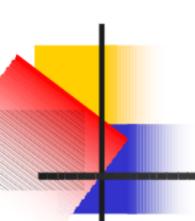




Media Gateway Control and the Softswitch Architecture

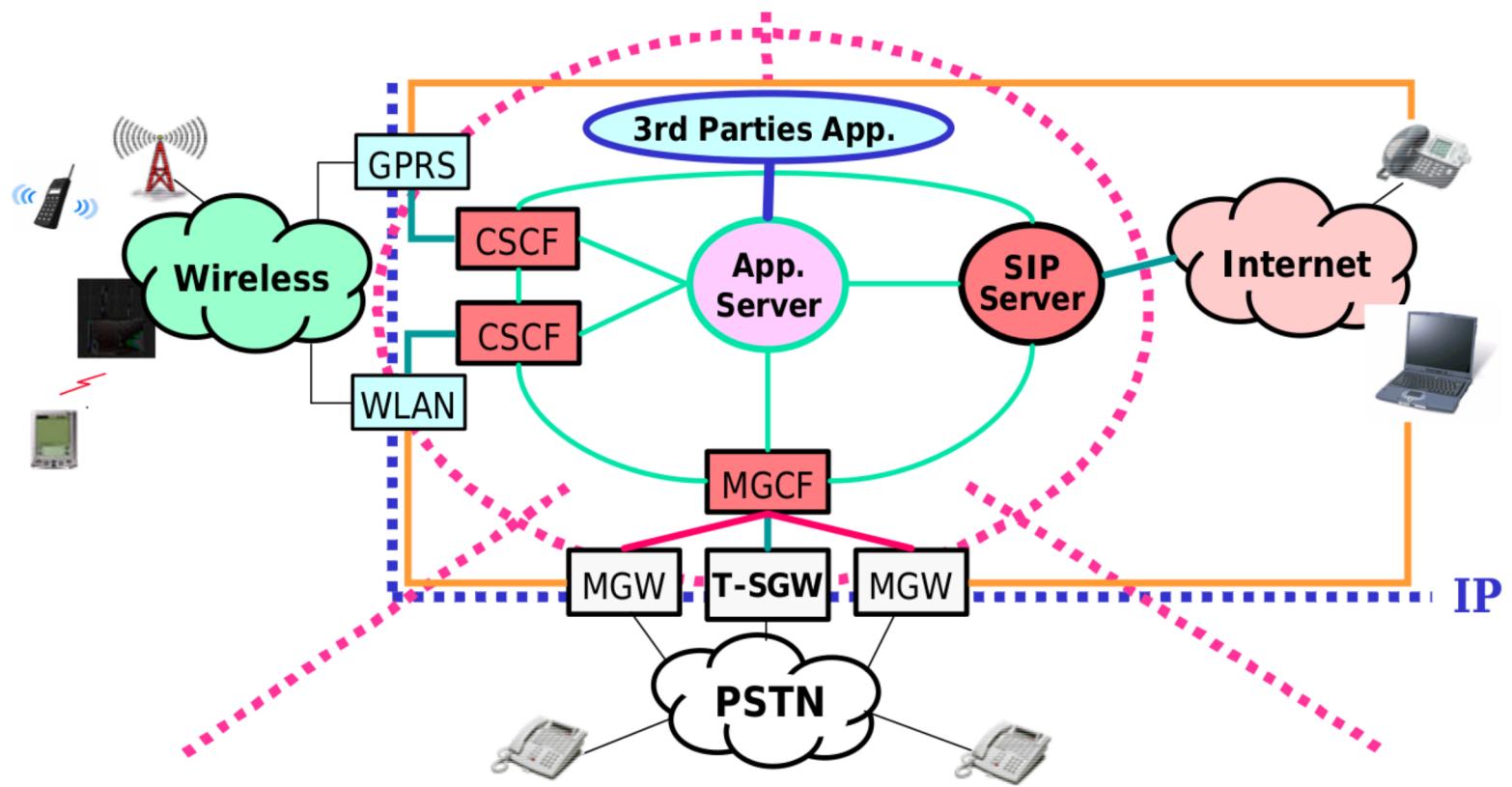


Outline

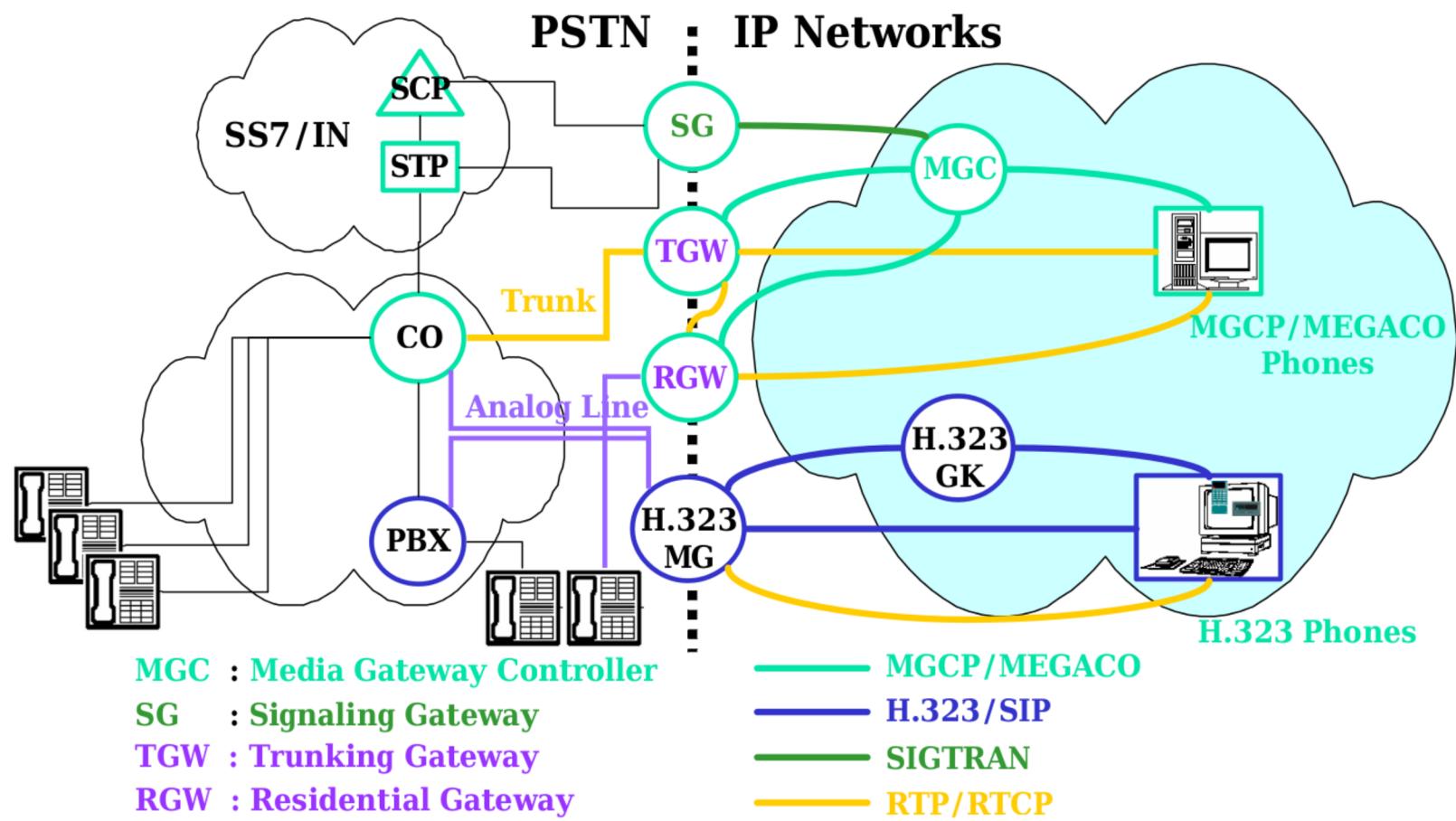
- Introduction
- Softswitch
 - Softswitch Architecture
 - Softswitch Operations
- Media Gateway Control Protocols
 - MGCP
 - MEGACO

Next Generation Network

- Internet Telecom & Wireless Communication



Gateways in Next Generation Networks



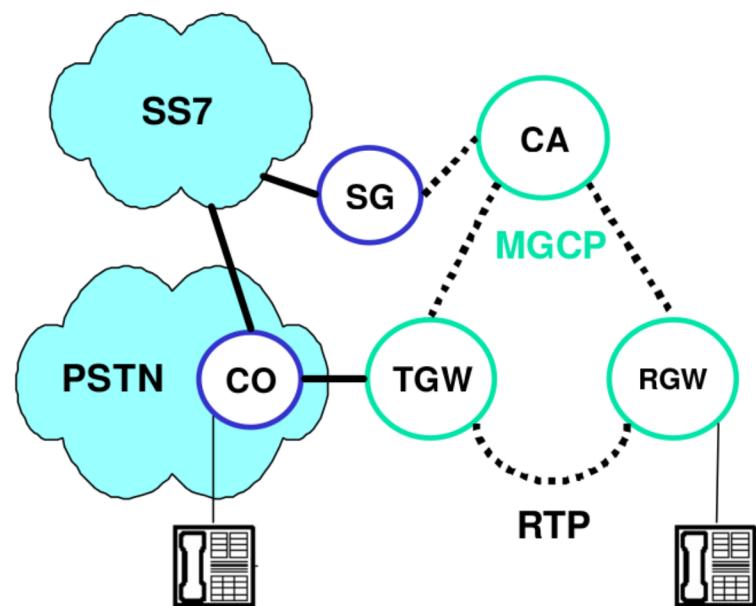
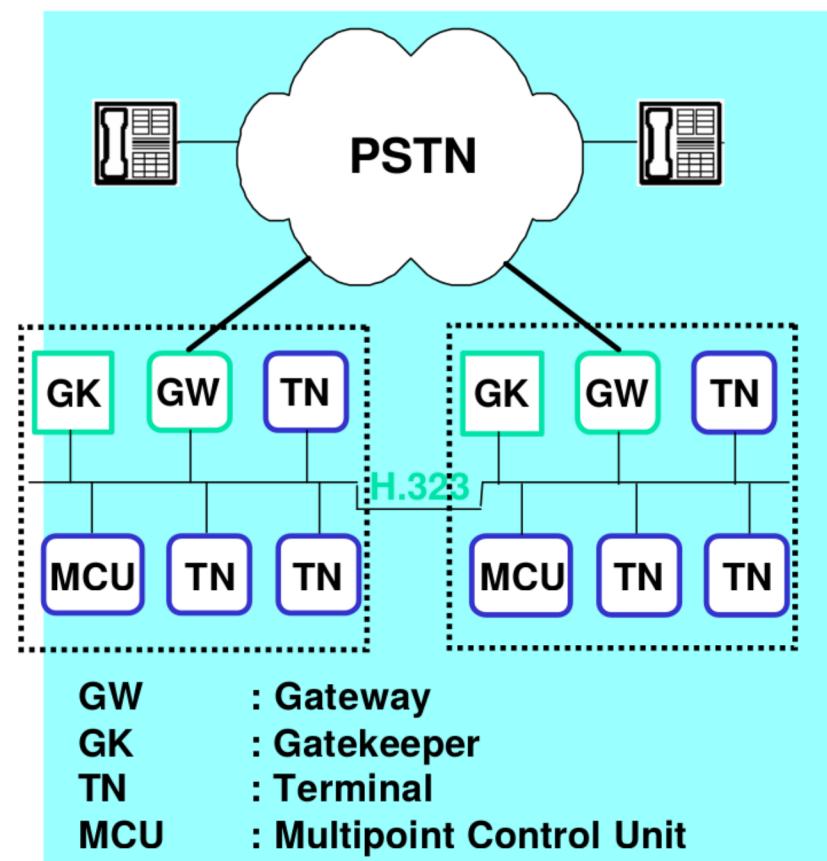
MGC : Media Gateway Controller

SG : Signaling Gateway

TGW : Trunking Gateway

RGW : Residential Gateway

H323, SIP & MGCP, MEGACO



Legend:

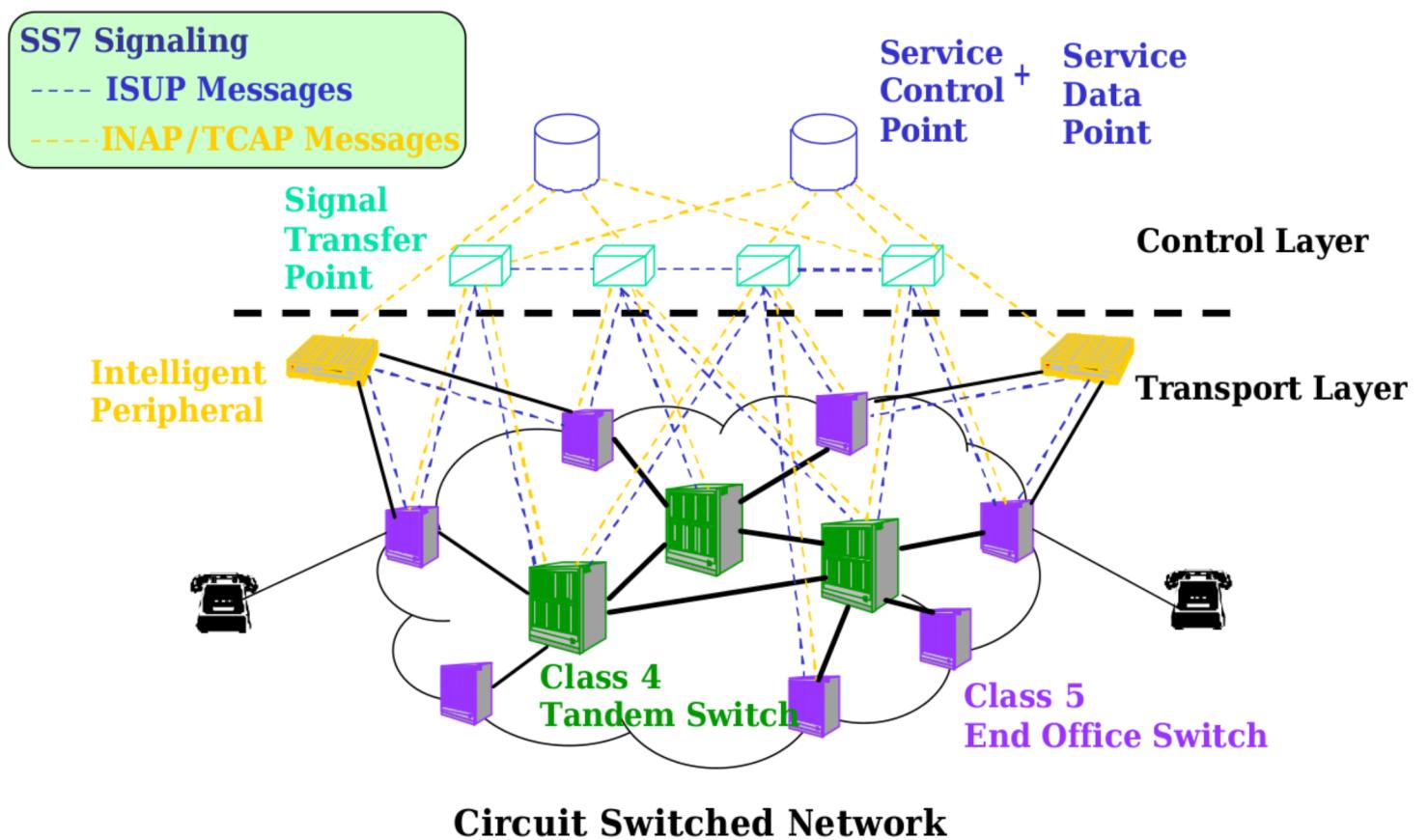
- CA : Call Agent
- TGW : Trunking Gateway
- RGW : Residential Gateway
- SG : Singling Gateway



H323, SIP & MGCP/MEGACO

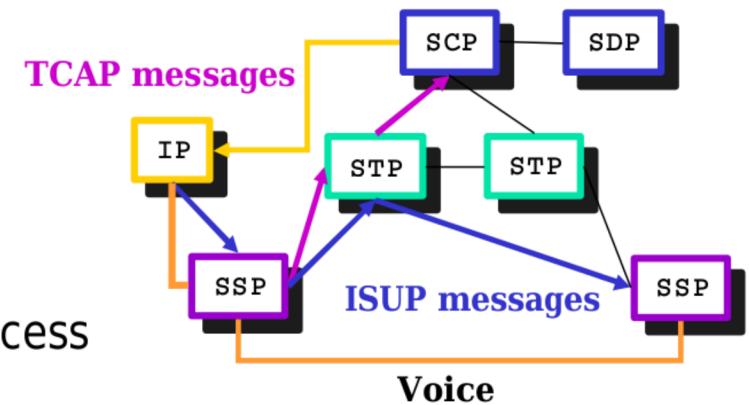
- H.323 , SIP
 - peer-to-peer
 - internet oriented
 - intelligent endpoint
 - optional GK
 - decentralized
- Problems
 - maintenance
 - cost & scalability of large systems
 - signaling & media control are coupled
 - interoperability with SS7
- MGCP/MEGACO
 - client-server
 - traditional telephony
 - intelligent server
 - “dumb” terminal
 - centralized
- Concept
 - gateway decomposed
 - separate call control from media ports
 - CA (MGC), MG, SG
 - interoperability with PSTN

The Telephone Network [1/2]



The Telephone Network [2/2]

- 5 Basic Components in Intelligent Networks
 - SSP/Service Switching Point
 - switching, signaling, routing, service invocation
 - STP/Service Transfer Point
 - signaling, routing
 - SCP/Service Control Point
 - service logic execution
 - SDP/Service Data Point
 - subscriber data storage, access
 - IP/Intelligent Peripheral
 - resources such as customized voice announcement, voice recognition, DTMF digit collection

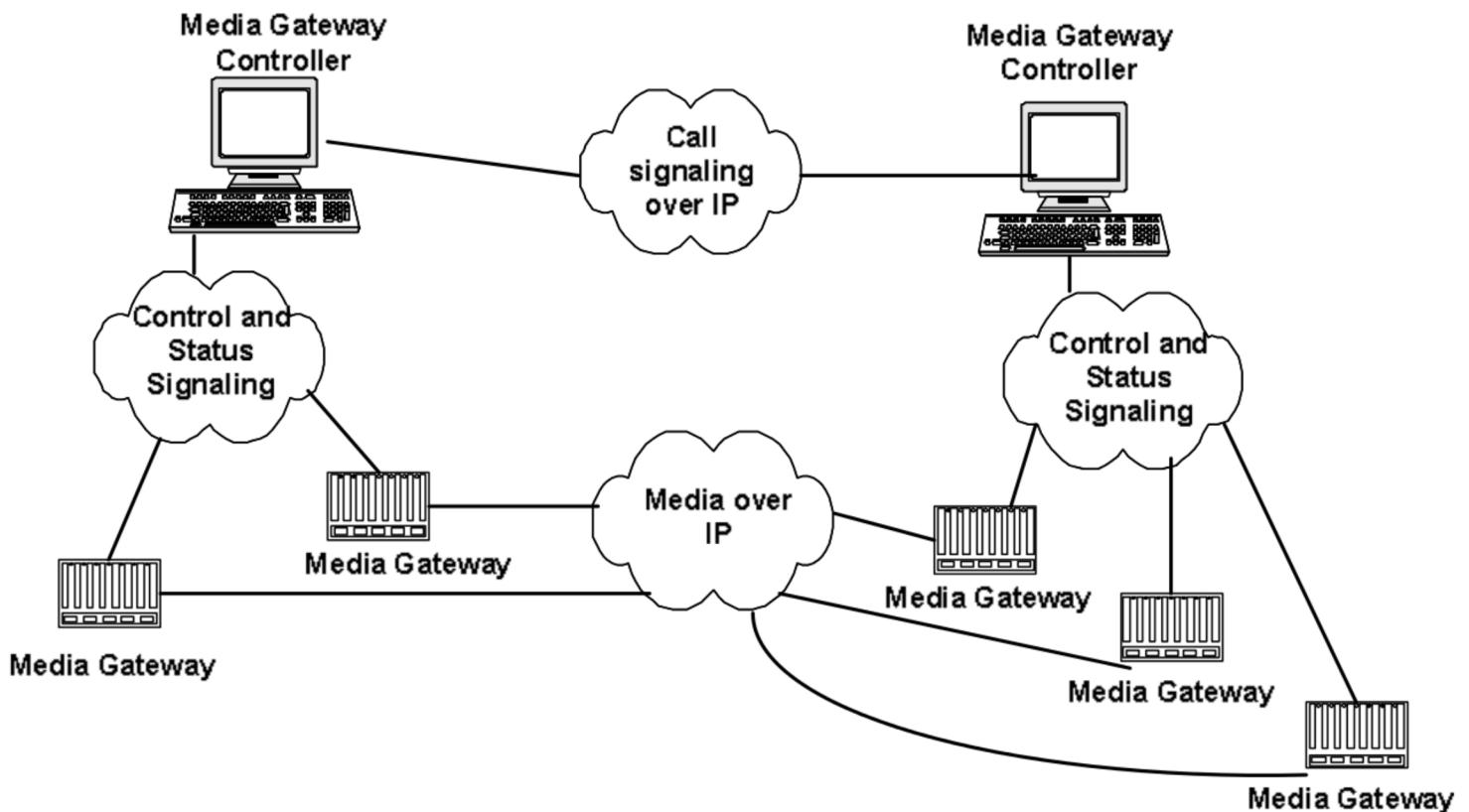




Softswitch

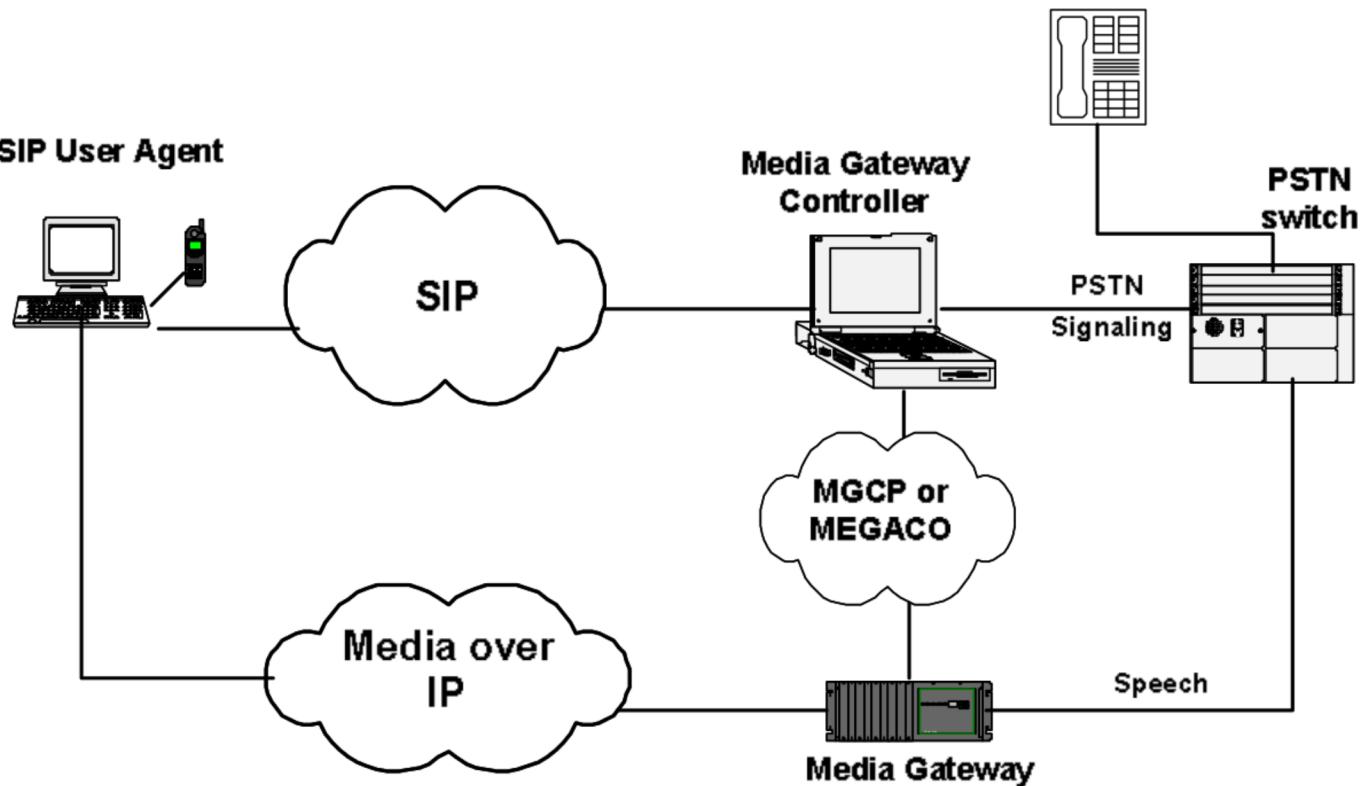
- The switching functions are handled by software
- International Softswitch Consortium (ISC)
 - www.softswitch.org
 - To promote the softswitch concept and related technologies
- Why the softswitch approach is popular?
 - A distributed architecture
 - For network operators
 - It is possible to use different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

Abstract Softswitch Architecture



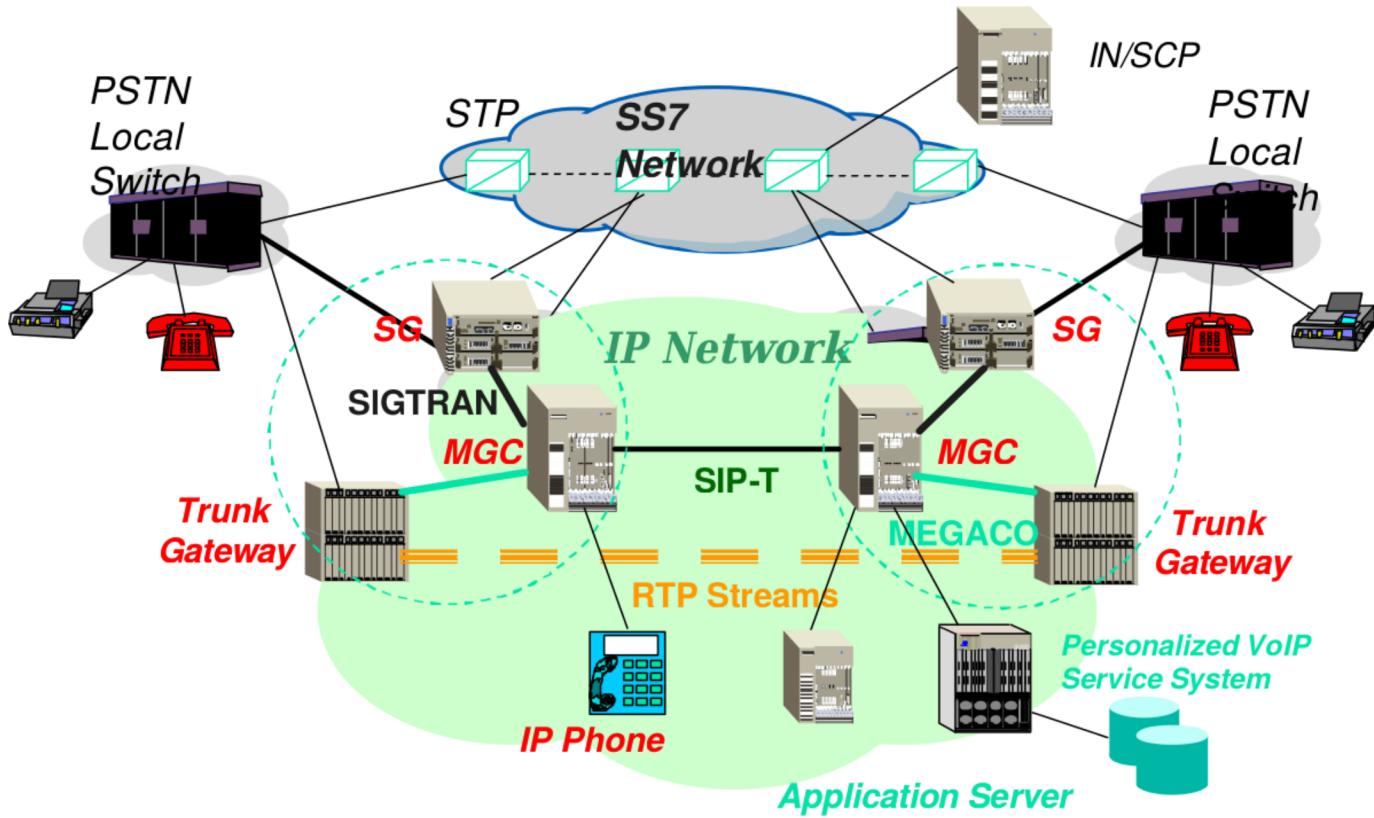
Softswitch/PSTN Interworking

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



Softswitch Overview [1/3]

- Softswitch: Emulating Circuit Switching in Software



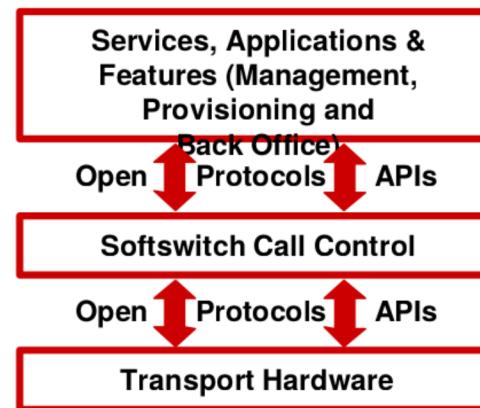
Softswitch Overview [2/3]

- Softswitch Provides Open Layered Architecture

Circuit-Switched



Soft-Switched



Open APIs for 3rd Party App develop.
Scalable, Open Interfaces for Comm.
Best-in-class Access Devices.

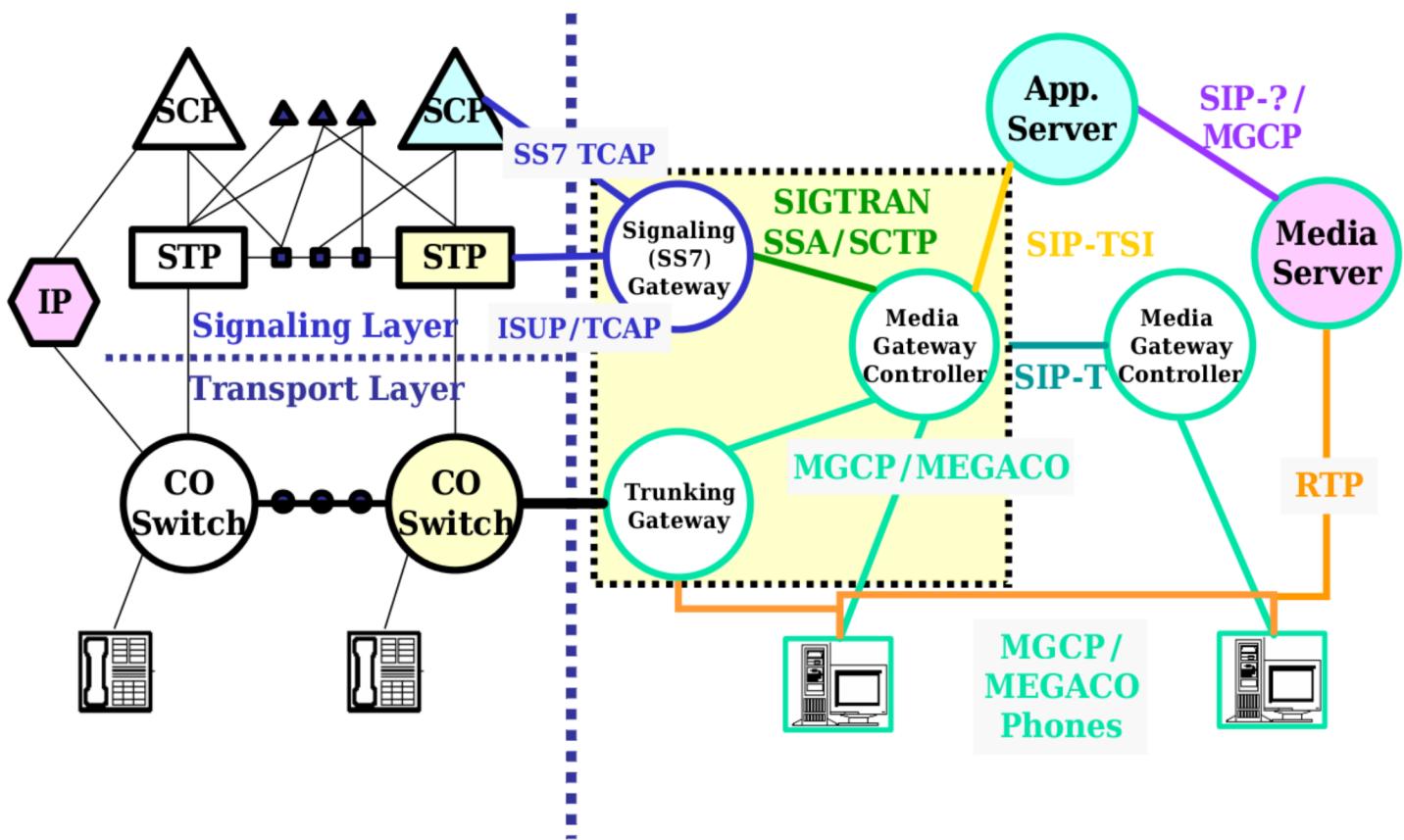
- Solutions in a proprietary box
- Expensive
- Little room for innovation

- Solutions are open standards-based
- Customers choose best-in-class products
- Open standards enable lower cost for innovation

Softswitch Overview [3/3]

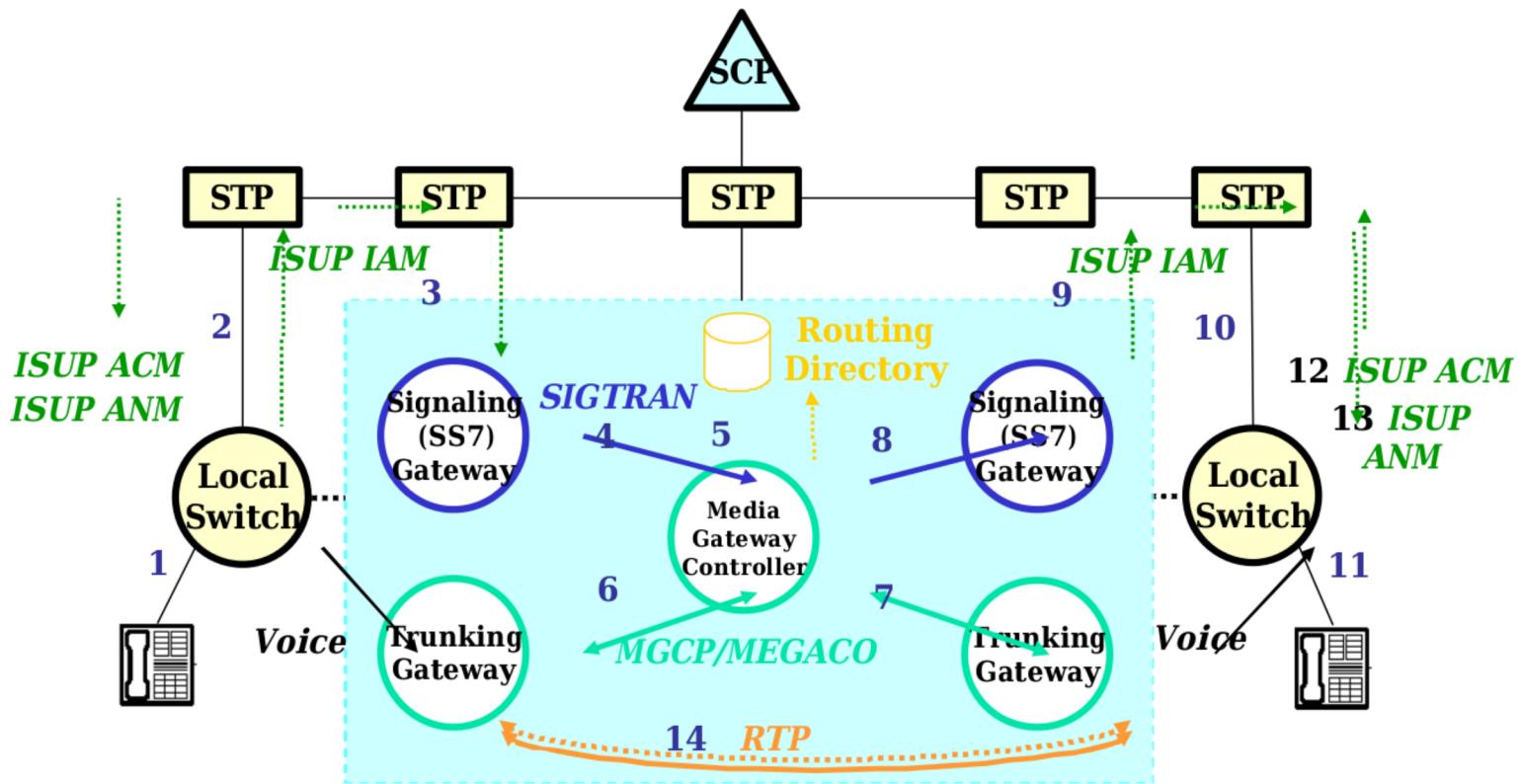
- Softswitch Changes the Telecom Landscape
 - Integration/Incorporation
 - Convergence of voice and data
 - Combination of telecom & internet technologies
 - Reuse PSTN database & IN services in packet networks
 - Multiple sources for app development & deployment
 - Decreased operating costs
 - Standardization
 - Standard interfaces (protocols) for communications
 - Open standards (APIs) for service creation
 - Customized services created by users themselves
 - Better scalability

Softswitch Architecture



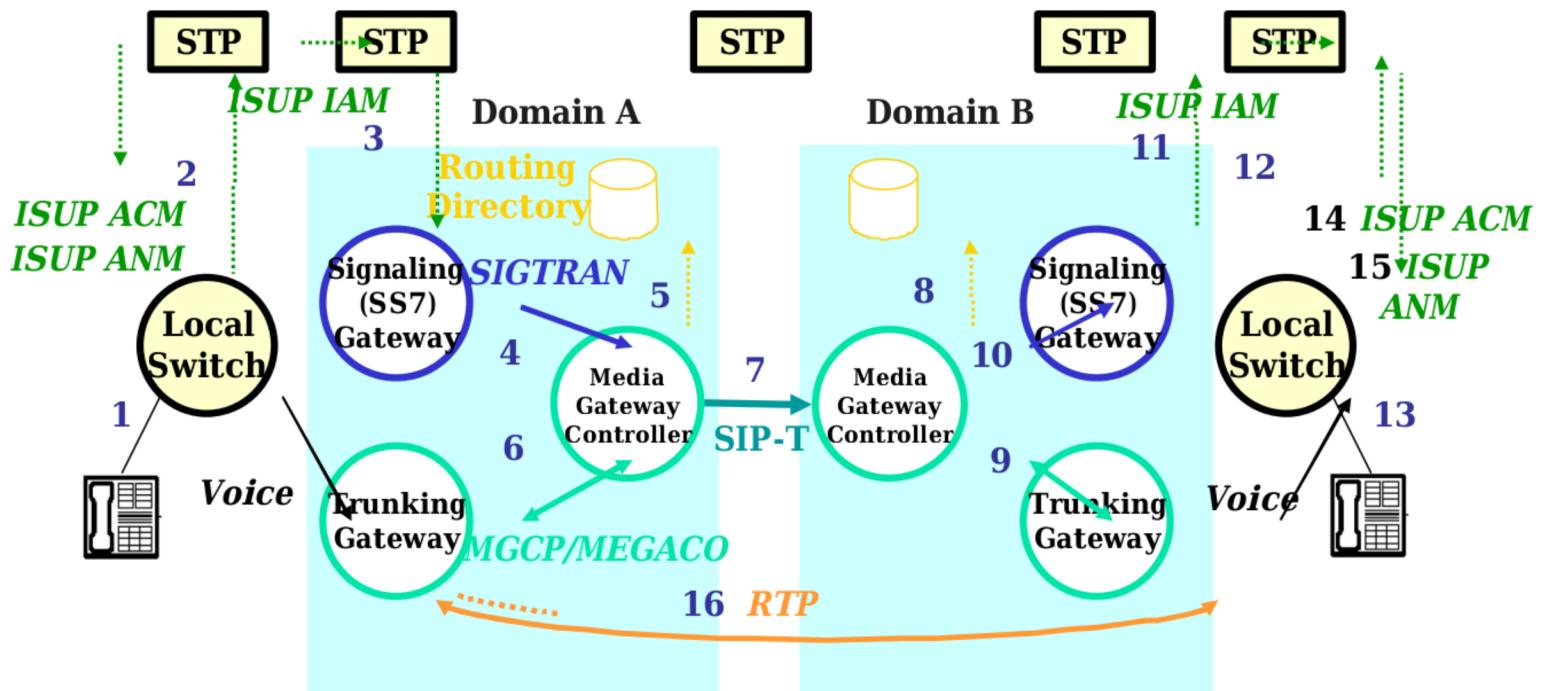
Softswitch Operations [1/3]

■ Basic Call Control



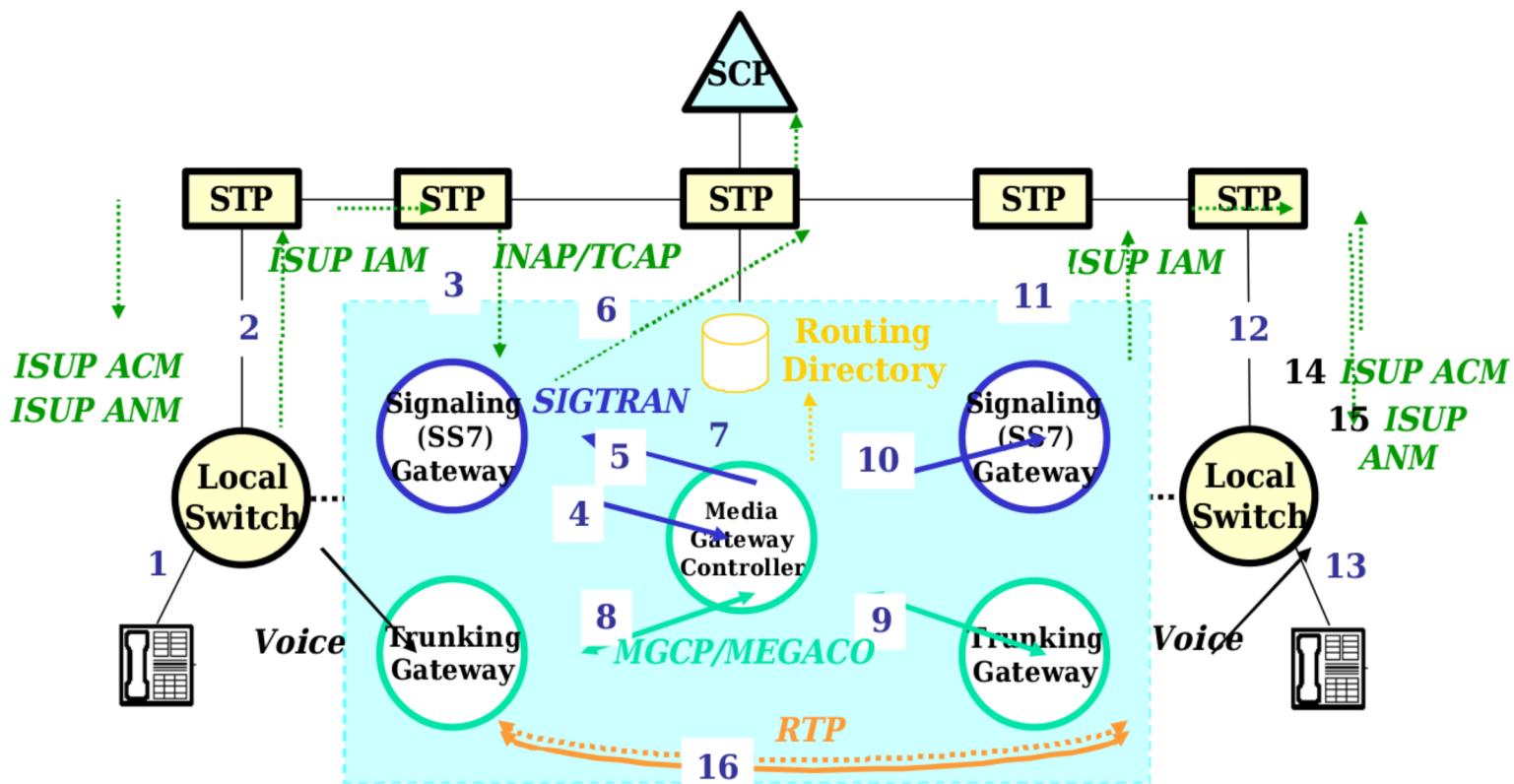
Softswitch Operations [2/3]

■ Inter-Softswitch Communications



Softswitch Operations [3/3]

■ IP-PSTN Interworking for IN Services





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

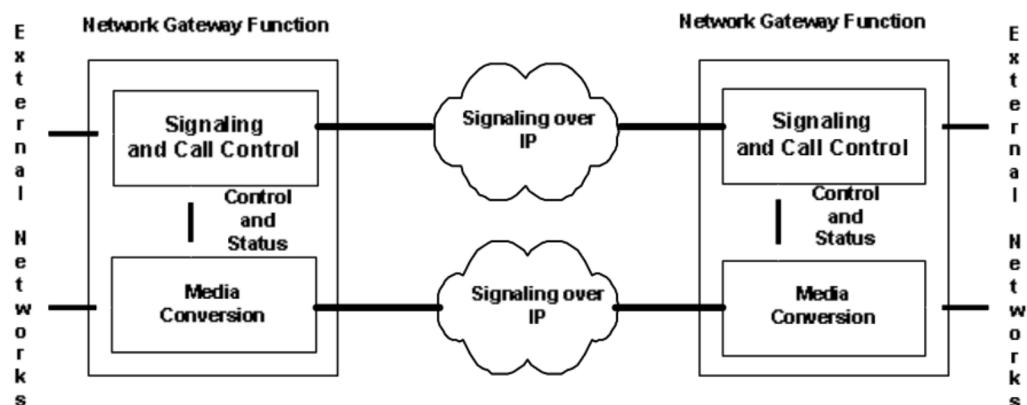


Separation of Media and Call Control

- 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



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]

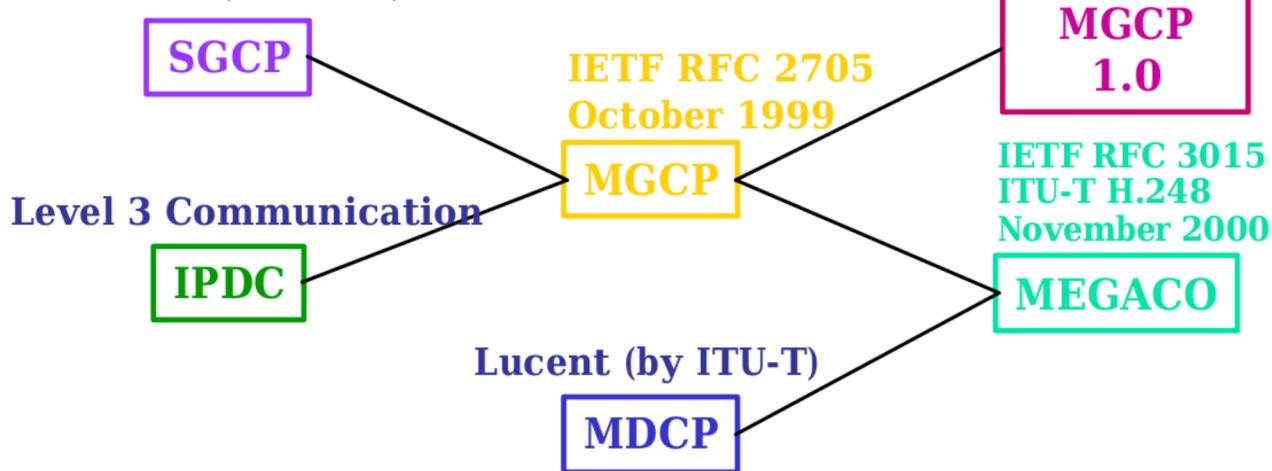
- Request the MG to apply tones or announcements
- The establishment of media streams according to certain QoS requirements
- Reporting QoS and billing/accounting statistics from an MG to an MGC
- The management of associations between an MG and an MGC
 - In the case of failure of a primary MGC
- A flexible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

Protocols for Media Gateway Control

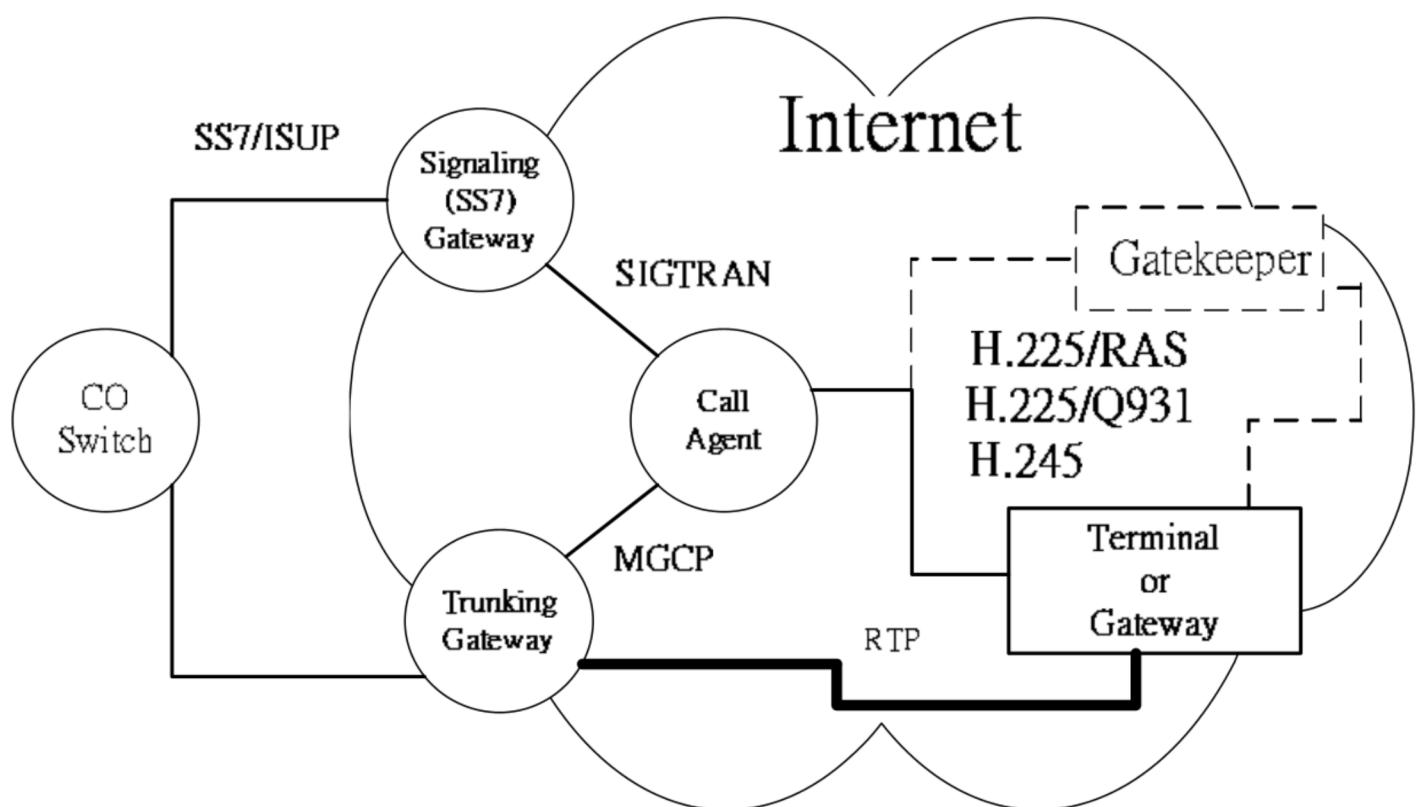
- The first protocol is MGCP
 - RFC 2705, informational
 - To be succeeded by MEGACO/H.248
 - Has been included in several product developments
- MEGACO/H.248
 - A standards-track protocol
 - RFC 3015 is now the official version.

IETF RFC 3435
January 2003

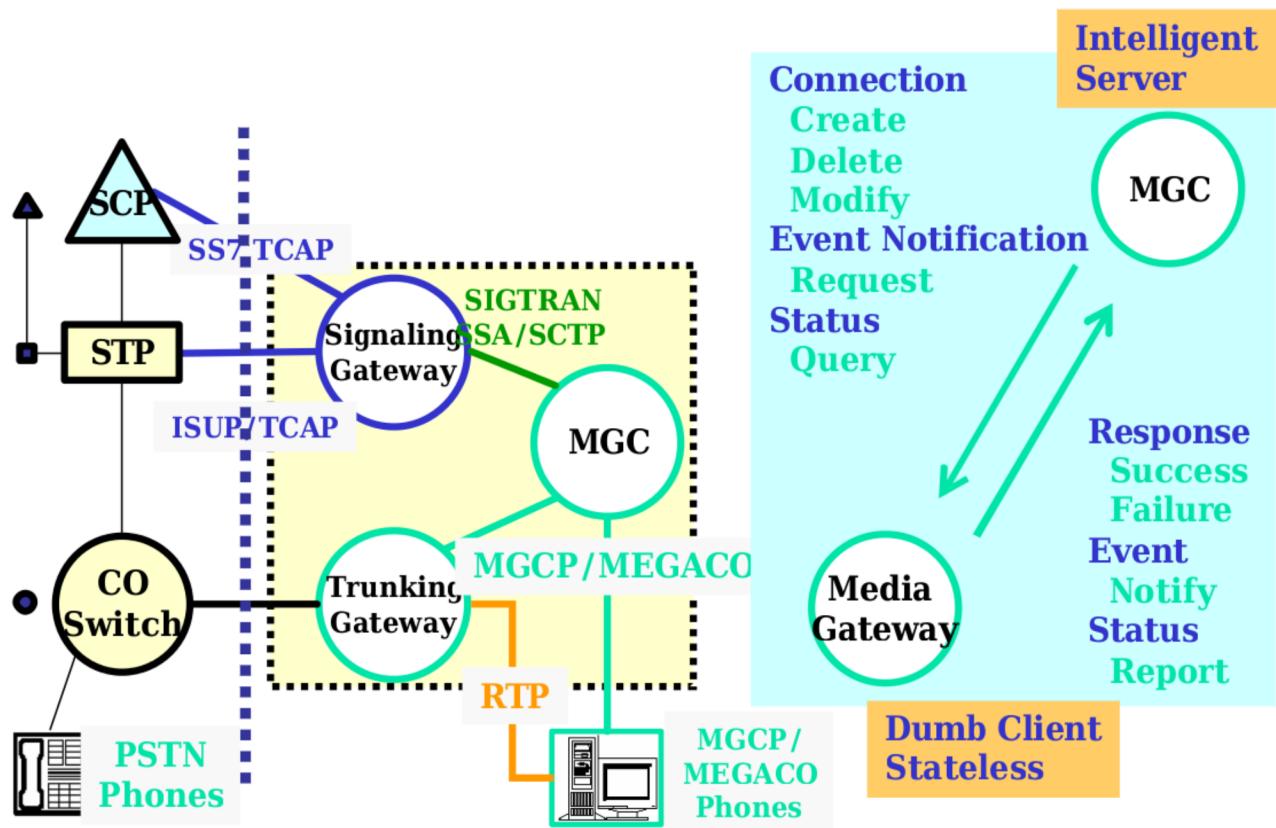
Telcordia (Bellcore)



Relation with H.323/SIP Standards



Concept of MGCP/MEGACO



- A master-slave protocol (A protocol for controlling media gateways)
 - 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 to analog/digital PBX
- 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 circuit-switched line and an RTP port on the IP side.
 - A single endpoint can have several connections



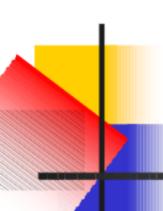
MGCP Endpoints [1/3]

- 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

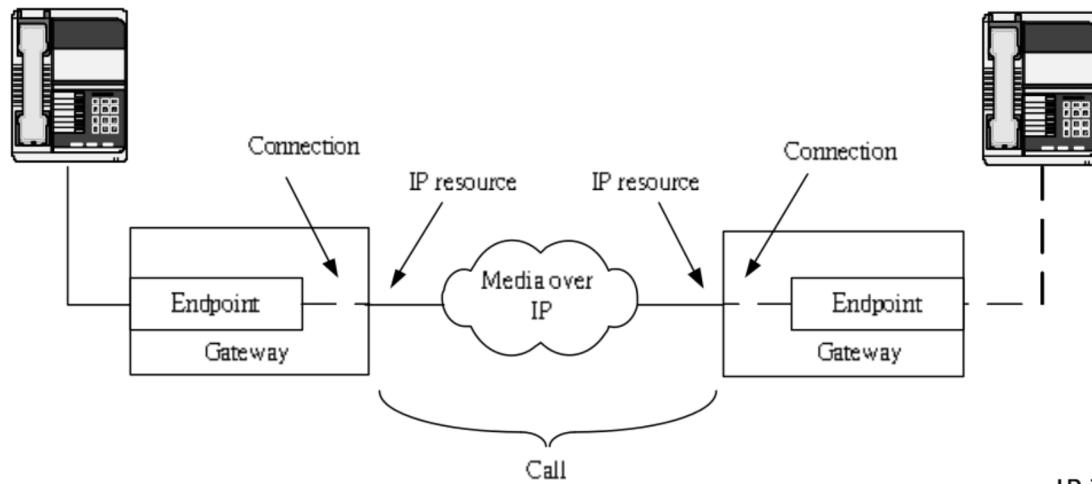


Endpoint Identifier

- 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



Calls, Connections and Call Agents

■ Call Identifier (Call ID)

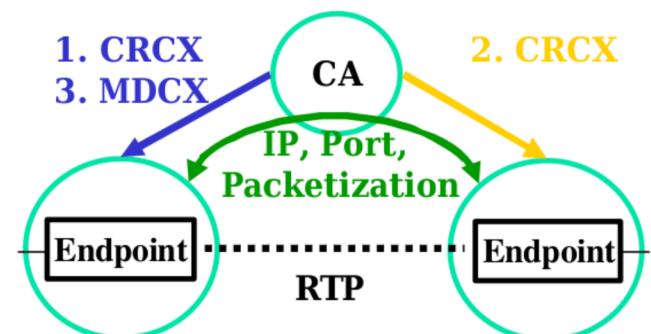
- Created by CA
- Unique within CA Scope

■ Connection ID

- Created by GW
- Unique under Its GW

■ CA Identifier (its domain name)

- Redundant CAs with a domain name: reliability





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

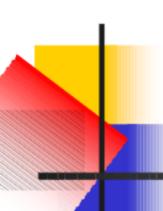
DLCX ■ DeleteConnection

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

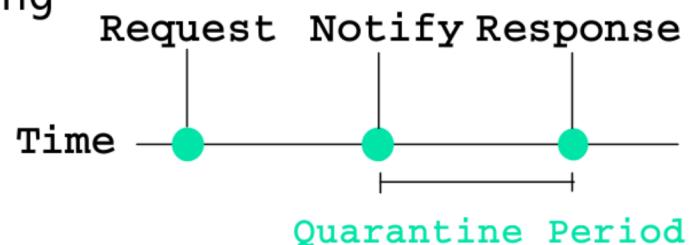
- Events & Signals
- package name(o)/event or signal name (insensitive)
 - L/hu = Hu (*if L is the default package for the endpoint*)
- packages: grouping of events & signals for a particular type of endpoints
 - Generic Media (G)
 - DTMF (D)
 - MF (M)
 - Trunk (T)
 - Line (L)
 - Handset (H)
 - RTP (R)
 - Script
 - Network Access Server (N)
 - Announcement Server (A)

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

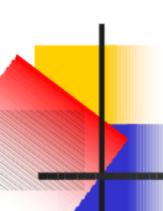
- The experimental packages have names beginning with the two character “x-”.

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|080xxxxxx|03xxxxxxxx|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



Return Code

- 100~199: provisional response
 - current being executed
- 200~299: successful completion
 - executed normally
- 400~499: transient error
 - could not be executed because of no sufficient resources at this time
 - phone already off/on hook
- 500~599: permanent error
 - endpoint unknown
 - protocol error



Protocol Description [1/2]

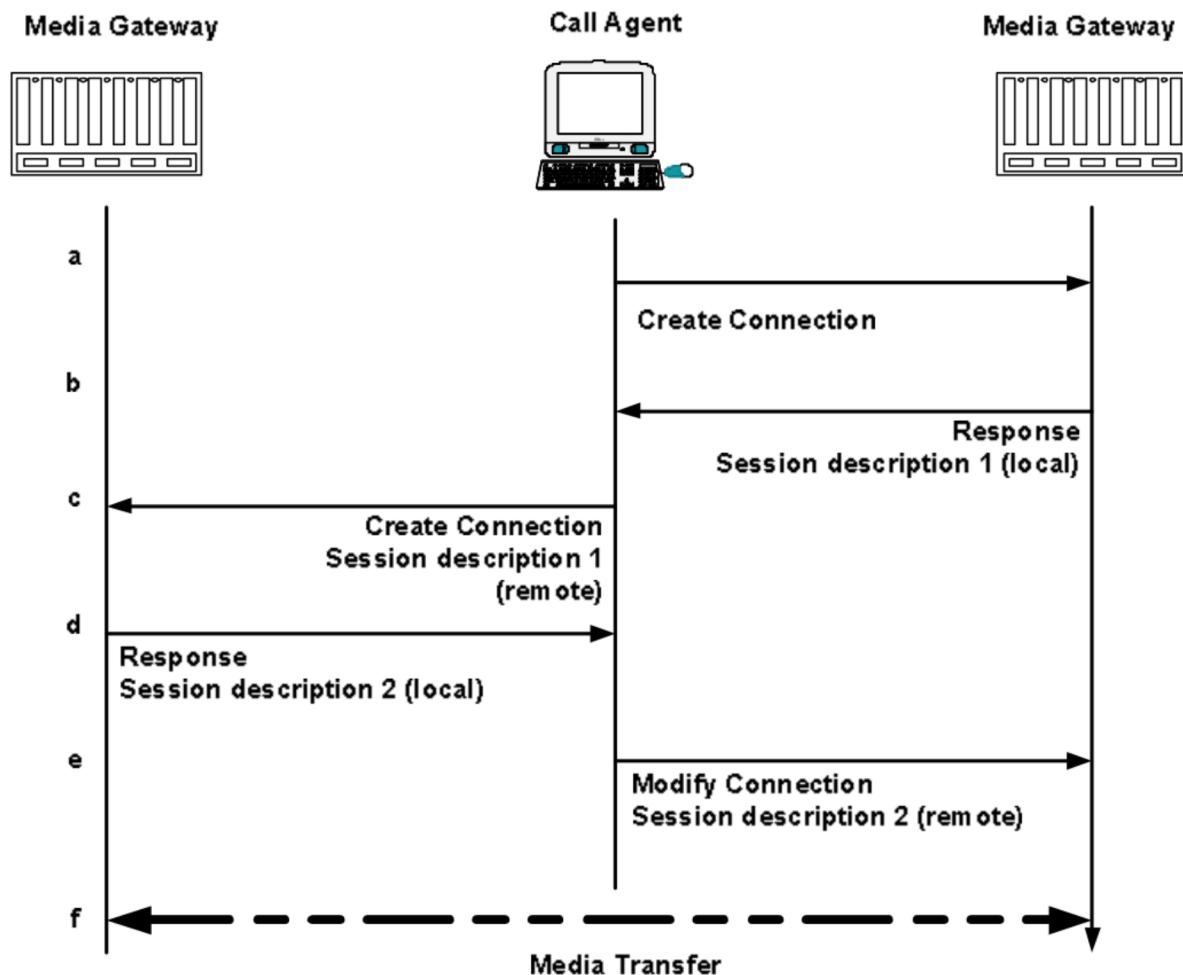
- Transactions (simple text format)
 - command
 - a command line (case insensitive)
 - Action + TransId + Endpoint + Version
 - a set of parameter lines
 - parameter name (upper case): value
 - Example
 - RQNT 1201 endpoint/1@rgw.net MGCP 1.0
 - X: 0123456789B1 (RequestIdentifier)
 - R: hd (requestedEvent: hang down)
 - S: rg (signalRequest: ring tone)
 - session description



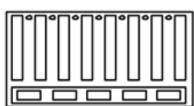
Protocol Description [2/2]

- Transactions
 - response
 - header
 - a response line
 - Response code + TransId + Commentary
 - a set of parameter lines (optional)
 - Example
 - 200 1201 OK
 - after CRCX(/MDCX/DLCX/Audit/Restart)
 - I: A3C47F21456789F0 (ConnectionId)
 - session description
 - Session Description Protocol (**RFC 2327**)
 - separated from header by an empty line

Call Setup Using MGCP



Media Gateway



Call Agent



Media Gateway

