Voice Over IP

Session 134

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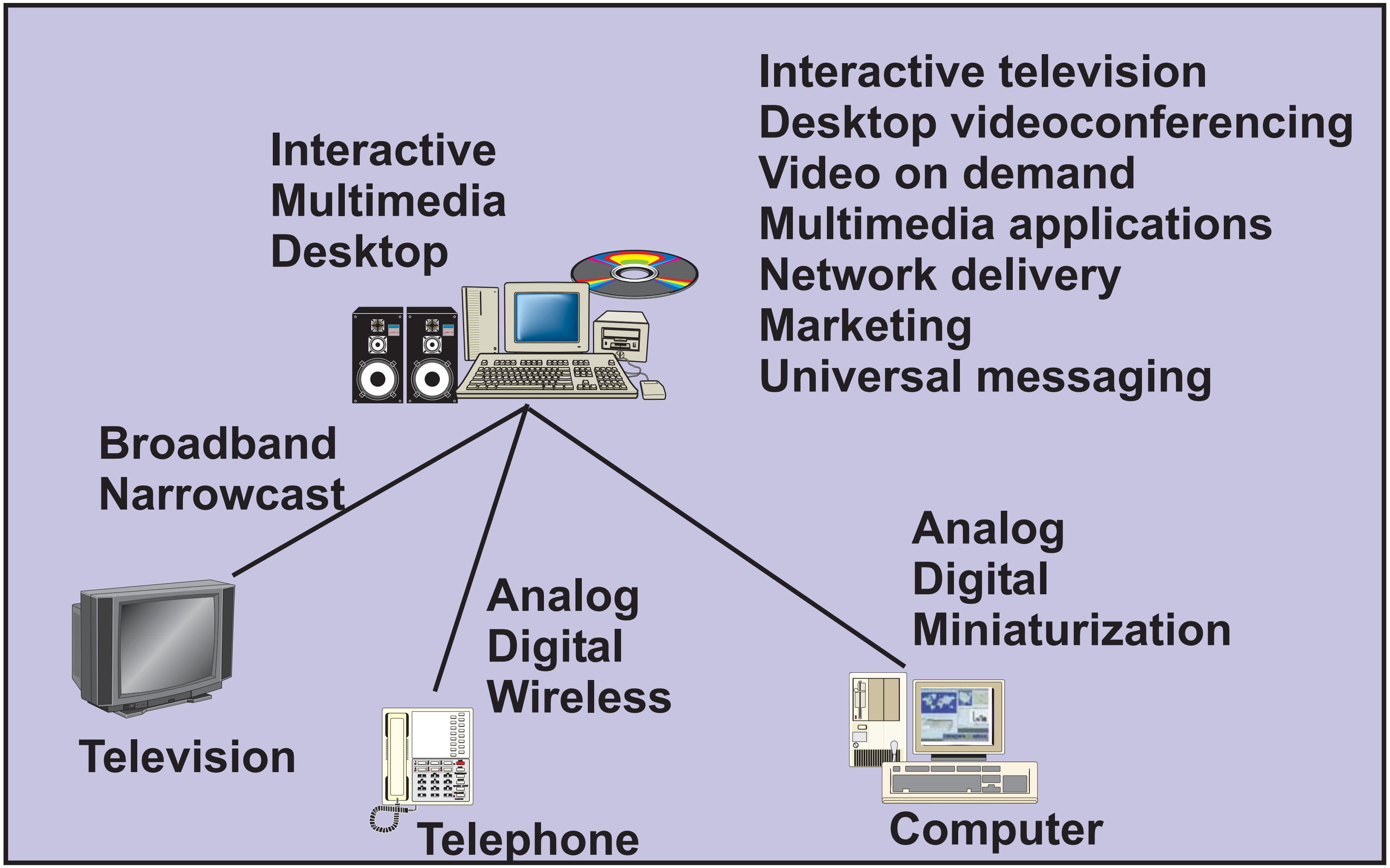
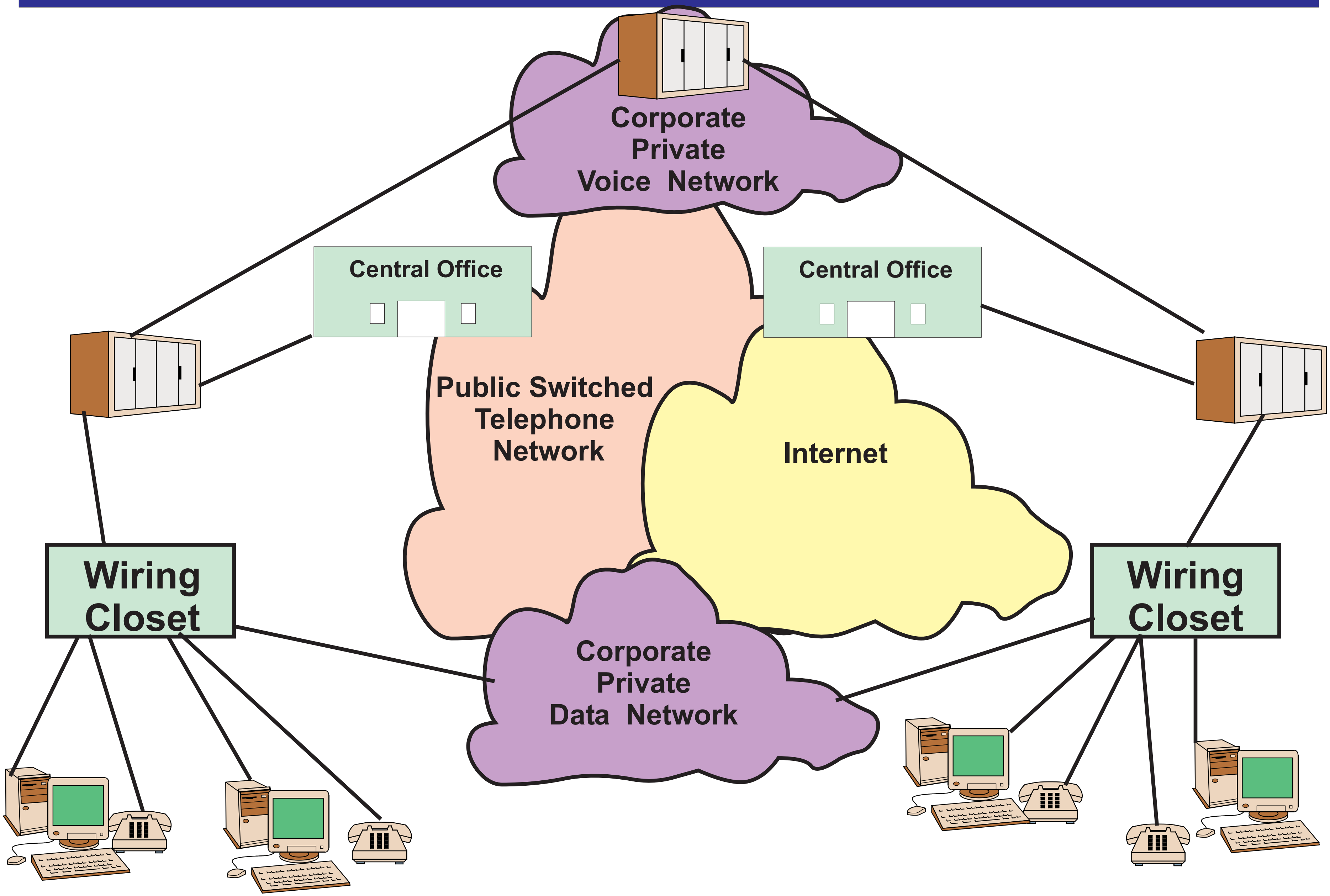
Technology Convergence

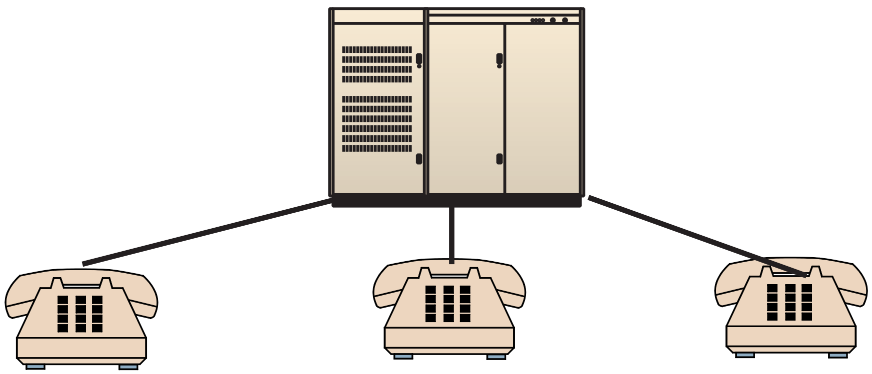
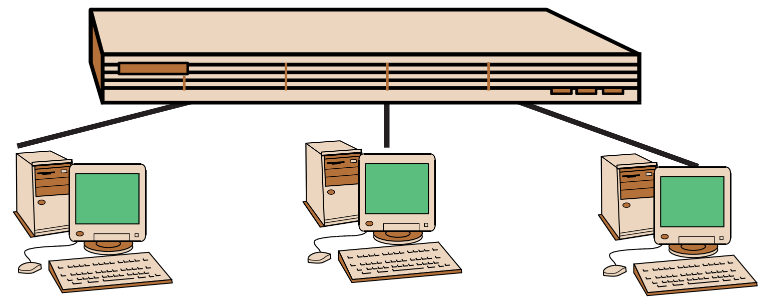


What about Network convergence?

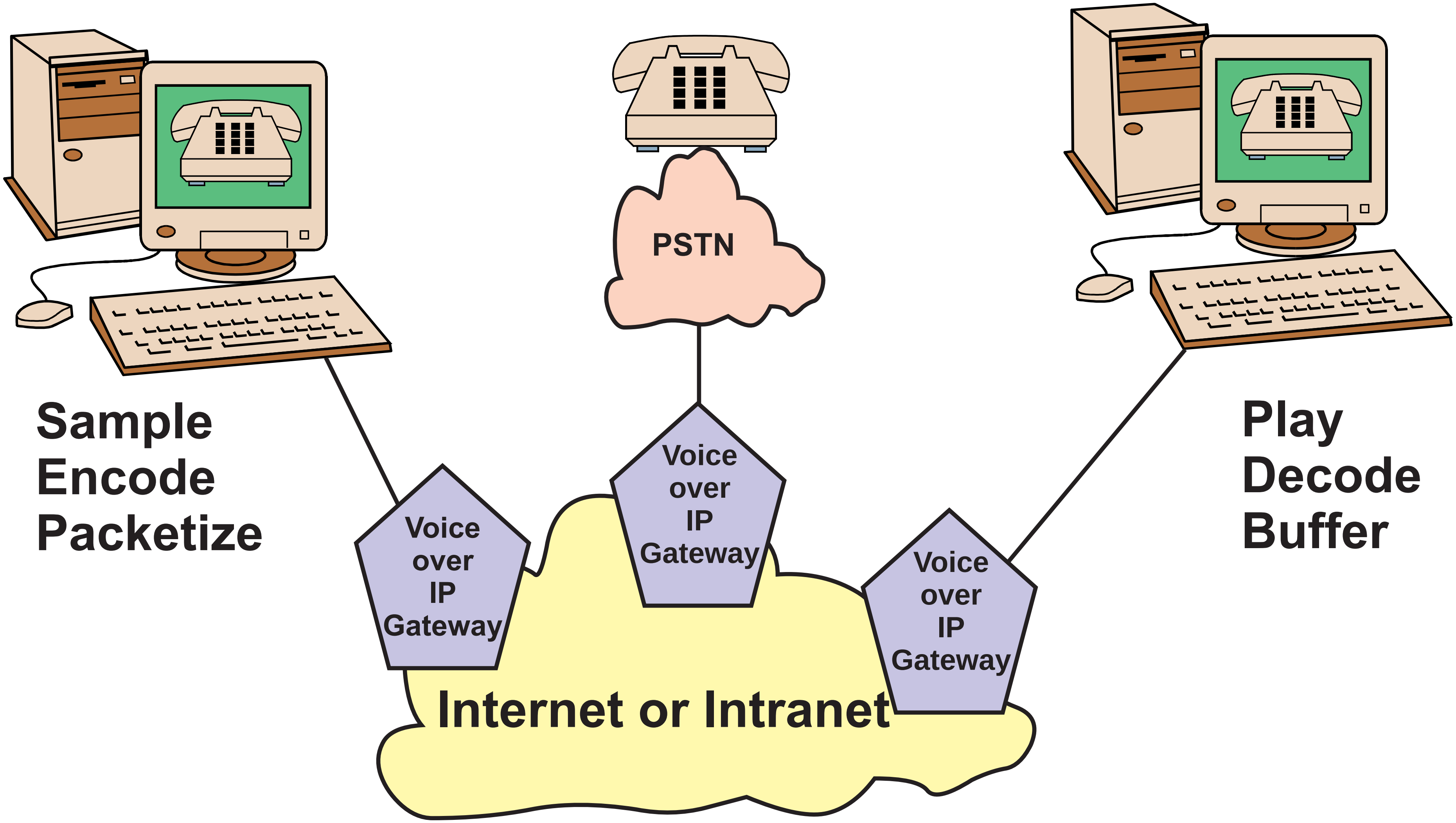
Voice and Data Networks



Voice and Data Switch Similarities

Class 5 Switch	Multilayer Switch
	
Handset aggregator	Computer aggregator
All telephones get a single analog/digital line	All devices get dedicated bandwidth
All devices have a phone number defined on the switch	All devices have an IP address defined on the host
Traffic engineering provides non-blocking	Non-blocking devices available
Path selection based on static least cost routing	Path selection based on dynamic routing protocol

Providing Voice Functions



Sample
Encode
Packetize

Play
Decode
Buffer

Coordinating IP and PSTN addresses
DNS resolution
Call setup

Choice of Solutions

H.323

SIP - Session Initiation Protocol

MGCP - Media Gateway Control Protocol

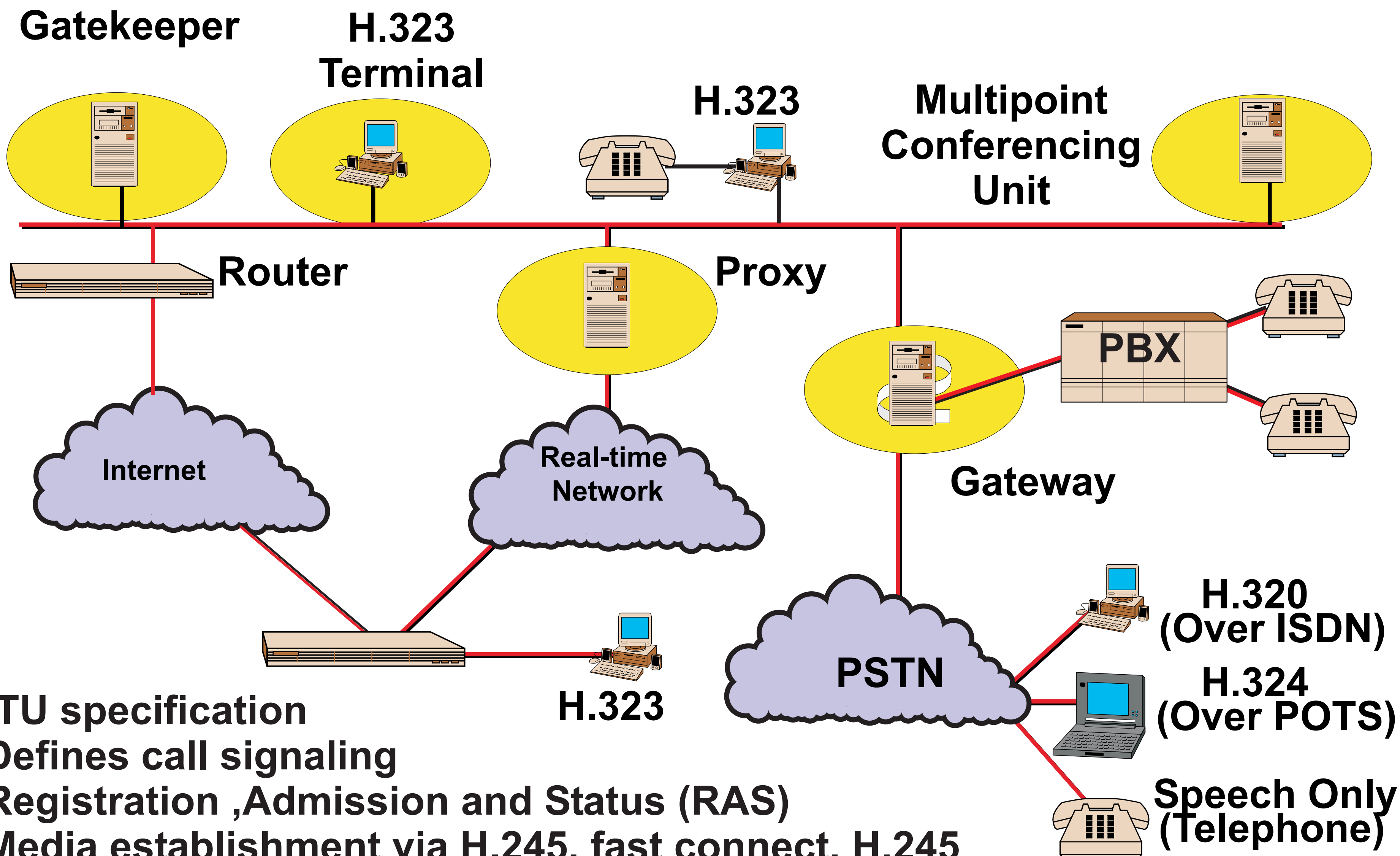
You need to understand what technologies vendors support as you make your decisions

- What do their endpoints support for signaling?
- What do their gateways support for signaling?
- What do their call centers support for signaling?

H.323 Structure and IP

IP Layered Model	H.323 VoIP Model
User	Caller
Application	Email ID E.164 Phone Number
Presentation	Audio Codec (G.711, G.729, G.723.1,..)
Session	H.225, H.245, RTP, RTCP
TCP | UDP	UDP Port Number
IP	IP Address
Data Link	Frame Relay DLCI, 802.3 MAC, ATM VPI/VCI
Physical	V.35, T1, T3

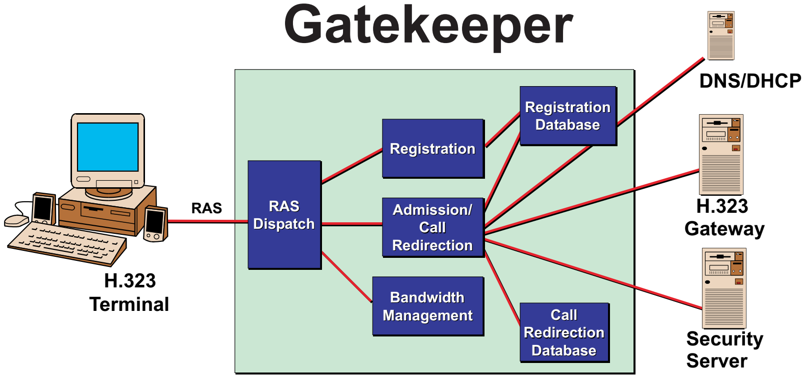
H.323 Infrastructure



- ITU specification
- Defines call signaling
- Registration ,Admission and Status (RAS)
- Media establishment via H.245, fast connect, H.245 tunneling

H.323 Components

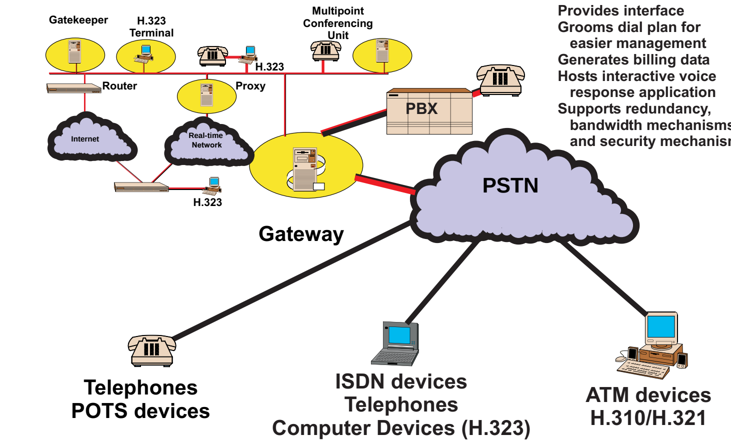
Gatekeeper



Mandatory
- Address translation
- Admissions control
- Bandwidth control
- Zone management

Optional
- Call control signaling
- Call authorization
- Bandwidth and call management
- Directory services

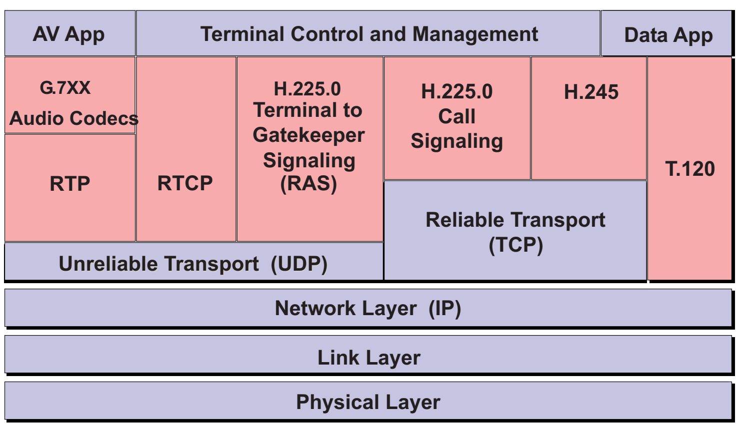
Gateway



Provides interface
Grooms dial plan for easier management
Generates billing data
Hosts interactive voice response application
Supports redundancy, bandwidth mechanisms, and security mechanisms

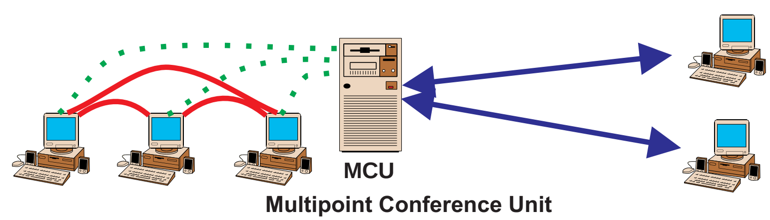
Converts between IP world and other networks

H.323 Terminal



Discovery to find Gatekeeper to use
Registers with Gatekeeper
Microsoft Netmeeting is often used H.323 compliant client
H.261 and H.263 provide video access

Multipoint Conference Unit



Decentralized site

Control processing
Terminal-terminal audio communication

Centralized site

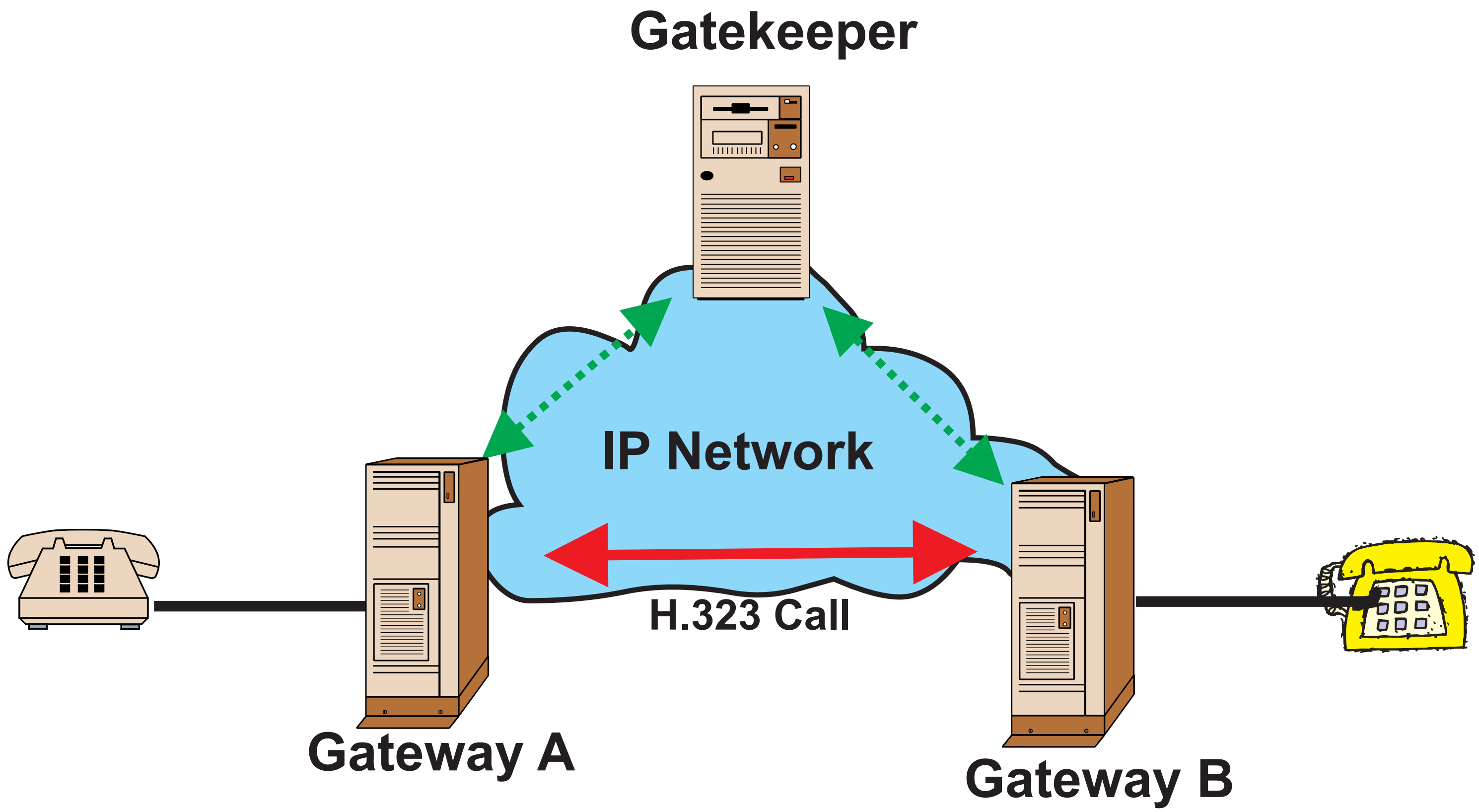
Control processing
Sends audio to participating terminals

Negotiates capabilities to ensure common level of communications

Supports decentralized and centralized multipoint conferences

Can control resources in multicast operation

H.323 Registration

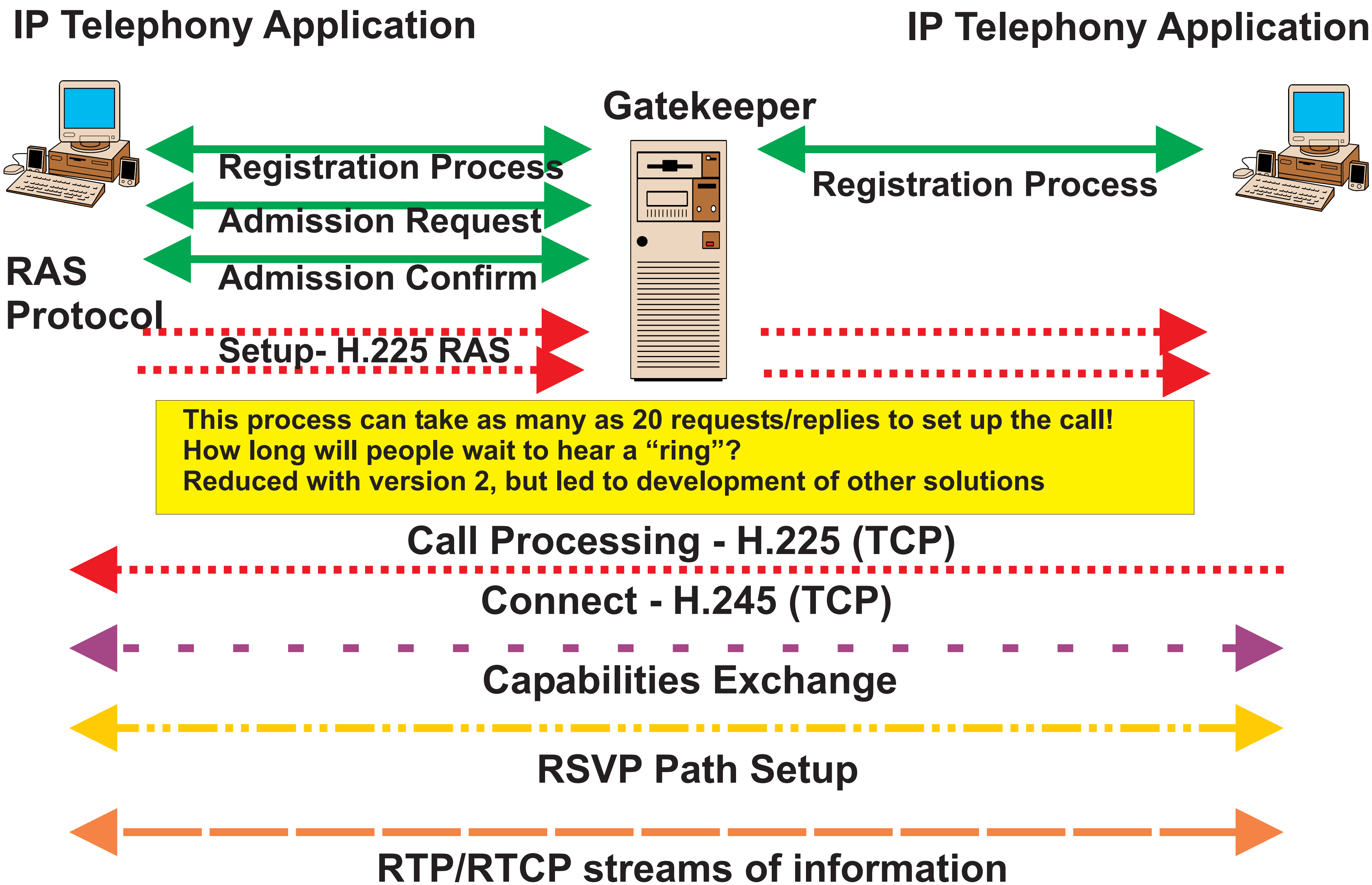


Gateways register with gatekeeper
(Knew gatekeepers address via either static or auto configuration)

Gateway A makes request to place a call, receives confirmation and receives IP address of gateway B

Gateway A places call to gateway B

H.323 Signaling



Real Time Protocol with Compression

4 Bytes	V E R		CC	M	Payload Type	Sequence Number
4 Bytes	RTP Timestamp					
4 Bytes	Synchronization Source (SSRC) ID					

Provides feedback on quality of data distribution

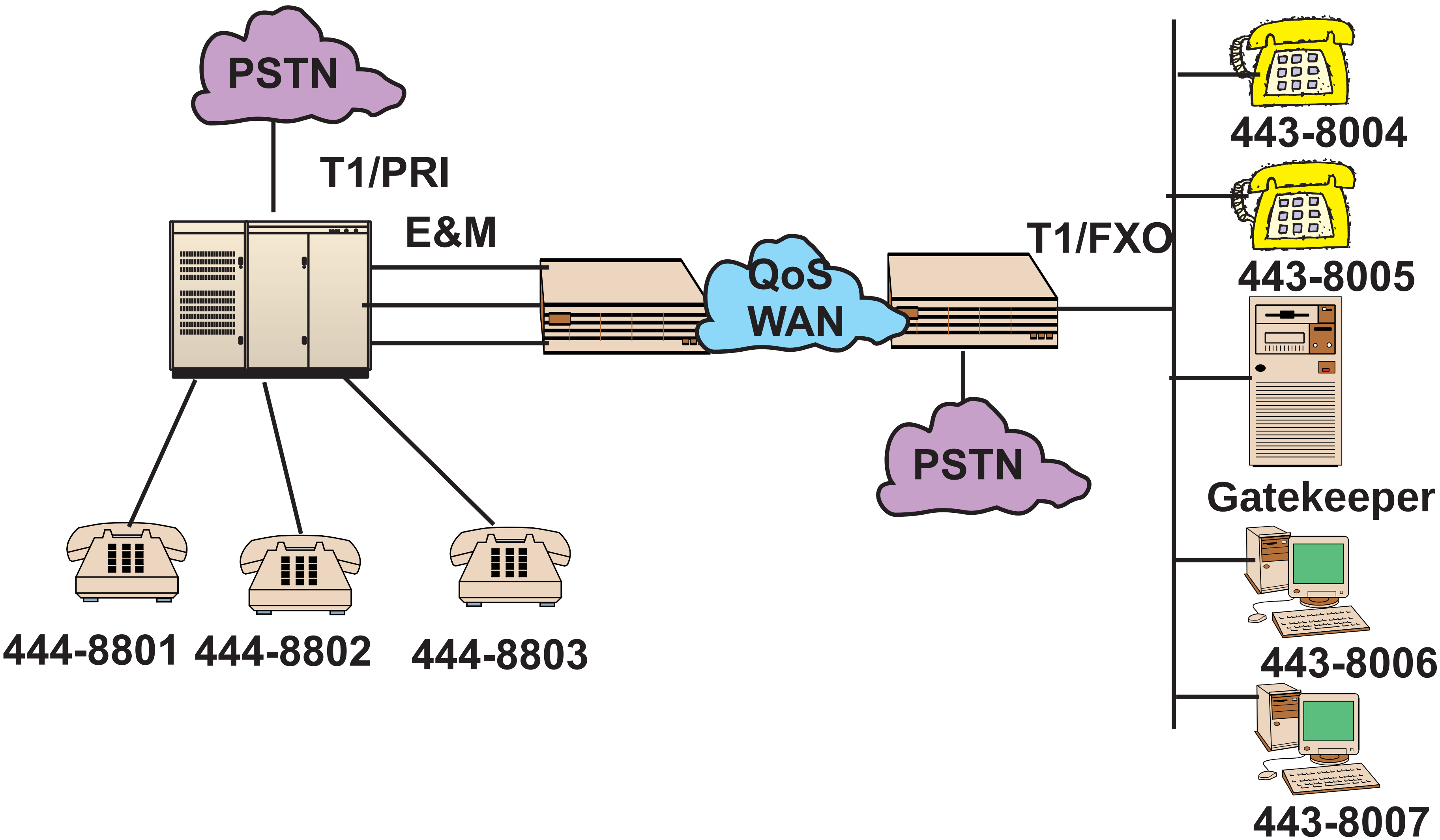
Tracks participants in an RTP session

Limits feedback send rate

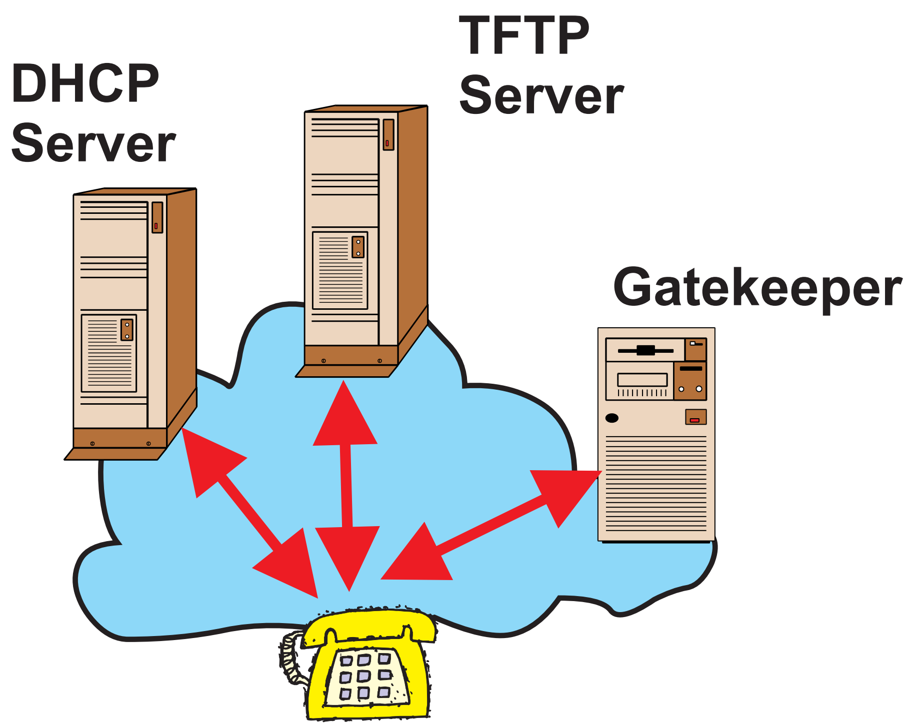
Conveys minimal session control information

Header compression: requires 20 byte payload
(20 ms @ 8kbps yields 20 byte payload)
(IP header =20; UDP header=8; RTP header=12)

IP Telephone



IP Telephone Call Setup



Phone makes DHCP request for IP information

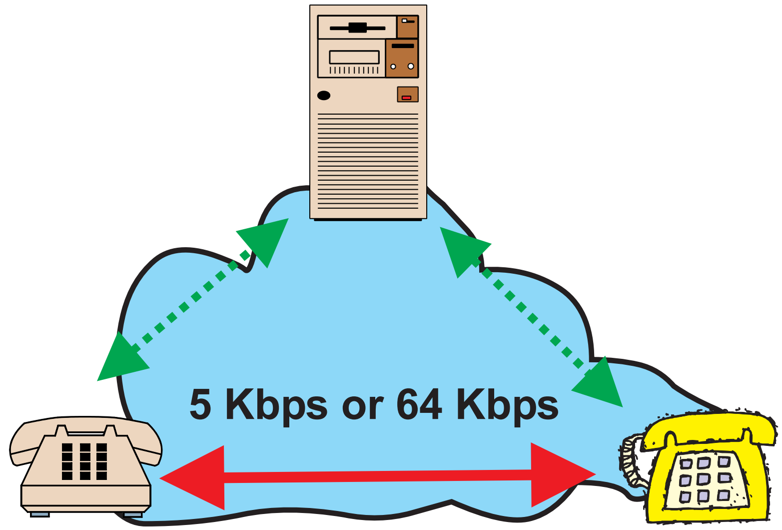
Phone makes TFTP boot file request to get gatekeeper

Phone registers with gatekeeper

Phone displays gatekeeper time/date

Phone is now ready to receive/place calls

IP Telephone Control



- Calling phone sends off-hook message to gatekeeper
- Gatekeeper directs phone to play dial-tone
- Phone sends dialed digits to Gatekeeper
- Gatekeeper rings called phone and accepts off-hook message
- Calling phone initiates VOIP RTP session
- Gatekeeper is notified of disconnect and records call details

H.323 and Other Advances

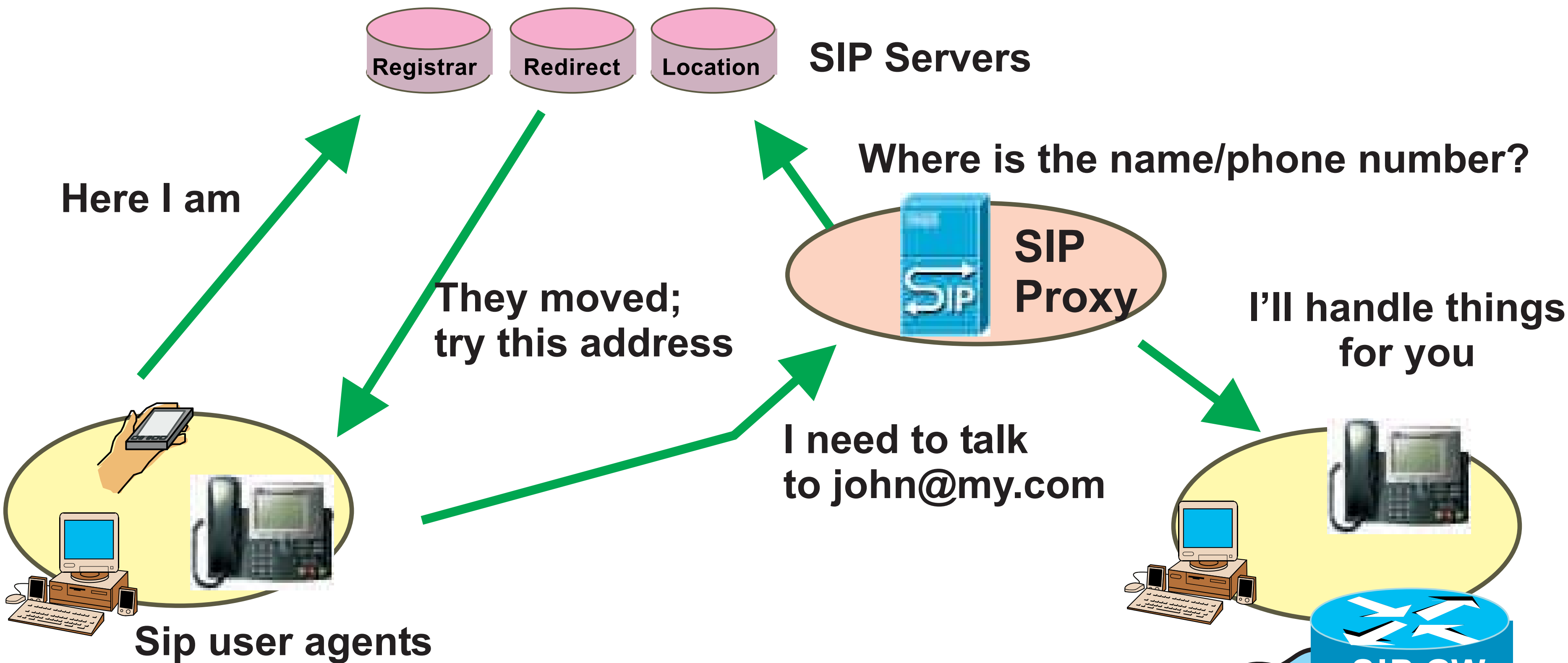
H.323 originally designed for LAN

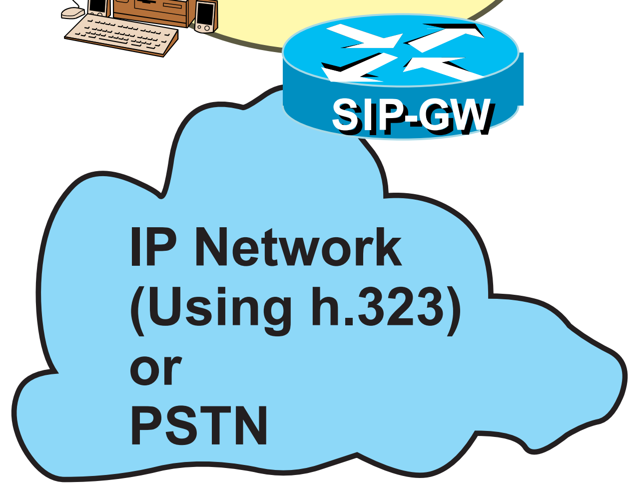
No concept of Internet
- wide area addressing
- loop cancellation
- call setup time

H.323v2
- fast connect
- call waiting
- RAS
- call transfer

H.323v3
- maintain and reuse
- multiplexing
- interdomain transfers
- call hold
- park
- pick-up
- message waiting

Session Initiation Protocol





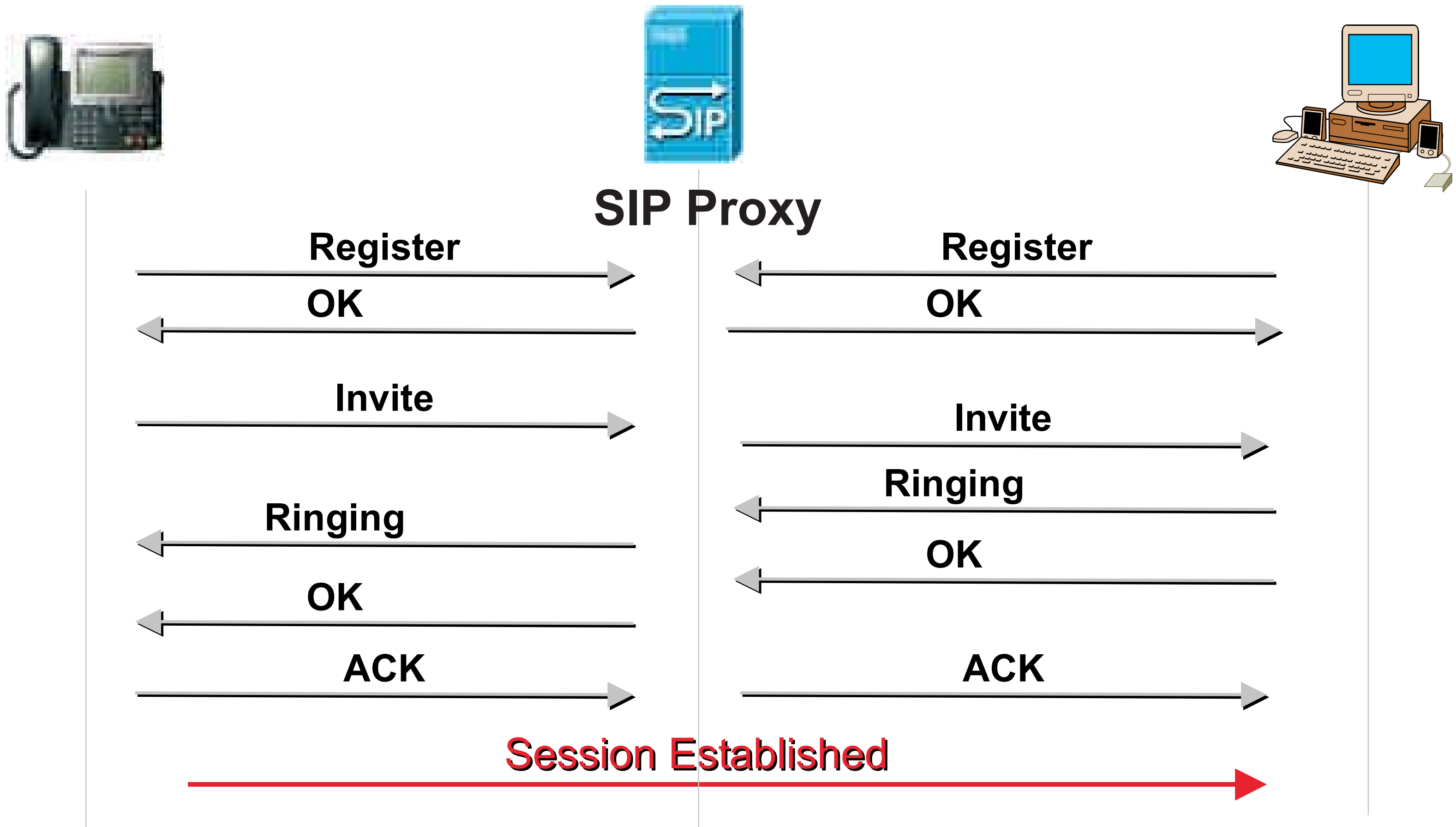
Compliments H.323 for intelligent edge devices

Compliments MGCP gateway

- MGCP provides device control
- SIP provides session control

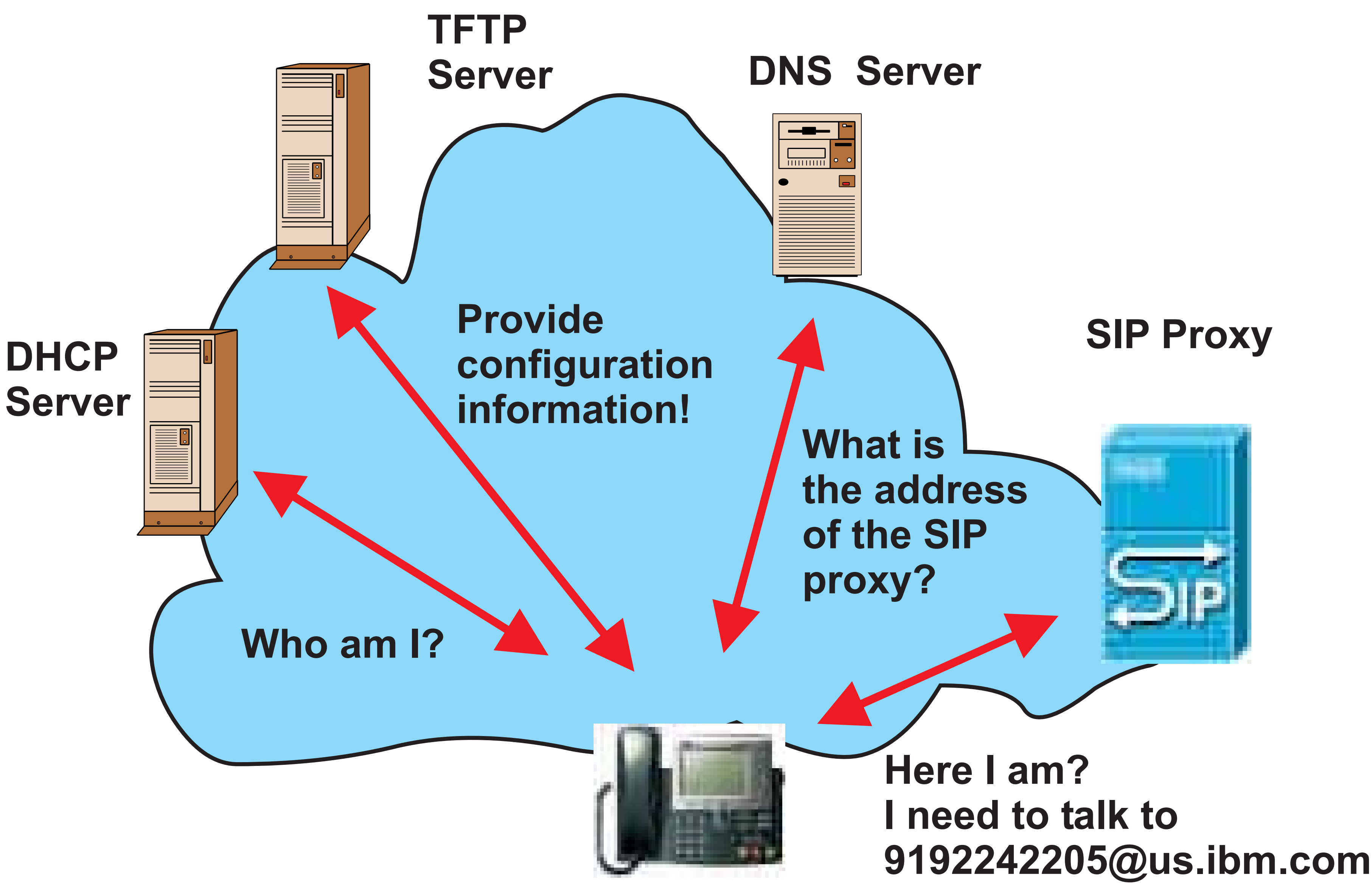
Uses either E.164, DNS, or E-mail for addressing

SIP - Session Initiation Protocol
RFC 2543

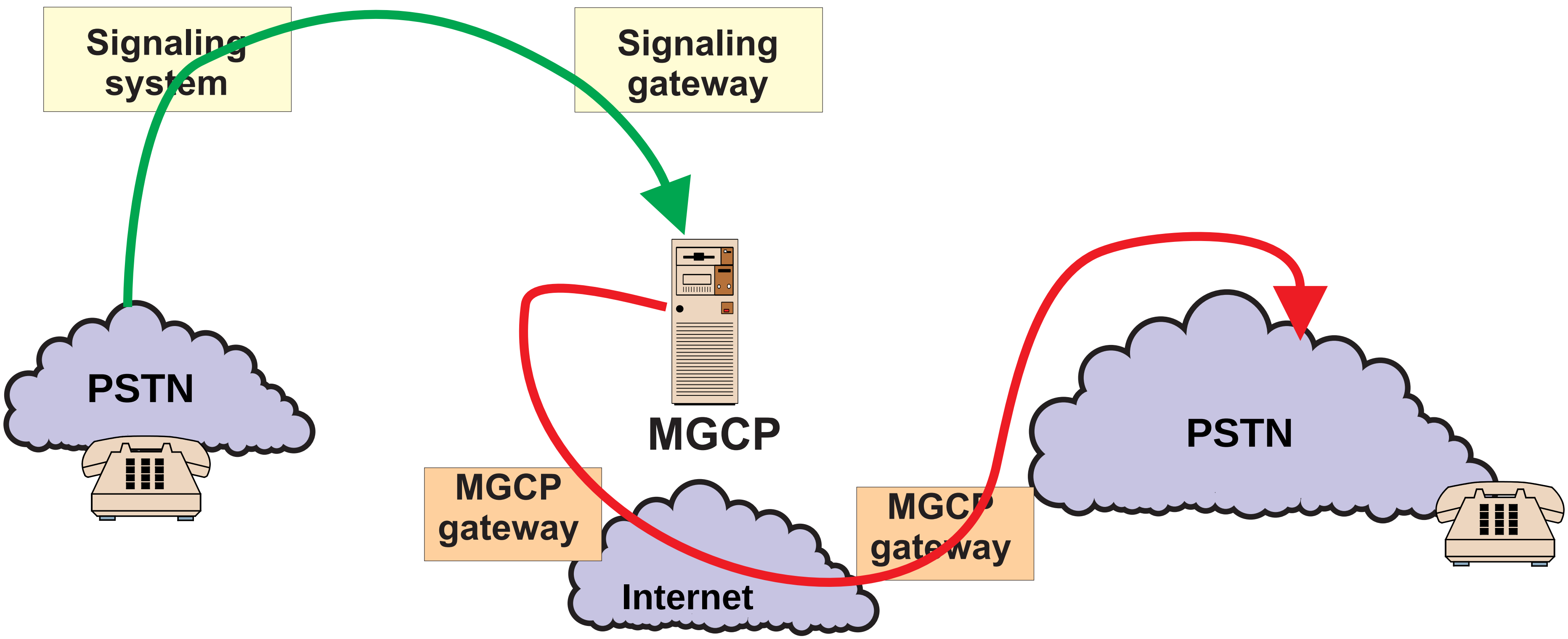


SIP defined by IETF RFC 2543
Defines transactions between clients and servers
Uses URL style addresses and syntax via E.164, E-mail, DNS
Simple extensible protocol
Works with both UDP and TCP (most implementations use UDP)

SIP - Phone


TFTP
Server
DNS Server
DHCP
Server
Provide
configuration
information!
SIP Proxy
What is
the address
of the SIP
proxy?
Who am I?
Here I am?
I need to talk to
9192242205@us.ibm.com

MGCP - Media Gateway Control Protocol



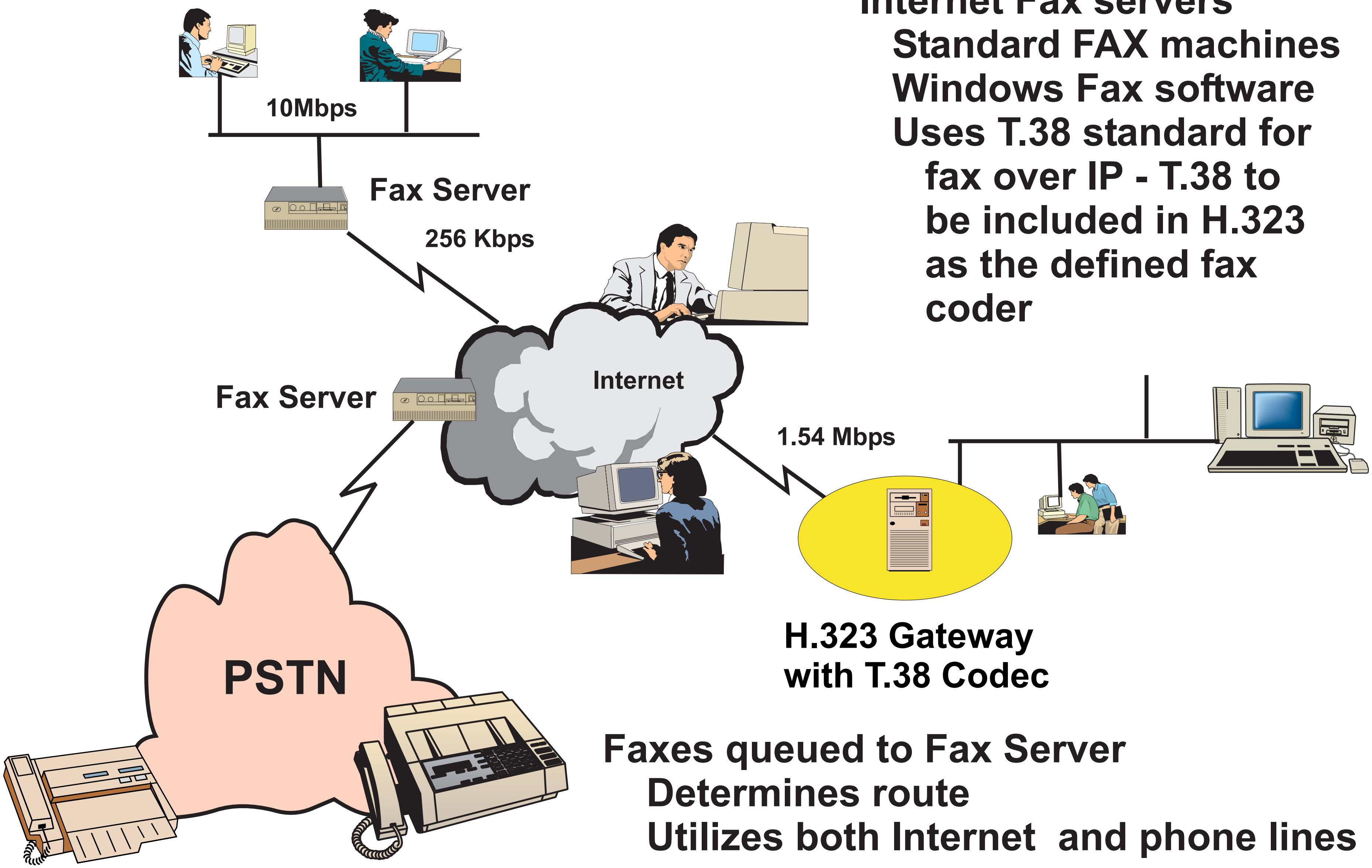
Designed for non-intelligent devices
Allows remote control of various devices
Create, modify and delete connections
Generate and detect events(tones)
Track resource states
Fits in well with H.323
Telcos support technology (trunking, residential and access gateways)

H.323 or SIP or MGCP: Confused?

	H.323	SIP	MGCP
Scope	Intelligent devices	Intelligent device	Non-intelligent devices
Call set-up	2 round trips*	1 round trip	2 round trips
Call control	Control multiple elements	Session control	Device control
Transport	TCP	UDP	UDP
Complexity	High	Low	Medium
Functionality	High	Low	Medium
Billing/Security	High	Low	Medium

Internet FAX

Internet Fax servers
- Standard FAX machines
- Windows Fax software
- Uses T.38 standard for fax over IP - T.38 to be included in H.323 as the defined fax coder

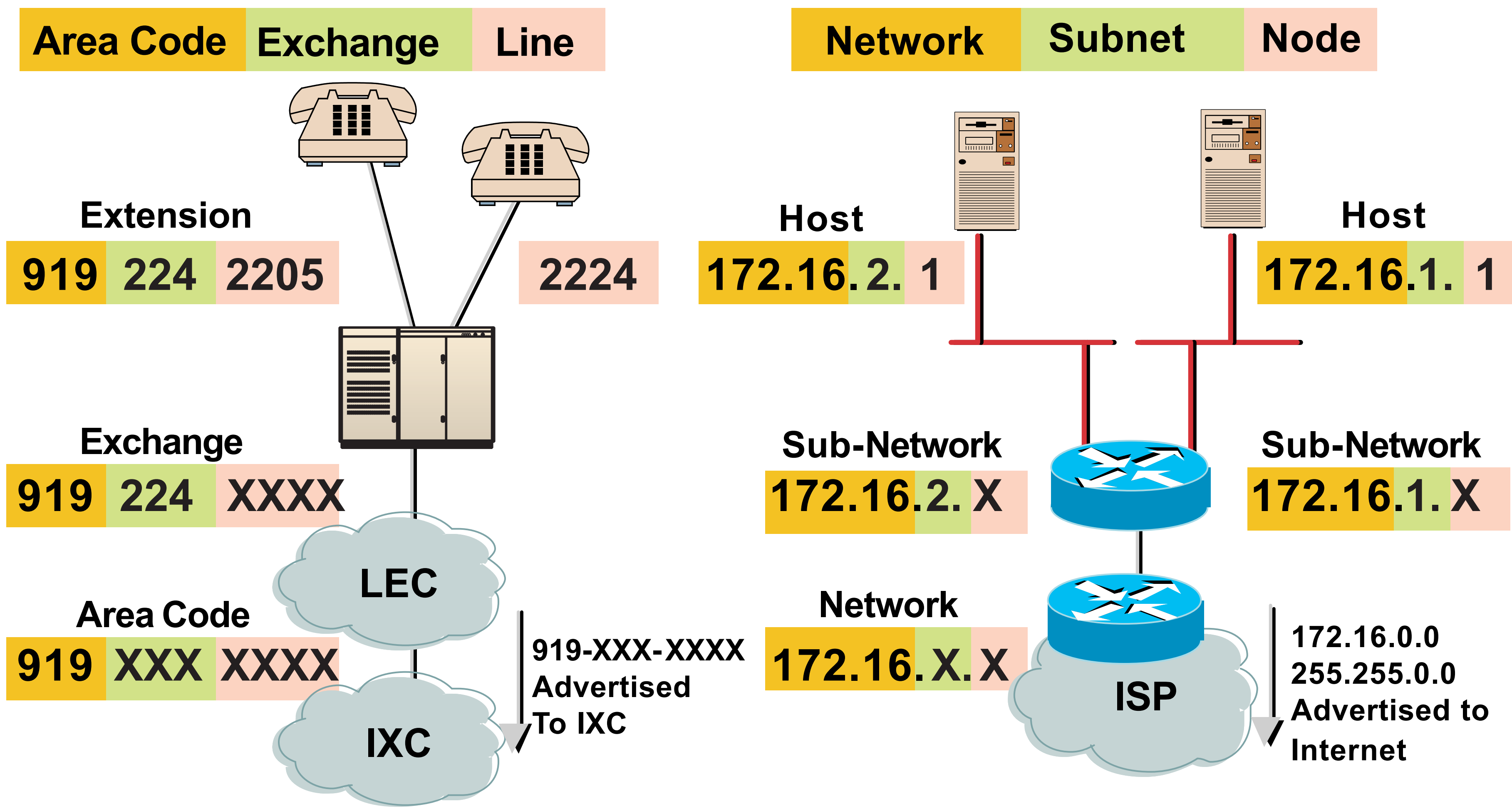


Faxes queued to Fax Server
- Determines route
- Utilizes both Internet and phone lines

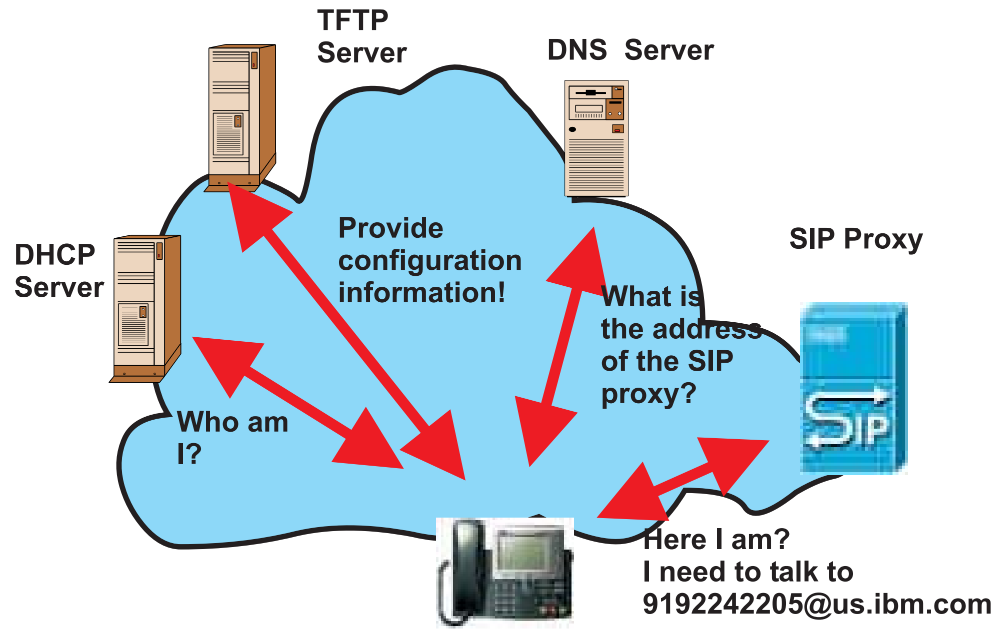
Voice Numbers and DNS Convergence

North American numbering plan direct inward dial

Internet Protocol Addressing



ENUM: Phone Numbers Meet the Net



DNS modified by RFC 2915 to add NAPTR field

Input to DNS: 5.0.2.2.4.2.2.9.1.9.1.e164.arpa

Output from DNS

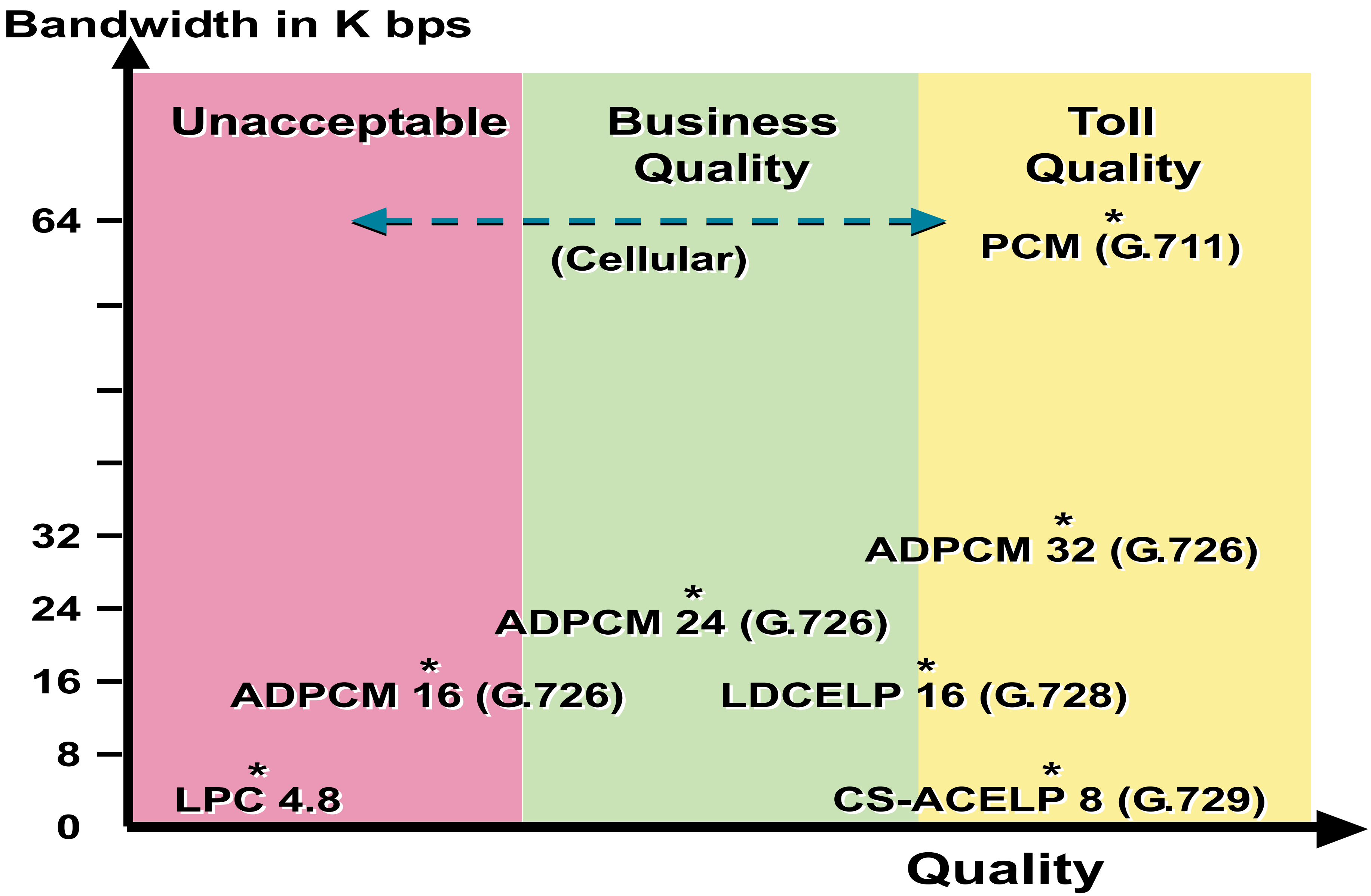
IN NAPTR 102 10 “u” “sip+E2U” “!^.”$!sip:laura@lauraknapp.com!”.

IN NAPTR 102 10 “u” “mailto+E2U” “!^.”$!mailto:ljknapp@us.ibm.com!”.

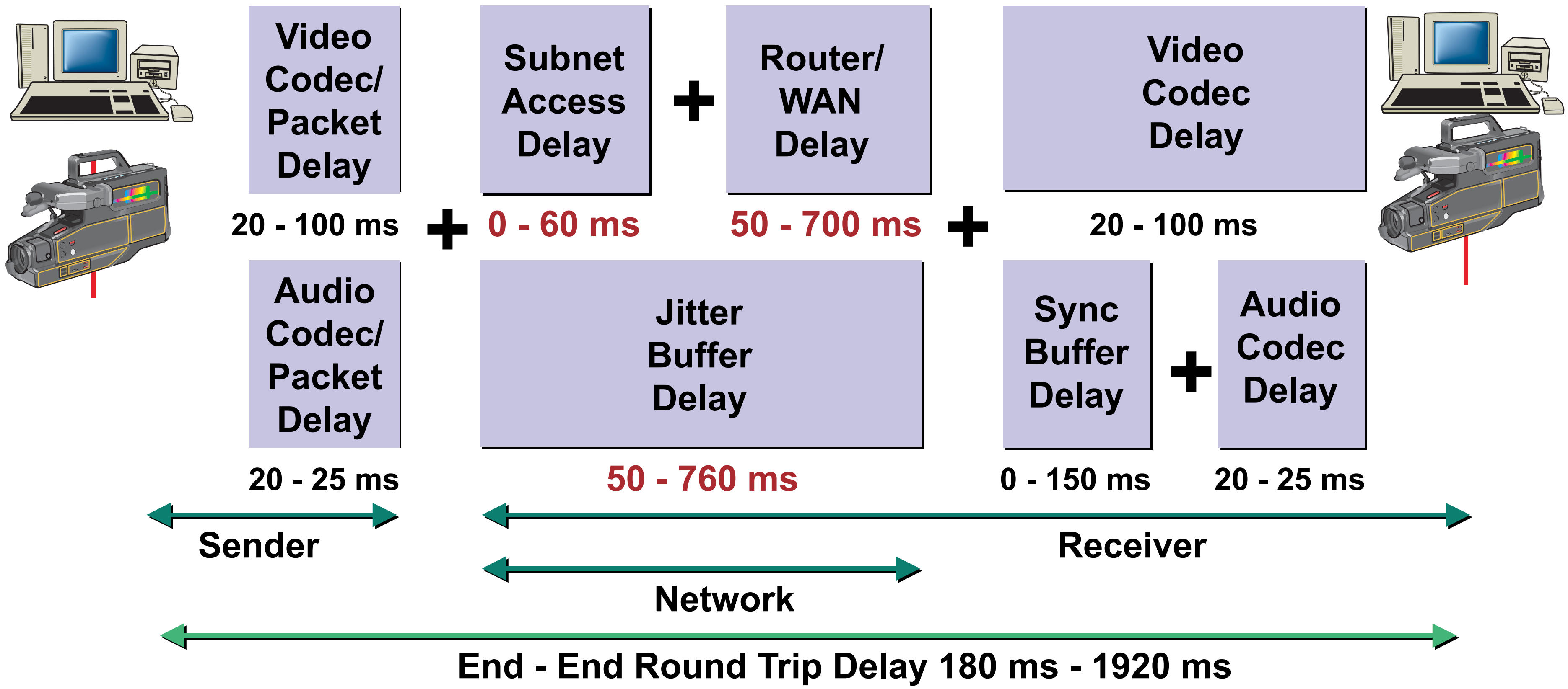
IN NAPTR 102 10 “u” “fax-t37+E2U” “!^.”$!tel+18002495324!”.

IN NAPTR 102 10 “u” “tel+E2U” “!^.”$!tel:+19192242205!”.

Voice Over IP Vocoders



Multimedia Delay Breakdown



Humans will tolerate only about 200 millisecond delay before hearing the response from the other person

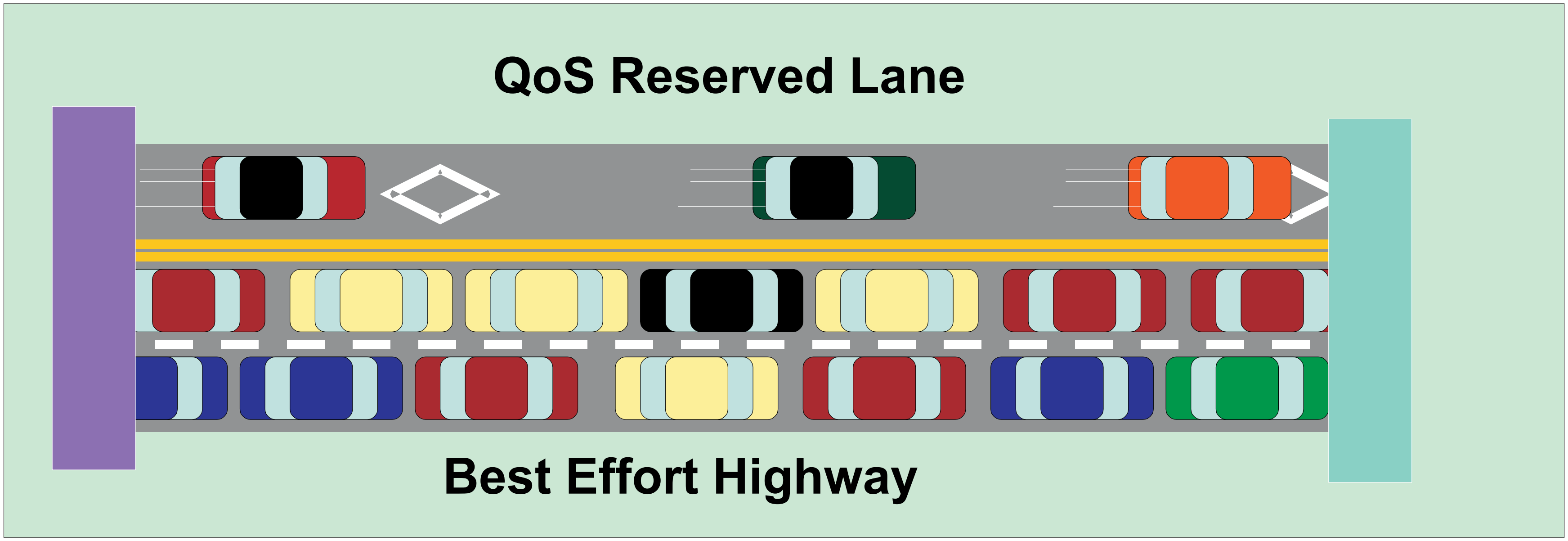
Why everyone is talking about QOS (Quality of Service) on the Internet!

Quality of Service

Let application request resources
- bandwidth
- latency
- priority

Applications need to
- reserve bandwidth
- prioritize packets

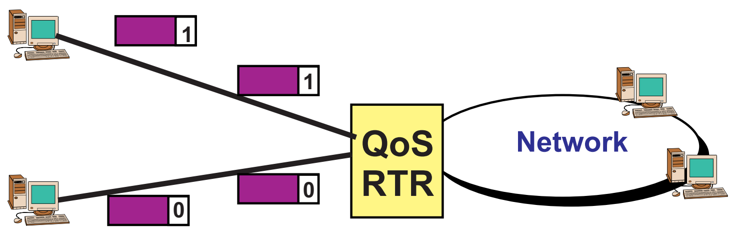
Network administrators
- police network usage
- provide service guarantees



DiffServ, RSVP, and MPLS will be used to provide QoS for IP data

Protocol Advances

DiffServ
Differentiated Services



Use bits in IP header to identify packet's level of service

Packets can be marked at source or other parts of network

Does require routers and switches that
are Differentiated Services enabled

Does not require end-to-end signaling

Does not require per-flow state

RSVP
Resource Reservation Protocol

End user applications
- Reserve bandwidth
- Lock in quality of service

Software for routers, hosts and applications

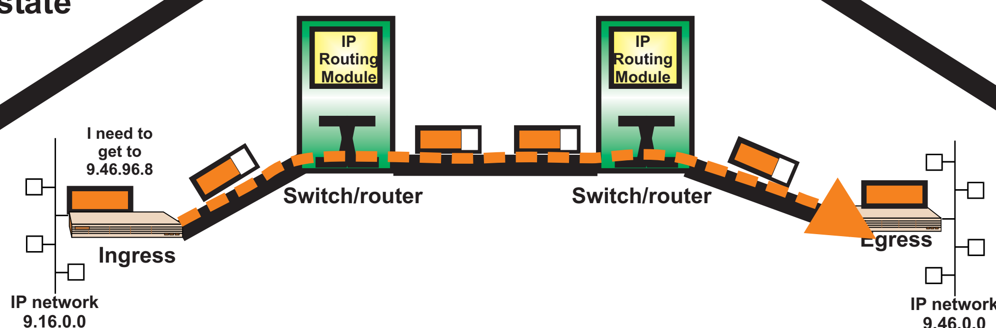
Quality of service requests repeated or reservation will lapse

Changes in network topology will revoke reservation

Applications must re-establish service levels

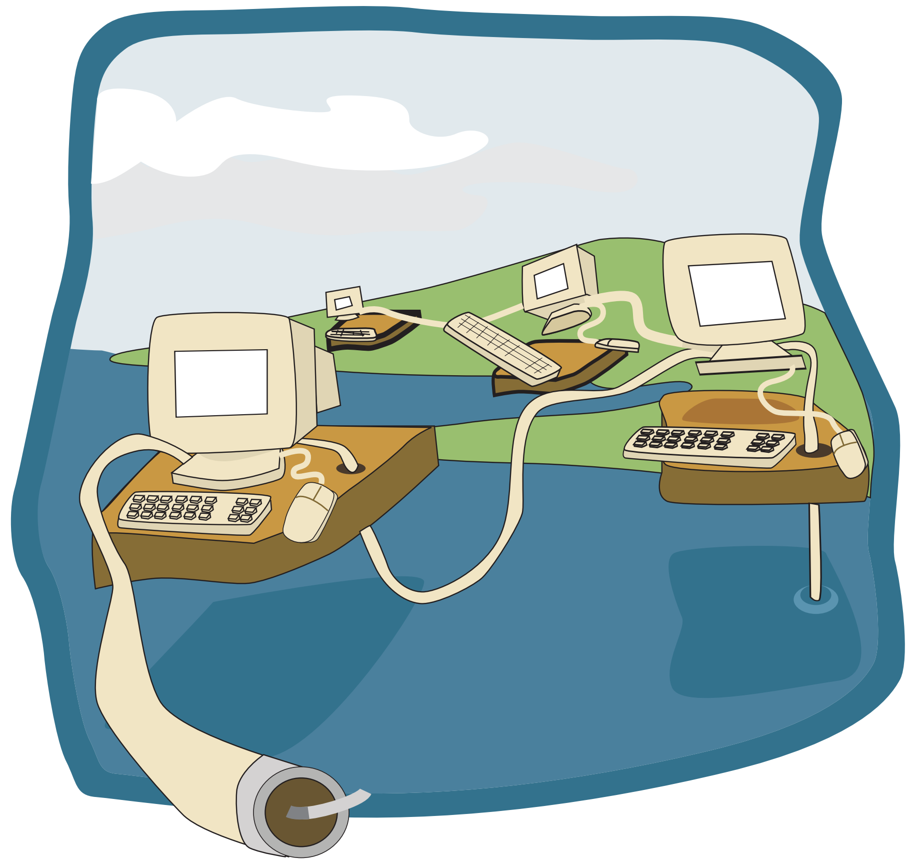
Reservations
- Shared (audio)
- Non-shared (video)

Quality of Service
- Guaranteed
- Controlled load



MPLS
Multiprotocol Label Swapping

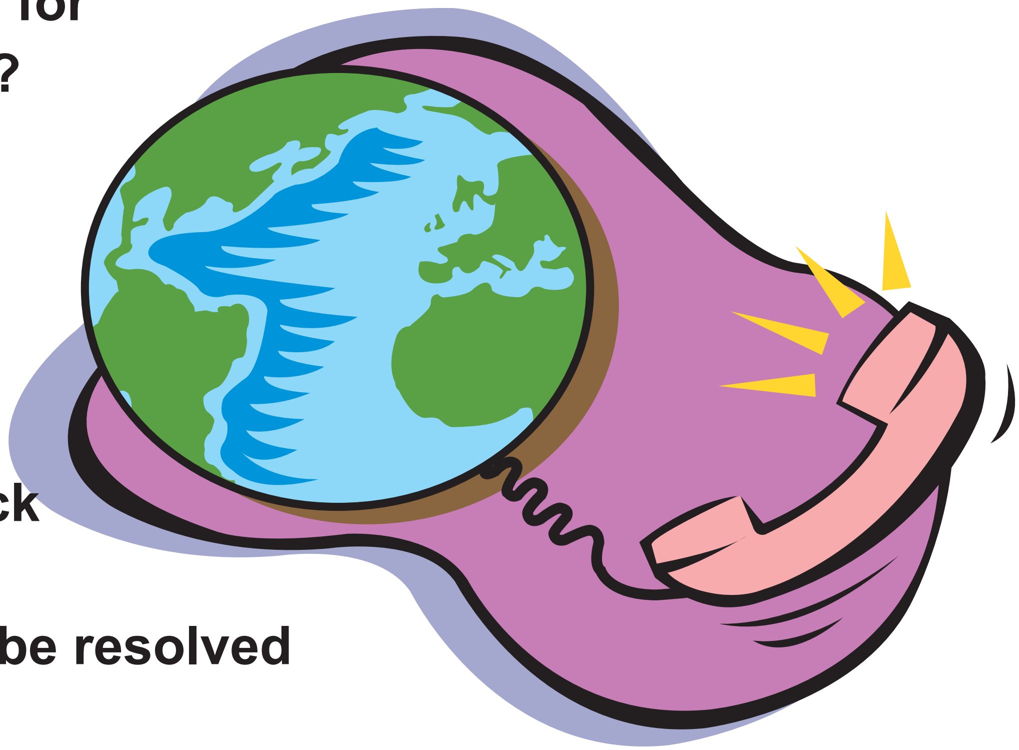
What to Look for in Products



- Form factor
- Architecture
- Circuit switched interface
- Max phone ports
- H.323/H.323 gatekeeper
- Prioritization scheme
- Encoding scheme
- Maximum compression

Sooner or Later !!!

Pieces emerging to finally allow for converged voice/data networks?



Complex

How will billing be handled?

QoS still a major stumbling block

Many application issues still to be resolved

Interoperability issues being resolved, but it will take time

Increasing government regulation

Over time..............should change our communications significantly

Background Information

SIP .... www.cs.columbia.edu/~hgs/sip/
SIP .... www.ietf.org
SIP .... www.greycouncil.com/sipug
SIP .... www.sipcenter.com
H.323 .... www.itu.int
H.323 .... www.imtc.org
H.323 .... www.packetizer.com
MGCP.... www.sofswitch.org
All .... www.etsi.org
ENUM.... www.cybetele-com.com
ENUM.... www.enum.org
ENUM.... www.enumworld.com
ENUM.... www.netnumber.com