H.323, Megaco/H.248 and Soft-Switches

INSE 7110 – Winter 2007
Value Added Services Engineering in Next Generation Networks
Week #5, Lecture 4
Outline

1. H.323
2. Megaco/H.248
3. Soft-switches
H.323

1. Introduction
2. Functional entities
3. Signaling protocols
4. H.323 vs. SIP
H.323: Introduction

An umbrella ITU-T standard including

- signalling standards:
  - H.225.0
  - Q.931
  - H.245
- Others (e.g. H.324 Terminal for low bit rate multimedia communications)
H.323: The functionality entities

Terminals
  - End point
  - Used for real time two way multimedia communications with another end point

Gatekeeper
  - Control how terminal access networks
  - Provide address translation

Gateway
  - End point
  - Used for communications between H.323 terminals and terminals in the PSTN

Multipoint control unit (MCU)
  - Provides centralized conferencing functionality
H.323 signaling: Registration Admission and Status (RAS)

Key features

- ASN.1 based messages
- Request / reply protocol
- Signaling between end-points
  - Terminal or gateway
  and
  - Gatekeeper
- Use unreliable channels
  - Retries
  - Timeouts
RAS: Gatekeeper discovery ...

Endpoint

GRQ

GCF/GRJ

Gatekeeper

T1521260-96
RAS: Admission request ...

**Endpoint**

- **RRQ**
- **RCF or RRJ**
- **URQ**
- **UCF/URJ**
- **URQ**
- **UCF**

**Gatekeeper**

- **RRQ**
- **RCF or RRJ**
- **URQ**
- **UCF/URJ**
- **URQ**
- **UCF**

- **Endpoint initiated Unregister Request**

- **Gatekeeper initiated Unregister Request**

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H.323 signaling: Call Set Up (H.225)

Key features
- ISUP signaling (Q.931) based
- ASN.1 based messages
- Transaction oriented protocol
- Signaling between end-points
  - Terminal or gateway
  and
  - Gatekeeper
- Use reliable channels
RAS: Call set up - No gatekeeper ...

Endpoint 1  

Setup (1)  
Call proceeding (2)  
Alerting (3)  
Connect (4)

Endpoint 2

Call Signalling Messages
RAS: Call set up - 1 gatekeeper ...
RAS: Call set up - Two gatekeepers …

- ARQ (1)
- ACF/ARJ (2)
- Setup (3)
- Call proceeding (4)
- Alerting (7)
- Connect (8)
- ARQ (5)
- ACF/ARJ (6)

- RAS Messages
- Call Signalling Messages
H.323 signaling: Media signaling (H.245)

Key features
- ASN.1 based messages for
  - Master/slave determination
  - Capabilities negotiation
  - Logical channel signaling
- Several modes
  - Request/reply
  - Commands
  - Indications
- Signaling between end-points
  - Terminal or gateway
  - Gatekeeper
- Use reliable channels
H.323 signaling: Master / slave determination

Diagram:

1. IDLE
   - DETERMINE.indication
   - REJECT.indication
   - DETERMINE.request
   - REJECT.indication
   - DETERMINE.confirm

2. INCOMING
   - AWAITING
   - RESPONSE
   - DETERMINE.indication
   - REJECT.indication
   - DETERMINE.confirm

3. OUTGOING
   - AWAITING
   - RESPONSE
   - DETERMINE.indication
   - REJECT.indication
   - DETERMINE.confirm
H.323 signaling: Capabilities exchange

1. IDLE
   - TRANSFER.request
   - REJECT.indication
   - AWAITING RESPONSE

2. AWAITING RESPONSE
   - TRANSFER.confirm

Diagram:
- Transition from IDLE to AWAITING RESPONSE on TRANSFER.request
- Transition from IDLE to IDLE on REJECT.indication
- Transition from AWAITING RESPONSE to IDLE on TRANSFER.confirm

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H.323 signaling: Capabilities exchange

- IDLE
- AWAITING RESPONSE

- TRANSFER.indication
- REJECT.request
- REJECT.indication
- TRANSFER.respons
H.323 signaling: Logical channels

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<th>incoming</th>
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<td>ESTABLISH.request</td>
<td>OpenLogicalChannelAck</td>
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<tr>
<td>2</td>
<td>ESTABLISH.confirm</td>
<td>ESTABLISH.response</td>
</tr>
</tbody>
</table>
```

T103
H.323 signaling: Logical channels

- RELEASE.request
- CloseLogicalChannel
- RELEASE.confirm
- CloseLogicalChannelAck
- RELEASE.indication
- T103

.outgoing    incoming
H.323 signaling: An important feature - Fast connect

Introduced as an afterthought in H.323
Allow call set up and logical channel set up using a single message
- FASTCONNECT
  - Include as parameter fast start to indicate that logical channel should be opened
  - May be refused by the other end (Fast connect refused)
H.323 signaling: Putting it together … alternative 1

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
H.323 signaling: Putting it together …alternative 2

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

Gatekeeper Cloud

Endpoint 1

Endpoint 2

H.245 Control Channel Messages
Call Signalling Channel Messages
RAS Channel Messages
H.323 signaling: Putting it together - alternative 3

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

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H.245 Control Channel Messages
Call Signalling Channel Messages
RAS Channel Messages

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Megaco / H.248

1. Introduction
2. Genesis
3. Concepts
4. Protocol
5. Call cases
Megaco/H.248: Introduction

Primary motives for decomposing gateways between PSTN and next generation networks:

- Scalability
- Specialization
- Opening up of market to new players

Side-effect

- Possibility of using the part of the decomposed gateway for call control
  - Soft-switches
Megaco/H.248: Introduction

Media Gateway controller

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Media gateway control protocol

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Media Gateway

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Media Gateway

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Media Gateway
Megaco/H.248: Genesis

A long history starting in 1998
- Simple Gateway Control Protocol (SGCP)
  - Text based encoding, limited command set
- IP Device Control Protocol (IPDCP)
  - A few more features to SGCP
- Media Gateway Control Protocol (MGCP)
  - Merge of SGCP and IPDC
- Media gateway Decomposition Control Protocol (MDCP)
  - Binary encoded
- Megaco / H.248 (Joint IETF / ITU-T specifications)
  - A compromise
    - Both text based and binary encoding
    - A wide range of transport protocols(e.g. UDP, TCP, SCTP)
Megaco/H.248: Concepts - Termination

Source or sink of media
• Persistent (circuit switched) or ephemeral (e.g. RTP)
• IDs
  – Unique or wildcard mechanism (ALL or CHOOSE)
• Properties/descriptors
  – Unique ids
  – Default values
  – Categorization
    • Common (i.e. termination state properties) vs. stream specific
    • For each media stream
      – Local properties
      – Properties of received streams
      – Properties of transmitted streams
• Mandatory vs. optional
  – Options are grouped in packages
Megaco/H.248: Concepts - Termination

Examples of properties/descriptors

• Streams
  – Single bidirectional stream
    • Local control: Send only – send/receive …
    • Local: media received
    • Remote: media sent

• Events
  – To be detected by the MG and reported to the controller
    • On hook / Off hook transition

• Signals
  – To be applied to a termination by the MG
    • Tones
    • Announcements

• Digit map
  – Dialling plan residing in the MG
  – Detect and report events received on a termination ..
Megaco/H.248: Concepts - Context

Context (mixing bridge)
- Who can hear/see/talk to whom
- Association between terminations
- May imply
  - Conversion (RTP stream to PSTN PCM and vice versa)
  - Mixing (audio or video)
  - Null context
    - Terminations that are not associated with no other termination (e.g. idle circuit switched lines)
- Topology
- Precedence
Megaco/H.248: Protocol - Commands

Add termination to a context

Modify the properties of a termination

Subtract a termination from a context

Move a termination from a context A to context B

Audit (values or capabilities)

Notify

ServiceChange (specific type of notify – terminations about to be taken out of service)
Megaco/H.248: Protocol - Transactions

- Possibility to send several commands in one go
  - Transaction Request
  - Transaction Reply
  - Transaction pending
Megaco/H.248: Protocol - Transportation

Several alternatives

An example

- UDP/IP
  - Unreliable, timeouts / resends
  - At most once functionality required (Receivers should keep track of received commands)
Megaco/H.248: PSTN / NGN Interconnection ...

User in NGN  \(\rightarrow\) MGC  \(\rightarrow\) MG  \(\rightarrow\) User in PSTN

- INVITE
- OK
- ACK

ISUP “INVITE” to PSTN

ISUP “OK” to MGC

Add RTP stream to context

Add PCM stream to context

RTP

PCM
Megaco/H.248: Conferencing ...

Participant 1       Participant 2       Participant 3       Signaling unit       Mixer

INVITE              INVITE              INVITE              OK                  RTP

ACK                 OK                  OK                  RTP

ACK                 INVITE             INVITE             ADD

ACK                 OK                  OK                  RTP

ACK                 INVITE             INVITE             ADD

ACK                 OK                  OK                  RTP

ACK

RTP

ADD
Megaco/H.248: Megaco IP phones

Phone considered as a media gateway …

- Terminations
  - User interface
  - Audio transducers
    - Hands free
    - Headset
    - Microphone

- Interactions
  - Add
  - Move
  - Subtract
  - Modify
Soft-switches

1. Introduction

2. Overview

3. A simplified call case
Soft-switch: Introduction

A “side effect” of media gateway decomposition

- Aggressively promoted by the soft-switch consortium, now known as the International Packet Communication Consortium (IPCC)
  - Adoption of existing standards (e.g. SIP, H.323, MGCP, Megaco)
- Gateway controller (plus some additional features) acts as a switch
  - Switching in software instead of hardware
- Can act as local exchange (class 5) or toll centre (class 4)
  - Lower entry costs for new incumbents
  - New local telephony networks and “by pass” for long distance call providers
- Soft-switches vs. classical switches debate
  - Scalability
  - Reliability
  - QoS
Soft-switches: Overview

Soft-switch (Media Gateway Controller + Some intelligence)

- ISUP
- H.323 or SIP
- MGC protocols

Media Gateway

Media Gateway

Media Gateway
Soft-switches: Overview

An example of soft-switch as class 5 replacement …

- Soft-switch
  - Signaling (e.g. ISUP, SIP)
  - MGC protocol
- Media Gateway (Residential gateway)
  - Media (I.e RTP)
- Soft-switch
  - MGC protocol
- Media Gateway (I.e, Residential gateway)

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Soft-switches: Overview

An example of soft-switch as class 4 replacement …

- **Soft-switch**
- **Signaling (e.g. ISUP, SIP)**
- **Soft-switch**

**Media Gateway**
- **MGC protocol**
- **RTP for media**

**Class 4 switch**
- **ISUP signaling**
- **PCM for media**

**Media Gateway**
- **MGC protocol**
- **PCM for media**
- **ISUP signaling**

**Class 4 switch**
Soft-switch: A simplified call case (Calling card)

Caller                 Local exchange      Soft-switch                 MG                MG           Soft-switch               Local exchange
Call to access number  (I.e. soft-switch)  
Info request (e.g. card number, Callee number)  
Verification (e.g. account, Digit analysis)  
Call request (e.g. SIP, SIP-T)  
Call request (ISUP)  
PCM                  RTP                  PCM
References ...

1. Moderassi and S. Mohan, special issue, Advanced Signaling and Control in Next Generation Networks, IEEE Communications Magazine, October 2000 – Include papers on:
   - H.323
   - SIP

2. Additional references on Megaco/H.248
   RFC 3525 (The protocol)
   RFC 3054 (IP Phone)