**PRINCE OF SONGKLA UNIVERSITY**
**FACULTY OF ENGINEERING**

Final Examination: Semester II          Academic Year: 2009
Date: 19 February 2010          Time: 09.00-11.00 (2 hrs)
Subject: 241-553 High Speed and Broadband Integrated Networks     Room: S201

- In this exam paper, there are eight questions,
- All notes and books are not allowed,
- Answers could be either in Thai or English,
- Only un-programmable calculator is allowed,
- Try to attempt answering all questions.

1. Gigabit Ethernet operates on 2 modes: shared access, and dedicated-access. Answer the following questions:

      1.1 Gigabit Ethernet uses CSMA/CD for shared-access with 2 important modifications. What are they? (10 marks)

      1.2 In dedicated-access topology enhancement, this mode is used for point-to-point connection and operated in full-duplex. What are the significant features? (10 marks)

**Answer**

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2 a) How does "Carrier Extension" work? (5 marks)

2 b)Why does Gigabit Ethernet need carrier extension? (5 marks)

**Answer**

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3. When Gigabit Ethernet operates in full-duplex mode, CSMA/CD (including the carrier extension and frame bursting) is disable. It introduces link-level flow control, so call "Pause Protocol". Please explain how Pause Protocol works. (10 marks)

**Answer**

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4. The below picture is 1000BASE-T using UTP Category 5. Please explain how Gigabit Ethernet can work out 1 Gbps speed on this cable. (10 marks)

**1000BASE-T**

| Coding | UTP Category 5 Cabling Utilization |
|---|---|
| -2 | |
| -1 | |
| 0 | |
| +1 | |
| +2 | |
| 5-Level PAM | |

**Answer**

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5. Below is Gigabit Ethernet Protocol Architecture. What are A, B,C, and D? (10 marks)



**Answer:**

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6. The table below is a comparison between 1000Base-T and 10GBase-T. What are A, B, and C? (10 marks)

| 1000BASE-T | 10GBASE-T |
|---|---|
| 5-level coded PAM signaling (2 information bits/symbol) | A |
| 8-state 4D Trellis code across pairs | 8-state 4D Trellis code across pairs |
| Full duplex echo-cancelled transmission | B |
| 125 Mbaud, ~80 MHz used bandwidth | 833 Mbaud, ~450 MHz used bandwidth |
| No FEXT Cancellation | C |

**Answer**

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7. 10G uses 4 pairs of each cable (same as 1000BASE-T). The encoding uses 3 information bits per symbol (baud) with baud rate: ~ 833 MBaud. Please explain how 10G can achieve 10 Gbps. (10 marks)

**Answer**

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8. We consider an analytical model for explicit rate flow control as shown in Figure 1. This scenario is used for the equal *ICR* case. The following conditions are used:

o There are 2 source groups: *S1* and *S2*. Where S1 consists of 3 sources, while group S2 consists of 2 sources.

o The round trip time between *S1* and its destination, and *S2* and its destination are 0.015 sec and 0.0005 sec respectively.

o All sources start transmitting data at 3 Mbps (*ICR*=3 Mbps) at time 0.

o The switch service rate is 155 Mbps. The switch allocation bandwidth is 95% of its full rate. However, when the queue length reaches a certain threshold, only 80% of its full bandwidth is allocated.

o The following parameters are used: *PCR*=155 Mbps, *RIF*=1/256.

o All sources are saturated sources, e.g. always send data as high as requested by the network.

Hint: The *S2* rate converts to *ER* before *S1* due to a shorter round trip time delay]. All necessary formulas are shown in Figure 2. The switch queue is not fully utilised since the total offered load is less than the service rate.
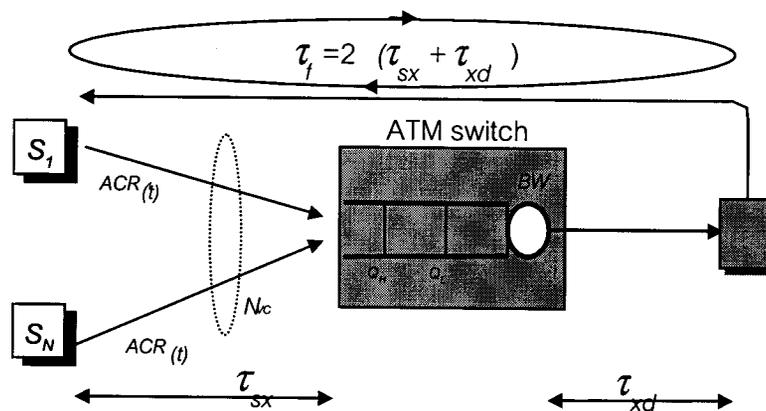


Figure 1 Analytical model for explicit rate flow control

$$\frac{dACR}{dt} = k \cdot ACR$$

$$ACR_C(t) = ACR_B(2\tau_f) \cdot e^{k\Delta t}$$

$$\frac{dACR(t)}{dt} = \frac{RIF \cdot PCR \cdot ICR}{NRM}$$

$$ACR_B(t) = ACR_A(\tau_f) + k \cdot \Delta t$$

$$\frac{dACR_D(t)}{dt} = \frac{RIF \cdot PCR \cdot BW}{N_{VC} \cdot N_{RM}}$$

$$ACR_D(t) = ACR_C(t_{exp}) + \frac{k}{N_{VC}} \cdot \Delta t$$

$$ACR_A(t) = ICR$$

$$ER = \delta \cdot BW \Big/ N_{VC}$$

Exponential

Linear with factor $N_{vc}$

If queue is fully utilised

If queue is under-utilised

ACR(t)

Linear

Constant

$ER1 = \beta BW/N_{vc}$

$ER2 = \delta BW/N_{vc}$

ICR

ER2

A   B   C   D   E   F   G

t

Figure 2 Source rate behaviour as a function of time with equal *ICR*

8.1 Draw a graph of transmission rate of the source S2, (5 Marks)
8.2 What are the values of ER1 and ER2? (5 Marks)
8.3 What is the condition that phase D will not be happen? (5 Marks)
8.4 What are the maximum time period of phase A and B? (5 Marks)

***Answer***

8.1



ACR(t)

ER1

A   B   C   E

t

Q(t)

t

Figure 3 Source S2 rate behaviour.

8.4 What are the time periods of phase A and B?
***Answer***

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8.2 What are the values of ER1 and ER2?
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8.3 What is the condition that phase D will not be happen?
*__Answer__*

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8.4 What are the time periods of phase A and B?
*__Answer__*

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