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Multimedia

Multimedia Networks and Applications

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Contents

- Synchronization Accuracy Specification (SAS) Factors
- Network Performance Parameters
- Various Multimedia Networks
  - MM over Internet
  - RTP and RSVP

MM Applications

- Streaming stored Audio/Video (A/V)
- Streaming live A/V
- Real-time interactive A/V

- All above common characteristics
- Delay Sensitivity Delay and Delay Jitter
- Tolerates some packet losses

- For Normal Data Transmission: Reverse of the above

QoS is a big issue

- Hard QoS (Patient monitoring)
- Soft QoS (Most MM Applications)

Synchronization Accuracy Specification (SAS) Factors

SAS factors used to specify the quality of sync.

- Delay: Acceptable time gape between transmission and reception
- Delay Jitter: Instantaneous difference between desired presentation time and actual presentation time of streamed multimedia objects.
- Delay Skew: Average difference between the desired and actual presentation time.
- Error rate: Level of error is specified by BER.

Synchronization Accuracy Specification (SAS) Factors

SAS factors for Audio

- Delay: 100 to 500 ms (conversation)
- Delay Jitter: 10 times better than Delay.
- Lip Sync: better than 80 ms.
- BER: 0.01 (tel); 0.001 (UC CD); 0.0001 (C CD)

Synchronization Accuracy Specification (SAS) Factors

SAS factors for Vedio

- Delay and Jitter: 50 ms (HDTV); 100 ms (TV); 500 ms (video conf.)
- Error rate: 0.000001 (HDTV); 0.00001 (TV); 0.0001 (video conf.)

Traffic Characterization Parameters

Variability of the bit rates

- CBR applications: uncompressed digitized voice transmission
- VBR applications: Video transmission using compression (Most!)
- Burstiness ratio: Mean bit rate/ Peak bit rate

Network Performance Parameters (NPPs)

- Throughput: Effective rate of transmission of information bits
- Delay: Time required for a bit to traverse through a network (250 ms)
- Delay Variance: Variance of delay (10 ms)
- Error rate: BER, PER, packet loss rate (PLR), and cell loss rate (CLR)
- NPPs + BW + SAS ➔ QoS of a network.

Circuit Switched Networks

Network	Data rate	Capability
PSTN	64 Kbps	Not suitable for RT video
ADSL	1.544 Mbps – 6.1 Mbps	VoD and Internet access at home
ISDN	144-192 Kbps 1.544 Mbps	Digital voice and video conf. Compressed VCR quality video
Fractional T1-T4	384 Kbps to 274 Mbps	Video conf. VCR, TV, HDTV
SONET	51.84 to 2844 Mbps	51.84 x N suitable for MM traffic

* QoS of circuit switched services is excellent because of end-end connectivity

Packet-switched Networks

Transmission Option:

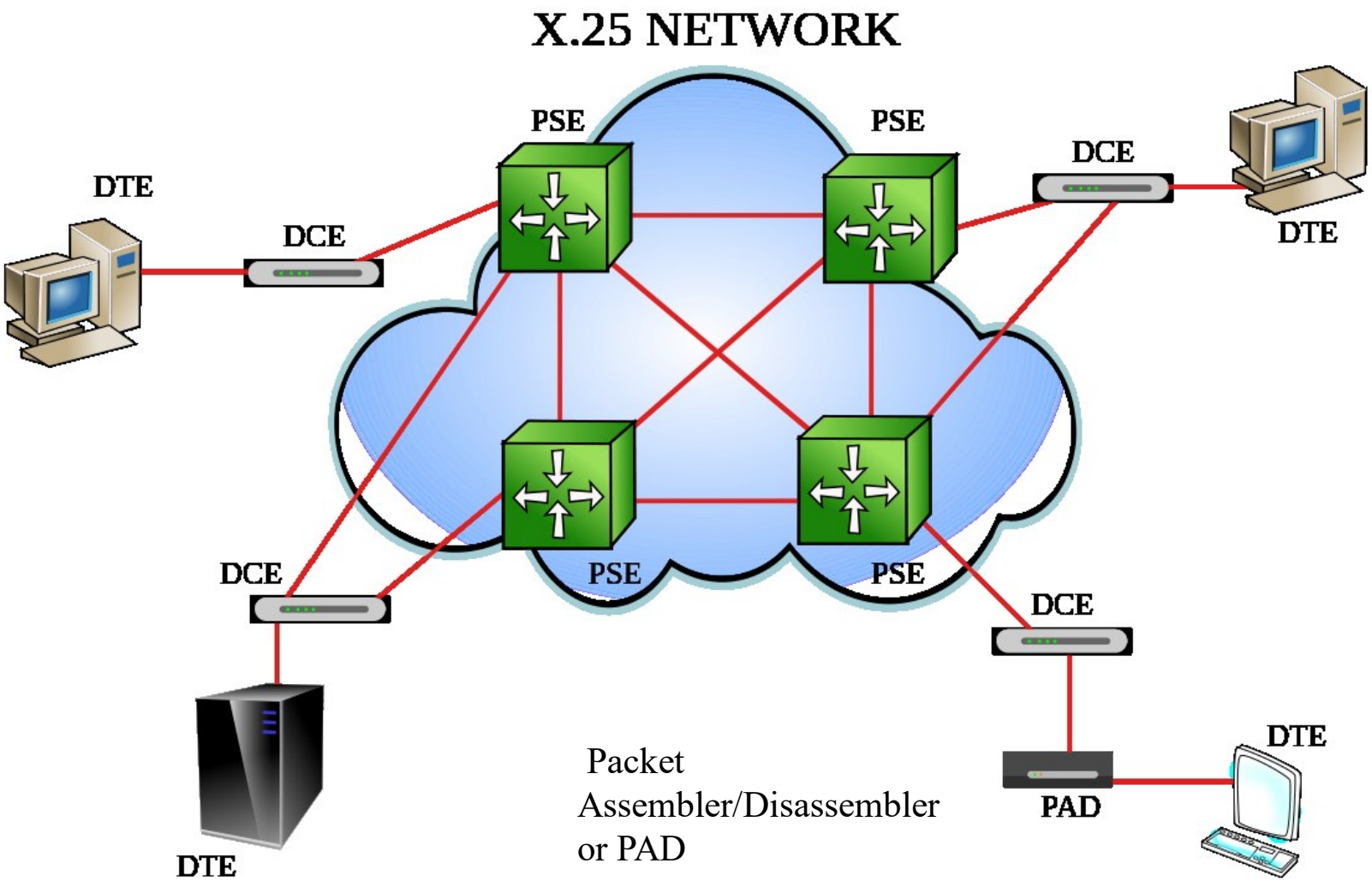
- Virtual circuit: Establishes end-end connectivity
- Datagram: Not end-to-end connectivity

In terms of QoS: VC-based connection is better that of DG-based.

Packet-switched Networks

Network	Data rate	Capability
X.25	64 Kbps	Not suitable for A/V traffic
Frame Delay	56 Kbps to 1.544 Mbps	
SMDS	1.544 Mbps to 46 Mbps	MM traffic

Switched Multi-megabit Data Service (SMDS): to connect LANs, MANs and WANs to exchange data.

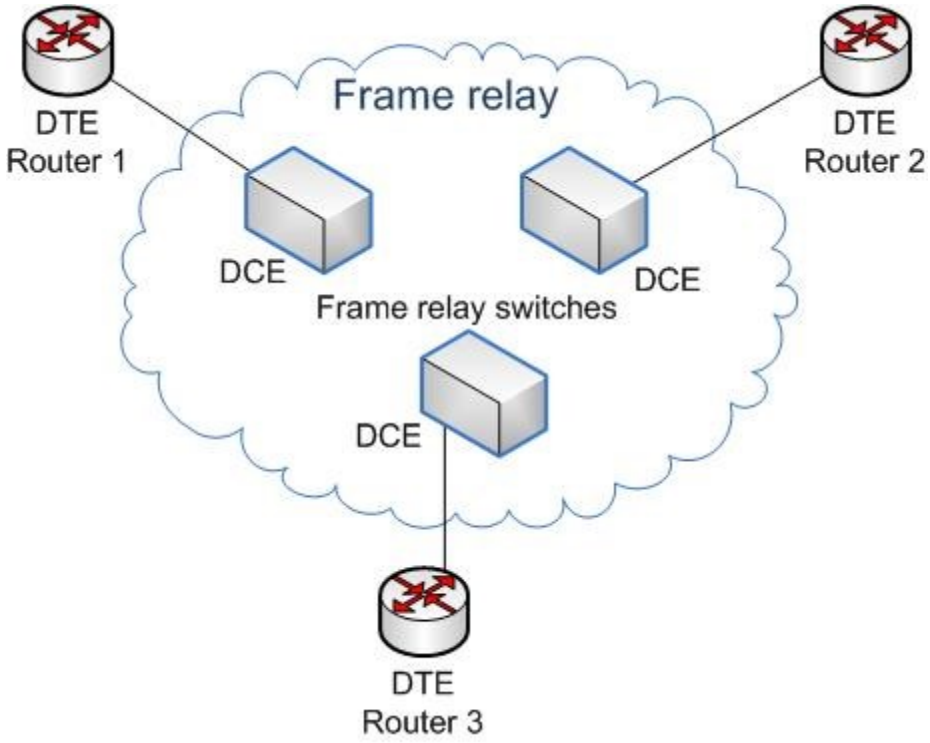


- standard protocol suite for packet switched wide area network (WAN) communication.

Wikipedia

Frame Relay

- Standardized WAN technology: PHY and Link-layer for digital comm.



Why X.25 not suitable for A/V

X.25

- Error detection and correction at every hop
- BW: 2 Mbps
- No BW reservation; no multicast
- MM applications, such as video conf. not possible

Multimedia Over LAN

LAN type	Speed (Mbps)	Throughput (Mbps)	Multimedia capability
Ethernet	10	3-9	Not suitable for multimedia
Switched Ethernet	10	9	Suitable for stored multimedia
Fast Ethernet	100	40-90	Suitable for both stored and live MM
Token-Ring	4	3.8	Not suitable
Token-Ring	16	15.5	Audio, video
FDDI-II	6.144	-	CBR broadcast TV
ATM	34-155	-	Designed for MM

Multimedia Over Internet

- At time of invention, Internet was not designed for MM traffic.

- Transmission Control Protocol TCP

Connection establishment, error control, flow control, congestion control: introduce delay jitter ➔ not suitable for MM

- User Datagram Protocol (UDP)

Connectionless protocol at the transport layer: can deliver RT data

- Internet Protocol (IP)

Delivering packets from the source host to the destination host solely based on the IP addresses in the packet headers.

Internet Protocol Suite

- Application layer: create user data and communicate this data to other applications.
- Transport layer: host-to-host communications on either the local network or remote networks separated by router.
- Internet layer: exchanging datagrams across network boundaries.
- Link layer: defines the local network link on which hosts communicate without intervening routers.

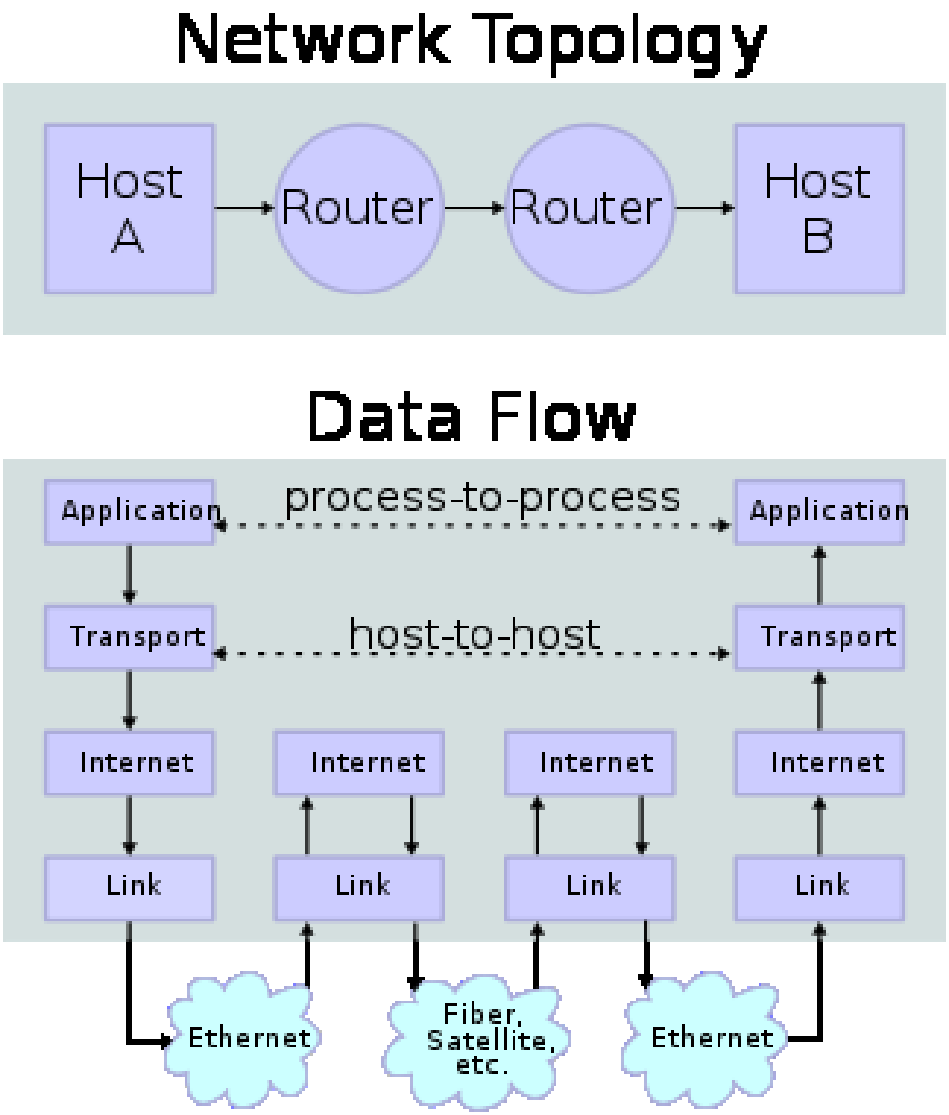
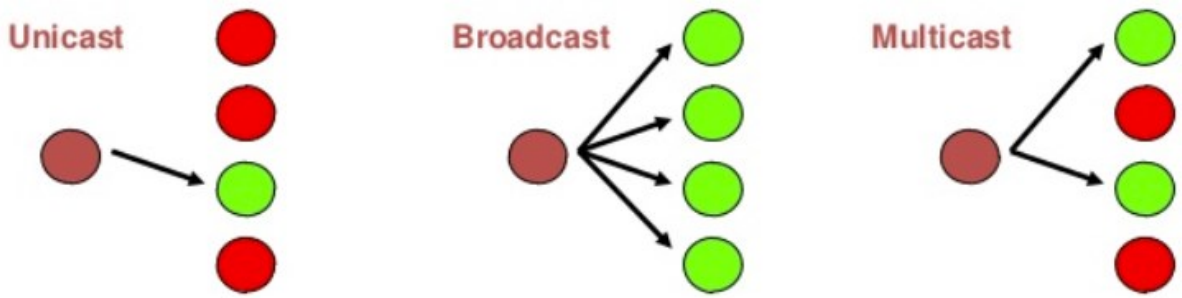


Fig: Wikipedia

Internet of MM Traffic

Enhancement required

Multicasting: A/V conference (one-to-many). Original IP is an unicast approach



- IP Multicast: An extension to original IP
  - Dynamic and distributed group membership
  - Multiple group membership
  - Multiple send/receive nodes

- Multicast Backbone: Practical implementation of IP Multicast.

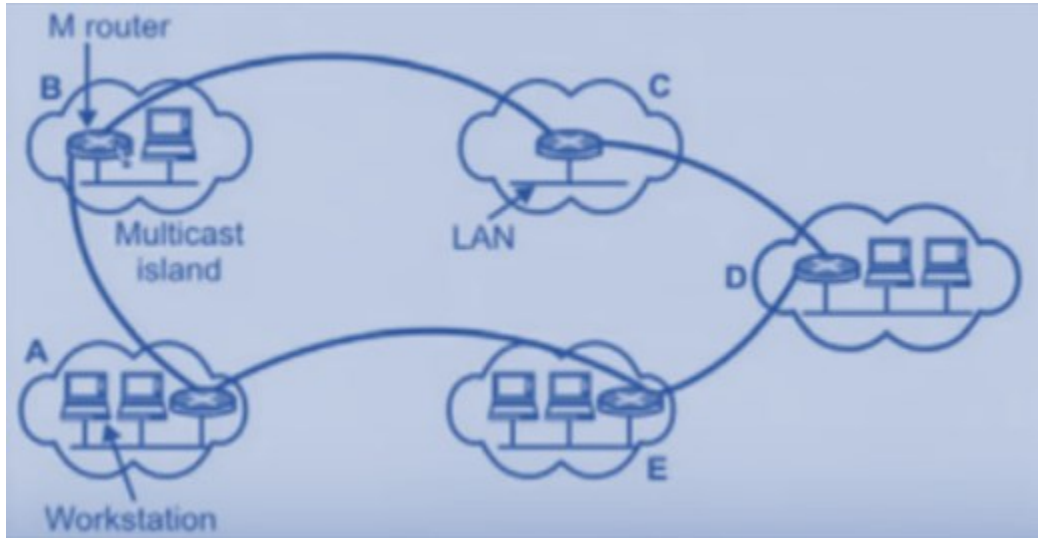
Multicast Backbone: Example

Internet Radio or TV

- Conversation or watch uncompressed movies

Implementation

- A virtual overlay network on the top of Internet
- It consists of multicast islands connected by tunnels



Internet of MM Traffic

Enhancement required

UDP is more suitable than TCP for interactive traffic. But, it requires the services of RTP

- Real-time Transport Protocol (RTP):
  - Application layer protocol to handle RT traffic (Example: audio/video)
  - No QoS guarantee

RT Delivery over Internet

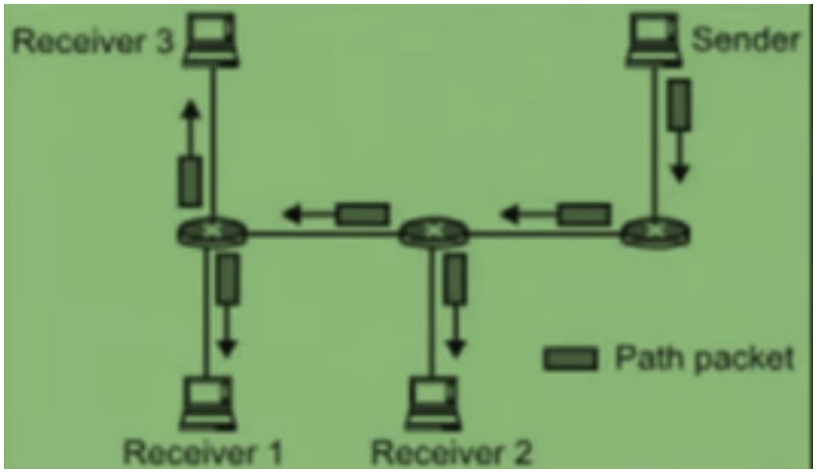
Resource ReSerVation Protocol (RSVP)

- A signaling protocol to provide QoS

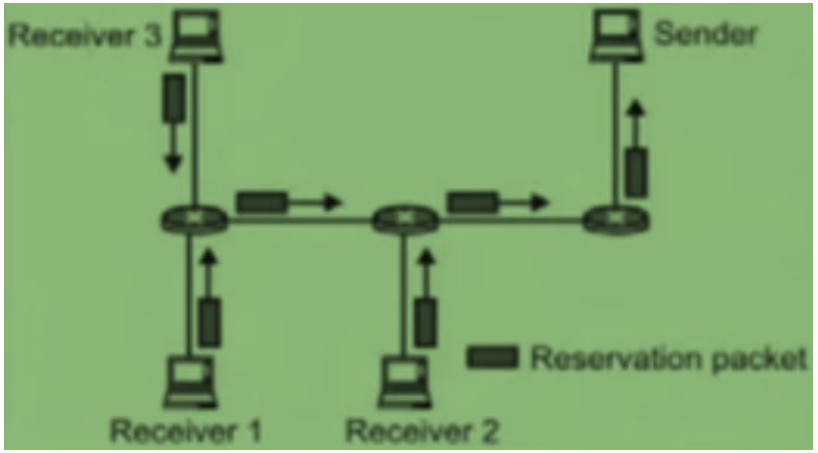
Two Components

- Rspec: Defines the resources that the flow needs to reserve
- Tspec: Define the traffic characteristics of the flow

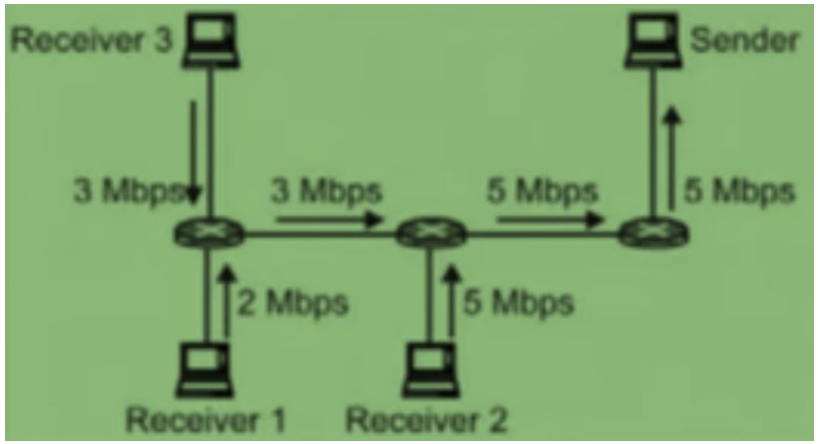
How RSVP works

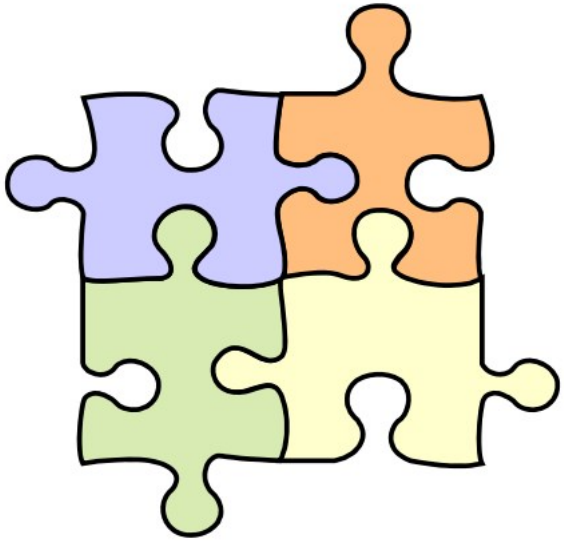


Path Messages



Reservation Messages



Reservation Merging

Q&A