KHARKIV NATIONAL UNIVERSITY OF RADIO ELECTRONICS

MSGCS PRACTICE #2

QOS in ATM Networks

ATM Traffic descriptors

An ATM source traffic is characterized by the following traffic descriptors:

- **Peak Cell Rate** (**PCR**);
- **Sustained Cell Rate** (**SCR**);
- **Maximum Burst Size** (**MBS**).

The Peak Cell Rate (PCR) is the maximum cell rate of the source. **The Sustainable Cell Rate (SCR) is a long term average cell rate** and, therefore, is less than the PCR. **The Maximum Burst Size (MBS) specifies the maximum number of cells that can be transmitted by the source at PCR while complying with the negotiated SCR**.

The MBS represents the burstiness factor of the connection. The CBR (Constant Bit Rate) traffic is characterized by the PCR. The VBR (Variable Bit Rate) traffic is characterized by the PCR, the SCR and the MBS. For the UBR (Unspecified Bit Rate) traffic, no traffic characterization is needed.

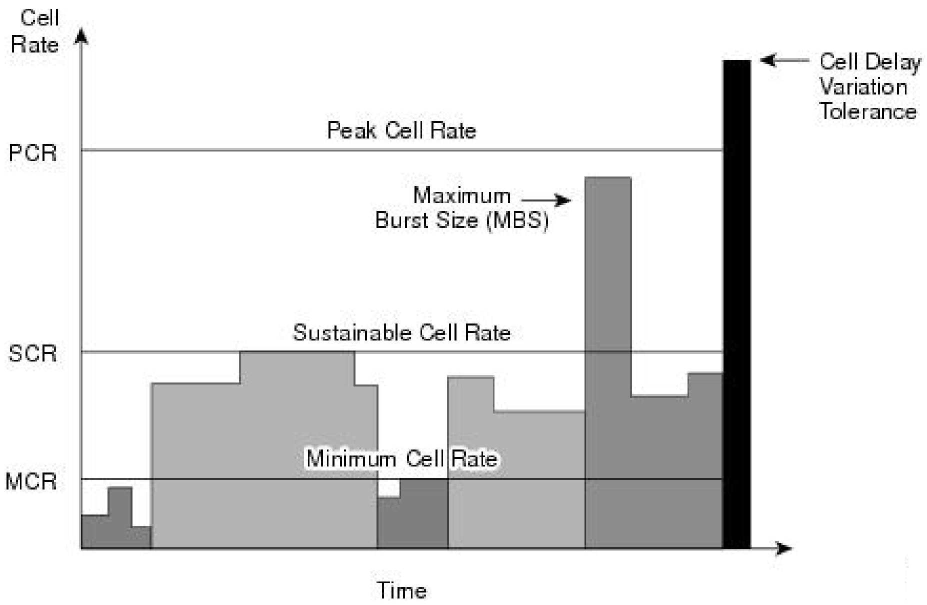

Figure 1 Relationships of ATM Traffic Parameters

Table 1 ATM Traffic Parameters and QoS Parameters by Service Category

ATM Service Category	Application Examples	Traffic Parameters	ATM QoS Parameters
ABR	Critical data transfer, such as for defense information where rapid access to network bandwidth is important.	MCR, PCR	CLR (optional)
CBR	Telephone conversations, voice	PCR, CDVT	Peak-to-peak CDV, maxCTD, CLR

	mail, or audio services (radio, or audio library). Videoconferencing, video on demand.		
nrt-VBR	Airline reservations, banking transactions.	PCR, CDVT, SCR, MBS	CLR
rt-VBR	Compressed or packetized voice or video including telephone conversations, voicemail, HDTV.	PCR, CDVT, SCR, MBS	Peak-to-peak CDV, maxCTD, CLR
UBR	File transfer and e-mail.	PCR (optional)	None supported
UBR+ (developed by Cisco Systems)	Interconnecting IP routers with virtual channel connections (VCCs) or virtul path connections (VPCs).	PCR (optional), MCR	None supported

ATM Connection Admission Control (CAC)

CAC for CBR traffic

The CAC algorithms for the CBR service are relatively straightforward. A CBR traffic source emits ATM cells periodically at every 1/PCR units. The CAC for CBR takes the PCR as the bandwidth required for the CBR connection. Let the total bandwidth allocated to CBR connections be w_{CBR}. The **total bandwidth** of the existing CBR connections is given by:

$$w_{CBR}^{N} = \sum_{i}^{N} PCR_i.$$

The $(N+1)^{th}$ request for a virtual connection with PCR_{N+1} comes to the ATM switch:

$$w_{CBR}^{N+1} = w_{CBR}^{N} + PCR_{N+1}.$$

Accept the request if

$$w_{CBR}^{N+1} < w_{CBR}.$$

Reject the request if

$w_{CBR}^{N+1} \geq w_{CBR}.$

CAC for VBR Traffic

$$Burstiness = \frac{SCR}{PCR}.$$

If the $Burstiness \ll 1$, the PCR-based CAC would be very inefficient. For the VBR services, a CAC based on effective bandwidths, α_i, is used:

$$\sum \alpha_i \leq Link\ Capacity.$$

Problems and Solutions

Problem 1

Referring to **Figure 2**, consider **100 customer lines** with **PCR** of **64 kb/s** each. Each line generates **3.6 ccs** (***Centi-Call Second***) **during the busy hour**. The total trunk capacity between ATM switches **A** and **B** is **1 Mb/s**. How much more bandwidth needs to be added between the two ATM switches to meet the blocking probability of **2%** during a busy hour?

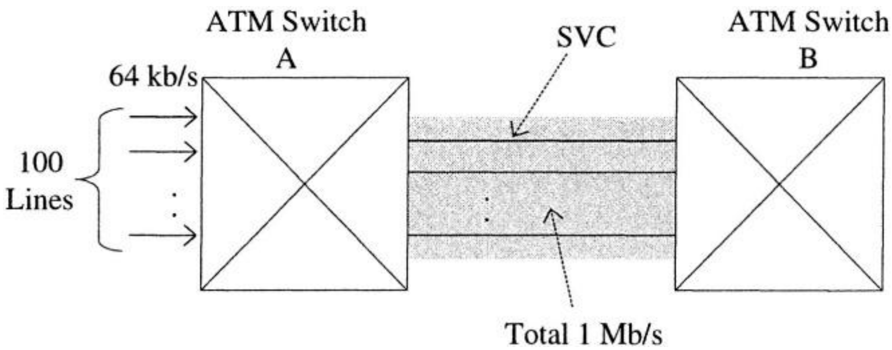

Figure 2

Solution

First, determine the total offered load at ATM switch **A** as follows:

$$L = 100 \times 3.6 = 360\ ccs = \frac{360}{36} = 10\ erlangs.$$

From the **Erlang B table**, determine the number of channels needed to meet $P_B = 2\%$: $N = 17$.

The total bandwidth needed is:

$$BW = 64 \times 17 = 1088\ kb/s.$$

Hence, $88\ kb/s$ of additional bandwidth is needed.

Problem 2

Referring to **Figure 3**, consider **200 customer lines**, each with **PCR** of **64 kb/s** and **SCR** of **40 kb/s**. Each line generates **1.8 ccs during a busy hour**. The total trunk capacity between ATM switches **A** and **B** is **850 kb/s**. Using this amount of bandwidth, **SVCs** are created, each with bandwidth equal to $\boldsymbol{\alpha}$ **kb/s**, where **SCR**$<\boldsymbol{\alpha}<$**PCR**. What should $\boldsymbol{\alpha}$ be to meet the blocking probability of **2%**?

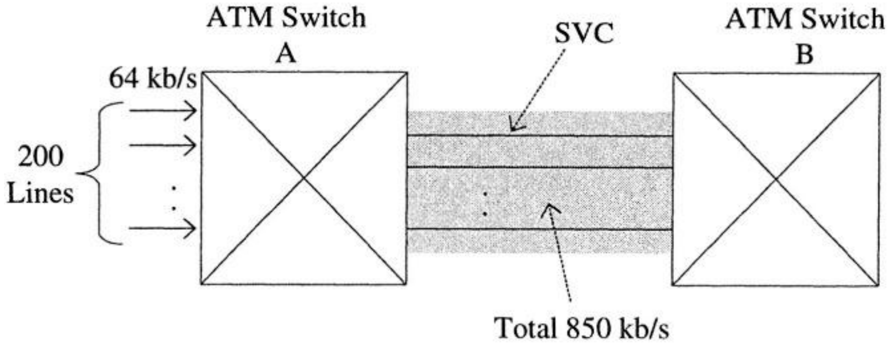

Figure 3

Solution

First, determine the total offered load at ATM switch **A** as follows:

$$L = 200 \times 1.8 = 360\ ccs = \frac{360}{36} = 10\ erlangs.$$

From the **Erlang B table**, the number of channels required to meet $P_B = 2\%$ is $N = 17$.

Solve the following for $\boldsymbol{\alpha}$**:**

$$\frac{850\ kbps}{\alpha} = 17;$$

$$\alpha = 50\ kb/s.$$

Problem 3

Consider **200 customer lines** with **PCR** of **32 kb/s** each as shown in **Figure 4**. Each line generates **1.8 ccs during the busy hour**. The total trunk capacity between ATM switches **A** and **B** is **320 kb/s**. Using this amount of bandwidth, **SVCs** are created, each with bandwidth equal to **PCR**, i.e., **32 kb/s**. Determine the blocking probability during the busy hour.

Solution

First, determine the number of trunked channels as follows:

$$N = \frac{320\ kbps}{32\ kbps} = 10.$$

Next, determine the total offered load at ATM switch A as follows:

$$L = 200 \times 1.8 = 360\ ccs = \frac{360\ ccs}{36\ ccs} = 10\ erlangs.$$

From the **Erlang B table**, with linear interpolation, $P_B = 21.4\ \%$.

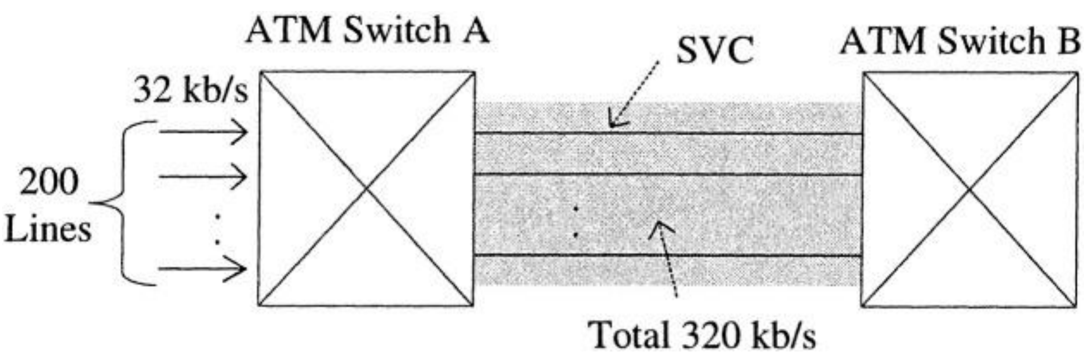

Figure 4

Problem 4

Consider **200 customer lines** with **PCR** of **32 kb/s** and **SCR** of **16 kb/s** each as shown in Figure 5. Each line generates **1.8 ccs during the busy hour**. The total trunk capacity between ATM switches **A** and **B** is **300 kb/s**. Using this amount of bandwidth, **SVCs** are created, each with bandwidth equal to **30 kb/s**. Determine the **blocking probability** during the busy hour.

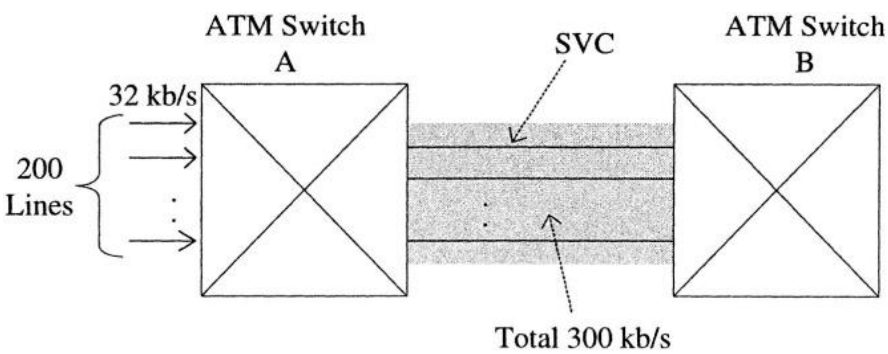

Figure 5

First, determine the number of trunked channels as follows:

$$N = \frac{300\ kbps}{30\ kbps} = 10.$$

Next, determine the total offered load at ATM switch **A** as follows:

$L = 200 \times 1.8 = 360\ ccs = 10\ erlangs.$

From the **Erlang B table**, with linear interpolation, $P_B = 21.4\ \%$.