



Media Gateway Control and the Softswitch Architecture



Introduction

- Voice over IP
 - Lower cost of network implementation
 - Integration of voice and data applications
 - New service features
 - Reduced bandwidth
- Replacing all traditional circuit-switched networks is not feasible.
- VoIP and circuit-switching networks coexist
 - Interoperation
 - Seamless interworking

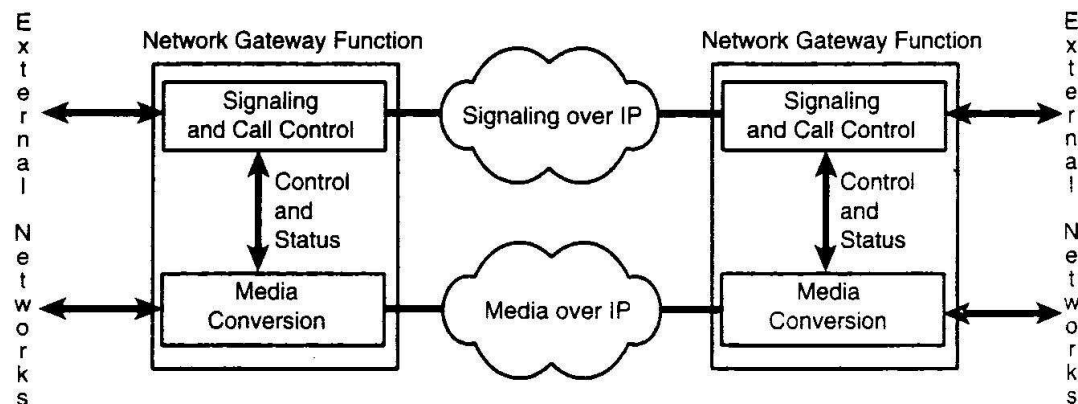


Separation of Media and Call Control

- Gateways
 - Interworking
 - To make the VoIP network appear to the circuit switched network as a native circuit-switched system and vice versa
- Signaling path and media path are different in VoIP systems.
 - Media – directly (end-to-end)
 - Signaling – through H.323 gatekeepers (or SIP proxies)
- SS7, Signaling System 7
 - The logical separation of signaling and media

Separation of Media and Call Control

- A network gateway has two related but separate functions.
 - Signaling conversion
 - The call-control entities use signaling to communicate.
 - Media conversion
 - A slave function (mastered by call-control entities)
- Figure 6-1 illustrates the separation of call control and signaling from the media path.

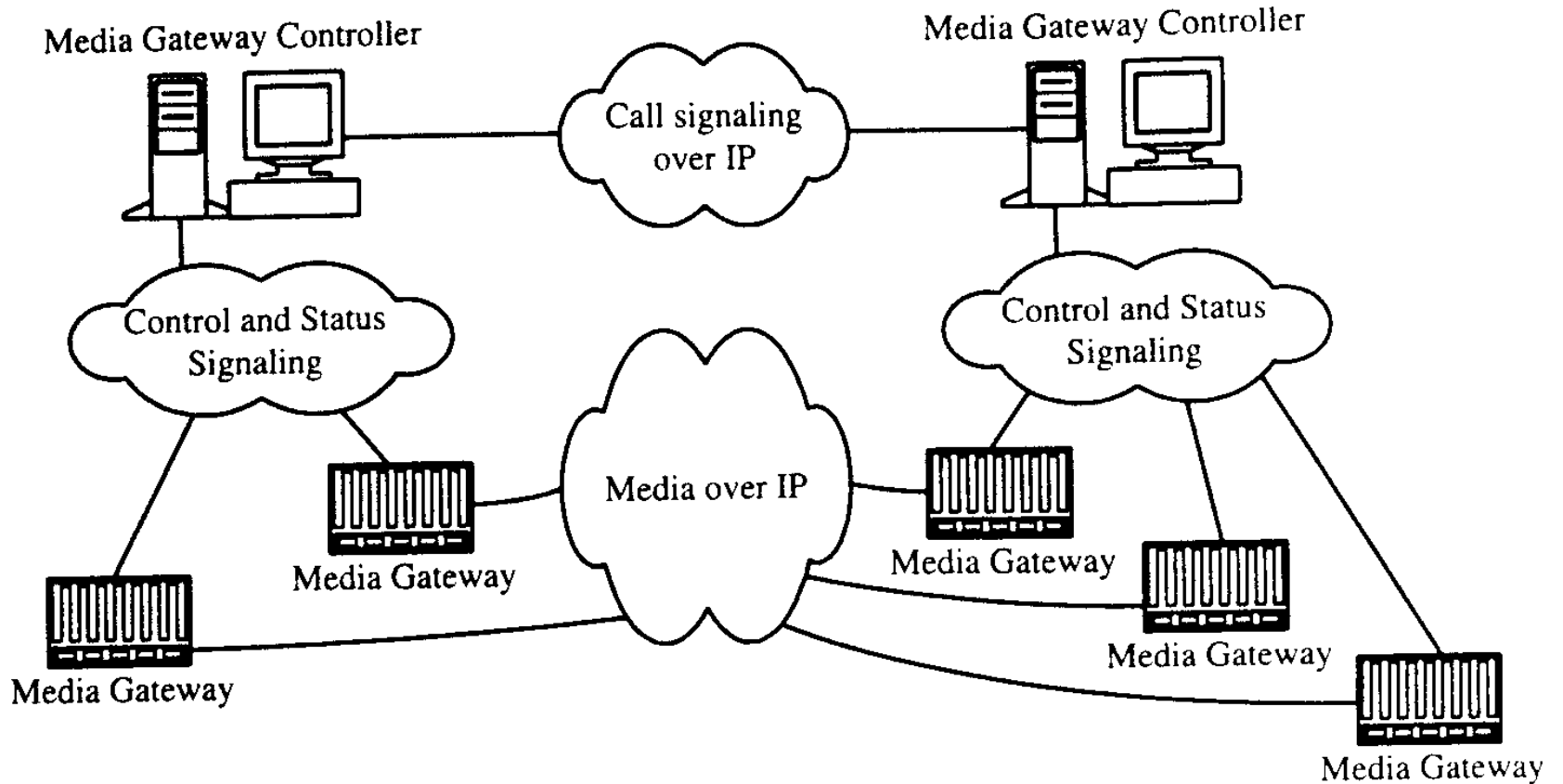




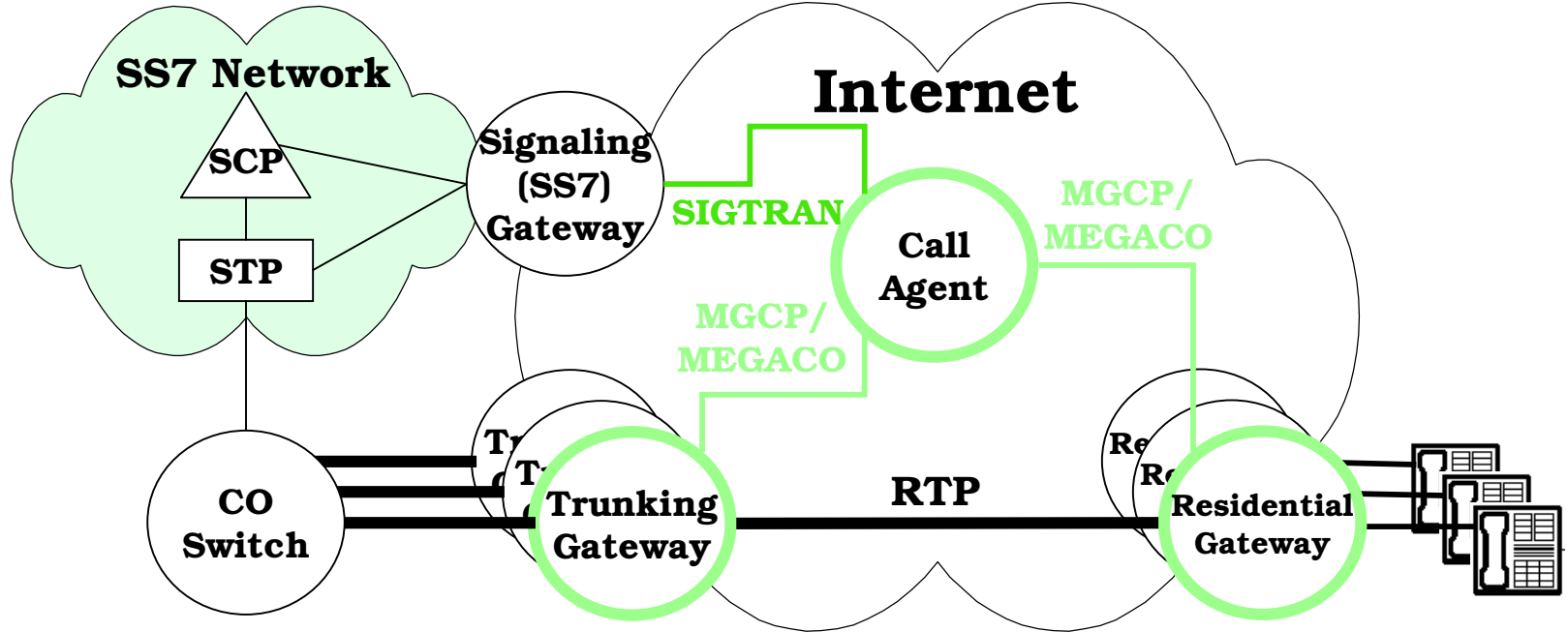
Separation of Media and Call Control

- Advantages of Separation
 - Media conversion close to the traffic source and sink
 - The call-handling functions is centralized.
 - A call agent (media gateway controller - MGC) can control multiple gateways.
 - New features can be added more quickly.
- MGCP, Media Gateway Control Protocol
 - IETF
- MEGACO/H.248
 - IETF and ITU-T Study Group 16

Softswitch Architecture [1/2]



Softswitch Architecture [2/2]



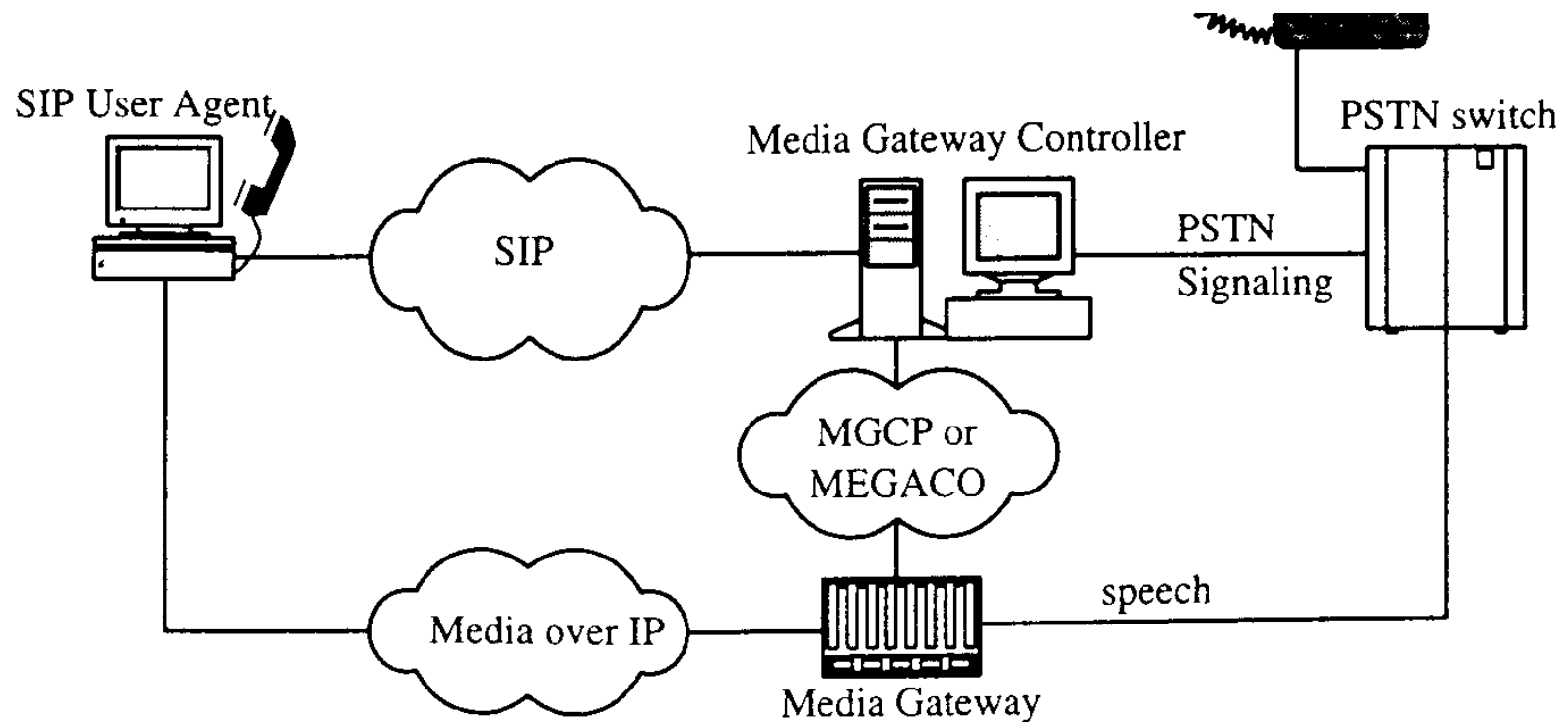


Softswitch

- The switching functions are handled by software
- International Softswitch Consortium (ISC)
 - www.softswitch.org
 - To promote the softswitch concept and related technologies
- Why the softswitch approach is popular?
 - A distributed architecture
 - For network operators
 - It is possible to use different network components from different vendors.
 - For equipment vendors
 - It is possible to focus on one area.

Softswitch/PSTN Interworking

- SIP is often used as the signaling protocol between the MGCs.





Requirements for Media Gateway Control [1/2]

- RFC 2895
 - Media Gateway Control Protocol Architecture and Requirements
- Requirement
 - The creation, modification and deletion of media streams
 - Including the capability to negotiate the media formats
 - The specification of the transformations applied to media streams
 - Request the MG to report the occurrence of specified events within the media streams, and the corresponding actions



Requirements for Media Gateway Control

[2/2]

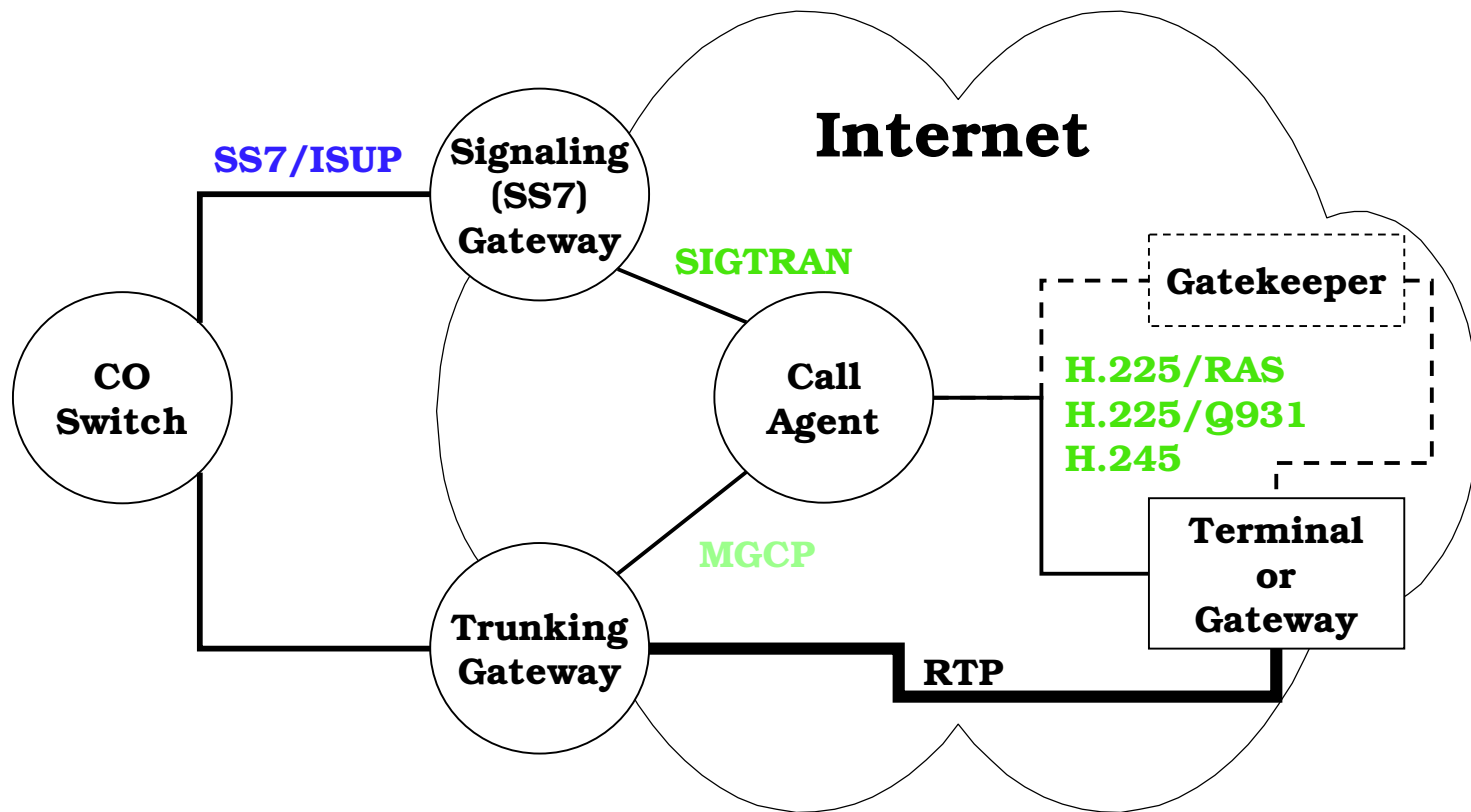
- Request the MG to apply tones or announcements
- The establishment of media streams according to certain QoS requirements
- Reporting QoS and billing/accounting statistics from an MG to an MGC
- The management of associations between an MG and an MGC
 - In the case of failure of a primary MGC
- A flexible and scalable architecture in which an MGC can control different MGs
- Facilitate the independent upgrade of MGs and MGCs



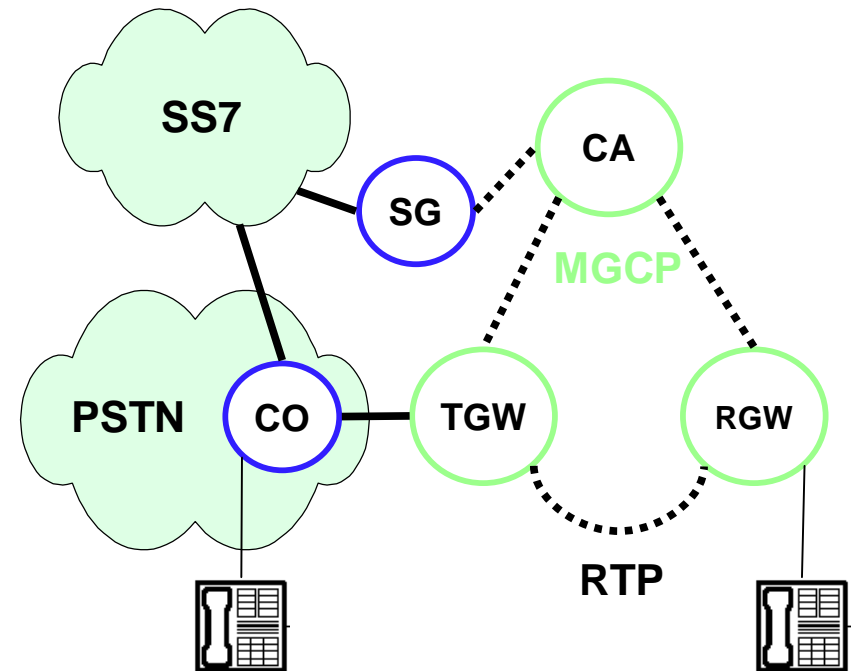
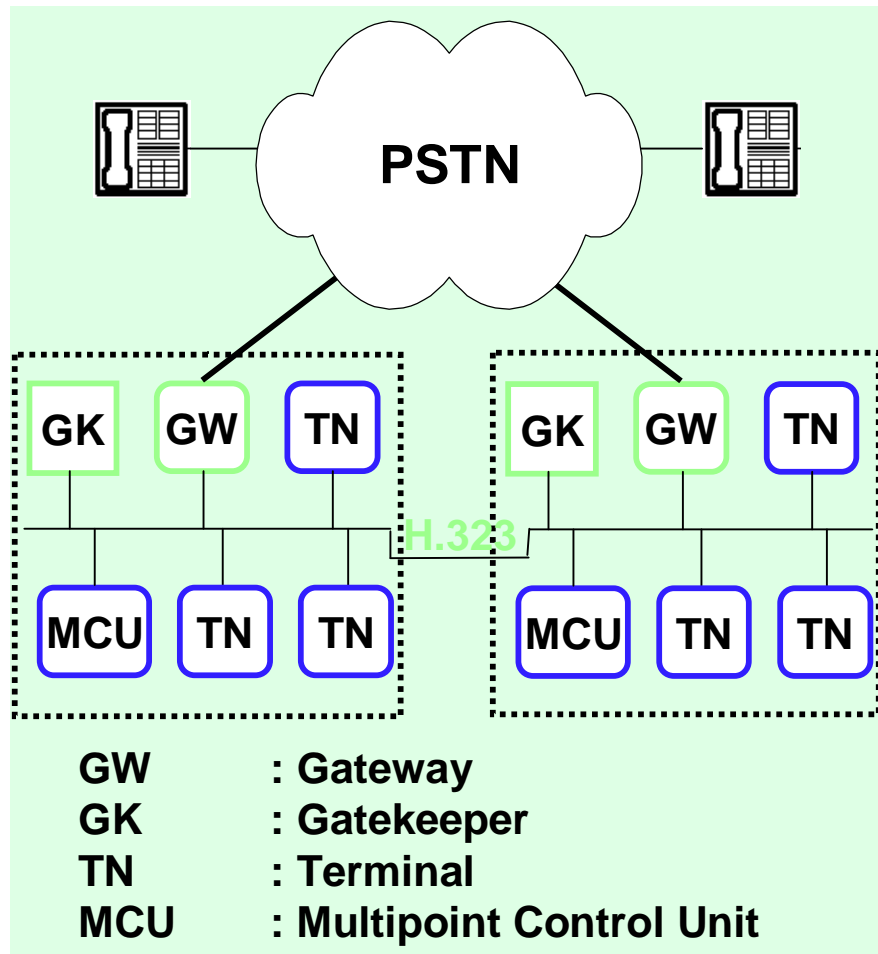
Protocols for Media Gateway Control

- The first protocol is MGCP
 - RFC 2705, informational
 - To be succeeded by MEGACO/H.248
 - Has be included in several product developments
- MEGACO/H.248
 - A standards-track protocol
 - RFC 3015 is now the official version.

Relation with H.323 Standards



H323, SIP & MGCP, MEGACO



- CA** : Call Agent
- TGW** : Trunking Gateway
- RGW** : Residential Gateway
- SG** : Singling Gateway



H323, SIP & MGCP/MEGACO

■ H.323 , SIP

- peer-to-peer
- internet oriented
- intelligent endpoint
 - optional GK
- decentralized

■ Problems

- maintenance
 - cost & scalability of large systems
- signaling & media control are coupled
- interoperability with SS7

■ MGCP/MEGACO

- client-server
- traditional telephony
- intelligent server
 - “dumb” terminal
- centralized

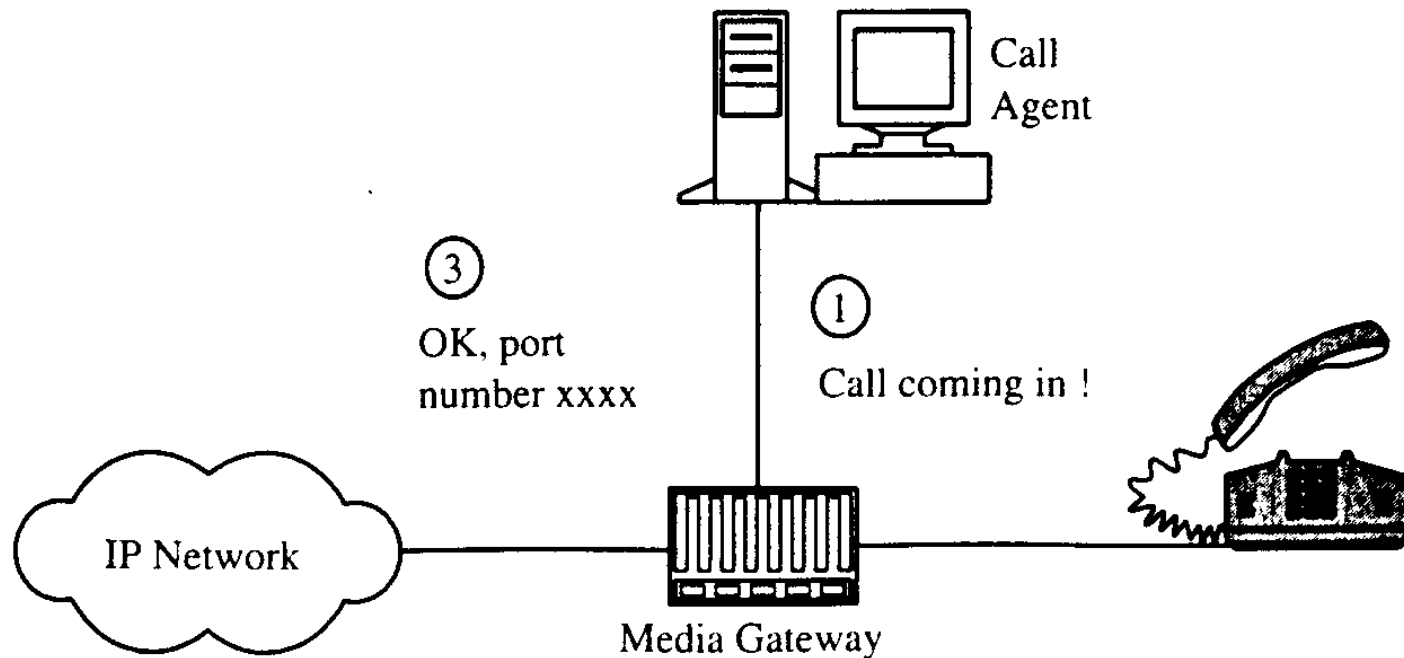
■ Concept

- gateway decomposed
 - separate call control from media ports
 - CA, MG, SG
- interoperability with PSTN

MGCP Connection Establishment

②

Select an RTP port and connect





MGCP

- A master-slave protocol
 - Call agents (MGCs) control the operation of MGs
 - Call-control intelligence
 - Related call signaling
 - MGs
 - Do what the CA instructs
 - A line or trunk on circuit-switched side to an RTP port on the IP side
- Types of Media Gateway
 - Trunking Gateway to CO/Switches
 - Residential Gateway to PSTN Phones
 - Access Gateway
- Communication between call agents
 - Likely to be the SIP



The MGCP Model

- Endpoints
 - Sources or sinks of media
 - Trunk interfaces
 - POTS line interfaces
 - Announcement endpoint
- Connections
 - Allocation of IP resources to an endpoint
 - An ad hoc relationship is established from a circuited-switched line and an RTP port on the IP side.
 - A single endpoint can have several connections



MGCP Endpoints [1/3]

- DS0 channel
 - A digital channel operates at 64kbps.
 - Multiplexed within a larger transmission facility such as DS1 (1.544 Mbps) or E1 (2.048 Mbps)
 - G.711 (u-law or A-law)
- Analog line
 - To a standard telephone line
 - An analog voice stream
 - Could also be audio-encoded data from a modem
 - The gateway shall be required to extract the data and forward it as IP packets.



MGCP Endpoints [2/3]

- Announcement server access point
 - Provide access to a single announcement
 - One-way
 - No external circuit-switched channels
- Interactive voice response (IVR) access point
 - Provide access to an IVR system
- Conference bridge access point
 - Media streams from multiple callers can be mixed
- Packet relay
 - A firewall between an open and a protected networks



MGCP Endpoints [3/3]

- Wiretap access point
 - For listening to the media transmitted
 - One way
- ATM trunk-side interface
 - The termination of an ATM trunk
 - May be an ATM virtual circuit

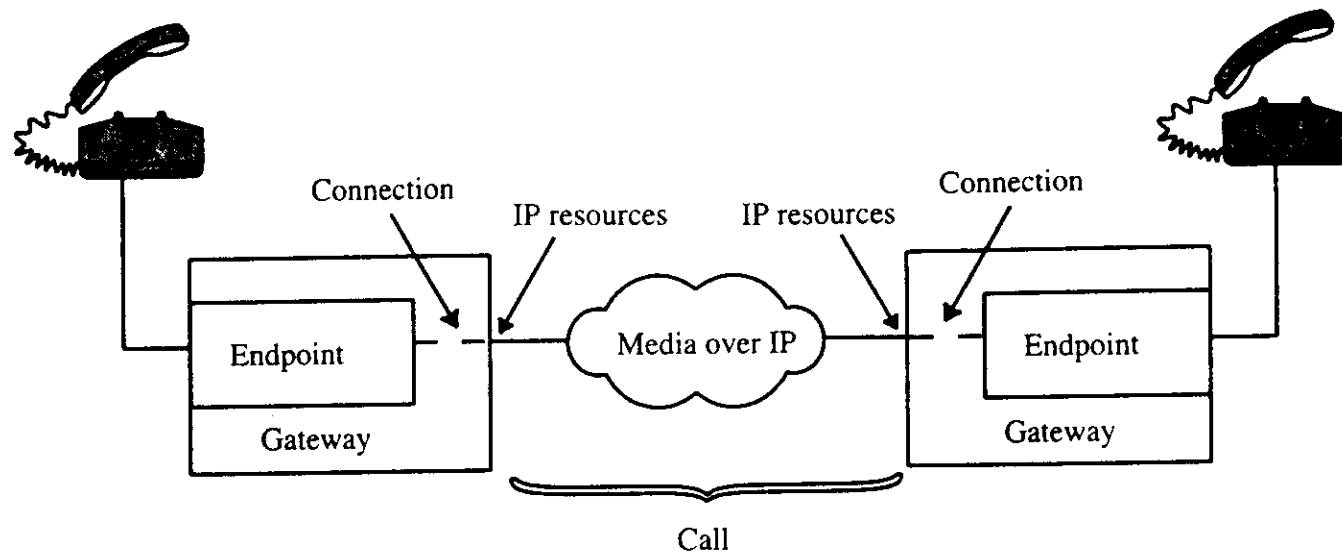


Endpoint Identifier

- GW's Domain Name + Local Name
- Local Name
 - A hierarchical form: X/Y/Z
- trunk4/12/7@gateway.somenetwork.net
 - To identify DS0 number 7 within DS1 number 12 on DS3 number 4 at gateway.somenetwork.net
- Wild-cards
 - \$, any; *, all
 - e.g., trunk1/5/\$@gateway.somenetwork.net
 - CA wants to create a connection on an endpoint in a gateway and does not really care which endpoint is used.
 - e.g., trunk1/5/*@gateway.somenetwork.net
 - CA requests statistical information related to all endpoints on a gateway.

MGCP Calls and Connections

- A connection
 - Relationship established between a given endpoint and an RTP/IP session
- A call
 - A group of connections
- The primary function of MGCP is to enable
 - The connections to be created
 - The session descriptions to be exchanged between the connections





MGCP Commands

- 9 commands to handle Connection/Endpoints
 - EPCF** ■ EndpointConfiguration (coding characteristics)
 - RQNT** ■ NotificationRequest (requested events)
 - NTFY** ■ Notify (GW: detected events)
 - CRCX** ■ CreateConnection
 - MDCX** ■ ModifyConnection
 - DLCX** ■ DeleteConnection
 - AUEP** ■ AuditEndpoint
 - AUCX** ■ AuditConnection
 - RSIP** ■ RestartInProgress (GW : taken in/out of service)
- All commands are acknowledged.



MGCP Command Format

- A command line
 - Request verb (the name of the command)
 - Transaction id
 - Endpoint id (for which the command applies)
 - Protocol version
- A number of parameter lines
- An optional session description (SDP)
 - Separated by a single empty line
- Command Encapsulation
 - One command can be included within another
 - Only one level of encapsulation
 - E.g., when instructing a gateway to create a connection, CA can simultaneously instruct the gateway to notify the CA of certain events.



MGCP Parameters [1/6]

- BearInformation (B)
 - The line-side encoding
 - B:e:mu
- CallId (C)
 - Comprised of hexadecimal digits
- Capabilities (A)
 - In response to an audit
- ConnectionId (I)
 - Comprised of hexadecimal digits
- ConnectionMode (M)
 - Send only, receive only and send-receive



MGCP Parameters [2/6]

- ConnectionParameters (P)
 - Connection-related statistical information
 - Average latency, jitter, packets sent/received/lost
 - GW -> CA
- DetectEvents (T)
 - That an endpoint should detect during quarantine period
 - E.g., off-hook, on-hook, hook-flash, DTMF digits...
- LocalConnectionDescriptor (LC)
 - An SDP session description
- LocalConnectionOptions (L)
 - Bandwidth, packetization period, silence suppression, gain control, echo cancellation...
 - L: e:off, s:on
 - To turn echo cancellation off and to turn silence suppression on



MGCP Parameters [3/6]

- EventStates (ES)
 - In response to an audit command
 - A list of events associated with the current state
- MaxMGCPDatagram (MD)
 - To indicate the maximum size MGCP packet supported by an MG
 - Included in the response to an AUEP command
- NotifiedEntity (N)
 - An address for the CA
- ObservedEvents (O)
 - Detected by an endpoint
- PackageList (PL)
 - Supported by an endpoint
 - Events and signals are grouped into packages
 - Analog line endpoint



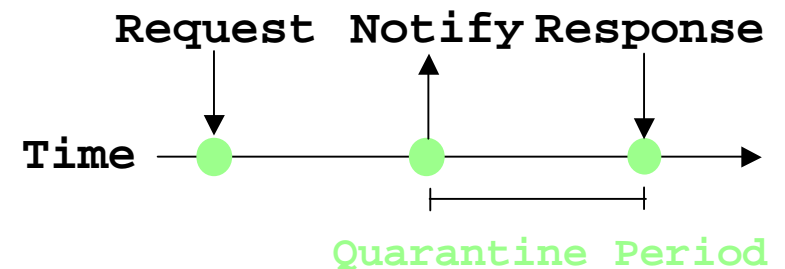
MGCP Packages

- Group events and signals into packages
- Generic Media (G)
- DTMF (D)
- MF (M)
- Trunk (T)
- Line (L)
- Handset (H)
- RTP (R)
- Network Access Server (N)
- Announcement Server (A)
- The experimental packages have names beginning with the two character “x-”.

Gateway	Supported packages
Trunk GW (ISUP)	G, D, T, R
Trunk GW (MF)	G, M, D, T, R
Network Access Server	G, M, T, N
Combined NAS/VOIP GW	G, M, D, T, N, R
Access GW (VOIP)	G, M, D, R
Access GW (VOIP + NAS)	G, M, D, N, R
Residential GW	G, D, L, R
Announcement GW	A, R

MGCP Parameters [4/6]

- QuarantineHandling (Q)
 - Events that occur during the period in which the GW is waiting for a response to a Notify command
 - Process the events or discard them
- ReasonCode (E)
 - When a GW deletes/restarts a connection
- RemoteConnectionDescriptor (RC)
 - An SDP session description



Q: **process**/discard
step/loop (notify)
T: events to detect
during quarantine



MGCP Parameters [5/6]

- RequestEvents (R)
 - A list of events that an endpoint is to watch for
 - Associated with each event, the endpoint can be instructed to perform actions
 - E.g., collect digits, or apply a signal
- RequestInfo (F)
 - In response to audit requests
 - The current values of RequestEvents, DigitMap, NotifiedEntity
- RequestIdentifier (X)
 - To correlate a given notification from a GW
- RestartDelay (RD)
 - A number of seconds indicating when an endpoint will be brought back into service



MGCP Parameters [6/6]

- RestartMethod (RM)
 - Graceful or Forced
- SecondConnectionId (I2)
 - The connection on a second endpoint
- SecondEndpointID (Z2)
 - A connection between two endpoints on the same GW
- SignalRequests (S)
 - Signals to be applied by an endpoint
- SpecificEndpointID (Z)
 - Used to indicate a single endpoint



Digit Map

- CA ask GW to collect user dialed digits
 - Created by CA
- Usage
 - Gateways detect a set of digits.
 - e.g., (11x|0800xxxxxx|049xxxxxx|002x.T)
 - Match accumulated digits
 - under-qualified, do nothing further
 - matched, send the collected digits to CA
 - over-qualified, send the digits to CA

Inter-digit Timer

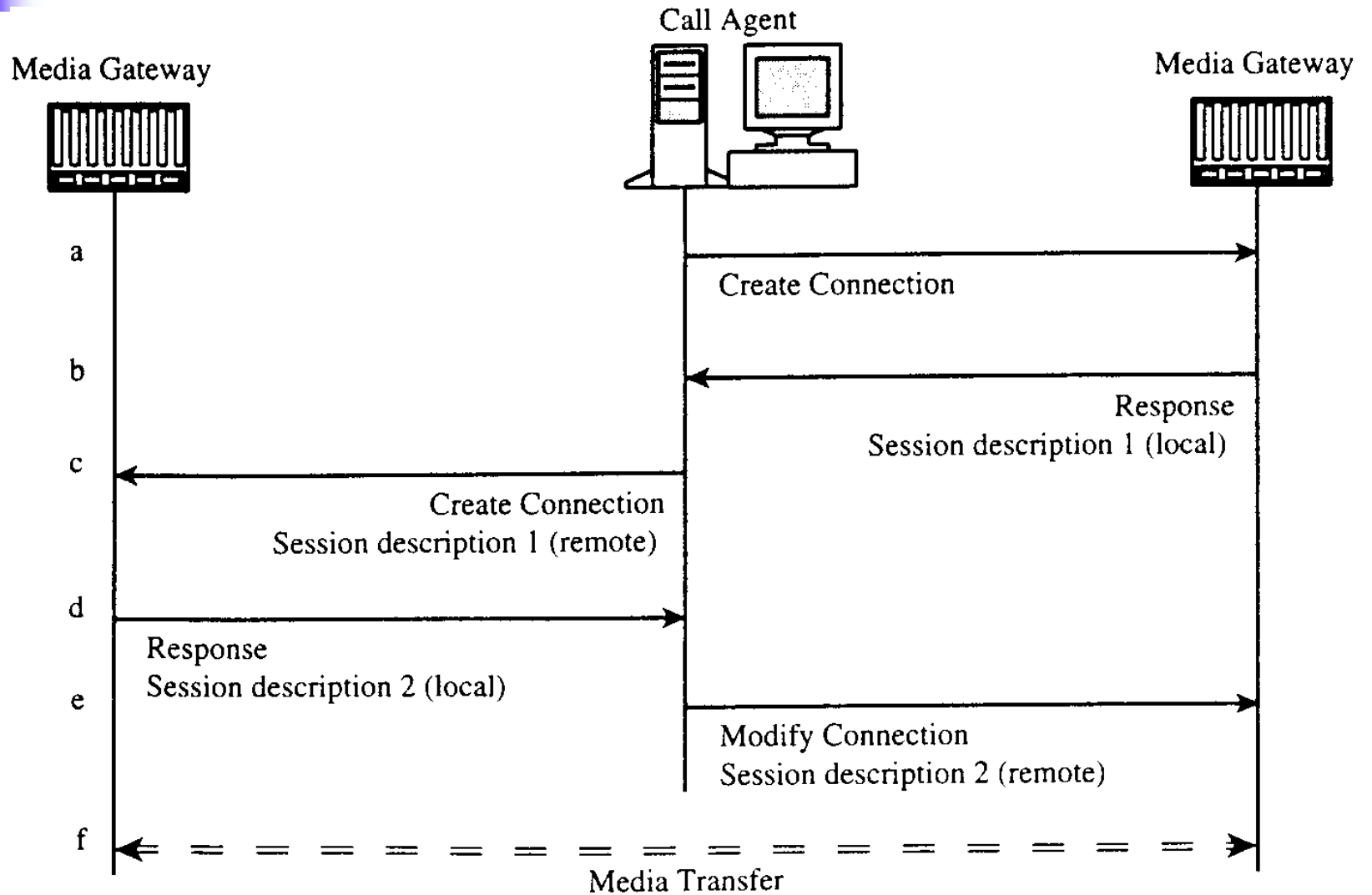


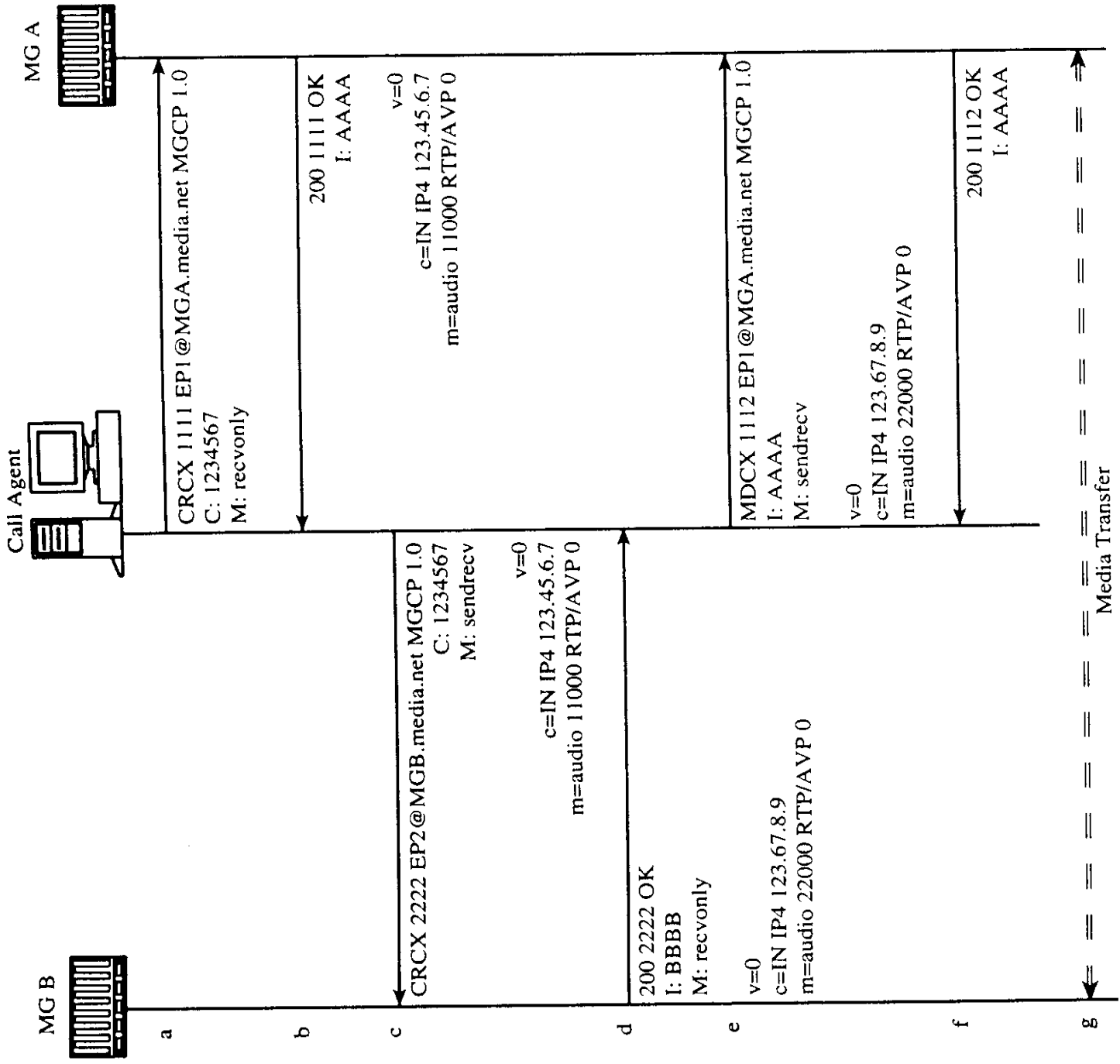


MGCP Response

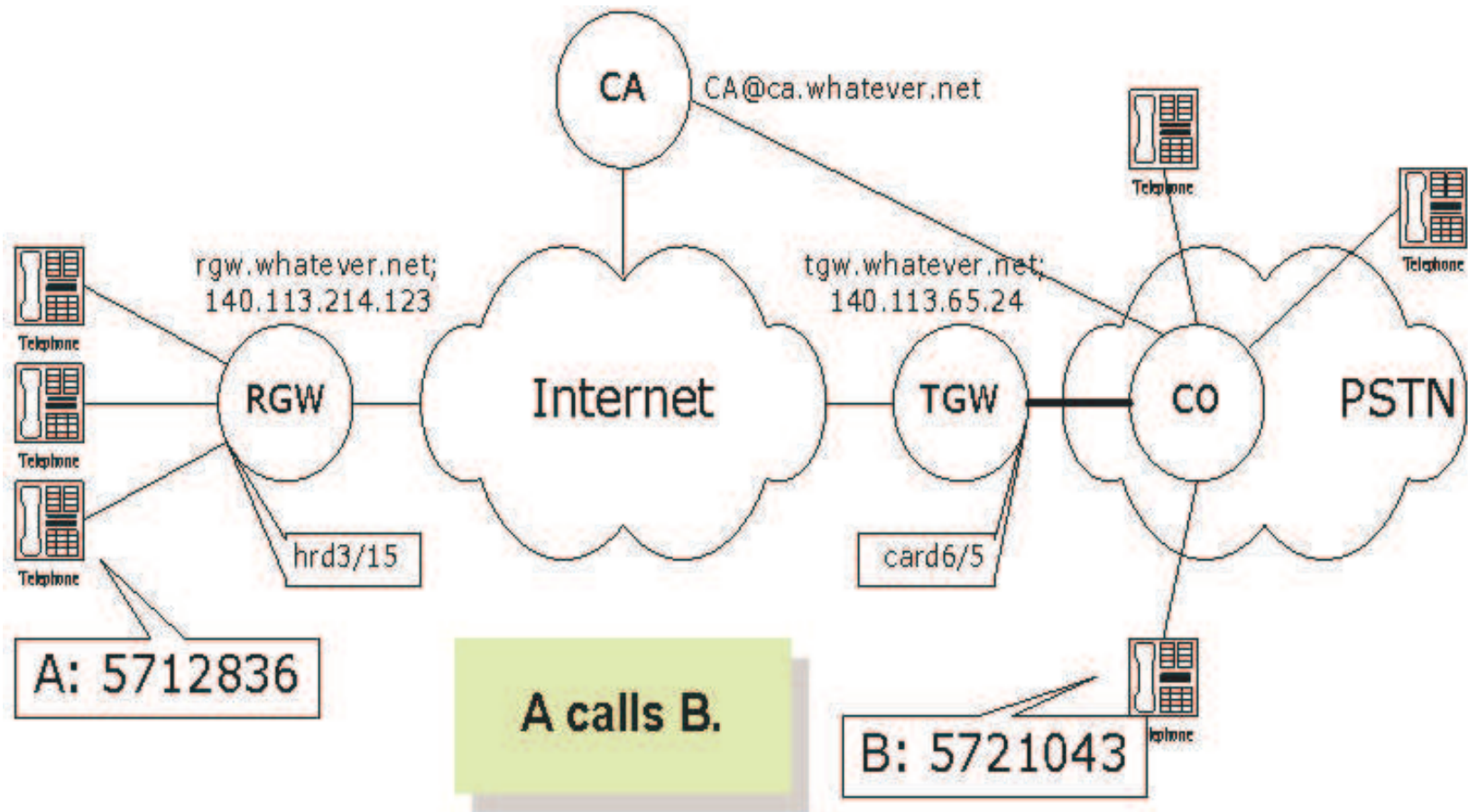
- Header
 - A response line
 - Return code + TransID + Commentary
 - A set of parameter lines (optional)
 - E.g., I: A3C47F21456789F0 (ConnectionId)
- Session Description
 - Session Description Protocol
 - separated from header by an empty line

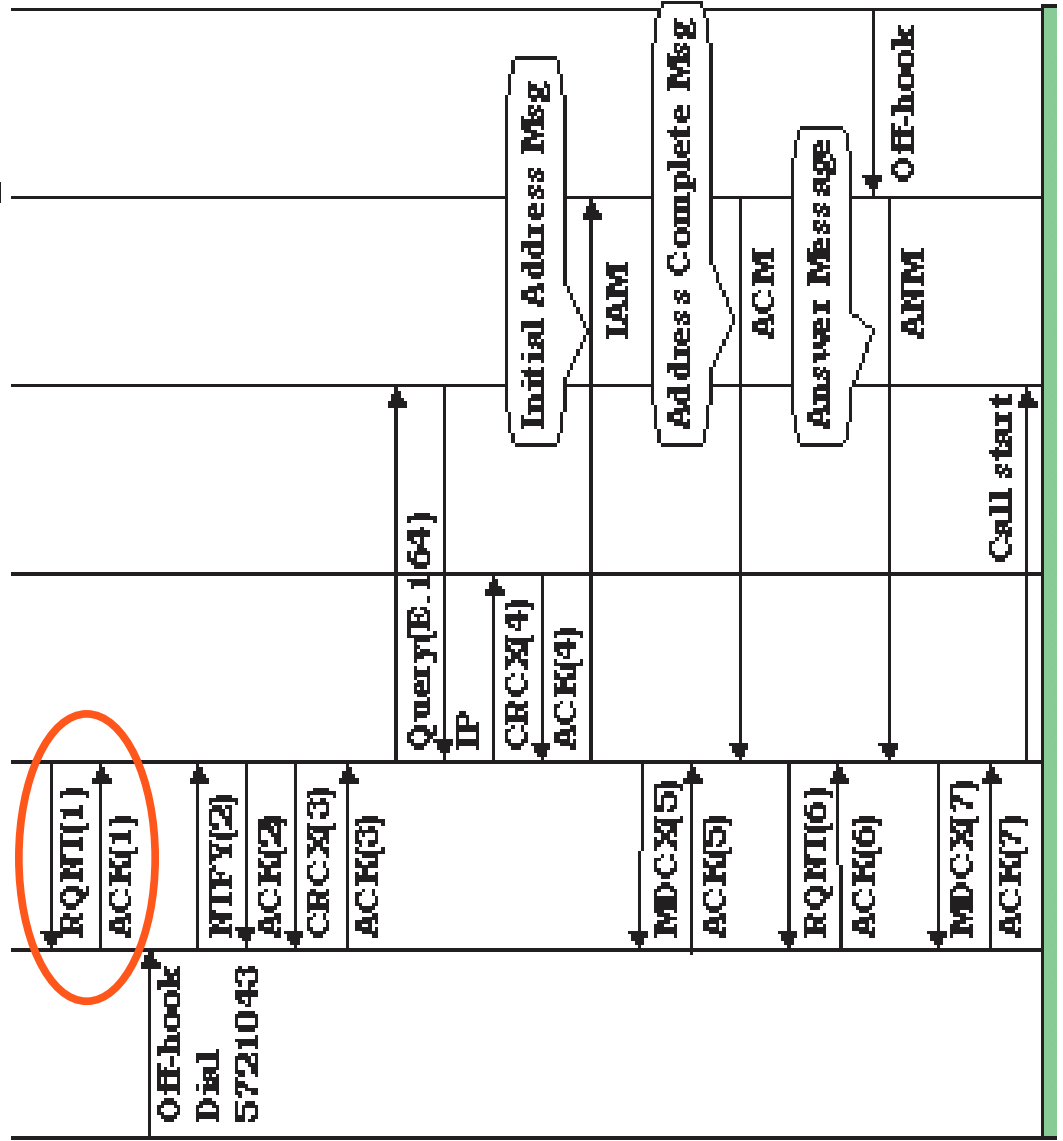
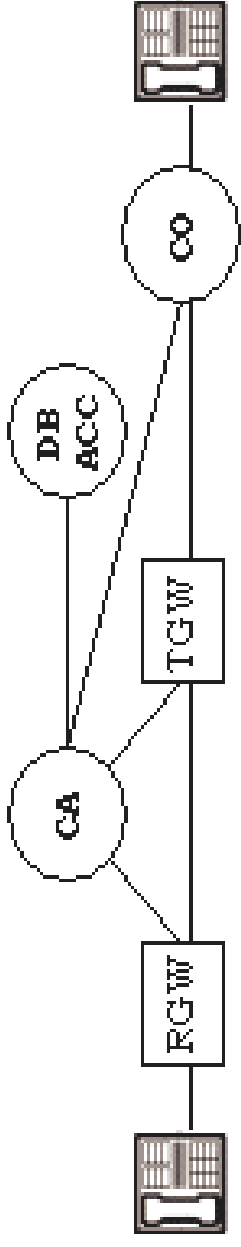
Call Setup Using MGCP





Call Flow for RGW to TGW





Call Flow for RGW to TGW

■ RQNT(1) : NotificationRequest

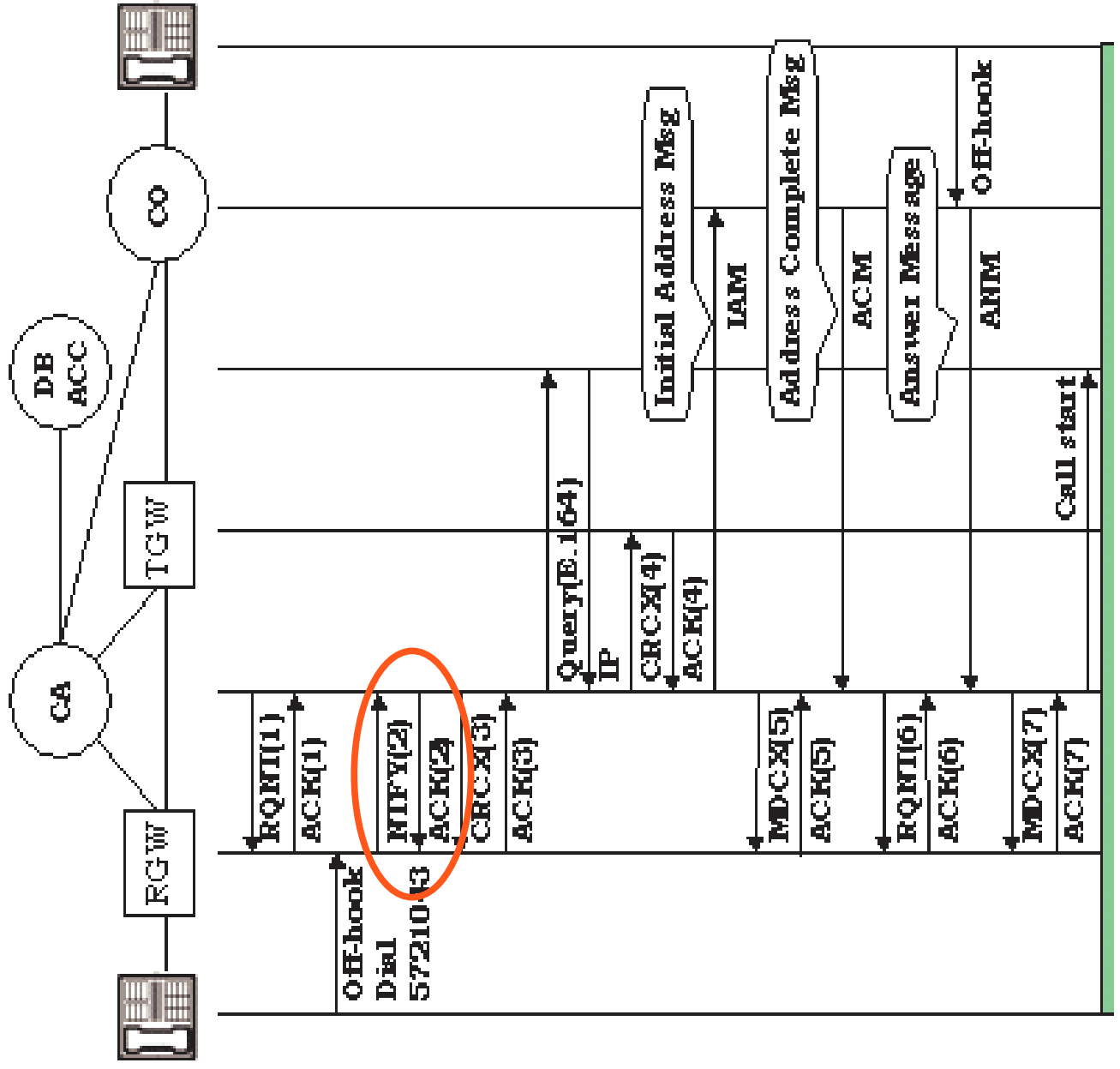
- RQNT 1201 hrd3/15@rgw.whatever.net MGCP 1.0
- N: CA@ca.whatever.net:5678
- X: 0123456789AC
- R: hd(E(R(hu(N)),S(dl),D/(D)))
- D: (11x|080xxxxxx|57xxxxx|002x.T)

```
N: NotifyEntity
X: RequestIdentifier
R: RequestEvents
D: DigitMap
```

■ ACK to RQNT(1)

- 200 1201 OK

```
E: Embedded Request
R: Notification Request
N: Notify immediately
S: Signal Request
D: Digit Map
```

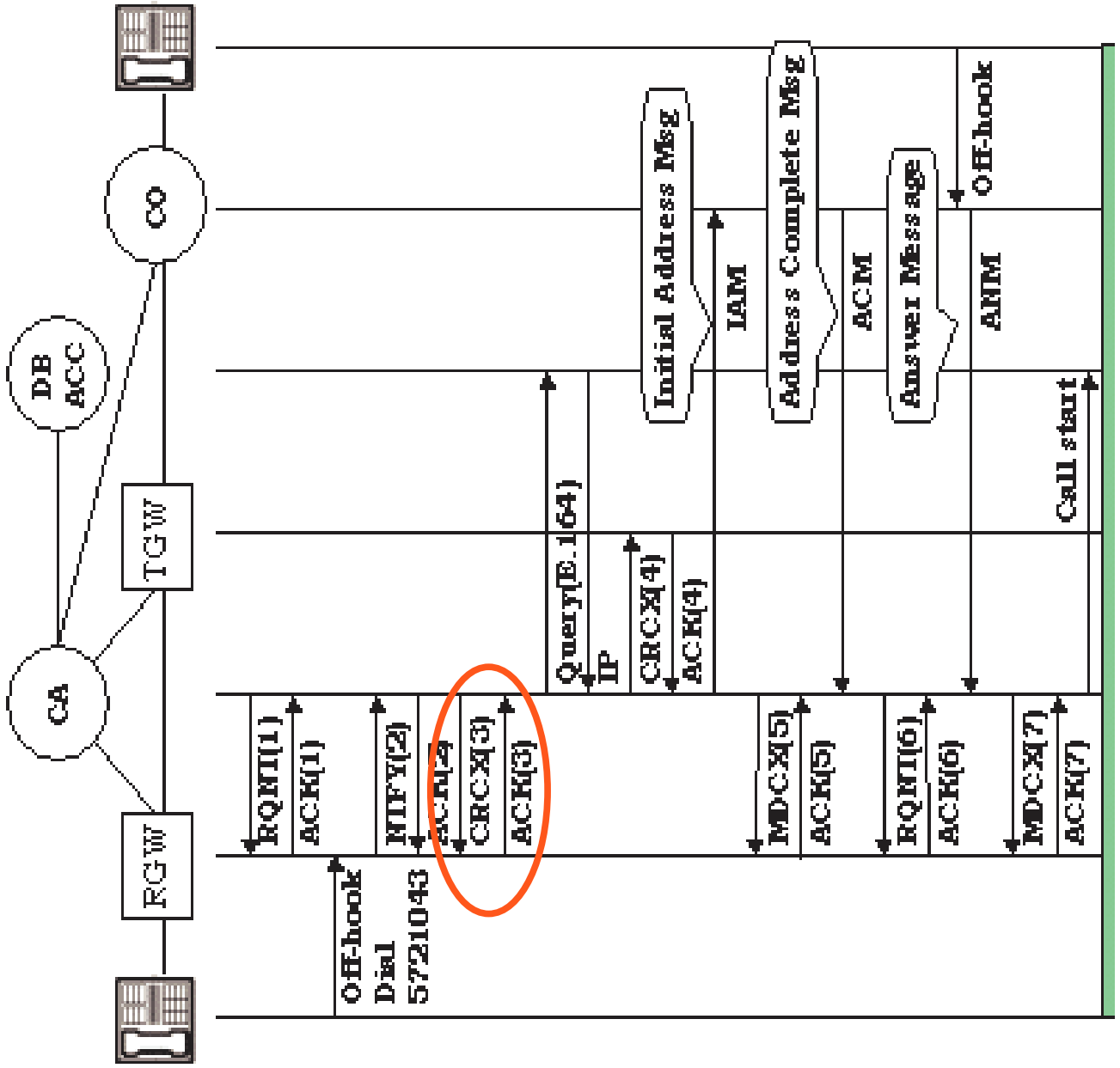




Call Flow for RGW to TGW

- NTFY(2) : Notify from RGW
 - NTFY 2002 hrd3/15@rgw.whatever.net MGCP 1.0
 - N: CA@ca.whatever.net:5678
 - X: 0123456789AC
 - O: 5721043
- ACK to NTFY(2)
 - 200 2002 OK

N: NotifyEntity
X: RequestIdentifier
O: ObservedEvent

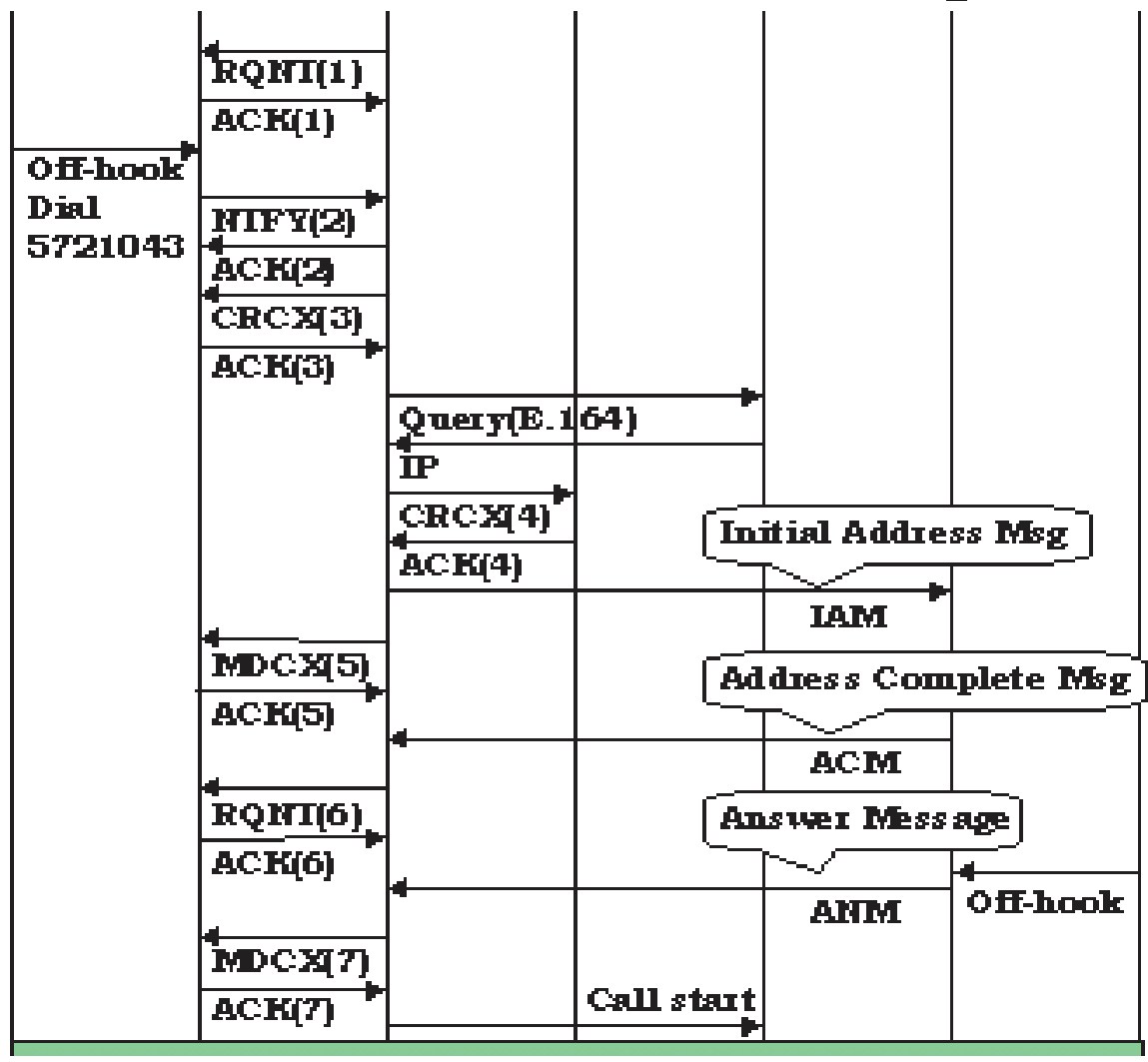
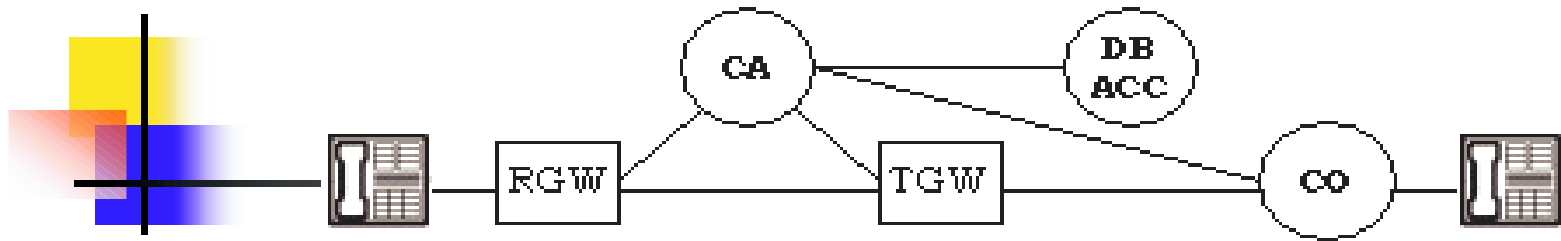




Call Flow for RGW to TGW

- **CRCX(3) : CreateConnection**
 - CRCX 1204 hrd3/15@rgw.whatever.net MGCP 1.0
 - C: A3C47F21456789F0
 - L: p:10, a: G.711; G.726-32
 - M: recvonly
 - X: 0123456789AD
 - R: hu
- **ACK to CRCX(3)**
 - 200 1204 OK
 - I: FDE234C8
 - Session Description

```
C: CallId
L: LocalCXOptions
  p: packetize period(ms)
  a: Compression Algo.
M: Mode
X: RequestIdentifier
R: RequestEvents
I: ConnectionId
```



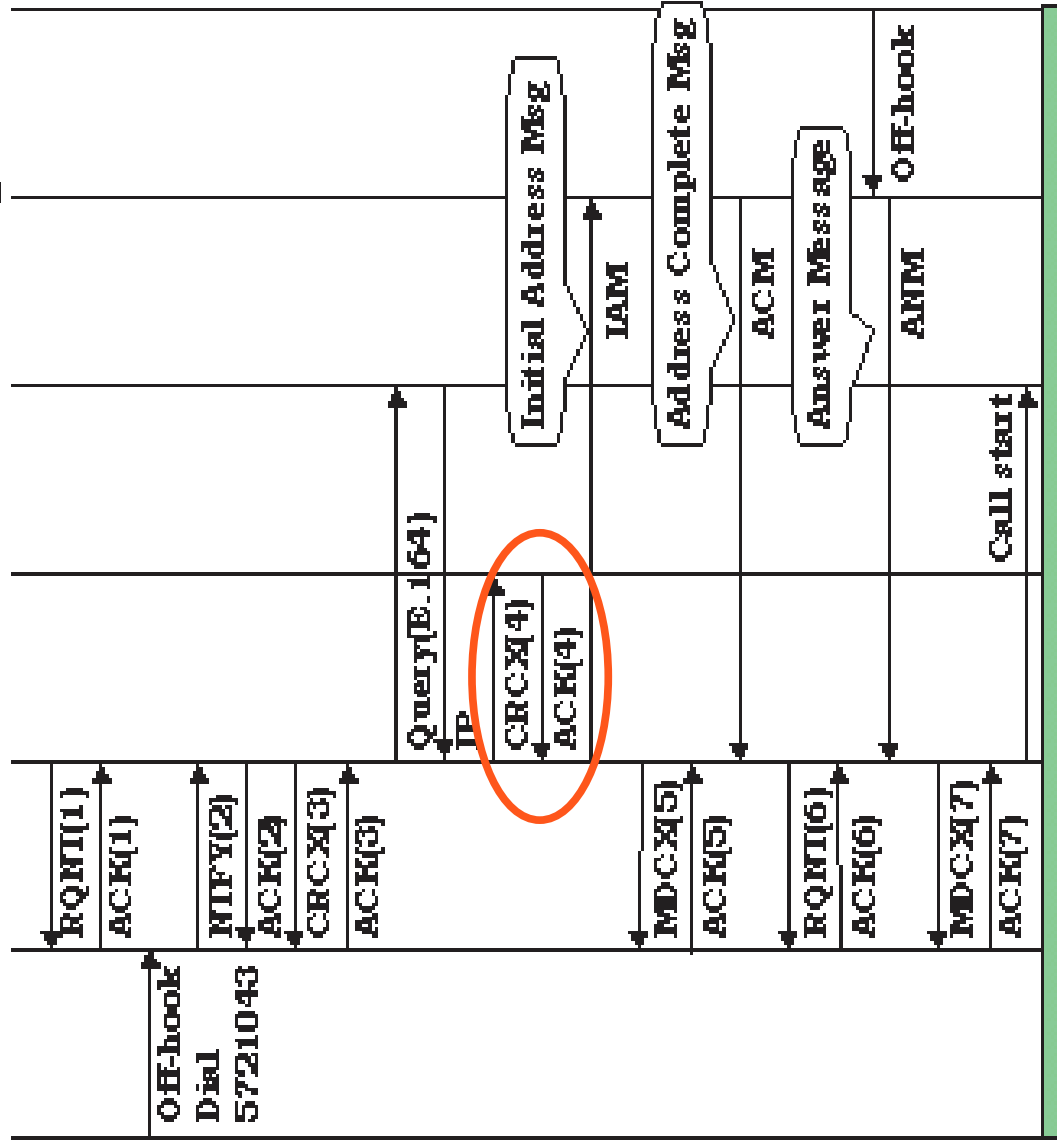
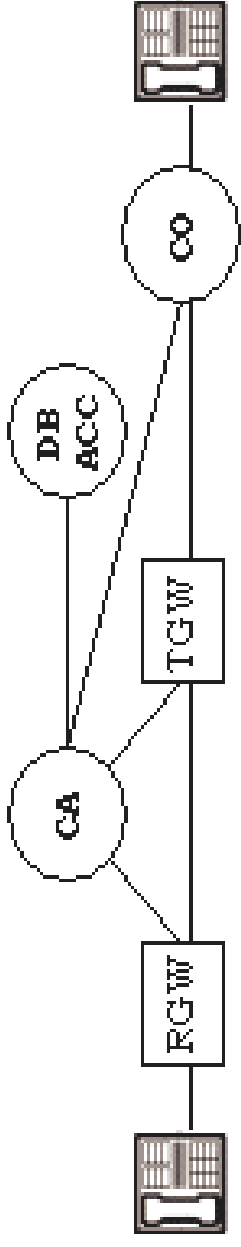


Call Flow for RGW to TGW

- ACK to CRCX(3) Session Description
 - v=0
 - c=IN IP4 140.96.102.166
 - m=audio 3456 RTP/AVP 0 96
 - a=rtpmap:96 G726-32/8000

**G726~G732 encoded
audio sample at 8 kHz**

```
v: protocol version
c: connection information
m: media name and transport address
a: more media attribute line
```

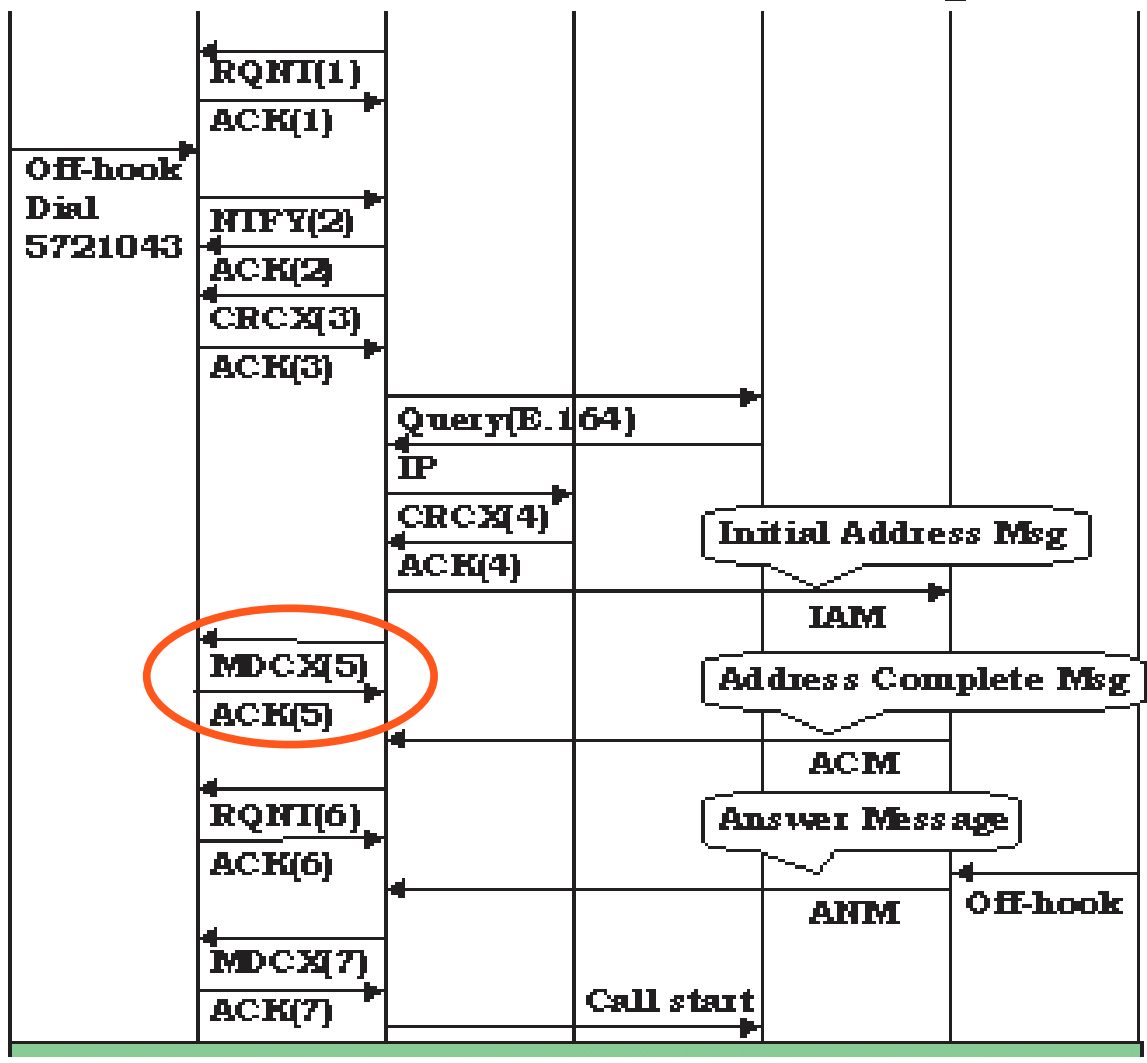
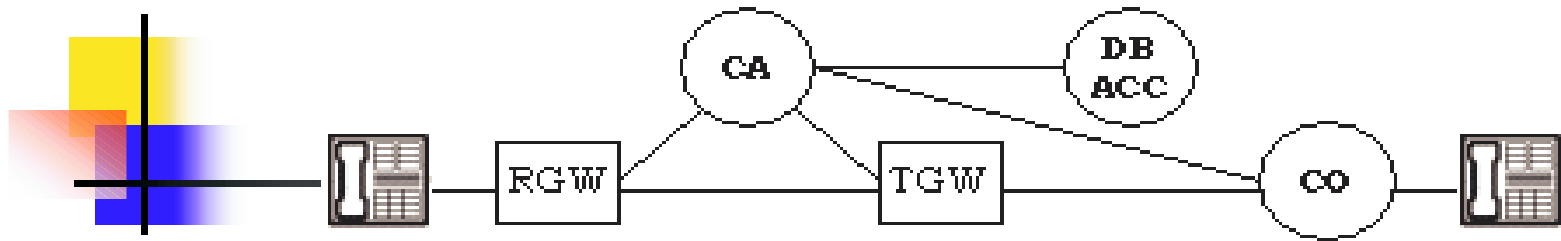




Call Flow for RGW to TGW

- CRCX(4) : CreateConnection
 - CRCX 1205 card6/5@tgw.whatever.net MGCP 1.0
 - C: A3C47F21456789F0
 - L: p:10, a: G.711; G.726-32
 - M: sendrecv
 - Session Description from ACK(3)
- ACK to CRCX(4)
 - 200 1205 OK
 - I: 32F345E2
 - Session Description

```
C: CallId
M: Mode
I: ConnectionId
```





Call Flow for RGW to TGW

- MDCX(5) : ModifyConnection

- MDCX 1206 hrd3/15@rgw.whatever.net MGCP 1.0

- C: A3C47F21456789F0

- I: FDE234C8

- M: recvonly

C: CallId

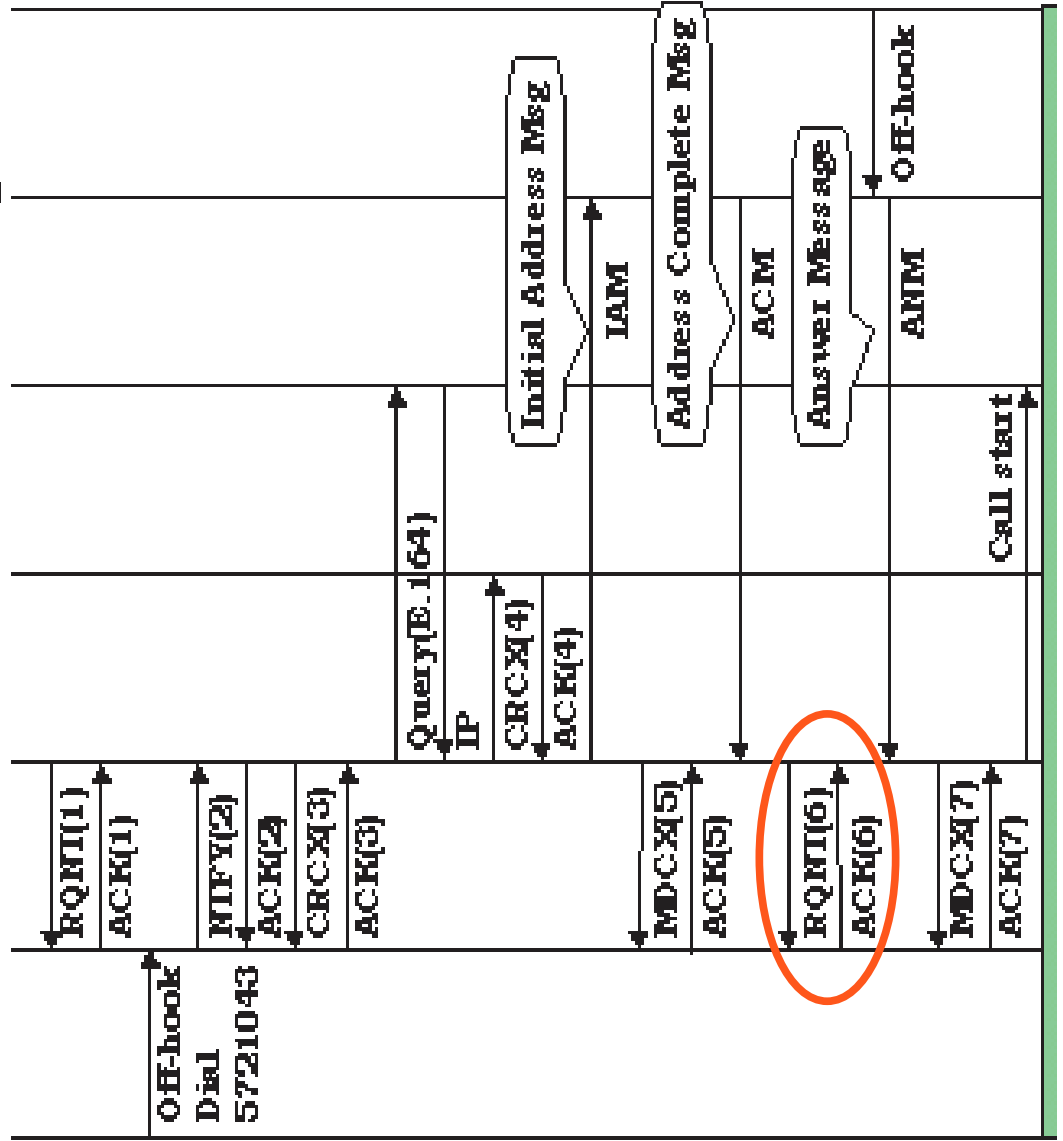
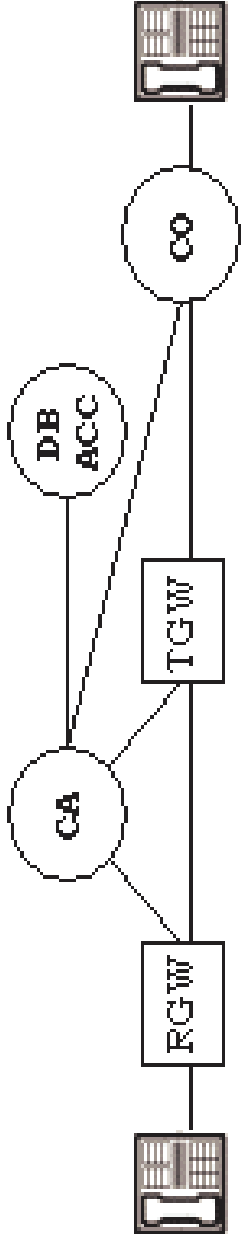
I: ConnectionId

M: Mode

- Session Description from ACK(4)

- ACK to MDCX(5)

- 200 1206 OK

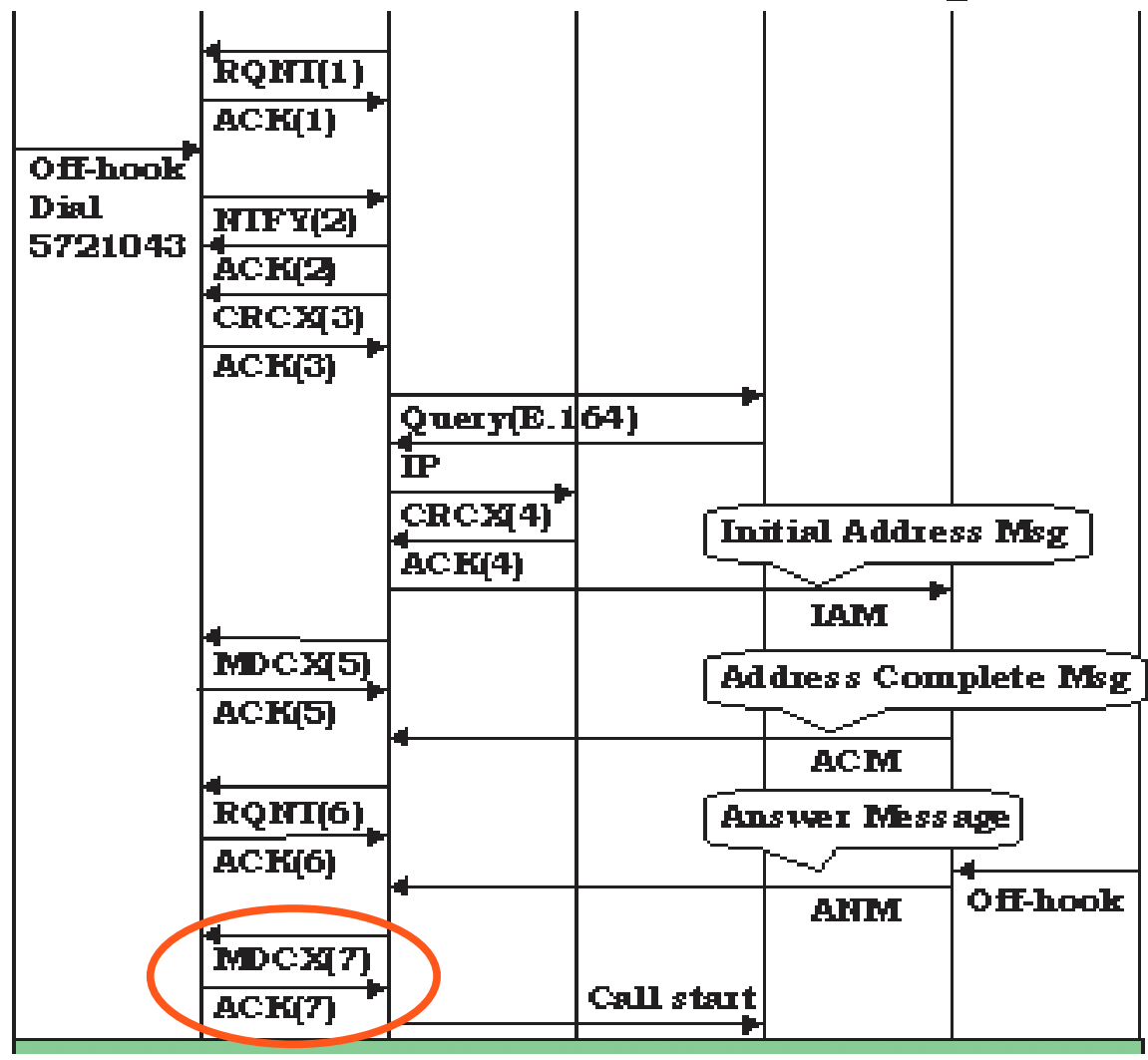
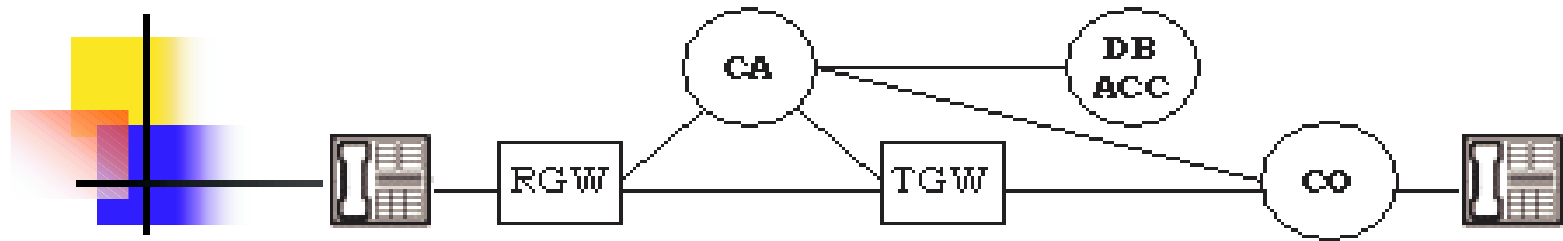




Call Flow for RGW to TGW

- RQNT(6) : NotificationRequest
 - RQNT 1207 hrd3/15@rgw.whatever.net MGCP 1.0
 - N: CA@ca.whatever.net:5678
 - X: 012345789AE
 - R: hu
 - S: v (alerting)
- ACK to RQNT(6)
 - 200 1207 OK

```
N: NotifyEntity
X: RequestIdentifier
R: RequestEvents
S: SignalRequests
```





Call Flow for RGW to TGW

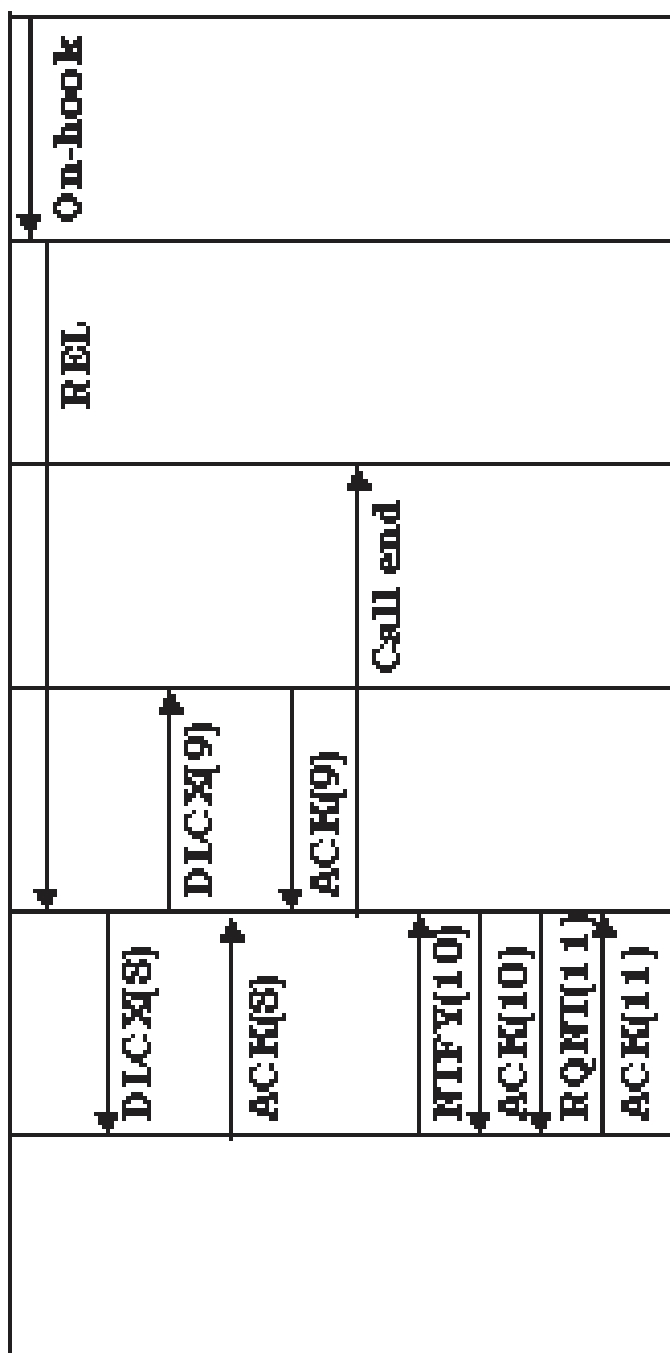
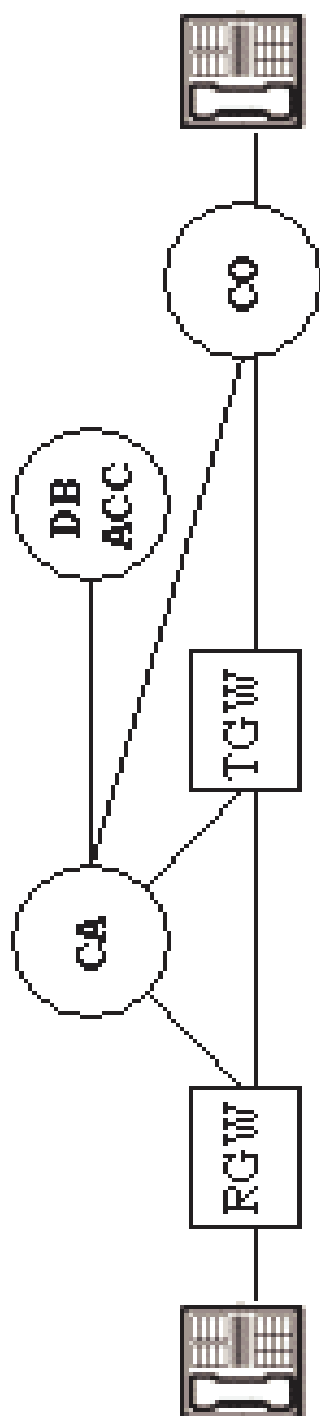
- MDCX(7) : ModifyConnection

- MDCX 1209 hrd3/15@rgw.whatever.net MGCP 1.0
- C: A3C47F21456789F0
- I: FDE234C8
- M: sendrecv
- X: 012345789AF
- R: hu

```
C: CallId
I: ConnectionId
M: Mode
```

- ACK to MDCX(7)

- 200 1209 OK



Call Flow for RGW to TGW

- **DLCX(8) : DeleteConnection**

- DLCX 1210 hrd3/15@rgw.whatever.net MGCP 1.0
- C: A3C47F21456789F0
- I: FDE234C8

```
C: CallId
I: ConnectionId
```

- **ACK to DLCX(8)**

- 200 1210 OK
- P: PS=1245, OS=62345, PR=780, OR=45123, PL=10, JI=27, LA=48

```
PS: Packets sent
OS: Octets sent
PR: Packets received
OR: Octets received
PL: Packets lost
JI: Average Jitter (ms)
LA: Average Latency (ms)
```



Usage of Commands

- NotificationRequest()
 - EndpointId,
 - [NotifiedEntity,]
 - [RequestedEvents,]
 - RequestIdentifier,
 - [DigitMap,]
 - [SignalRequests,]
 - [QuarantineHandling,]
 - [DetectEvents,]
 - [encapsulated EndpointConfiguration]



Usage of Commands

- CreateConnection()
 - CallId,
 - EndpointId,
 - [NotifiedEntity,]
 - [LocalConnectionOption,]
 - Mode,
 - [{RemoteConnectDescriptor|**SecondEndpointId**}]
 - [Encapsulated NotificationRequest,]
 - [Encapsulated EndpointConfiguration]

Hairpin Connection



Usage of Commands

- DeleteConnection()
 - Delete one connection from Call Agent
 - ConnectionId in the parameter line
 - GW responds with Connection parameters
 - Delete multiple connections from Call agent
 - Only EndpointId (and CallId) in the parameter line
 - GW does not respond with Connection parameters
 - From gateway
 - Reason-Code & Connection-Parameters in Command



Usage of Commands

- RestartInProgress()
 - EndPointId
 - RestartMethod
 - [RestartDelay]
 - [Reason-code]
- ReturnCode
 - [NotifiedEntity]

RestartMethod

- Forced**
- Restart**
- Disconnected**
- Graceful**



Usage of Commands

- AuditEndPoint()

- EndpointId
- [RequestedInfo]

- ReturnCode

- EndPointIdList

{RequestedEvents

DigitMap

SignalRequests

RequestIdentifier, ... }

**If EndpointId is
“wildcard”,
EndPointIdList is returned**

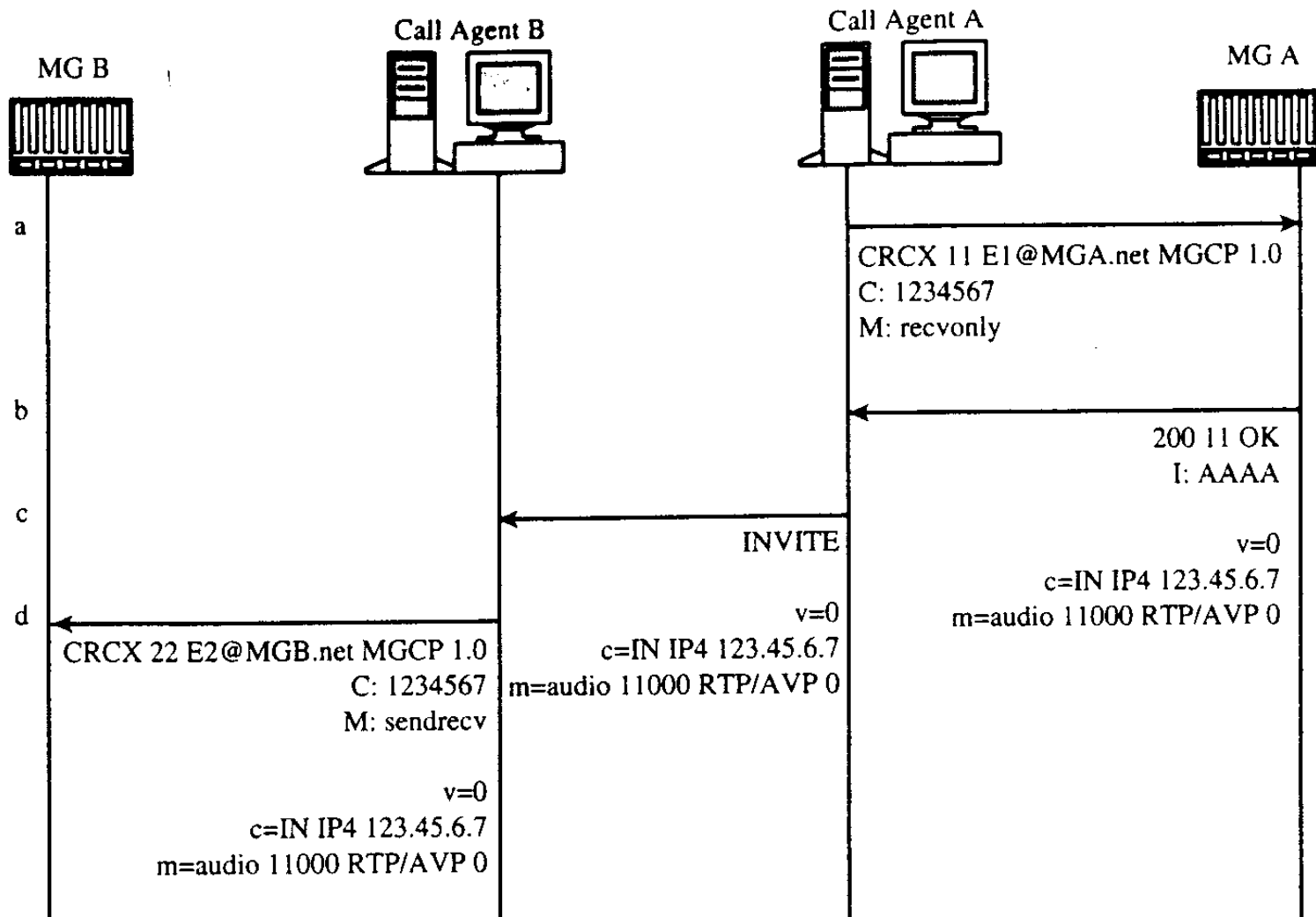


Usage of Commands

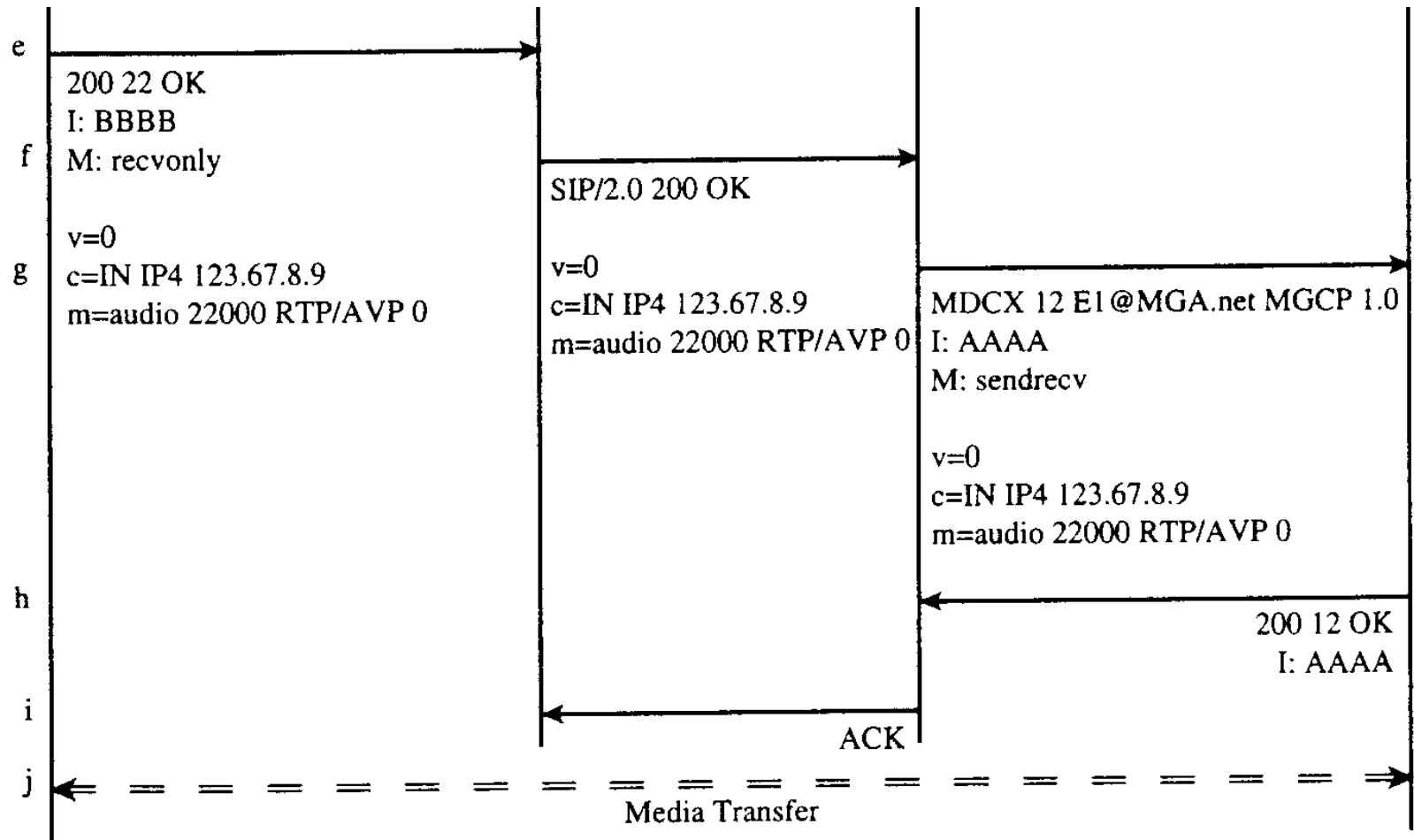
- AuditConnection()
 - ConnectionId
 - RequestedInfo
- ReturnCode
 - CallId
 - NotifiedEntity
 - LocalConnectionOptions ...

“Wildcard” shall not be used

Interworking between MGCP and SIP



Interworking between MGCP and SIP





MEGACO/H.248



MEGACO Connection Model

	MGCP	MEGACO
1	Endpoint	Termination
2	Connection	Context
3	Call Agent (CA)	Media Gateway Controller (MGC)

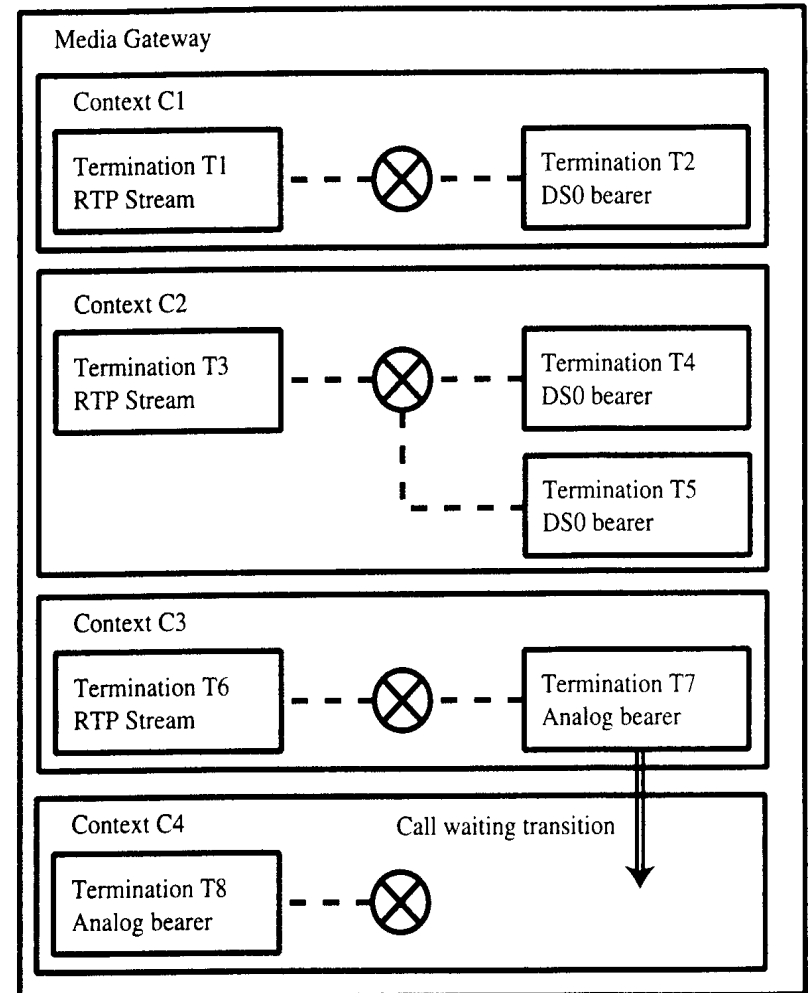


MEGACO Termination

- A logical entity on a MG
 - that sources/sinks media/control streams
- Termination ID
 - an arbitrary string assigned by the MG
 - at the time of their creation
- Two kinds of Termination
 - Physical Interface
 - RTP stream
- Root Termination
 - The entire MG itself

MEGACO Context

- An association between a collection of Terminations (within an media gateway)
- Context ID
 - A 32 bit integer chosen by the MG
 - * : ALL ; - : NULL; \$: Choosing one
- Null Context
 - Containing all Terminations that are not associated to any other Termination



MEGACO Connection Model

■ Media Flow

■ Topology of a Context

- describe the media flow between Terminations within a Context
- refer to **Topology Descriptor**

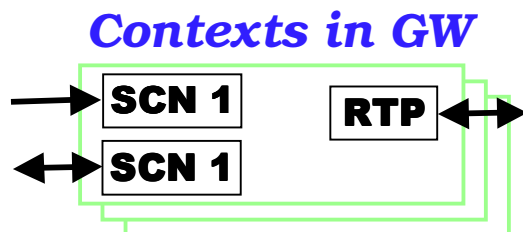
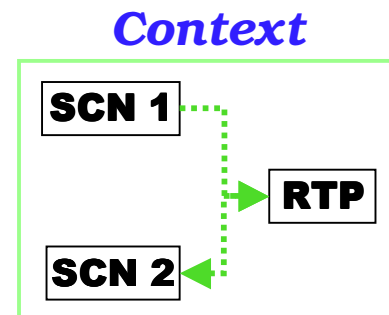
■ Mode of a Termination

- describe the media flow at the ingress/egress of the media gateway
- refer to **Media Descriptor**

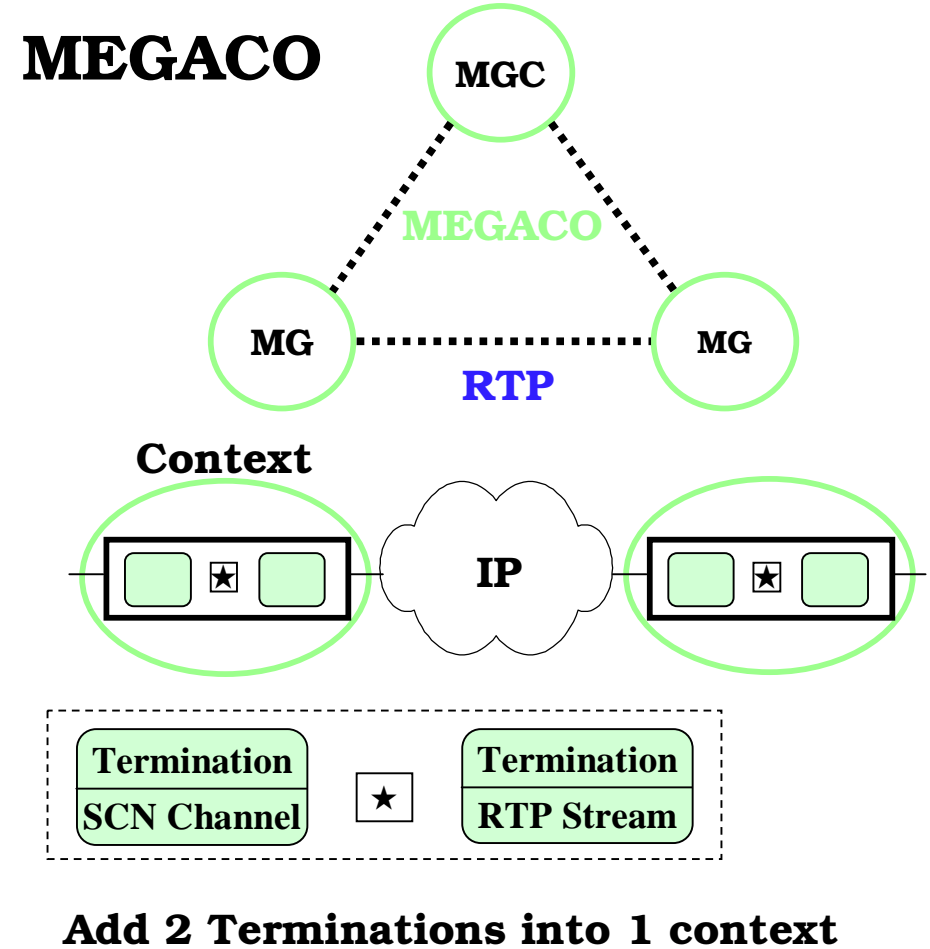
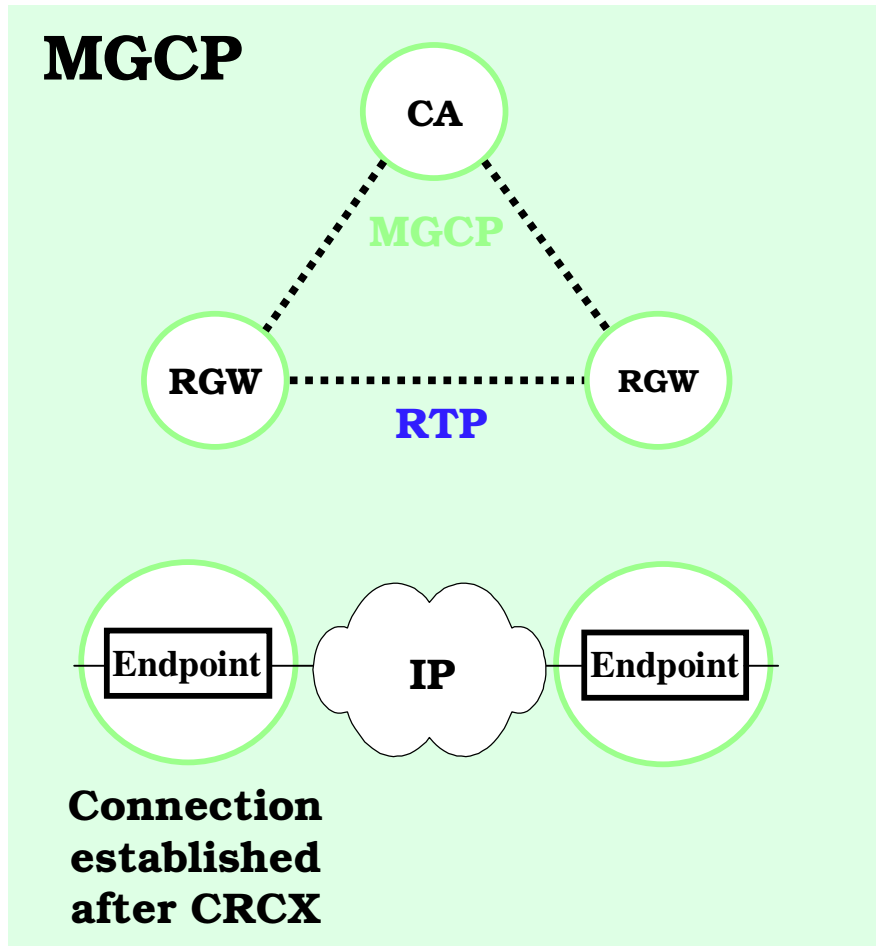
Stream Descriptor

Local Control Descriptor

(receive-only, send/receive, ...)



Concept of Context





MEGACO Command Naming

MEGACO	Similar Commands in MGCP
(1) Add (Termination to Context)	(1) CreateConnection (Endpoint)
(2) Modify (Termination-descriptor)	(2) ModifyConnection (Endpoint)
(3) Subtract (Termination)	(3) DeleteConnection (Endpoint)
(4) Move (Termination)	≈ CreateConnection + DeleteConnection
(5) AuditValue (Termination-cur)	(4) AuditEndpoint
(6) AuditCapability (Termination)	(NONE)
(7) Notify (Termination)	(5) Notify (Endpoint)
(8) ServiceChange (Termination)	(6) RestartInProgress (Endpoint)
(NONE)	(7) AuditConnection
⊃ Add, Modify, Move	(8) NotificationRequest (Endpoint)
⊃ Add, Modify, Move	(9) EndpointConfiguration (Endpoint-encode)



Transaction & Message

- Transaction
 - Multiple commands can be grouped.
 - Commands are executed in sequence
 - If a command fails, the subsequent commands are not processed
 - Not the case for optional commands
 - O-”command-name”
- Messages
 - Concatenate multiple transactions
 - The transactions are treated independently

MEGACO Transactions

Transaction

Action 1 for One Context

Command
1

Command
2

Command
3

Action 2 for the Other Context

Command
1

Action 3 for Another Context

Command
1

Command
2

MGC to MG1:

MEGACO/1 [123.123.123.41]:5555

Transaction = 10003 {

```
Context = $ {  
  Add = A4444,  
  Add = $ {  
    Media {  
      Stream = 1 {  
        LocalControl {  
          ...}  
        Local {  
          v=0  
          c=IN IP4 $  
          m= audio $ RTP/AVP 4  
          ...  
        }  
      }  
    }  
  }  
}
```




Descriptors

- To form the parameters of the commands/ responses
- To provide additional information to qualify a given command/response
- Termination Descriptors
- Context Descriptors

Termination Descriptors

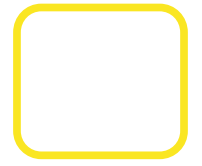
Transaction

Action 1 for One Context

Topology Descriptor

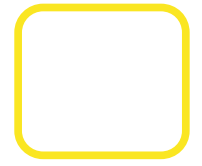
Command

1



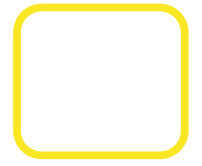
Command

2



Command

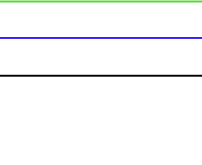
3



Action 2 for Another Context

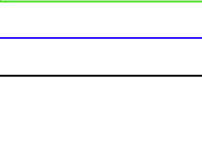
Command

1



Command

2



Media Descriptors

Modem Descriptors

MUX Descriptors

Events Descriptors

Signals Descriptors

Digit Map Descriptors

Audit Descriptors (no reply)

Service Change Descriptors

Observed Events Descriptors

Event Buffer Descriptors

Statistics Descriptors

Error Descriptors



Media Descriptor

- Describe the various media streams
- A hierarchical descriptor

Media descriptor

Termination state descriptor

Stream descriptor

Local control descriptor

Local descriptor

Remote descriptor



Termination State Descriptor

- ServiceStates
 - To indicate whether the termination is available for use
 - “test”, “out of service”, “in service”
- EventBufferControl
 - To specify whether events detected by the termination are to be buffered following detection or processed immediately
- Other properties of a termination that are not specific to any media stream



Stream Descriptor

- Stream ID
- LocalControlDescriptor
 - **Mode**: sendonly, receiveonly, sendreceive, inactive, and loopback
 - With respect to the exterior of the context
 - MGC specifies a set of choices for the session
 - **ReserveGroup** and **ReserveValue** indicate the resources should be reserved
- LocalDescriptor and Remote Descriptor
 - Usage of SDP



Event & Signal Descriptors

- Event Descriptor
 - RequestIdentifier
 - A list of events that the MG should detect and report
- Signal Descriptor
 - On/off
 - Timeout
 - Brief



ServiceChange Descriptor

- Used only in association with the ServiceChange command
- ServiceChangeMethod (The type of service change)
 - Graceful, the removal of existing terminations w/o interrupting existing connections
 - Forced, an abrupt removal
 - Restart, after a specified delay
 - Disconnected, applied to the entire MG
 - Handoff, from the old MGC; a new MGC is taking over
 - Failover, from MG to MGC
- ServiceChangeDelay, a number of seconds
- ServiceChangeReason



DigitMap Descriptor

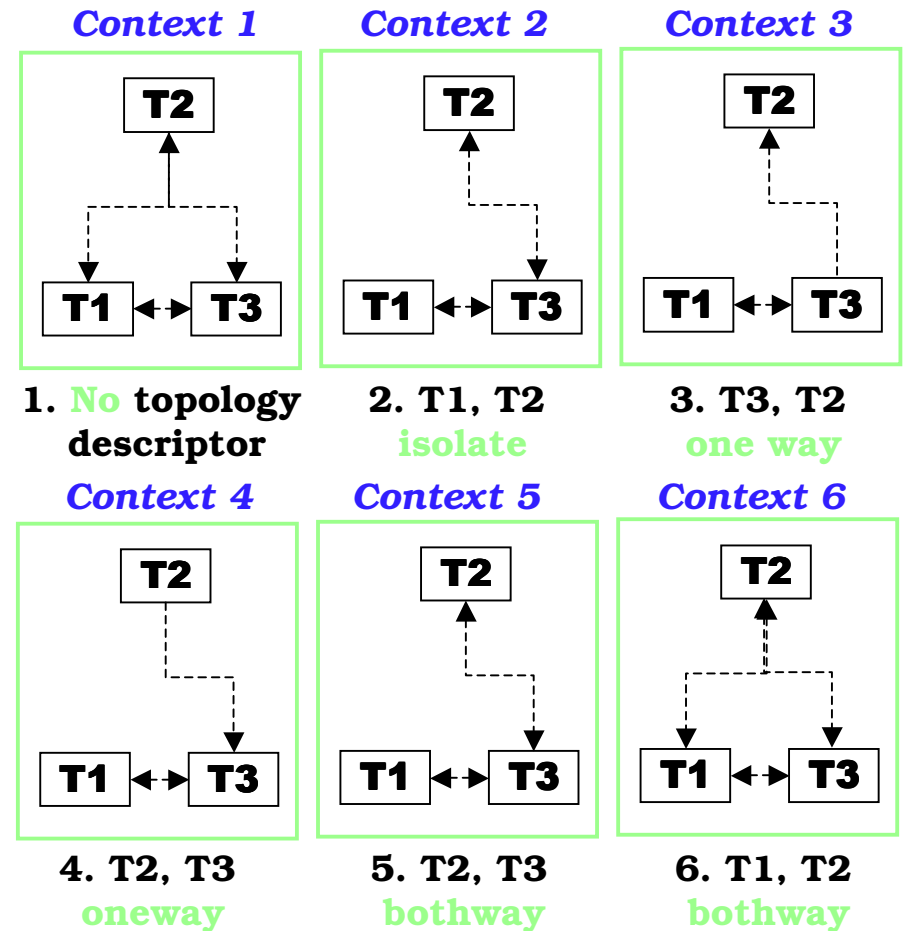
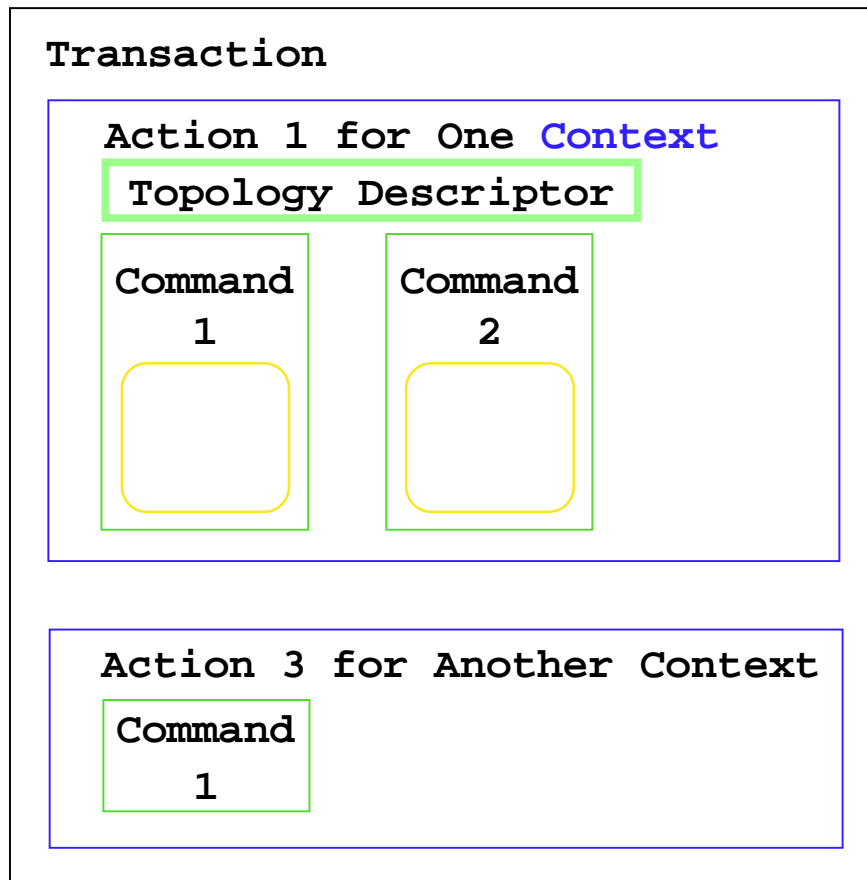
- A dialing plan
- A start timer, to start
- A short timer, when more digits are needed
- A long timer, to differentiate different routing

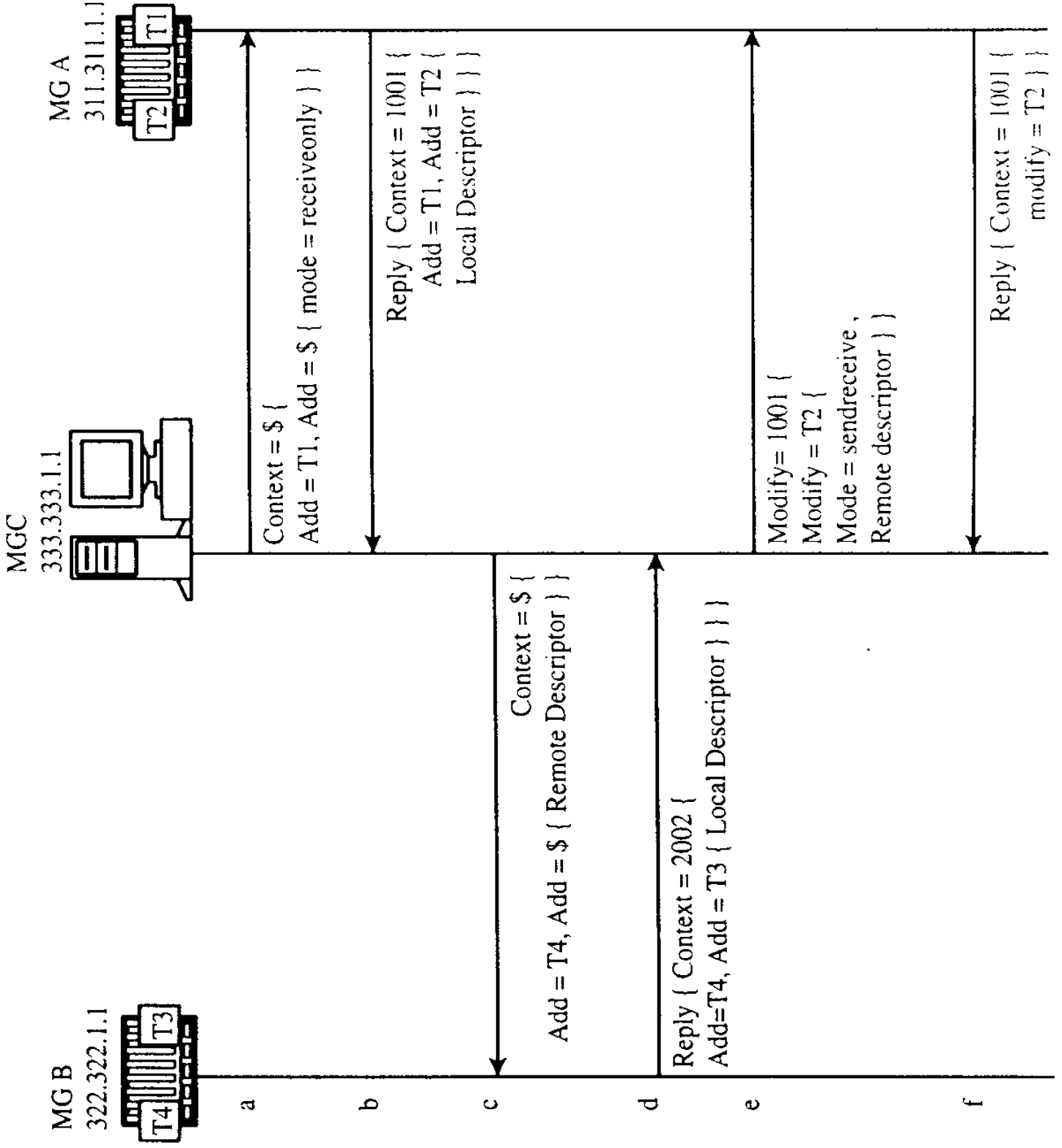


ObservedEvents Descriptor

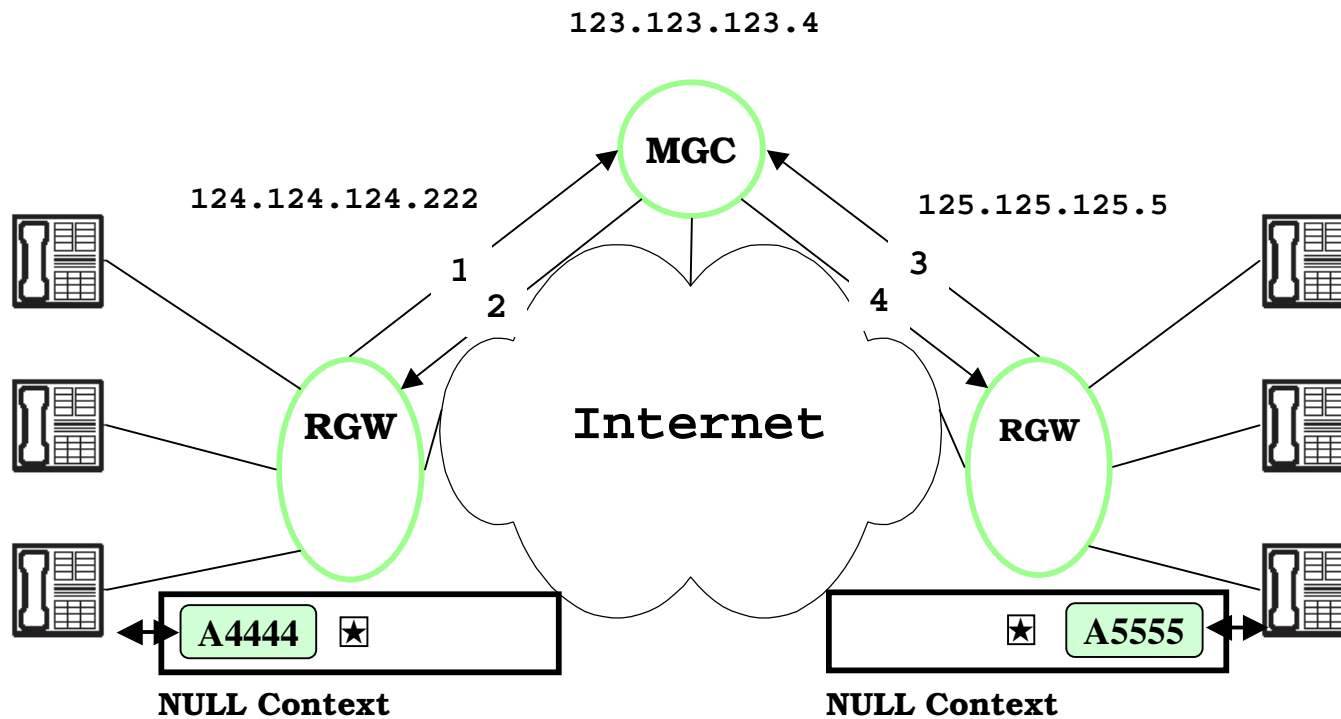
- Mandatory in the Notify command
 - RequestIdentifier
 - Optional time-stamp for each observed event
- Except for the response of a ServiceChange command
- In a response to the AuditValue command
 - Events stored in the event buffer

Context Descriptors





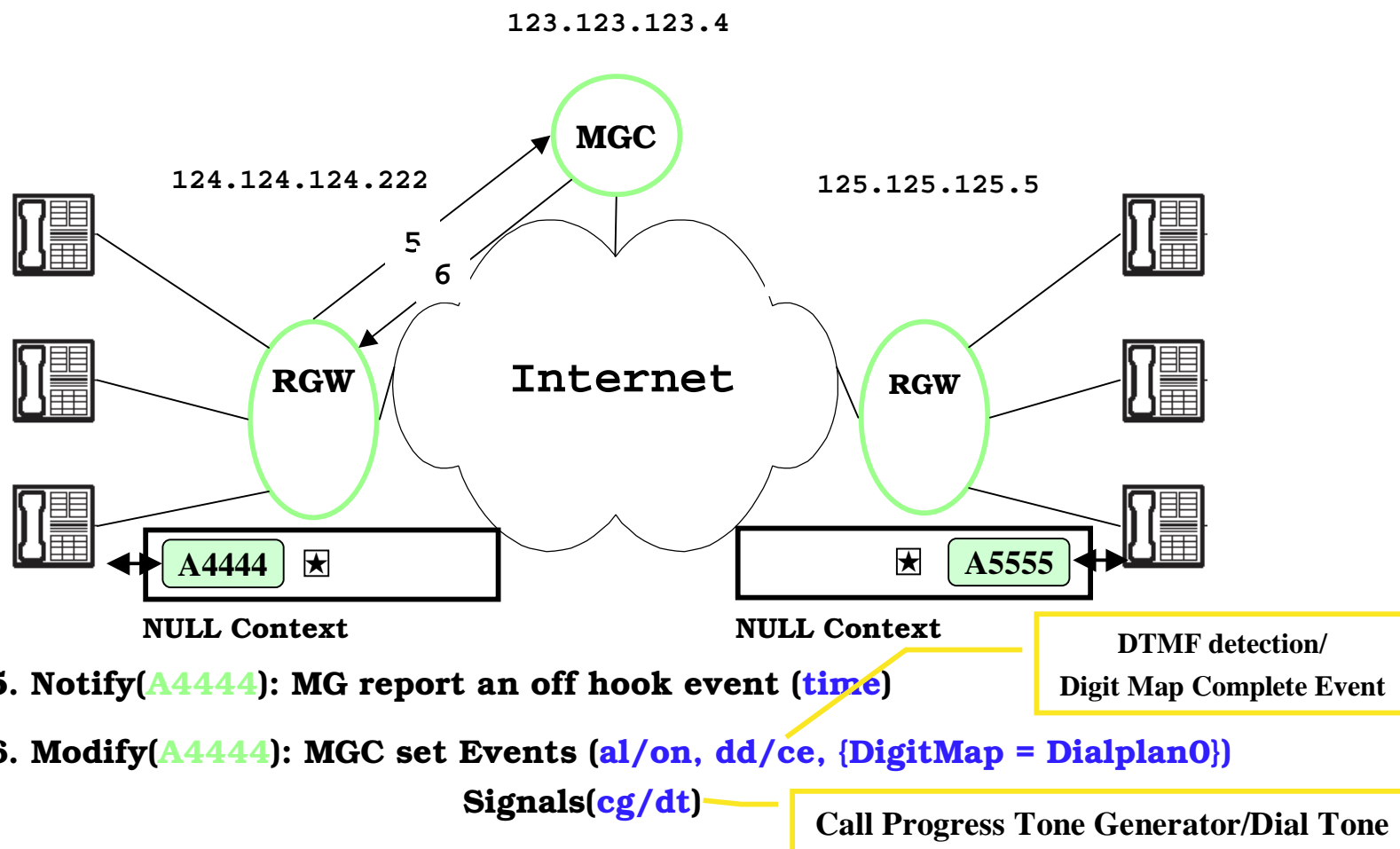
Call Flow: RGW to RGW



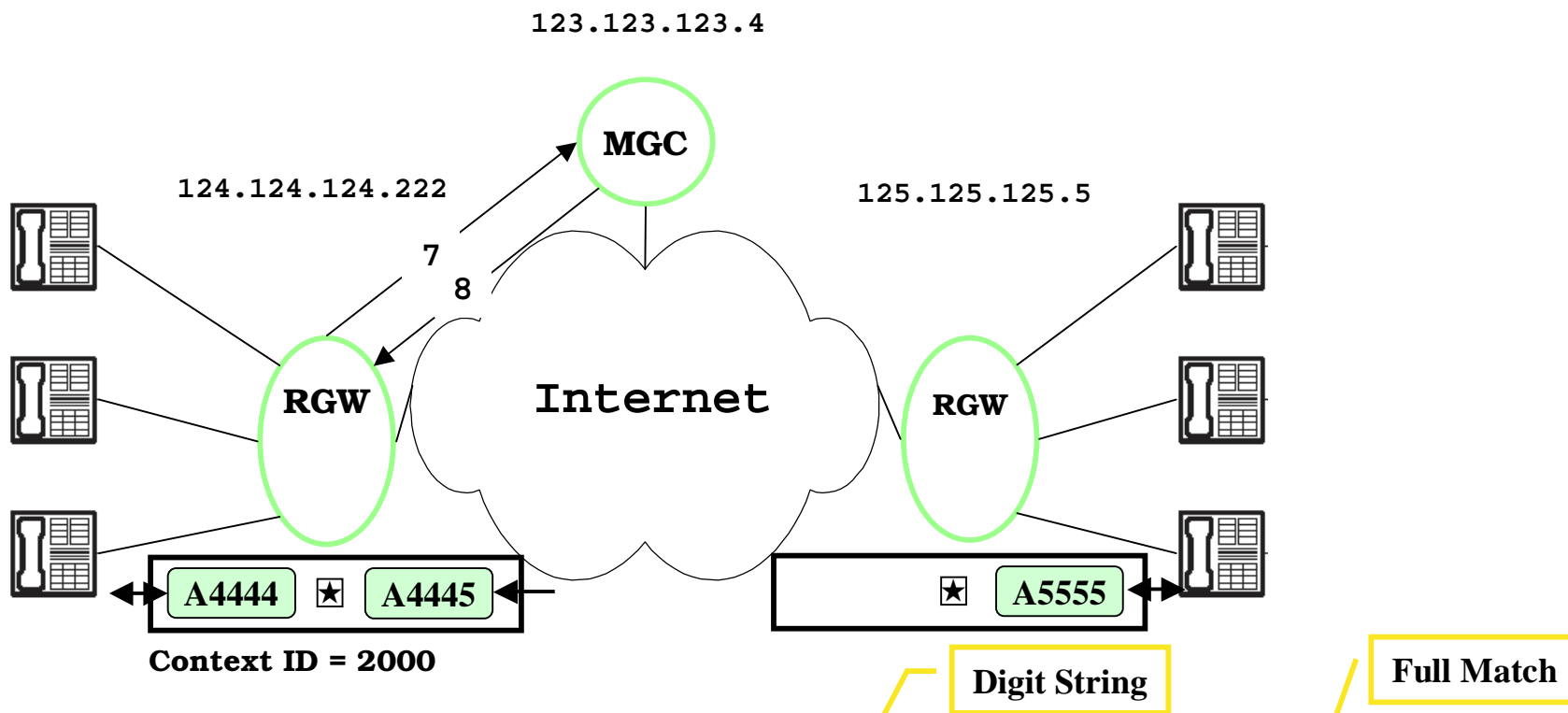
1.(3) **ServiceChange(ROOT)**: MG register with MGW

2.(4) **Modify(A4444)**: MGW set Mode(SendReceive) & Events(al/of)

Call Flow: RGW to RGW



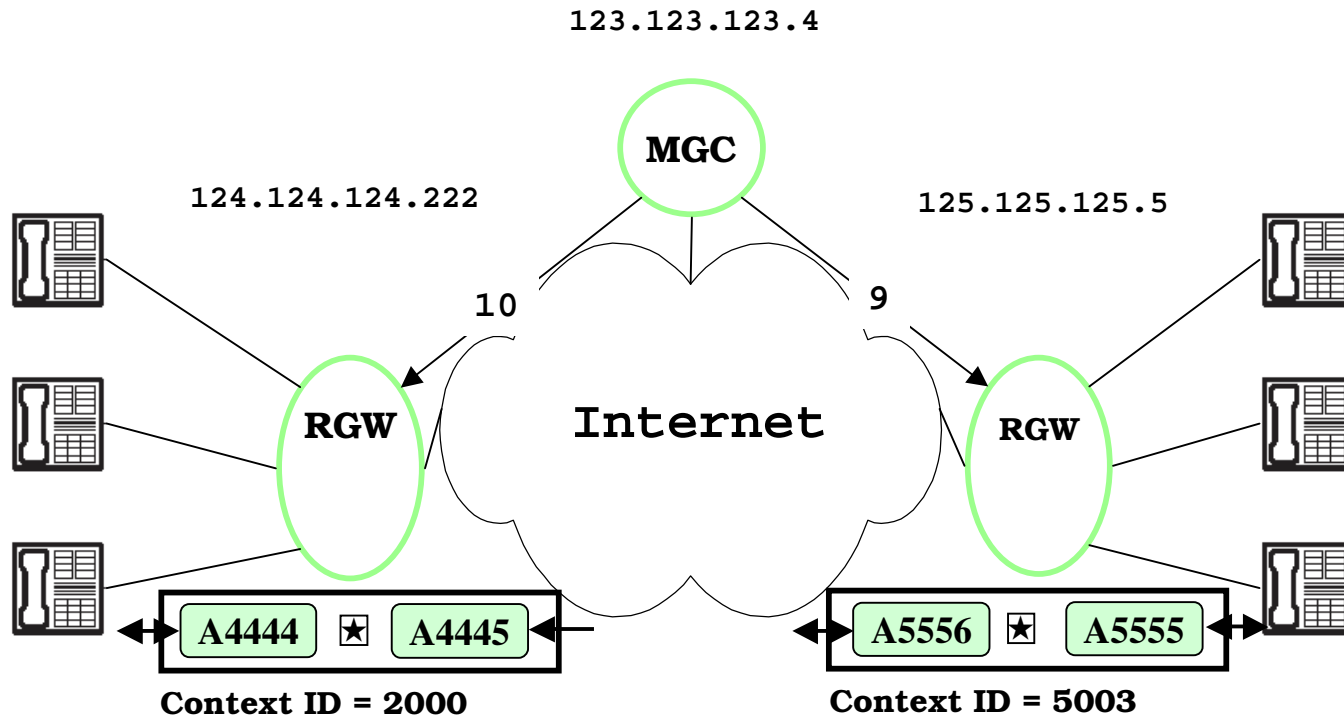
Call Flow: RGW to RGW



7. Notify(A4444): MG report a Digit Map Complete event(ds=916135551212,Meth=FM)

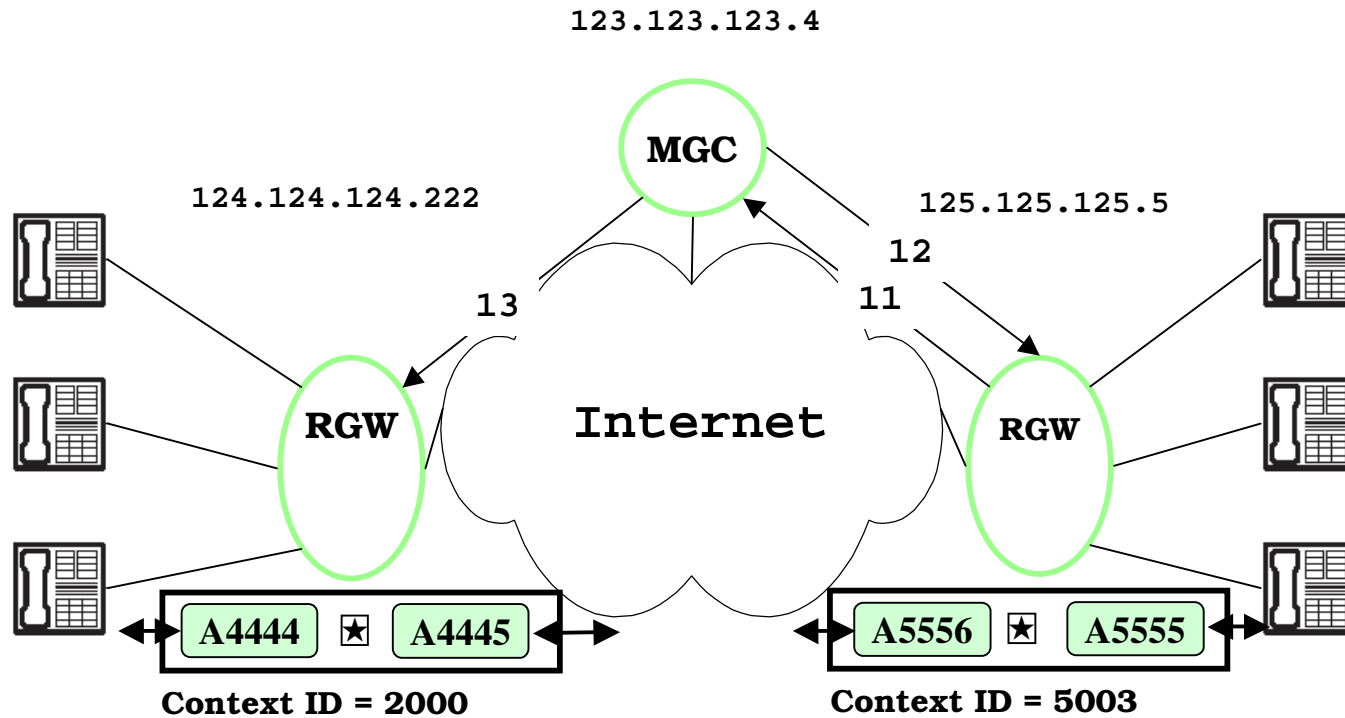
8. Add(A4444,\$:Mode(ReceiveOnly), Local(RTP))

Call Flow: RGW to RGW



9. Add(A5555: Mode(SendReceive), Events(al/of), Signals(al/ri),
\$: Mode(SendReceive), Local(RTP), Remote(...))
10. Modify(A4444: Signals(cg/rt), A4445: Remote(...))

Call Flow: RGW to RGW



11. Notify(A5555: Observed(al/of))

12. Modify(A5555: Events(al/on), Signals()); to turn off ringing

13. Modify(A4445: Mode(SendReceive), A4444: Signals())