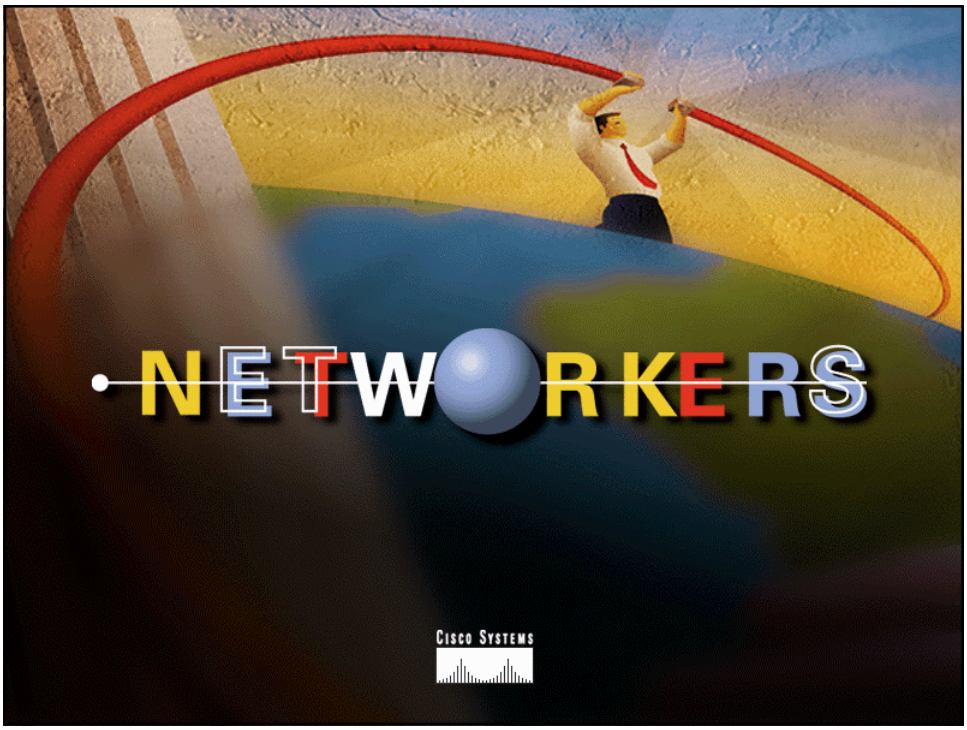

Topics

- **Brief Introduction to H.323 and Applications**
- Sample Network Scenario
- Design Topics
- Billing Topics
- Q & A

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H.323 Standard

- ITU recommendation
  - V1 approved in 1996, v2 in January 1998
- Defines multimedia applications over packet-based networks
- Leverages existing standards
- Wide market acceptance
- Facilitates interoperability between vendors
- Cisco VoIP solutions are H.323 compliant

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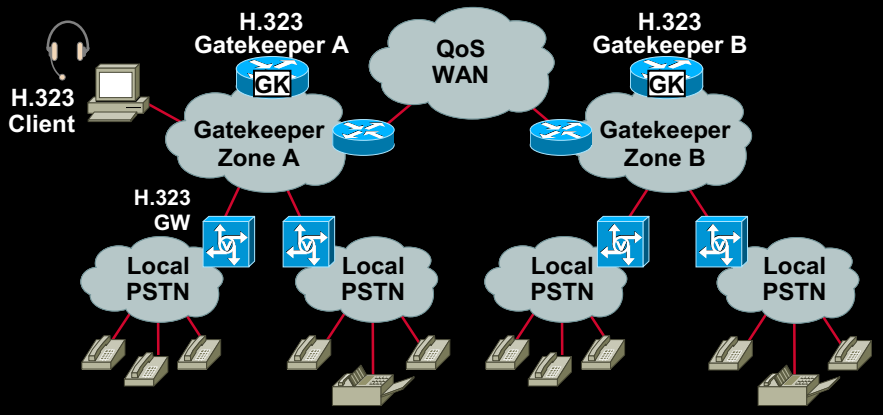
Example: H.323 Zones



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Gatekeeper Mandatory Services

- **Address translation**
  - Translates H.323 aliases or E.164 addresses into IP transport addresses (e.g. 10.1.1.1 port 1720)
- **Admissions control**
  - Authorizes access to the H.323 network
- **Bandwidth control**
  - Manages endpoint bandwidth requirements
- **Zone management**
  - Provides the above functions to all terminals, gateways, and MCUs that register to it

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RAS Messages

- **GRQ/GCF/GRJ (discovery)**
  - Unicast—multicast, find a gatekeeper
- **RRQ/RCF/RRJ (registration)**
  - Endpoint alias/IP address binding, endpoint authentication
- **ARQ/ACF/ARJ (admission)**
  - Destination address resolution, call routing
- **LRQ/LCF/LRJ (location)**
  - Inter-gatekeeper communication
- **DRQ/DCF/DRJ (disconnect)**
  - Get rid of call state

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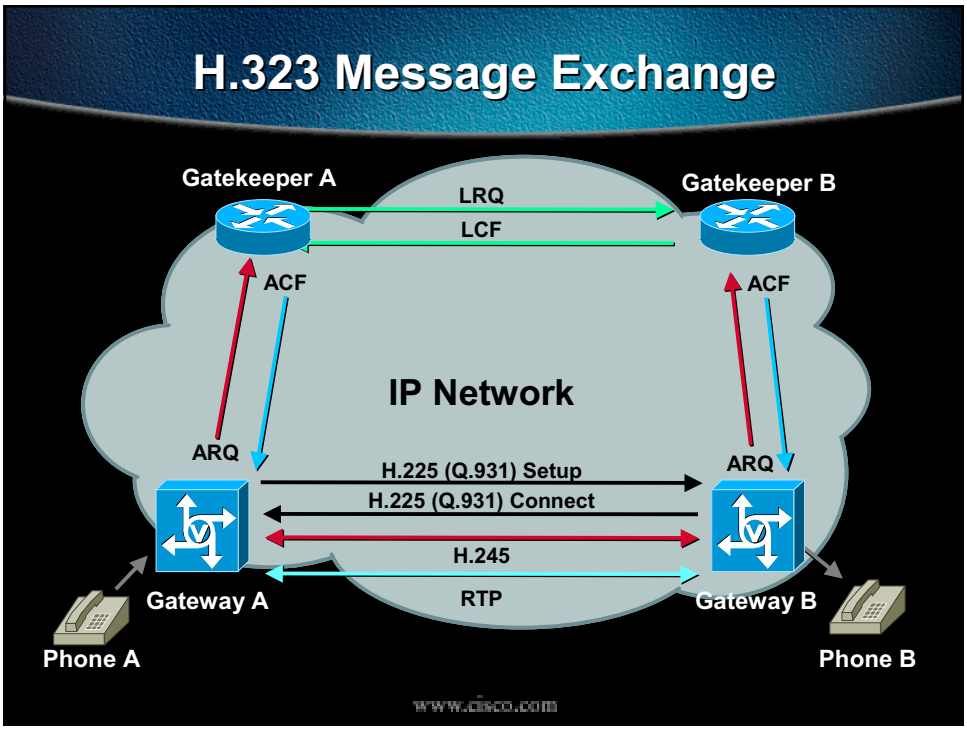
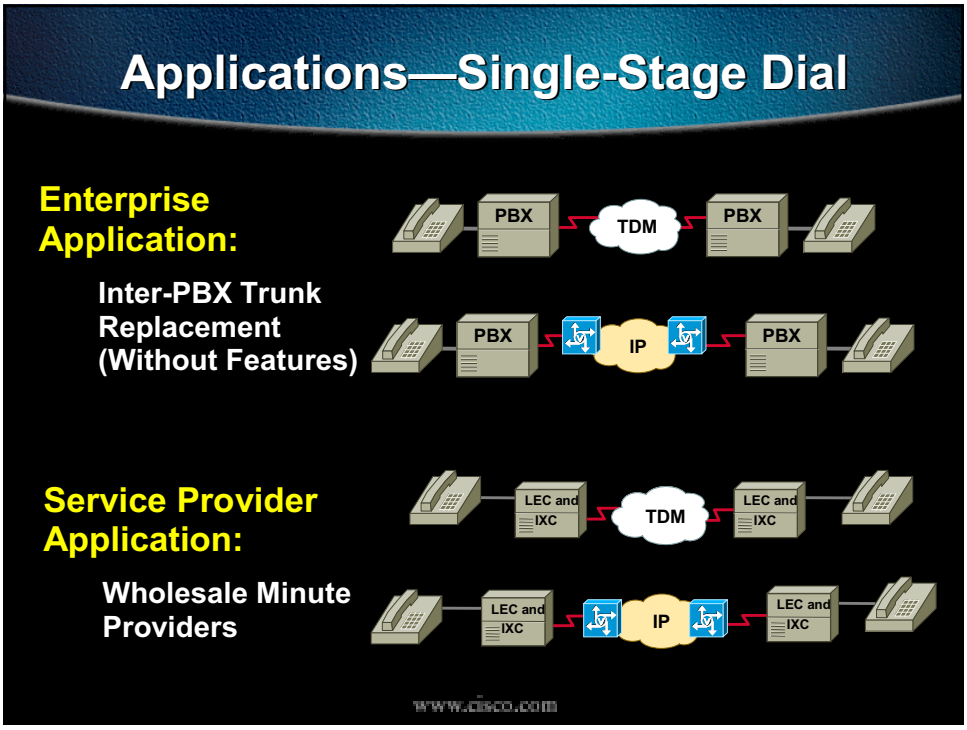
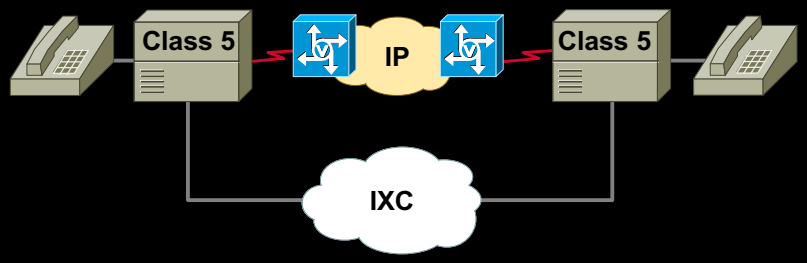




Applications—Two-Stage Dial



- **Service Provider Application:**

  The customer has selected traditional IXC, but dials a number to get access to the bypass provider's network. After authenticating can make the call to the ultimate destination

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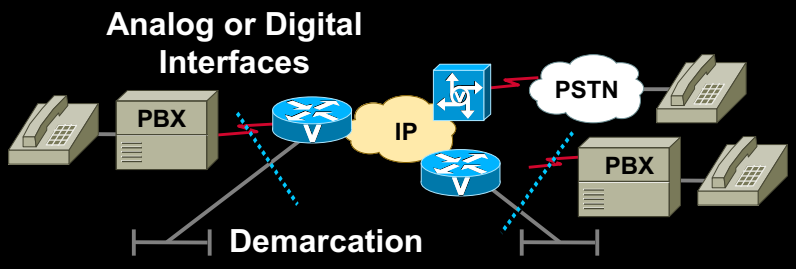
Enterprise Managed Service



- **Service Provider application:**

  The enterprise customer can choose to purchase long distance service, and/or an intracompany VPN service

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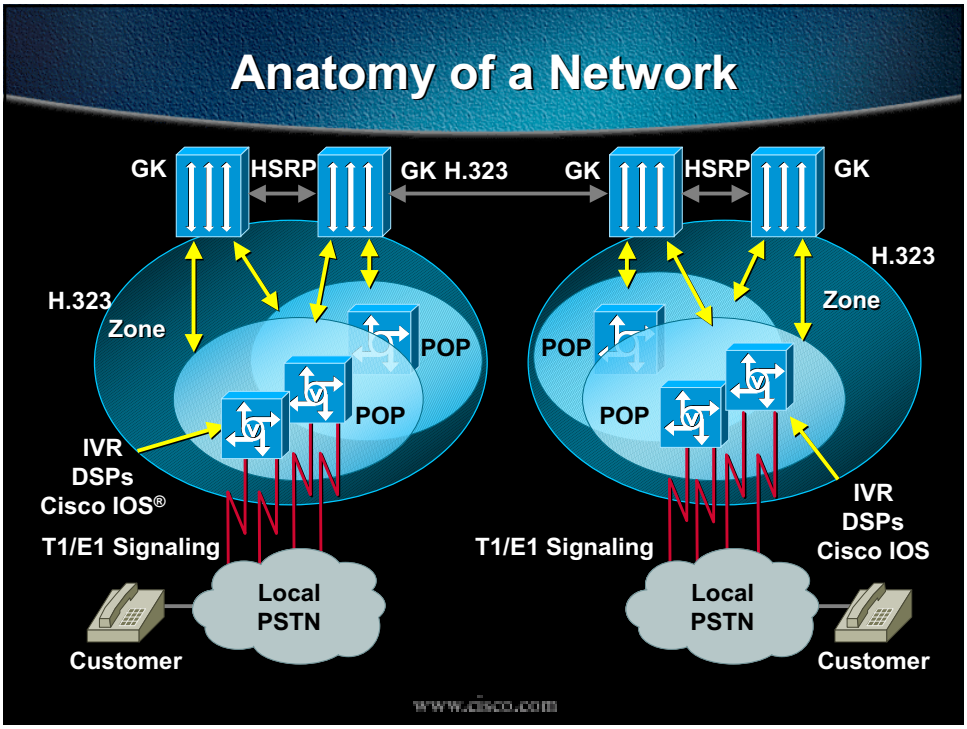
Anatomy of a Network



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Sample Network Dimensioning

- 20 POPs across the U.S.
- Have access servers today providing dial-up services. Familiar with and prefer to use RADIUS for billing
- 96 voice ports per POP, have 720x routers for backhaul
- Provide two-stage calling card and wholesale to smaller carriers
- Voice and fax calls
- Wants to deploy in NY, Chicago, LA, and Miami now
- Deploy in the rest of the POPs within a year
- Design for growth over the next year

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Sample H.323 Design

- Anticipating future growth we have carved the nation into four zones
- Each zone has HSRP enabled redundant 3640 Gate Keepers (GK). Since a GK can handle approximately 1000 active calls, this represents 20 AS5300s (or 10 POPs) with today's DSP densities
- For cities that are not serviced by this network, hop-off the traffic in Chicago to a wholesale long distance carrier.
- The GKs will use direct signaling mode
- On the GWs Loopback interfaces are used for H.323 gateway definitions to protect from a single interface failure

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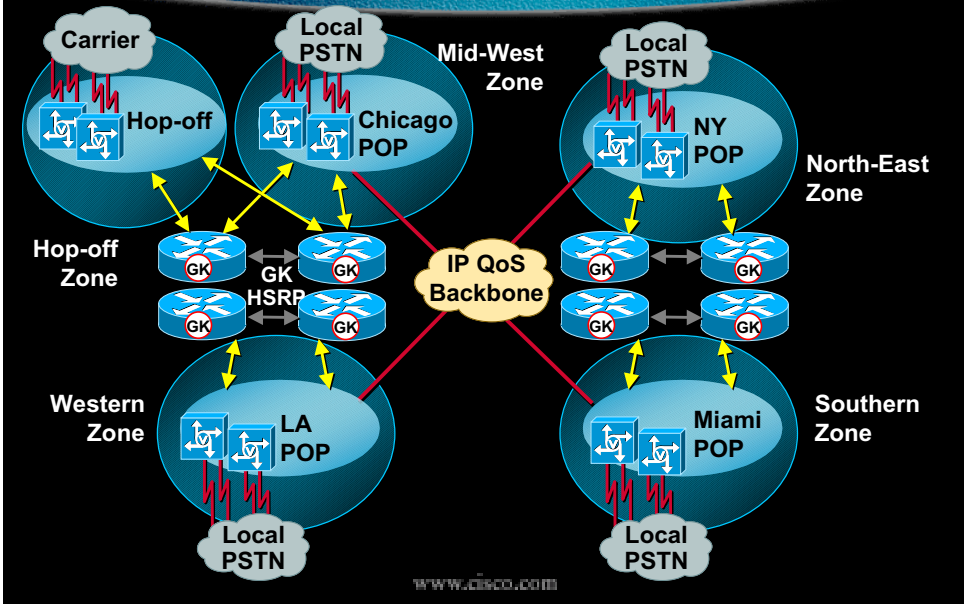
Initial Network (Four POPs)



Sample Network (Cont.)— POP Sizing

POP Sizing

- Number of gateways:
  48 ports per AS5300* --> Two AS5300s
- WAN bandwidth:
  Bandwidth per call:
  66 bytes * 8 bits/byte * 50 pps = 26.4 kbps
  Total WAN bandwidth
  = 26 kbps * (96/2) calls [VAD provides 50% efficiency]
  = 1.27 Mbps

* Up to 60 ports for an E1 scenario

Assumptions:

- Voice or fax calls
- Statistically there is silence on half the calls at any given time (use Voice Activity Detection)
- 60 byte packets + link layer (no header compression)
- G.729 CODEC used
- With higher density DSPs, a single chassis will meet the needs

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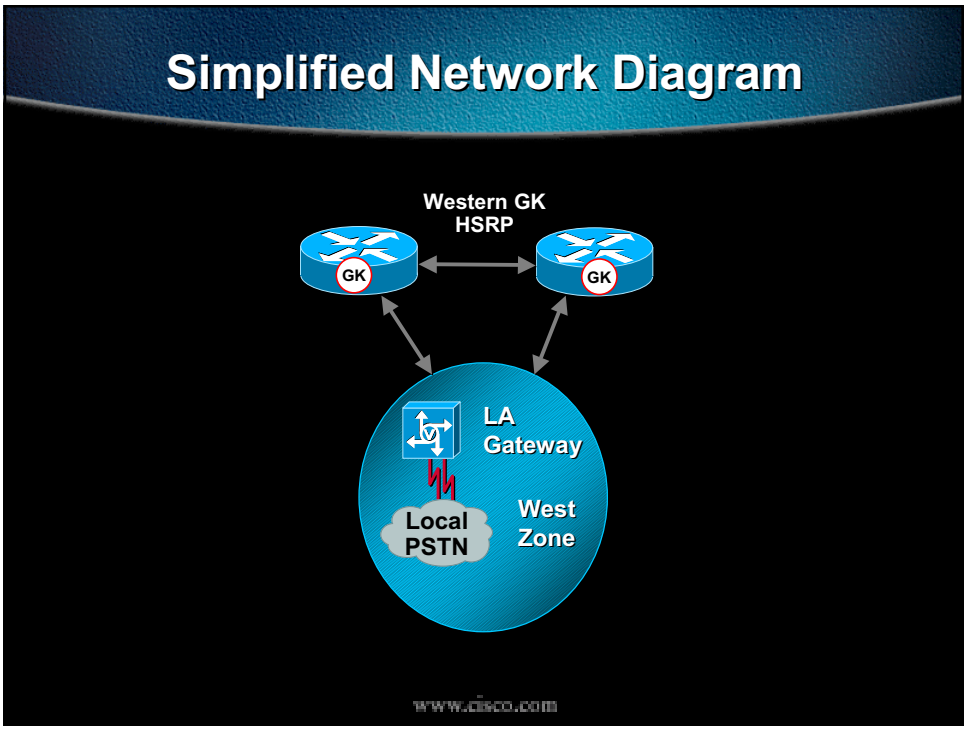
Simplified Network Diagram



Gateway Configuration—LA

```
hostname la1-gw
gateway
!
interface Loopback0
 ip address 10.10.250.1 255.255.255.0
 h323-gateway voip interface
 h323-gateway voip id gk-west ipaddr 10.10.254.10 1719
 h323-gateway voip h323-id la1-gw
 h323-gateway voip tech-prefix 1#
!
interface Ethernet0
 ip address 10.10.254.5 255.255.255.0

la1-gw.west #show gateway
 Gateway  la1-gw is registered to Gatekeeper gk-west
```

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Gatekeeper Configuration—West

```
hostname gk1-west
!
interface Ethernet0/0
 ip address 10.10.254.4 255.255.255.0
 standby 1 priority 110 <-- Active GateKeeper
 standby 1 ip 10.10.254.10
!
gatekeeper
 zone local gk-west acme.com 10.10.254.10
 zone remote gk-hopoff acme.com 10.10.253.10 1719
 zone remote gk-mwest acme.com 10.10.253.10 1719
 zone subnet gk-west 10.10.250.0/24 enable
 zone prefix gk-west 213*
 zone prefix gk-mwest 224*
 zone prefix gk-hopoff *
 gw-type-prefix 1#* default-technology
 no shutdown
```

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Gatekeeper Show Commands—West

```
gk1-west#show gatekeeper endpoints
                    GATEKEEPER ENDPOINT REGISTRATION
                    ================================
CallSignalAddr  Port  RASSignalAddr   Port  Zone Name   Type     F
--------------- ----- --------------- ----- ---------   ----     -
10.10.250.1     1720  10.10.250.1     4461  gk-west   VOIP-GW
    H323-ID: la1-gw


gk1.mwest #show gatekeeper zone prefix
      ZONE PREFIX TABLE
      =================
GK-NAME               E164-PREFIX
-------               -----------
gk-west                  213*
gk-mwest                 224*
gk-hopoff                *
```

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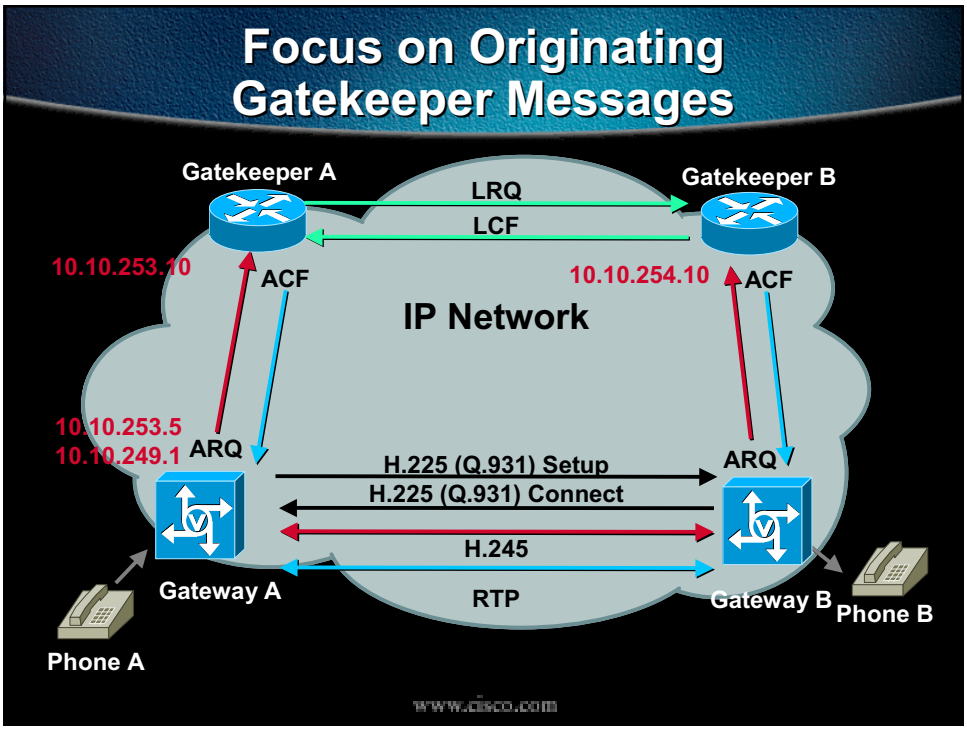
Focus on Originating Gatekeeper Messages



Originating Gatekeeper Debugs

```
gk1-mwest # debug ras
gk1-mwest #

RASLibRASRecvData ARQ (seq# 3365) rcvd from [10.10.253.5]

RASLibRASSendLRQ LRQ (seq# 5) sent to 10.10.254.10

RASLibRASRecvData LCF (seq# 5) rcvd from [10.10.254.10]

RASLibRASSendACF ACF (seq# 3365) sent to 10.10.249.1

The call is in progress

RASLibRASRecvData DRQ (seq# 3366) rcvd from [10.10.253.5]

RASLibRASSendDCF DCF (seq# 3366) sent to 10.10.249.1
```

Topics

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Design Topics

- Intra-gatekeeper gateway selection
- Inter-gatekeeper communication
- Resource availability indicator
- Light-weight registration
- Designing around failure scenarios

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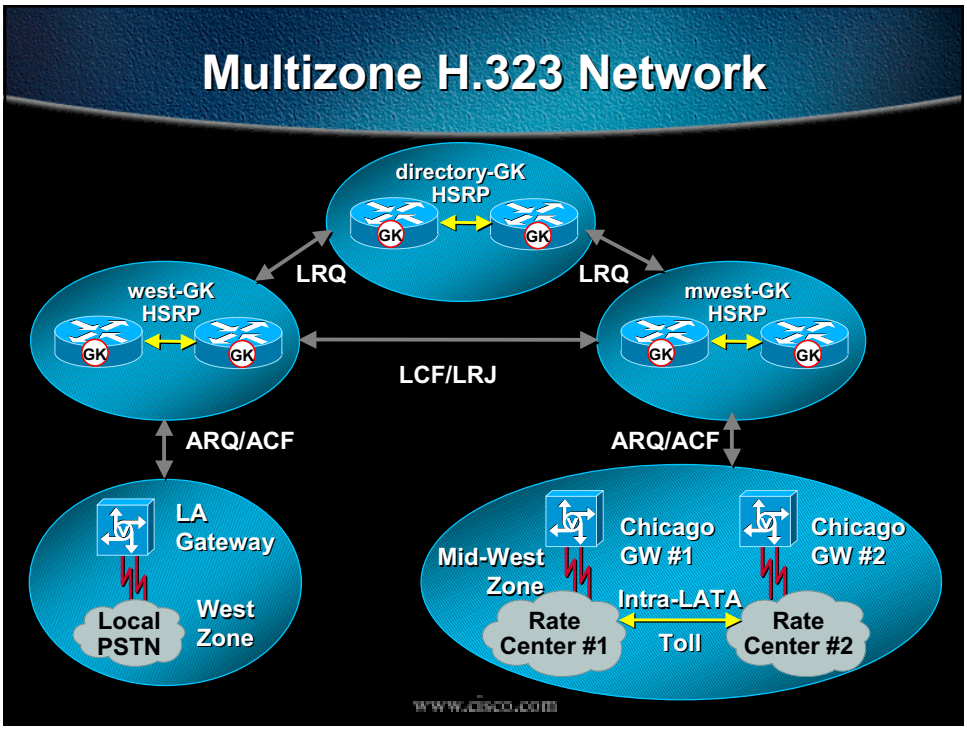
Multizone H.323 Network



Intra-Gatekeeper—Gateways Selection

- Calls are assigned to the gateways based on the prefix and their priority
- Among the gateways with the same priority the calls are assigned in a random fashion

Gateway Selection (CLI)

- Priority is between 0–10, 0 do not give any calls, and 10 is the best option. By default all gateways have priority of five

```
gatekeeper
 zone local gk-mwest acme.com 10.10.253.10
 zone prefix gk-mwest 224212* gw-priority 10 ch1-gw
 zone prefix gk-mwest 224512* gw-priority 10 ch2-gw
 zone prefix gk-mwest 630*
```

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Gatekeeper Show Command

```
gk-mwest#show gate gw-type-prefix
GATEWAY TYPE PREFIX TABLE
=========================
  Zone gk-mwest prefix 224212* priority gateway list(s):
   Priority 10:
    10.14.254.8:1720 ch1-gw
   Priority 5:
    10.10.249.1:1720 ch2-gw
  Zone gk-mwest prefix 224512* priority gateway list(s):
   Priority 10:
    10.10.249.1:1720 ch2-gw
   Priority 5:
    10.14.254.8:1720 ch1-gw
  Zone gk-mwest prefix 630* priority gateway list(s):
   Priority 5:
    10.14.254.8:1720 ch1-gw
    10.10.249.1:1720 ch2-gw
```

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Inter-Gatekeeper— LRQ Forwarding

- Prior to 12.0(3)T there is a requirement to create a full-mesh between the gatekeepers
- Does not allow for scaling with a lot of zones, most vendors have to create a full-mesh for routing
- There was a need to create a hierarchical architecture between the gatekeepers
- 12.0(3)T added a Directory-gatekeeper which resolves E.164 addresses to gatekeepers. This reduces the routing information in a lower-level gatekeeper

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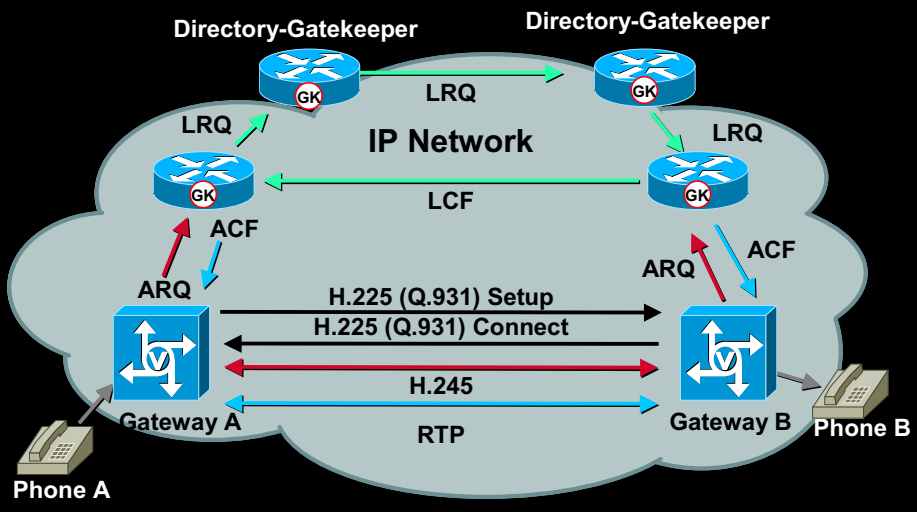
LRQ Forwarding in Action



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LRQ Forwarding Notes

- HSRP works the same with the Directory-Gatekeeper
- There is a hard limit of five recursive LRQs
- The Directory-Gatekeeper does not maintain states about the forwarded-LRQ calls, because those calls are between two other zones
- A Directory-Gatekeeper can also manage local zones of its own—and as far as those calls are concerned it is just like any other gatekeeper

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LRQ Forwarding (CLI)

```
gatekeeper
 zone local dir-gk-us.acme acme.com 10.10.254.20
 zone remote gk-mwest acme.com 10.10.253.10 1719
 zone remote gk-west acme.com 10.10.254.10 1719
 zone prefix gk-west 213*
 zone prefix gk-mwest 224*
 gw-type-prefix 1#* default-technology
 lrq forward-queries
```

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Resource Availability

- A mechanism for a gateway to inform the gatekeeper that it is short on resources—DS0s and DSPs
- Once the gatekeeper receives the RAI it will not assign a call to the gateway low on resources

* Unless there is only a single GW within a zone, the GK will give the GW call hoping that there are enough resources to terminate the new call, otherwise the preference commands will reroute the call at the ingress GW.

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Resource Availability (CLI)

- Specify the high- and low-resources mark, under the gateway section

```
ch1-gw.mwest (config)#resource threshold all high 90 low ?

  <1-100>  low threshold percentage value
```

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Light Weight Registration

- Upon startup a GW performs a full registration. As a keep alive mechanism a GW can send a "Light Weight Registration" as a notification that the GW is still available/alive
- Before 12.0(5)T, GWs send a full registration every 30 sec. Increasing the CPU utilization
- GK can age out the GW if it does not receive the RRQ

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A sample Light Weight RRQ

```
la1-gw#value RasMessage ::= registrationRequest :
{
- SNIP -
 gatekeeperIdentifier "gk-west",            <---- Mandatory
 endpointVendor                             <---- Mandatory
 {
   vendor
   {
     t35CountryCode 0181,
     t35Extension 00,
     manufacturerCode 018
   }
 },
 timeToLive 0060,                           <---- Time
 keepAlive TRUE,                            <---- Mandatory
 endpointIdentifier "60EB1E6C00000004",     <---- Mandatory
 willSupplyUUIEs FALSE
}
```

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Failure Scenarios

- Gatekeeper failure
- Remote gateway failure or resource unavailable
- IP connectivity failure (Gateway or Gatekeeper)

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GK Failure Scenario

- Cisco provides Hot Standby Router Protocol (HSRP)

  Hello protocol for the standby GKs to monitor the active GK. In case of a failure the backup assumes the active GKs IP & MAC address, the GW continue to work as normal.

* Only Works with Cisco GKs, that are connected on a bridged network
* Working on adding support for AltGK

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Gatekeeper HSRP CLI

```
interface Ethernet0/0
 ip address 10.10.254.4 255.255.255.0
 standby 1 priority 110 <-- Active GateKeeper
 standby 1 ip 10.10.254.10
```


Remote GW or GK or IP Failure

- The originating GW will attempt to reach the terminating GW or GK, and will not get a response
- The Originating GW waits for 6 seconds and then looks for an alternative dial-peer
- If another dial-peer with a lower priority exists, the call is processed again

* This feature provides multiple call treatment for any failure—increases call processing time

Preference CLI

```
hostname la1-gw
gateway
!
Dial-peer voice 408 voip
 destination-pattern 1408.....
 Session target ras
 <default preference 0>
!
Dial-peer voice 4081 pots
 destination-pattern 1408.....
 Port 3:0
 preference 1
```

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Topics

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Billing Mechanisms

- RADIUS—supported today
- Settlements protocols
  - Open Settlements Protocol (OSP)
    - Released in Cisco IOS in mid-July
  - iNOW—committed

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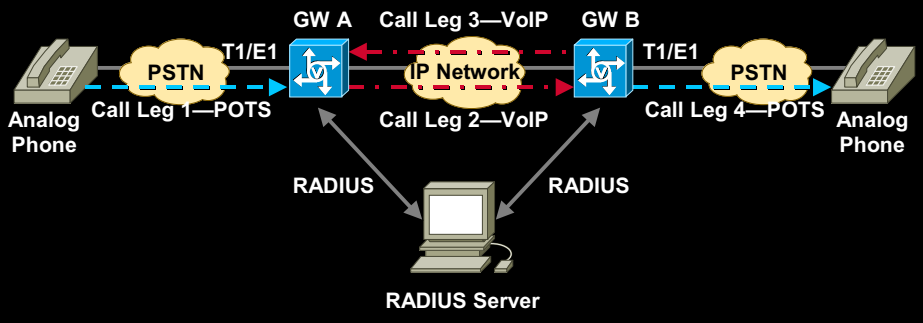
Call Legs



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Call Leg RADIUS Records

- Each of the call legs can generate start and stop records
- Each call leg reports the NTP time for:
  - SETUP
  - CONNECT
  - DISCONNECT
- The stop records have the required information for billing

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RADIUS Record Format

Attribute	Value	Description RFCs 2139, 2139
NAS-IP-Address	4	IP address in 4 hex octets (ASCII string)
NAS-Port-Type	61	4 octets (used for MLPPP)
User-Name	1	ASCII string field up to 63 octets
Called-station-Id	30	1 or more octets (DNIS phone number, ASCII string)
Calling-station-Id	31	1 or more octets (ANI phone number, ASCII string)
Acct-Status-Type	40	4 octets (hex ASCII number)
Service-Type	6	4 octets (hex ASCII number)
Acct-Session-Id	44	"overloaded" for CDR— ASCII string up to 256 bytes
Acct-Input-Octets	42	4 octets stop records only (hex number)
Acct-Output-Octets	43	4 octets stop records only (hex number)
Acct-Input-Packets	47	4 octets stop records only (hex number)
Acct-Output-Packets	48	4 octets stop records only (hex number)
Acct-Session-Time	46	4 octets (hex number rep. Seconds) stop records only
Acct-Delay-Time	41	4 octets (hex number in seconds)

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Overloaded Session ID

Field	Description
session id	The standard (RFC 2139) RADIUS *account-session-id*
call leg setup time	The Q.931setup time for this connection in NTP format.
gateway id	The name of the underlying gateway. Name string is of form gateway.domain_name"
connection id	A unique global identifier used to correlate call legs that belong to the same end-to-end call. The field consists of 4 long words (128 bits). Each long word is displayed in hexadecimal value and separated by a space character.
call origin	Indicates origin of the call relative to the gateway. Possible values are originate" and "answer".
call type	Indicates call leg type. Possible values are: "Telephony" and " VoIP."
connect time	The Q.931 connect time for this call leg in NTP format. (stop only)
disconnect time	The Q.931 disconnect time for this call leg in NTP format. (stop only)
disconnect cause	Documented in Q.931 specification . Can be in the range of 1-160. (stop only)
remote IP address	IP address of the remote gateway used in this connection (stop only)

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Stop Record for Call Leg 2

```
Thu Feb  4 121429 1999
        Client-Id = 10.10.253.5
        NAS-Port-Type = Async
        User-Name = "1234"
        Called-Station-Id = "4085551212"
        Calling-Station-Id = "408"
        Acct-Status-Type = Stop
        User-Service-Type = Login-User
        Acct-Session-Id = "25/120918.074UTC Thu Feb 4 1999/ch1-gw.mwest
          ./FC82262C 9CD60028 0 4C285F4/originate/VoIP/120922.018
        UTC Thu Feb 4 1999/120932.022 UTC Thu Feb 4 1999/10  /10.10.254.5"
        Acct-Input-Octets = 2300
        Acct-Output-Octets = 12800
        Acct-Input-Packets = 115
        Acct-Output-Packets = 640
        Acct-Session-Time = 13
        Acct-Delay-Time = 0
```

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12.0(4) XH1 VSA Format

- Overloaded session ID is running out of room
- Start placing more variables in VSAs (Vendor Specific Attribute), and create room for additional parameters
- For example, add Icpif (G.113-QoV) as a RADIUS attribute

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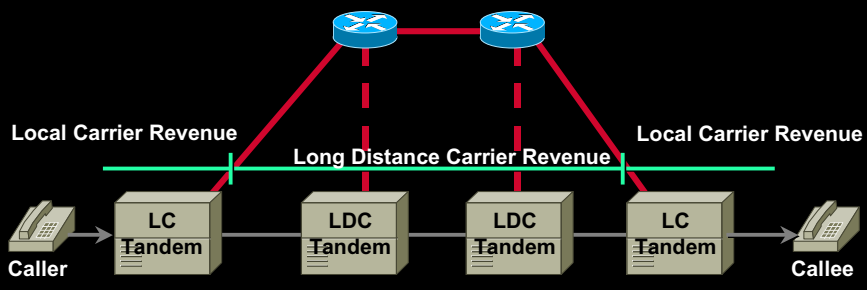
Voice Settlements



- Ability to divide per call revenue among multiple carriers

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Telephony and VoIP Settlement

- Telephony settlement
  - Bilateral agreement between carriers
  - Static intercarrier routing
  - CDR from C7/SS7 information
- VoIP settlement
  - ISPs to build connectivity and sign with ClearingHouse
  - Settlement provider does inter-ISP routing/authorization

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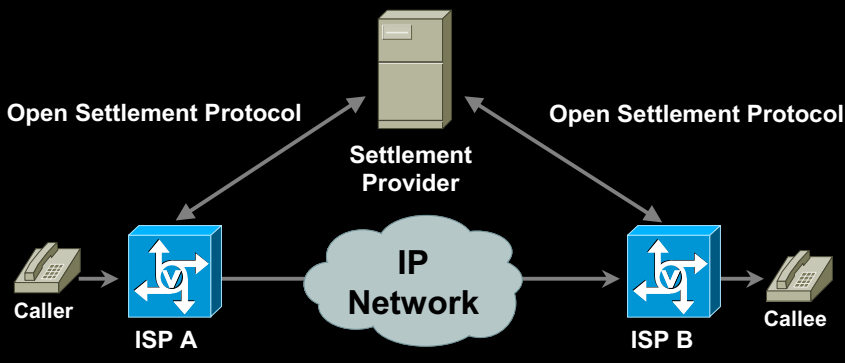
VoIP Settlement Scenario



- Secure settlement protocol
- Call signalling protocol is not included

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Open Settlement Protocol

- Standard track within ETSI, approval in September 1998
- Wide support

  TransNexus, iPass, GRIC, Cisco, 3Com…
- Extendable to additional services
- Settlement independent from IVR, gatekeeper…

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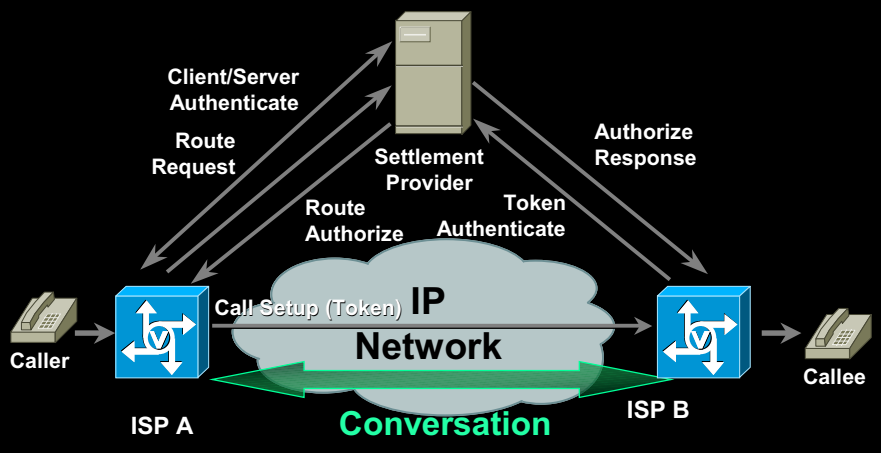
OSP and Gateways



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Cisco Implementation

- GW only: Add a dial-peer and point to the Settlement server
- The Settlement Provider, provides the route resolution and billing settlements between the providers
- Single Settlement Provider per GW

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Configuration with OSP

```
dial-peer voice 510 voip
 destination-pattern 1510.......
 codec g711ulaw
 no vad
 session target settlement0 <-- Check with the OSP Provider
!
settlement 0 <-- There is only a single Settlement Provider
!
type osp

 url http//10.100.1.3:443/ <-- Settlement Server

 device-id 200 <-- Identifies this GW

 customer-id 4000 <-- Identifies this customer to OSP Prov.
```

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