# Internet Telephony: H.323

# Overview

- H.323 architecture
- elements: gatekeepers, terminals, . . .
- H.323 call setup
- H.323 features
- comparison with SIP

# H.323 Components

**H.323:** overall architecture =

**H.225.0:** call control, RAS to gatekeeper: “may I?”, user location; RTP/RTCP

**H.235:** security for H.323 terminals

**H.245:** capabilities exchange, indications, notifications

**H.246:** interoperability with PSTN

**H.332:** large group conferences

**H.450:** supplementary services

**H.246:** interworking between H.323 and other H.xxx standards

**Q.931:** call setup = ISDN, similar to Q.2931 (ATM)

**Q.932:** supplementary services

## H.323

- derived from H.320 (ISDN multimedia)
- mostly ASN.1 (PER) based
- signaling TCP-based, except for H.323v4

# H.323 Components

**G.711:** 64 kb/s $\mu$/A-law audio

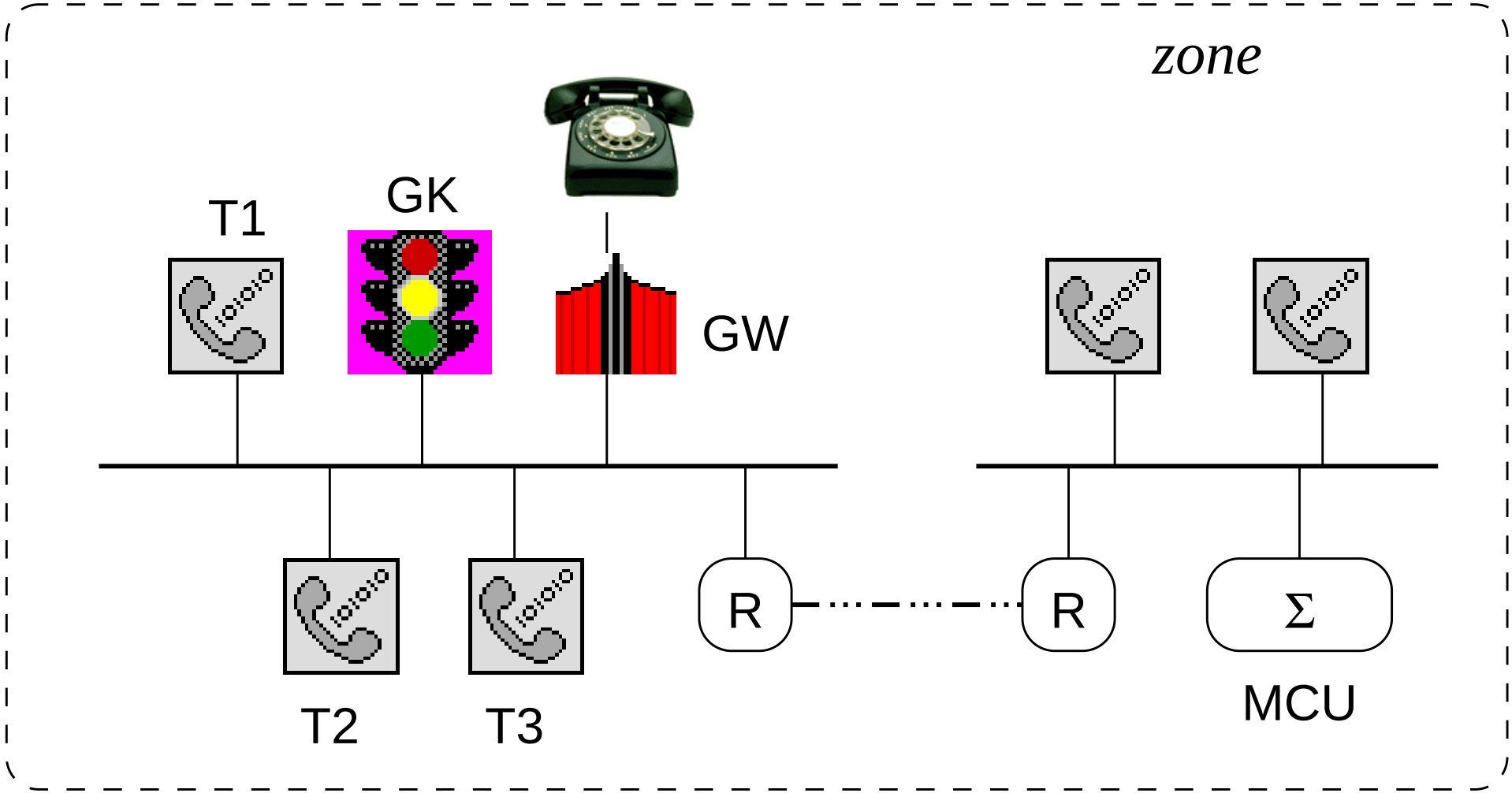
**G.723:** 5.6 or 6.3 kb/s audio

**G.729:** 8 kb/s audio

**H.261, H.263:** conference video coding

- ITU SG-16
- version 2 in use (Feb. 1998), version 3 (Sep. 1999)

# H.323 Zones



# H.323 Elements

**H.323 Terminal** : PC with H.323 software

**MCU:** multipoint control unit ➠ mixes audio and video

**MC:** multipoint controller ➠ performs signaling for centralized conferences

**MP:** multipoint process ➠ actual device for mixing

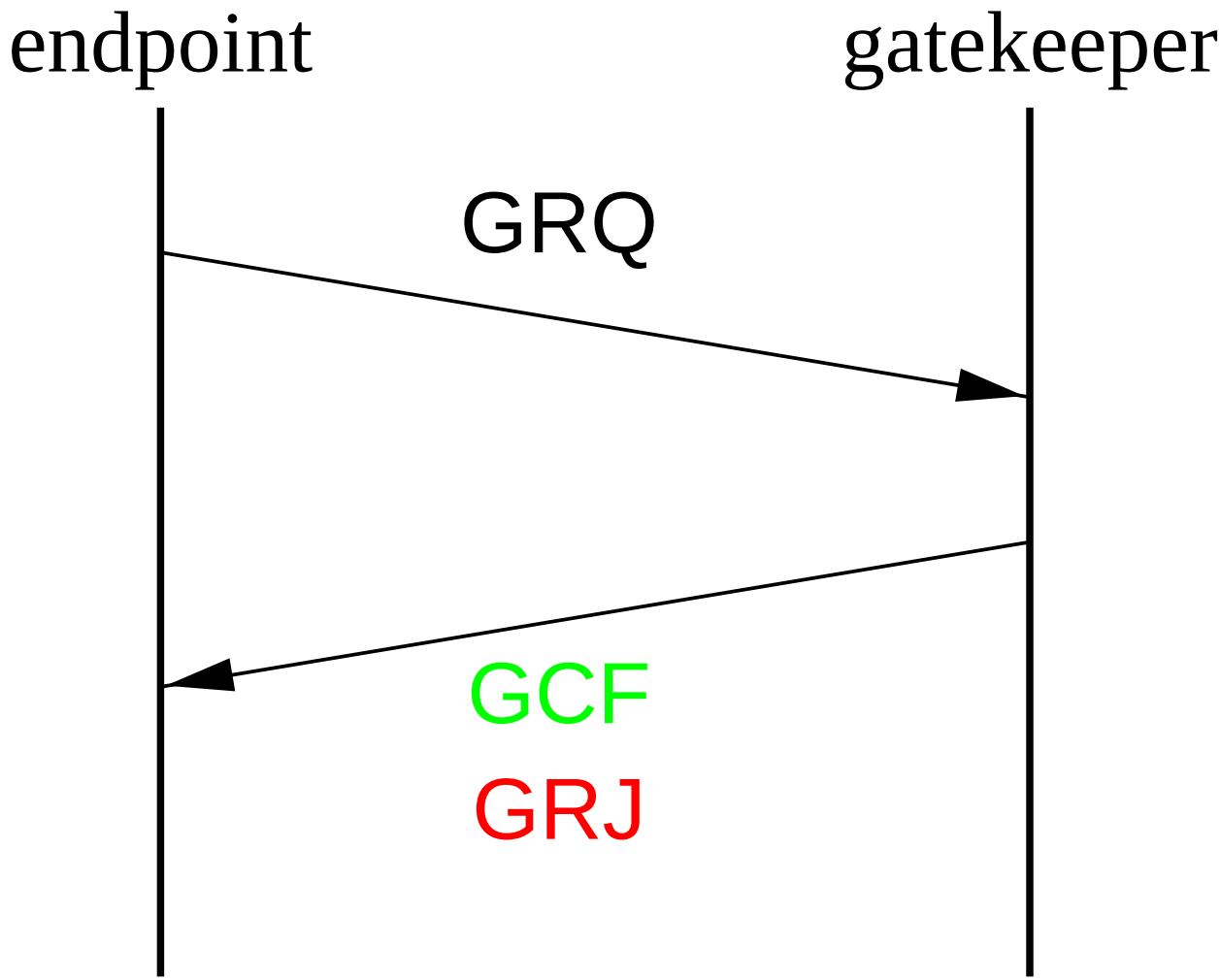
**gatekeeper:** session control: address translation, admission control, bandwidth control, zone management

**gateway:** interface between H.323 systems and other systems: PSTN, H.323 (PSTN mm), H.320 (ISDN), H.321 (ATM mm)

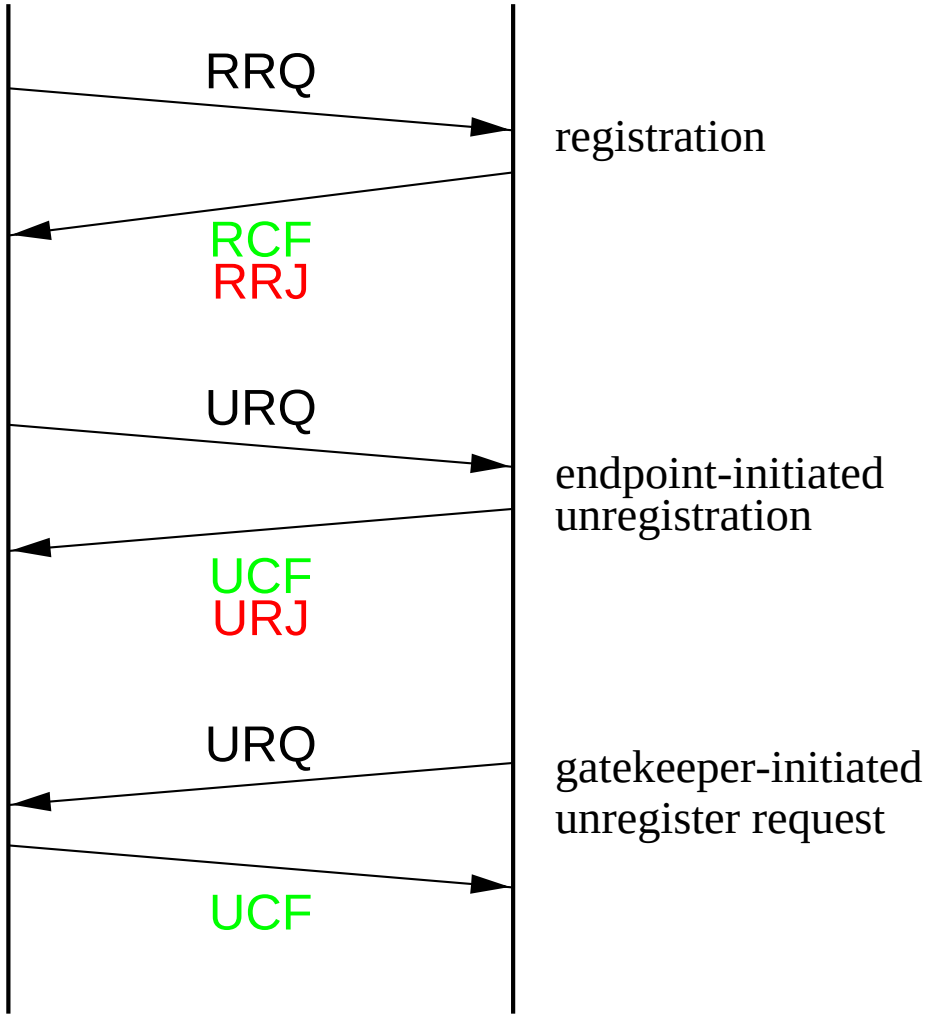
# H.323 gatekeeper

- controls sessions
- performs user location and registration
- admission control
- reroutes signaling
- processes RAS (registration, admission, status) from H.323 terminals

# Gatekeeper Discovery



# Registration with Gatekeeper



# H.323 Phases

**Initialization:** register with GK

**GK admission:** obtain permission
GK resolves address

**Call signaling:** signaling connection to peer
call initiation and completion/rejection

**Negotiation/configuration:** negotiate roles during call
capability exchange
determine mode of operation

**Media exchange:** configure and open logical channels
transmit and receive data streams

**Re-negotiation:** change members, parameters, media, . . .

**Shutdown:** terminate the call/conference
deregister user on log-off

# H.323 Channels

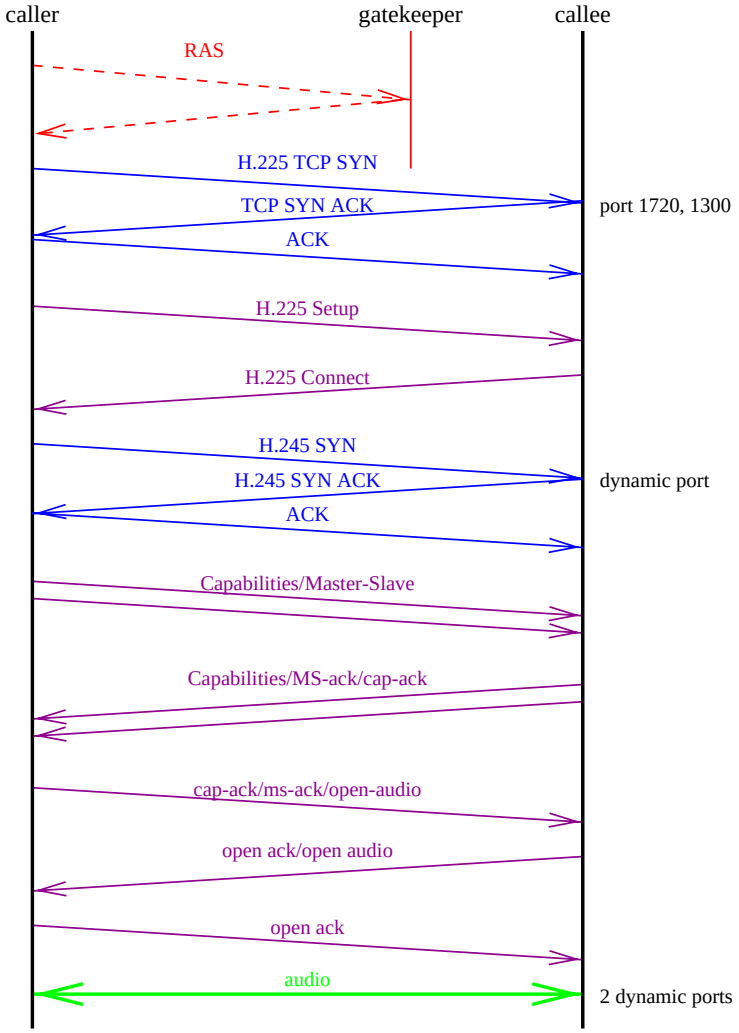
**RAS:** endpoint – gatekeeper: H.225.0 (UDP)

**Call signaling:** call control & supplementary services; ≈ Q.931 (TCP; v3: also UDP)

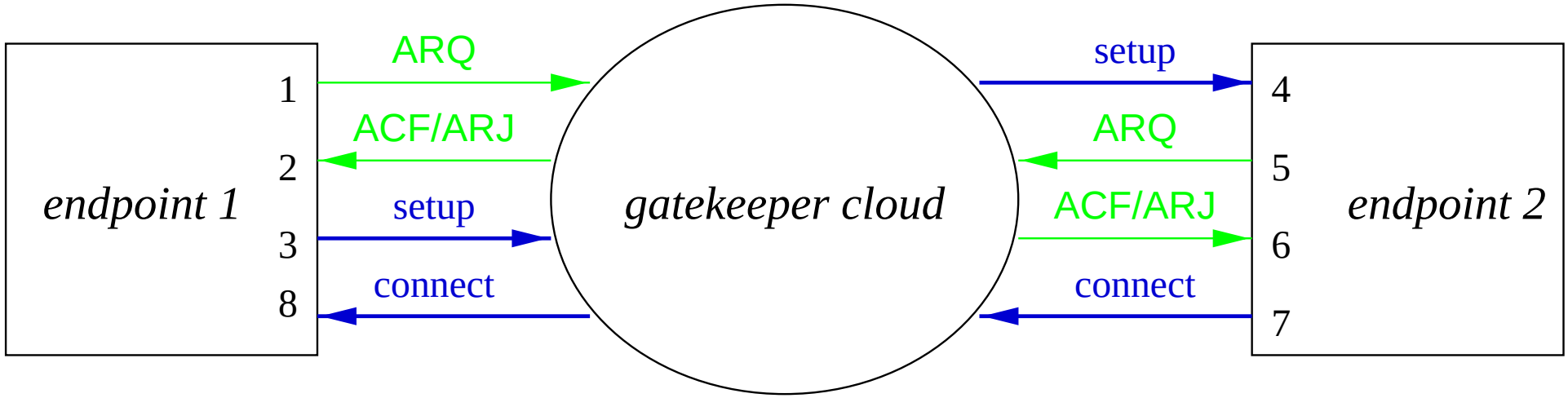
**H.245 control:** media control, capability exchange; open “logical channels” (TCP)

**Logical channel:** carry audio, video, media (UDP)

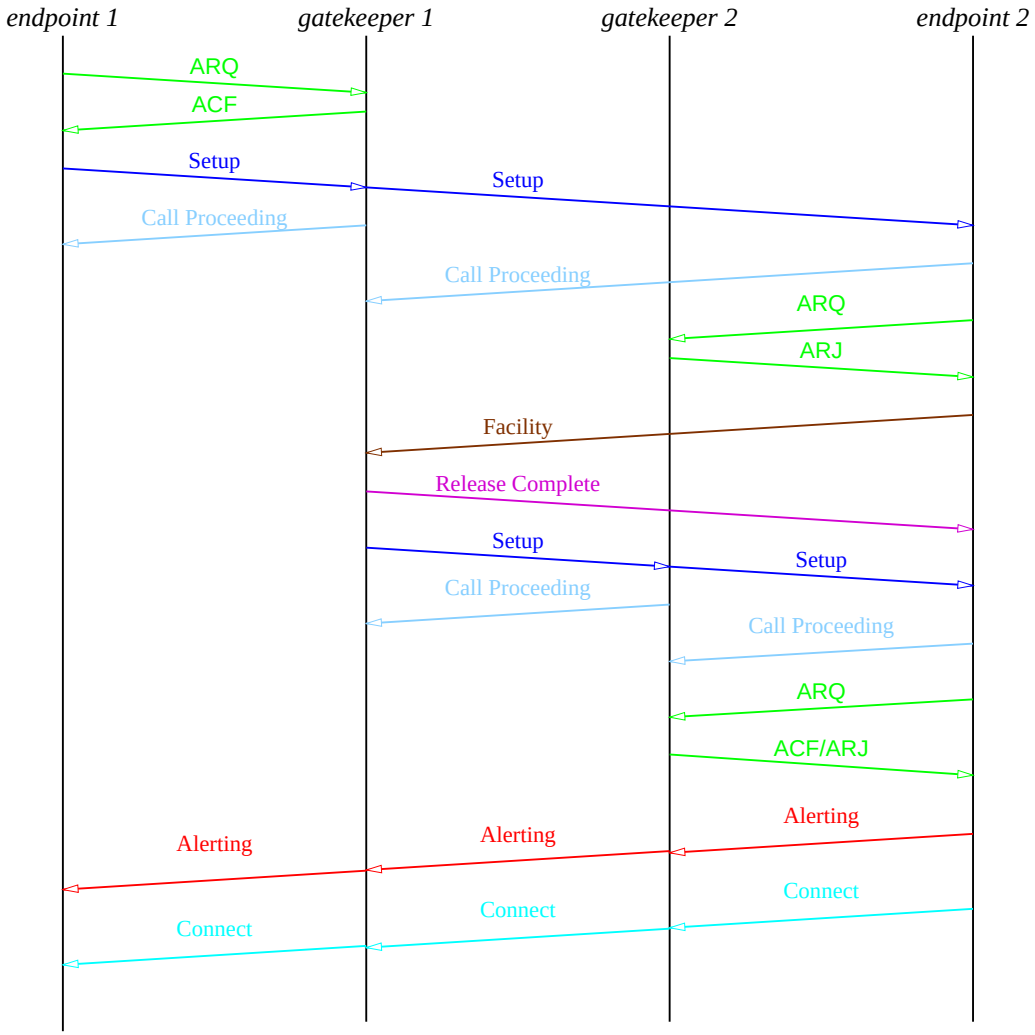
# H.323v1 call setup (w/o fastStart)



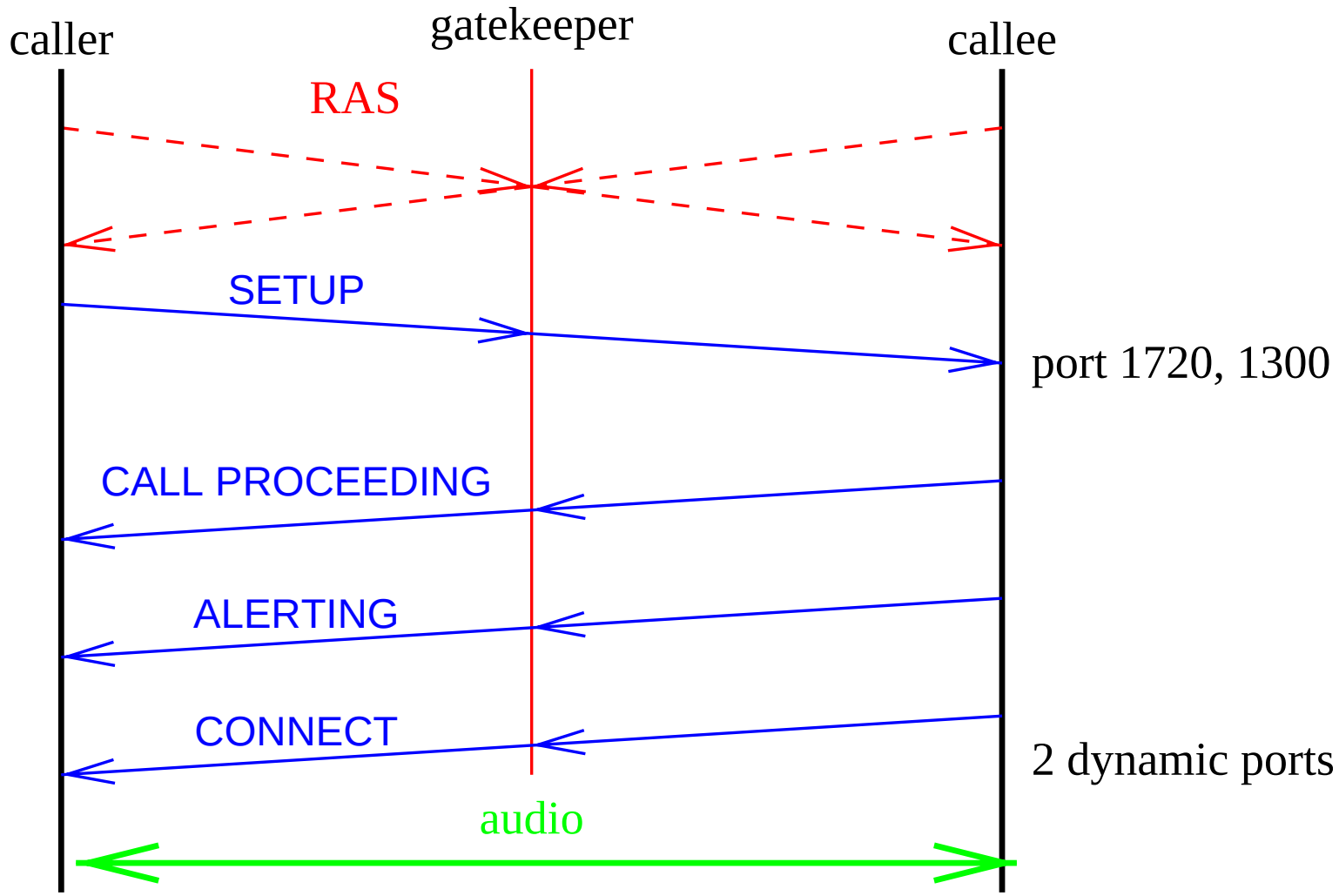
# Gatekeeper-routed Signaling



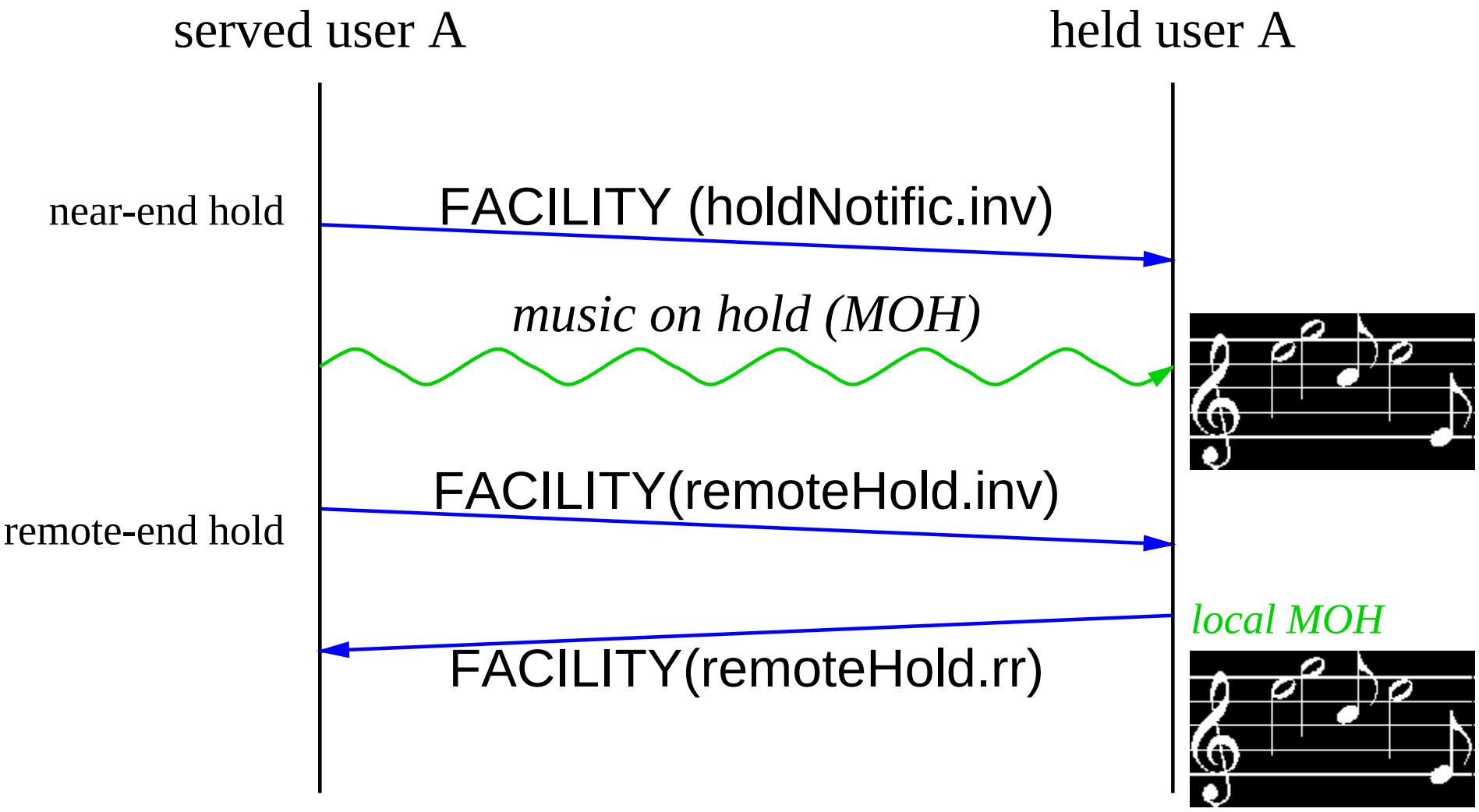
# Both Endpoints Registered – GK Routed



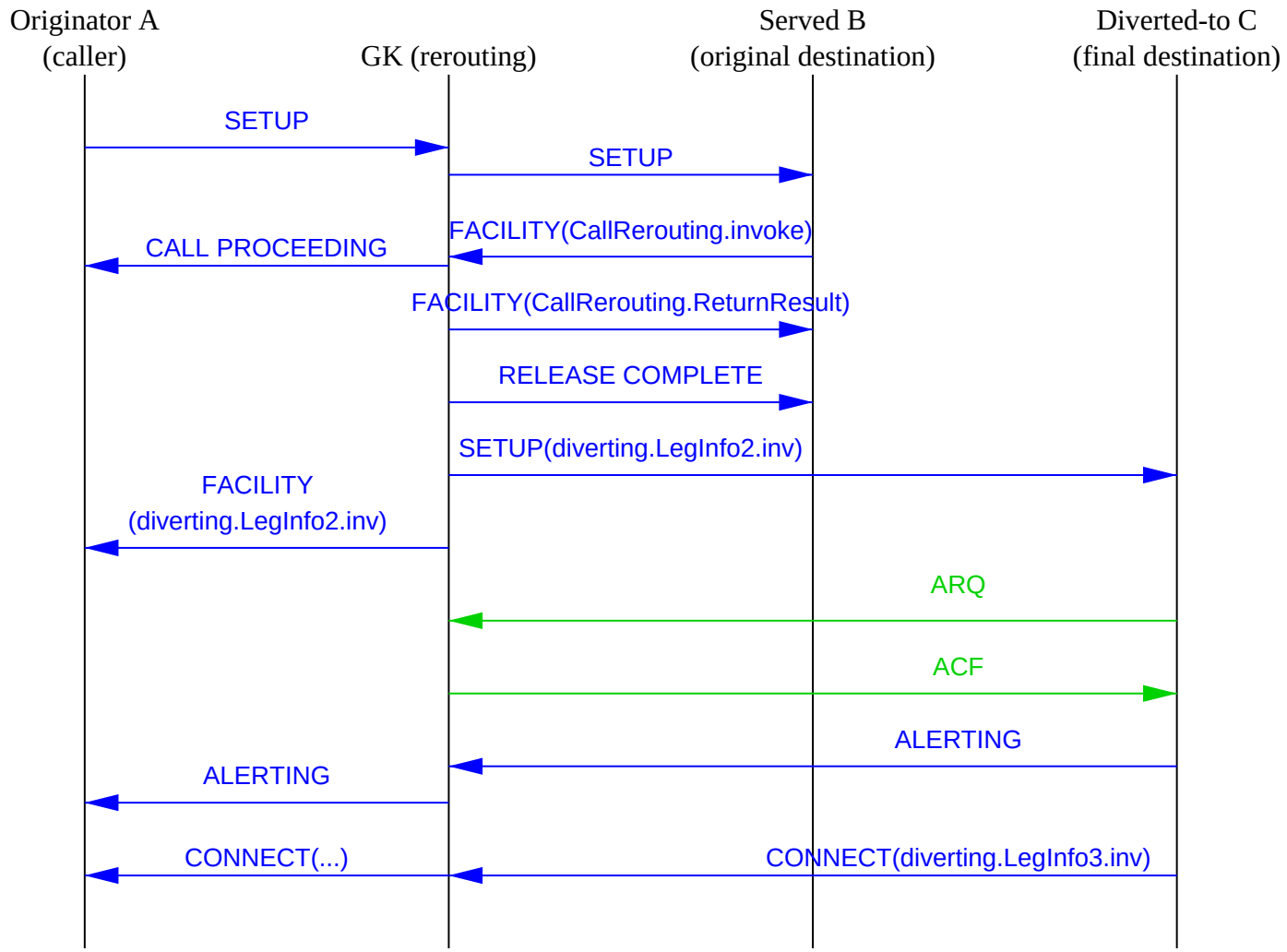
# H.323v3 call setup



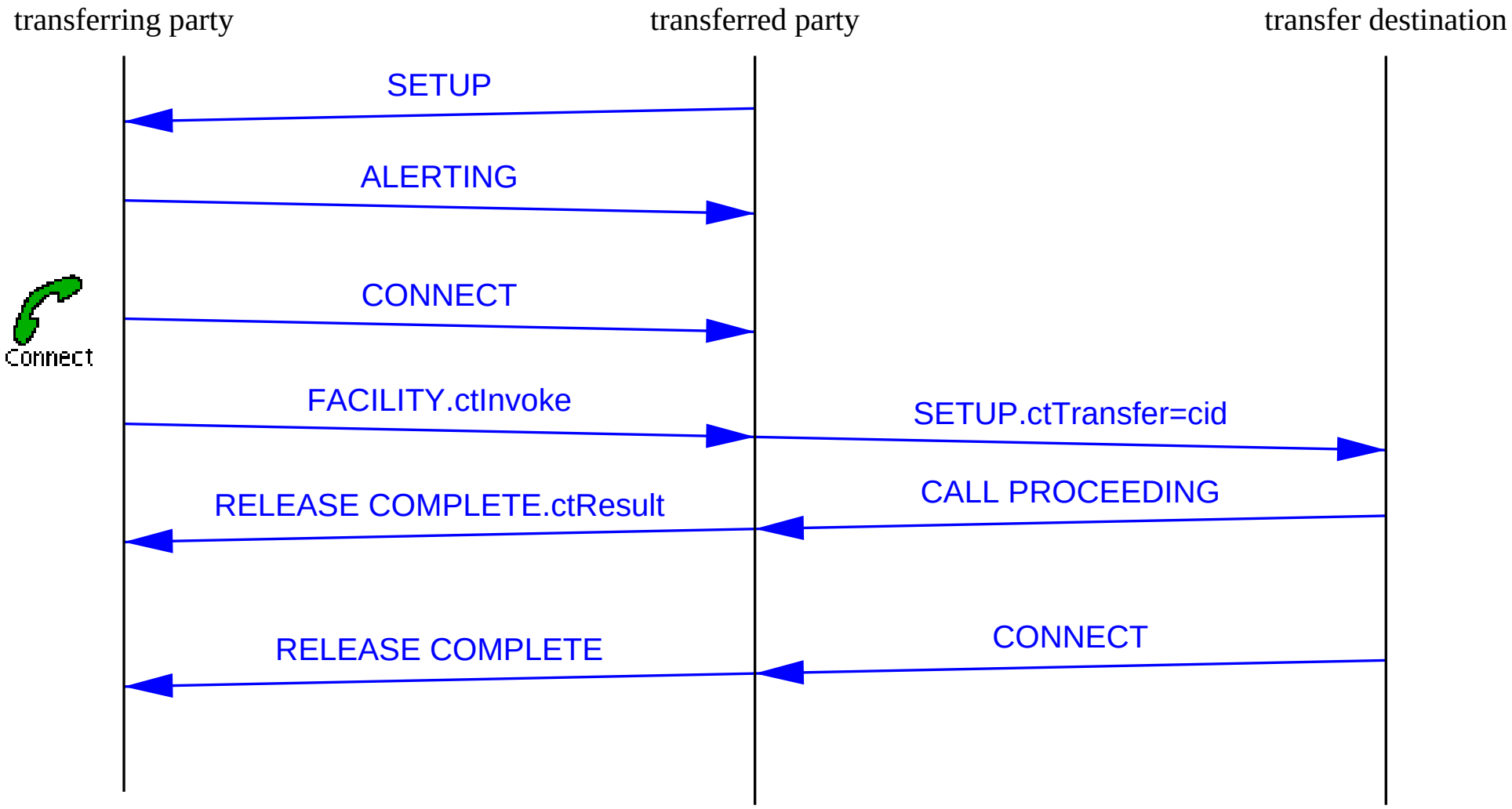
# H.323 call holding: near & remote-end



# H.323 call diversion



# H.323 blind call transfer



# H.323 problems

- very complex (200+ pages; 65 pages for call forwarding!)
- no multicast signaling
- limited multicast conferences (➠ MCUs)
- call = TCP connection ↔ mobility, reliability
- but: better capability negotiation (H.245)
- no media servers
- agile ports ➠ firewalls difficult

# H.323 delay

- several TCP connections ➠ very long latency (6.5-8 RTTs)
- 1 TCP SYN loss ➠ delay of 6 seconds
- 2 TCP SYN losses ➠ delay of 24 seconds

➠ H.323v2 for fewer connections, UDP?

# SIP – H.323 comparison

| | H.323 | SIP |
|---|---|---|
| Architecture | stack | element |
| Conference control | yes | no |
| Protocol | mostly TCP | mostly UDP |
| Encoding | ASN.1, Q.931 | HTTPish |
| Emphasis | telephony | multimedia, multicast |
| Address | flat alias, E.164 | SIP, E.164 URLs |

Both SIP and H.323 are evolving: SIP additions, H.323v2 implemented, v3 to be decided.

## SIP – H.323 comparison

- I. Dalgic and H. Fang, “Comparison of H.323 and SIP for IP Telephony Signaling”, *Proc. of Photonics East*, Boston, Massachusetts. Sept. 1999.
- H. Schulzrinne and J. Rosenberg, “A Comparison of SIP and H.323 for Internet Telephony”, *NOSSDAV*, Cambridge, England. July 1998.

## H.323 Resource Reservation

- *local* admission decision
- prior to call setup $\longrightarrow$ no information about bandwidth available
- works only for “yellow cable Ethernet”
- other applications have to notify GK
- SIP: RSVP, YESSIR, DiffServ + call preconditions

## SIP vs. H.323 call setup

**H.323v1:** several TCP connections (H.245, Q.931) $\longrightarrow$ very long latency (6.5-8 RTTs), particularly with packet loss; currently in *NetMeeting*

**H.323v2:** merge H.245 and Q.931 (“FastConnect”)

**H.323v3:** allow UDP

End systems need to support all versions.

# H.323 vs. SIP: basic call control

(modified from Dalgic and Fang, *Comparison of H.323 and SIP*)

| Service | H.323v1 | v2 | v3 | SIP |
|---|---|---|---|---|
| Call holding | no | yes | yes | yes |
| Call transfer | no | yes | yes | yes |
| Call forwarding | no | yes | yes | yes |
| Call waiting | no | yes | yes | yes |

# H.323 vs. SIP: advanced features

| Service | H.323v1 | v2 | v3 | SIP |
|---|---|---|---|---|
| Third party control | no | no | no | yes |
| Conference | yes | yes | yes | yes |
| Click-to-dial | ? | ? | ? | PINT |
| Capability exchange | better | better | better | yes |
| HTML transport | no | no | no | yes |

# H.323 vs. SIP: services

| Service | H.323 | SIP |
|---|---|---|
| Call transfer | H.450.2 | “30x” |
| Call diversion | H.450.3 | “30x” |
| Call hold | H.450.4 | SDP-based |
| Call park | H.450.5 | REGISTER |
| Call waiting | H.450.6 | INVITE |
| Message waiting | H.450.7 | email, NOTIFY |
| Call forward busy | H.450.9 | “30x” |

# H.323 vs. SIP: quality of service

| | H.323v1 | v2 | v3 | SIP |
|---|---|---|---|---|
| Call setup delay | 6-7 RTT | 3-4 | 1.5-2.5 | 1.5 |
| Loss recovery | TCP | TCP | better | better |
| Fault detection | yes | yes | yes | yes |
| Mid-call failure | fail | fail | fail | live |
| Registrar failure | fail | fail | backup | multicast |
| GK/Proxy redundancy | no | no | backup | SLP, DNS, DHCP |
| Loop detection | no | no | PathValue | Via, hops, time |

## H.323 vs. SIP: manageability

| | H.323v1 | v2 | v3 | SIP |
|---|---|---|---|---|
| Admission control | yes | yes | yes | no (RSVP) |
| Policy control | yes | yes | yes | ob proxy |
| Resource reservation | local | local | local | no (RSVP) |

## H.323 vs. SIP: scalability

| | H.323v1 | v2 | v3 | SIP |
|---|---|---|---|---|
| Complexity | more | more | more+ | less |
| Server processing | SF | SF | SF/SL, TSF | SL, TSF/TSL |
| Inter-server | no | no | yes | yes |

TS: transaction state; SF: call statefull; SL: call stateless

# H.323 vs. SIP: flexibility

| | H.323v1 | v2 | v3 | SIP |
|---|---|---|---|---|
| Transport protocols | TCP | TCP | TCP/UDP | any |
| Extensibility | unlabeled | vendor extensions | | IANA, labeled |
| Customization | | harder | | easier |
| Version compatibility | N/A | yes | yes | N/A |
| SCN interoperability | good | good | good | TBD |
| protocol encoding | binary (ASN.1, Q.931) | | | text |