Basic Architecture of H.323

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Agenda

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

- 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”

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

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

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\(^1\) TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU
Background to H.323

• H.323 borrowed much of the multimedia conferencing aspects from other H.32x-series\textsuperscript{2} Recommendations, such as H.320
  - good interoperation with ISDN
  - 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

\textsuperscript{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) over modem links
Scope of H.323

- 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

• 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)

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

**Centralized** multipoint conference

**Decentralized** multipoint conference

- **unicast** media streams
- **multicast** media streams

MC: call signaling, conference control
MP: switching/mixing of media streams
Some MPs can do *real-time transcoding* of the received audio/video streams. Every participating terminal can choose its preferred audio/video codec. Transcoding of video streams is computationally expensive, so this is normally done in dedicated DSPs.

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

- 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

• 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 (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)

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

• Call control  e.g. call transfer, call forwarding busy
  – direct call signaling/control  GK routed call signaling/control

![](image)
H.323 Protocols Overview

- **Registration Admission Status:** RAS
- **Call Signaling:** Q.931
- **Call Control:** H.245
- **Video Codecs:**
  - H.261
  - H.263
- **Audio Codecs:**
  - G.711
  - G.722
  - G.723.1
  - G.729
- **Data Protocols:** T.120

**Information Transfer:***
- **TPKT:** Using TCP, UDP
- **RTP/RTCP:** Using UDP

**Stack Layer:**
- IP / Data Link / Physical
H.323 Protocols Overview: RAS

- 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 IP Address)
  - Admission control
  - Bandwidth control
  - Status requests

- UDP, ports 1718 (GK discovery) / 1719
H.323 Protocols Overview: Q.931, H.245

- **Q.931**
  - call signaling protocol used in the *ISDN D-Channel*
  - Encoded in ASN.1
  - H.323 specific data in Q.931 UU-IE

- **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

- **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)

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\(^1\) 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

- **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

- **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

- 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)

Phase C: Call Control

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)

Transmit and receive media streams
H.323 Links

- [http://www.itu.int/rec/recommendation.asp?type=products&parent=T-REC-h](http://www.itu.int/rec/recommendation.asp?type=products&parent=T-REC-h) (H series standards from the ITU)
- [http://www.iec.org/online/tutorials/h323/index.html](http://www.iec.org/online/tutorials/h323/index.html) (H.323 tutorial from Intel)