Possible Extensions / Future Work[1]

- Relax the “mini-priority” service restriction for the p-customers
- Relax the regularity of the p-customers to include more elaborate traffic models
- Relax the i.i.d nature of the background traffic
- Investigate the correlation of the jitter of successively departing p-customers
- Use all the “generalizations” above to derive end-to-end jitter in a network of queues and obtain simple upper bounds for jitter moments.

1. Will be presented in INFOCOM 94.

Discussion

- Defined formally and derived analytically the jitter distribution

- Obtained upper bounds for jitter variance

- Jitter variance varies linearly with the background traffic variance

- Derived simple limiting distribution:

  When $T \to \infty$: approximation for large periods.

  When $\rho \to 1$: approximation for heavy queue utilization

Limiting Behavior

- In heavy traffic, we obtain a simple approximation

$$\rho \to 1 \Rightarrow \tilde{J}(z) \to z^{1-T}(B(z))^{T}$$

- For large periods

$$T \to \infty \Rightarrow Q_2(z) = Q_1(z) \text{ and } \tilde{J}(z) \to Q_2(z)\, Q_2\left(\frac{1}{z}\right)$$

Jitter Analysis / Distribution

- The goal is to obtain the joint distribution of the queue size seen by two consecutive P-customers, i.e.

$$E[z^{Q_2 - Q_1}]$$

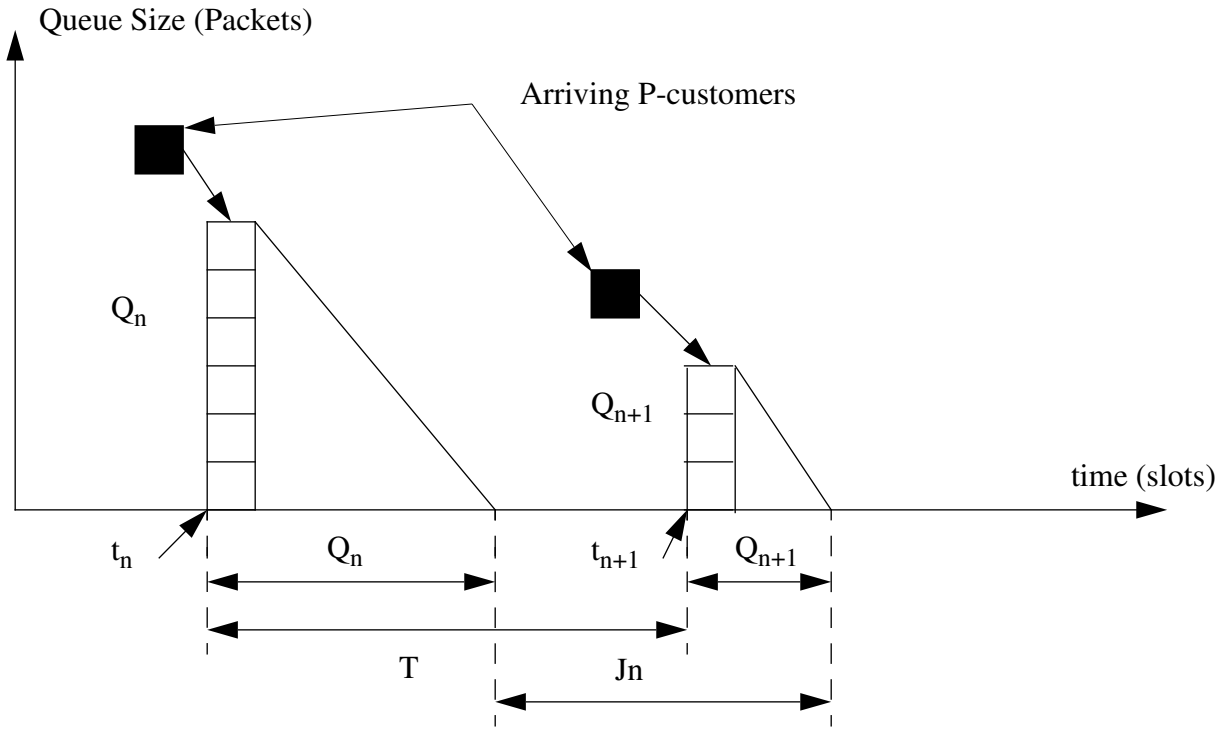
- We trace the evolution of the queue size over a period of T slots

$$Q_2(z) = z^{1-T}(B(z))^T Q_1(z) + F(B(z), \text{unknowns})$$

- We condition on Q_1 and then decondition to obtain the jitter distribution $\tilde{J}(z)$.

$$\tilde{J}(z) = z^{1-T}(B(z))^T + G(B(z), \text{cond-prob})$$

Jitter Definition



$$t_{n+1} - t_n = T$$

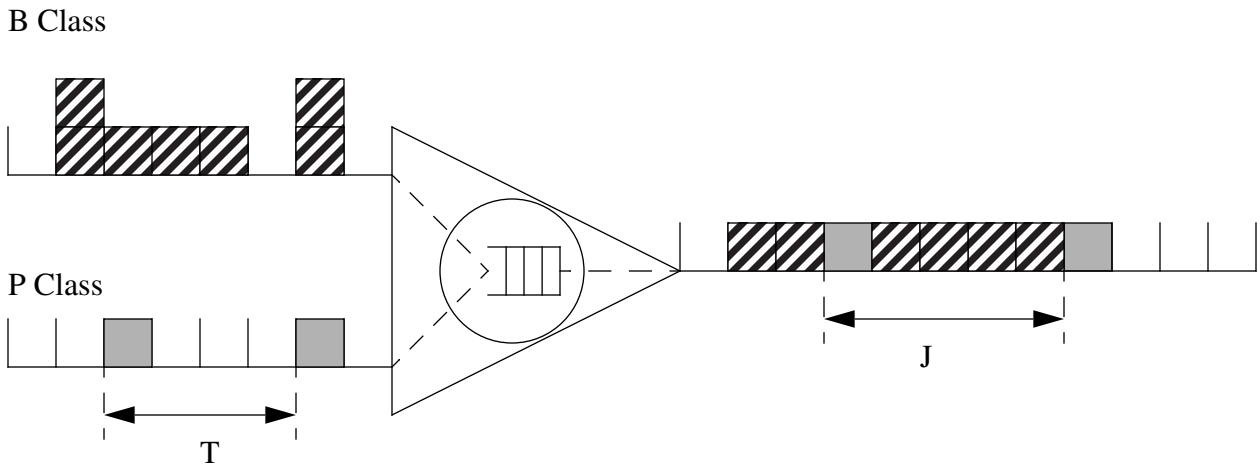
$$\tau_{n+1} = t_{n+1} + Q_{n+1}$$

$$\tau_n = t_n + Q_n$$

$$J_n = \tau_{n+1} - \tau_n = T + Q_{n+1} - Q_n$$

$$\tilde{J}_n = J_n - T = Q_{n+1} - Q_n$$

Multiplexer Queueing Model



- Slotted Time Axis
- Two streams of traffic

  Periodic traffic with Period T: P Class

  Background traffic of i.i.d batches of size B: B Class
- Customer transmission time: one time unit / one slot
- Service Order

  FIFO for arrivals in different slots

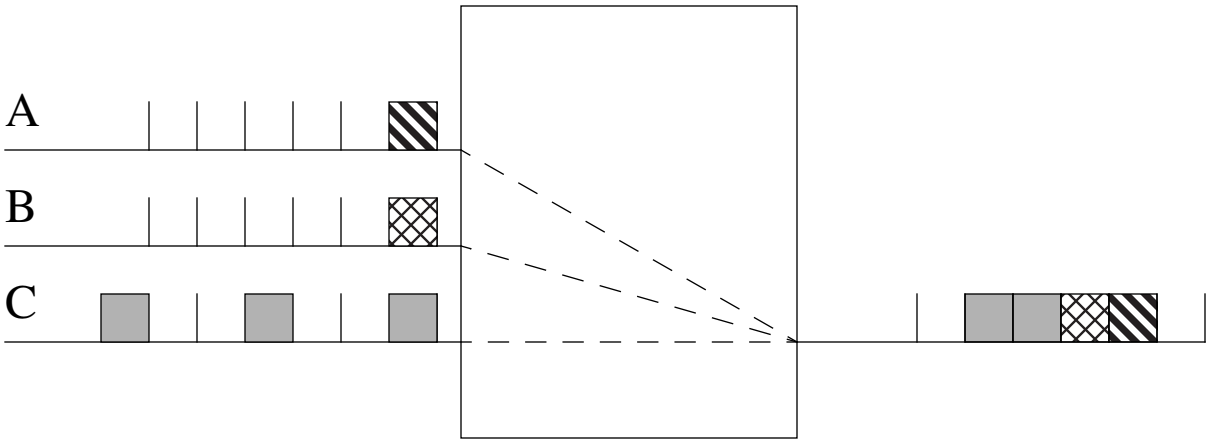
  Random for b-customers from the same batch

  P-customer is served ahead of b-customer arriving in the same slot

Objective of this study

- How is a session's input traffic process transformed to an output traffic process when multiplexed with other sessions?

- In particular, if the session is a periodic traffic and is multiplexed with other traffic -> characterize the alteration of the initial time structure of the cell streams passing through the multiplexer.



Introduction

- ATM networks are expected to support various services such as data, voice, images and video
- Statistical Multiplexing introduces flexibility but may have severe impacts on QOS.
- CBR is expected to be a major traffic in ATM.
- Jitter is an important measure for periodic traffic.

Jitter Analysis in ATM Networks

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1. Work done partly at IBM with C. Bisdikian and K. Sohraby