CS 414 – Multimedia Systems Design

Lecture 16 – Multimedia Transport Subsystem (Part 3)

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Administrative

- Sign up for demonstration of MP2 for Friday 22, 2008 5-7pm
- Sign either during class or send email to William

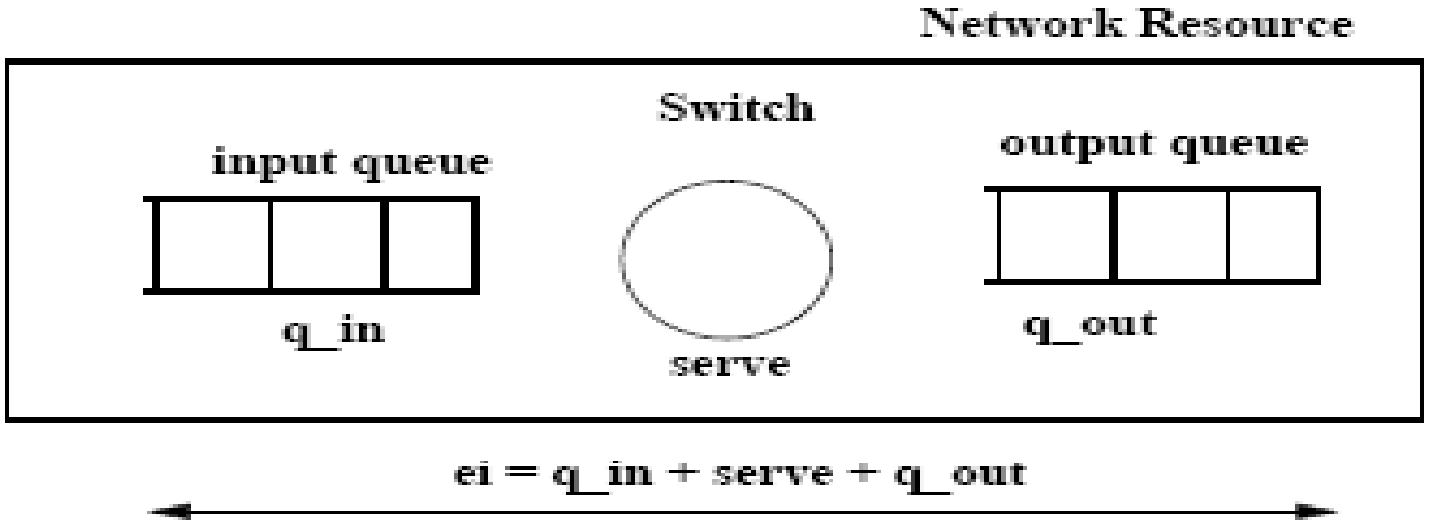
Outline

- Establishment Phase
  - Negotiation, Translation (Monday)
  - Admission, Reservation (Wednesday)
- Transmission Phase
  - Traffic Shaping (Wednesday)
    - Isochronous Traffic Shaping (Wednesday)
    - Shaping Bursty Traffic (Friday)
  - Rate Control (Friday)
  - Error Control (Friday)

Packet Scheduling Admission

- At switches/routers – packet scheduling decision needs to be made when admitting new streams of packets
- Need packet schedulability tests
  - Note that in networking only NON-PREEMPTIVE scheduling exists!!!

Packet Scheduling Admission



e_i – processing of a packet 'i' in network node

Admission Test:

$e_i \leq$ deadline (within a switch)

$\sum_{(i=1,\ldots,n)} serve_i / (1/r) \leq 1$

serve – packet service time at the processors – constant time due to hardware implementation

q_in and *q_out* are variable

$q = N/\lambda$ (Little Theorem)

r – service rate of the switch

Network Resource Reservation/Allocation

- Bandwidth reservation
  - Pessimistic reservation with maximal bandwidth allocation: Given (M_N, R_A, *and* M_A)
    - if $M_A = \max_{i=1,..n}(M_A^i)$ then

$$B_N = M_N \times \left(\lceil M_A / M_N \rceil \right) \times R_A$$

Pessimistic Resource Reservation (Example)

- Example: Consider sequence of MPEG video frames of size 80KB, 60 KB, 20KB, 20 KB, 60KB, 20 KB, 20 KB (Group of Pictures I, P, B, B, P, B, B),
- Pessimistic frame size calculation:
  - M_A = max(80, 60, 20, 20, 60, 20, 20) = 80KB
- Given video frame rate RA = 20 fps
- If Given MN = 10 KB (network packet size, e.g., packet size for the transport layer like TCP/UDP), then need to consider bandwidth/ throughput reservation for
  - BN = 10KB x (8 network packets per application frame) x 20 application frames per second= 1600 KB/second = 12800 Kbps

Optimistic Resource Reservation/Allocation

- Optimistic reservation considers average bandwidth allocation
- Given MA, RA, MN, where

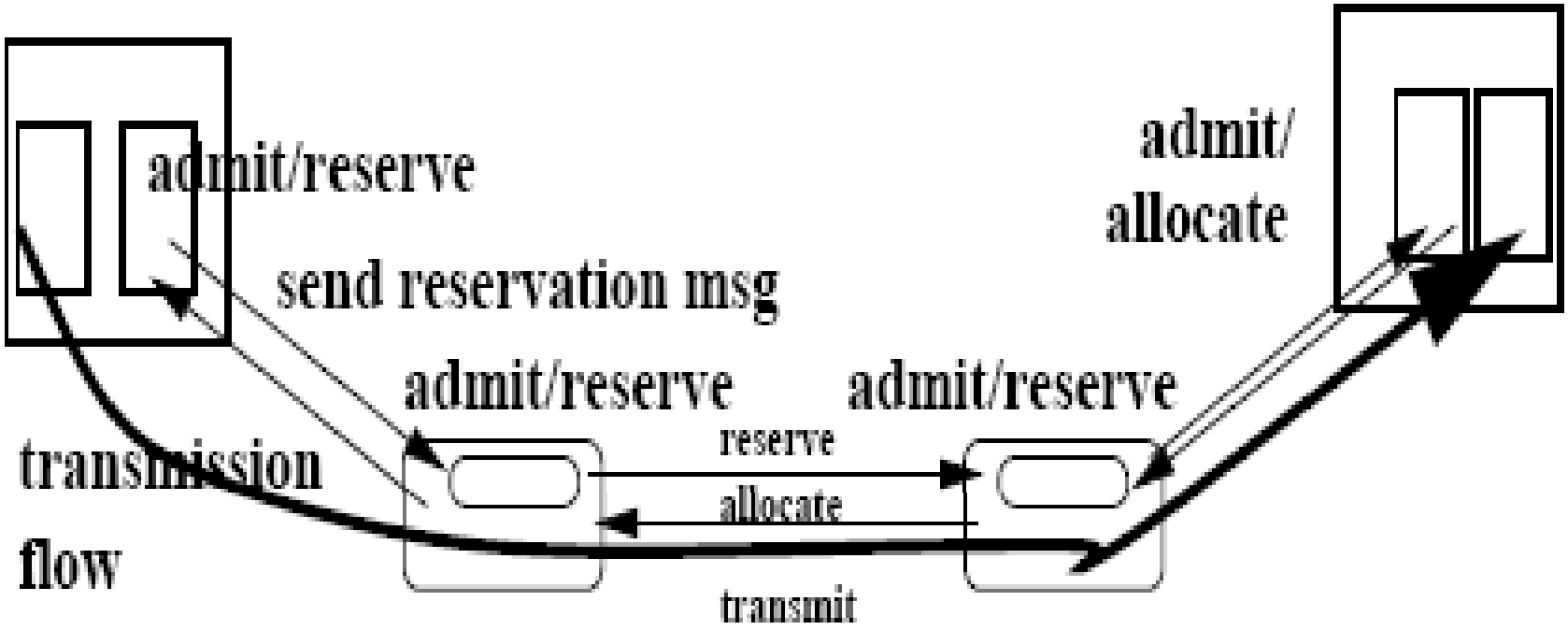
$$M_A = (1/n \times \sum_{i=1}^{n} M_A^i)$$

- Then $$B_N = M_N \times (\left\lceil \frac{M_A}{M_N} \right\rceil) \times R_A$$

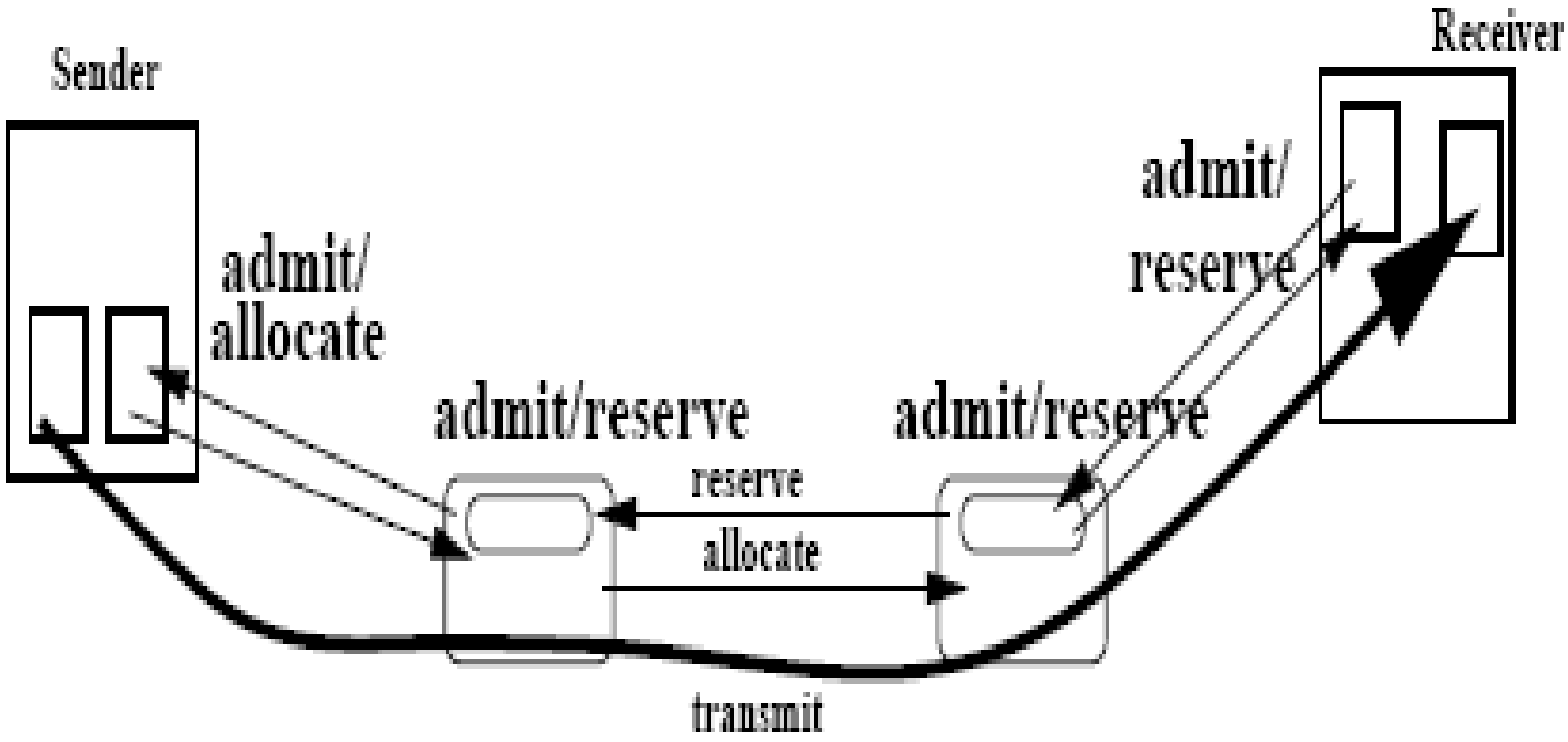
Optimistic Resource Reservation (Example)

- Example: Consider sequence of MPEG video frames of size 80KB, 60 KB, 20KB, 20 KB, 60KB, 20 KB, 20 KB (Group of Pictures I, P, B, B, P, B, B,),
- Optimistic frame size calculation:
  - M_A = 280/7 = 40 KB
- Given video frame rate RA = 20 fps
- If Given MN = 10 KB (network packet size, e.g., packet size for the transport layer like TCP/UDP), then need to consider bandwidth/ throughput reservation for
  - BN = 10KB x (4 network packets per application frame) x 20 application frames per second= 800 KB/second = 6400 Kbps

Sender-Oriented Reservation Protocol



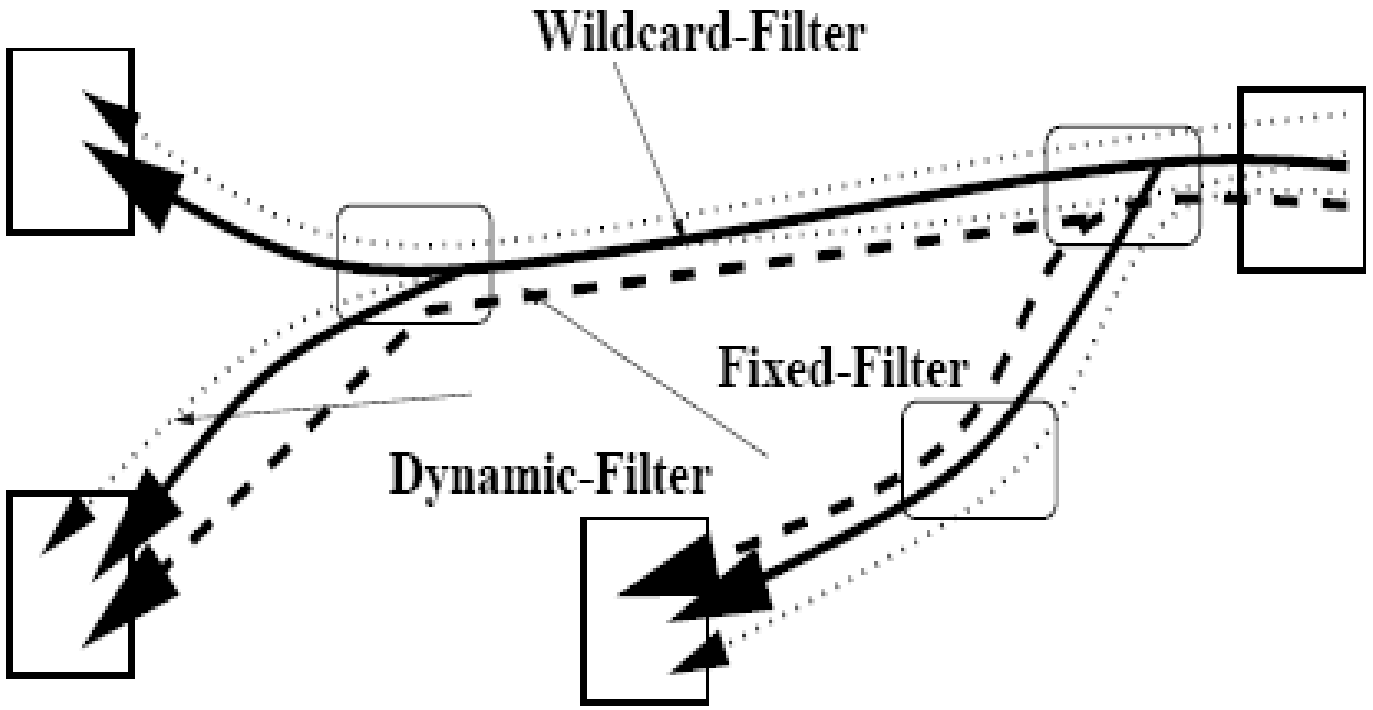
Receiver-Oriented Reservation Protocol



Reservation Styles

- IETF (Internet Engineering Task Force) standard defines three types of reservation styles
  - Wildcard
    - Allows receiver to create a single reservation along each link shared among all senders for the given session
  - Fixed filter
    - Allows each receiver to create a single reservation from a particular sender whose packets it wants to receive
  - Dynamic filter
    - Allows each receiver to create N reservations to carry flows from up to N different senders. This style allows the receiver to do channel switching (similar to TV channel switching)

Reservation Styles



QoS Enforcement – Traffic Shaping

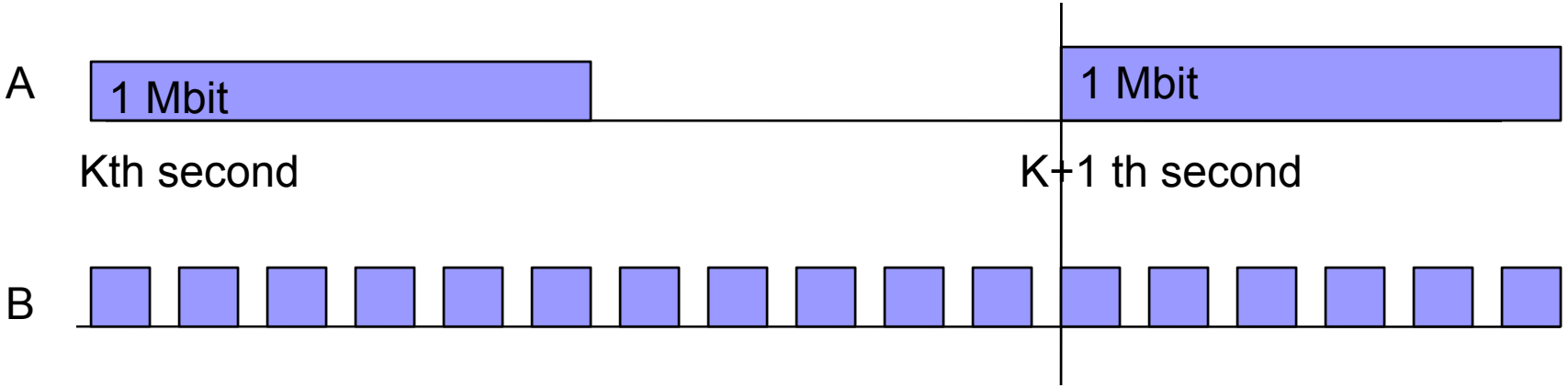
- In Packet Network, admission control, reservation is not sufficient to provide QoS guarantees
- Need **traffic shaping** at the entry to network and within network
- Traffic shaping
  - Decides how packets will be sent into the network , hence regulates traffic
  - Decides whether to accept a flow's data
  - Polices flows

Purpose of Traffic Shaping

- **Traffic shape**
  - A way of a flow to describe its traffic to the network
- Based on traffic shape, network manager (s) can determine if flow should be allowed in
- Given traffic shape, network manager(s) can periodically monitor flow's traffic

Example

- If we want to transmit data of 100 Mbps,
  - Traffic Shape A: Do we take 1 packet size of size 100 Mbit and send it once a second, or
  - Traffic Shape B: Do we take 1 packet of size 1 Kbit and send it every 10 microseconds?



Flow's Traffic Shape Parameters

- Traffic Envelope
  - Peak rate
  - Average rate
  - Burst length
  - Burst duration
- Service Envelope
  - Maximum tolerable delay
  - Desired delay jitter
  - others

Conclusion

- Packet Admission Control (bandwidth and schedulability) is especially important for guaranteed deterministic class of service
- Reservation goes hands-in-hands with negotiation, i.e., if negotiation happens at higher level (e.g., session level) in P2P fashion, underlying resources need to be admitted and reserved along the P2P path
- Understanding of Traffic shapes / shaping is of great importance for multimedia networks