PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester I — Academic Year: 2004
Date: 2 October 2004 — Time: 13.30 – 16.30
Subject: 240-543 Broadband Integrated Networks — Room: R200

- In this exam paper, there are FIVE questions,
- All notes and books are not allowed,
- Answers could be either in Thai or English,
- Only un-programmable calculator is allowed,
- Answer all questions. Each question has the same score.

1. Please describe the following terms and definitions clearly (20 Marks):
   1.1 ATM Forum
   1.2 SONET
   1.3 B-ISDN
   1.4 Public UNI/Private UNI
   1.5 Cell delineation
   1.6 VCI/VPI
   1.7 CS and SAR sub-layer in AAL
   1.8 Rate Based Flow Control
   1.9 Credit Based Flow Control
   1.10 Address resolution protocol.

2

2.1 Picture below shows the main working steps of CLIP (Classical IP over ATM). Please describe each step in Figure 1, how it works. (10 Marks)

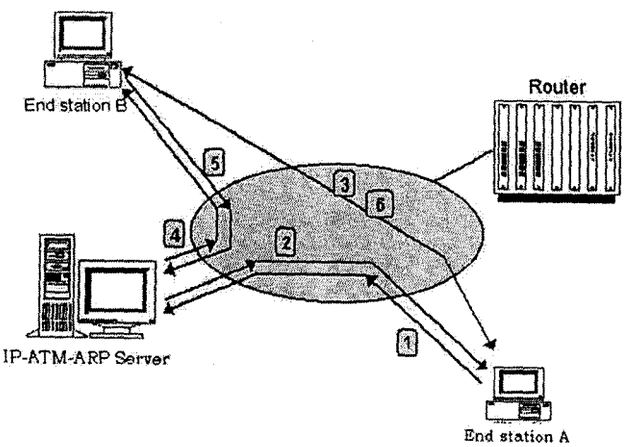


Figure 1 Working steps of classical IP over ATM (for Question 2)

2.2 This question ask you about LANE (LAN Emulator). Figure 2 shows how LANE works. Describe each step clearly (from step 1 to 7). (10 Marks)

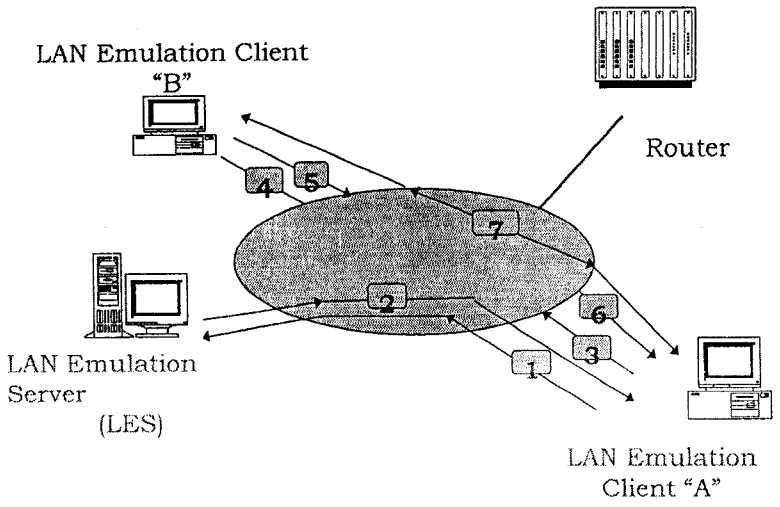


Figure 2 Working steps in LANE

3. Two questions in this heading about VBR (Variable Bit Rate) in ATM networks (20 Marks).
3.1 (10 Marks) It can be shown that VBR traffic can be policed by two Generic Cell Rate Algorithm (GCRA) inspecting the cell flow in parallel:

- the first GCRA verifies of the conformance of the peak cell rate (PCR),
  GCRA1 [T=T(PCR), τ=τ(PCR)]
- the second GCRA verifies the conformance of the sustainable cell rate (SCR)
  GCRA1 [T=T(SCR), τ=τ(SCR)]

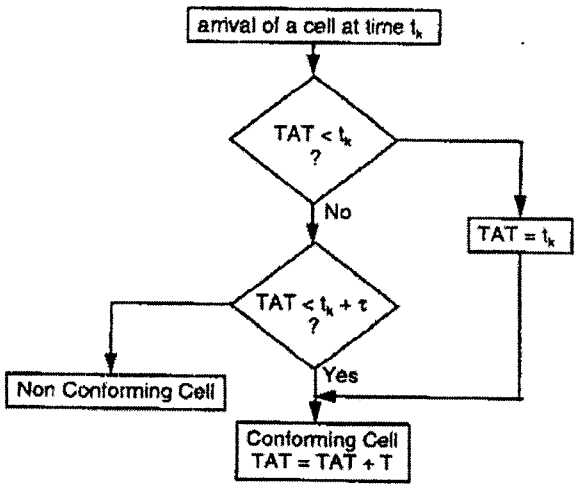


Figure 3 Generic Cell Rate Algorithm (GCRA)

If the VBR traffic stream, as shown in Figure 4, enters the system which has the following VBR traffic contract parameters:

T(PCR)= 1 cell time, τ(PCR) = 0 cell time, T(SCR) = 3 cell time, MSB = 3 cells,
τ(SCR) = 4 cell time.

All traffic conformant to GCRA(1,0), GCRA(3,4) have to be verified. Please indicate each non-conformant/conformant cell clearly. You need to show that why each cell receive such status.

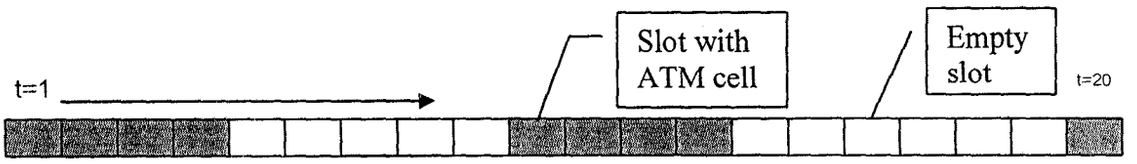


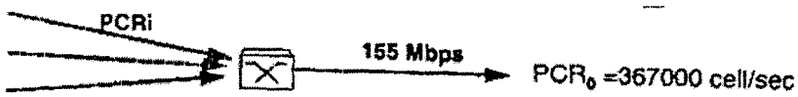
Figure 4 VBR traffic stream and its time slots

t=1 : _____
t=2 : _ t+ τ = 6, conforming TAT = 7 <- 4+3 ___
t=3 : _____
t=4 : _____
t=10 : _____
t=11 : _____
t=12 : _____
t=13 : _____
t=14 : _____

3.2 (10 Marks) The following steps are the rule for worst case allocation for VBR VCs:

1. Assume that all connections are compliant with GCRA(1/PCR,0) and GCRA(1/SCR,τ_s),
2. Determine N, the maximum number of source NxSCR ≤ PCR,
3. Find out the worst case for one source with MBS = integer [1+τ_s/(1/SCR – 1/PCR))],
4. Assume that all sources are synchronised and transmit their worst case traffic,
5. Find the buffer size to avoid any overflow Req_Buf= (N-PCR_o/PCR) x MBS,
6. Compute the maximum delay D ≤ Req_Buf/PCR_o.

In our system the out-going link bandwidth is 155 Mbps. There are four types of sources tested in out system with the following source traffic parameters:



Type A: MSB = 200 cells, SCR = 5,000 cells/sec, PCR = 25 MBPS
Type B: MSB = 200 cells, SCR = 5,000 cells/sec, PCR = 155 MBPS
Type C: MBS = 1,000 cells, SCR = 15,000 cells/sec, PCR = 59,000 cells/sec
Type D: MBS = 1,000 cells. SCR = 15,000 cells/sec, PCR = 367,000 cells/sec

Please determine how many connections of each type of sources can be admitted (you must show how you get the answer).

4. We consider an analytical model for explicit rate flow control as shown in Figure 5. This scenario is used for the equal *ICR* case. The following conditions are used:

- There are 2 source groups: *S1* and *S2*.
- The round trip time between *S1* and its destination, and *S2* and its destination are 0.015 sec and 0.0005 sec respectively.
- All sources start transmitting data at 3 Mbps (*ICR*=3 Mbps) at time 0.
- The switch service rate is 155 Mbps. The switch allocation bandwidth is 95% of its full rate.
- The following parameters are used: *PCR*=155 Mbps, *RIF*=1/256.

- 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 6. The switch queue is not fully utilised since the total offered load is less than the service rate.

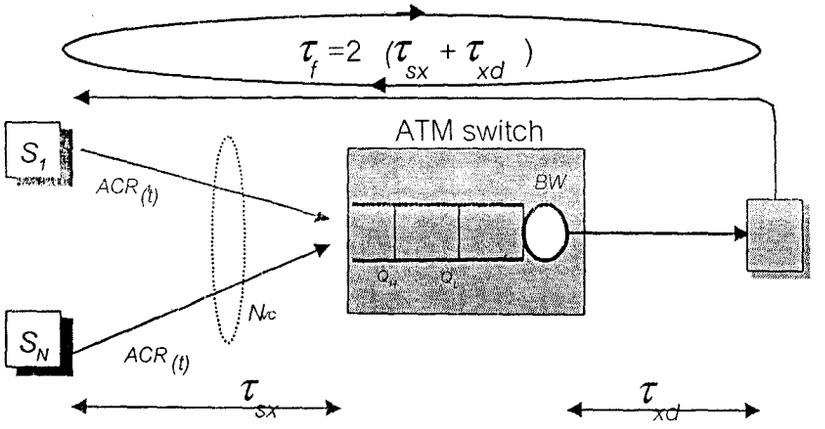


Figure 5 Analytical model for explicit rate flow control

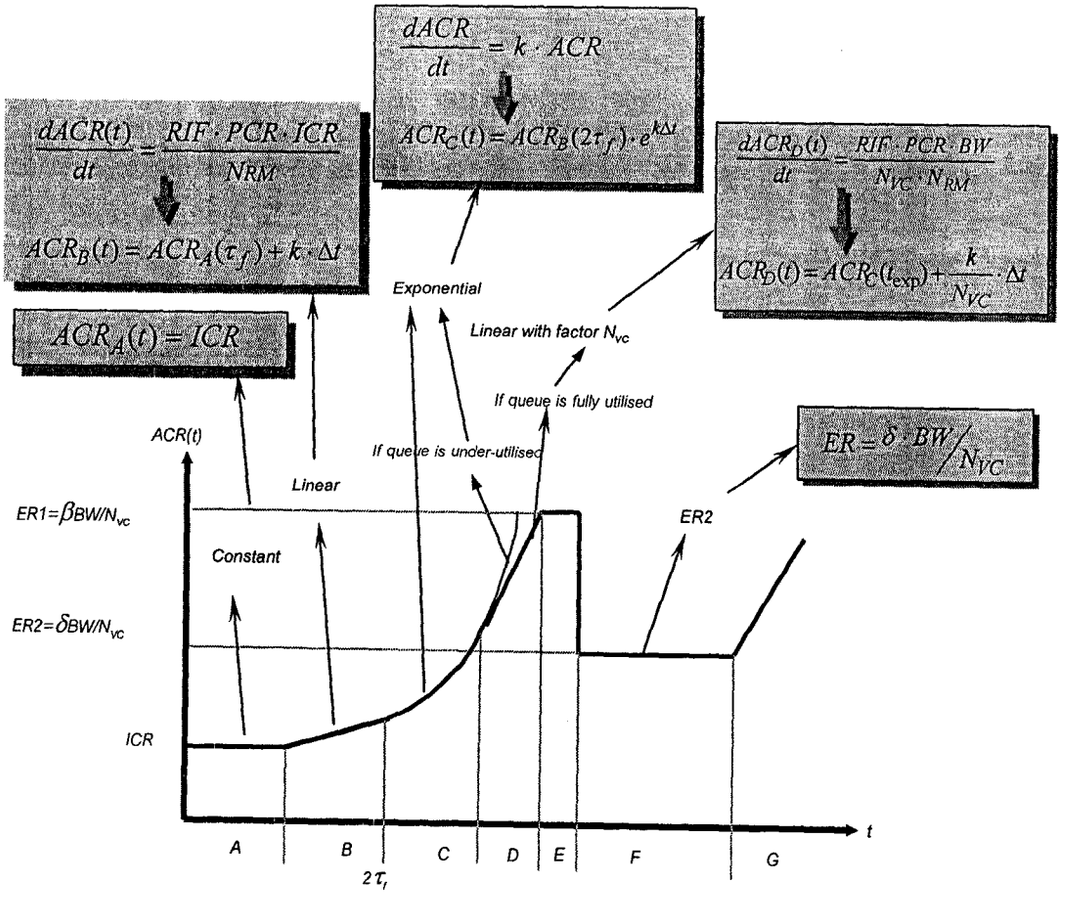
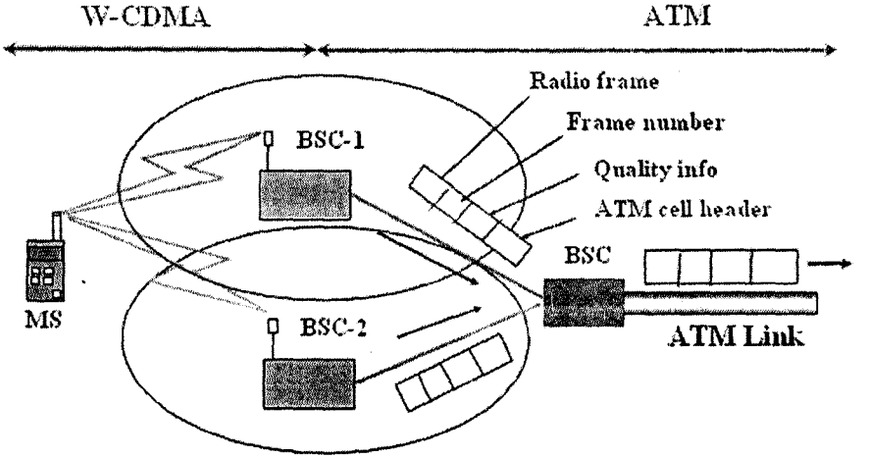


Figure 6 Source rate behaviour as a function of time with equal *ICR*

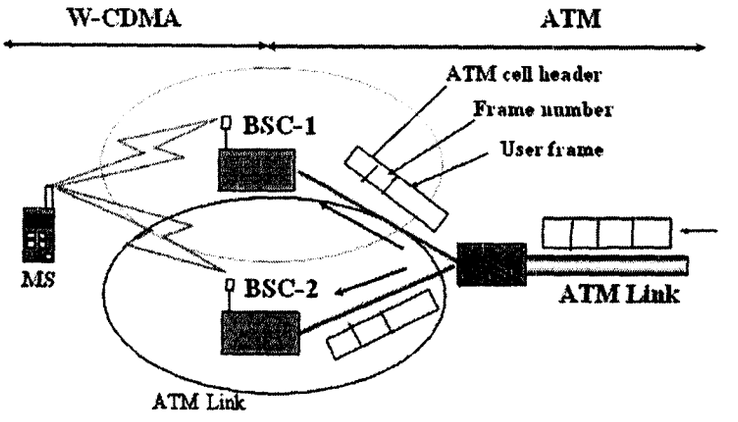
4.1 Draw a graph of transmission rate of the source S2, (5 Marks)
4.2 What time does the source S2 get its fair share rate? (5 Marks)
4.3 What is the transmission rate of the source S2 at time 0.005 and 0.010 sec. (10 Marks)

5. ATM technology is employed to carry voice and video traffic for both fixed-wire and wireless networks, so called VTOA (Voice and Telephony over ATM). Answer the following questions concerning about VTOA:

5.1 What are limitations of applying AAL1 to carry voice traffic? (5 Marks)
5.2 AAL2 with multiplexing capability is recently employed to carry voice traffic, please describe how this scheme works. (5 Marks)
5.3 Figure 7 shows applying ATM technology for 3rd generation mobile phone.



a) Down link



b) Up Link

Figure 7 Applying ATM as a switching technology for 3rd generation mobile phone

(a) Explain how ATM switches in Figure 7 work. (5 Marks)
(b) How does ATM help the improvement of the network operation in terms of efficiency, reliability, and quality of service? (5 Marks)