send, assuming all are allocated the same amount?
Time available for Frame Transmission = TRT – Ring Latency = 350 – 30 = 320 µs
Number of synchronous frame bytes for 10 stations = 4KB = 4000 bytes
Number of synchronous frame bytes for 1 station = 4000 / 10 = 400 bytes

(ii) Assume stations A, B, C are in increasing order on the ring. Due to uniform synchronous traffic, the TRT without asynchronous data is 300 µs. B sends a 200-µs (2.5-Kb) asynchronous frame. What TRT will A, B, and C then sees on their next measurement? Who may transmit such a frame next?

If we Ignore the latency between A, B and C then
B transmits at T=0

To allow TRT measurement, timeline is T = -300
Now,

Time	Action
T = -300	Token passes A, B, C
T = 20	Token passes A; B seizes the token
T=200	B finishes and releases token; C sees it Measured_TRT of C = 500 (Too big to transmit)
T = 500	Token returns to A, B, C Measured_TRT of A = 500 Measured_TRT of B = 500 Measured_TRT of C = 300

From the above information we can observe that C can transmit next since its measured_TRT is less than Total Token Rotation Time i.e. TTRT = 350. It can be presented as follows:
measured_TRT of C = 300
TTRT = 350
measured_TRT of C < TTRT

Hence, if all stations want to transmit then the token will propagate down the ring employing the round robin scheme.

Question No. 2:

a) ARP and RARP both map addresses from one space to another. In this respect, they are similar. However, their implementations are fundamentally different. In what major way do they differ?
b) What is the total efficiency of ATM using AAL2 and describe the format of an ATM cell?
c) Explain why padding is unnecessary in AAL1 and AAL2, but necessary in AAL3/4 and AAL5?

Solution:

a) ARP and RARP both map addresses from one space to another. In this respect, they are similar. However, their implementations are fundamentally different. In what major way do they differ?

In RARP, the requests are answered by RARP Server. However, ARP lacks a server i.e. ARP does not have a server and hence the requests in ARP are handled by the hosts themselves instead of server.

b) What is the total efficiency of ATM using AAL2 and describe the format of an ATM cell?

Total Efficiency of ATM using AAL2

The Total Efficiency of ATM using AAL2 can be given by the formula as follows:

$$\text{Total Efficiency of ATM} = \frac{\text{Received Bits}}{\text{Sent Bits}}$$

In AAL2,
Received Bits = 45
Sent Bits = 53
Putting the given Values in the above formula we get;

$$\text{Total Efficiency of ATM using AAL2} = \frac{45}{53}$$

$$\text{Total Efficiency of ATM using AAL2} = \frac{45}{53} = 84.9\% \approx 85\%$$

$$\text{Total Efficiency of ATM using AAL2} = \frac{45}{53}$$

or

$$\text{Total Efficiency of ATM using AAL2} = 85\%$$

Format of AAL2 ATM Cell

AAL2 was originally designed to support variable data rate bit stream however, the current version of AAL2 has been redesigned to support low bit rate and short frame traffic for instance audio, video, fax etc. AAL2 provides the feature of multiplexing short frames into one cell. The application of AAL2 is in mobile technology.
The format of AAL2 ATM cell is given as under:

AAL2 ATM Cell		
Header	**Payload**	**Trailer**

1 byte	45 bytes	2 bytes

The header of the ATM cell is further elaborated as under:

AAL2 Header		
CSI	**SC**	**IT**
1 bit	3 bits	4 bits

CSI (Convergence Sublayer Identifier) - 1 bit
1 bit CSI field used for signaling but not yet defined.

SC (Sequence Count) - 3 bits
3 bit SC field used for ordering and identifying cells for error and flow control
IT (Information Type) - 4 bits
4 bit IT field for identifying the Information Type.

The trailer of the ATM cell is further elaborated as under:

AAL2 Trailer	
LI	**CRC**
6 bits	10 bits

LI (Length Indicator) - 6 bits
First six bits of the trailer to indicate how much of last segment is data and how much is padding.
CRC (Cyclic Redundancy Check) - 10 bits
Last 10 bits of trailer used for detecting errors and for correcting single bit errors.

c) Explain why padding is unnecessary in AAL1 and AAL2, but necessary in AAL3/4 and AAL5?

Padding is not necessary in AAL1 and AAL2 because they take a continuous stream of bits from the user and without any boundaries. Since there are always bits to fill the data unit, there is no need for padding. However, in case of AAL3/4 and AAL5, they take a bounded packet from the upper layer which is why padding is necessary in AAL3/4 and AAl5.

Question No. 3:

Read the attached research paper entitled "Wireless Medium Access Control Protocols" with this assignment very carefully. Answer the following questions:

1. Why packet transmission is vulnerable in RI+BTMA? Does RI+BTMA solve hidden node problem completely? Discuss in the light of paper.

2. According to authors, why it is difficult to compare different MAC protocols? Give a detailed but to the point answer in the light of paper.

Solution:

Please! Consult the mentioned Research Paper.

Question No. 4:

Read the attached research paper entitled "Routing in Multiple Layers: Challenges and Opportunities" with this assignment very carefully. Answer the following questions:

1. Elaborate the challenges in multiple layer routing environments discussed by authors. Give your suggestions about to possible ways to tackle each challenge.
2. Classify the expected research opportunities in sight of discussed challenges by authors in this paper.

Solution:

Please! Consult the mentioned Research Paper.

Question No. 5:

Consider the following topology:

Each link is a duplex link with 5Mb bandwidth and 10msec delay. Nodes 1 and 2 send UDP data to node 4, each with packet size of 1000 bytes and 500 packets per second. Nodes 1 and 2 start sending data at 0.5 sec and stop at 4.5 sec. Create a trace file for the simulation and execute nam to view the simulation.

a) Write tcl script for the above simulation scenario in file 'assign1.tcl'
b) Node 3 is an intermediate node, why it discards some packets from its queue?

Solution:

a) **Required** 'assign1.tcl'**solution file is attached in .rar file.**
b) **Nodes 1 and 2 send data to node 4, each at rate of 1000 * 8 * 500 = 4 Mbps. Hence, node 3 receives data at 8 Mbps. The link from node 3 to node 4 is 5Mbps. Hence node 3 cannot forward packets at the rate it receives, hence it drops some packets.**