COMVERSE Network Systems Academy

Technical Seminar

In Depth H.323 Overview November, 2000

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This presentation assumes previous familiarity with H.323

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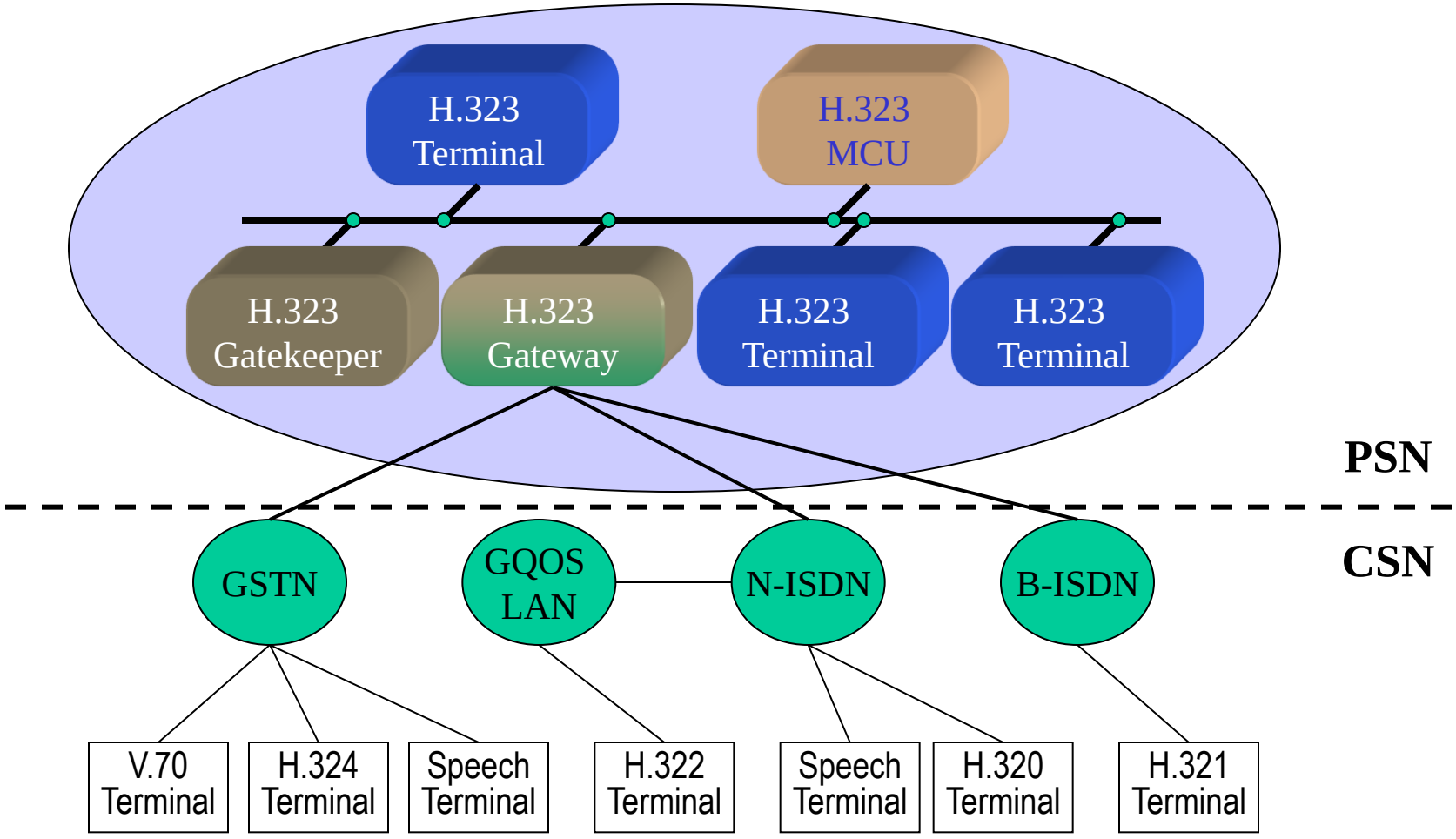
Agenda

- **What is H.323 ?**
- **H.323 version suites**
- **The recommendations**
  - H.323
  - H.323 Annexes
  - H.225.0 (Call Signaling and RAS)
  - H.245 (Media control)
  - H.235 (security)
  - H.341 (SNMP)
  - H.450 (Supplementary Services)
  - H.246 (Interworking Gateways)
  - H.248 Gateway Control protocol (Megaco)

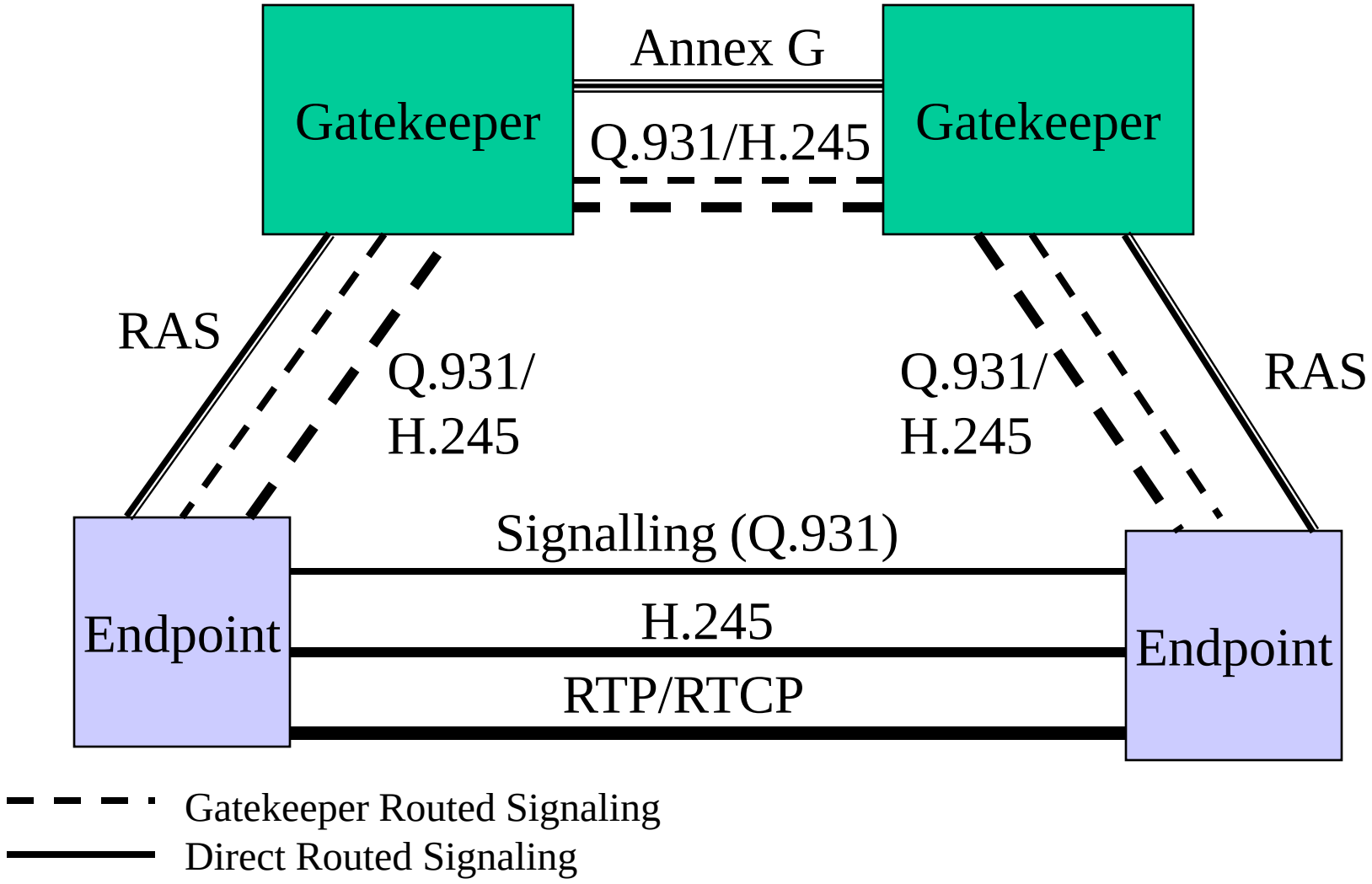
What is H.323 ?

H.323 Recommendation describes terminals and other entities that provide multimedia communications services over Packet Based Networks (PBN) which may not provide a guaranteed Quality of Service.

Reminder : H.323 Network Elements



H.323 basic protocols



Source:
Lior Moscovici

H.323 relation to other standards

- **RTP/RTCP : RFC 1889 and 1890.**
- **T.120 - data conferencing**
- **Audio Codecs: G.711, G.722, G.723.1, G.728, G.729**
- **Video Codecs: H.261, H.263**
- **T.38: Realtime FAX**
- **Q.931**
  - Historical, confusing and misleading
- **E.164 (1997)**
  - *The international public telecommunication numbering plan.*
- **ATM Forum Technical Committee, AF-SAA-0124.000**
  - *Gateway for H.323 Media Transport Over ATM, 1999.*

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H.323 Version Suites

With complements to Paul Jones

http://www.packetizer.com/iptel/h323

H.323 version 1

- "Visual telephone systems and equipment for local area networks which provide a non-guaranteed quality of service".
- **Recommendations**
  - H.323 (1996)
  - H.225.0 (1996) `protocolIdentifier=`
    {itu-t (0) recommendation (0) h (8) 2250 version (0) **1**}
  - H.245 (1997) `protocolIdentifier=`
    {itu-t (0) recommendation (0) h (8) 245 version (0) **2**}

- **Note the H.245 version is erroneously stated as 1996 in V2 and V3. This will be corrected in V4.**

H.323 Version 2

- "Packet-based multimedia communications systems"
- **Recommendations**
  - H.323 (1998)
  - H.225.0 (1998) `protocolIdentifier=`
    {itu-t (0) recommendation (0) h (8) 2250 version (0) **2**}
  - H.245 (1998) `protocolIdentifier=`
    {itu-t (0) recommendation (0) h (8) 245 version (0) **3**} (or higher)
  - H.235 (1998)
  - H.246 (1998)
  - **H.450.1 (1998) Call Signaling**
  - **H.450.2 (1998) Call Transfer**
  - **H.450.3 (1998) Call Forward**
- **Note: H.450 .2 and .3 were not decided until <u>after</u> H.323V2 decision**

What's new in H.323 v2 ?

- **H.235 Security**
  - Authentication of participant (I.e. originating gateway)
  - Integrity of data
  - Privacy/Confidentiality (encryption)
  - non-repudiation (form of digital signature)
- **Fast Connect (a.k.a. Fast Start)**
- **Supplementary Services**
  - H.450.1 Signaling protocol
  - H.450.2 Call Transfer
  - H.450.3 Call Diversion (CF, CFB, CFNR, Call Deflection)
- **T.120 integration (as a logical channel)**
- **Call Identifier (globally unique)**

New in H.323 v2 - cont'd

- **Tunneling H.245 in the call signaling channel**
- **Overlapped Sending (for Ph-Ph service)**
- **Progress Message, RIP message**
- **New Alias types**
  - Email, URL, Transport ID and Party Number
- **Pause (empty H.245 capability set)**
- **H.245 User Input Indication full DTMF description**
- **QoS : OLC includes RSVP parameters**
- **Alternate Gatekeeper and endpoint (redundancy)**
- **Status (resource availability)**
- **Pre Granted ARQ**
- **More ...**

H.323 Version 3

- **Recommendations**
  - H.323 (1999)
  - H.225.0 (1999) `protocolIdentifier=`
    {itu-t (0) recommendation (0) h (8) 2250 version (0) **3**}
  - H.245 (1999) `protocolIdentifier=`
    {itu-t (0) recommendation (0) h (8) 245 version (0) **5**} (or higher)

  - **H.235 (1998)**
  - **H.246 (1998)**
  - **H.341 (1999)**

  - **H.450.1 (1998)**
  - **H.450.2 (1998)**
  - **H.450.3 (1998)**
  - **H.450.4 (1999) Call Hold**
  - **H.450.5 (1999) Call Park and Pickup**
  - **H.450.6 (1999) Call Waiting**
  - **H.450.7 (1999) MWI**

What's new in H.323 v3 ?

- Reuse of signaling channels and Annex E
- Conference out of Consultation
- Caller ID support (including blocking caller ID)
- Language Preference (important for IVR)
- Remote device control (H.282)
- H.225.0 Annex G (Inter Domain)
- H.323 Annex F (Simple Endpoint Type)
- H.341 - MIB
- Supplementary Services (450.4 - 450.7)

H.323 Version 4 (decision Nov 17, 2000)

- **Recommendations**
  - **H.323 (2000)**
  - **H.225.0 (2000)** `protocolIdentifier=` {itu-t (0) recommendation (0) h (8) 2250 version (0) **4**}
  - **H.245 (2000)** `protocolIdentifier=` {itu-t (0) recommendation (0) h (8) 245 version (0) **7**}
  - **H.235 (1998)**
  - **H.246 (1998)**
  - **H.248 (2000)**
  - **RFC 2068 HTTP/1.1 (1999)**
  - **RFC 2045 MIME (1996)**
  - **many other RFC**
  - **H.450.1 (1998)**
  - **H.450.2 (1998)**
  - **H.450.3 (1998)**
  - **H.450.4 (1999)**
  - **H.450.5 (1999)**
  - **H.450.6 (1999)**
  - **H.450.7 (1999)**
  - **H.450.8 (2000) Name Identification**
  - **H.450.9 (2000) Call Completion**

What's new in H.323 v4 suite ?

- **H.323 Architecture: Gateway Decomposition**
- **Supplementary services explained**
- **H323 URL** h323:user@host:port
- **H.323 Annex K (HTTP)**
  - HTTP-based control for H.323 devices
  - suitable for implementing service creation environments
- **H.450.8: Name Identification Service (Caller ID++)**
- **H.450.9: Call Completion**
- **Robustness: Alternate Gatekeeper explained**
- **H.323 Annex L (Stimulus) - was not determined**

New in H.323 v4 - (page2)

- Usage Information reporting (Billing and H.225.0/G)
- Tones and announcements (2 stage dialing)
- Indicating Desired protocols (e.g. fax all the way)
- Improved BW management for conferencing
- Fast Connect /Early H.245 improved
- Protocols Extension mechanism (as in SIP !)
- Tunneling QSIG and ISUP (H.323 Annex M.1 & M.2)

New in H.323 v4 - (page3)

- **RTP payload format for DTMF**
- **Switching between voice and fax**
- **Additional annexes now embedded:**
  - Updated Annex D (Real Time FAX)
  - Updated Annex E (multiplexed call signalling transport)
  - Annex F (S.E.T.)
- **Multiplexed streams for audio+video (H.222, H.223)**

Zoom in: What's New in H.225.0 v4 ?

- **PSTN Signaling Tunneling (with H.323 Anx M.1, M.2)**
- **PSTN(SS7) end-to-end circuit selection**
- **PSTN originated call diversion**
  - Redirecting Number IE added
- **Multiple Calling Party Numbers**
  - `additionalSourceAddresses` in SETUP
- **End-to-end compatibility signaling** (`signallingProtocol`)
  - Used e.g. for routing fax calls to fax capable endpoints
- **Support Non Reliable Transport (Annex E/H.323)**
  - Call-id in each message
- **Support Annex K in RAS and Signaling messages**
  - New RAS commands for Service Control: SCI, SCR

What's New in H.225.0 v4 ? (page 2)

- **Alternate Gatekeeper mechanism revised**
  - procedural text moved to H.323
- **Fast Connect refined**
  - Early H.245 in parallel to Fast Connect establishement
  - may indicate symmetric codec negotiation
  - text clarifications in the Implementers Guide
- **Interzone enhancements**
  - loop prevention
  - reject reason (resource unavailable)
- **Caller-ID Screening**
  - `ExtendedAliasAddress, ScreeningIndicator`

New in H.225.0 (page 3)

- **Support for large scale GWs:**
  - New reporting mechanism: Call capacity (can replace RAI)
  - Segmented IRR for large scale GWs
  - Additive registration
- **Tones and announcements support**
  - H.248 package is embedded in some RAS messges
  - 2-stage dialing is supported by the GK in ARJ
- **Billing support**
  - usage reporting (compatible with Annex G/H.225.0)
- **Mobile networks address aliases added (H.246/E)**

New in H.225.0 (page 4)

- **Generic Data (Extensible) added for future use**
  - Will not require ASN.1 full revision for each change
- **Referencing Q.931 (1998) instead of (1993)**
- **New Appendix V:** ASN.1 Usage in H.225.0
- **Codecs:**
  - Annex E: MPEG-4 video codec added (?)
  - Annex F New audio codecs:
    - G.729 : Added Annex C, D, E
    - G.722.1
    - IS-136 ACELP , IS-136 US1 , IS-127 EVRC
    - H.223 MUX-PDU Packetization

H.323 Implementers Guide

- Not what it sounds
- Contains “last minute” changes
- Applicable to the full H.323 umbrella

- Is the formal latest version

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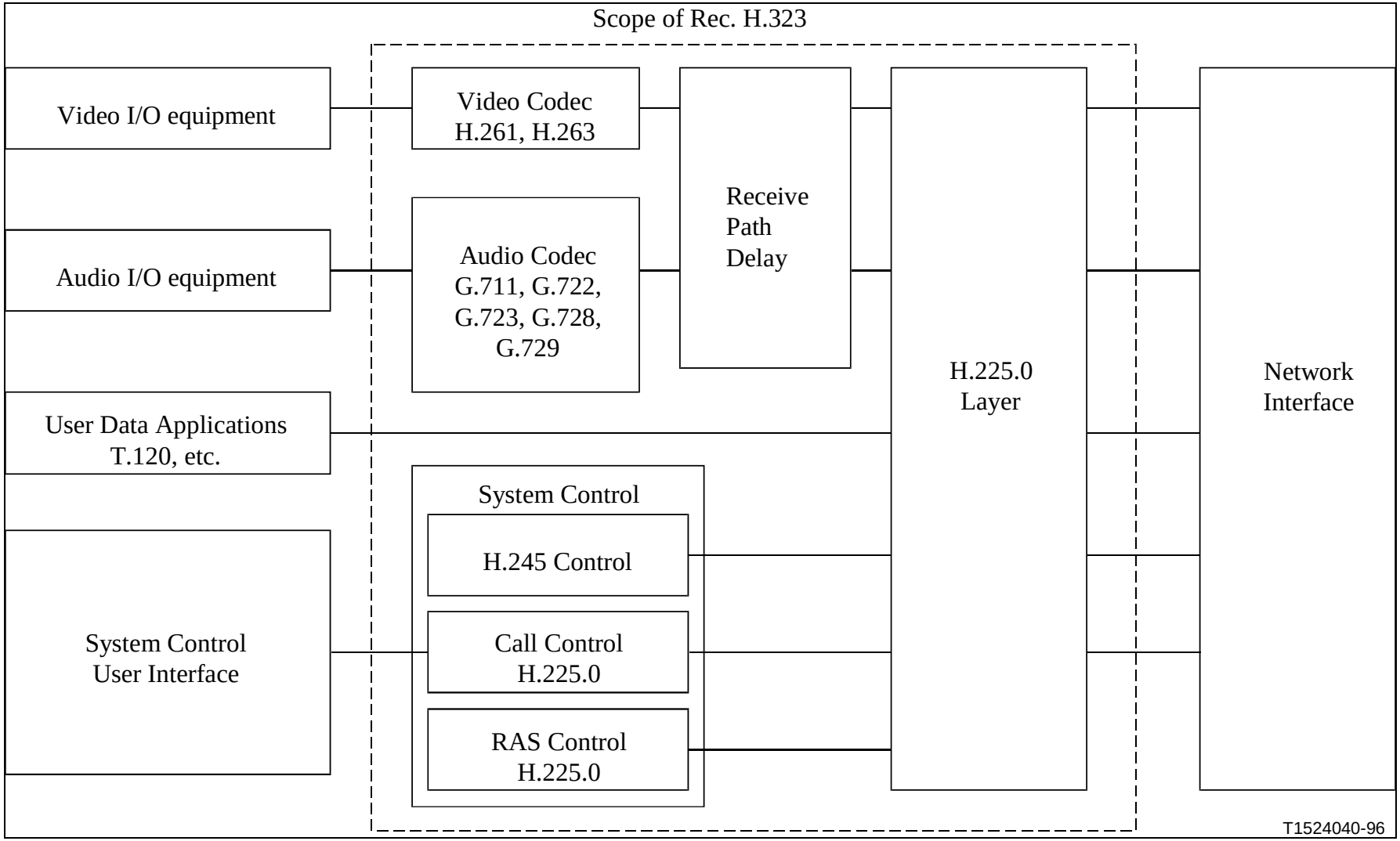
The Recommendations

Take a deep breath ...

academy

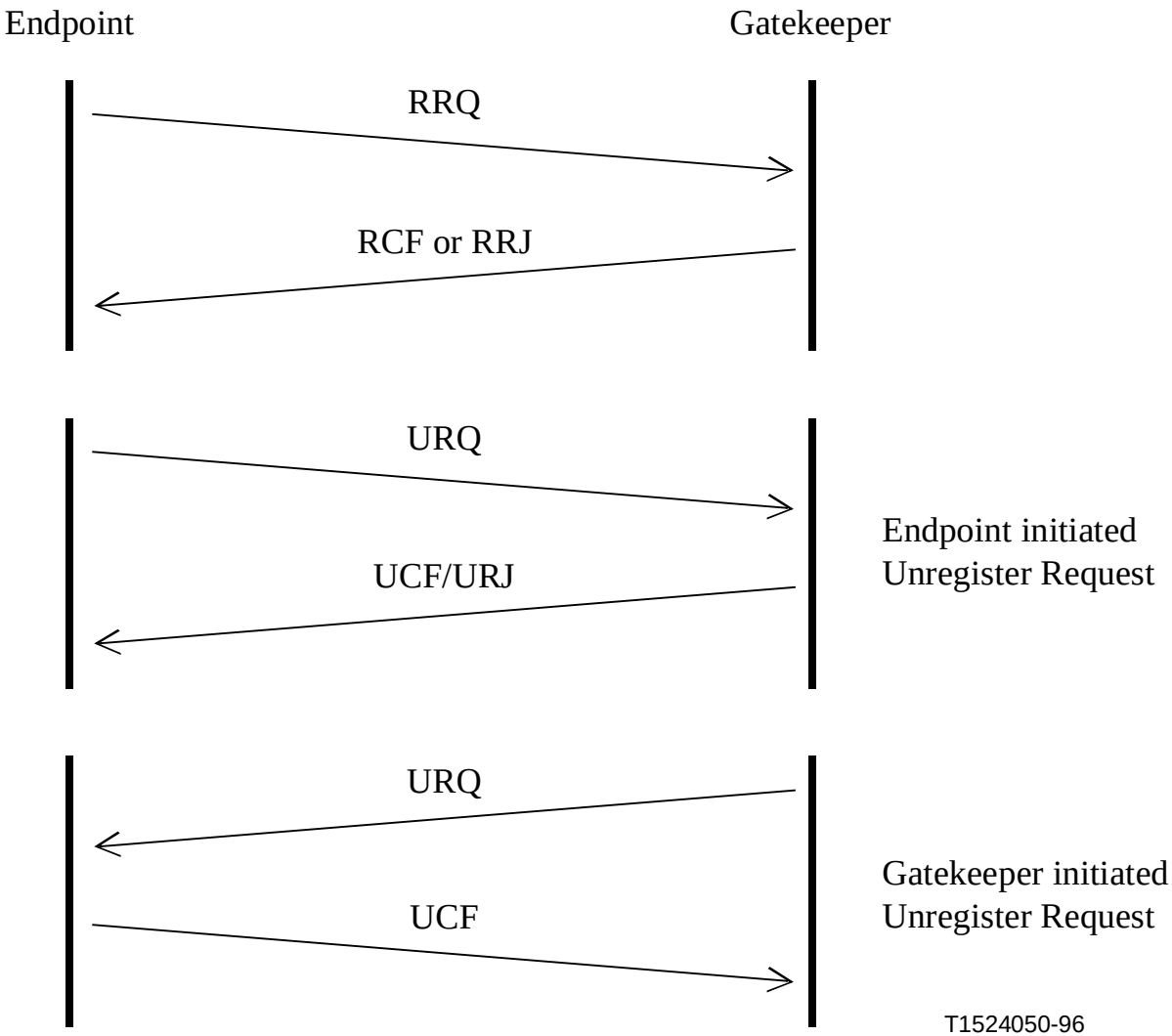
H.323 Recommendation scope



H.323 recommendation (based on V3)

- **(6) System Description**
- **(7) Call signalling**
  - (7.1) Addresses
    - Unique Network address (e.g. IP)
    - multiple TSAP identifier (e.g. TCP port)
    - alias address (e.g. e-mail)
  - (7.2) RAS Channel (unreliable)
    - GK Discovery (GRQ)
    - Endpoint registration (RRQ)
    - Endpoint Location (LRQ)
    - Admission and bandwidth (ARQ, BRQ)
    - Access Tokens

H.323 Registration

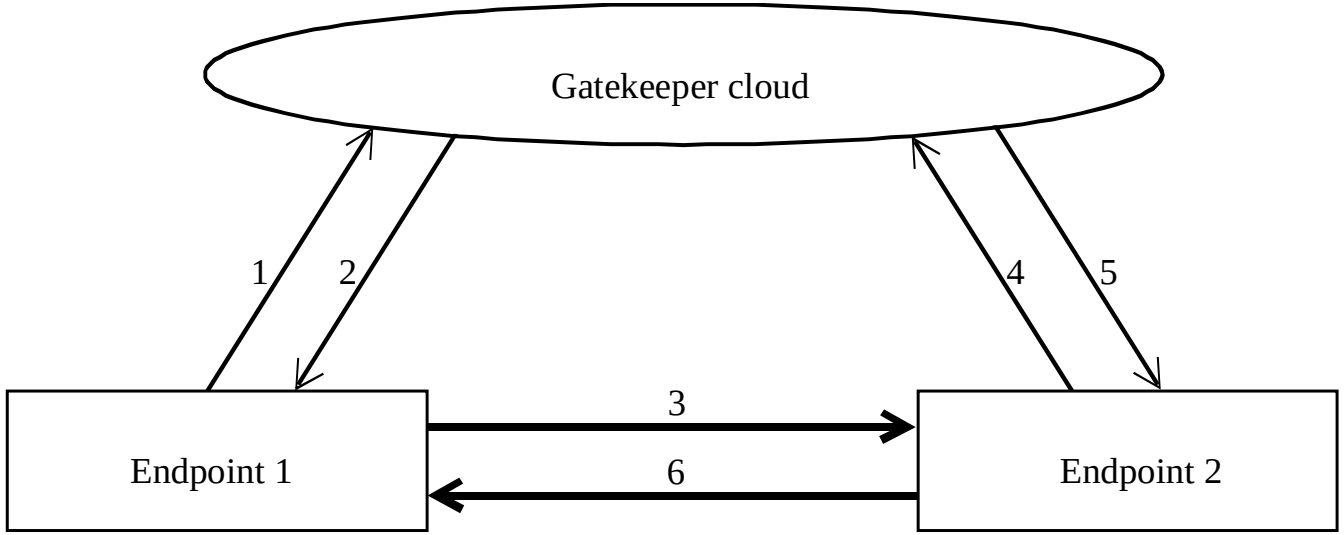


H.323 Call Signaling

- (7.3) Call Signaling Channel (reliable)
  - Networks without GK
  - Call Signalling Routing
    - Direct (endpoint) routed Call signalling (DRC)
    - Gatekeeper Routed Call signalling (GRC)
      - » Including H.245 (GK Routed H.245)
      - » Excluding H.245 (Direct H.245)

DRC - Direct Endpoint Call Signaling

1 ARQ
2 ACF/ARJ
3 Setup
4 ARQ
5 ACF/ARJ
6 Connect



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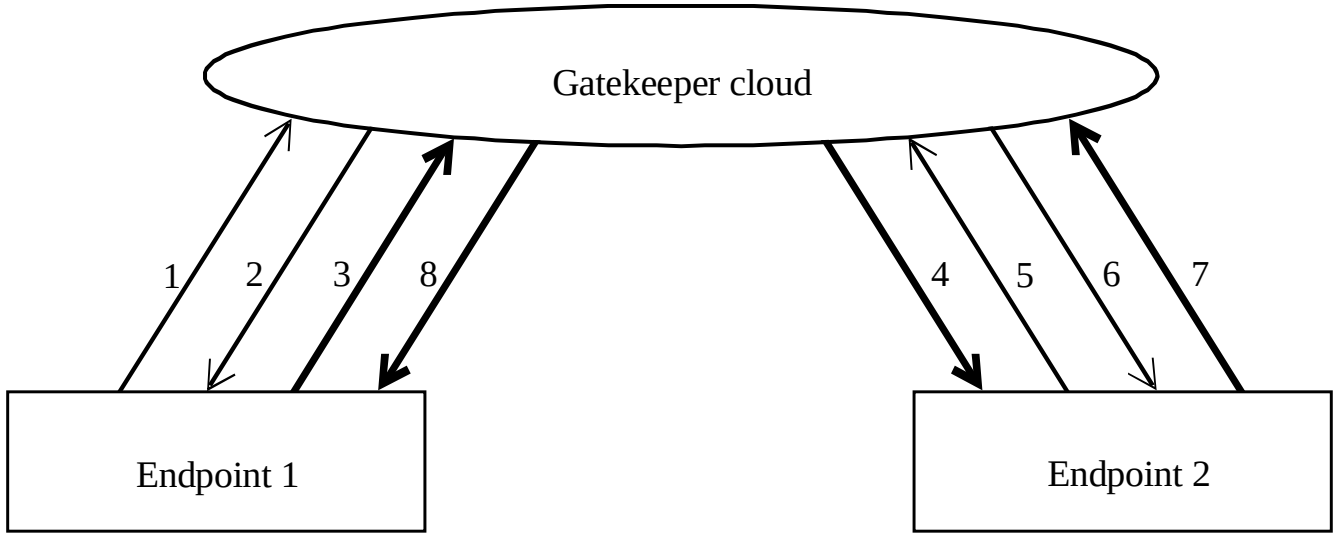
Call Signalling Channel Messages

RAS Channel Messages

GRC - GK Routed Call signaling

1 ARQ
2 ACF/ARJ
3 Setup
4 Setup
5 ARQ
6 ACF/ARJ
7 Connect
8 Connect



Call Signalling Channel Messages

RAS Channel Messages

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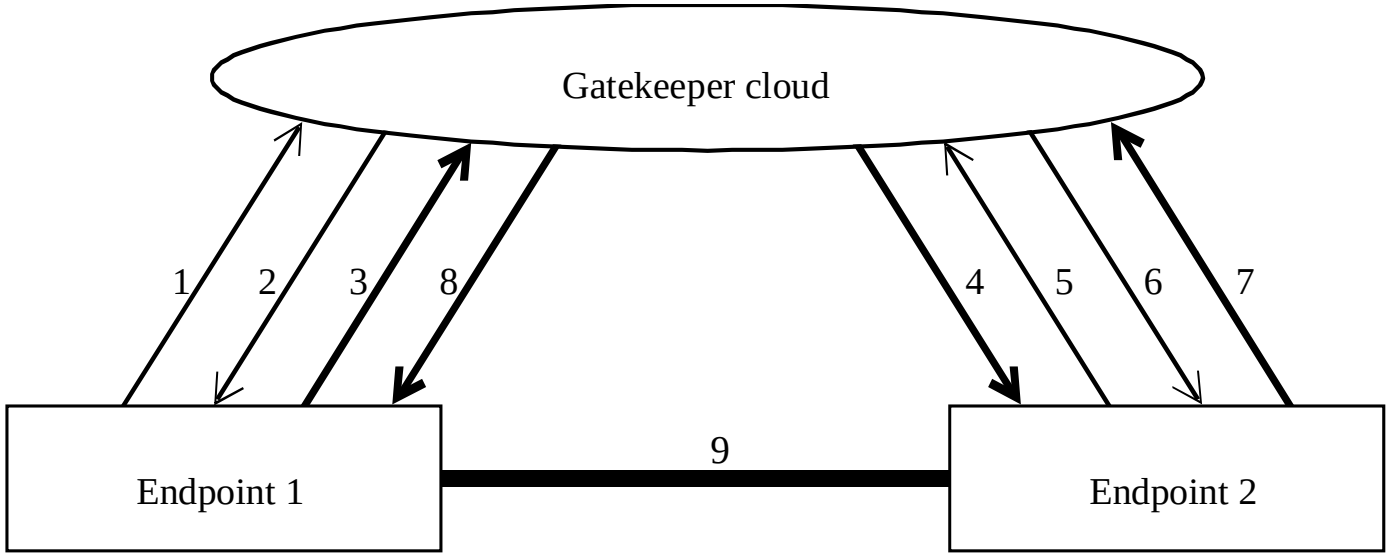
GRC with Direct H.245

1 ARQ
2 ACF/ARJ
3 Setup
4 Setup
5 ARQ
6 ACF/ARJ
7 Connect
8 Connect
9 H.245 Channel



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H.245 Control Channel Messages

Call Signalling Channel Messages

RAS Channel Messages

H.323 Call Signaling (cont'd)

- Hierarchical identification of the call:
  - CRV: Call reference value
    - identifies H.225.0 messages between 2 entities within a call
    - One CRV for RAS and another for Call Signaling
  - Call ID
    - a GUID, **associates all messages between all entities within the same call**
  - CID (Conference ID)
    - associates all messages between all entities within all calls in the same conference

H.323 Call Signaling Procedures

- **(8) Call Signaling Procedures**
  - Phase A: Call setup
    - All combinations of GRC/DRC , same or different GKs
    - Fast Connect Procedure
    - Call forwarding using Facility (restarts the procedure)
    - Setting up conferences
  - Phase B: Initial communication and capability exchange
    - Capability exchange, Master/Slave determination
    - H.245 tunneling
  - Phase C: Establishment of audiovisual communication
    - Using H.245
    - Conference oriented

H.323 Call Signaling Procedures

- Phase D: Call services (without H.450)
  - B/W change (video oriented)
  - Status Information Request (IRQ/IRR) for management
  - Conference expansion
  - Conference out of Consultation
  - **Supplementary Services: Points to H.450 (optional)**
- Phase E: Call termination

H.323 recommendation cont'd

- **(9) Interoperation with other terminal types**
  - Refers to the Gateway and H.246. Lists the following:
    - Speech only terminals
    - Visual telephone terminals over the ISDN (H.320)
    - Visual telephone terminals over GSTN (H.324)
    - **Visual telephone terminals over mobile radio (H.324/M)**
      - For further study.
    - Visual telephone terminals over ATM (H.321 and H.310 RAST)
    - Visual telephone terminals over GQoS LANs (H.322)
    - Simultaneous voice and data terminals over GSTN (V.70)
    - T.120 terminals on the packet based network
    - **Gateway for H.323 Media Transport Over ATM**

H.323 con't

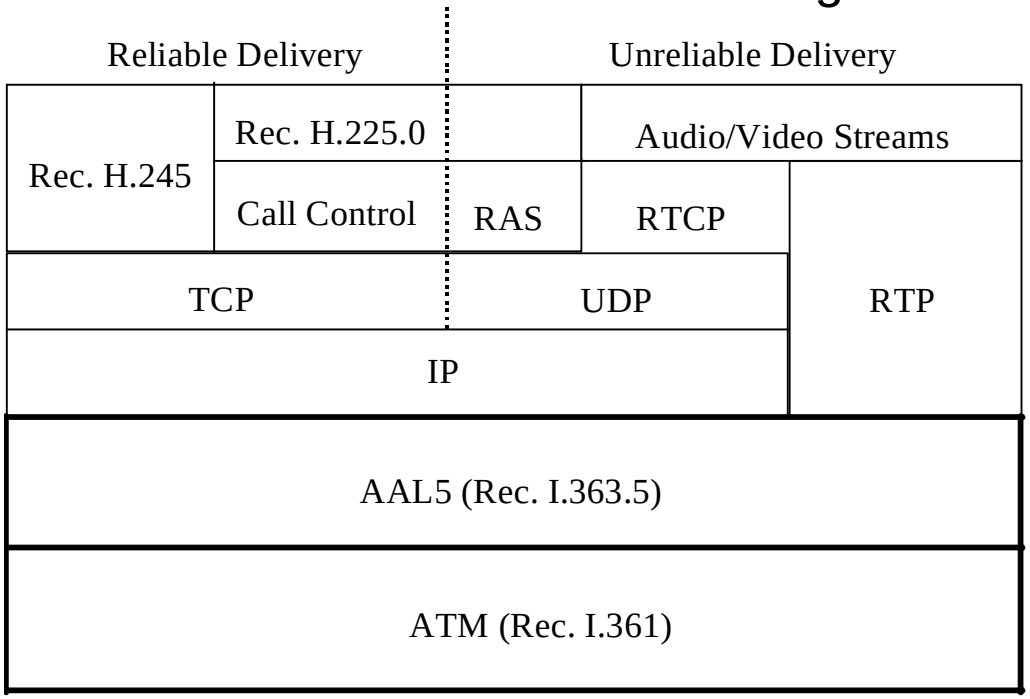
- **(10) Optional Enhancements**
  - Encryption (H.235)
  - Conference Control (H.243)
  - QSIG and ISUP tunneling (in V4)
- **(11) Maintenance**
  - Loopback (for video terminal)
- **Appendix II : Transport Level Resource Reservation Procedure (how to use RSVP)**
- **Appendix III: Using GRC for call diversion**
  - No Reply
  - Busy
  - Multiple endpoints in parallel (like SIP)

H.323 con't

- **New in H.323 v4:**
  - Appendix V: E.164 explained (terminology change compared to V1,2,3

H.323 Built in Annexes A-F

- **Annex A: Table of H.245 messages used**
- **Annex B: Using Layered Video codecs**
- **Annex C: H.323 on ATM**
  - Allowing H.323 endpoints to establish QOS-based media streams on ATM networks using AAL5.



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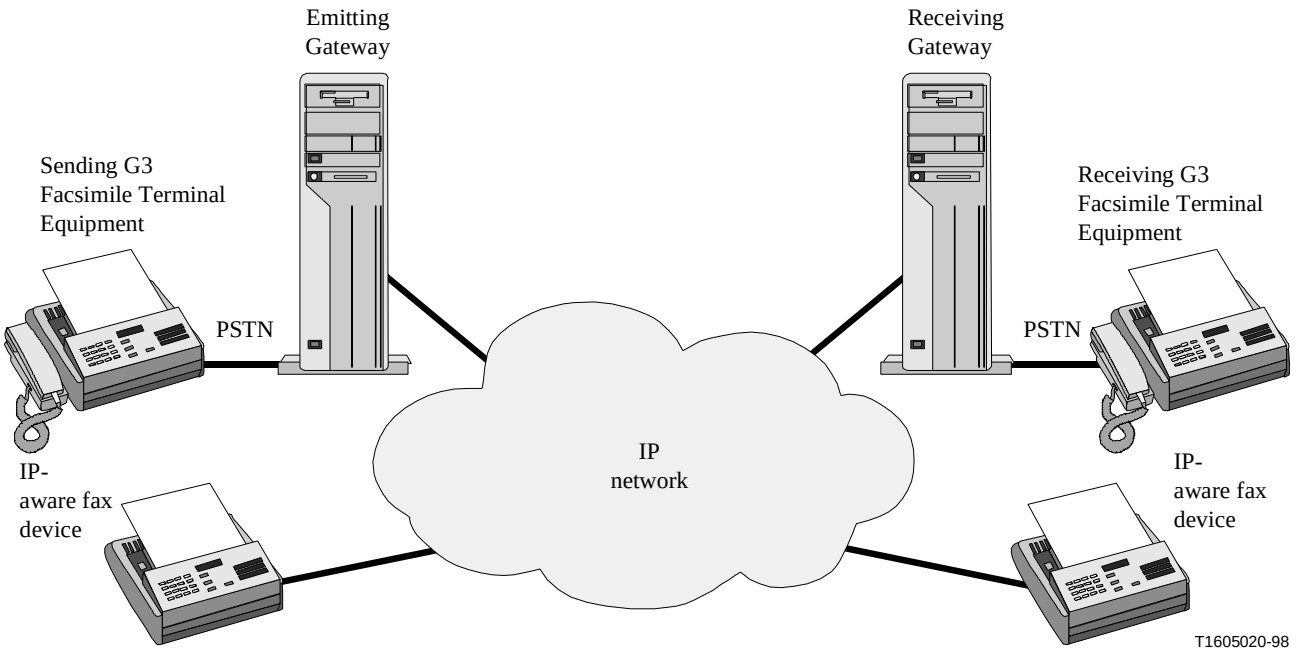
H.323 Annex D (v2 02/00)

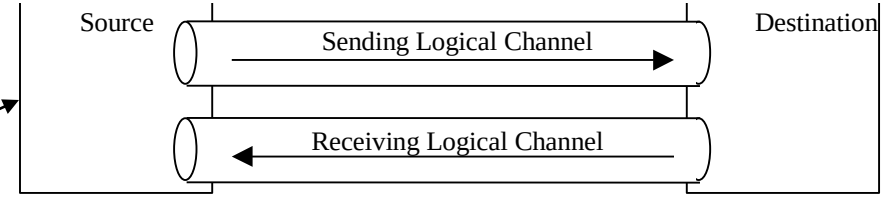
Real-time facsimile over H.323 systems

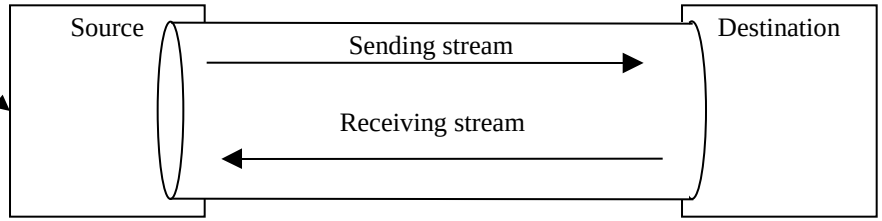
- **Use H.323 (FastStart recommended)**
  - OpenLogicalChannel:
    - two unidirectional
    - one bidirectional
  - May be over UDP or TCP
  - Use T.38 within that channel
- **H.245 was expanded to support FAX params in OLC**
- **DTMF**
  - DTMF out of band for T.38/B terminals H.245 `UserInputIndication`
  - DTMF in band allowed otherwise

H.323 Annex D: Fax



One or two FAX Channels

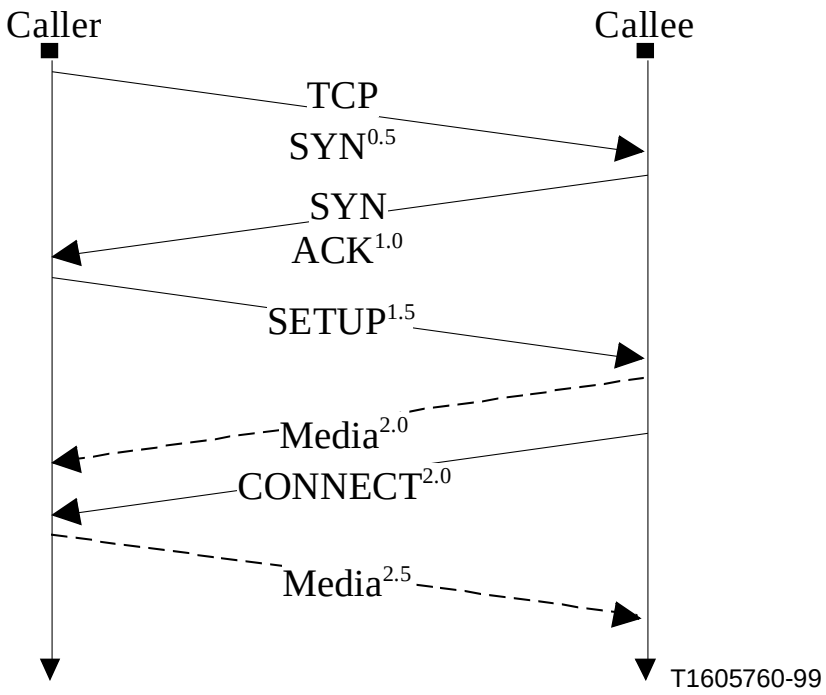


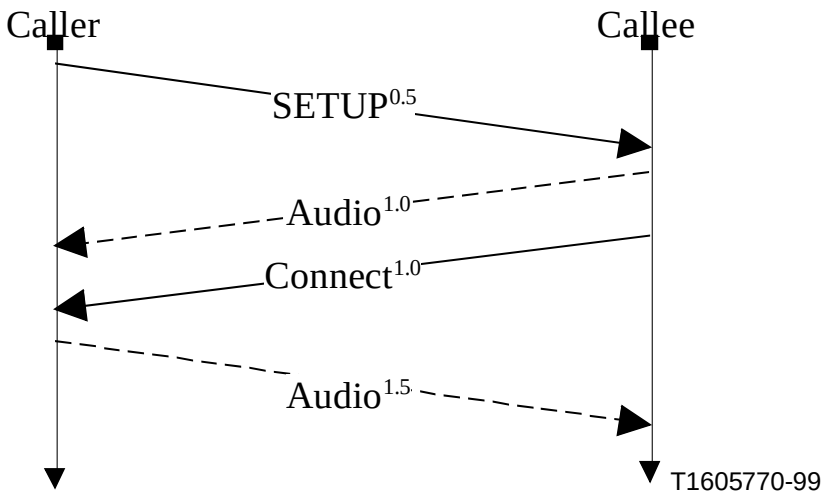


H.323 Annex E (05/99)

- A PROTOCOL FOR MULTIPLEXED CALL SIGNALLING TRANSPORT
- Useful for trunk replacement (many calls in the same path)
- For engineered networks (not public Internet)
- Includes a semi-reliable protocol for call signalling over UDP (optional)
- Solves Important H.323 deficiency (SIP signals over UDP)
- Extremely important for GRC

TCP vs UDP Call Signaling





TCP: 2.5 Round Trip messages using Fast Start

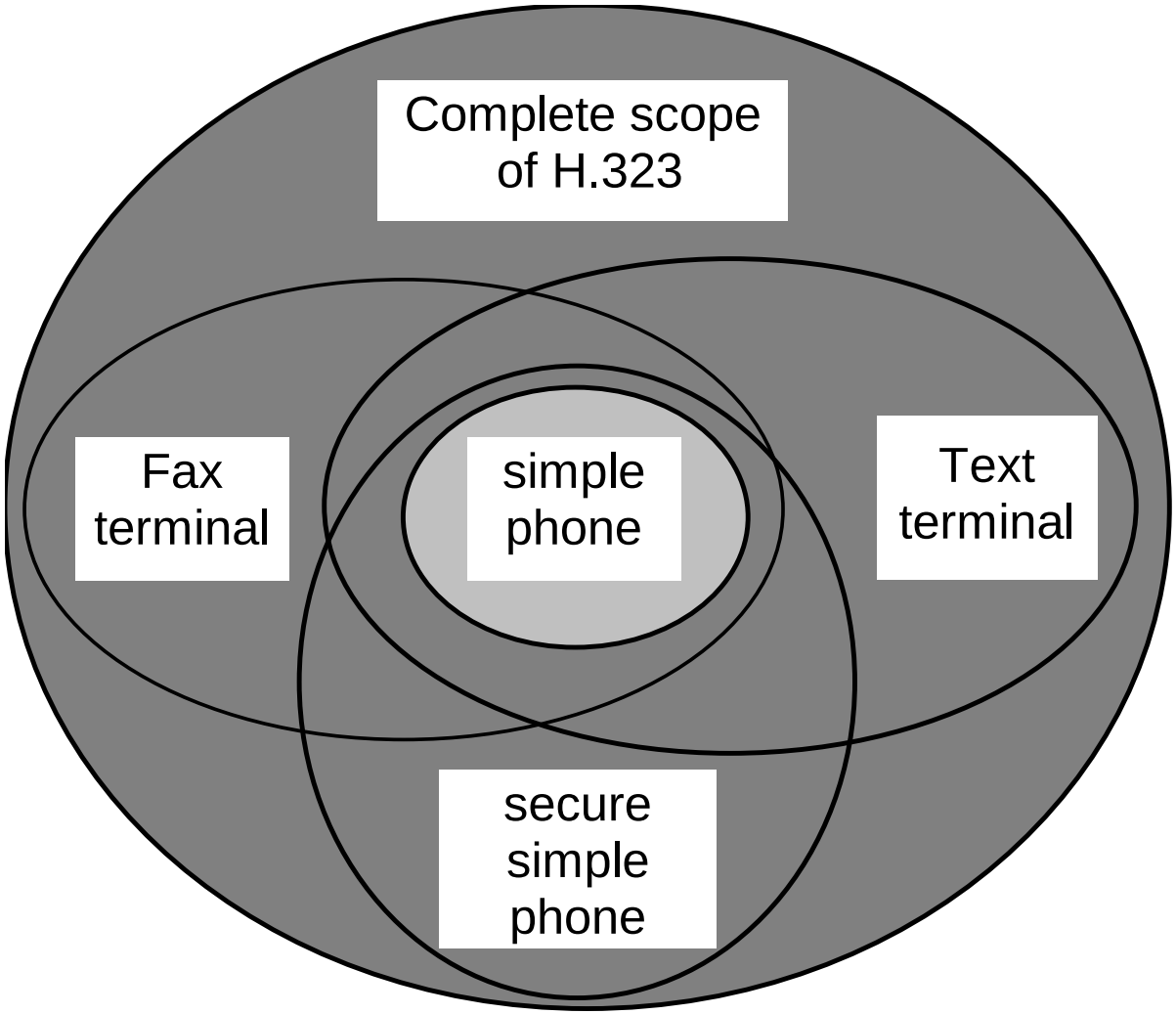
UDP: Only 1.5 RT using Fast Start

H.323 Annex F: SET (05/99)

Simple Endpoint Type

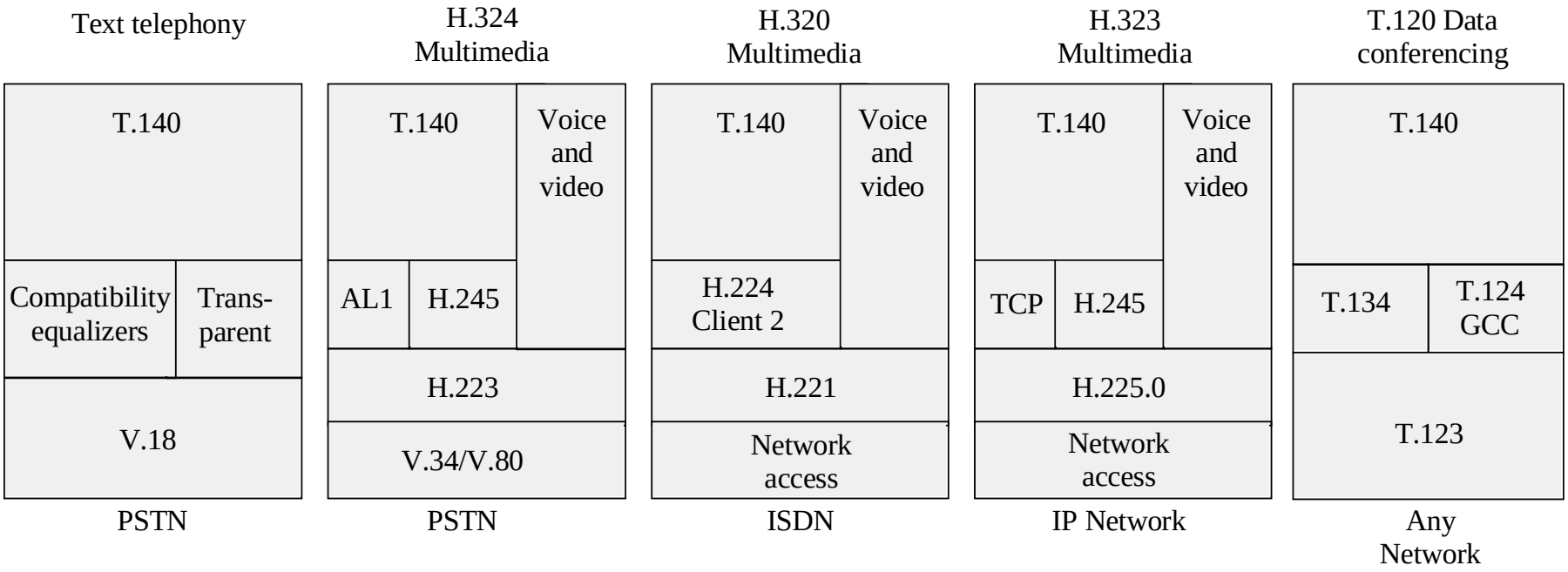
- **A lightweight version for single use terminals in contrast to full H.323 multimedia terminals**
- **Some Simple Endpoint Types:**
  - Palmtop computer with audio communications capabilities (voice, file transfer, fax, ...)
  - Telephone with an RJ-45 connector
  - Text telephones (using ITU-T Recommendation T.140)
  - Cellular IP phone
  - Mobile system with integrated voice and data communications (UMTS, IMT2000)
- **See H.323 Annex J: Security for Annex F**

Functional ranges of SET devices



H.323 Annex G: Text SET (02/00)

- Defines a TEXT SET as a superset of Audio SET
- Use of T.140 within a H.245 logical channel
- Use "RTP Payload format for Text Conversation"



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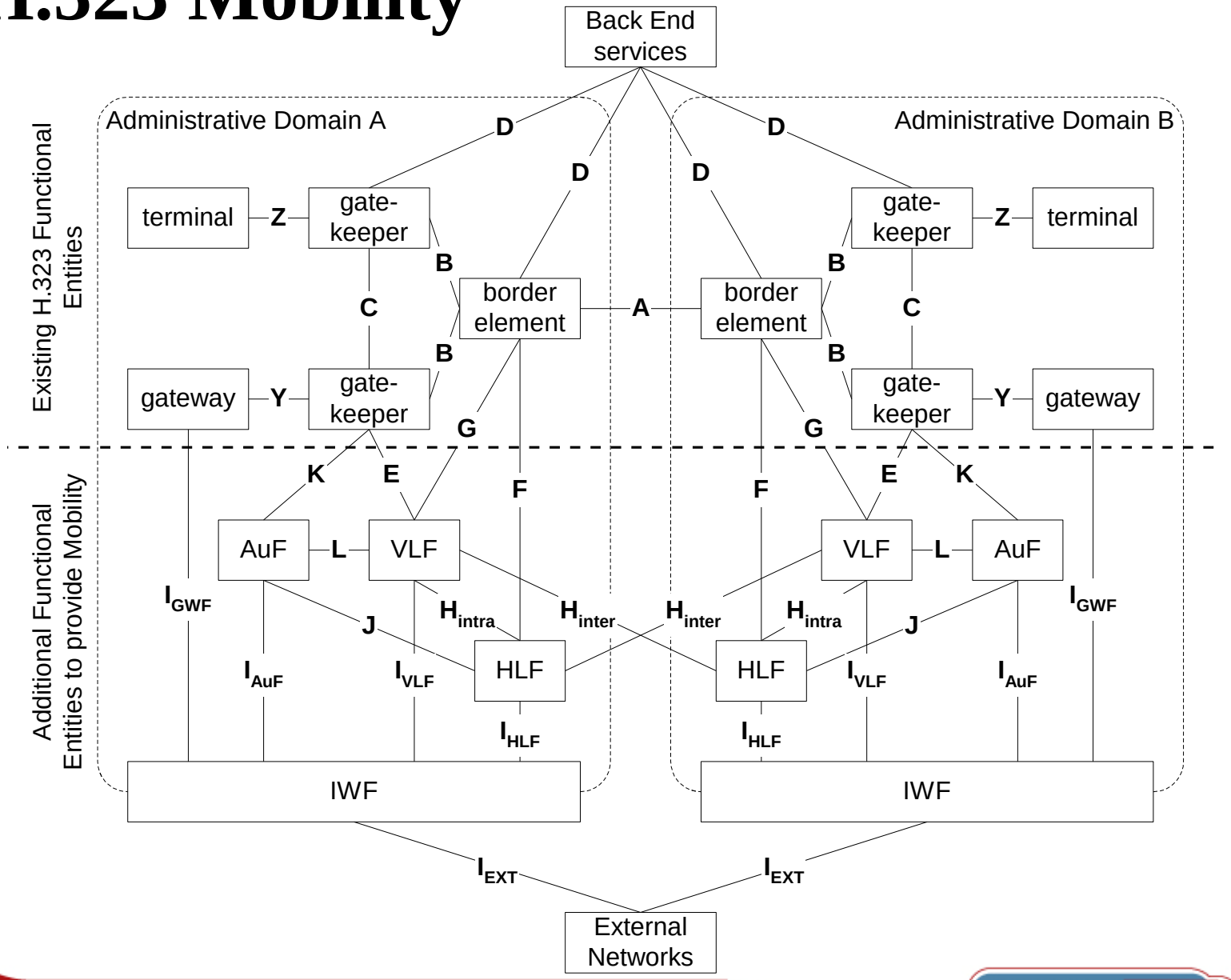
H.323 Annex H: Mobility (2001)

- User, Terminal and Service Mobility
- **Defines Mobility Management functionalities:**
  - Home Location Function (HLF)
  - Visitor Location Function (VLF)
  - Authentication Function (AuF)
  - Interworking Function (IWF)

- **Status**
  - **Mobility Ad-Hoc team**
  - **Moving Slowly**
  - **Big question if this will catch at all**
  - **SIP has been chosen in 3GPP as the only VoIP protocol for UMTS release 2000**

H.323 Mobility



H.323 Annex I: Low QoS Networks (2001)

- Supposed to define transport issues for wireless environments
- No advancement so far
- Will probably not happen

H.323 Annex J: Secure SET (11/00)

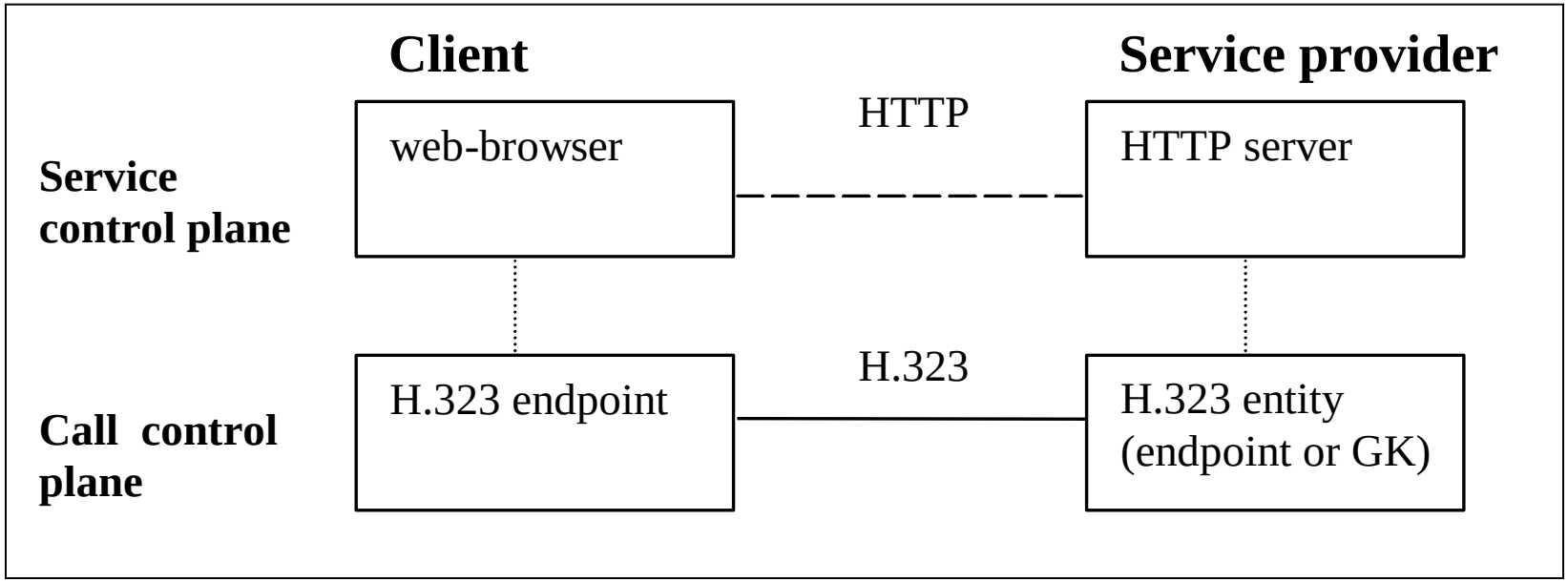
- Earlier version was in fact an H.235 Profile
- now folded into H.235 v2 Annex D
- Initialy focused on SASET (secure Audio SET)
- RFC 2268: The RC2® Encryption Algorithm

The procedures defined in H.235/D

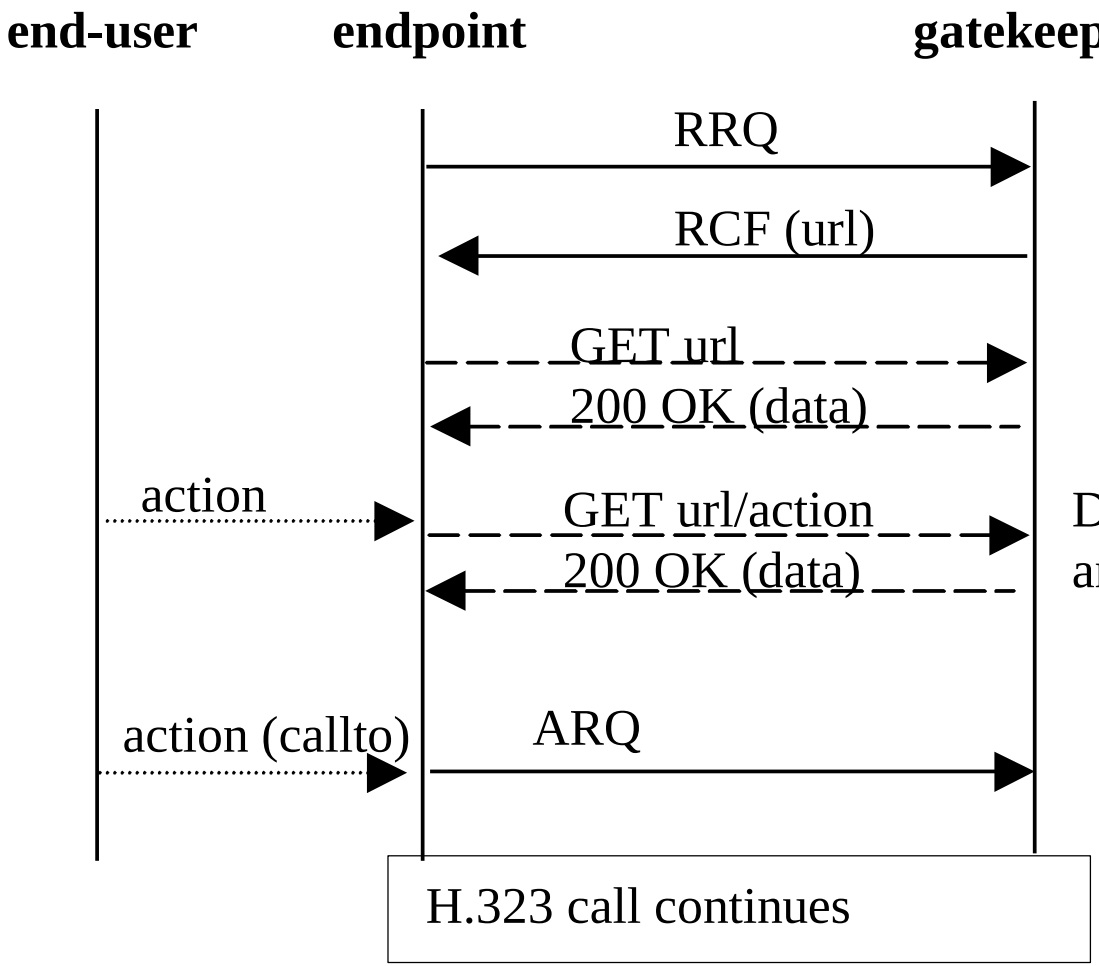
Security Services	Call Functions						
	RAS	H.225.0		H.245	RTP		
Authentication	Password HMAC-SHA1-96	Password HMAC-SHA1-96		Password HMAC-SHA1-96			
Non-Repudiation							
Integrity	Password HMAC-SHA1-96	Password HMAC-SHA1-96		Password HMAC-SHA1-96			
Confidentiality					56-bit DES	56-bit RC2-com-patible	168-bit Triple-DES
Access Control							
Key Management	Subscription-based password assignment	Subscription-based pass-word assign-ment	authenti-cated Diffie-Hellman key-ex-change	Integrated H.235 session key management (key distribution, key update using 56-bit DES/ 56-bit RC2-compatible/ 168-bit Triple-DES)			

H.323 Annex K: HTTP control (11/00)

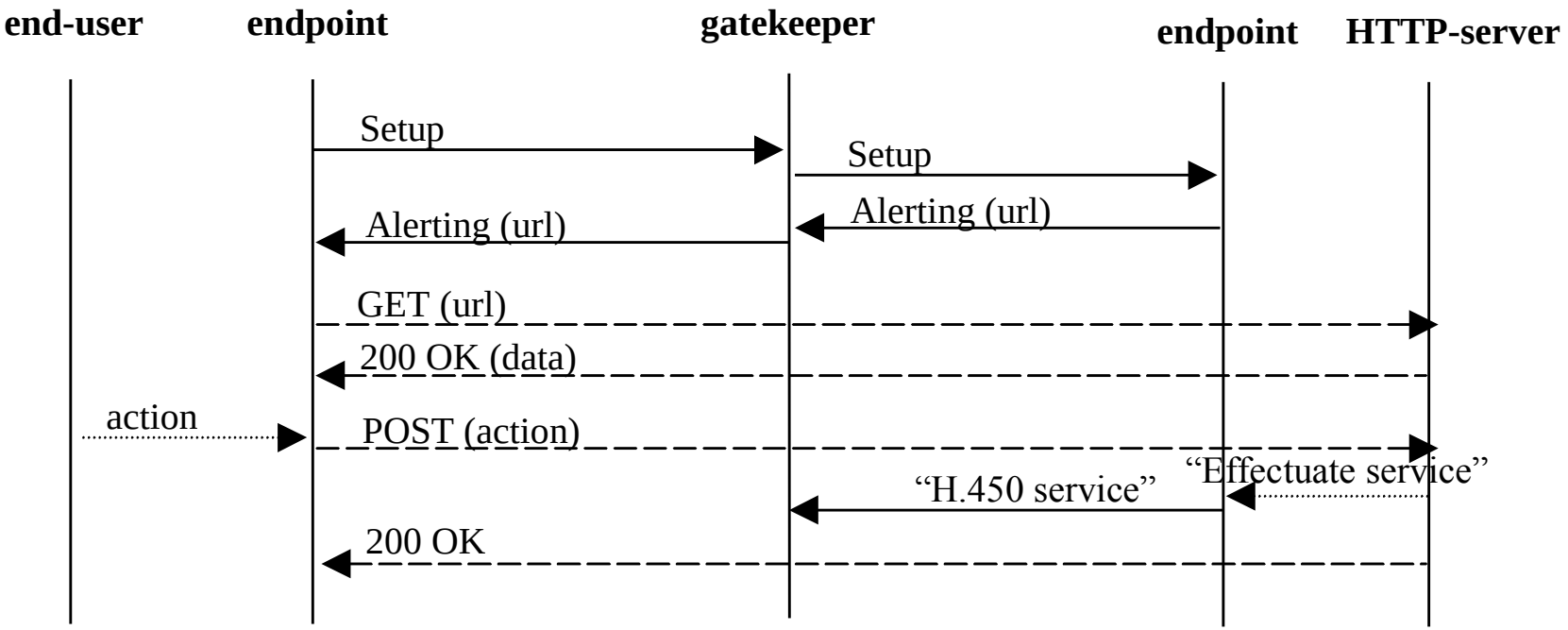
- **HTTP Based Service Control Transport Channel**
- **A URL is received in RAS messages**
- **Contains many useful examples !!**



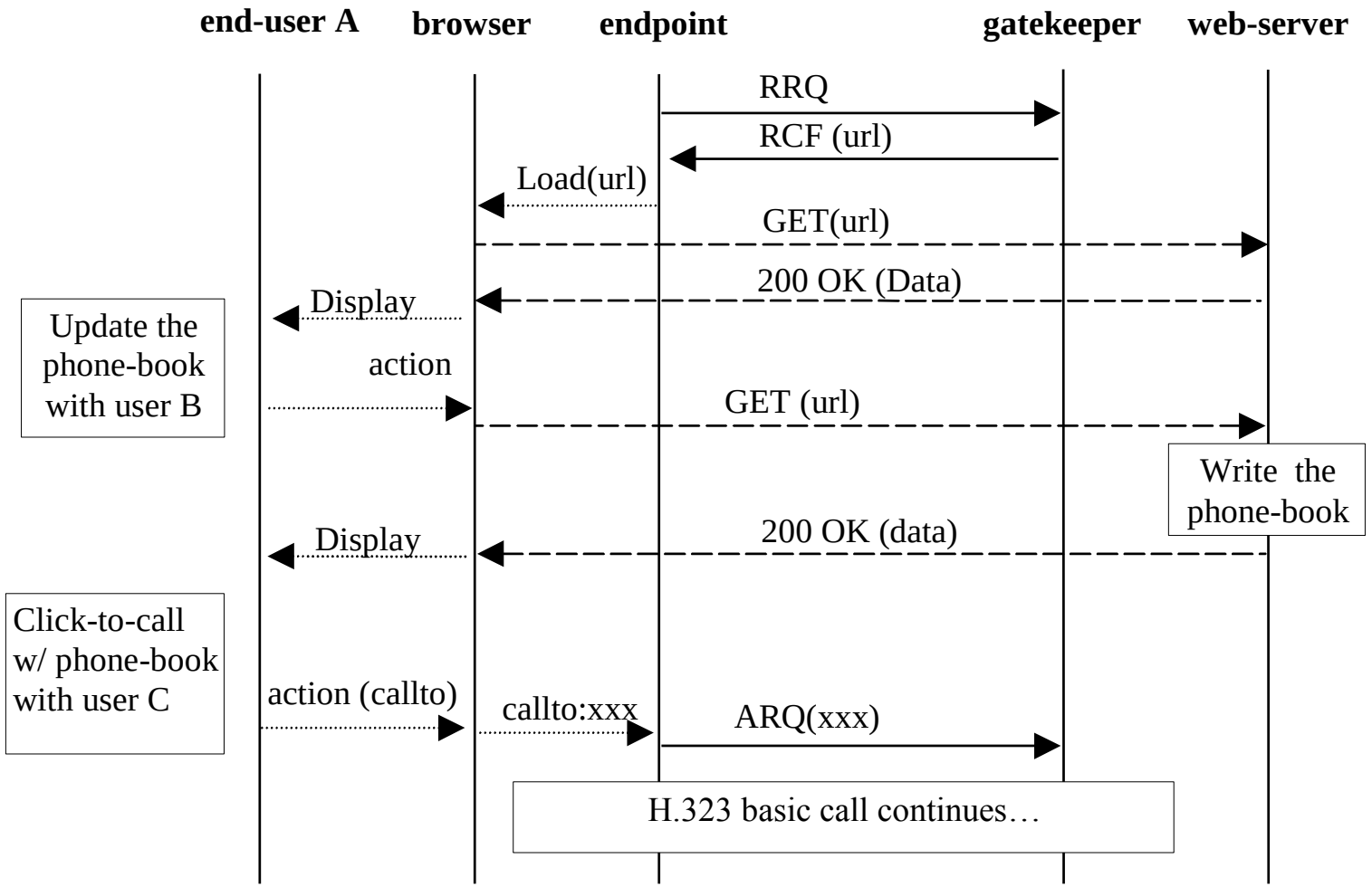
Non Call related example



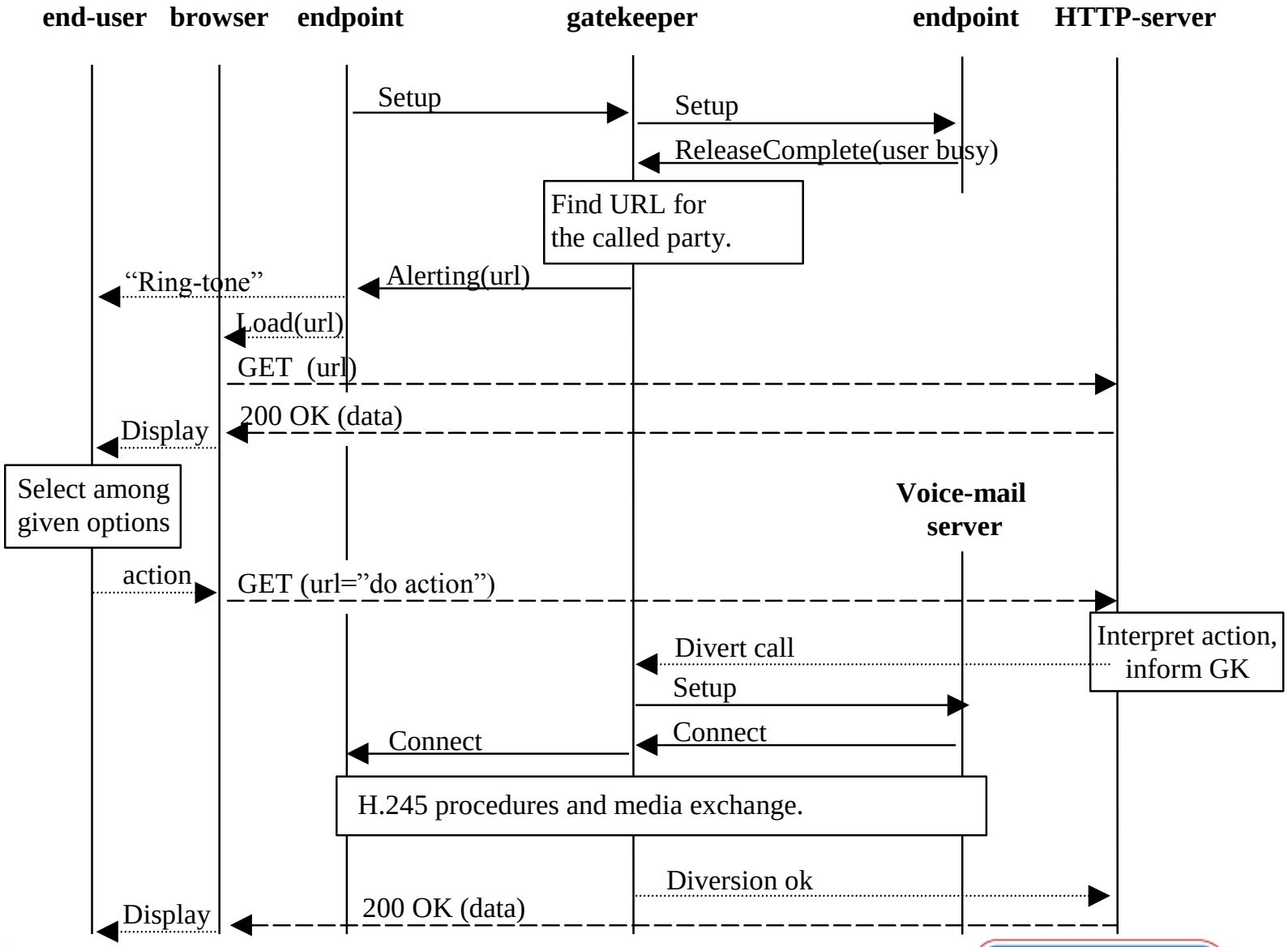
Call Related example



WEB based PAB integration example



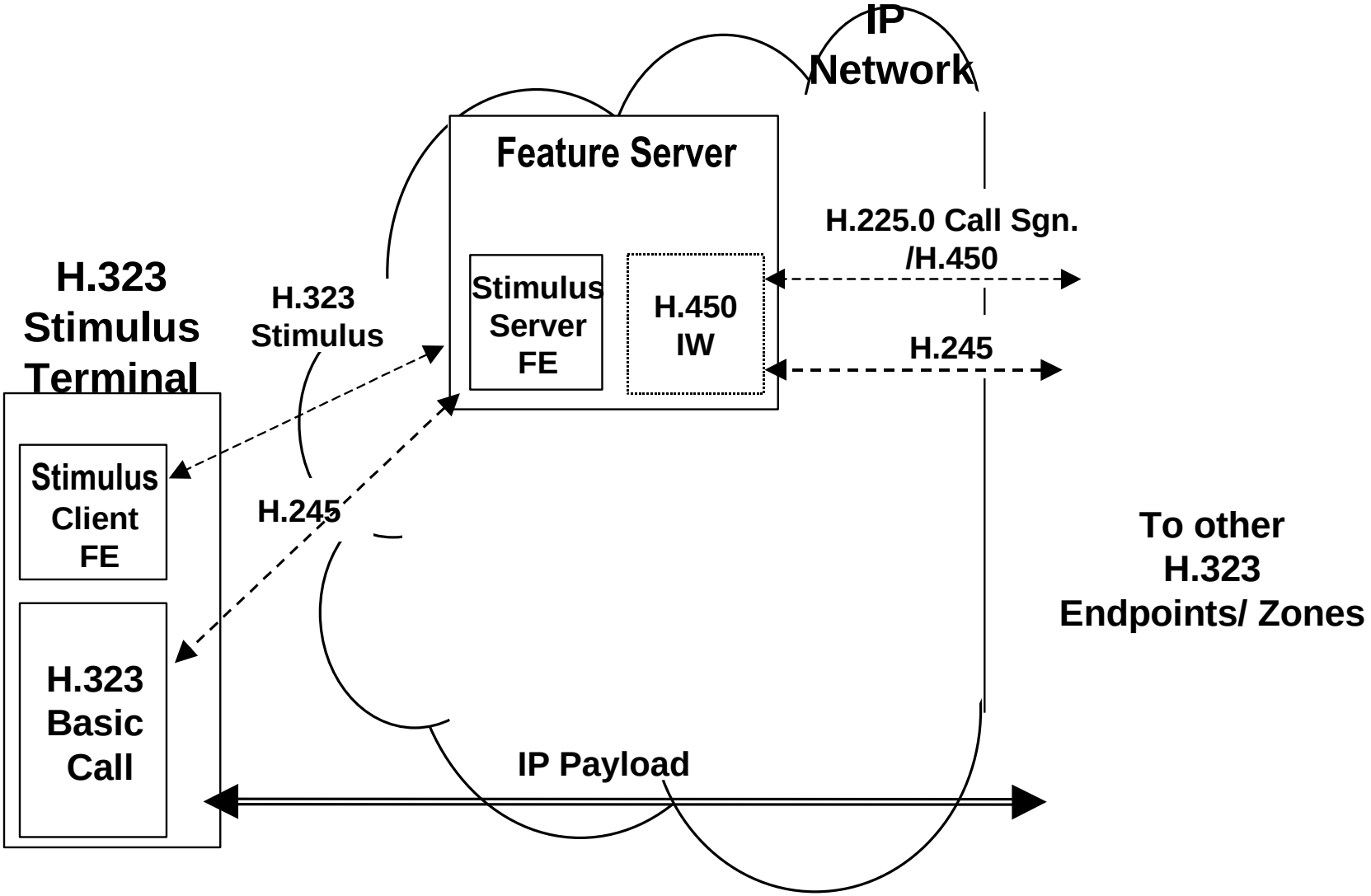
Do you want to leave a voice message ?



H.323 Annex L: Stimulus Sig. (11/00)

- **Stimulus signalling procedures between H.323 terminals and a Feature Server functional entity.**
- **Standard H.225.0 signalling for basic call control.**
- **Example: LAN attached feature phone**
- adopts H.248 for control of stimulus supplementary services
- Feature server may reside in IP PBX
- Feature server translates to H.450

Example of Annex L



H.323 Annex M: Sig. Tunneling (11/00)

- M.1: QSIG tunneling
- M.2: ISUP tunneling
- M.3 : DSS1 tunneling (future)
- …
- Mechanism in H.323 (v4) section 10.4

H.323 Annex N: QoS (2002 !!)

- End-to-end Qos Control and signaling
- Very thorough analysis from ETSI TIPHON

H.323 Annex O: Internet IWK (2001)

- **H.323 - internet Interworking**
- **SIP track**
  - RadVision very active
  - Details will go into H.246
- **Other Internet techlonolgies**
  - Addressing
    - Align the use of DNS and e-mail aliases
    - Register the H.323 url
    - LDAP
  - Service Location using TRIP (Telephony Routing Inforation Protocol)
  - CPL
  - Make H.323 work with NAT (important for GPRS)

H.323 Annex R: Robustness (2001)

- **Work on refining the architecture for recovery from crashes**
- **Currently two architectures proposed**
- **For small scale, simple**
  - Each element responsible to detect failure of others
  - Then goes to backup elements
  - Some state information is then provided
- **For large scale, complex**
  - Shared Repository
  - Depends on a fault-tolerant element

H.225.0

- **Call signalling protocols and media stream packetization for packet-based multimedia communication systems**
  - Describes the means by which audio, video, data, and control are associated, coded, and packetized for transport between H.323 equipment on a packet-based network
  - The scope of H.225.0 communication is between H.323 entities on the same packet-based network, using the same transport protocol
- **H.225.0 versions coordinated with H.323**

H.225.0 Annexes

- **Annex A: RTP/RTCP and how to use them**
- **Annex B: RTP Profile (open issues from An. A)**
- **Annex C: RTP payload format for H.261**
- **Annex D: RTP payload format for H.261A**
- **Annex E: Video Codecs (H.263, MPEG-4 video)**
- **Annex F: Packetization for Audio formats**
  - external references (MPEG-4 audio, MPEG-2/H.222 mux)
  - G.723.1, G.728, G.729, G.722.1, GSM codecs
  - Silence Suppression
  - TIA/EIA-136 **ACELP** , TIA/EIA-136 **US1**, IS-127 **EVRC**
  - H.223 MUX-PDU Packetization

H.225.0 Annex and Appendices

- **Annex G: Inter-domain (separate document)**
- **Annex H: ASN.1 syntax**
- **Annex I: reference to H.263+**
- **Appendix IV: Important detail! (TPKT, GK discovery)**
  - TPKT is a packet format as defined in IETF RFC1006. It is used to delimit individual messages (PDUs) within the TCP stream

H.245

- **CONTROL PROTOCOL FOR MULTIMEDIA COMMUNICATION**
- specifies syntax and semantics of terminal information messages as well as procedures to use them for in-band negotiation at the start of or during communication

- **Version 7 is now required for FAX (Annex D/H.323)**

H.323 v1	H.245 v1
H.323 v2	H.245 v3
H.323 v3	H.245 v5
H.323 v4	H.245 v7

H.235 v2 (11/00)

- Security and encryption for H-Series (H.323 and other H.245-based) multimedia terminals
- See H.323 Annex J

H.341 (05/99)

- Multimedia MIB
- Covers H.323 and H.320
- consistent with SNMP V2

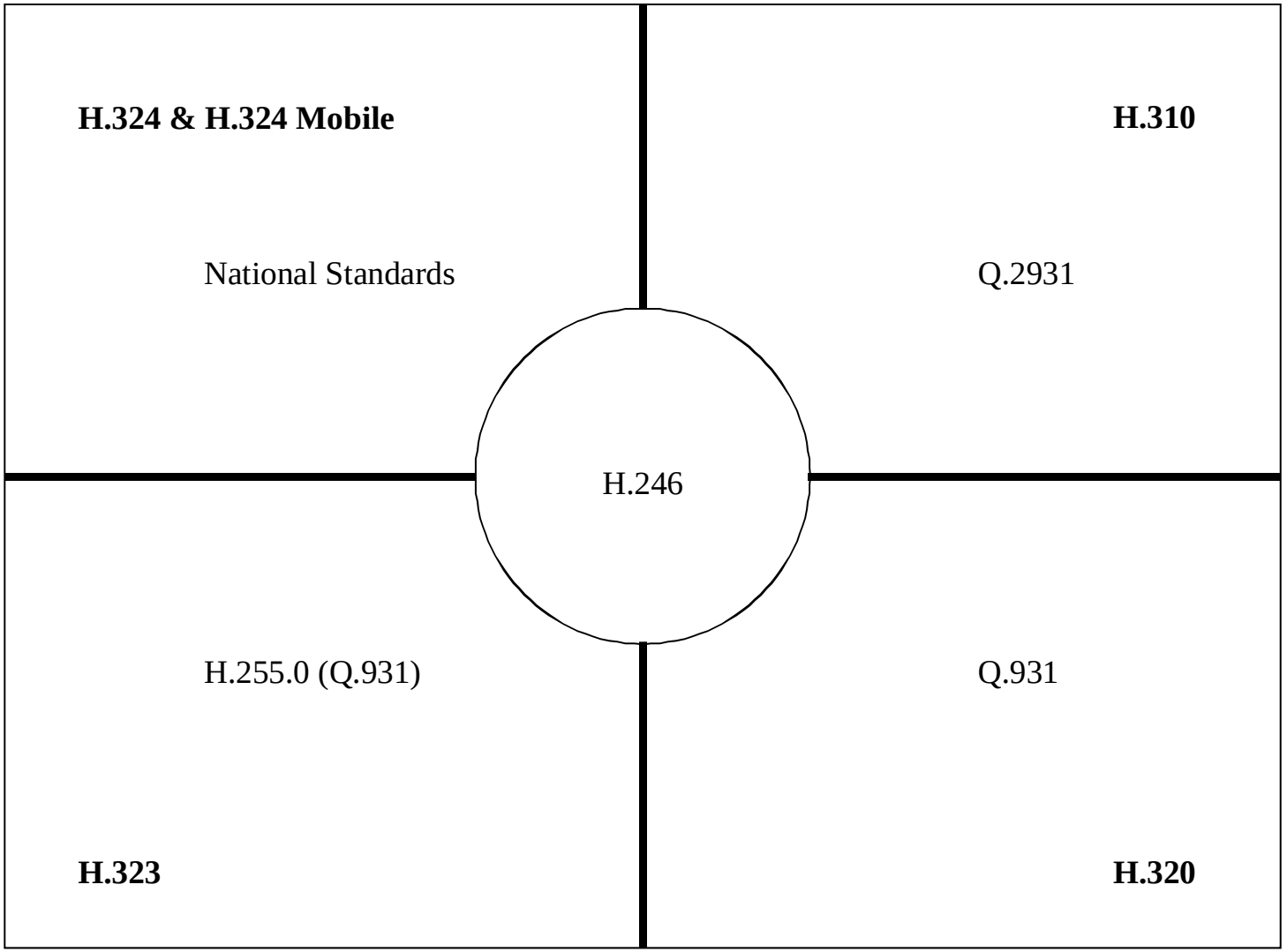
H.450 Supplementary Services

- **Adapted from PBX signaling**
- **A few more services defined with each H.323 vers.**
  - H.450.1 (1998) Call Signaling
  - H.450.2 (1998) Call Transfer
  - H.450.3 (1998) Call Forward
  - H.450.4 (1999) Call Hold
  - H.450.5 (1999) Call Park and Pickup
  - H.450.6 (1999) Call Waiting
  - H.450.7 (1999) Message Waiting Indication (MWI)
  - H.450.8 (2000) Name Identification
  - H.450.9 (2000) Call Completion
  - H.450.10 (2001) Call Offer
  - H.450.11 (2001) Call Intrusion
  - H.450.12 (2001) Common Information Additional Network Services

H.246 (1998)

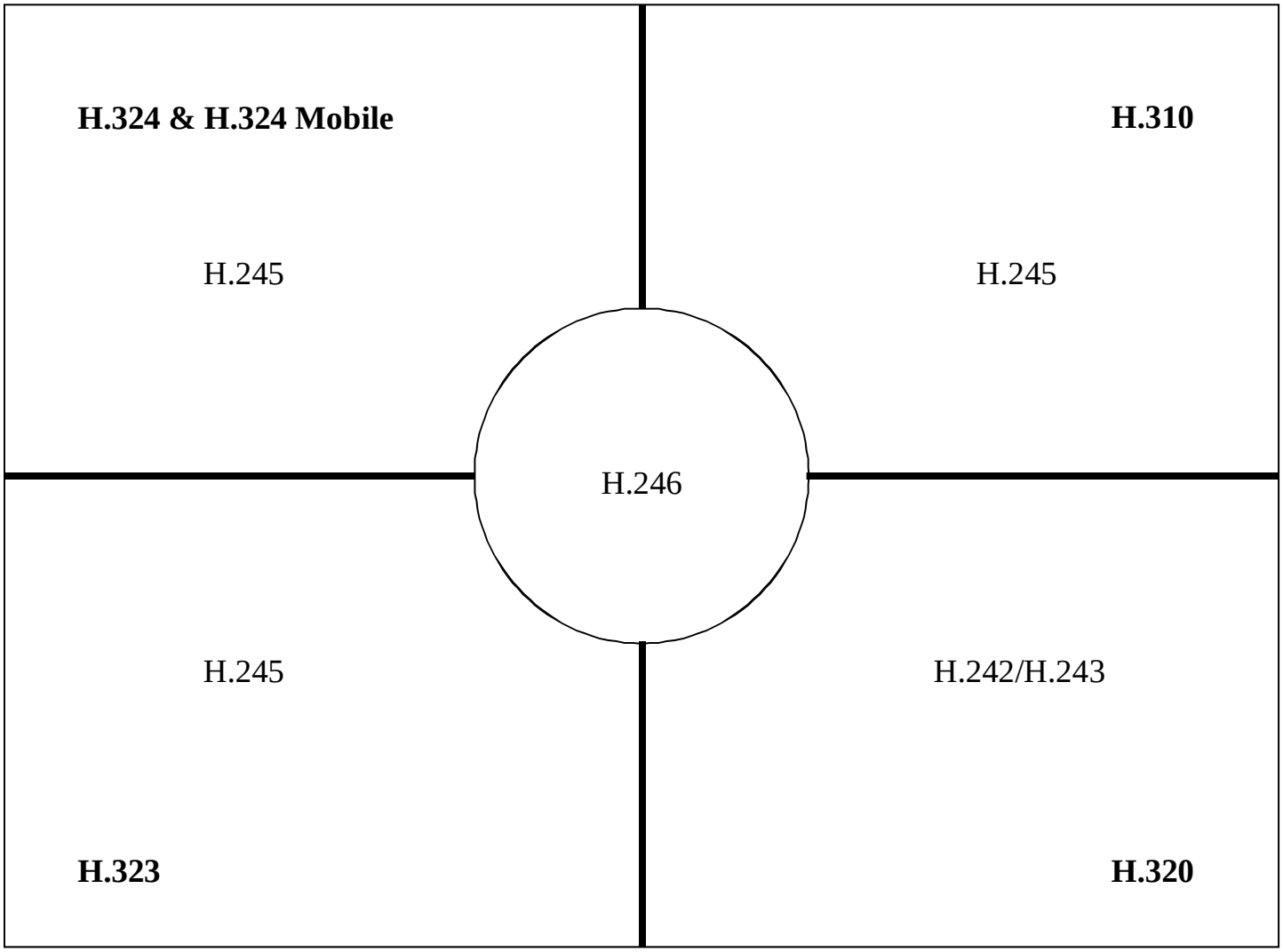
- **Details for gateways between H Series terminals**
- **Introduced to H.323 in v2**
- **Annex A: H.323 - H.320**
- **Annex B: H.323 - Voice terminal on GSTN**
- **Annex C: H.323 - ISUP (02/2000)**
  - specifies the necessary mapping to achieve connectivity and functionality between an H.323 network and an ISDN User Part network.
  - table maps ISUP to H.225.0 signaling
  - Very detailed
- **Annex D: H.323-IN interworking**
  - Proposed and edited by yours truly while at VocalTec
  - No development due to lack of contributions

H-series Call Control Interoperability



T1602610-97

H-series System Control Interoperability



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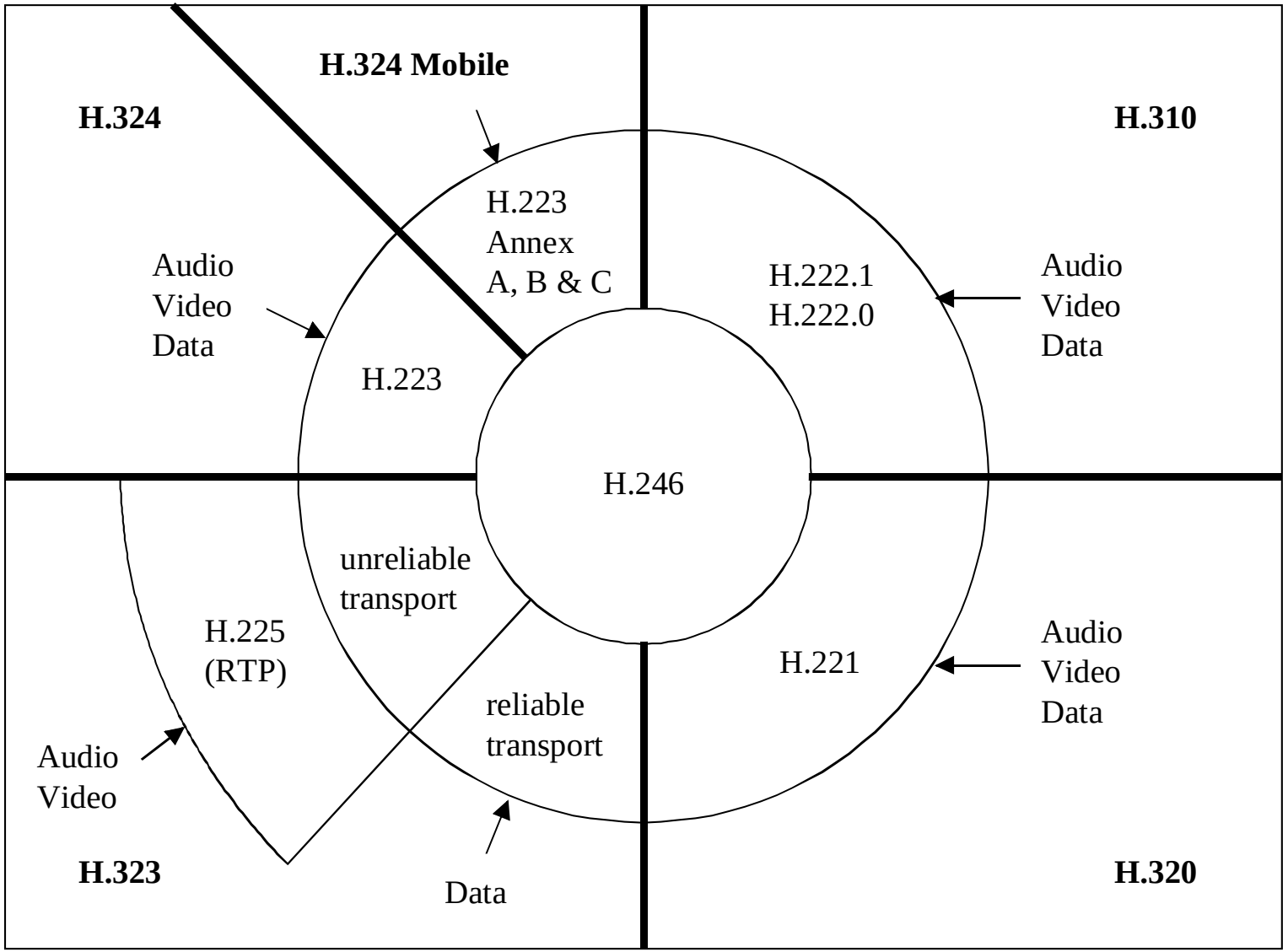
H-series Media Interoperability



H.246 annex E

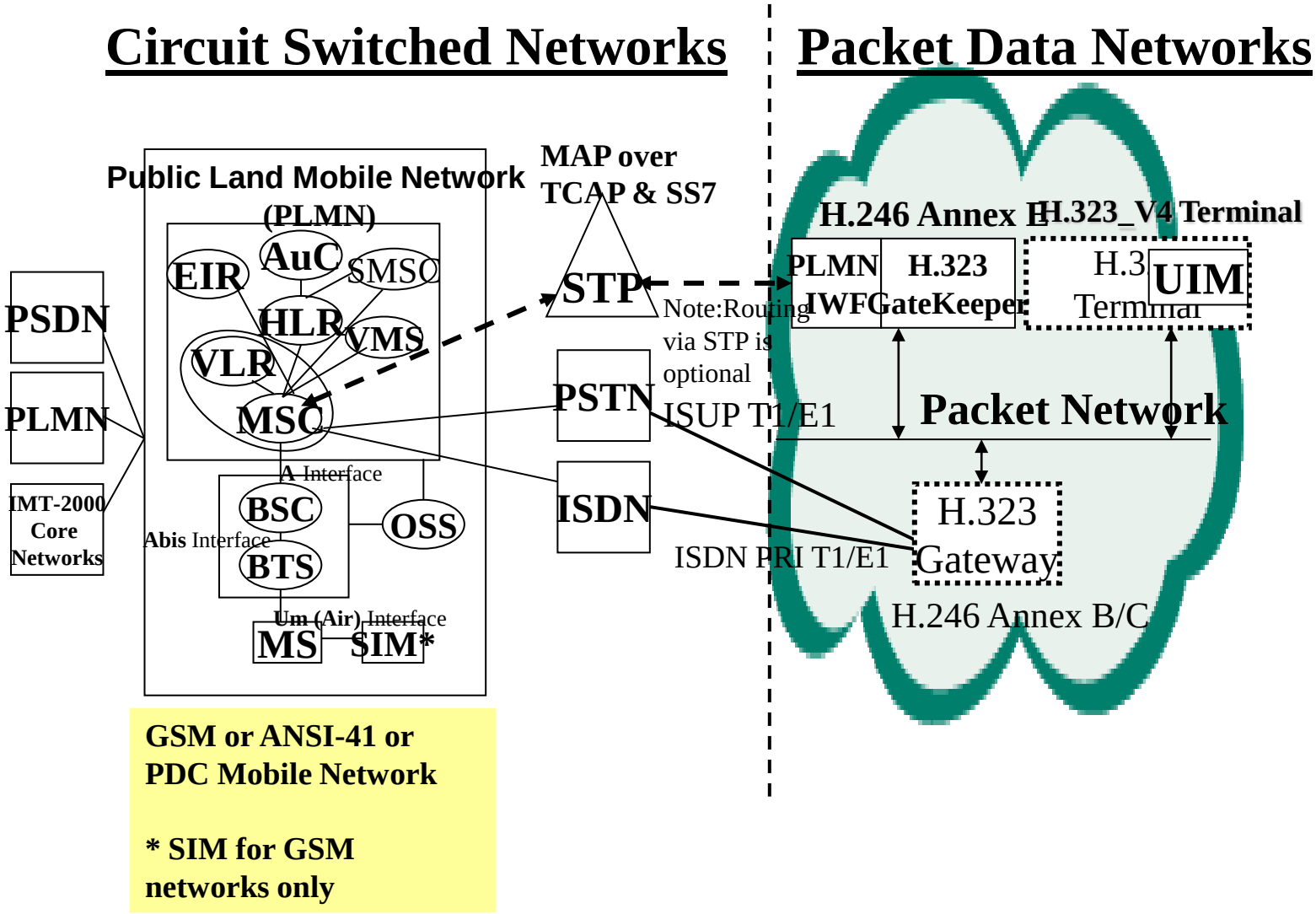
- **H.246 Annex E**
  - Allows H.323 terminals to be identified as Mobile phones
  - First focus on ANSI-41 MAP (now called Annex E.1)
  - Other PLMNs may be developed in the future (E.2, E.3, E.4)
  - Pushed by Intel as a quick way forward, with a specific target as opposed to H.323 Annex H (Mobility) full solution.
  - Works with zero changes to PLMN

H.246 Annex E concept

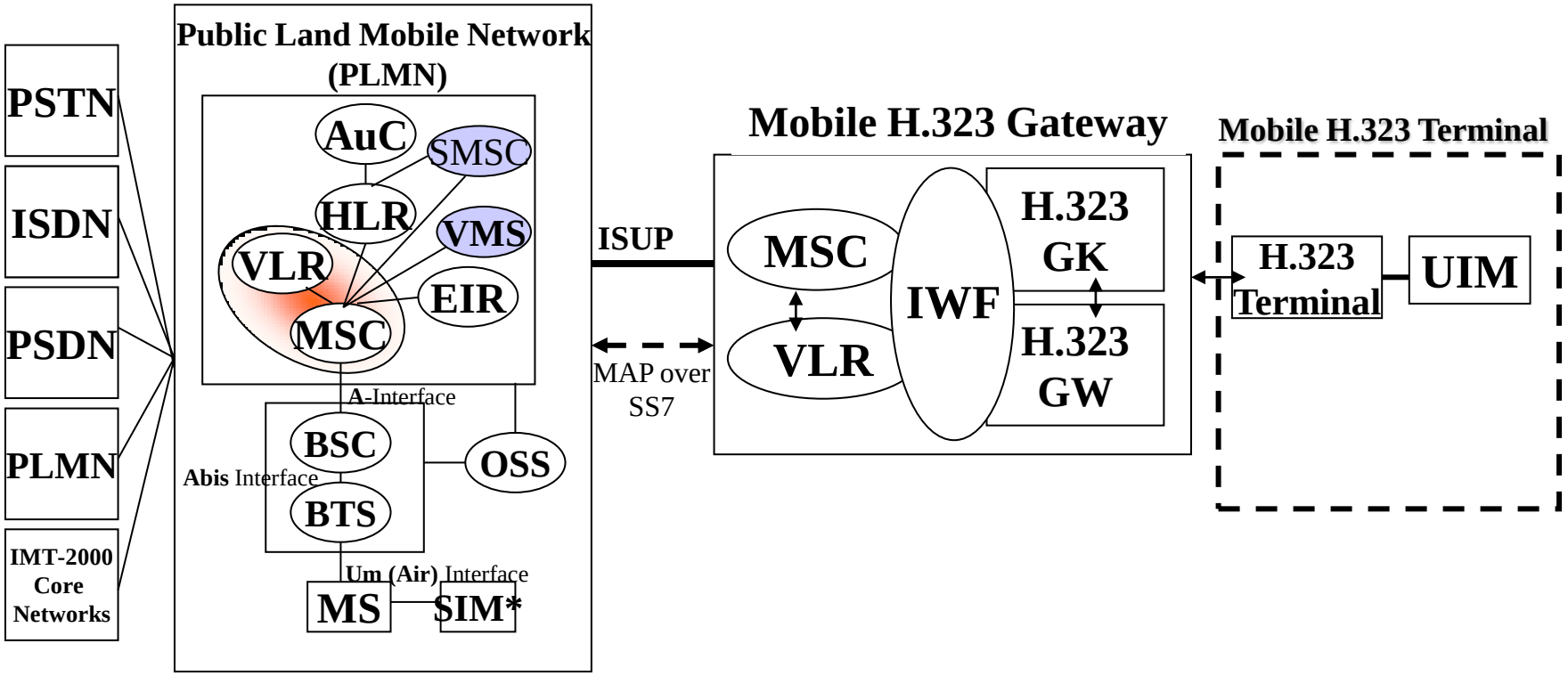
1. **Utilize the PC (or other IP device) as a Mobile Station (handset)**
   - User Identity Module (UIM) is uploaded unto PC
   - For GSM, SIM card adapter to pcmcia or USB
2. **PC connects to managed IP network via ISP or corporate LAN**
3. **H.323 network functions as a Location Area (last mile access)**
4. **The PC application uses UIM to register with the MSC (via the GK)**
5. **Home HLR is notified**

⇨ **PC has become the mobile phone !**

H.246 Annex E Network Architecture



H.246 Annex E Gateway Implementation



GSM or ANSI-41 or PDC or PHS or 3G Mobile Network

*** SIM for GSM networks only**

H.248 : GCP (06/00)

- **Gateway Control Protocol**
- **Developed in coordination with IETF Megaco**
- **Major differences from proprietary MGCP**
  - A context represents a multiparty, multimedia conference
  - Object Oriented extension ‘packages’, registered with IANA
  - Binary encoding
- **Annex A: Binary encoding (typically ITU H.323)**
  - Syntax is specified in ASN.1
  - Encoded in BER (Basic Encoding Rules)
- **Annex B: Text encoding (typically IETF)**
  - Syntax specified in ABNF (RFC 2234)

H.248 cont's

- **Annex C: Tag/Value definitions for ITU**
- **Annex D: Transport over IP (UDP or TCP)**
  - MGCs **shall** implement both UDP+TCP, MGs either
  - UDP with application level framing (ALF)
    - port 2944 default for text encoding
    - port 2945 default for binary encoding
    - Reliability algorithm
  - TCP using TPKT

H.248 cont'd

- **Annex E: Basic packages**
  - E.1 generic
  - E.2 base root package
  - E.3 Tone Generator
    - E.5 Basic DTMF Generator (extends E.3)
    - E.7 Call Progress Tone Generator (extends E.3)
  - E.4 Tone Detection
    - E.6 DTMF Detection (extends E.4)
    - E.8 Call Progress Tone Detection (extends E.4)
  - E.9 Analog Line Supervision
  - E.10 Basic Continuity test
  - E.11 Network Terminations (generic)
    - E.12 RTP (extends E.11)
    - E.13 TDM Circuit (extends E.11)

H.248 Appendices

- **Appendix A. Example call flow**
  - using SDP for encoding the stream descriptors
  - An MG registers with an MGC :

```
MEGACO/1 [124.124.124.222]
Transaction = 9998 {
    Context = - {
        ServiceChange = ROOT {Services {
            Method=Restart,
            ServiceChangeAddress=55555, Profile=ResGW/1}
        }
    }
}
```

H.248 External Annexes

- **External documents**
- **Annex F: Facsimile, text conversation and call discrimination packages (2000 ?)**
  - Fax/textphone/modem Tones Detection (extends E.4)
  - Text Conversation package
  - Text Telephone package
  - Call Type Discrimination package (voice/fax/modem call)
  - Fax package (T.30)
  - IP Fax package (T.38/T.37)
- **Annex G: UI Elements and Actions package (2000)**
- **Annex H: Transport over SCTP (compare Annex D)**

http://www.comversens.com