



CS 414 – Multimedia Systems Design
Lecture 20 –
Case Studies for Multimedia
Network Support (Layer 2)

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Administrative

■ Homework 1

- deadline – February 29
- solutions will be posted on March 1

■ Midterm

- March 3 (Monday), 11-11:50am, 1103 SC
- Class Notes + Chapters to read/study:
 - Media Coding and Content processing book
 - Chapter 2, chapter 3.1-3.2, 3.8, chapter 4.1-4.2.2, 4.3, 4.5, chapter 5, chapter 7.1-7.5, 7.7
 - Multimedia Systems
 - Chapter 2, Chapter 5.1



Outline

- Multimedia Network Technologies at the Layer 2
 - Current technologies - Gigabit Ethernet and ATM
 - Previous early technologies – Token Ring and FDDI



Gigabit Ethernet (1)

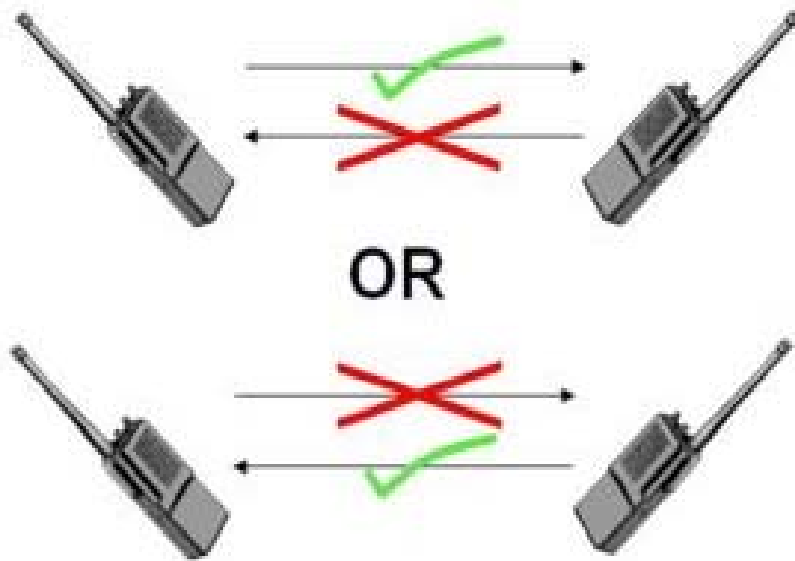
- Very high throughput - 1 Gigabit per second
- Current Ethernet is a switched technology, i.e., all desktops connect to a switch
 - Earlier Ethernet (10 MBps) was a bus-based technology, where all desktops were connected to a bus
- Basic Ethernet access protocol to the physical layer/medium is **CSMA/CD (Carrier Sensing Medium Access/Collision Detection)**



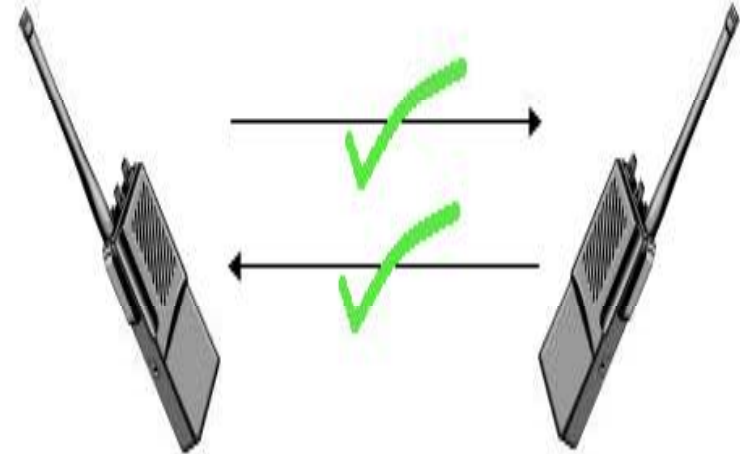
Major Changes in Gigabit Ethernet to support Multimedia Applications

- Gigabit Media Interface was widened
 - Transmit and receive paths were widened to 8 bits (instead of 4 bits in earlier Ethernet)
- Adaptation of Fiber Channel Encoding (merger of FDDI technology and Ethernet)
- Modified CSMA/CD – slot time was increased from 512 bit times to 512 byte times

Half-Duplex vs Full Duplex



Half-Duplex used in
1 Gigabit Ethernet –
Need CSMA/CD



Full-Duplex used in 10 Gigabit
Ethernet – don't need CSMA/CD



QoS in Ethernet

- Simple prioritization of packets was introduced
- This is the only support of QoS in Ethernet Layer 2
- No concept of connection establishment
- No routable traffic (hop-by-hop technology)
- Ethernet philosophy is that Layer 3 (Network IP Layer) or higher layers will take care of QoS and differentiate traffic



ATM Networks

- ATM – Asynchronous Transfer Model (ATM)
Layer 2 Networks
- Broadband Integrated Data Service Network (B-ISDN)
- Started 1988
- Efficient and flexible for variable bit rate traffic
 - Basics: packet (called cell) is 53 bytes with 48 bytes payload and 5 bytes header
- ATM consists of two sub-layers
 - ATM Adaptation Layer (AAL)
 - ATM Layer



ATM Networks

- Switched network

- Switched at very high speeds

- Bandwidth

- End host 155 Mbps and higher, backbone switches 1 Gbps and higher into terabits

- Switching functions allow for routing (space switching) and queuing (time switching)

- Multicast and Broadcast support

- Important for video conferencing and VoD



QoS in ATM

- Support of Service Classes (also called Traffic Classes)
 - CBR Class (Constant Bit Rate) class – supports voice traffic
 - QoS parameter: Peak Cell Rate (PCR)
 - VBR Class (Variable Bit Rate) class – supports video traffic
 - Deploys traffic shaping
 - QoS parameter: PCR, Sustainable Cell Rate (SCR), Maximum Burst Size (MBS)
 - ABR Class (Arbitrary Bit Rate) – supports data traffic – file transfer, web traffic
 - UBR Class (Ubiquitous Bit Rate)



QoS in ATM

■ Performance

- High throughput
- Low bit error rate
- Low connection blocking
- Low cell loss probability
- Minimal switching delay

■ Support for connection establishment

- Control protocol with QoS control and bandwidth reservation



Connection Establishment in ATM

- ATM connection is called **Virtual Circuit** (VC)
- ATM is routable network, i.e., supports routing function
 - During connection establishment find a route
- VC is defined
 - VCI – Virtual Circuit Identifier
 - VPI – Virtual Path Identifier (identifies the route)



ATM Routing

- Routing has two important metrics
 - Routing decision time
 - Can be used either for routing connections to decide which connection to route or for routing of cells to decide which cell to route
 - Routing information place
 - Determines where the information is stored
 - It can be stored either in each cell through 'routing tag' or in switching blocks via 'routing tables'



ATM Connectivity to other LAN/MAN Networks

- ATM is usually deployed in the backbone
- LAN (Local Area Networks) or MAN (Metropolitan Area Networks) deploy Ethernet
- Interconnectivity needs to consider
 - Translation between different frame/cell sizes (e.g., Ethernet's frame size is 1500 Bytes, ATM cell size is 53 bytes)
 - Solution for interconnectivity since Ethernet is connection-less packet service network and ATM is connection-oriented network



ATM Interconnectivity Solutions

- Installation of semi-permanent connections using Virtual Path in the ATM
- Provision of special message identification in AAL
- Provision of very fast call setups



Conclusion

- Layer 2 technologies are very diverse
- Some go for very high throughput, but do not care about delay control
- Connection-less packet service versus connection-oriented service
- Small packets versus larger packets
- Next big Layer 2 research in wireless technologies
 - Difficult to achieve QoS
 - Several attempts, e.g., change access protocol from CSMA/CA to TDMA