

H.323 Tutorial

Agenda

- Brief description of Voice over Data, VoIP market drivers and applications
- H.323 entities
- Protocols in H.323
- H.323 signalling models
- Typical call setup and tear down
- H.323 version 2 and beyond

What is Voice Over Data?

- Voice over Data (VoD) transmits traditional voice services over data networks
- Such data networks can be Frame Relay (VoFR), ATM (VoATM) or IP (VoIP)
- Voice is usually compressed to save bandwidth

The Drive Towards Voice Over IP

- “Internet phone” can provide very low-cost, long-distance and international phone calls
- Internet traffic quickly surpasses voice traffic in volume; therefore, why transfer data over voice networks (e.g. today’s modems) when you can optimize for data and transfer voice over data?
- New carriers can build a single, integrated data network to support both voice and data services
 - Delta-3, IDT and others already implement VoD phone calls

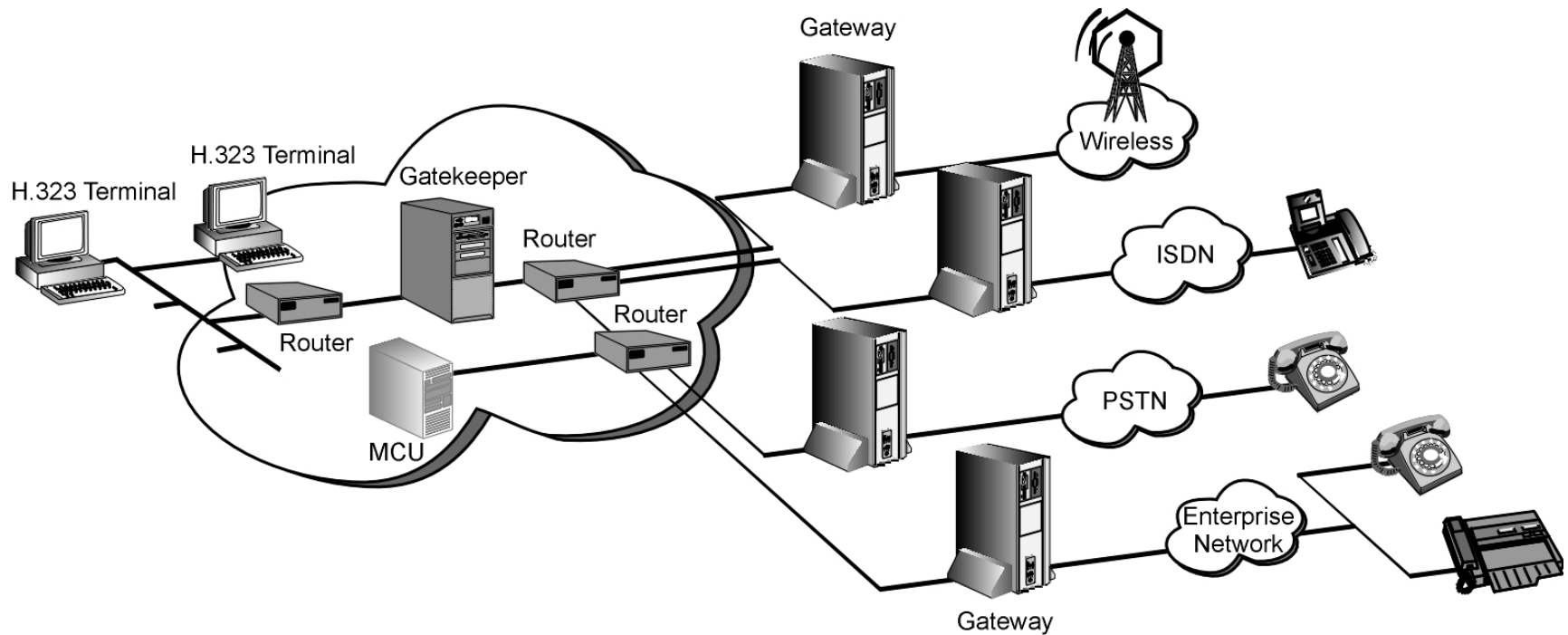
VoD Enables New Applications

- “Click to talk” web sites for e-commerce
- Digital white-board conferences
- Broadcast audio and video over the Internet or a corporate Intranet
- Integrated messaging: check (or leave) voice mail over the Internet
- Fax over IP

ITU-T H.323 Standard

- Umbrella standard covering multimedia communications over LANs that do not provide a guaranteed Quality of Service
- Entities
 - Terminals
 - Gateways
 - Gatekeepers
 - MCUs
- Protocols
 - Parts of H.225.0 - RAS, Q.931
 - H.245
 - RTP/RTCP
 - Audio/video codecs

H.323 Architecture



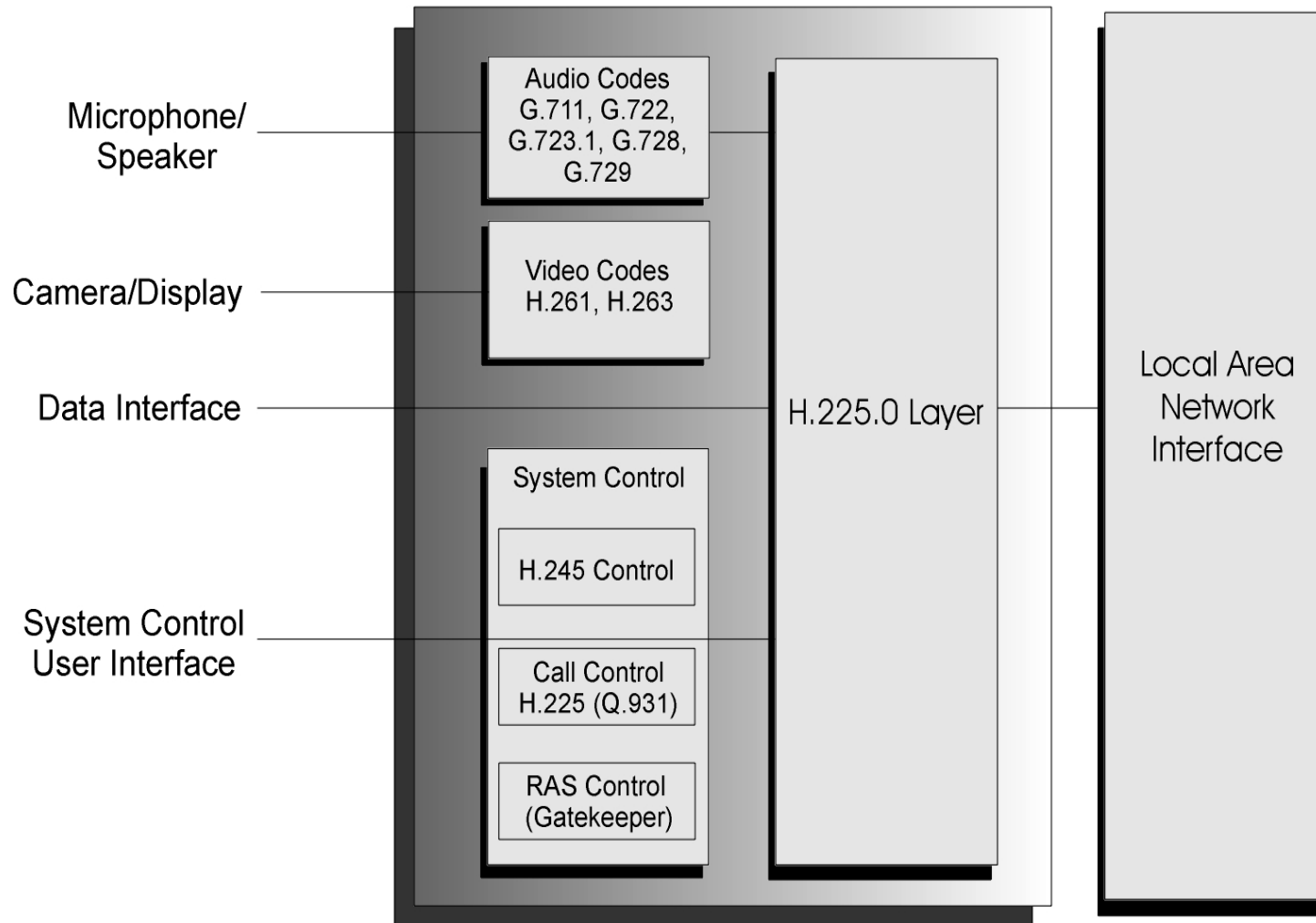
H.323 Network Architecture and Components

H.323 Entities: Terminals

- Endpoint on a LAN
- Supports real-time, 2-way communications with another H.323 entity
- Must support:
 - Voice - audio codecs
 - Signalling and setup - Q.931, H.245, RAS
- Optional support:
 - Video
 - Data

H.323 Entities: Terminals (cont.)

H.323 Terminal

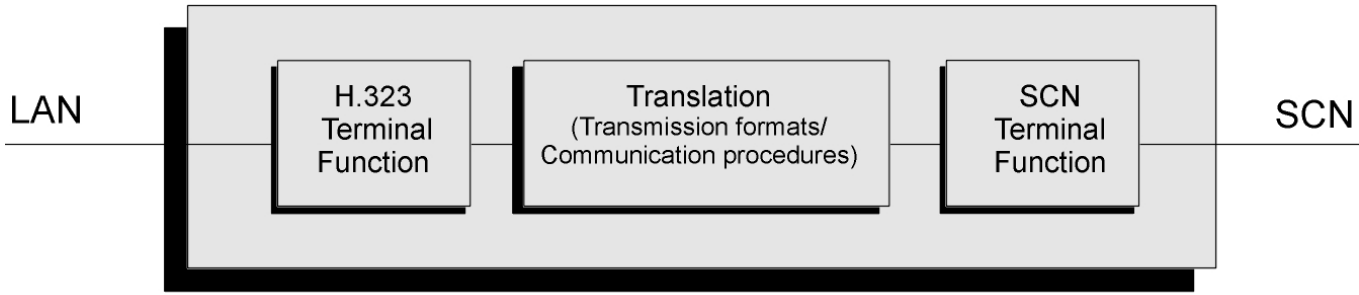


H.323 Entities: Gateways

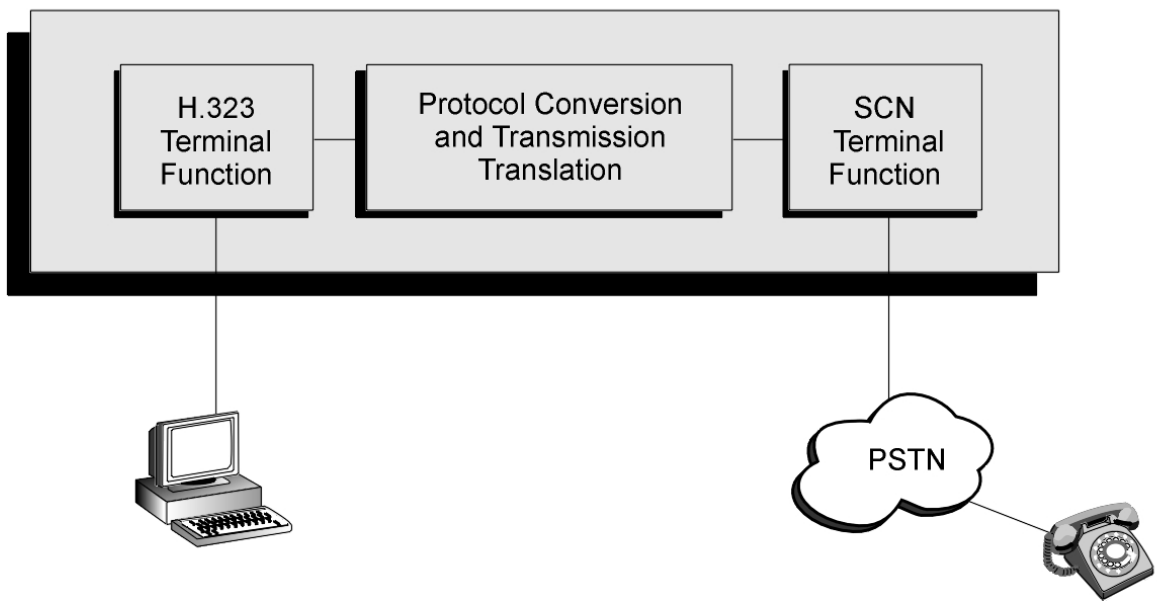
- Interface between the LAN and the switched circuit network
- Translates communication procedures and formats between networks
- Call setup and clearing
- Compression and packetization of voice
- Example: IP/PSTN gateway

H.323 Entities: Gateways (cont.)

Gateway Function



IP/PSTN Gateway



H.323 Entities: Gatekeepers

- Optional (e.g., Netmeeting does not use gatekeepers), but must perform certain functions if present
- Manage a zone (a collection of H.323 devices)
- Usually one gatekeeper per zone; alternate gatekeeper might exist for backup and load balancing
- Typically a software application, implemented on a PC, but can be integrated in a gateway or terminal

H.323 Entities: Gatekeepers (cont.)

- Mandatory functions:
 - Address translation (routing)
 - Admission control
 - Minimal bandwidth control - request processing
 - Zone management
- Optional functions:
 - Call control signalling - direct handling of Q.931 signalling between endpoints
 - Call authorization, bandwidth management, and call management using some policy
 - Gatekeeper management information (MIB)
 - Directory services

H.323 Entities: MCUs

- MCU - Multipoint Control Unit
- Endpoint that supports conferences between 3 or more endpoints
- Can be stand-alone device (e.g., PC) or integrated into a gateway, gatekeeper or terminal
- Typically consists of multi-point controller (MC) and multi-point processor (MP)
 - MC - handles control and signalling for conference support
 - MP - receives streams from endpoints, processes them, and returns them to the endpoints in the conference

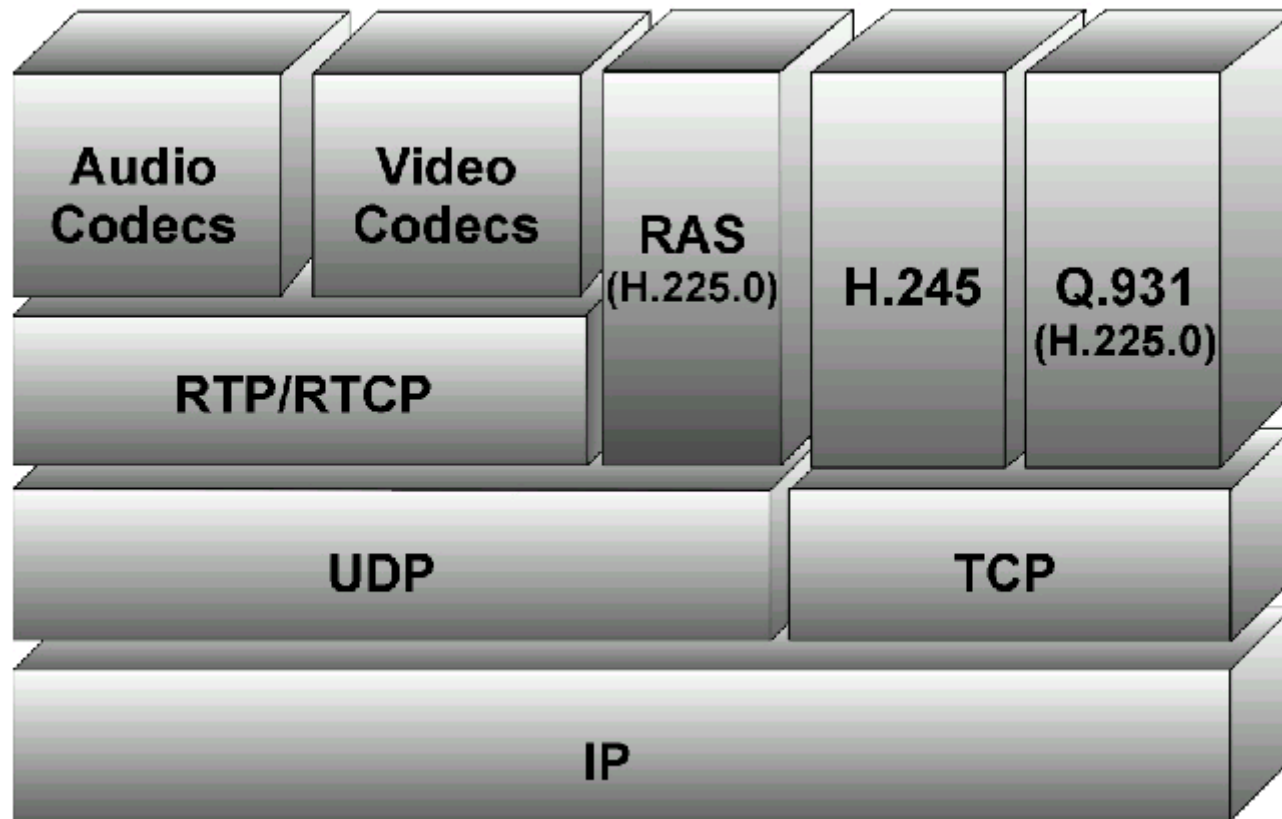
Centralized vs. Decentralized Conferences

- Centralized - MCU handles both signalling (MC) and stream processing (MP)
- Decentralized - MCU handles only signalling, streams go directly between endpoints
 - In this case MCU functions without MP

H.323 Protocol Stack

- Audio codecs (G.711, G.723.1, G.728, etc.) and video codecs (H.261, H.263) compress and decompress media streams
- Media streams transported on RTP/RTCP
 - RTP carries actual media
 - RTCP carries status and control information
- RTP/RTCP carried unreliably on UDP
- Signalling is transported reliably over TCP
 - RAS - registration, admission, status
 - Q.931 - call setup and termination
 - H.245 - capabilities exchange

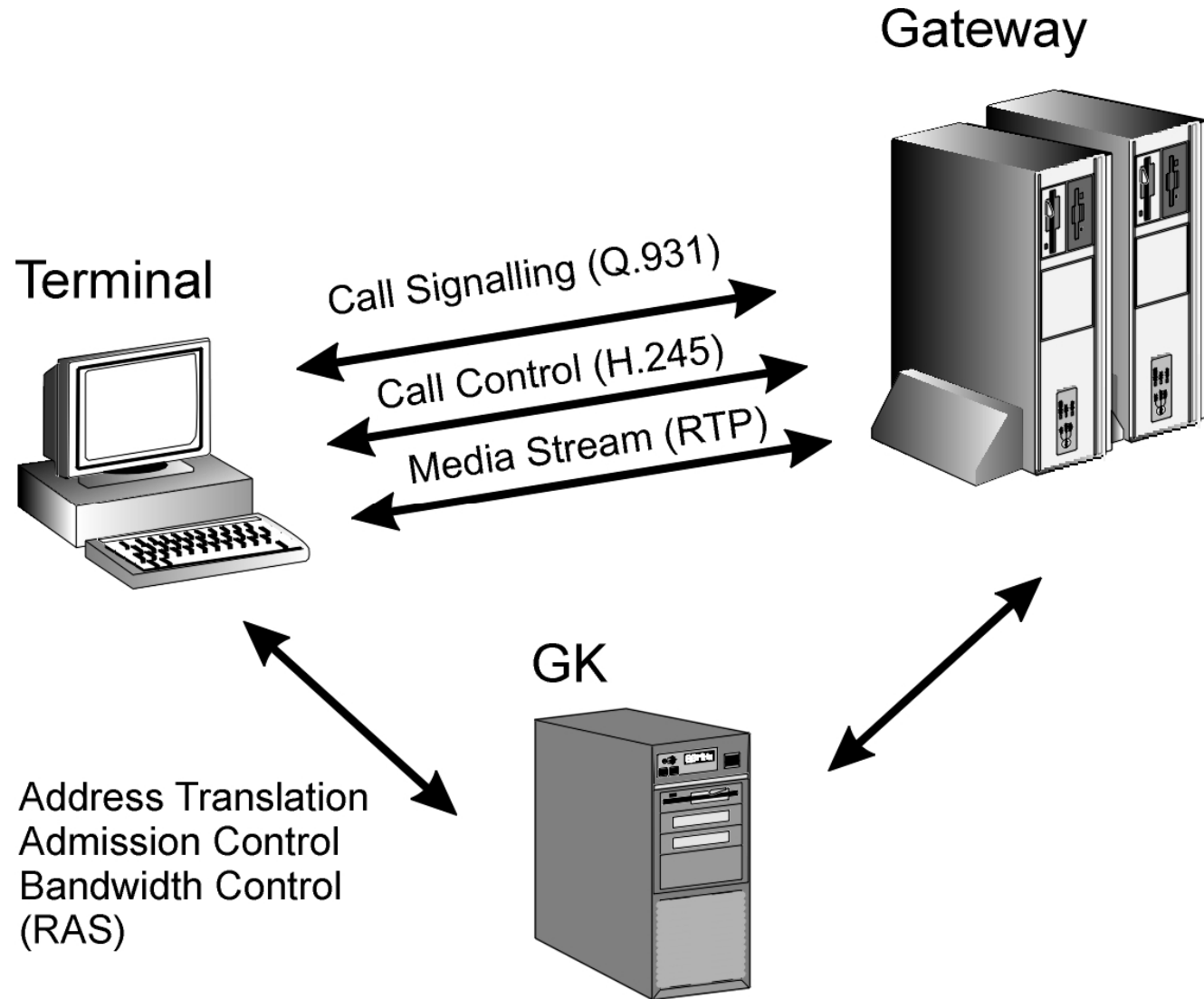
H.323 Protocol Stack



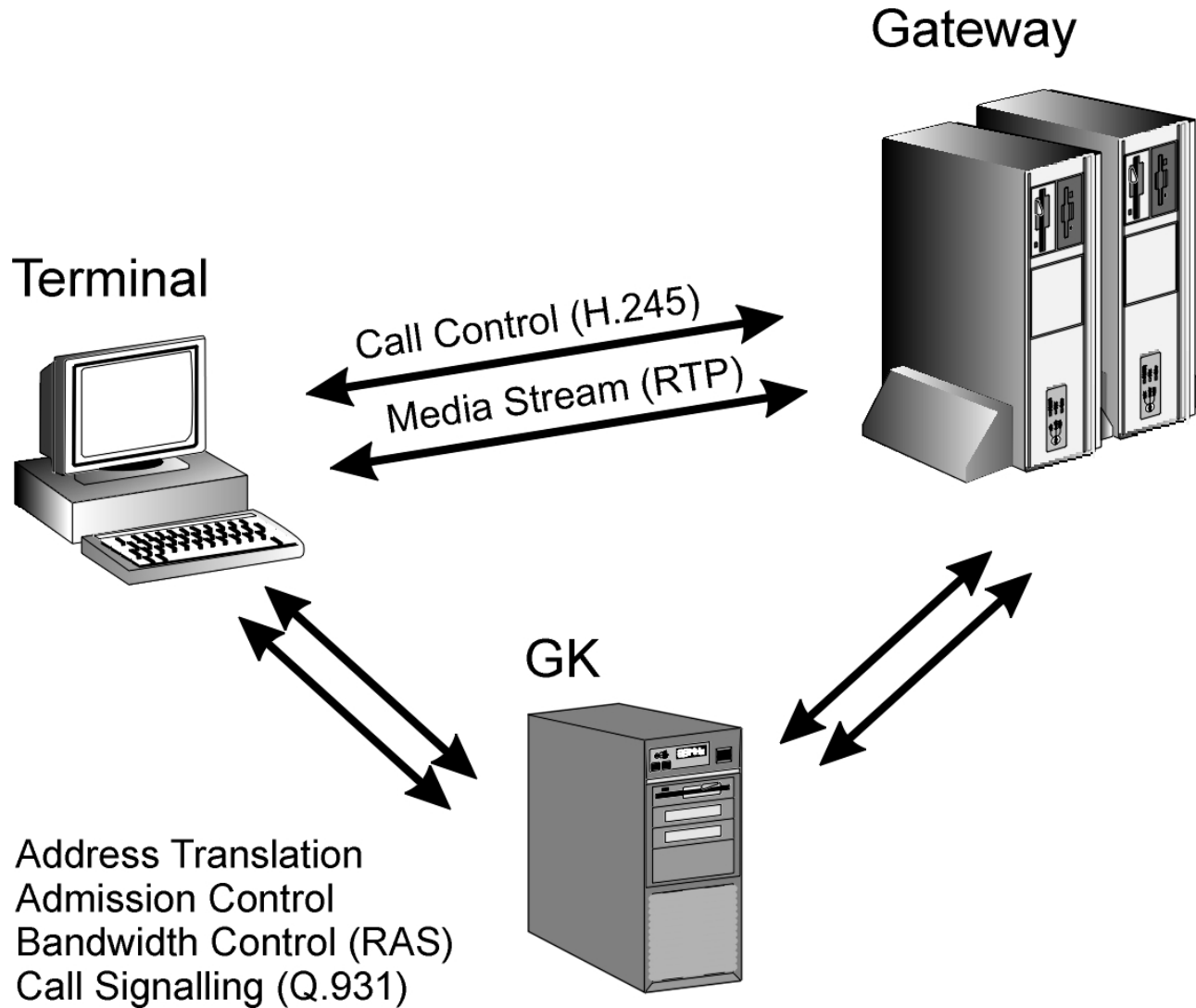
Signalling Models

- Determines which protocol messages pass through the gatekeeper, and which pass directly between the two endpoints
- The more messages that are routed between the gatekeeper, the more the load and responsibility (more information and more control)
- The gatekeeper ultimately decides on the signalling model
- Media never passes through the gatekeeper function

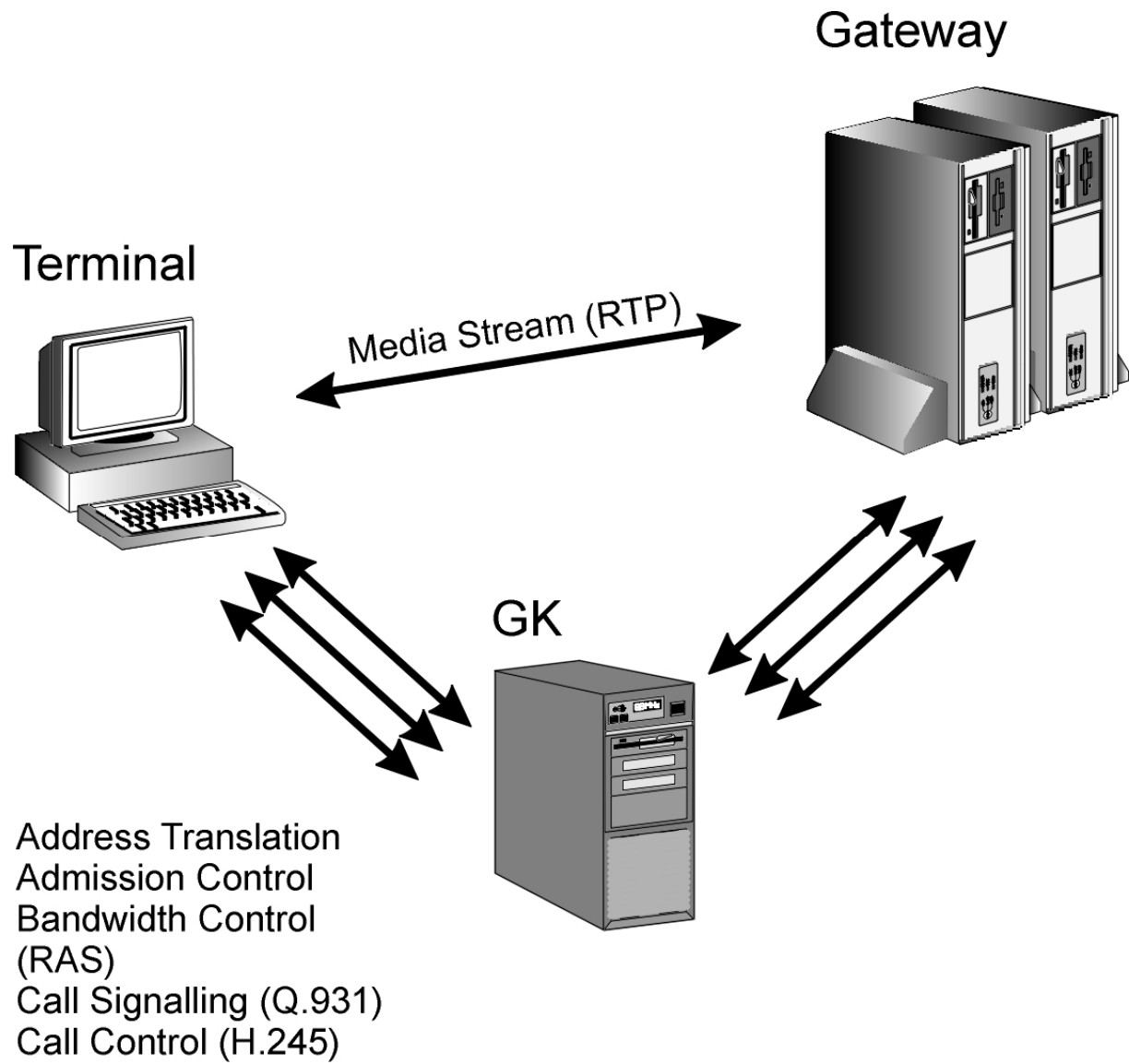
Direct Endpoint Call Signalling



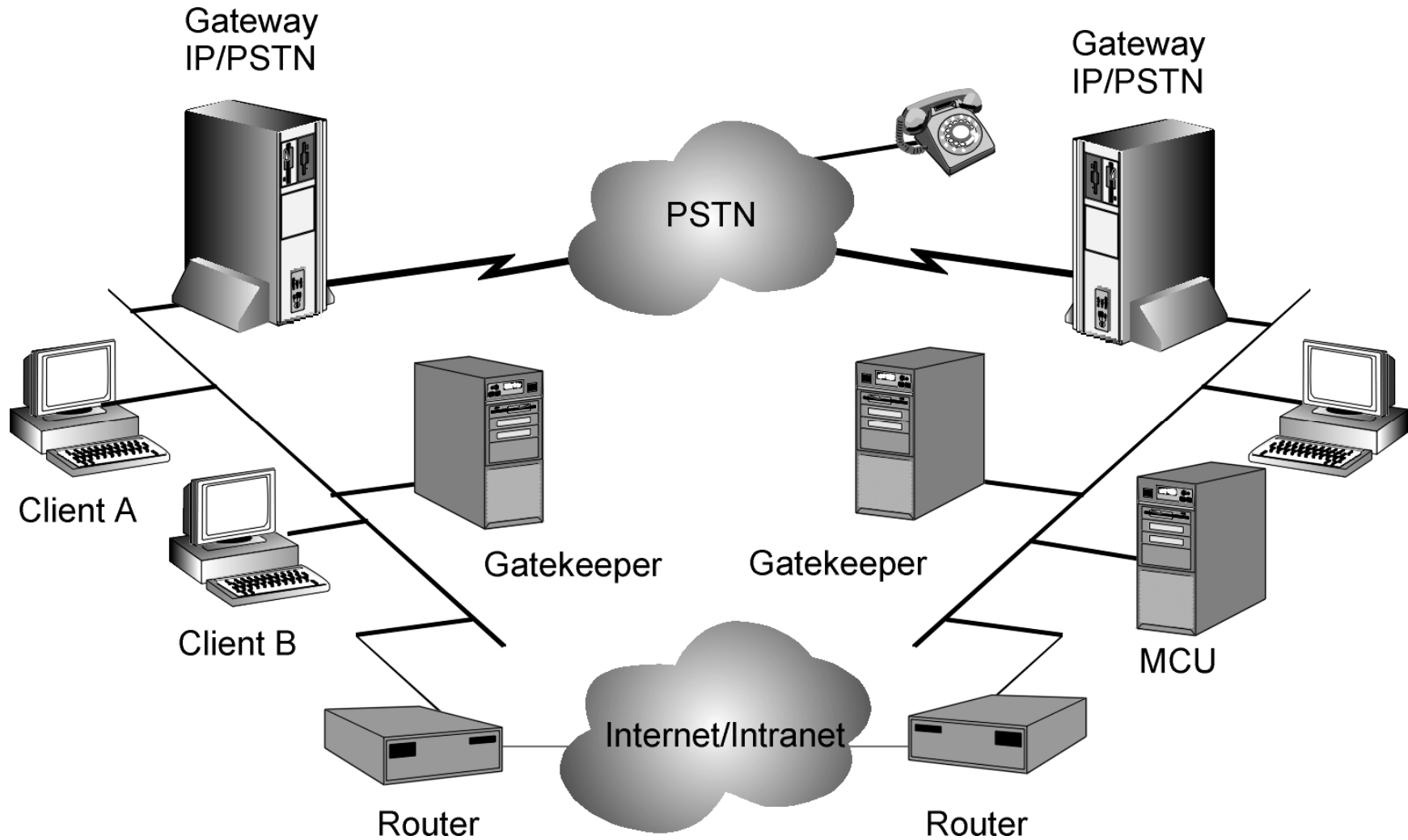
Gatekeeper Routed Call Signalling (Q.931)



Gatekeeper Routed Call Signalling (Q.931/H.245)



Typical H.323 Network Deployment



Example

Gatekeeper Routed Call Signalling (Q.931/H.245) between client A and client B

- Establishing a call between client A and client B:
 - Discover and register with the gatekeeper - RAS channel
 - Routed call setup between the endpoints through the gatekeeper - Q.931 call signalling
 - Initial communications and capability exchange - H.245 call control
 - Establish multimedia communication/call services - H.245 call control
 - Call termination - H.245 call control & Q.931 call signalling

Discover Gatekeeper (RAS)

- Client transmits a Multicast Gatekeeper Request packet (who is my gatekeeper?)
- Gatekeeper responds with a Gatekeeper Confirmation packet or Gatekeeper Reject packet

Register with Gatekeeper (RAS)

- Client notifies gatekeeper of its address and aliases
- Client transmits Gatekeeper Registration Request
- Gatekeeper responds with either Registration Confirmation or Registration Rejection
- In network deployment in diagram, both client A and client B register with gatekeeper A

Call Admission (RAS)

- Client A initiates Admission Request (can I make this call?); the packet includes a maximum bandwidth requirement for the call
- Gatekeeper responds with Admission Confirmation
 - Bandwidth for call is either confirmed or reduced
 - Call signalling channel address of gatekeeper is provided

Call Setup Through Gatekeeper (Q.931)

- Client A sends call setup message to gatekeeper
- Gatekeeper routes message to client B
- If client B accepts, admission request with gatekeeper is initiated
- If call accepted by gatekeeper, client B sends a connect message to client A specifying the H.245 call control channel for capabilities exchange

Capabilities Exchange (H.245)

- Clients exchange call capabilities with Terminal Capability Set message that describes each client's ability to transmit media streams, i.e. audio/video codec capabilities of each client
- If conferencing, determination of MCU is negotiated during this phase
- After capabilities exchange, clients have a compatible method for transmitting media streams; multimedia communication channels can be opened

Establish Multimedia Communication

- To open a logical channel for transmitting media streams, the calling client transmits an Open Logical Channel message (H.245)
- Receiving client responds with Open Logical Channel Acknowledgement message (H.245)
- Media streams are transmitted over an unreliable channel; control messages are transmitted over a reliable channel
- Once channels established, either client or gatekeeper can request call services, i.e. client or gatekeeper can initiate increase or decrease of call bandwidth

Call Termination

- Either party can terminate the call
- Assume client A terminates call
- Client A completes transmission of media and closes logical channels used to transmit media
 - Client A transmits End Session Command (H.245)
 - Client B closes media logical channels and transmits End Session Command
 - Client A closes H.245 control channel
 - If call signalling channel is still open, a Release Complete message (Q.931) is sent between clients to close this channel

New Features in H.323 Version 2

- H.235 - security and authentication, i.e. passwords for registration with gatekeeper
- H.450.x - supplementary services such as call transfer and forwarding
- Fast call setup:
 - Bypasses some setup messages
 - Triggered by Q.931 Fast Start message that contains basic capabilities

New Features in H.323 Version 2 (cont.)

- Mechanism to specify alternative gatekeepers to endpoints
- Gatekeeper can request forwarding of Q.931 information on direct routed calls; only RADCOM can play back H.323 streams off a network: a true differentiation
- Smoother integration of T.120 (optional standard for data)
 - T.120 channel opened like any H.323 channel

The Future of H.323

Inter-Gatekeeper Communication:

- Current H.323 standards do not provide an inter-zone model that scales well for large networks
- Inter-gatekeeper protocols being discussed to enable gatekeepers to efficiently locate one another to route calls to non-local address
- Hierarchical arrangements with “clearing house” gatekeepers have been proposed
- This is critical for widespread interoperability between VoIP service providers

Internet Sites for Further Reading

- www.imtc.org:
 - Includes tutorial information and the Voice over IP Forum
- www.pulver.com:
 - Many useful VoIP links
 - Free subscription to VoIP newsletter
 - Links to CLECs using Voice over Data
- www.data.com:
 - Data communications provide many business-oriented articles about voice