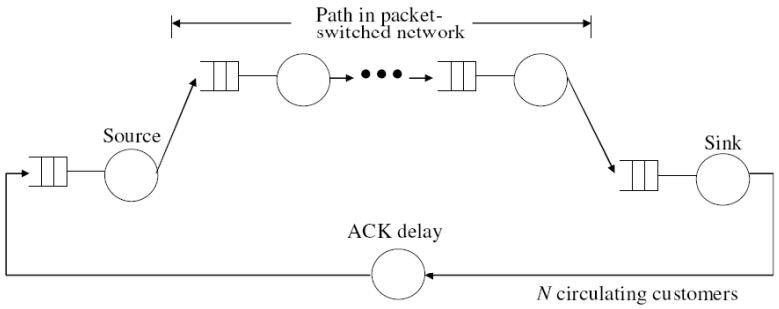
Applications to Computer Networks

Closed Network Model

Closed Network Model with Multiple Classes

- Suitable for modeling “virtual circuit” (VC) with window flow control
- Data sources/sinks are modeled explicitly

Model of a VC with Window Flow Control



Model of a VC with Window Flow Control

- Source, sink, channels are modeled by FCFS single server facilities
- ACK (acknowledgement) delay is modeled by an IS (infinite server) facility
- When source server is not idle, each customer represents an authorization to send one data packet on VC
- Data packets are individually acknowledged

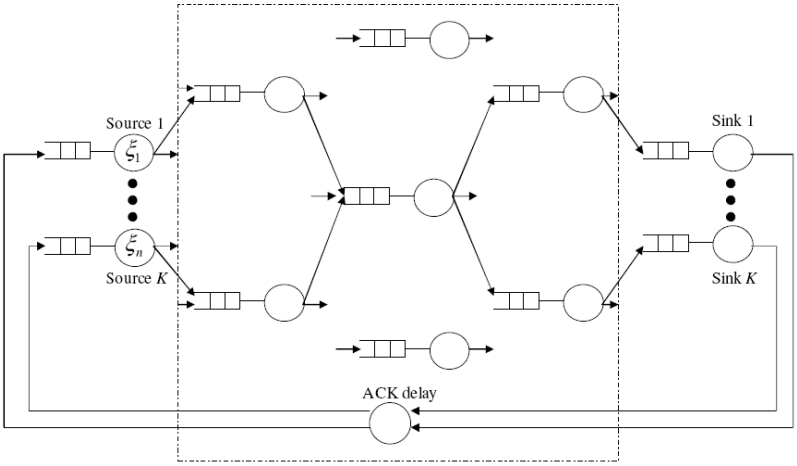
Model of a VC with Window Flow Control

- A customer entering the source queue represents the reception of an ACK by the source
- *N* is the window size
- When all *N* data packets are unacknowledged, the source is idle; this models the situation that the window is closed
- No loss of packets due to error or buffer overflow

Closed Network Model

- Each VC is modeled by a “closed” class
- No. of customers belonging to each class is constant
- Channels visited by each class are defined by the routing algorithm

Example



Model Assumptions

- M servers
  - FCFS single server for source, sink, and channels
  - IS for ACK delay
- Service time distribution at server i
  - exponential with parameter μC_i if server i is FCFS (same distribution for all classes)
  - exponential with parameter ξ_k for class k if server i is IS

Analytic Results

- For one class of customers, results are found in the Closed Network Model Section
  - performance measures can be expressed as a function of G
  - procedure to compute G: number of operations is $O(MN)$
- Results can be extended to multiple classes
  - number of operations to compute G is $O(MK\prod_{k=1}^{K} N_k)$
  - computation may be difficult if K is large