

CS 414 – Multimedia Systems Design
Lecture 21 –
Case Studies for Multimedia
Network Support (Layer 3)

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Outline

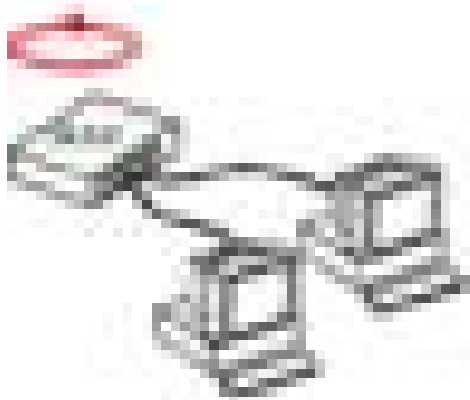
- Multimedia Network Technologies at the Layer 2
 - Gigabit Ethernet and ATM
 - Earlier technologies (now visible in wireless) – Token Ring
- Multimedia Network Technologies at the Layer 3
 - Past/Current technologies: IPv4
 - Future technologies: IPv6, IntServ, DiffServ



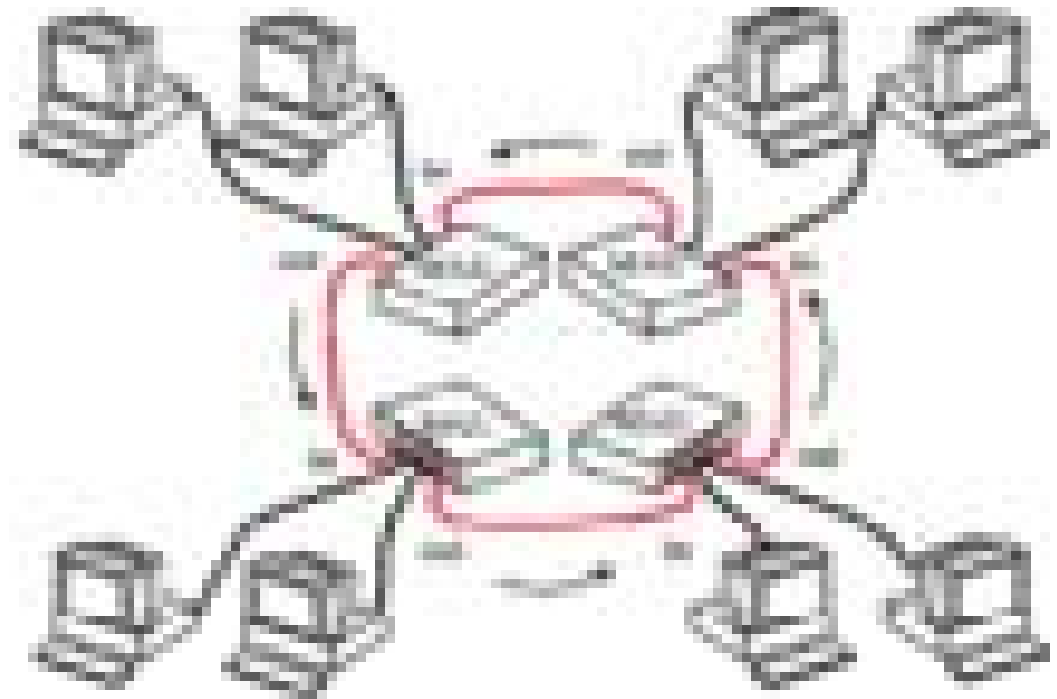
Token Ring (Layer 2 MAC Protocol)

- Old Technology, but has some nice algorithms for support of QoS that are appearing in newer network technologies (e.g., cellular technology, 802.15 wireless technology) or in higher layers
- Characteristics:
 - Throughput 4-16 Mbps
 - Ring topology
 - Media Access Control (MAC) Protocol is **Token-based protocol**
 - Uses two types of messages: (1) token, (2) Data Frames
 - Two operating modes: listen and transmit

Token Ring Architecture



(a)



(b)



Token-based Protocol

- Each node in the ring can be in **transmitting mode** if it holds a token
- Each node can hold the token only up to the **token holding time** (not longer).
 - The token holding time should be long enough to transmit a frame
- Once the token holding time is up, the node must release the token, and send it to its neighbor
- Each node that does not hold token is in **listening mode**



QoS in Token Ring

- Connection-less packet service network, but supports **multiple priorities**
- Priority Scheme:
 - Priority is stored in token and in the frame header (Access Control Field)
 - Priority operations allow for reservation of priority token
 - Fairness is important



QoS in Token Ring

■ Priority Allocation

- 0: Applications
- 1-3: free for any use (higher priority applications if needed)
- 4: used by bridges
- 5-6: reserved but not used
- 7: used by ring management

■ Priorities 1-3 allow for transmission of multimedia streams

Provision of Guarantees in Token Ring

- Priority Scheme + fixed maximal propagation delay provide guaranteed transmission
- Token-based protocol provides predictable nature of station's opportunity to transmit

□ Token Rotation Time:

$$t_{trt} = \tau_l + \sum_{i=0}^{n-1} \tau_i$$

□ τ_l – ring latency

□ τ_i - token holding time of station i



Provision of Guarantees

- Worst case to wait for token:

$$t_{trt} \leq \tau_l + (N - 1)\tau_{\max}$$

$$t_{trt}^{worst} \approx (N - 1)\tau_{\max}$$



Delay Bounds

- Reservation mechanism helps to bound delay for high priority traffic
- Delay bounds

$$t_{access} \leq 2 \times \tau_{max}$$

$$t_{access} \leq (M - 1)\tau_{mm} + 2\tau_{max}$$

- τ_{mm} is transmission time of high-priority multimedia traffic



Resource Reservation in Token Ring

- Static Resource Reservation
- Dynamic Centralized Resource Reservation
- Dynamic Distributed Resource Reservation
 - Available Resource Table (art)
 - Bandwidth Reservation and Allocation protocol



Layer 3 Internet Services

■ **Internet Protocol (IP) – IP Version 4**

- Provides unreliable deliver of datagrams in a point-to-point fashion
- Runs on top of any Layer 2 technologies
- Supports
 - IP address of 32 bits
 - Different types of services (TOS)
 - Precedence relation
 - Services such as minimization of delay, maximization of throughput
 - Multicast
 - Internet Group Management Protocol for managing groups



New Internet Protocol - IPng

■ **Next Generation IP – IP Version 6**

- Supports new features
 - New addressing and routing
 - IP Address 128 bits
 - Large hierarchical addresses, multicast addresses
 - More options of flow control and security
 - Real-time flows
 - End-to-end security
 - Provider selection
 - Host mobility
 - Auto-configuration/auto-reconfiguration
 - Traffic Classes



Conclusion

- Token-based medium access protocol I is a possibility for wireless access
- One can find similar approaches in newer cellular and other wireless standards if more deterministic control of shared medium is required
- Alternative to Token-based protocol is TDMA (Time-division Media Access)