Basic Architecture of H.323

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Agenda

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- Background to H.323
- Components of H.323
- H.323 Protocols Overview
- H.323 Call Establishment

Background to H.323

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- **ITU-T[1] published Version 1 of Recommendation H.323 in 1996:**

  "Visual Telephone Systems and Equipment for* LANs *which provide a non-guaranteed Quality of Service"

  Æ **this standard was not designed for the *Internet***
  (Bandwidth/QoS of Internet links did not allow for transmitting video streams in real-time)

  Æ **Internet scalability issues were neglected (only local calls, small number of users)**

[1] TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

Background to H.323

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- **H.323 borrowed much of the multimedia conferencing aspects from other H.32x-series[2] Recommendations, such as H.320**
  Æ good interoperation with ISDN
  Æ bad interoperation with Internet Standards (security, addressing)
- **The name was changed in Version 2 (1998) to "*Packet-Based Multimedia Communications Systems*"**
- **In November 2000 the most recent Version 4 of H.323 was published**

[2] H.320: N-ISDN Videoconferencing
H.321: B-ISDN (ATM) Videoconferencing
H.322: Guaranteed QoS LAN (e.g. Iso-Ethernet) Videoconferencing
H.324: GSTN Videoconferencing (low bit-rate multimedia communication)
Æ over modem links

Scope of H.323

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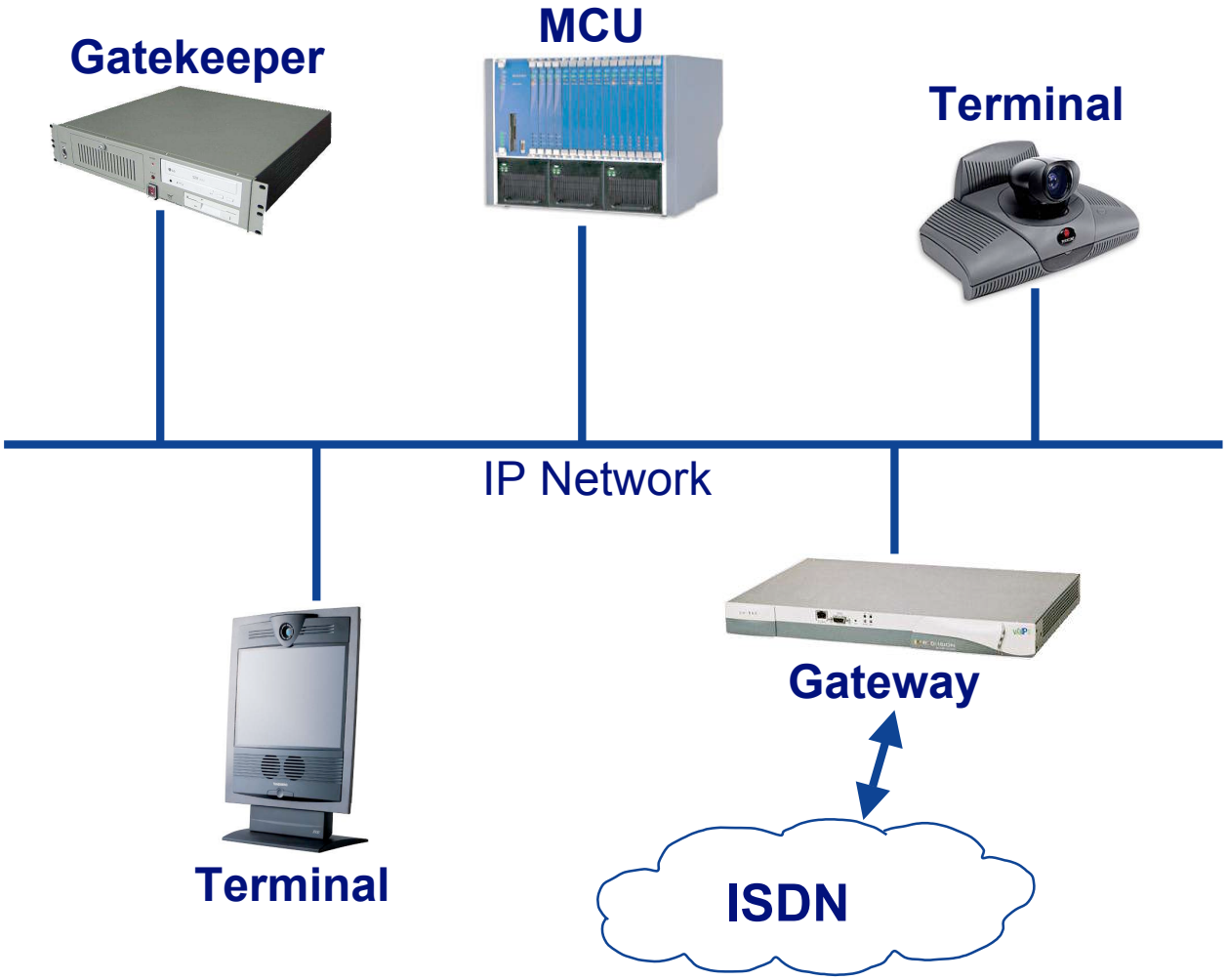
- **H.323 defines the *interworking of***
  - ***call signaling,***
  - ***call control,***
  - ***and media stream protocols*,**

  in order to build a packet-based multimedia communications system
- **H.323 further describes the *network components* that are used to build up such a communications system**

- **H.323 can be seen as an “umbrella standard” which aggregates standards for multimedia conferencing over packet-based networks**

H.323 Components



- Terminal
  - Video/audio/data client
- MCU
  - Conference control
  - Content mixing
- Gateway
  - Protocol translation
- Gatekeeper
  - Address resolution
  - Admission control

- Terminals, MCUs, and Gateways are called *H.323 Endpoints*

- An endpoint is “callable”

H.323 Terminals

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- **An endpoint on the network which provides for *real-time, two-way communications with another H.323 terminal, GW, or MCU***
- **This communication consists of speech only, speech and data, speech and video, or speech, data and video**

Multipoint Control Unit (MCU)

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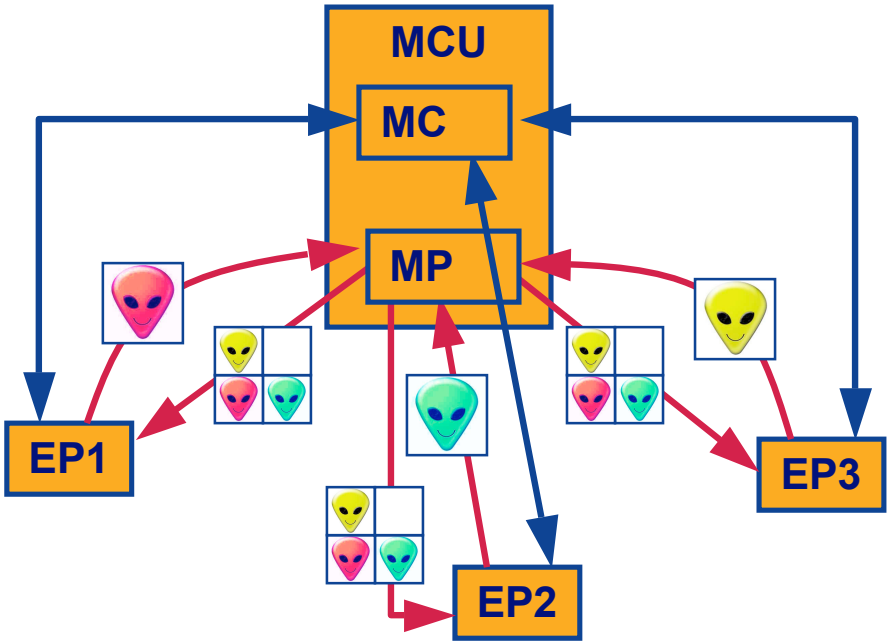
- **An MCU consists of a mandatory *Multipoint Controller* (MC) and an optional *Multipoint Processor* (MP)**

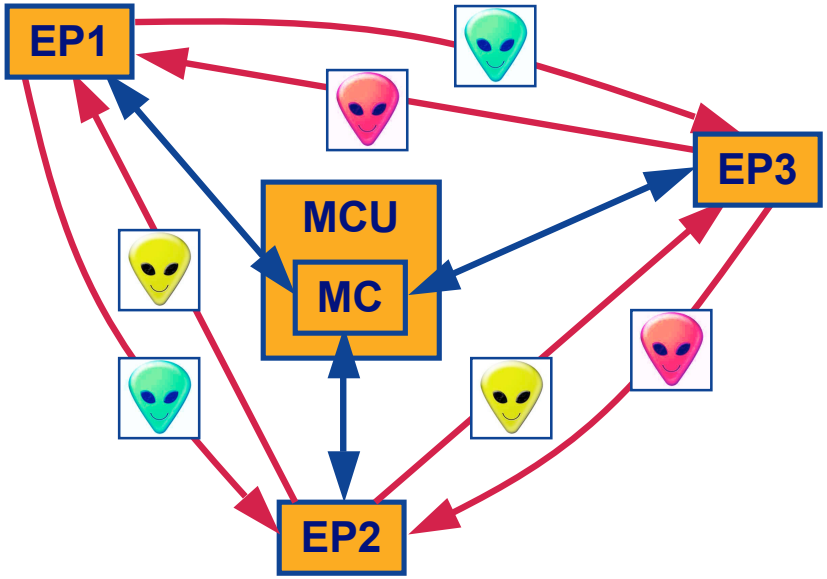
MC: call signaling, conference control
MP: switching/mixing of media streams

***Centralized* multipoint conference**



***unicast* media streams**

***Decentralized* multipoint conference**



***multicast* media streams**

Multipoint Control Unit (2)

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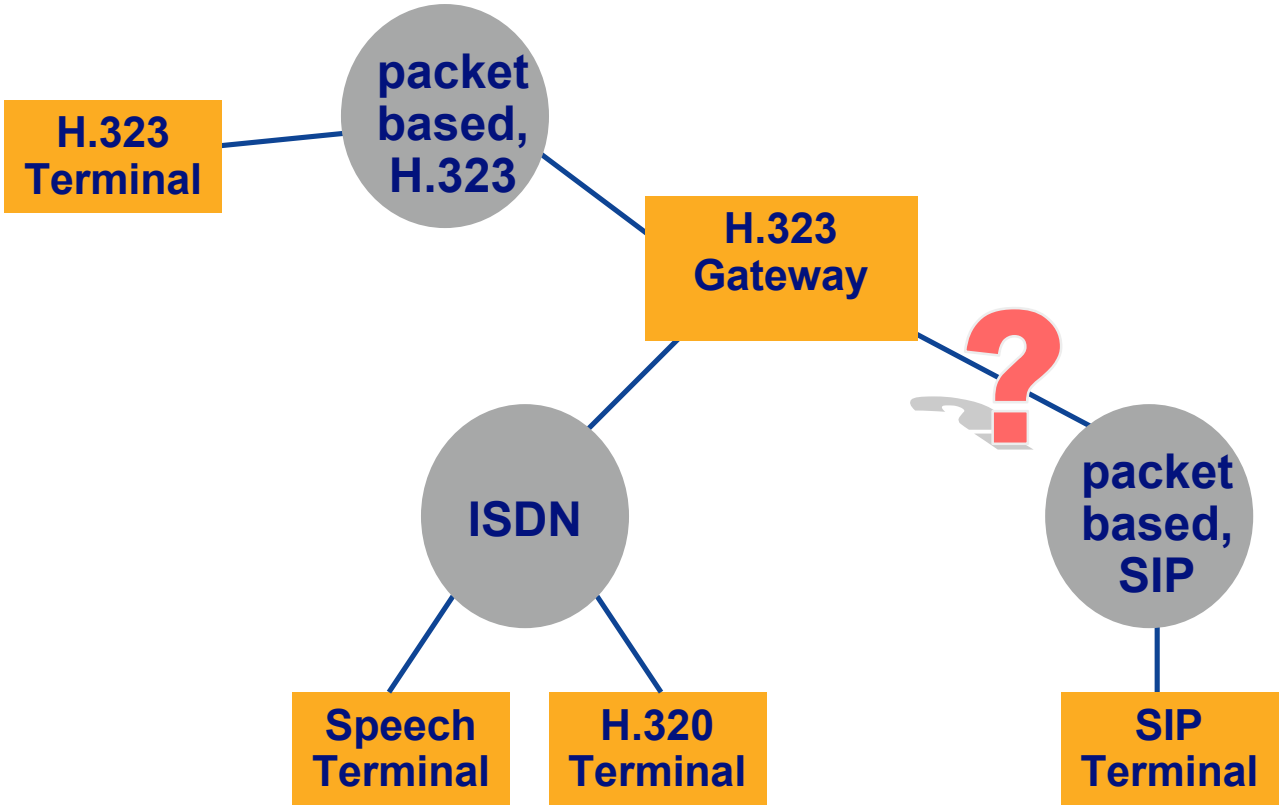
- **Some MPs can do *real-time transcoding* of the received audio/video streams**
  - **Æ every participating terminal can choose its preferred audio/video codec**
  - **Æ transcoding of video streams is computationally expensive, so this is normally done in dedicated DSPs**

MCU with real-time transcoding (Accord MGC-100)

Gateway (GW)

- **H.323 Gateway = H.323 endpoint which provides for real-time, two-way communications between *terminals belonging to networks with different protocol stacks***



Gatekeeper (GK)

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- **A GK is an H.323 entity on the network that provides *address translation* and *controls access to the network resources* for H.323 terminals, GWs and MCUs**
- **Endpoints do register themselves at a GK**
- **All H.323 endpoints registered to a single GK build an *H.323 zone***
  - **H.323 zones are independent of physical network topology**
  - **Each zone has only one GK (exception: Alternate GKs)**

Gatekeeper Functionality

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- **Address translation:**
  - No “normal” DNS address resolution is possible
  - Endpoints do register with their H.323 aliases[1] and call signaling IP address
  - A GK translates H.323 aliases into call signaling IP addresses (especially useful for endpoints with dynamic IP addresses)
  - Multiple GKs can communicate to build a multi-zone address translation service (Æ e.g. Global Dialing Scheme, GDS)

[1] H.323 alias = email-ID (e.g. schlatter@switch.ch), or
e164Number (e.g. 004112681549)

(H.323 defines other alias types, but they are rarely used)

Gatekeeper Functionality (2)

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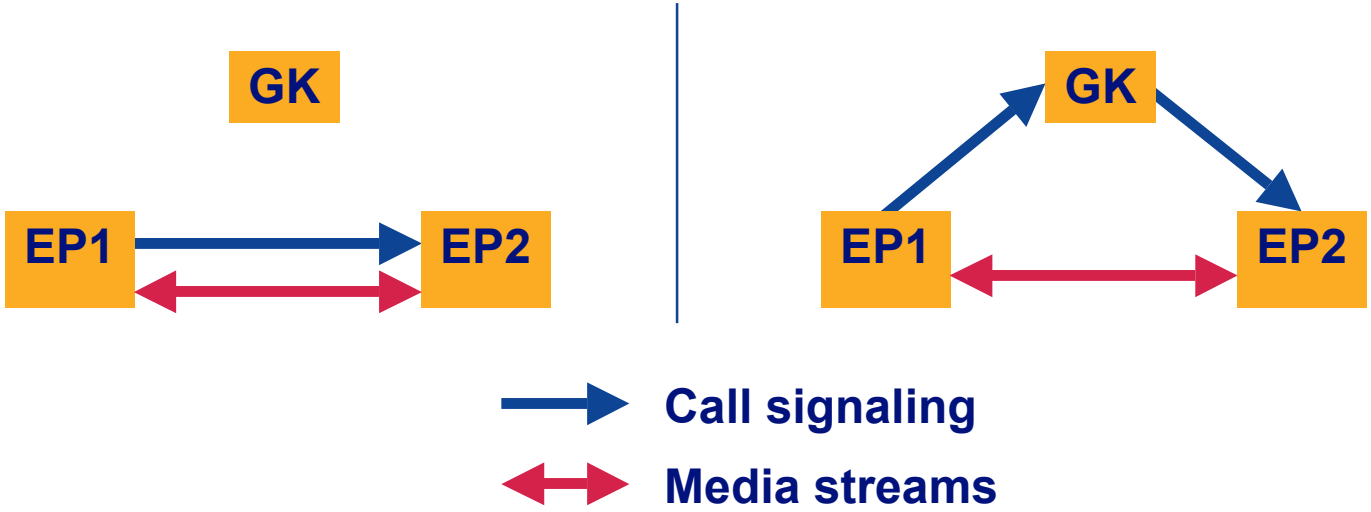
- **Admission control / bandwidth control**
  - Every call within the zone gets authorized by the GK
    Æ admission requests (destination address, bandwidth) to GK

- **Call control Æ e.g. call transfer, call forwarding busy**
  - direct call signaling/control GK routed call signaling/control



H.323 Protocols Overview

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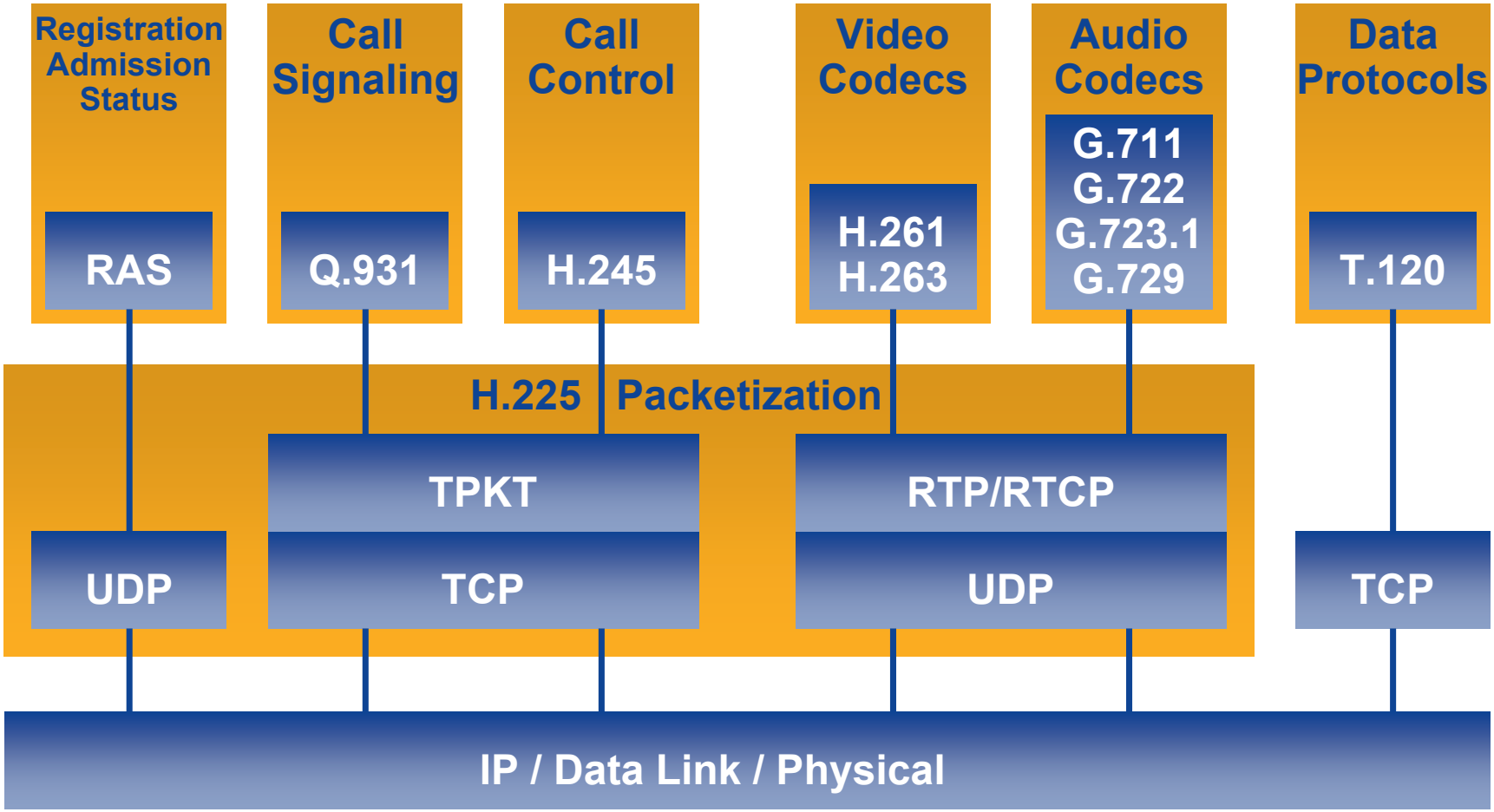

H.323 Protocols Overview: RAS

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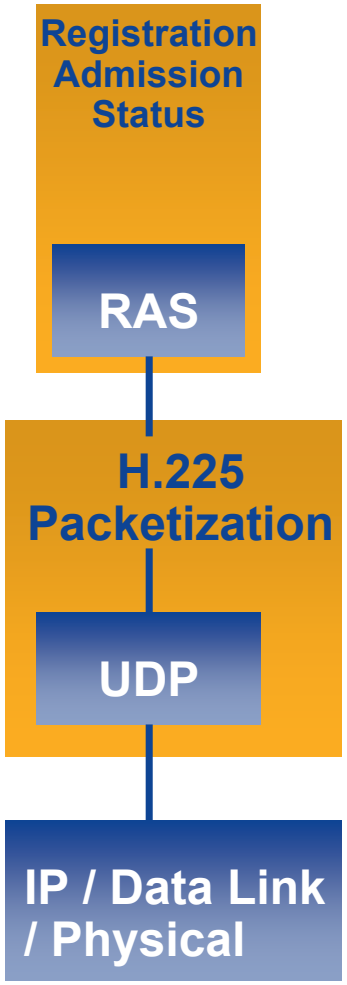

- Specified in H.225
- RAS messages are encoded using ASN.1
- RAS messages are used for:
  - Gatekeeper discovery (often done manually)
  - Gatekeeper registration
  - Name resolution (H.323 alias Æ IP Address)
  - Admission control
  - Bandwidth control
  - Status requests
- UDP, ports 1718 (GK discovery) / 1719

H.323 Protocols Overview: Q.931, H.245

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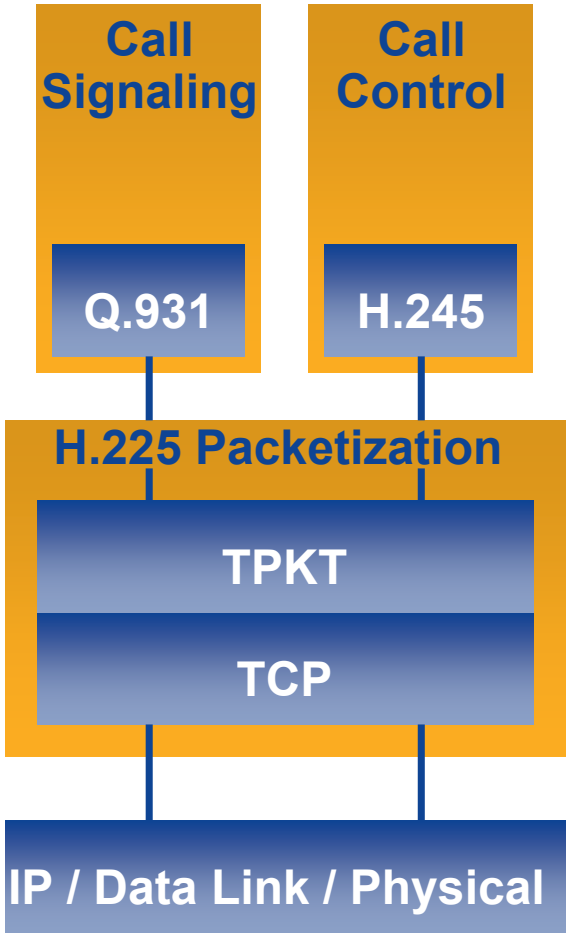

- **Q.931**
  - call signaling protocol used in the *ISDN D-Channel*
  - Encoded in ASN.1
  - H.323 specific data in Q.931 UU-IE[1]
- **H.245**
  - Master/slave determination
  - Capability exchange
  - Management of media and data streams
  - Encoded in ASN.1
- **TPKT**
  - delimit individual messages within the TCP stream (type, length header)
- **Q.931: TCP, port 1720**
- **H.245: TCP, dynamic port (>1024)**

[1] Q.931 UU-IE: User-User Information-Element: Optional element of a Q.931 packet, that includes application specific data (not defined by Q.931)

H.323 Protocols Overview: Video Codecs

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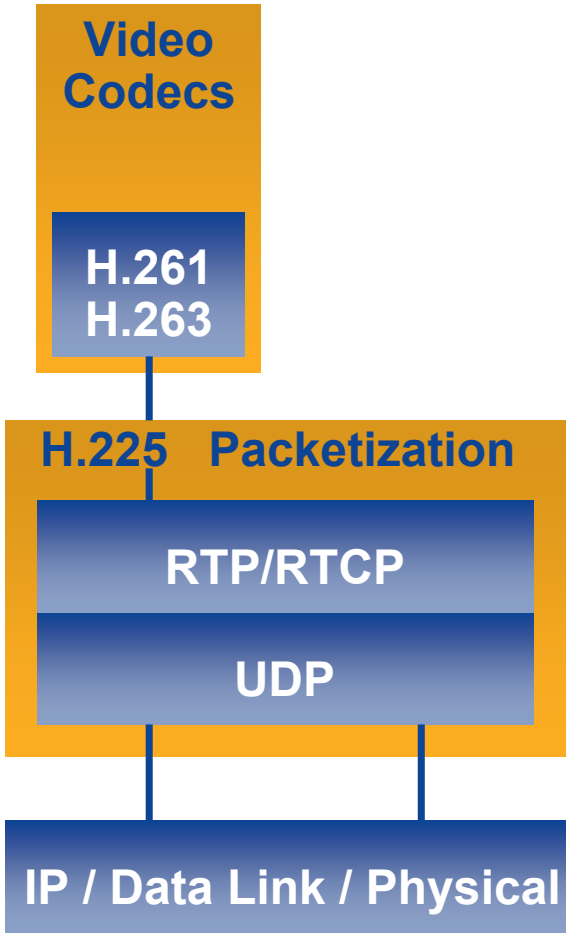

- H.261
  - *Intra-frame* image compression (similar to JPEG, I-Frames) and *inter-frame* motion compensation (P-Frames)
  - QCIF, CIF[1] (optional)
- H.263
  - successor of H.261
  - same video quality as H.261 but lower bitrate
  - SQCIF, QCIF, CIF, 4CIF, 16CIF
- Future: H.264 = MPEG-4

- Real Time Transport Protocol (RTP)
  - IETF RFC 1889
  - end-to-end network transport function
  - payload type, sequence number, timestamp

- UDP, dynamic port (>1024)
  (RTP: even, RTCP: odd numbered port)

[1] Common Intermediate Format (CIF): 352 x 288 pixels, QCIF = 1/4 CIF, SQCIF = 1/4 QCIF, 4CIF = 4 x CIF, 16CIF = 16 x CIF

H.323 Protocols Overview: Audio Codecs

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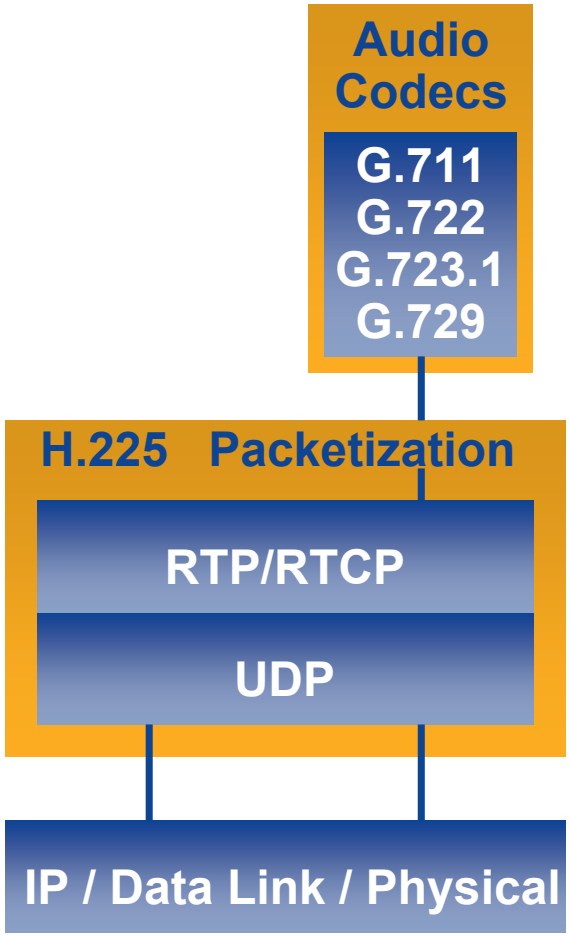

- G.711
  - PCM, 64 kbits, voice quality: good
- G.722
  - 16 kbits, voice quality: low
- G.723.1
  - 5.3 kbits, voice quality: low
- G.729
  - 8 kbits, voice quality: good

- RTP Control Protocol (RTCP)
  - quality feedback, RTP session control

- UDP, dynamic port (>1024)
  (RTP: even, RTCP: odd numbered port)

H.323 Protocols Overview: T.120

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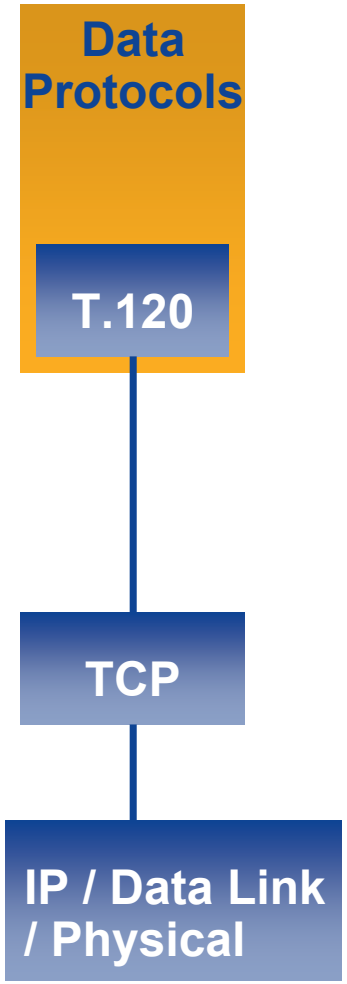

- T.120
  - Used for “data conferencing”
  - White board, image sharing (T.127)
  - File transfer (T.128)
  - Text chat (T.134)
  - Application sharing (non standardized)
- TCP, port 1503

H.323 Call Establishment

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- There are three phases to establish a call:
  - Phase A: GK Communication (admission, address translation)
  - Phase B: Call Signaling (SETUP, ALERTING, CONNECT)
  - Phase C: Call Control (Capability exchange, open/close media streams)

Call signaling = connection level signaling
Call control = application level signaling

H.323 Call Establishment
(direct call signaling)

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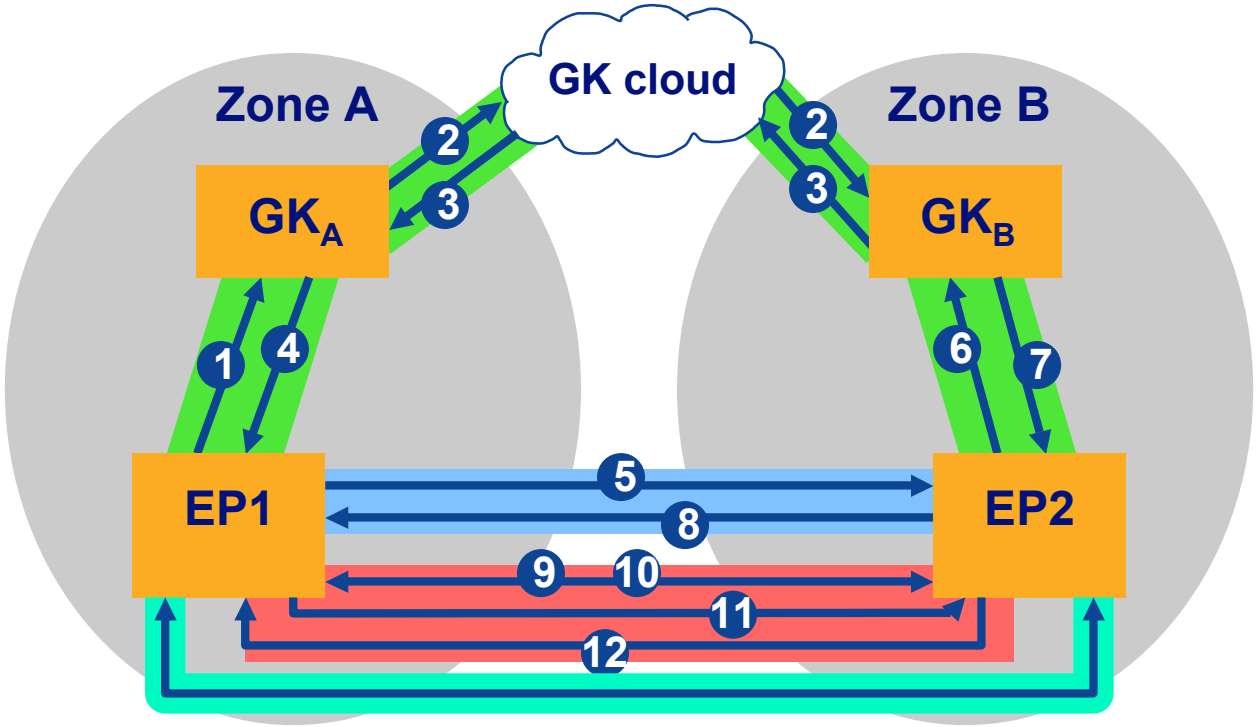
Phase C: Call Control



Transmit and receive media streams

1 AdmissionRequest (ARQ)
2 LocationRequest (LRQ)
3 LocationConfirm (LCF)
4 AdmissionConfirm (ACF)
5 Q.931 Setup
6 AdmissionRequest (ARQ)
7 AdmissionConfirm (ACF)
8 Q.931 Connect
9 Capability Exchange
10 Master/Slave
11 OpenLogicalChannel
12 OpenLogicalChannelAck

RAS channel: UDP, port 1719 (H.225)
Call Signaling channel: TCP, port 1720 (Q.931)
Call Control channel: TCP, dynamic port >1024 (H.245)
Audio/Video streams: UDP, dynamic port >1024 (RTP/RTCP)

H.323 Links

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- http://www.packetizer.com/iptel/h323/
  (excellent H.323 Info Page, all standards for free!)
- http://www.itu.int/rec/recommendation.asp?type=products&parent=T-REC-h
  (H series standards from the ITU)
- http://www.openh323.org/
  (An H.323 open source implementation project)
- http://www.iec.org/online/tutorials/h323/index.html
  (H.323 tutorial from Intel)