Voice over IP: Issues and Challenges
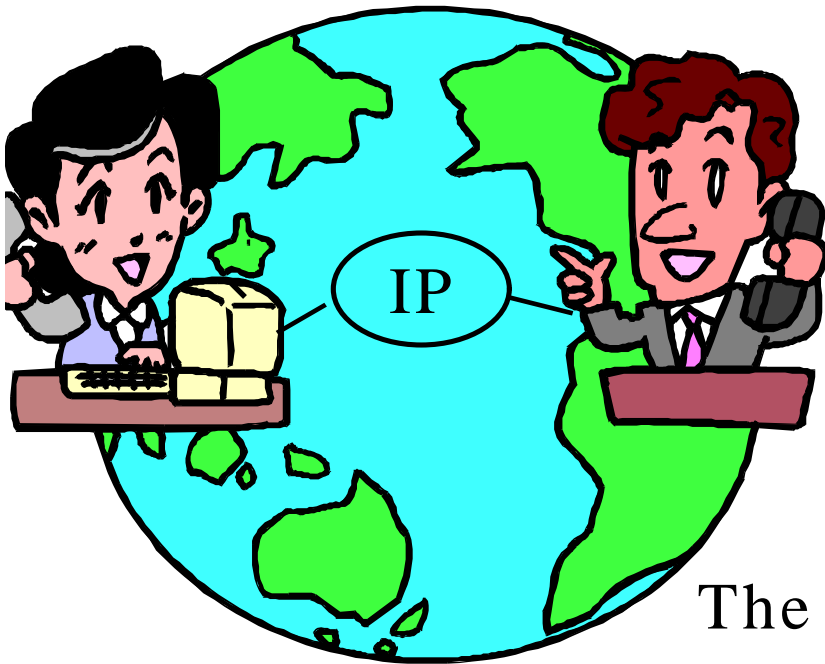
IP

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Overview

Voice over IP: Why?

Sample Products and Services

3 Technical Issues

Other Issues

Protocols

H.323 Standard

Market

International VOIP calls could cost 1/5th of normal rates $\Rightarrow$ Big share of $18B US to foreign calls. $15B within Europe.

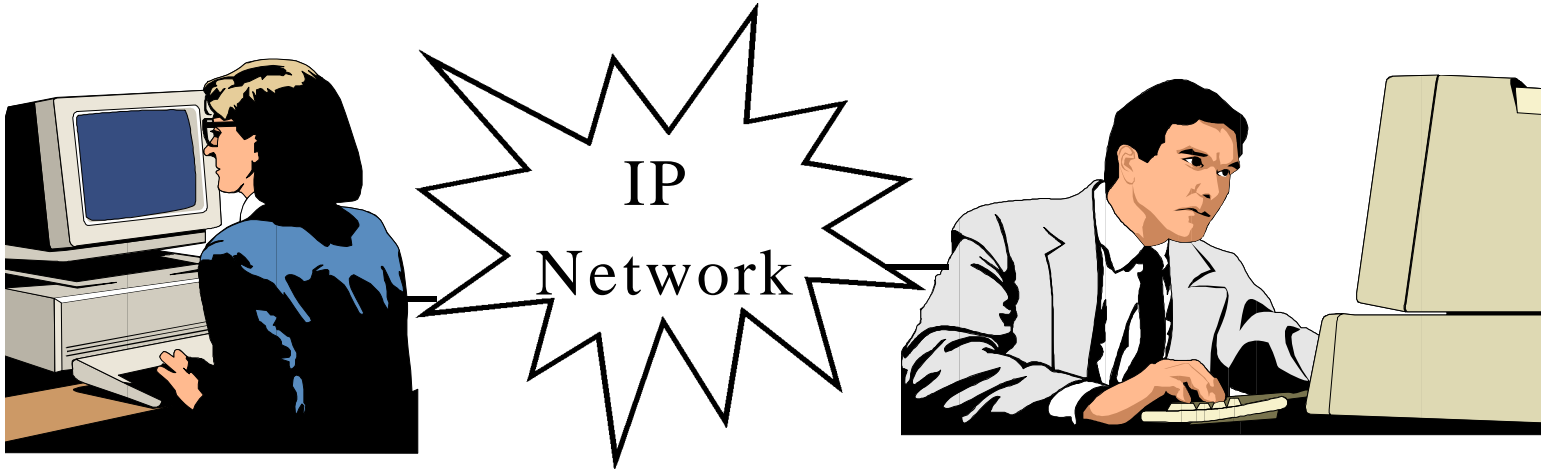500,000 IP telephony users at the end of 1995.

5% of all voice calls on IP/Internet by 2000 $\Rightarrow$ 10M users and $500M in VOIP product sales in 1999 [IDC]

US VOIP service will grow from $30M in 1998 to $2B in 2004 [Forester Research]

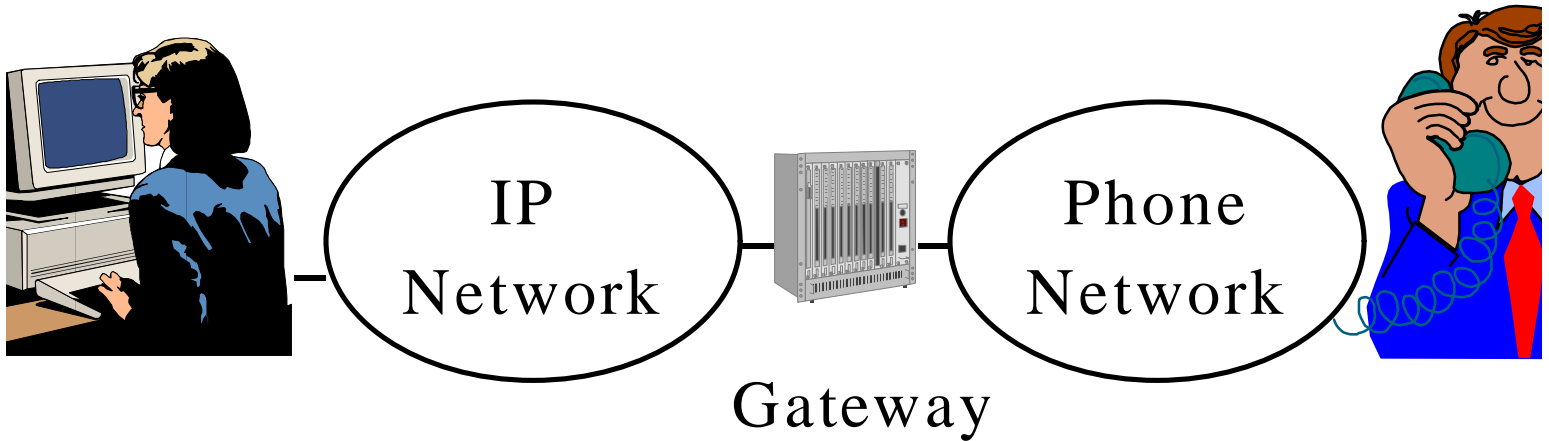$2B in 2001 and $16B by 2004 [Frost & Sullivan]

Scenario 1: PC to PC

IP Network

Need a PC with sound card
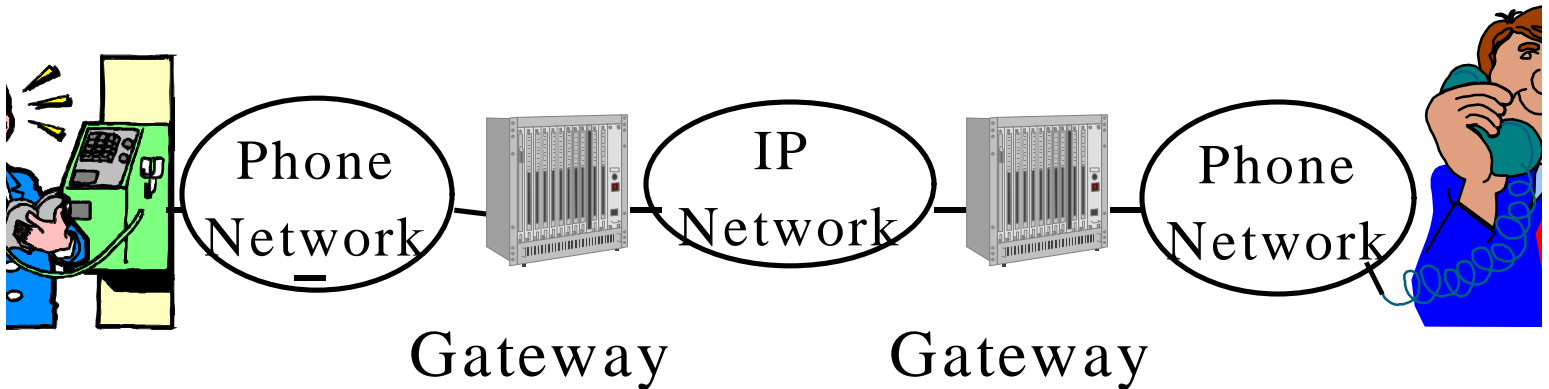
IP Telephony software: Cuseeme, Internet Phone, ..

Video optional

Scenario 2: PC to Phone

IP Network   Gateway   Phone Network

Need a gateway that connects IP network to phone network (Router to PBX)

Scenario 3: Phone to Phone

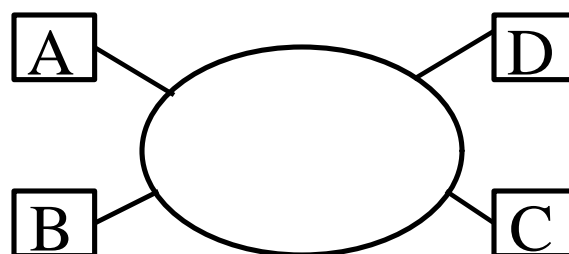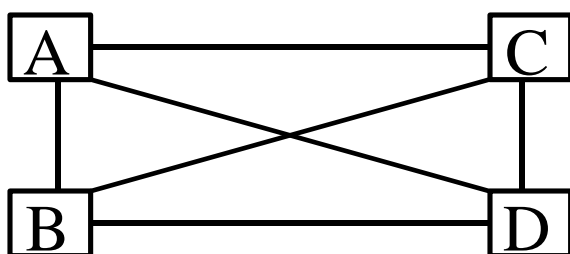Phone Network — Gateway — IP Network — Gateway — Phone Network

Need more gateways that connect IP network to pho[ne] networks

The IP network could be dedicated intra-net or the [I]nternet.

The phone networks could be intra-company PBXs [or] the carrier switches

Advantages

Private voice networks require n(n-1) access links.
Private data networks require only n access links.

Voice has per-minute distance sensitive charge
Data has flat time-insensitive distance-insensitve charge

Easy alternate routing $\Rightarrow$ More reliability

No 64kbps bandwidth limitation
$\Rightarrow$ Easy to provide high-fidelity voice

Applications

Any voice communication where PC is already used

❍ Document conferencing

❍ Helpdesk access

❍ On-line order placement

nternational callbacks

many operators use voice over frame relay)

ntranet telephony

nternet fax

Sample Products

VocalTec Internet Phone: PC to PC.

Microsoft NetMeeting: PC to PC. Free.

Internet PhoneJACK: ISA card to connect a standard phone to PC. Works with NetMeeting, InternetPhone etc. Provides compression.

Internet LineJACK: Single-line gateway.

Micom V/IP Family:

❍ Analog and digital voice interface cards

❍ PC and/or gateway

Products (Cont)

PBX — Gateway

PC w V/IP S/w — Router — IP Network
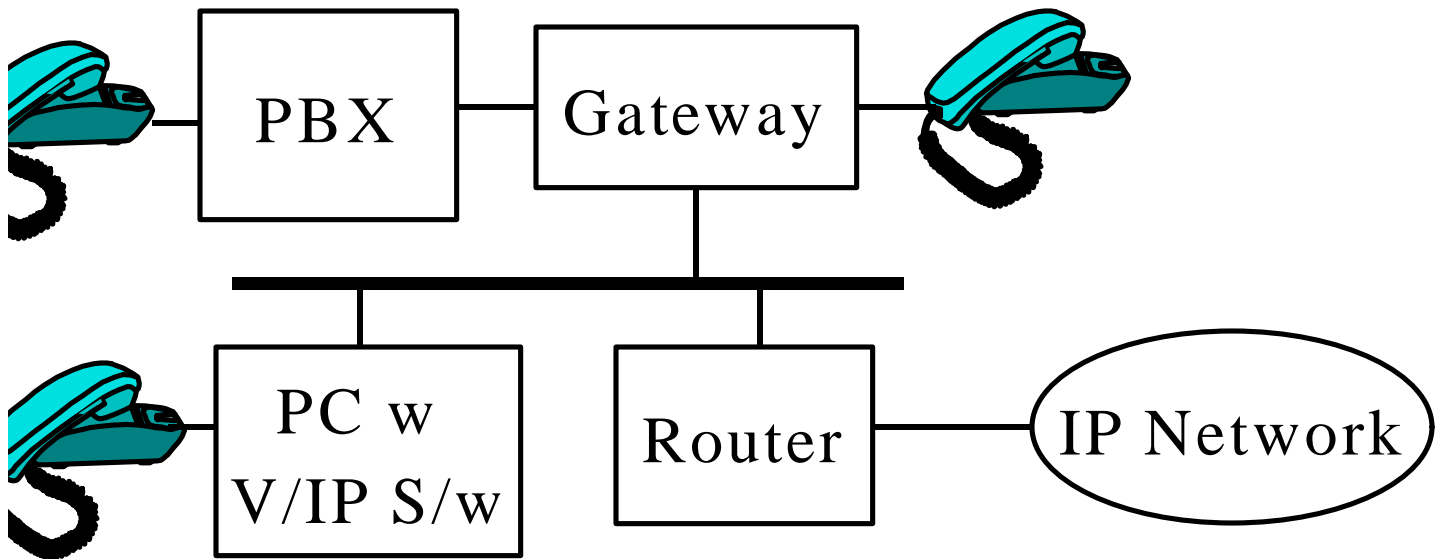
○ Features:

  ❑ Compression

  ❑ Phone number to IP address translation.

  ❑ Supports RSVP.

  ❑ Limits number of calls.

Products (Cont)

VocalTec Internet Telephony Gateway:

❍ Similar to Micom V/IP

❍ Interactive voice response system for problem reporting

❍ Allows WWW plug in

❍ Can monitor other gateways and use alternate routes including PSTN

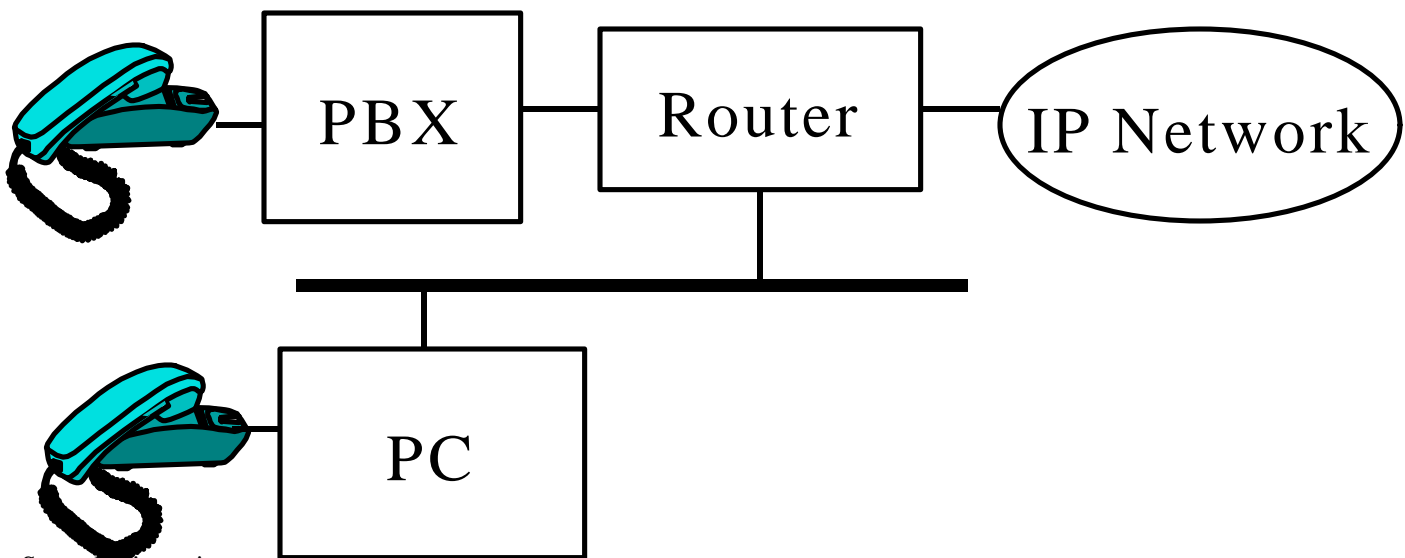❍ Sold to Telecom Finland. New Zealand Telecom.

Lucent's Internet Telephony Server: Gateway|
Lucent PathStar Access Server

Products (Cont)

CISCO 2600 Routers: Voice interface cards (VICs) Reduces one hop.

Baynetworks, 3COM, and other router vendors have announced product plans

Sample Services

DT Corporation offers Net2Phone, Carrier2Phone, Phone2Phone services.

Global Exchange Carrier offers international calls using VocalTec InternetPhone s/w and gateways

Qwest offers 7.5¢/min VOIP Q.talk service in 16 cities.

ITXC provides infrastructure and management to Internet Telephone Service Providers (ITSPs)'

America On-line offers 9¢/min service.

AT&T announced 7.5¢/min VOIP trials in 9 US citie

Services (Cont)

Other trials: USA Global link, Delta 3, WorldCom, MCI, U.S. West, Bell Atlantic, Sprint, AT&T/Japan, KDD/Japan, Dacom/Korea, Deutsche Telekom in Germany, France Telecom, Telecom Finland, and New Zealand Telecom.

Level 3 is building a nation wide IP network for telephony.

Bell Canada has formed 'Emergis' division.

Bellcore has formed 'Soliant Internet Systems' unit

Bell Labs has formed 'Elemedia' division

Technical Issues

Large Delay

❍ Normal Phone: 10 ms/kmile $\Rightarrow$ 30 ms coast-to-coast

❍ G.729: 10 ms to serialize the frame + 5 ms look ahead + 10 ms computation = 25 ms one way algorithmic delay

❍ G.723.1 = 100 ms one-way algorithmic delay

❍ Jitter buffer = 40-60 ms

❍ Poor implementations $\Rightarrow$ 400 ms in the PC

❍ In a survey, 77% users found delay unacceptable.

Technical Issues (Cont)

Delay Jitter: Need priority for voice packets. Shorter packets? IP precedence (TOS) field.
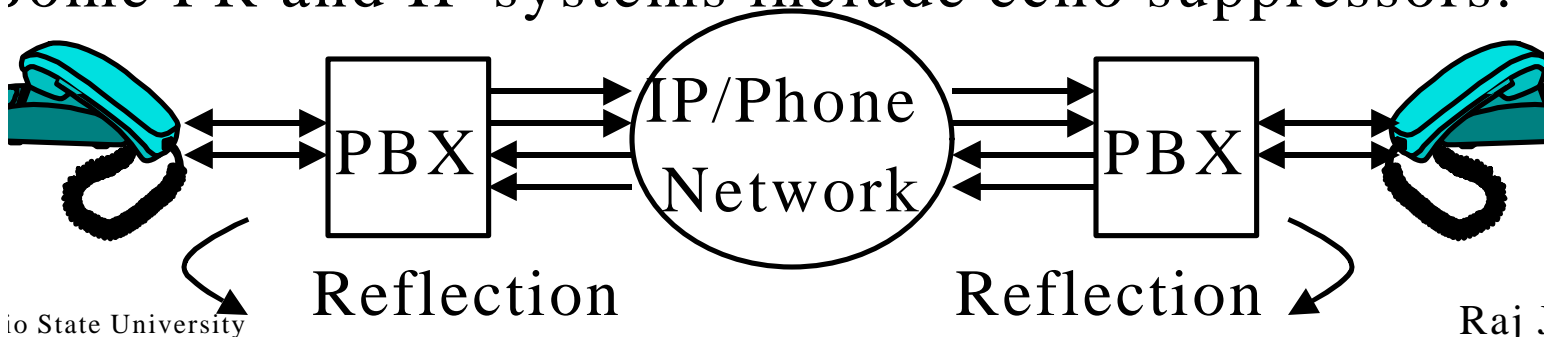
Frame length: 9 kB at 64 kbps = 1.125 s
Smaller MTU $\Rightarrow$ Fragment large packets

Lost Packets: Replace lost packets by silence, extrapolate previous waveform

Echo cancellation: 2-wire to 4-wire.
Some FR and IP systems include echo suppressors.

PBX — IP/Phone Network — PBX

Reflection   Reflection

Technical Issues (Cont)

Silence suppression

Address translation: Phone # to IP. Directory servers

Telephony signaling: Different PBXs may use differ
signaling methods.

Bandwidth Reservations: Need RSVP.

Multiplexing: Subchannel multiplexing
$\Rightarrow$ Multiple voice calls in one packet.

Security: Firewalls may not allow incoming IP traf

Insecurity of internet

Voice compression: Load reduction

Other Issues

Per-minute distance-sensitive charge vs flat time-insensitive distance-insensitive charge

Video requires a bulk of bits but costs little. Voice is expensive. On IP, bits are bits.

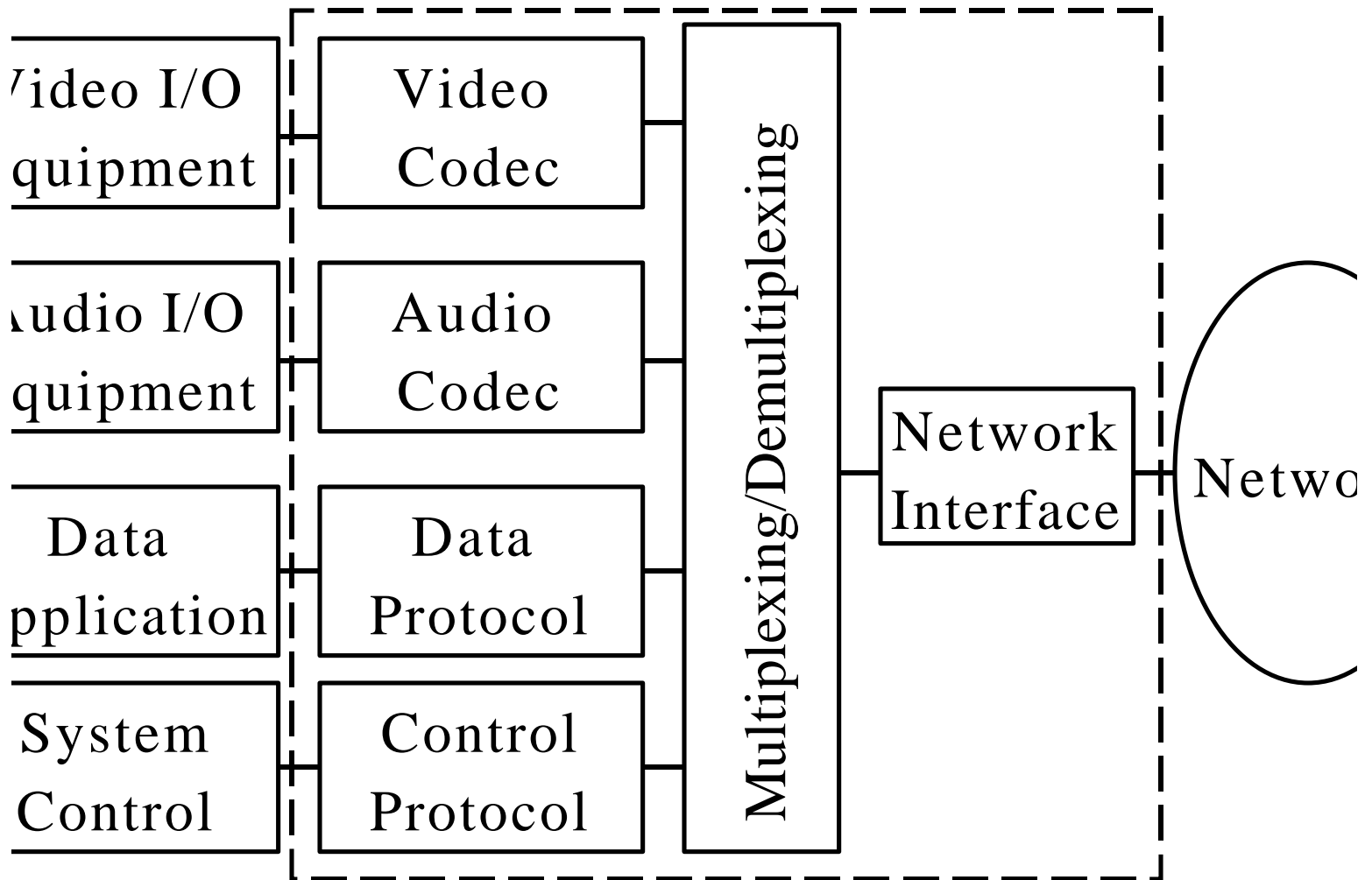National regulations and government monopolies
⇒ Many countries forbid voice over IP
In Hungary, Portugal, etc., it is illegal to access a we site with VOIP s/w. In USA, Association of Telecommunications Carriers (ACTA) petitioned FC to levy universal access charges in ISPs

Modem traffic can't get more than 2400 bps.

Video I/O Equipment	Video Codec		
Audio I/O Equipment	Audio Codec	Multiplexing/Demultiplexing	Network Interface
Data Application	Data Protocol		
System Control	Control Protocol		

Netwo

Conferencing Standards

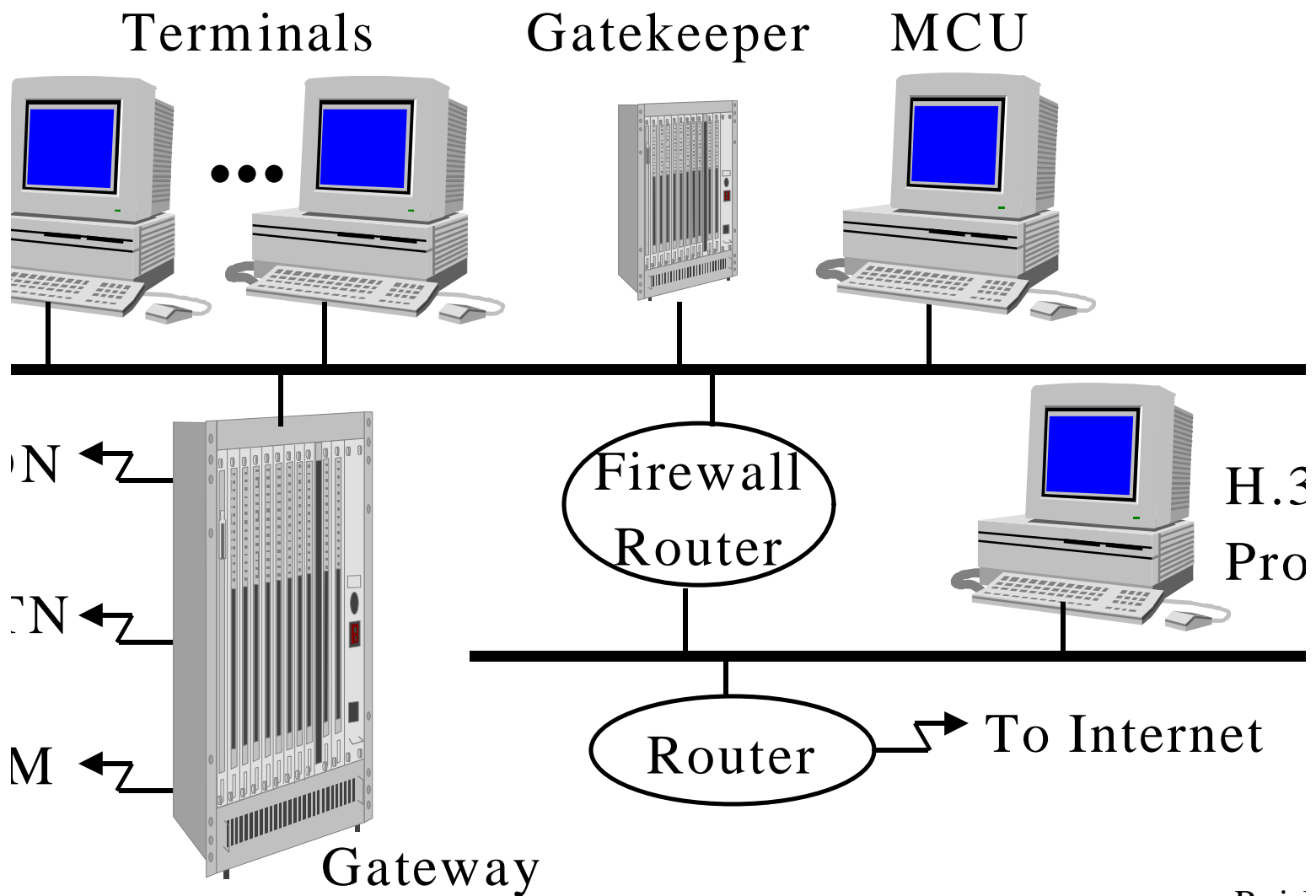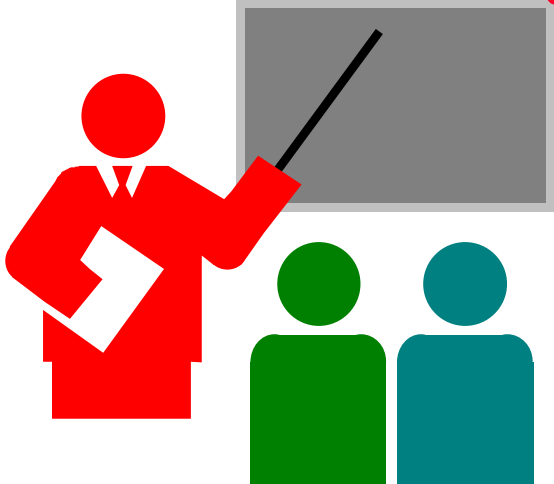| etwork	ISDN	ATM	PSTN	LAN	POTs
onf. Std.	H.320	H.321	H.322	H.323 V1/V2	H.324
ear	1990	1995	1995	1996/1998	1996
udio odec	G.711, G.722, G.728	G.711, G.722, G.728	G.711, G.722, G.728	G.711, G.722, G.723.1, G.728, G.729	G.723.1, G.729
udio Rates ps	64, 48-64	64, 48-64, 16	64, 48-64, 16	64, 48-64, 16, 8, 5.3/6.3	8, 5.3/6.3
ideo odec	H.261	H.261, H.263	H.261, H.263	H.261 H.263	H.261 H.263
ata Sharing	T.120	T.120	T.120	T.120	T.120
ontrol	H.230, H.242	H.242	H.242, H.230	H.245	H.245
ultiplexing	H.221	H.221	H.221	H.225.0	H.223
gnaling	Q.931	Q.931	Q.931	Q.931	-

H.323 Protocols

Multimedia over LANs

Provides component descriptions, signaling procedures, call control, system control, audio/video codecs, data protocols

Video	Audio		Control and Management			Da
H.261 H.263	G.711, G.722, G.723.1, G.728, G.729	RTCP	H.225.0 RAS	H.225.0 Signaling	H.245 Control	T.1
RTP			X.224 Class 0			T.1
UDP			TCP			T.1
Network (IP)						
Datalink (IEEE 802.3)						

H.323 Components

Terminals   Gatekeeper   MCU

• • •

N

N

M

Firewall
Router

H.3

Pro

Router   → To Internet

Gateway

Summary

Voice over IP products and services are being rolled

deal for computer-based communications

P needs QoS for acceptable quality

A number of working group at IETF are working on

H.323 provides interoperability

References

See

http://www.cis.ohio-state.edu/~jain/refs/ref_voip.htm

for a detailed list of references.

Thank You!