CS 414 – Multimedia Systems Design

Lecture 14 – Multimedia Transport Subsystem (Part 1)

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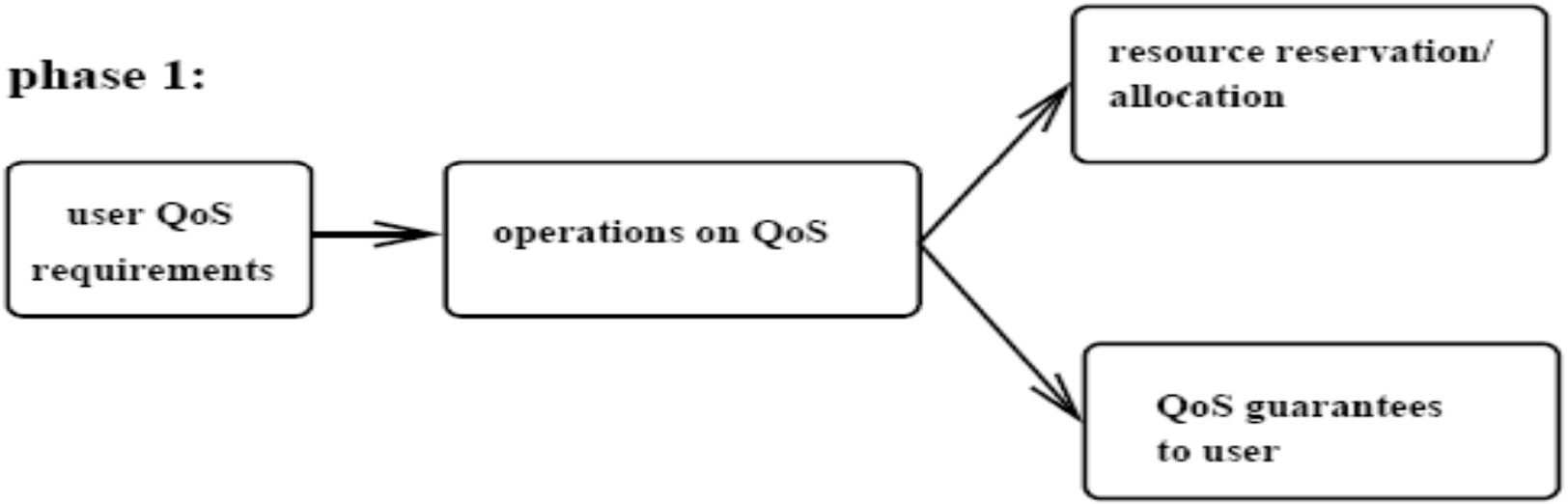
Administrative

- MP2 posted
- Discussion Section II on Monday, 2/18, 2008 (3405 SC)
- Deadline for ¼ unit proposals – 2/15 midnight (see website for further instructions)

Relation between QoS and Resources



Phase 2: Operations during Enforcement/Transmission Phase

- Enforcement Operations
  - enforce QoS guarantees
- QoS Management Operations
  - Manage and adapt QoS parameters and initiate resource re-allocation/adaptation

Enforcement Operations

- Resource scheduling
  - Example: rate-monotonic scheduling
- Rate control – traffic shaping
  - Example: leaky bucket
- End-to-end error control
  - Example: forward error correction
- Flow control
  - Open loop flow control (no feedback)
  - Close look flow control (with feedback channel)
- Flow synchronization

QoS Management during Transmission Phase

- Resource and QoS Monitoring
  - Flexibility, i.e., monitoring should be turned on/off
  - Two types of monitoring
    - User-mode monitoring
    - Network-mode monitoring
- QoS Maintenance
  - Compares monitored QoS with contract QoS
- QoS Degradation
  - graceful degradation needed

QoS Management during Transmission Phase

- QoS Renegotiation and Signaling
  - In case QoS parameters need to change, renegotiation must be initiated
- QoS/Resource Adaptation
  - As a result of re-negotiation request (request for change in quality) adaptation in QoS and resource allocation must happen

QoS/Resource Adaptation

- Renegotiation request can come from
  - User
  - Host system
  - Network
- Resource to adapt
  - Network adaptation (e.g., dynamic re-routing mechanism)
  - Source adaptation (e.g., temporal scaling with feedback)

Resource De-allocation – Tear-Down Phase

- Resource must be freed up once multimedia session is over
- Tear-down process
  - Sender-initiated closing
  - Receiver-initiated closing

Investigation of Resource Managements in Distributed Multimedia Systems

- Multimedia Transport Systems and Network Resource Management
- Multimedia Buffer Management and Caching
- Multimedia File Systems and Multimedia Servers
- Multimedia Process Management

Multimedia Transport System

- Overview what needs to be considered
  - Requirements of multimedia onto transport subsystems
    - User/application requirements
    - Processing and protocol constraints
    - Mapping to OSI layers
  - Network QoS and Resource Management Concepts
    - Negotiation, translation, admission
    - Traffic shaping, rate control, error control
    - Monitoring, adaptation

Multimedia Transport system

- Case Studies for multimedia transport systems (protocols, network technologies)
  - Streaming Protocols in P2P Overlay Networks
  - Streaming Support in Internet and Internet2
  - Examples of QoS Support in access networks such as Ethernet, ATM, …

Requirements on Services and Protocols

- Audio/video communication needs to be bounded by deadlines
- End-to-end jitter must be bounded
- End-to-end guarantees are required
- Synchronization mechanisms for different data streams are required
- Variable bit rate traffic support is required
- Services and protocols should make sure that no starvation occurs

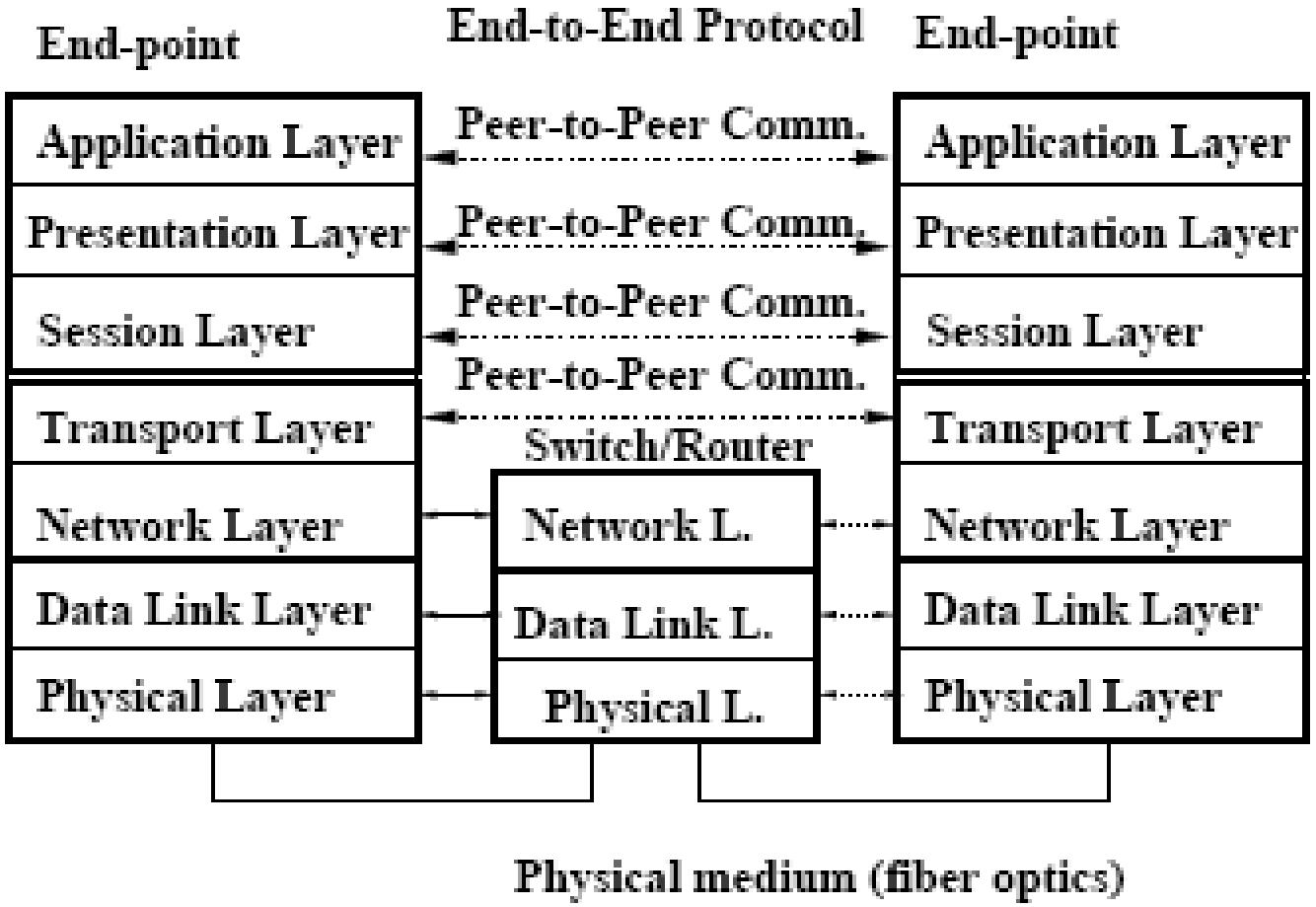
User and Application Requirements

- **Data Throughput** – need to support application data with stream-lime behavior and in real time
- **Fast data forwarding** – the faster the transport system can move packets the fewer packets have to be buffered
- **Service Guarantees** – need appropriate resource management
- **Multicasting** – need service for efficient resource sharing and reaching groups of users in applications such as video conferencing

Processing and Protocol Constraints

- **Adapter-to-adapter transmission** achieves fast transmission, but does not allow control over streams
- **Data movement in protocol stack** – requires expensive data copying, hence need to explore other buffer management techniques and strategies
- **Segmentation and re-assembly** – are part of the protocol stack and need to be done fast and efficiently
- **Retransmission error-recovery**
- **Underlying network** – may provide different transmission modes

OSI (Open System Internconnection) Layering Standard



Mapping of Multimedia Requirements into OSI Layers

- Physical layer
  - Defines transmission methods of individual bits over physical medium
  - For MM – need high bandwidth and minimum delay (gigabit/terabit rates)
- Data Link Layer (MAC)
  - Defines transmission of blocks, called data frames, as well as access protocols to physical medium, error recognition, correction, flow control, block synchronization
  - For MM – need reservations and throughput guarantees, and different error correction mechanisms

OSI and Multimedia

- Network layer
  - Defines transmission of information blocks, called packets (IP packets)
  - For MM
    - Need reservations and guarantees
    - Request for guarantees defined by network QoS parameters
    - Preferable connection-oriented behavior where reservation is done during connection setup along the path
    - Network QoS should be negotiated at this layer

OSI and Multimedia

- Transport Layer
  - Defines a process-to-process connection
  - For MM
    - Network QoS can be enhanced, i.e., if network service is poor, then transmission layer bridges the gap between what the transport user wants and network provides
    - Error-handling based on process-to-process communication
      - Error handling may not include retransmission due to delay and jitter constraints
    - Rate control may be supported

OSI and Multimedia

- Session layer
  - Guarantees existence of multimedia connection(s) during whole multimedia session
  - For MM
    - Need synchronization within a stream and among streams
    - Need support for point-point session and multicast session

OSI and Multimedia

- Presentation Layer
  - Abstracts from different formats
  - For MM
    - Need transformation service between application specific formats and the agreed upon transport format
    - Audio/video format conversion is needed since many formats exist
- Application Layer
  - Provides specific application services
  - For MM
    - need real-time access support
    - Playback, record, FF, rewind and pause functions