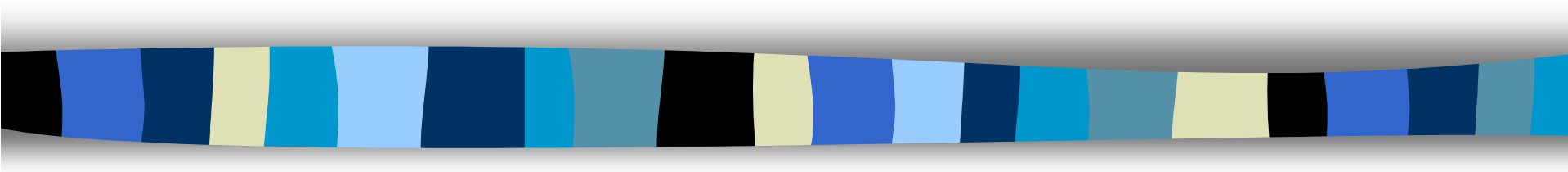
Multimedia Communications



Directions and Innovations

Introduction

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Multimedia Communications: Source Representations, Networks and Applications

- Introduction
- Networks and Network Services
- Multimedia Sources
- Source and Destination Terminals
- Applications of Multimedia Communications Networks
- Conclusions

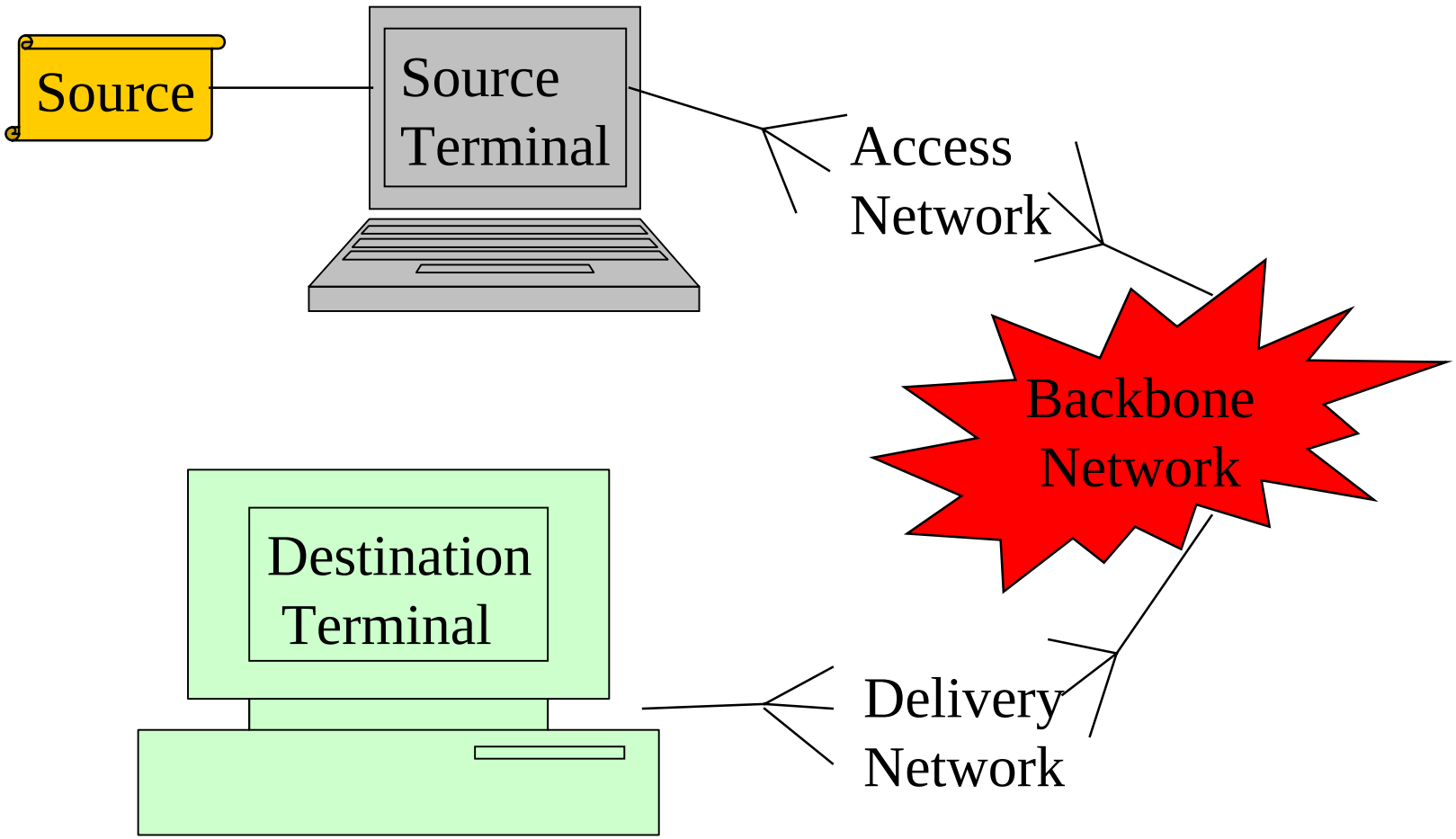
Introduction

- Universal access to multimedia information
- Multimedia communications
- Transmission of multimedia information over networks

Multimedia

- data
- voice
- graphics
- still images
- audio
- video

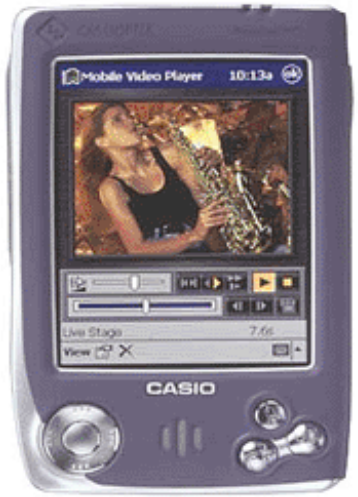
Components of Multimedia Communications Networks



Source

- Consists of any or more of the multimedia sources

Source Terminal



- Compress the source
- May be battery-power-limited
- May be aware that the destination terminal is limited in signal processing power
- Packetize the data (guard against packet loss; aid error corrections)

Access Network

- May be modeled by a single line connection (28.8 Kbit/s, 56Kbit/s, 1.5Mbit/s, ADSL, …)
- It may be a network that has shared capacity (have packet loss and delay)

Backbone Network

- May consist of a physical circuit switched connection (PSTN)
- Dedicated virtual path through a packet switched network (GPRS)
- Standard TCP/IP connection
- Characteristics: bandwidth, latency, jitter, packet loss, QoS guarantees

Delivery Network

- Like the Access Network
- One to many transmissions

Destination Terminal

- Varying power
- Varying mobility
- Varying display
- Varying audio capabilities

Networks and Network Services

- Transmission rate
  - Must be pushed as high as possible
- Transmission reliability
  - May suffer

Networks and Network Services

Services / Network	Rate
POTS	28.8-56 Kbit/s
ISDN	64-128 Kbit/s
ADSL	1.544-8.448 Mbit/s(downstream) 16-640 Kbit/s (upstream)
VDSL	12.96-55.2 Mbit/s
CATV	20-40 Mbit/s
OC-N/STS-N	N × 51.84 Mbit/s
Ethernet	10 Mbit /s
Fast Ethernet	100 Mbit/s
Gigabit Ethernet	1000 Mbit/s
FDDI	100 Mbit/s
802.11 (wireless)	1, 2, 5.5, and 11 Mbit/s in 2.4 GHz band
802.11a (wireless)	6-54 Mbit/s in 5 GHz band

Bottlenecks

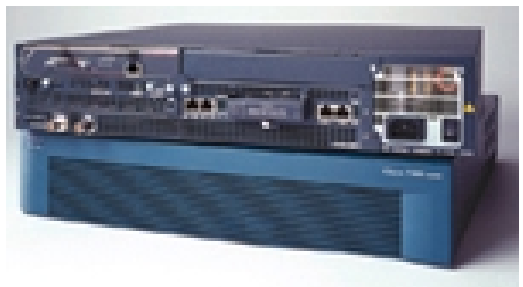
- As users obtain higher access rates bottlenecks move to the Backbone Network
- The bottleneck can be in Access Network, Backbone network, in the Delivery Network or in the accessed server

Transmission Protocols

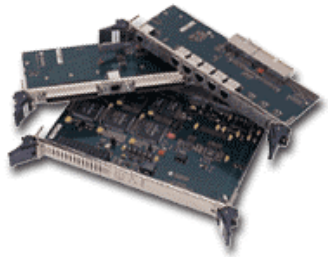
- TCP (Transmission Control Protocol)
  - Reliable
  - Connection-oriented service
  - Well suited for data traffic via Internet
  - Retransmission of lost packets
    - Problematical for delay-sensitive multimedia traffic

Transmission Protocols (cont.)

- UDP (User Datagram Protocol)
  - Connectionless
  - Best-effort services over the Internet
  - Avoid delays associated with transmission
  - Not reliable (possible packet loses)



Packet Switched Networks



- Unicast
  - Source terminal sends packets to a single Destination Terminal
- Broadcast
  - Source terminal sends packets to all terminal on a network
- Multicast
  - Source terminal sends packets to a multicast group

Multicasting

- Currently not supported by many of the routers
- Achieved by using Multicast Backbone or Mbone
- Implemented on top of the Internet using tunneling
- Standard IP address is used to encapsulate the multicast transmissions

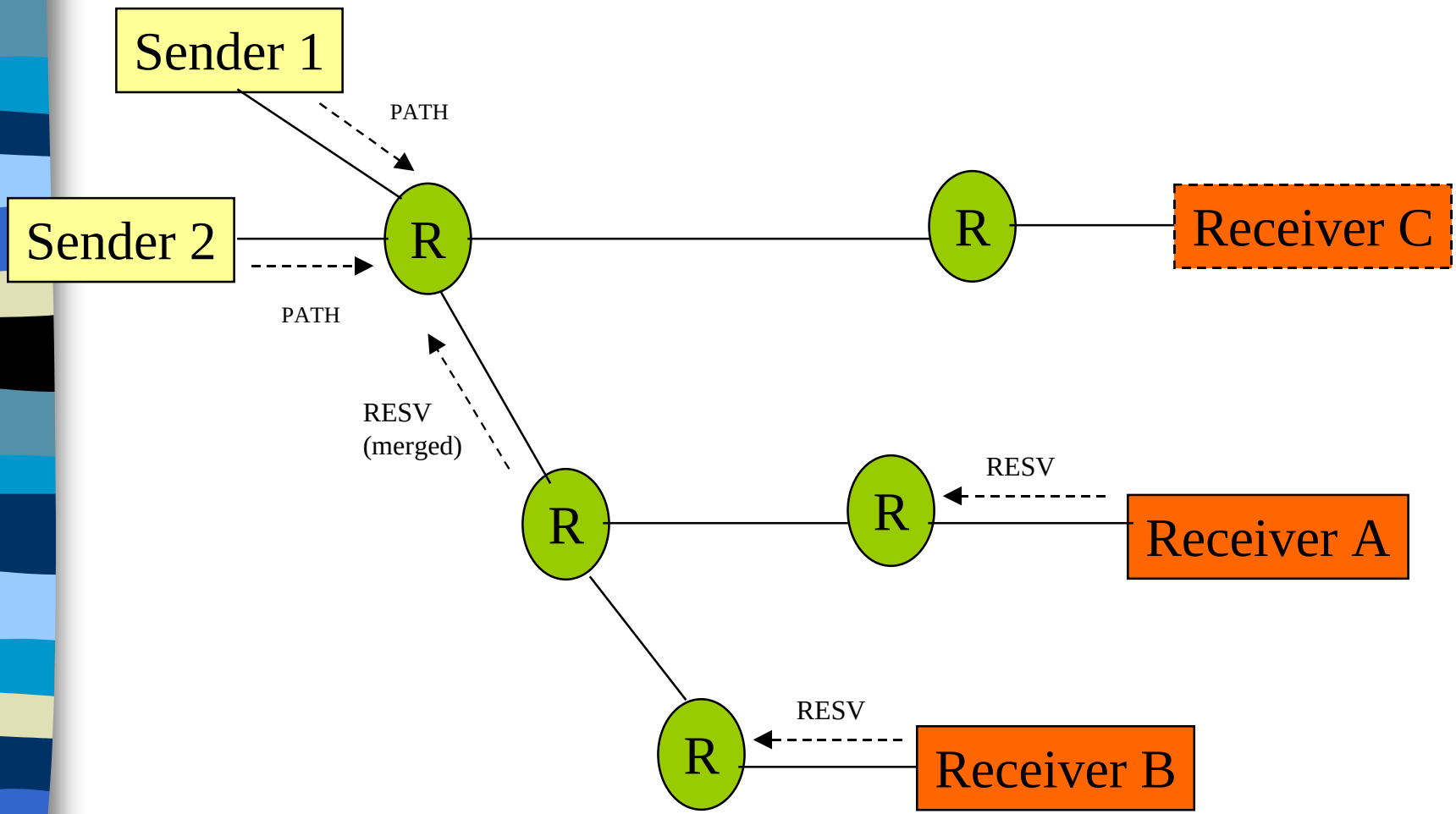
Real-time Transport Protocol

- Developed by IETF for multimedia communications
- Associated control protocol: RTCP
- Allows multimedia applications to work together
- Compression techniques can be negotiated
- Synchronization of multiple media
- RTCP is adjusted to the actual traffic

Resource Reservation Protocol (RSVP)

- Allows a receiver to request certain performance requirements
- Supports unicast and multicast
- For multicast it allows reservations to be merged

RSVP and Multicast



Other Protocols

- H.320 or H.324 videoconferencing (ITU)
- IETF was working on similar protocols
- ITU and IETF collaboration -> H.323
- H.323 includes H245 call control protocol

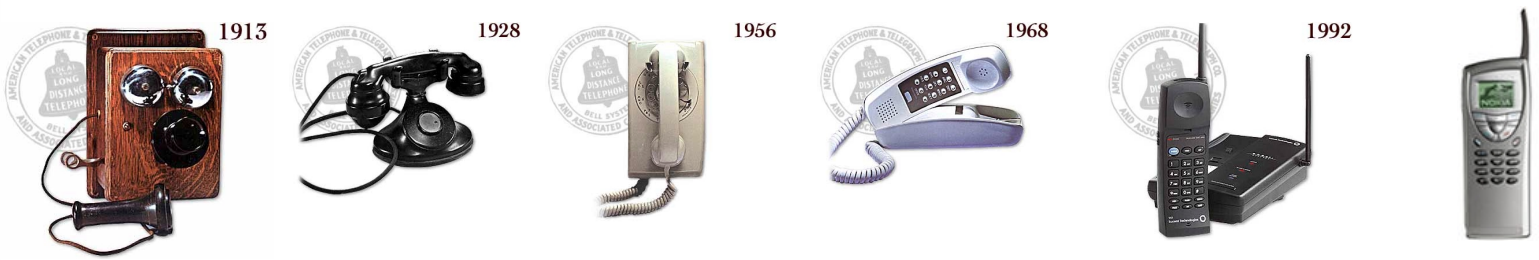
Multimedia Sources

Source	Bandwitdth (Hz)	Sampling rate	Bits per Sample	Bit Rate
Telephone voice	200-3400	8000 samples/s	12	96 Kbit/s
Wideband speech	50-7000	16000	14	224Kbit/s
Wideband audio two chanels	20-20,000	44,1 Ks/s	16 per chanel	1.412 Mbit/s two chanels
Color image		512 x 512	24	6.3 Mbit/s
CCIR TV		720 x 576 x 30	24	300 Mbit/s
HDTV		1280 x720 x 60	24	1327 Mbit/s

Compression is needed…

Telephone Bandwith Speech Coding Standards

Coder	Bit Rate (Kbit/s)	Quality	Complexity(MIPS)
Log PMC (G.711)	64	Toll 4-4.3 MOS	0.01
ADPMC (G.726)	16-40	Toll at 32 Kbits/s 4.1 MOS	2
LD-CELP (G.728)	16	4.0 MOS	30
RPE-LTP (GSM)	13	3.5 MOS	6
QCELP (IS-96)	0.8-8.5 (variable)	3.3 MOS	15
VSELF (IS-54)	7.95	3.5 MOS	14
EFR (IS-641)	8	3.8 MOS	14
EVRC (IS-127)	1.2-9.6 (variable)	3.8 MOS	20
CS-ACELP (G.729)	8	4.0 MOS	20
CS-ACELP (G.729A)	8	3.75 MOS	11
MPC-MLQ (G.723.1)	5.3-6.4	3.5 MOS	16
CELP (FS 1016)	4.8	3.2 MOS	16



Videoconferencing Standards

Standard	Network	Video	Audio
H.320 (1990)	ISDN	H.261	G.711
H.323 (1996)	LANs/Internet	H.261	G.711
H.324 (1995)	PSTN	H.263	G.723.1
H.310 (1996)	ATM/B-ISDN	H.262	MPEG-1

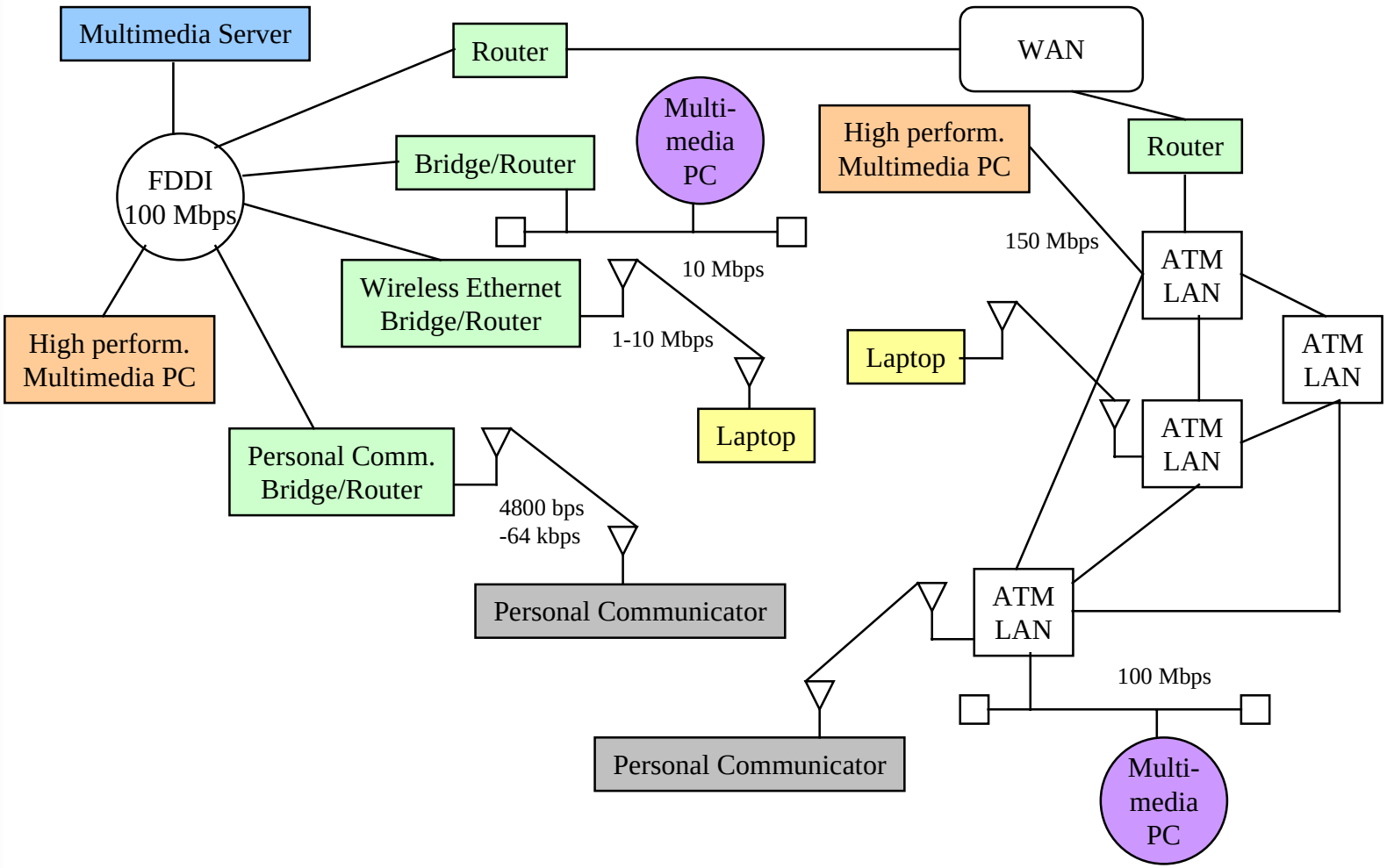
Source and Destination Terminals

Terminal:
Any device that connects a user to the network

Applications of Multimedia Communications Networks

- The two most common multimedia communications applications are:
  - Video streaming to multiple users
  - Party-to-party or multiparty videoconferencing

Video Streaming to Multiple Users



Videoconferencing

- One-to-one
  - Relatively easy to deal with
  - Latency, round trip delay
  - Users negotiate compression methods and transmission rates
  - Audio has priority

Videoconferencing (cont.)

- Multiparty videoconferencing
  - All participants receive all audio
    - Mixing the audio from all participants at a central location
    - For each participants to transmit audio of all other participants (requires same coding method)
  - Video to display
    - All participants see all the others (Hollywood Squares)
    - Director control
    - Loudest audio control

Conclusions

- Delivery of multimedia content via seamless network connectivity is becoming reality
- New solutions are developed every day