

**RAD** COM

**TEST-OF-THE-ART**

**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**

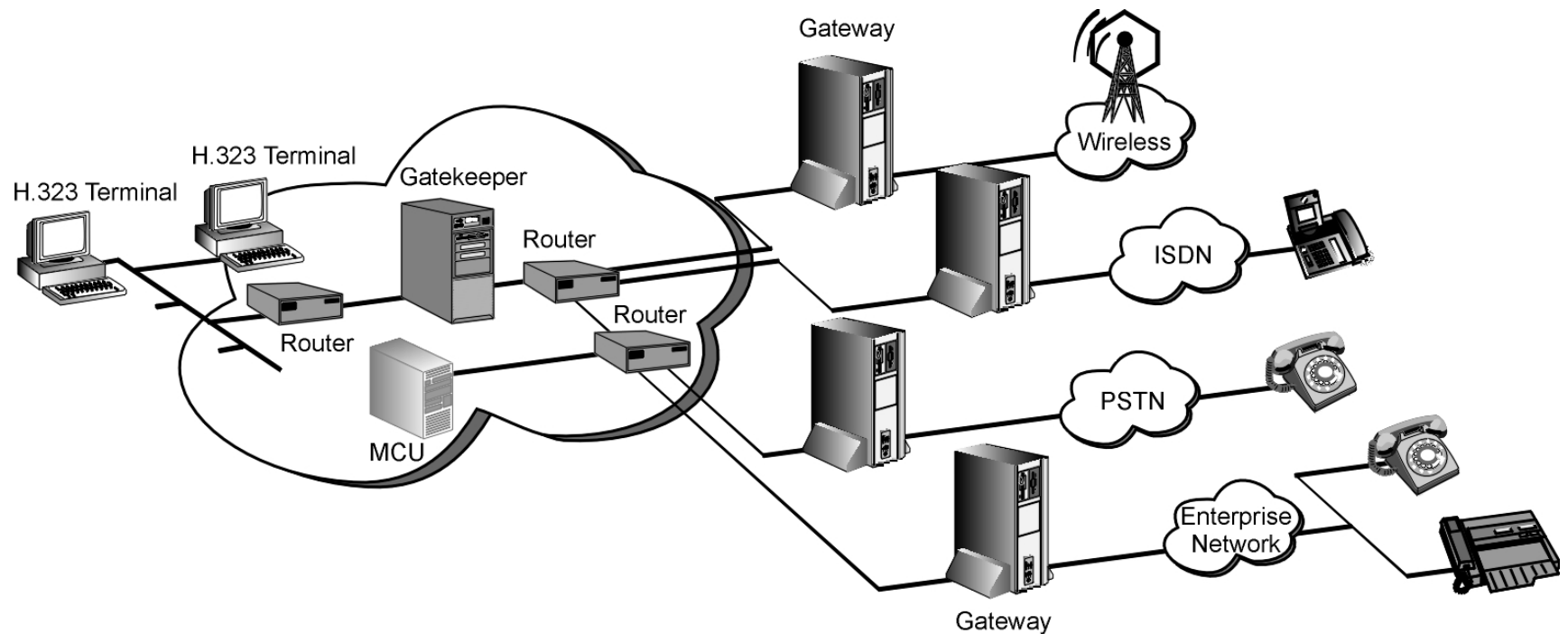
✓ **Entities**

- Terminals
- Gateways
- Gatekeepers
- MCUs

✓ **Protocols**

- Parts of H.225.0 - RAS, Q.931
- H.245
- RTP/RTCP
- Audio/video codecs

# H.323 Architecture



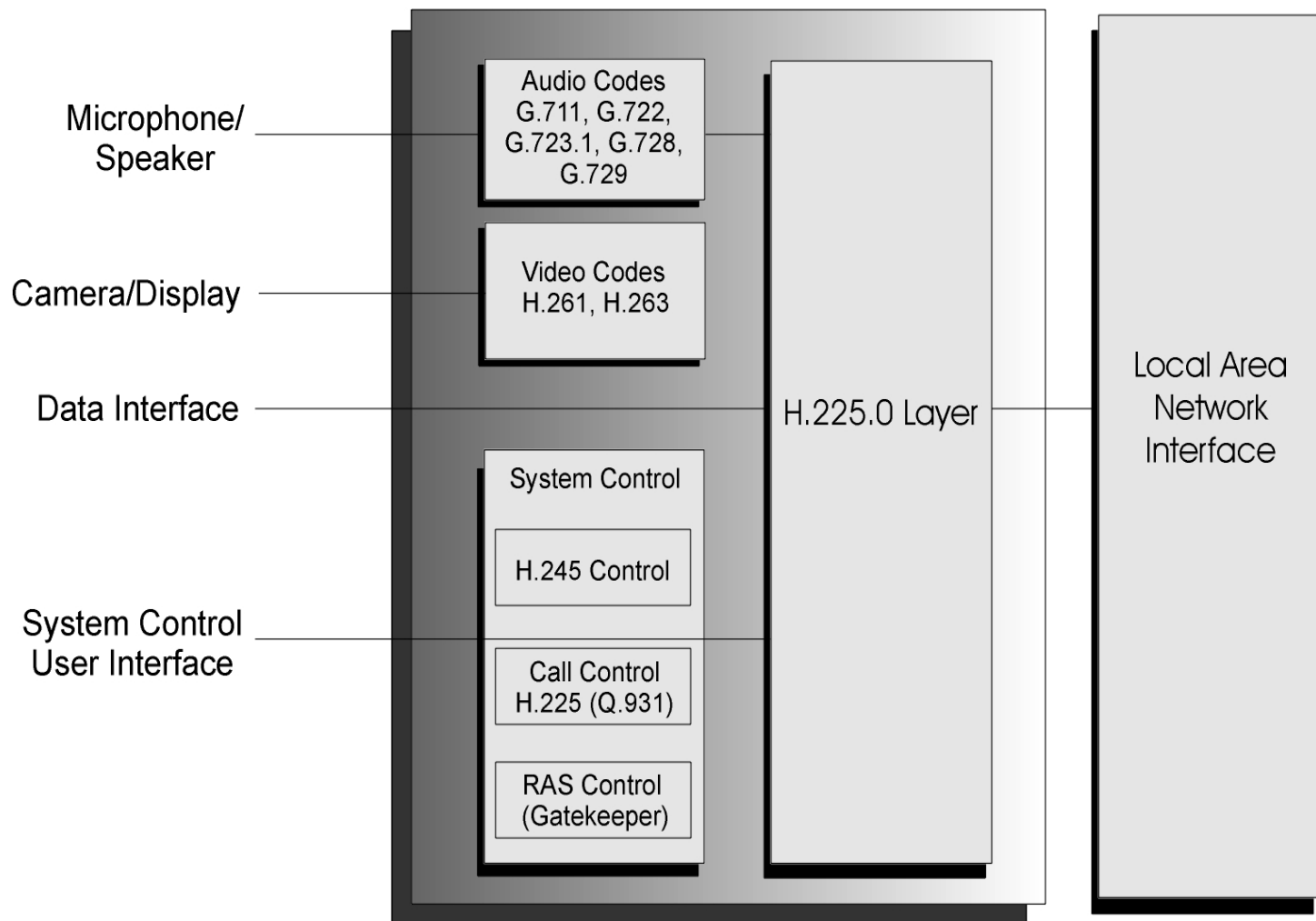
## H.323 Network Architecture and Components

# 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

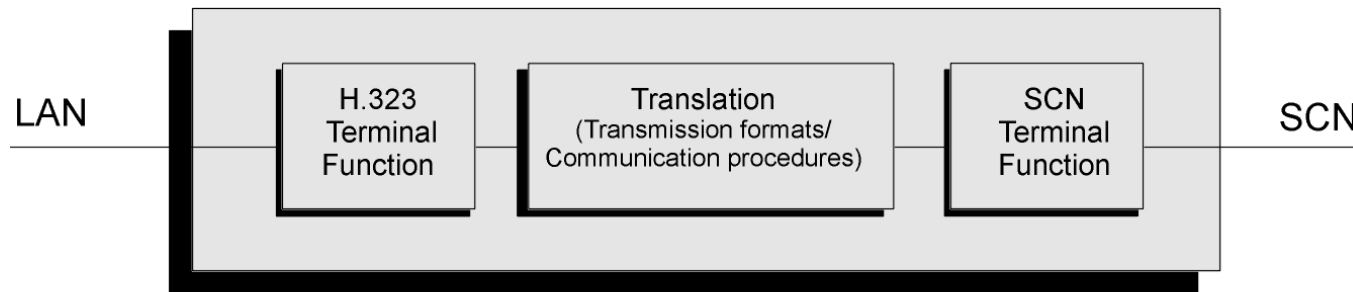


## **H.323 Entities: Gateways**

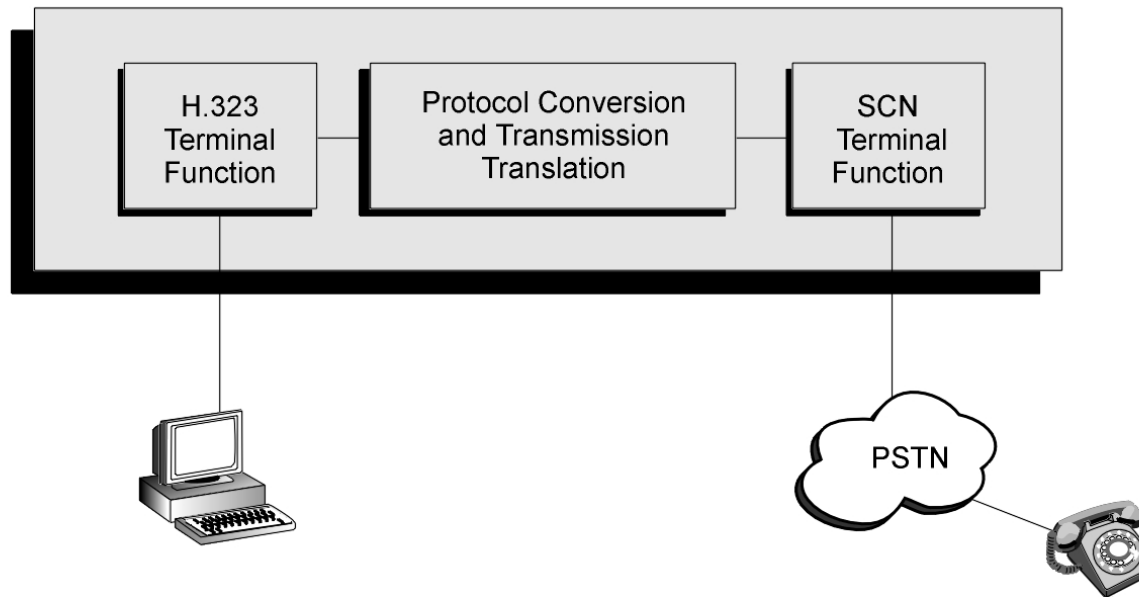
- ✓ **Interface between the LAN and the switched circuit network**
- ✓ **Translates communication procedures and formats between networks**
- ✓ **Call setup and clearing**
- ✓ **Compression and packetization of voice**
- ✓ **Example: IP/PSTN gateway**

# 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**

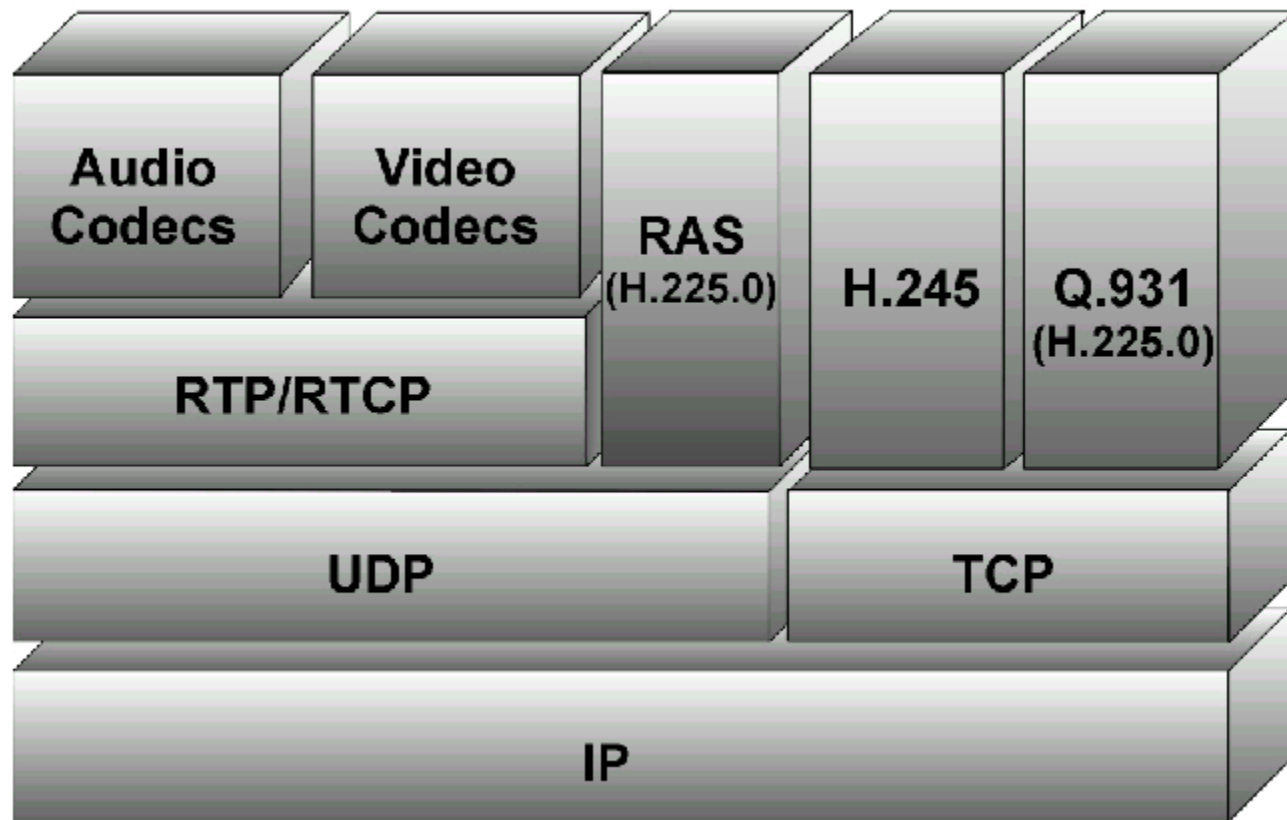
# Centralized vs. Decentralized Conferences

- ✓ **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

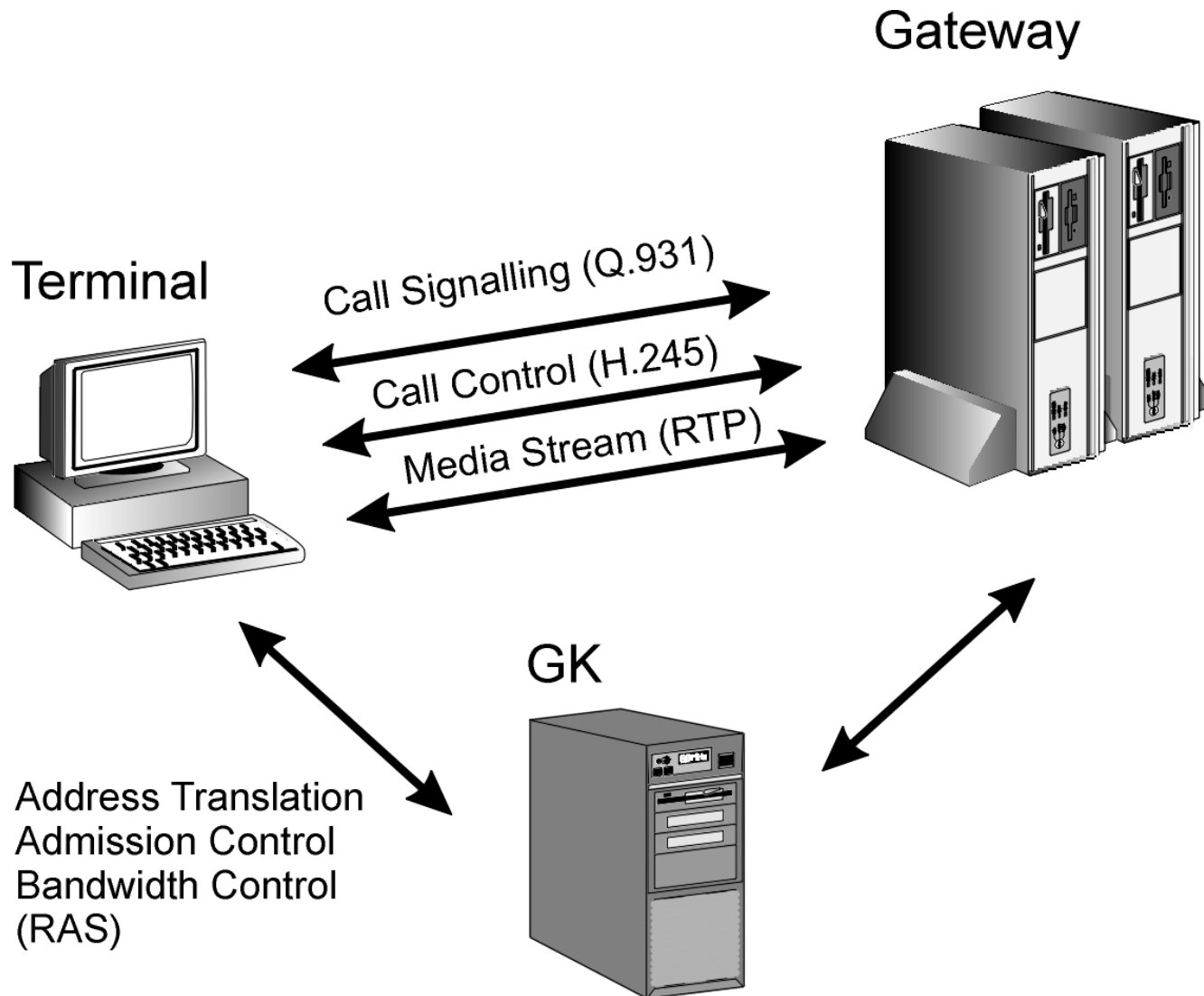
# H.323 Protocol Stack



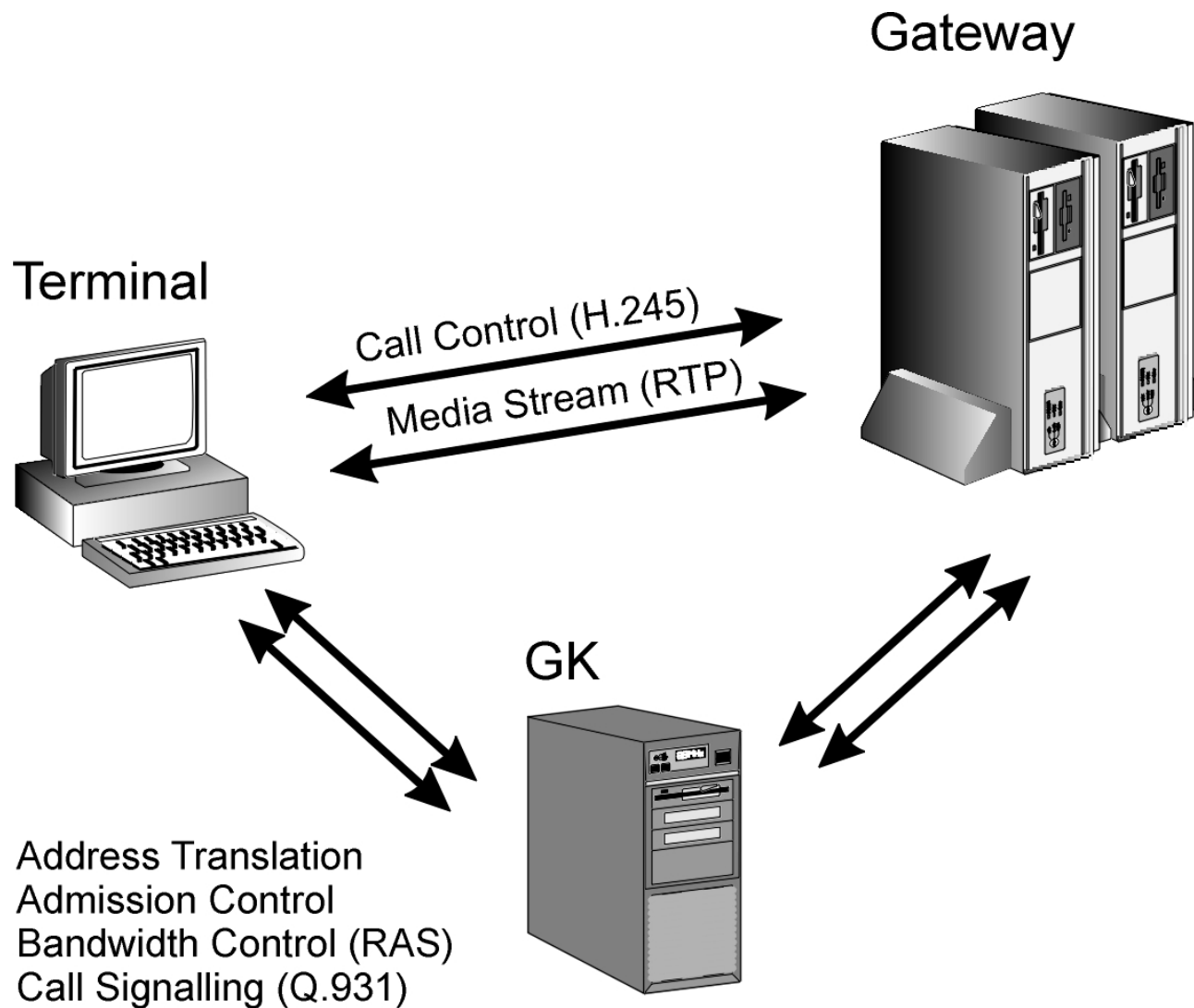
# Signalling Models

- ✓ **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**

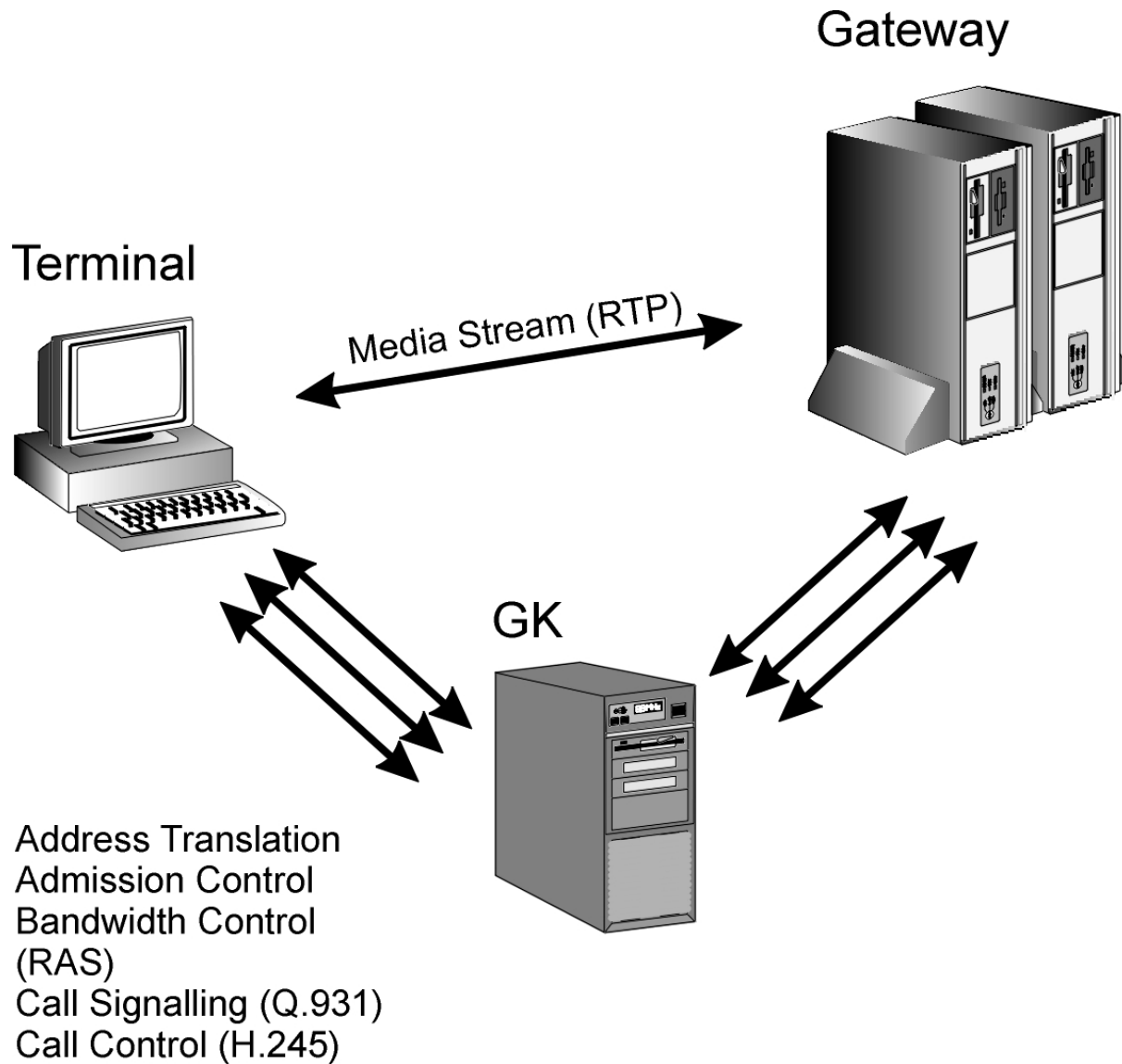
# Direct Endpoint Call Signalling



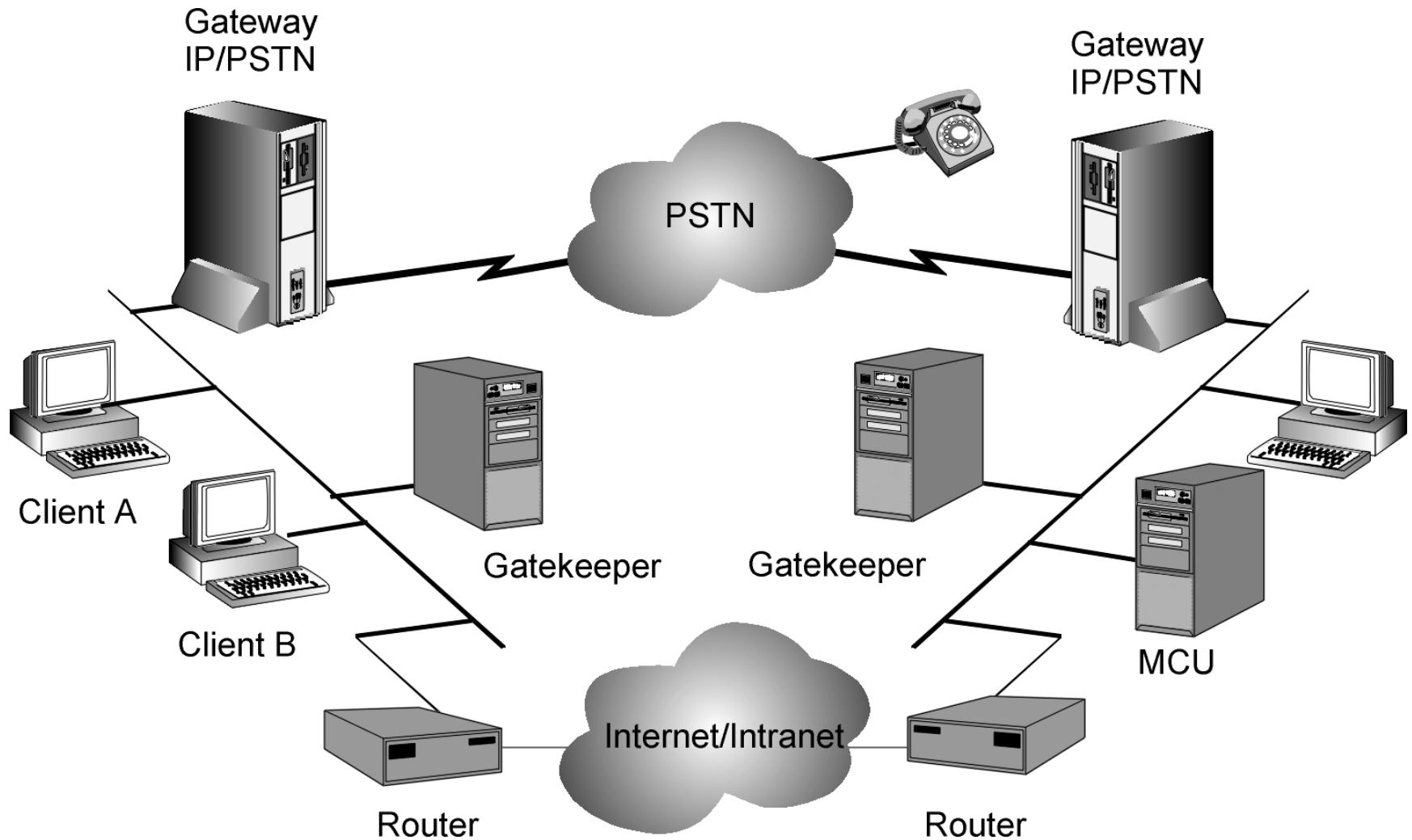
# Gatekeeper Routed Call Signalling (Q.931)



# 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

**A** **BDE**

## 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