Multimedia Communications

Presented by

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Multimedia Communications
Overview

Conclusions • Research Directions • Adaptive Mechanisms • Resource Reservation • Quality of Service • Resource Management • Requirements • Multimedia

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Multimedia communications: Transfer, protocols, services, and mechanisms of transfer digital media in over digital networks

Multimedia: Integrated manipulation (capture, process, communicate) of some continuous as well as some discrete media (e.g., audio and video).

- Continuous Media: Time dependent (e.g., audio and video)
- Discrete Media: Time independent (e.g., text and graphics)
Requirements

- Reliability
- Delay
- Bandwidth

Traffic requirements: Data stream dependent

- Unicast: One-to-one communication
- Multicast: Provide a single copy of data to multiple receivers

Functional requirements

- Video streaming, medical, etc.

Requirements are dependent on the application (videoconferencing,

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Requirements
Establish a relationship between the data to be transmitted and network resources and ensure timely delivery.

Resource Management
Definition: Set of parameters that defines the properties of media streams.

Quality of Service (QoS)

To provide QoS parameters during the runtime of the application, resource reservation must be made. Shaping the traffic (filtering and scaling) to the available resources and work nodes, protocols, application (server, network, links, net-)

All hardware and software components must handle the data accord-
Quality of Service

Transmission of continuous media data

Bandwidth: Available (maximum/average) bandwidth

Delay: Maximum end-to-end delay of data unit

Reliability: Loss and corruption of data

Jitter: Variance of delay

Specification: [required, desired]

QoS parameters are negotiated at connection set-up time

Transport of continuous media data

Quality of Service
Steps

1. Capacity test and calculation
2. Reservation of resource capacities
3. Enforcement of QoS guarantees
4. Quality of Service

Classes

- Guaranteed QoS: Most costly
- Statistical QoS: Average case
- Best effort: No reservation is made at all

Quality of Service
Quality of Service

The notation of QoS is different at various system layers.

Example of QoS layers:

- Network QoS: Packet size, packet loss rate
- Application QoS: Frame size, frame rate, color depth

Each of the layers needs QoS specified in its own terms, which means that a mapping between layers is necessary.
QoS can only be guaranteed if it is supported at the data link layer.

1. Ethernet: Not able to guarantee any kind of QoS due to indeterminism of collision sense/multiple access/collision detection
2. Fast Ethernet: Increases bandwidth but provides no QoS guarantees
3. Token ring: Able to support QoS (priorities are supported)
4. FDDI: Able to support QoS

QoS in Computer Networks (Data Link Layer)
- Supports priorities
  - Based on the flow label, the router processes the packet
  - Packet header contains flow label
  - Flows may be established by reservation protocols (e.g., RSVP)

In IPv6, pseudoconnection terminology is introduced: packet streams between sender and receiver.

- Not considered in IPv4, since support for continuous media was not an issue, but maybe usable for QoS.
Real-Time Transport Protocol

- Designed to transport real-time data
- Does not define any QoS
- Uses UDP/IPv4
- No reordering
- No retransmission
- Provides sequence number

QoS in Computer Networks (Transport Layer)
QoS in Telecommunication Networks

Integrated Service Digital Network (ISDN):
- Replaces telephone network in Europe and East Asia
- Primary access rate: 30 B-channels and one D-channel
- Basic access rate: Two B-channels and one D-channel
  - D-channel: 16 Kbps - signaling and data
  - B-channel: fixed, guaranteed rate of 64 Kbps

QoS in Telecommunication Networks
QoS in ATM

CeIl loss may happen but cell order is preserved

Small packet termed as cell: 5 bytes header + 48 bytes of data

Connection-oriented

ITU-T and ATM Forum

Motivated by the merger of computer and telecommunication networks

Broadband ISDN (B-ISDN)
QoS in ATM

QoS parameters supported for ATM connections include:

- Cell loss ratio
- Maximum cell loss variation
- Maximum end-to-end delay
- Cell loss rate
- Must be expected
- Maximum burst length: Time interval in that at most one burst must be supported
- Peak rate: Maximum number of cells that may happen in one burst
- Sustainable rate: Minimum number of cells per second that can be supported
- Calculated party
- QoS is negotiated among the calling party, the network, and the called party.
ATM Service Categories

- Negotiable: sustainable rate, peak rate and loss rate
  - Non-real-time variable bit rate (nrt-VBR)

- Minimize loss and provide fairness among connections
- Provides feedback to the application for rate control
- Best effort

- Available bit rate (ABR)

- Does not require to allocate resource for the connection
  - Non-real time applications without restrictions on the end-end delay or jitter
  - Weakest service

- Best effort

- Unsolicited bit rate (UBR)
Real-time variable bit rate (rt-VBR):

- Designated for applications providing fixed rate for the duration of the connection.
- Suitable for time-critical data such as voice and video.
- Specify all parameters but peak rate.
- Use the remaining bandwidth between sustainable rate and peak rate for other non-real-time connections.
- ATM Service Categories

Constant bit rate (CBR):

- Suitable for applications requiring fixed rate for the duration of the connection.
- Suitable for time-critical data such as voice and video.
- Specify all parameters but peak rate.
- Use the remaining bandwidth between sustainable rate and peak rate for other non-real-time connections.
- ATM Service Categories
Resource Reservation

Resource management: Provides mechanisms for media streams with guaranteed or statistical QoS.

Reservation protocols are needed to exchange and negotiate QoS requirements among end systems and routers.

Admission control: Based on the current state, decide whether enough resources are available for the traffic to be admitted.

State of the node must be maintained: May require significant overhead.

Resource Reservation
Is reservation necessary?

Pros: Needed for reliability and individual throughput

Cons: Bandwidth will always increase, reservation makes Internet unfair, and wastes resources. Any kind of bandwidth that can be provided in the visible future will be drained by the new services without the reduction of congestion.

Resource Reservation

• Network management
• Receiver oriented
• Sender oriented

Resource Reservation

Reserve Resource Reservation
RSVP (Resource Reservation Protocol for the Internet)
Anywhere

Violators are punished by tagging cells that can be dropped anywhere.

TWO-step procedure, first negotiation, then resource guarantees.
Adaptive Mechanisms

- Feedback to sender to modify transmission
- Filtering
- Scaling

Which part of the data must be preserved and which part might be discarded
Multiresolution-Multicast Transmission

Diagram:
- Encoder
- High End Receiver
- High End Receiver
- Medium End Receiver
- Low End Receiver
- Proxy
- Low End Receiver
- Medium End Receiver
- Proxy
- Low End Receiver
- Proxy
- Low End Receiver

Stream Types:
- High Quality Stream
- Medium Quality Stream
- Low Quality Stream
Research Directions

- Pricing
- QoS-driven routing
- Number of applications
- Number of participants
- Scalability
Conclusions

- IP over ATM is needed
- Probably ATM will be used in backbone
- RSVP will be widespread use
- Currently Internet does not support any QoS
- Multimedia applications will be increasingly used

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