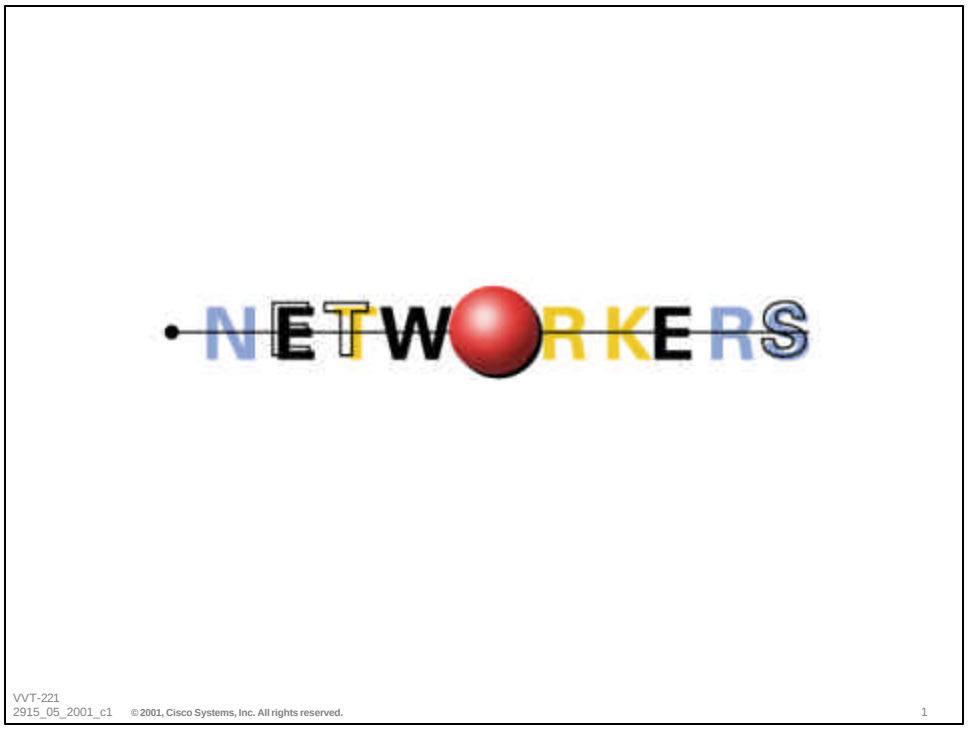

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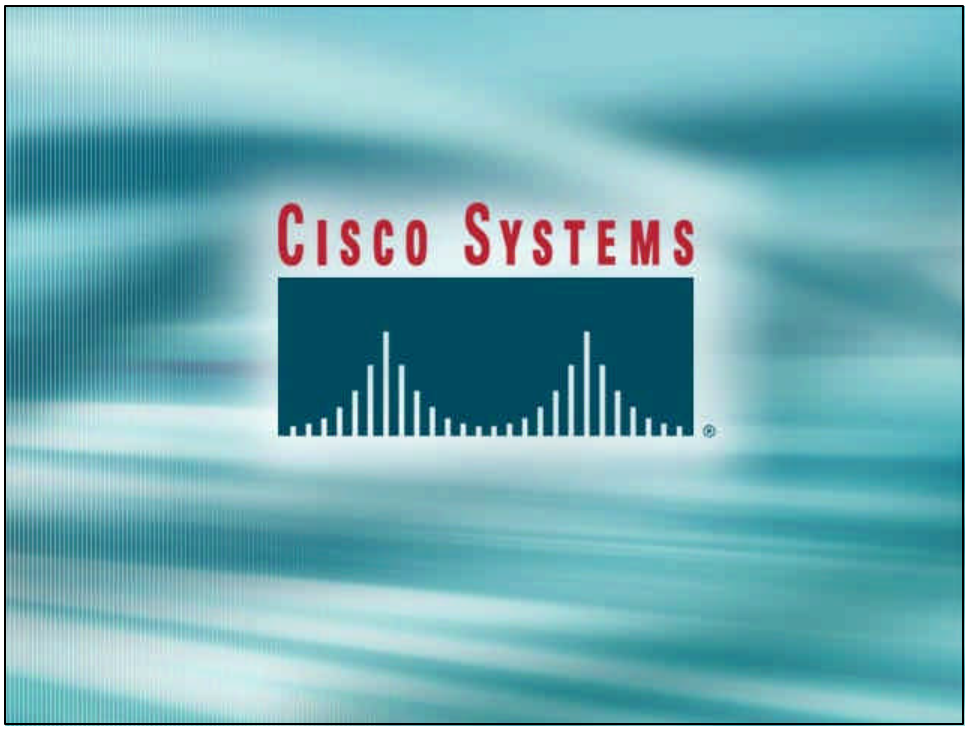

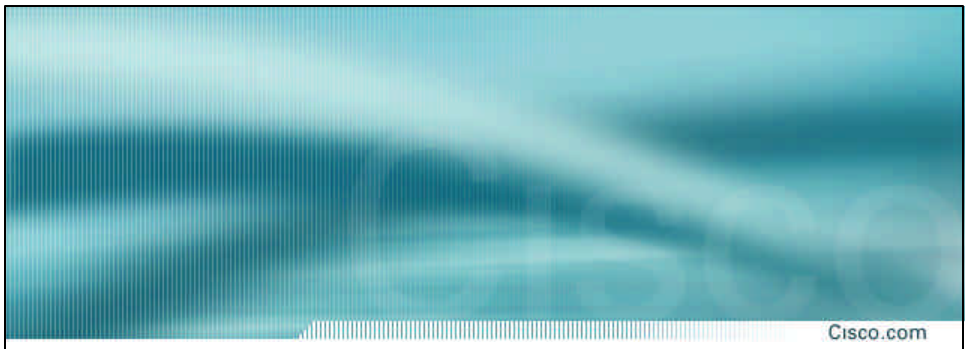

Deploying Large-Scale H.323 VoIP SP Networks

Session VVT-221

Core Message

- **H.323 networks can be used in large service provider VoIP networks, if proper architecture and features are deployed**

Pondering H.323 for Large-Scale SP Networks

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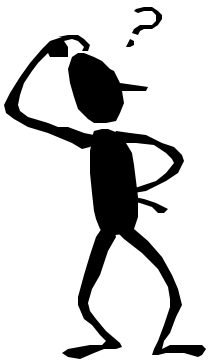
- What are the key components in a large-scale H.323 network?
- How can we design the H.323 network to scale?
- What are the performance criteria to design around?
- How can we size the network?
- What are some configuration examples?
- How do we increase availability?
- What are some case study examples?
- What else should I consider?



Today's Agenda

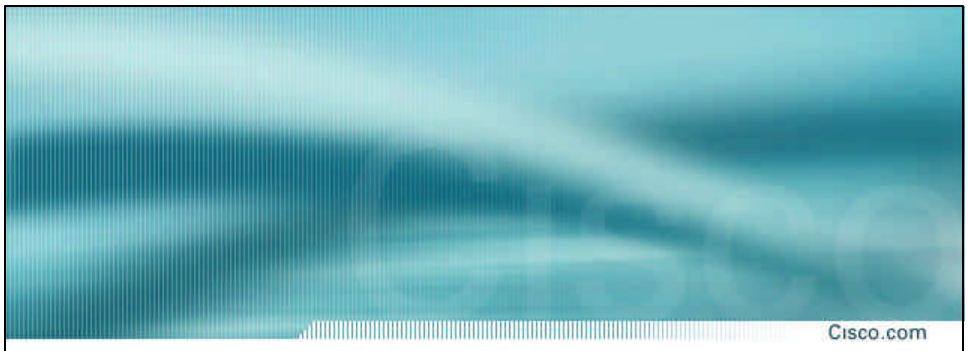
Cisco.com

- Review of H.323 Architecture
- Anatomy of a Large-Scale H.323 SP Network
- Gatekeeper Core and Components
- Call Routing in the H.323 Network
- Network Dimensioning
- Case Study: Dimensioning of an ITSP
- Increasing Availability

Today's Agenda

Cisco.com

- Billing in the H.323 Network
- Security
- Expanding the Coverage Area
- Interconnecting to TDM-Based Carriers
- Interconnecting to IP-Based Carriers
- Interconnecting with Non-Cisco-Based Carriers
- Other Services: Card Services
- Network Management Solutions
- What's Next?



Review of H.323

H.323 Review

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- ITU-T specification
  - Defines multimedia applications over Packet Based Networks
- Defines call signaling
  - Direct signaling
  - Gatekeeper Route Call Signaling (GKRCS)
- Elements
  - Terminal
  - Gateway
  - Gatekeeper
  - Multipoint Conference Unit
- Registration, Admission and Status (RAS) H.225
- Media establishment
  - H.245
  - Fast connect
  - H.245 tunneling

H.323 Components

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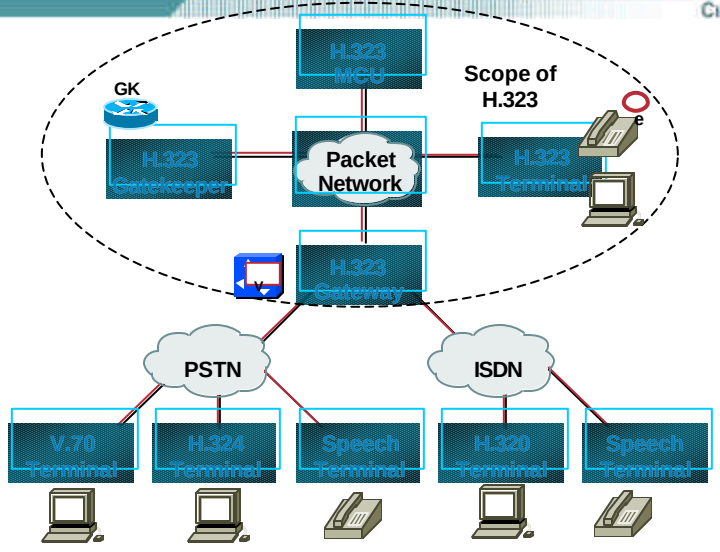
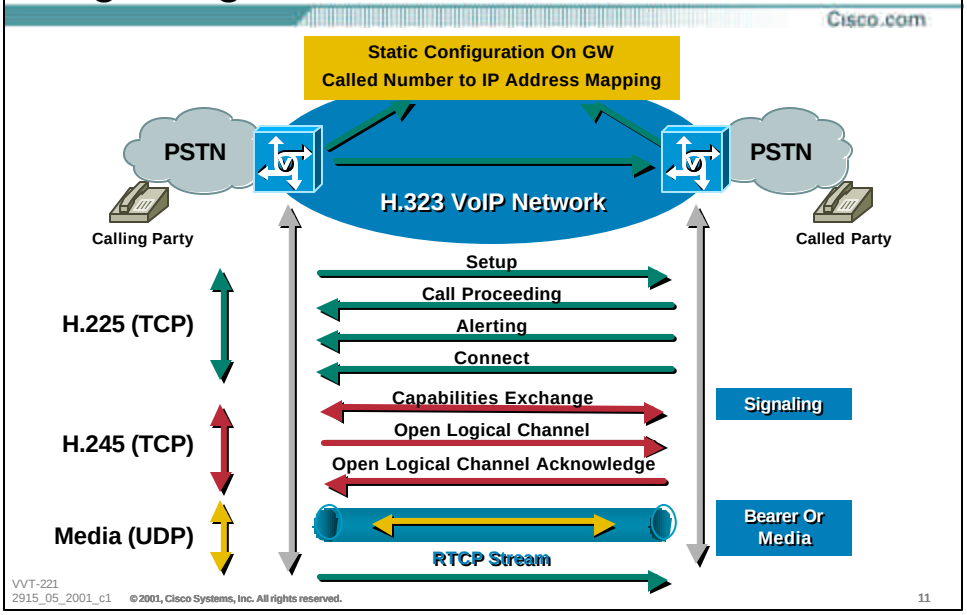
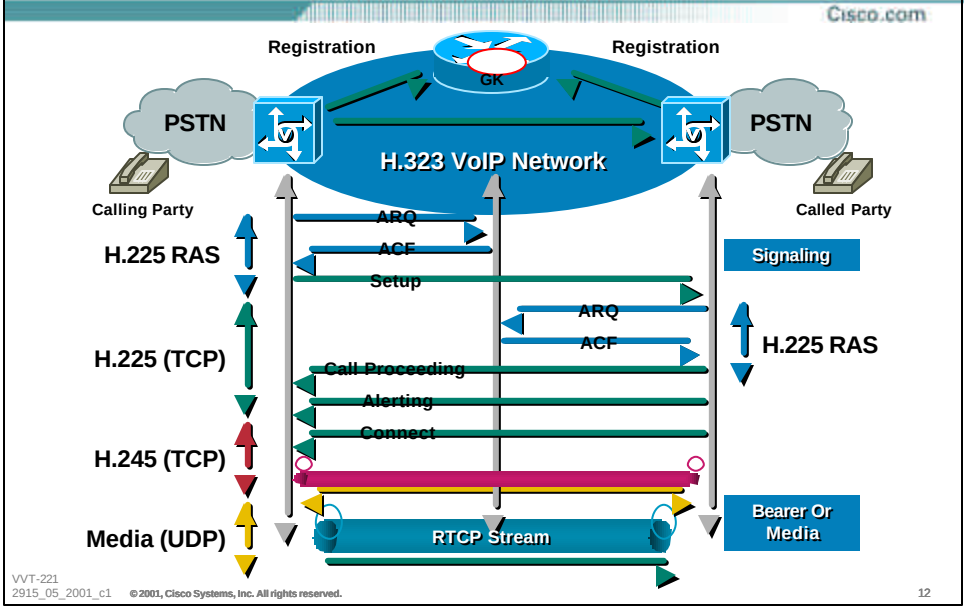
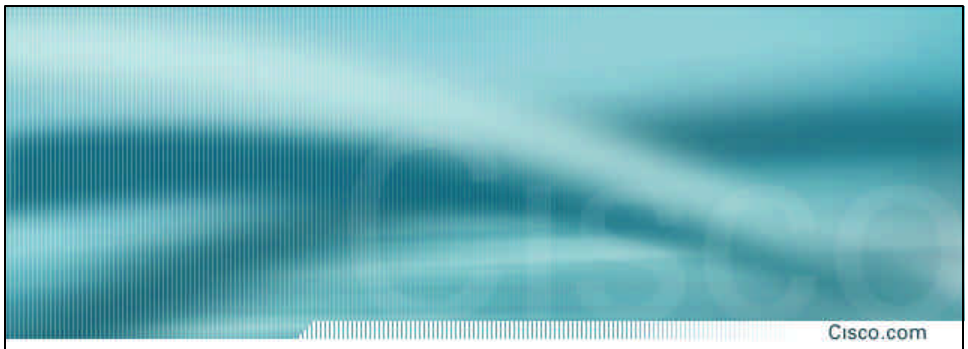


H.323 VoIP Review
Signaling Call Flow



H.323 VoIP Review
Addition of the Gatekeeper





Anatomy of Large-Scale H.323 Network

Needs of Large H.323 Networks

- Accommodate large number of POPs
- Allow new POPs to be added
- Manage POPs centrally
- Support a scaleable dial plan
- Handle high volume of minutes
- Keep call success rates high
- Maintain high availability
- Enable only authorized usage
- Support interconnecting with other TDM (SS7 or non-SS7) or IP carriers

Large-Scale H.323 Functions

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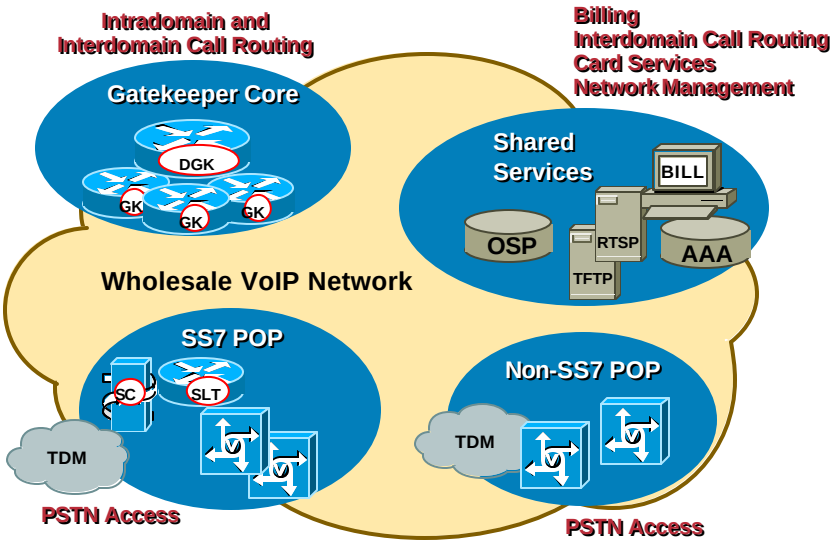
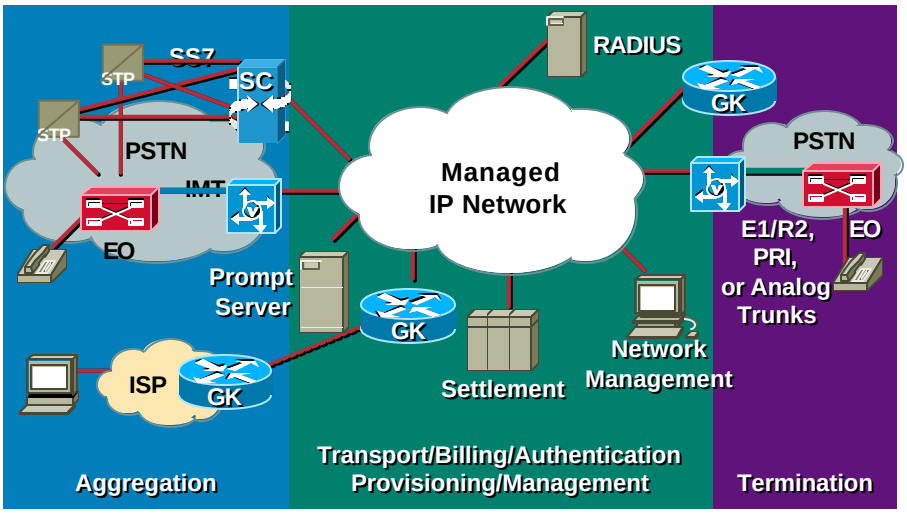
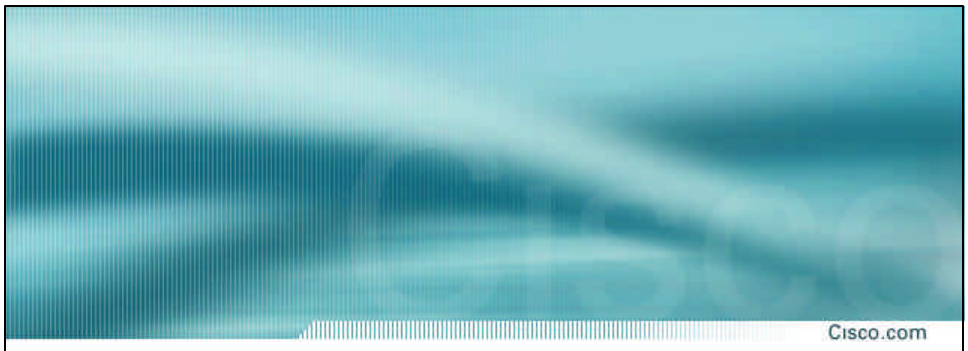


Large-Scale H.323 Network Components

Cisco.com





Gatekeeper and Gateway Core

Gateways

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- Provides interface between PSTN and IP
- Grooms dial plan for easier management and higher scaling
- Generates billing data (start/stop records) to billing server (AAA/RADIUS or OSP)
- Hosts Interactive Voice Response (IVR) application
- Supports redundancy mechanisms
- Supports bandwidth efficiency mechanisms
- Supports security mechanisms

Gatekeepers

Cisco.com

- Maintain registration of GWs and administers zone
- Manages GW resources to increase availability
- Maintain call routing information (zone prefix tables)
- Supports redundancy mechanisms
- Supports GKTMP interface for enhanced call routing and services

H.323 Component Summary – Gateway and Gateway and Gatekeeper

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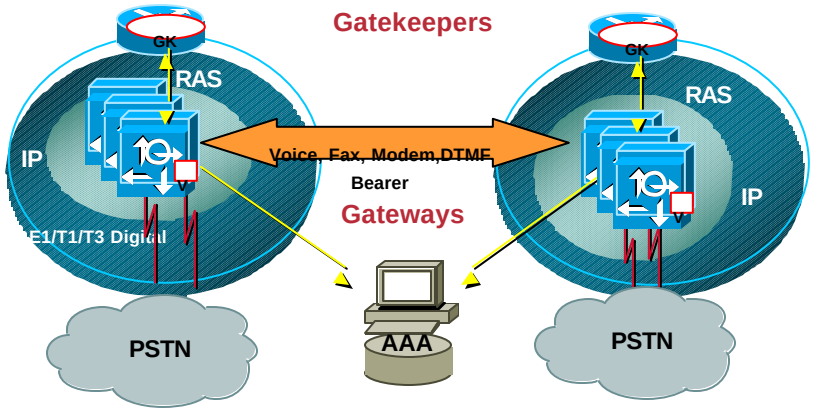
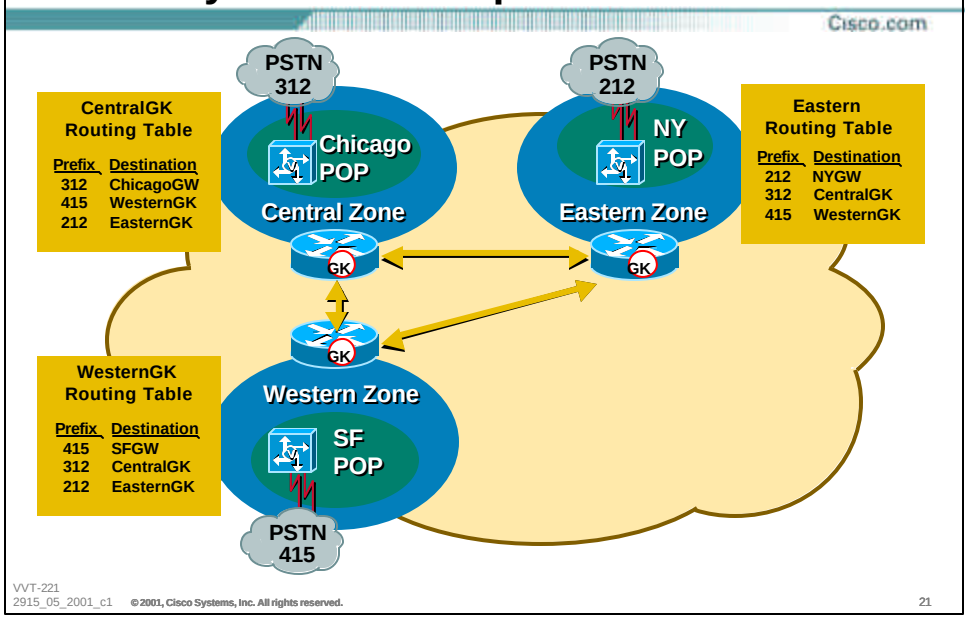
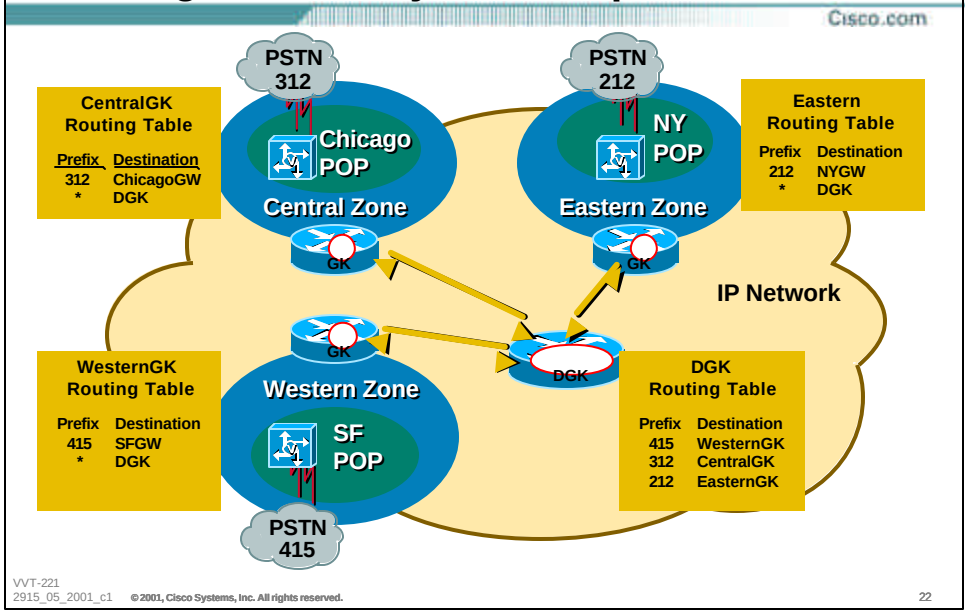


Gateway and Gatekeeper



Adding a Directory Gatekeeper



Directory Gatekeeper

Cisco.com

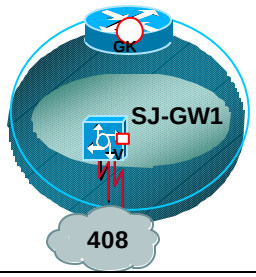
- Create a hierarchical architecture of GKs
- Performs inter-regional call routing
- Eliminate need for fully-meshed gatekeeper configuration
- Maintain master zone prefix table
- Simplify dial-plan management when GK zones are added or deleted
- Performs interdomain call routing

SJ-GW Configuration

Cisco.com

```
hostname SJ-GW1
!
!
isdn switch-type primary-5ess
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
dial-peer voice 1 voip
 destination-pattern 1....……
 session target ras
!
dial-peer voice 408 pots
 destination-pattern 408.......
 port 0:D
 prefix 408
!
Repeat for other NPA-NXXs served
```

```
gateway
!
interface Loopback0
 ip address 10.1.1.1 255.255.255.0
 h323-gateway voip interface
 h323-gateway voip h323-id SJ-GW1
 h323-gateway voip id US-GK ipaddr 11.1.1.1 1719
 h323-gateway voip tech-prefix 1#
!
interface Ethernet0
 ip address 13.1.1.1 255.255.255.0
!
interface Serial0:23
 isdn switch-type primary-5ess
 isdn incoming-voice modem
!
```

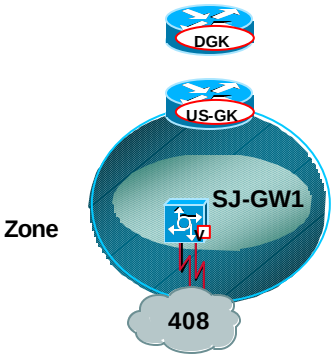


US-GK Configuration

Cisco.com

```
Hostname US-GK
!
interface Ethernet0
 ip address 11.1.1.1 255.255.255.0
!
!
gatekeeper
 zone local GK netman.com 11.1.1.1 1719
 zone remote DGK netman.com 99.1.1.1 1719
 zone prefix US-GK 408*
 zone prefix DGK *
 lrq forward-queries
 no shutdown
```

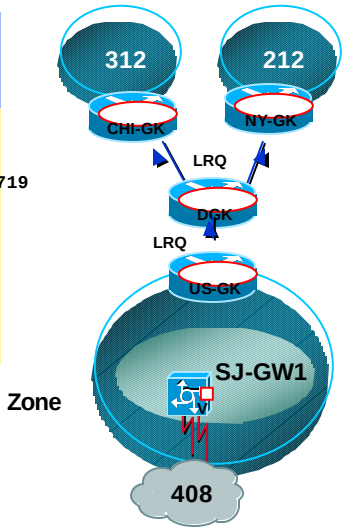
```
US-GW1# show gateway
 Gateway  US-GW1 is
    registered to Gatekeeper GK
```



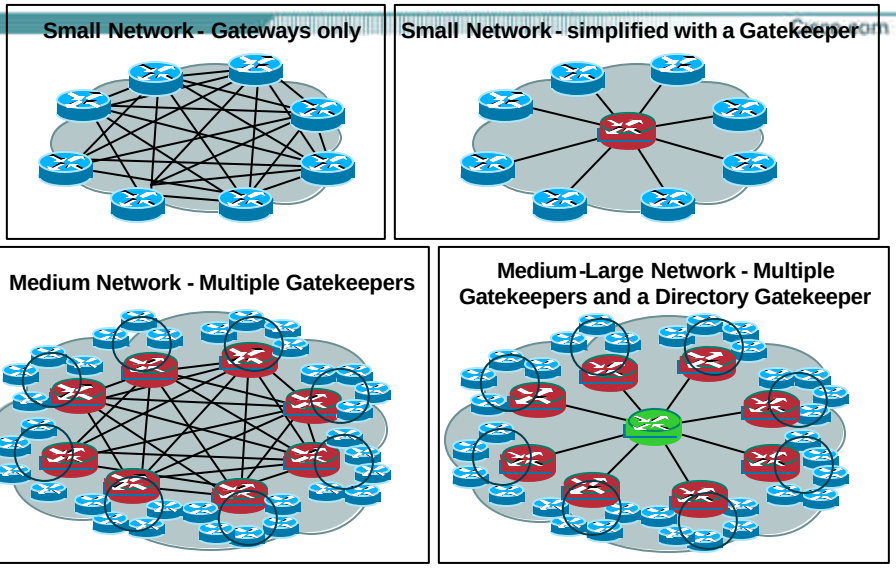
Directory GK Configuration

Cisco.com

```
Hostname dirgatekeeper
!
interface Ethernet0
 ip address 99.1.1.1 255.255.255.0
!
!
gatekeeper
 zone local DGK netman.com 99.1.1.1 1719
 zone remote CHI-GK netman.com 12.1.1.1 1719
 zone remote NY-GK netman 13.1.1.1 1719
 zone prefix US-GK 408*
 zone prefix CHI-GK 312*
 zone prefix NY-GK 212*
 lrq forward-queries
 no shutdown
```

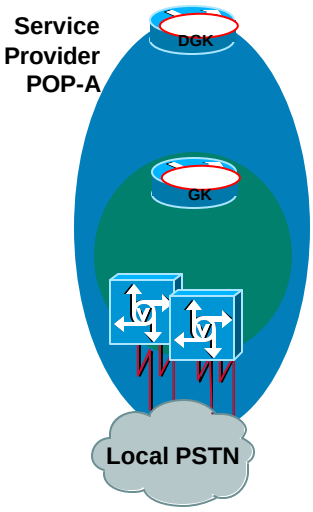


Hierarchical Design - Network Scaling



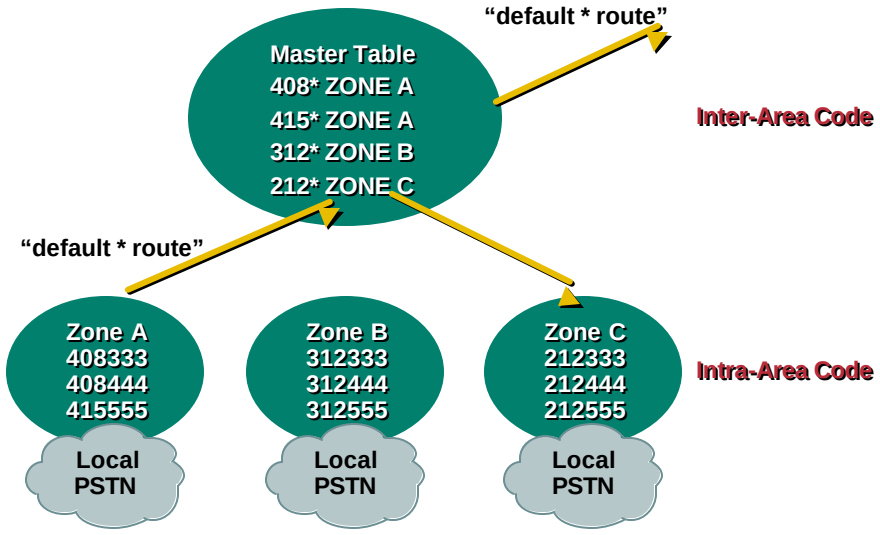
Adagio Components
Gatekeeper Core Summary

- **Directory Gatekeeper**
  - Performs call routing search at highest level
    - Example = Country Code Distributes
  - Country codes among other DGKs Forwards LRQ to Partner DGK if call doesn't terminate in local SP DGK
- **Gatekeeper**
  - Performs call routing search at intermediate level
    - Example = NPA-NXX
  - Distributes NPA among other GKs
  - Provides GW resource management (RAI, gw-priority...)
  - Provides Zone maintenance
- **Gateway**
  - Acts as interface between PSTN and IP
  - Normalizes numbers from PSTN before entering IP
  - Normalizes numbers from IP before entering PSTN
  - Contains the dial peer configuration
  - Registers to GK



Call Routing in the H.323 Network

Creation of Call Routing Layers



Call Routing in the Network

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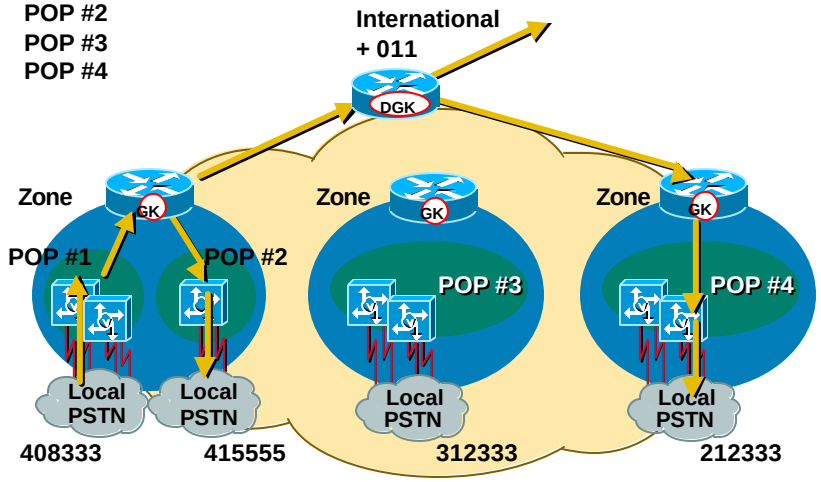
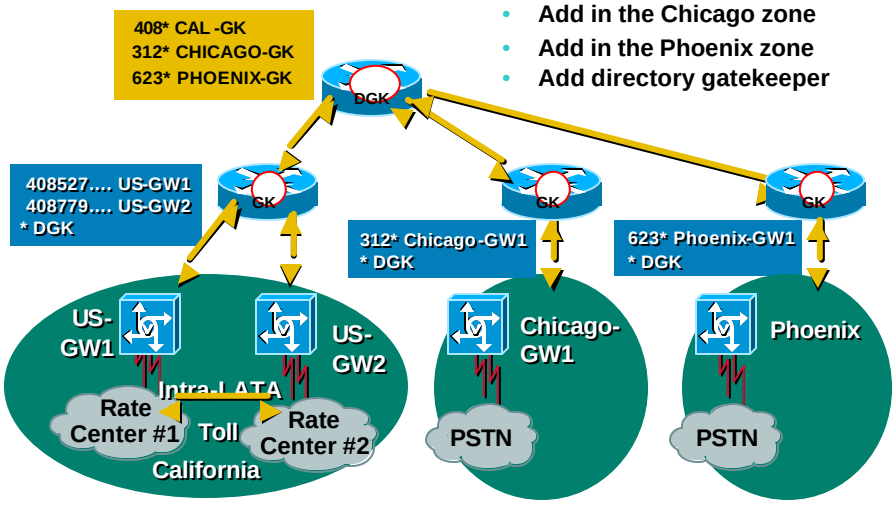
- Coverage area
  - POP #1
  - POP #2
  - POP #3
  - POP #4
- Use of gatekeeper
- Use of directory gatekeeper



DGK Administration with National Dial Plan

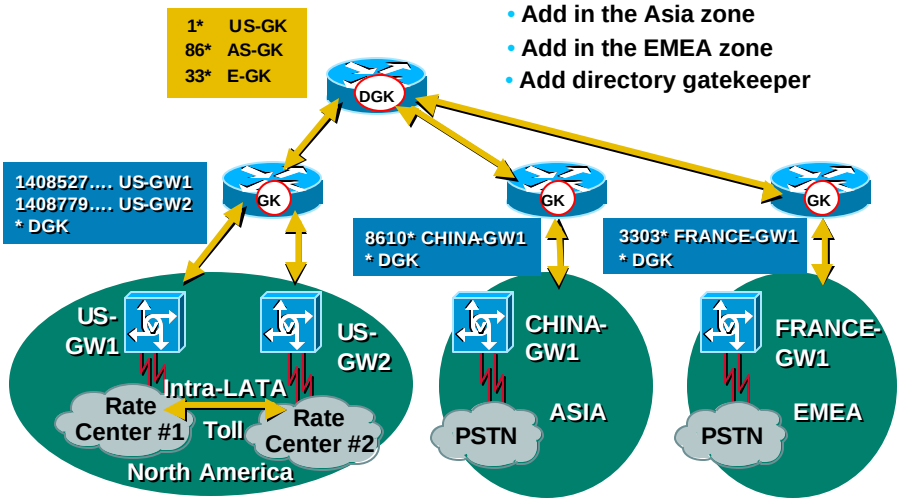
Cisco.com

- Add in the Chicago zone
- Add in the Phoenix zone
- Add directory gatekeeper



DGK Administration with International Dial Plan

Cisco.com



Need for Grooming

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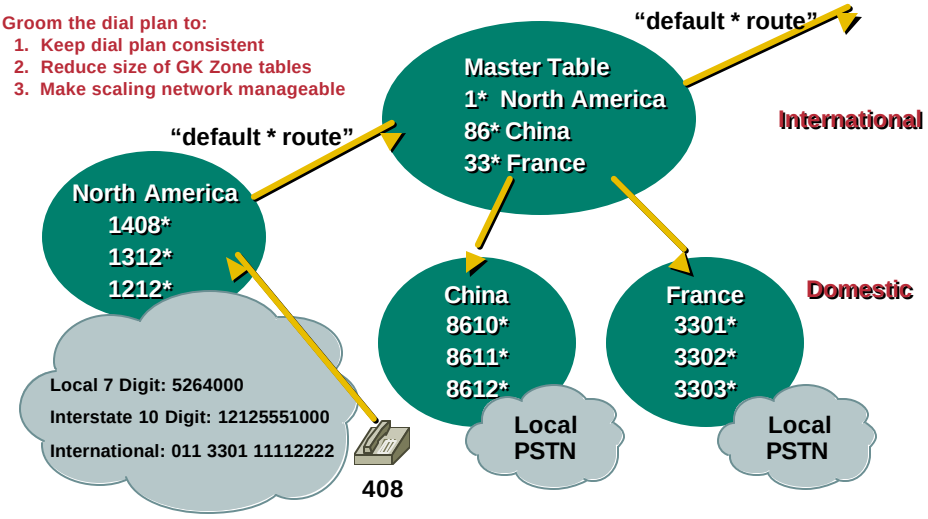
Groom the dial plan to:
1. Keep dial plan consistent
2. Reduce size of GK Zone tables
3. Make scaling network manageable



Gateway Number Translation Example

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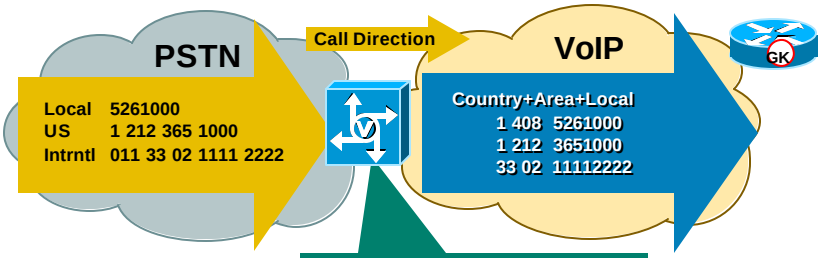

Number Manipulation On Outgoing VoIP Dial-Peer:

- For International Calls, Strip the Access Code (011)
- For US Calls, Different Area Code, Keep the Same Format
- For Local Calls, Same Area Code, Add the Country and Area Code

Translation Rules Example

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Translation-rule 1

Rule 0 ^5.... 408525

Rule 1 ^6.... 408526

Rule 2 ^7.... 408527

Rules say that for any digit pattern beginning with a 5, 6, or 7 followed by any 4 digits, then prepend with a 408525, 408526 or 408527

i.e.. 51234 translates to 4065251234

External URL needed here

http://von.cisco.com/Solutions/ios_dial_plan_digit_manipulation_enhancements.htm

Translation Rules Example (Cont.)

Cisco.com

Where do you apply translation rules?

Method 1: Applying Rules to POTS/VoIP Dial Peers
Method 2: Applying Rules to a physical POTS interface

Example:

```
!
translation-rule 1
   Rule 0 ^5.... 408525
   Rule 1 ^6.... 408526
   Rule 2 ^7.... 408527
!
port 1/0/0
translation called 1
```

Useful commands:
debug translation-rule detail
test translation-rule 1 51122

Exercise—Translation Rules and Dial Peers

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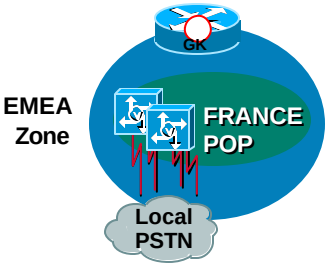
```
hostname FRANCE-GW1
!
translation-rule 2
 Rule 0 ^01.% 3301
 Rule 1 ^02.% 3302
 Rule 2 ^03.% 3303
 Rule 3 ^04.% 3304
 Rule 4 ^05.% 3305
 Rule 5 ^06.% 3306
!
translation-rule 3
 Rule 0 ^001.% 1
 Rule 1 ^002.% 2
 Rule 2 ^003.% 3
 Rule 3 ^004.% 4
 Rule 4 ^005.% 5
 Rule 5 ^006.% 6
 Rule 6 ^007.% 7
 Rule 7 ^008.% 8
 Rule 8 ^009.% 9
```

```
!
dial-peer voice 1 voip
 destination-pattern 00T
 translate-outgoing called 3
 session target ras
!
dial-peer voice 2 voip
 destination-pattern 0[1-6].....
 translate-outgoing called 2
 session target ras
!
gateway
```



- Assume a GW in a France POP
- Area Code = 03
- Country Code = 33
- Dialing Habits

  Local—Include Area Code (0x) + 8 Digits
  Long Distance—Use Area Code (0x) + 8 Digits
  International—00 Access Code

Normalize local dialing patterns

Outbound Gateway Number Translation Tasks

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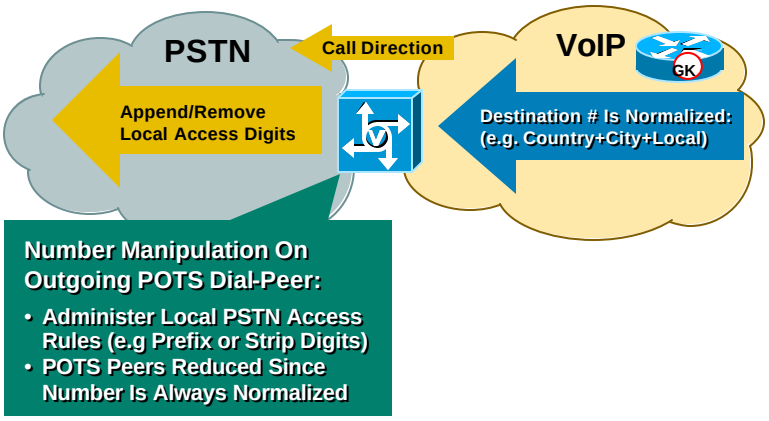

Number Manipulation On Outgoing POTS Dial-Peer:

- Administer Local PSTN Access Rules (e.g Prefix or Strip Digits)
- POTS Peers Reduced Since Number Is Always Normalized

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Network Dimensioning and Hierarchical Design

Network Dimensioning

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- How many GWs per POP?
- How many GWs per GK zone?
- How many GKs per DGK?

Designing the POP

Cisco.com

- Design the SP POP with following factors
  - Busy Hour Call Attempts (BHCA)
  - Number of gateways required to handle the anticipated call volume
  - Number of Gatekeepers required to process the GW signaling/RAS messages

Sizing Exercise

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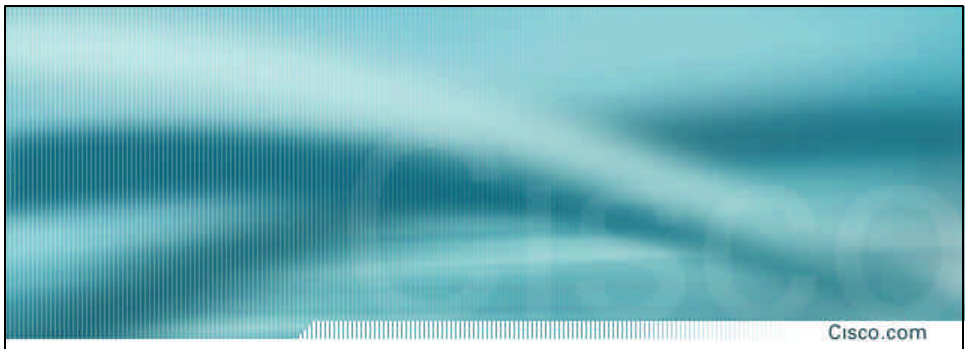
Given:

- 1,000,000 BHCA network with average hold time = 3 minutes
- Max BHCA per DS0 = 60 min/hour/3 min HT = 20 BCHA per GW
- DS0s per GW will depend on signaling type
- 92 T1 DS0s (PRI) max on AS5300, 92 X 20 BHCA/DS0 = 1840
- 96 T1 DS0 (CAS) max on AS5300, 96 X 20 BHCA/DS0 = 1920
- 120 E1 DS0s max on AS5300, 120 X 20 BHCA/DS0 = 2400

	T1 PRI	T1 CAS	E1 PRI	E1/R2
GW BHCA	1840	1920	2400	2400
# GWs	544	521	417	417
# Zones	6	6	5	5



Case Study Part 1: Building to Core

Customer A Profile

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Customer A	50 Customers, Toll Arbitrage and Clearinghouse
Network Type	100% Cisco VOIP, Card, Systems Integrator
Growth Areas of Interest	VOIP in Targeted Areas, Expand to ITSP in China
# VOIP GWs	???
Minutes of Traffic per Month	1 Million
Number of POPs	5
Location Profile of PPs	San Jose, New York, Miami, Mexico, Venezuela
Traffic BHCA per POPs	18,000 BHCA per POP

Brand A Network Map

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Customer A Design Needs

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- Allow for POPs located in 5 cities
- Traffic needs
  - 18,000 BHCA for each POP
- Enable network to scale to allow future addition of 5 new POPs in each country
- Increase availability of core components
- Allow for billing of VoIP calls
- Allow for security

Case Study Design

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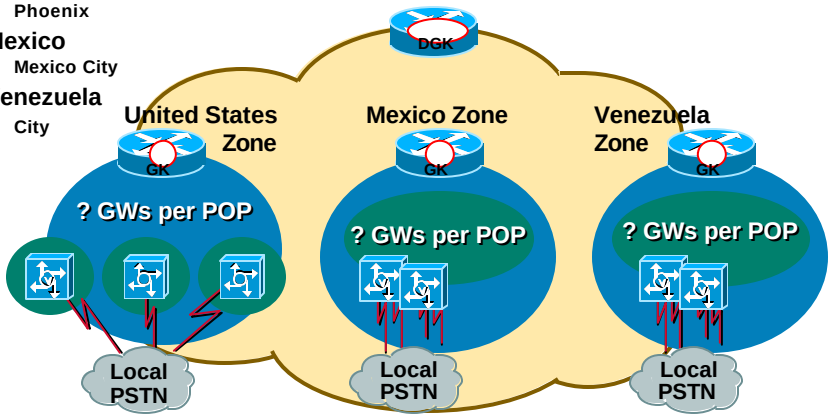
- **Coverage Area**
  - United States
    - San Jose
    - Miami
    - Phoenix
  - Mexico
    - Mexico City
  - Venezuela
    - City
- **Use of gatekeeper and directory gatekeeper**
  - Create zones based on country code



POP Sizing—Number of GWs per POP

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Assumptions:

- POP must service 18,000 BHCA
- Each call has 3 minute Hold Time (HT)
- Number of DS0s per GW is platform dependent
- 120 E1 DS0s per GW (AS5300)
- 5 CPS max x 60 sec/min x 60 min/hr =18,000 BHCA for POP

Calculating number of GWs:

- **Calls/DS0 per hour**
  - = (60 min/hour)/(hold time)
  - = 60/3
  - = 20 BHCA/DS0
- **BHCA capacity of AS5300**
  - = (DS0/GW) * (BHCA/DS0)
  - = 120 * 20
  - = 2,400 BHCA/GW (0.67 calls/sec)
- **# GWs needed**
  - = (POP BHCA)/(BHCA/GW)
  - = X/2400 GWs needed
  - = 18,000/2400 GWs needed
  - = 7.5 GW = 8 GWs needed
  - To support 18,000 BHCA

Number of GKs Needed for Given GWs

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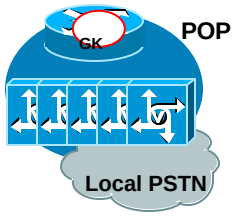
Assumptions:

- Consider the max CPS for a GW; This varies depending on platform
- I.e. AS5300 = 2 CPS
- # GWs x 2CPS = Max CPS on GK



Calculating Number of GKs Required to Administer 8 GWs

- **Total GWs in US x GW max CPS**
  - = 24 x 2
  - = 48 CPS Max
- **Refer to performance numbers**
  - Where:
  - # Endpoints = 24
  - 48 CPS max
  - We have seen call success rates of 99% with 100 endpoints at 60 CPS
  - This falls within approved range of performance

Dimensioning—Number of DGKs Needed for Given GKs

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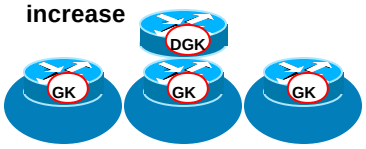
Assumptions:

- Design in DGK to be under 65% CPU utilization
- Testbed: 100% of new calls on GK utilized DGK (e.g. 60 CPS); Findings determined that each GK uses 8–10% of the DGK CPU
- For GKs that send 100% of new calls to DGK, 6 GKs will use 60% of DGK CPU

  6:1 GK/DGK ratio
- Typical DGK deployments handle less than 100% of new calls; GK/DGK ratios will increase



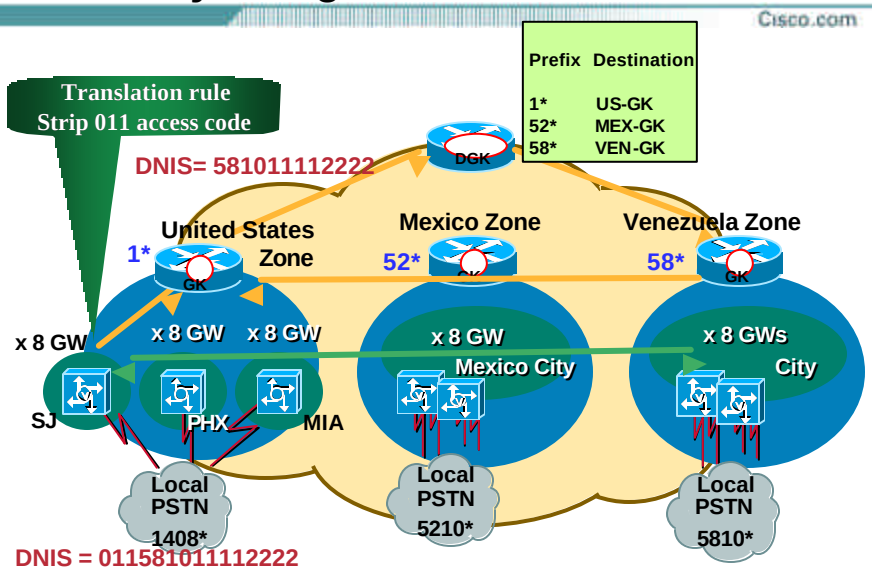
Calculating Number of DGKs Required to Administer GKs

- For case study
- Total GKs in network = 3
- The total GK RAS messaging sent to DGK is estimated at 20%
- Since 6:1 GK/DGK ratio for 100% new calls, then at 20% = 30:1 ratio

Recommendation is 6:1 GK:DGK ratio

Case Study Design

Cisco.com



San Jose GW1

Cisco.com

GATEWAY CONFIG

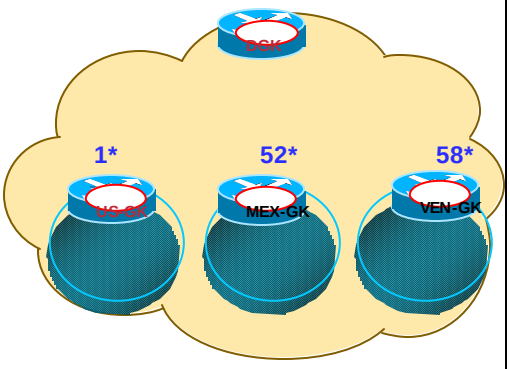
```
!
hostname SJ-GW1
!
interface Ethernet0/0
 ip address 10.1.1.1 255.255.255.0
 h323-gateway voip interface
 h323-gateway voip id US-GK ipaddr 10.1.1.2 1719
 h323-gateway voip h323-id SJ-GW1
 h323-gateway voip tech-prefix 1#
!
isdn switch-type primary-5ess
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
!
interface Serial0:23
 isdn switch-type primary-5ess
 isdn incoming-voice modem
!
!
dial-peer voice 1408 pots
 destination-pattern 1408.....
 port 0:D
!
dial-peer voice 1 voip
 destination-pattern 011T
 translate-outgoing called 1
 session target ras
!
gateway
!
translation-rule 1
 Rule 0 ^0111.% 1
 Rule 1 ^0112.% 2
 Rule 2 ^0113.% 3
 Rule 3 ^0114.% 4
 Rule 4 ^0115.% 5
 Rule 5 ^0116.% 6
 Rule 6 ^0117.% 7
 Rule 7 ^0118.% 8
 Rule 8 ^0119.% 9
!
<strips the 011 access code>
```


US-GK and DGK Configurations

Cisco.com

```
hostname DGK
!
gatekeeper
 zone local DGK  netman.com 99.1.1.1 1719
 zone remote US-GK netman.com 10.1.1.2 1719
 zone remote MEX-GK netman.com 11.1.1.2 1719
 zone remote VEN-GK netman.com 12.1.1.2 1719
 zone prefix US-GK 1*
 zone prefix MEX-GK 52*
 zone prefix VEN-GK 58*
 lrq forward-queries
 no shutdown
!
```

```
hostname US-GK
!
gatekeeper
 zone local US-GK netman.com 10.1.1.2 1719
 zone remote DGK netman.com 10.1.1.3 1719
 zone prefix US-GK 1408*
 zone prefix US-GK 1623*
 zone prefix US-GK 1305*
 zone prefix DGK *
 gw-type-prefix 1#* default-technology
 lrq forward-queries
 no shutdown
```



GK Zone Sizing

Cisco.com

Number of Busy Hour Call Attempts (BHCA) per GK depends upon:

- GK platform
- Fault-tolerance features
- Number of registered endpoints
- Dial plan complexity
- Average hold times

Single Gatekeeper Performance

Cisco.com

Testbed Consisting of 3660 Platform

CPS	Endpoints 1000	2500	5000	7500
20	99.90	99.90	99.14	98.90
30	99.59	99.70	99.16	98.72
40	99.56	99.60	97.10	92.97
50	97.00	95.72	85.24	75.46

IOS version 12.1(5)XM

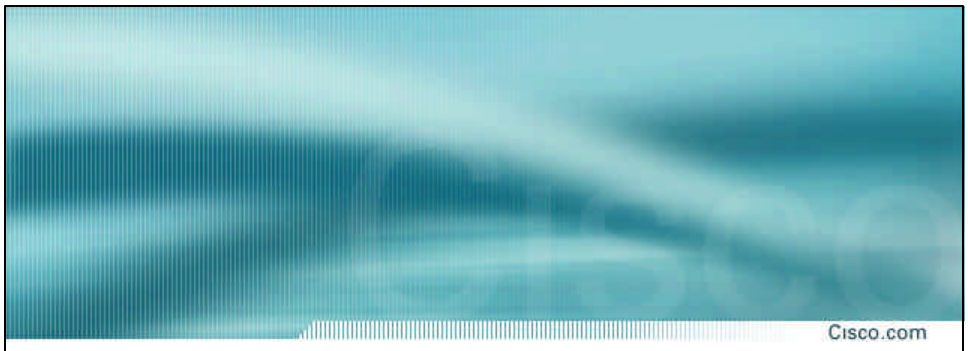
Single Gatekeeper Performance (Cont.)

Cisco.com

Testbed Consisting of 7200 Platform Endpoints

CPS	1000	2500	5000	7500
20	99.90	99.90	99.95	99.95
30	99.59	99.70	99.71	98.00
40	99.73	97.45	96.56	73.06
50	99.66	99.71	92.70	48.41
60	99.57	99.51	82.52	47.86*

IOS version 12.1(5)XM



Increasing Availability in the H.323 Network

Redundancy Mechanisms

Cisco.com

- Gateways
  - Multiple GWs servicing same coverage area
  - Rotary dial peers
  - RAI, GW priority
- Zone gatekeeper
  - Alternate GK
  - GK clustering
- Directory GK
  - HSRP
  - Alternate DGK

Rotary Dial Peers

Cisco.com

- Multiple dial-peers with a preference assigned to dial-peers to establish order
  - Zero is the highest priority (default)
  - Nine is the lowest priority
- Select dial-peer based on longest matching destination pattern
  - (e.g. select 55511.. over 555….)
- Then use preference values for equally matching destination patterns
- Dial-peers with equally matching destination patterns and equal preference values are chosen at random

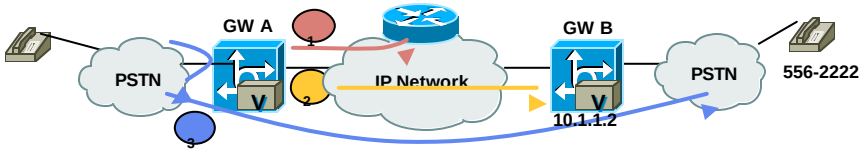
Rotary Dial Peer Benefits

Cisco.com

- **Simple load balancing**
  - Multiple dial-peers with equal preferences
  - Randomly select a destination gateway if multiple terminating gateways are available
- **Simple least-cost routing**
  - Multiple dial-peers with various preferences.
  - Try the most preferred endpoint first
- **PSTN fall-back (hairpinning)**
  - Re-routes incoming PSTN call back to PSTN if no gateway hop-off point is available on the VoIP network

Rotary Dial-Peer Example

Cisco.com



GW A Configuration

First choice	dial-peer voice 100 voip destination-pattern 556.... session target ras
Second choice	dial-peer voice 200 voip destination-pattern 556.... session target ipv4:10.1.1.2 preference 1
Third choice	dial-peer voice 300 pots destination-pattern 556.... port 0:d preference 2

Call Admission Control to Route Calls to Free Resources

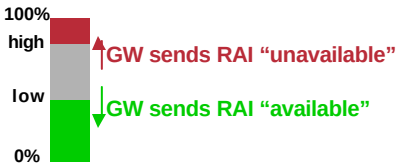
Cisco.com

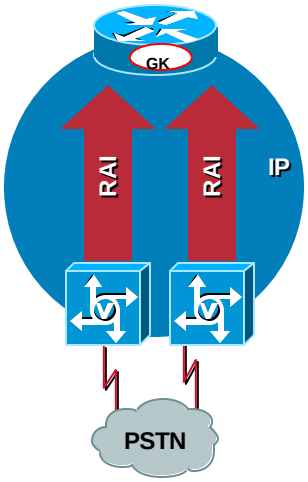
- **What happens when a Gateway is "getting full"?**

  H.323 Resource Availability Indicator (RAI) informs Gatekeeper when no Circuits (DS0s) or DSPs available

  Gatekeeper can select best available GW the first time to increase call completion rates and lower post-dial delay

  Once the gatekeeper receives the RAI it will not assign a call to the gateway low on resources.





RAI Configuration Example

Cisco.com

gw1(config-gateway)# resource threshold [all] [high %-value] [low %-value]

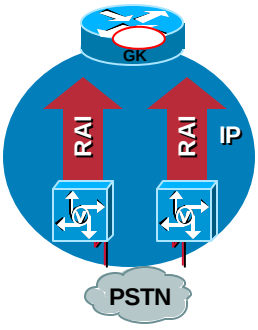
default: both values are 90%

E.g. resource threshold high 90 low 80

gw1(config-gateway)# resource threshold 90 80

E.g. resource threshold high 90 low 80

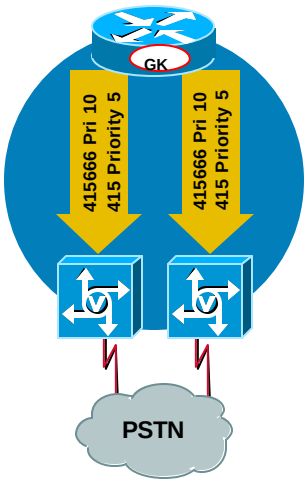
```
5300-GW #show gateway
 Gateway  5300-GW  is registered to Gatekeeper  gk.mwest

 H323 resource thresholding is Enabled and Active
 H323 resource threshold values:
  DSP: Low threshold 80, High threshold 90
  DS0: Low threshold 80, High threshold 90
```



Call Admission Control to Assign Priority to GW

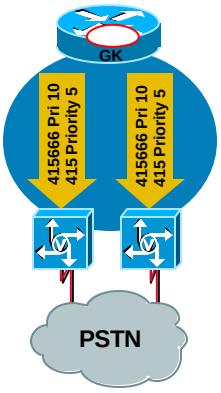
Cisco.com

- GW priority selected on GK to prioritize GW selection
- Gatekeeper can select best available GW the first time to increase call completion rates and lower post-dial delay



GW Priority Config Example

Cisco.com



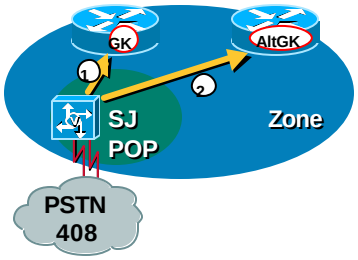

```
GK(config)# gatekeeper
GK(config-gk)# zone local west-gk cisco.com 10.1.1.1
GK(config-gk)# zone prefix west-gk  415666.... gw-pri 10 gw1
GK(config-gk)# zone prefix west-gk  415777.... gw-pri 10 gw2

default priority is 5
```

```
resultant  Master list
master list: gw1, gw2
408666 list: pri 10 gw1; pri 5 gw2
408777 list: pri 10 gw2; pri 5 gw1
```

Fault Tolerance—Alternate GK

Cisco.com

- Gateways register to the GK
  - Static registration statement configured on GW
  - Lightweight RRQs sent from GW to GK as keepalive
- Alternate GK can be added
  - Secondary registration statement configured with lower priority
  - If GK fails to send RCF back to GW, RRQ sent to Alternate GW
  - Alt GK is geographic independent



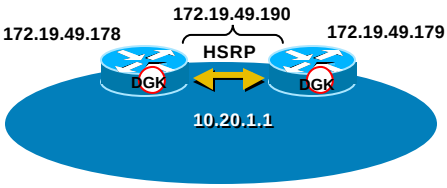
GW Configuration for Alternate GK

Cisco.com

```
hostname US-GW1
!
!
interface Ethernet0/0
 ip address 172.1.1.1 255.255.255.0
 h323-gateway voip interface
 h323-gateway voip id NA-GK ipaddr 172.1.1.2 1719 priority 1
 h323-gateway voip id NA-ALTGK ipaddr 172.1.1.3 1719 priority 2
 h323-gateway voip h323-id US-GW1
!
```

Fault Tolerance—HSRP at the DGK

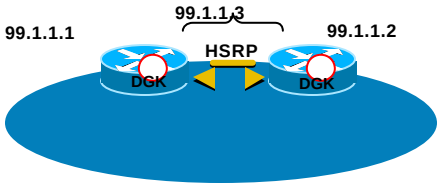
Cisco.com



- **Directory GK can use a backup DGK with HSRP**
  - **Standard Cisco Hot Swap Routing Protocol**
  - **Interval time can be configured (default = 10 sec)**
  - **Convergence time**
  - **Must be on same LAN**
  - **HSRP only used on DGK, since zone HSRP GK cannot support GW registrations**

Sample Configuration HSRP at the DGK

Cisco.com



ACTIVE ROUTER

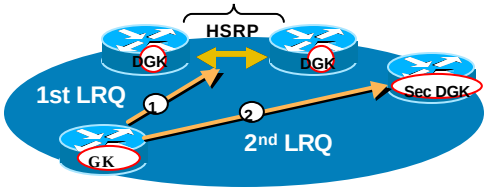
```
!
interface FastEthernet0/0
 ip address 99.1.1.1 255.255.255.0
 duplex auto
 speed auto
 standby 1 priority 110
 standby 1 ip 99.1.1.3
 standby timers x x
```

STANDBY ROUTER

```
!
interface FastEthernet0/0
 ip address 99.1.1.2 255.255.255.0
 duplex auto
 speed auto
 standby 1 priority 100
 standby 1 ip 99.1.1.3
```

Fault Tolerance – Secondary Directory GK

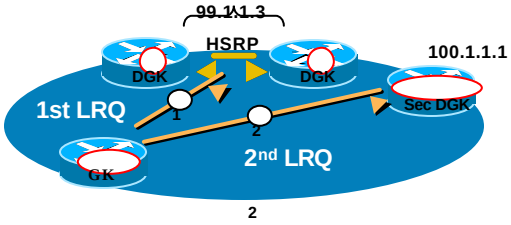
Cisco.com



- Used to backup the HSRP DGK pair
- HSRP pair may take x seconds to complete failover (default = 10 sec)
- Calls not processed during this failover time
- Uses sequential LRQ from zone GK to enable secondary DGK
- Interval time between #1 and #2 is configurable in ms on zone GK
- Zone prefix table on Secondary configured identical to Primary DGK

Sample Configuration Secondary Directory GK

Cisco.com



- **Secondary DGK**

  Special configuration required at Zone GK

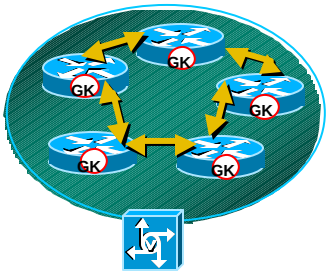
```
gatekeeper
 zone local GK netman.com 11.1.1.1 1719
 zone remote DGK netman.com 99.1.1.3 1719
 zone remote SecDGK netman.com 100.1.1.1 1719
 zone prefix US-GK 408*
 zone prefix DGK *
 zone prefix SecDGK *
 lrq forward-queries
```

  Zone prefix table on AltDGK should match primary DGK

Fault Tolerance—GK Clustering

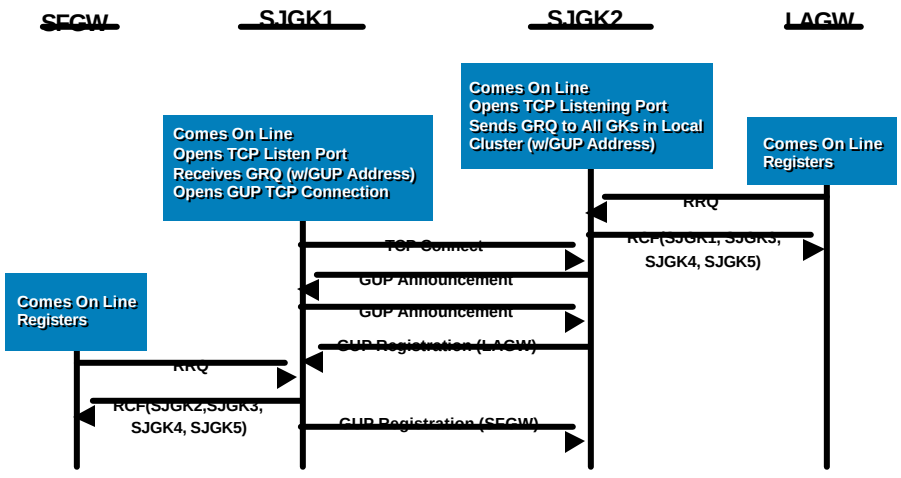
Cisco.com

- Gatekeepers can be configured as "Cluster"
  - Cluster consists of up to 5 Gatekeepers
  - Aimed at increasing CPS throughput and endpoints registered
  - Allows individual GKs to collect group information such as Registrations, Bandwidth, and individual load
  - Clustering benefits include redundancy, load-balancing/sharing
  - Uses Gateway Uptime Protocol (GUP)
  - External entity needs to only send LRQ to one member of cluster
  - LRQ load shared between elements of the cluster



Redundancy (GUP, Message Flow)

Cisco.com



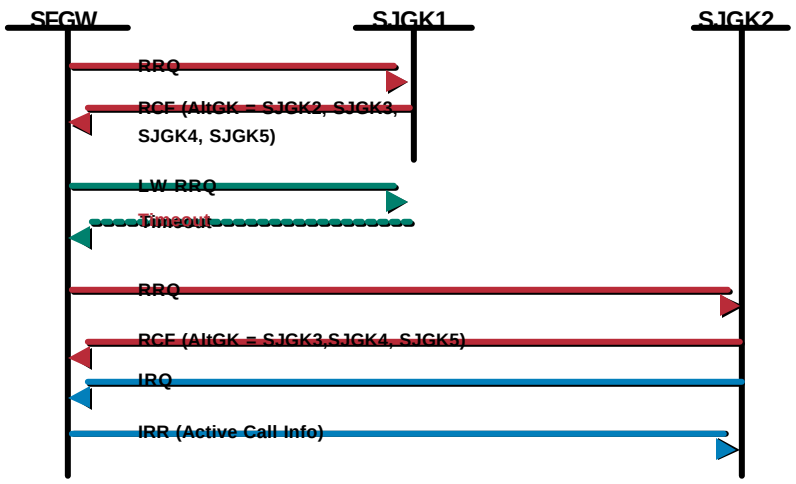
Redundancy

Cisco.com

- Endpoints are informed of the alternate Gatekeepers at Registration (RCF) in priority order
- Endpoints re-register with the highest priority alternate if primary fails

Redundancy (Message Flow) When One GK Becomes Unavailable

Cisco.com



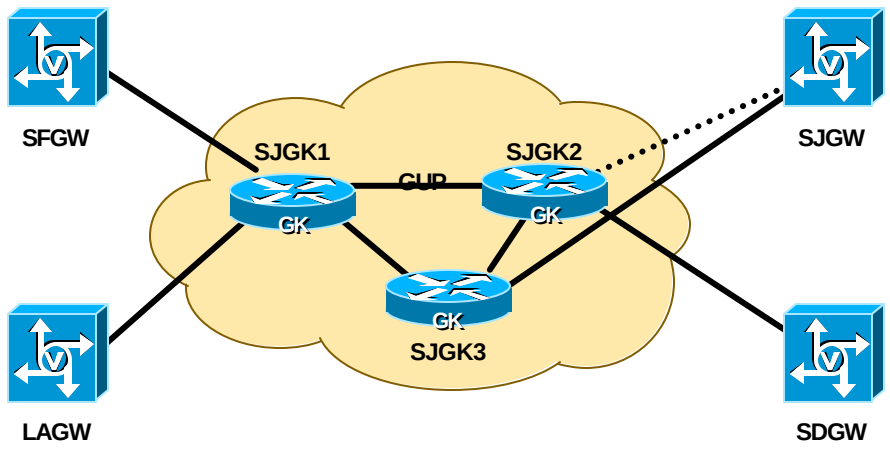
Load Balancing

Cisco.com

- If a GK gets overloaded, it may ask an Endpoint to go to another GK in the local cluster
- The Endpoint gives the new GK a list of active calls via IRRs
- Does not balance loads equally but is a means to offload extra load
- Gatekeeper will send the list of best alternate in RCF/RRJ or ARJ to endpoints; this list changes real-time, depending on load conditions

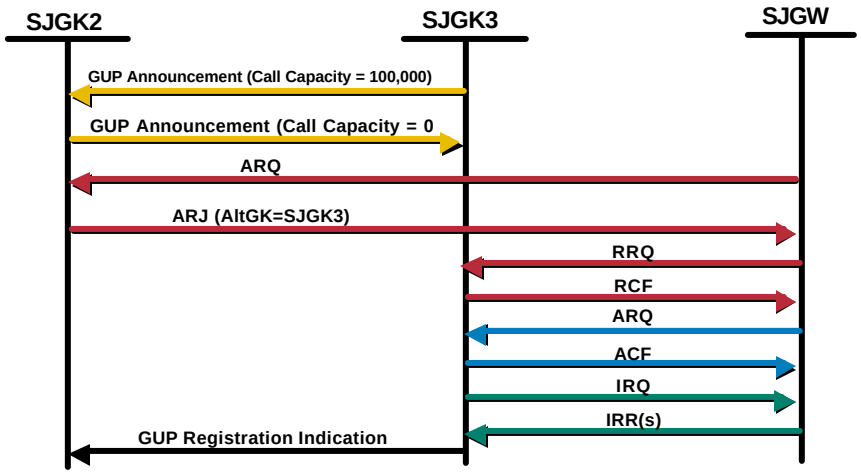
Load Balance

Cisco.com



Load Balance (Message Flow)

Cisco.com



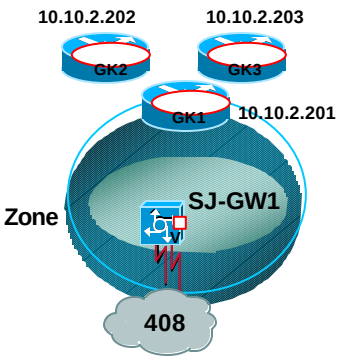
US-GK Cluster Configuration

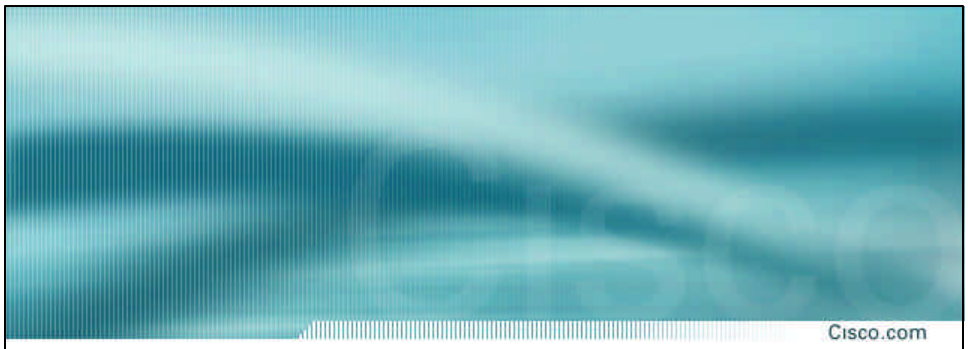
Cisco.com

```
gatekeeper
 zone local Zone1 cisco.com 10.10.2.201
 zone cluster local gozer Zone1
  element Zone2 10.10.2.202 1719
  element Zone3 10.10.2.203 1719
```

```
gatekeeper
 zone local Zone2 cisco.com 10.10.2.202
 zone cluster local gozer Zone2
  element Zone1 10.10.2.201 1719
  element Zone3 10.10.2.203 1719
```

```
gatekeeper
 zone local Zone3 cisco.com 10.10.2.203
 zone cluster local gozer Zone3
  element Zone1 10.10.2.201 1719
  element Zone2 10.10.2.202 1719
```





Case Study: Adding in Redundancy

Customer A Design Needs

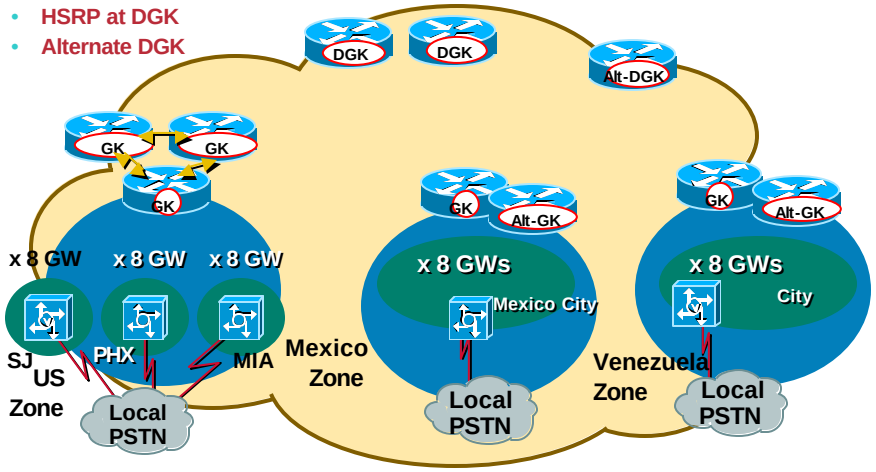
Cisco.com

- Allow for POPs located in 5 cities
- Traffic needs
  - 18,000 BHCA for each POP
  - 5 CPS Calls Per Second for each POP
- Enable network to scale to allow addition of 5 new POPs in next 6 months
- **Increase availability of core components**
- Allow for billing of VoIP calls
- Allow for security

Case Study
Adding Redundancy

Cisco.com

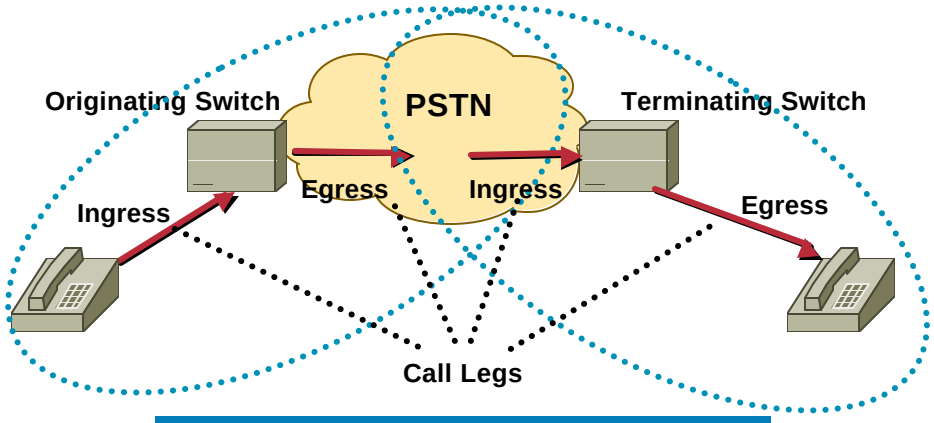
- Clustering for US zone
- Alternate GK at Mexico and Venezuela zone
- HSRP at DGK
- Alternate DGK



Cisco.com

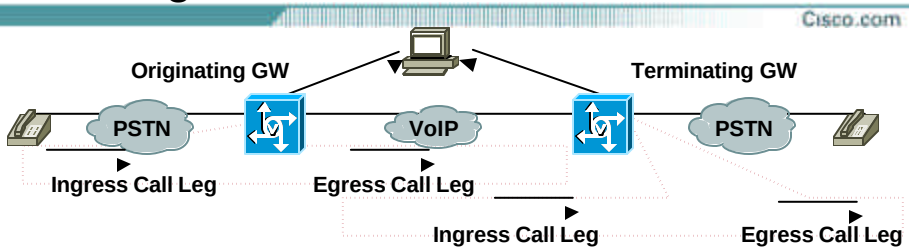
Billing in the H.323 Network

Call Legs



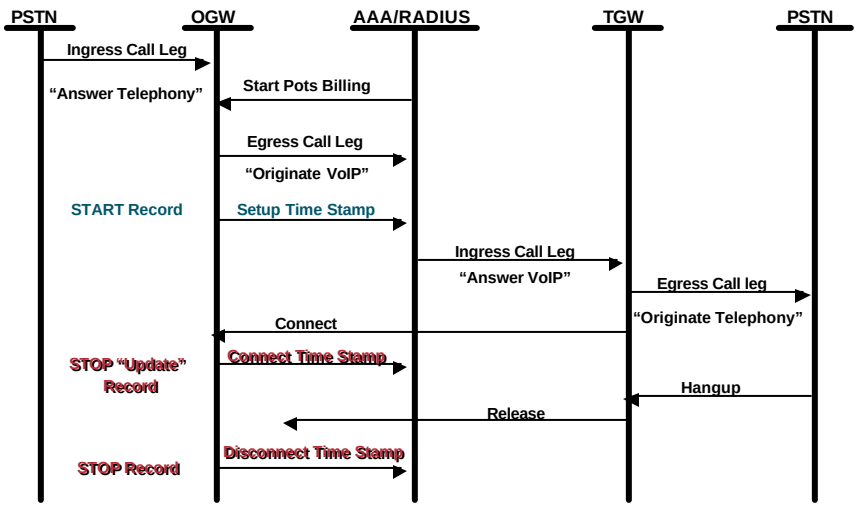
Each Switch Has Bridged Together Two Call Legs, But the Call Legs Are of Local Significance

Call Leg Records

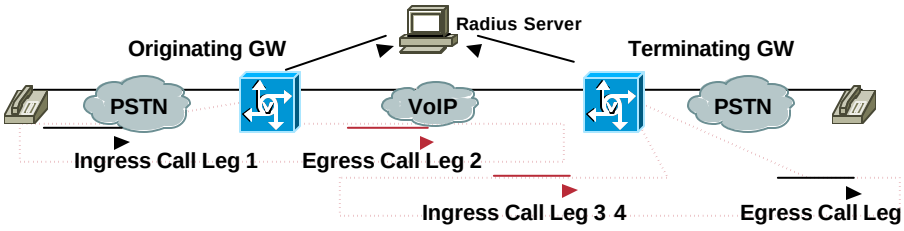


- Each call leg generates start, update and stop records
- Each record has information specific to its call leg
- Each call leg reports the NTP time for when the SETUP (start) was issued, the call was CONNECTED (update) and the DISCONNECT (stop) was received
- The stop records have the information for billing
- The various call leg records for a single end-to-end call can be correlated using the conference ID

Billing Call Flow

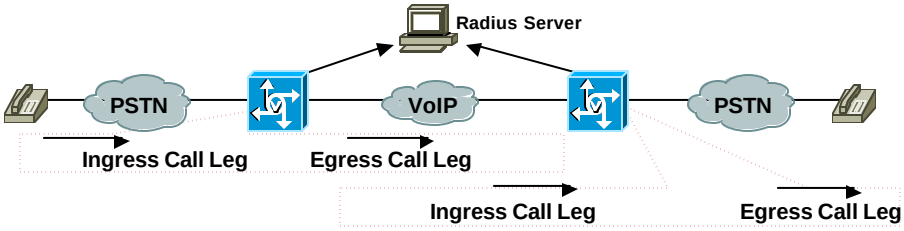


Which Call Leg Do We Bill On?



- Generally speaking, bill from call legs 2 or 3
- Connect state is determined off of call leg 2 or 3
- Call leg 1 will have excess time (user authentication, IVR, radius authorization)

Timestamps – “Let’s get in Sync..”



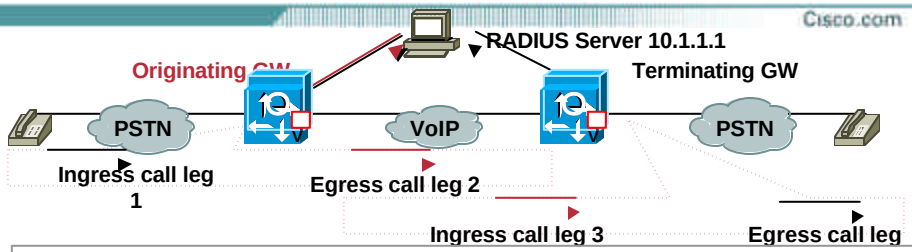
- Each call leg reports the NTP time for when the SETUP was issued, the call was CONNECTED and the DISCONNECT was received

No NTP = Invalid Timestamps

*Jan 1 00:02:17.502: connect time : *16:02:10.842 PST Fri Dec 31 1999

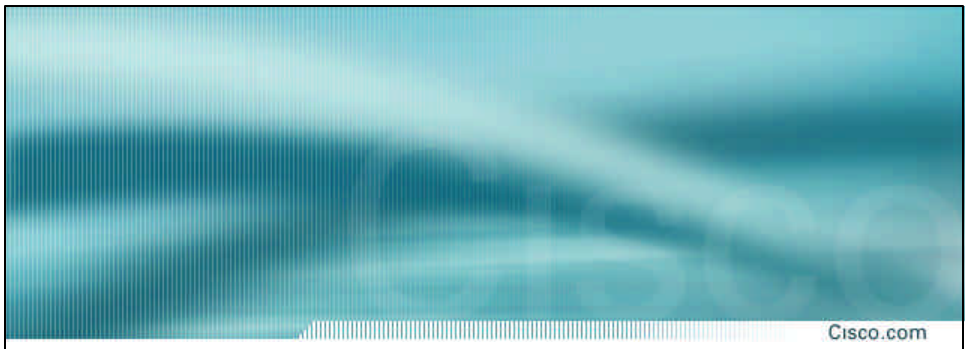
*Jan 1 00:02:17.502: disconnect time : *16:02:17.502 PST Fri Dec 31 1999

Sample GW Configuration




```
OGW(config)# aaa new-model
OGW(config)# aaa accounting connection h323 stop-only group radius
OGW(config)# radius-server host 10.1.1.1 auth-port 1645 acct-port 1646
OGW(config)# radius key test123
OGW(config)# radius-server vsa send accounting
OGW(config)# gw-accounting h323 vsa
OGW(config)# gw-accounting voip
```

Don’t forget to configure for NTP !



Security Options

Security Options

- H.235 security
- Class of Restriction
- Access Control Lists

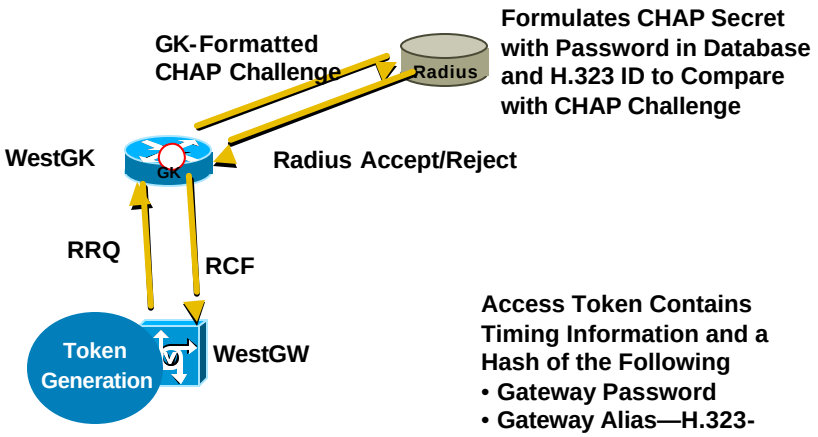
H.235 Security

Cisco.com

- Can be configured for:
  - GW registration only
  - Per call only
  - Both
- GW Registration Security
  - Secure Registration from GWs
  - GK validates source of RAS messages with AAA Server using Access Token (AT) – Chap-like
  - Access Token = GW password + H.323 ID
- Per Call Security
  - For per call, authenticates users of gateways rather than the gateways themselves using ARQ/ACF
  - 2 CPS limitation on GK to AAA interaction; may not be suitable for high call volumes, intra-domain

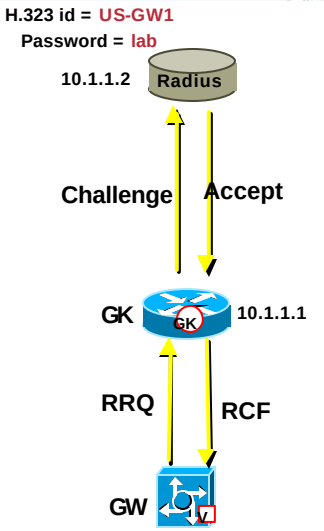
H.323 Security Options Registration Security

Cisco.com



H.323 Security Configuration
Registration Security

Cisco.com

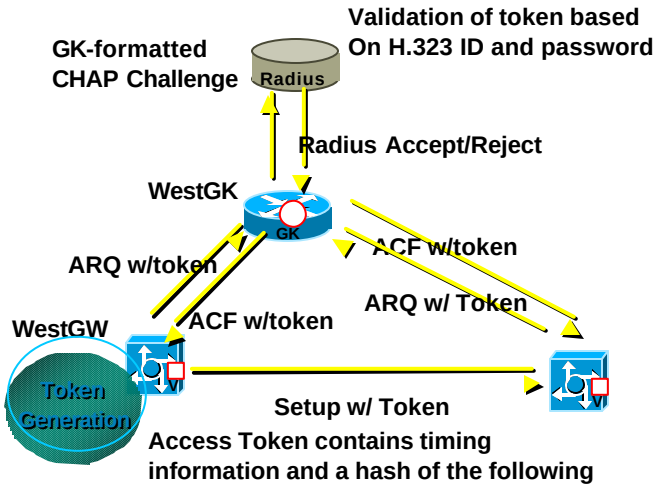



```
!
gatekeeper
 zone local NA-GK netman.com 10.1.1.1
 security token required-for registration
 gw-type-prefix 1#* default-technology
 lrq forward-queries
 no shutdown
!
radius-server host 10.1.1.2 auth-port 1645
       acct-port 1646 key lab
radius-server retransmit 3
radius-server key cisco
!
ntp master
```

```
!
gateway
 security password lab level endpoint
!
interface Ethernet0/0
 h323-gateway voip h323-id US-GW1
!
ntp clock-period 17208214
ntp server 10.1.1.1
```


H.323 Security Options
Per Call Security

Cisco.com



Access Token contains timing information and a hash of the following

- Gateway password
- Gateway Alias - H323-ID

H.323 Class of Restriction (COR)

Cisco.com

- Determine inbound/outbound classification rules
- Administratively group dial-peers
- Apply to dial-peers to allow/disallow dial-peers from utilizing other “groups” of dial-peers
- COR specifies which incoming dial-peer can use which outgoing dial-peer to make a call
- Example A: Offnet callers cannot dial anywhere but to 140852xxxx (PBX)
- Example B: FXS phones A and B can only call 1-800 #’s and each other, but FXS phone C and D can call anywhere

COR – Sample Configuration

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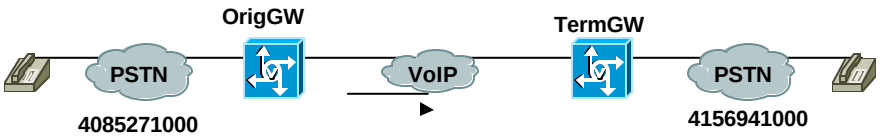
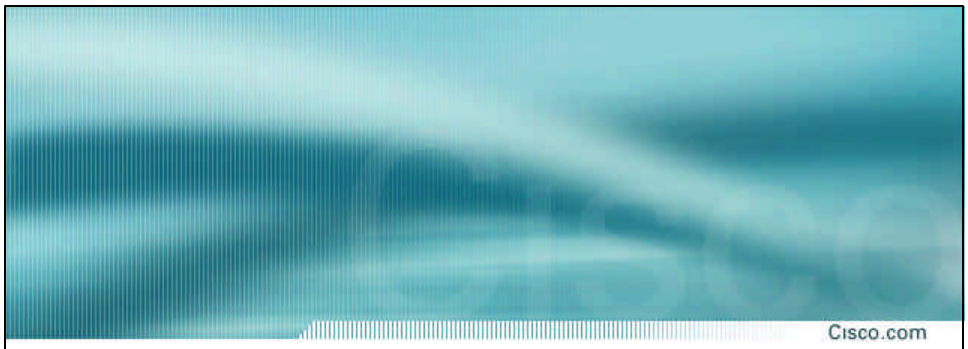


EXAMPLE: Configure TermGW to block calls originating from 4085271000 destined for 4156941000

```
Hostname TermGW
!
dial-peer cor custom
 name 408_call
 name 415_call
!
dial-peer cor list list1
 member 408_call
!
dial-peer cor list list2
 member 415_call
!
```

```
port 1/0/0
!
dial-peer voice 5 pots
 corlist incoming list1
 destination-pattern 4156941000
 port 1/0/0
!
dial-peer voice 4 voip
 corlist outgoing list2
 destination-pattern 4085271000
 session target ras
!
gateway
```



Case Study # 1: Adding in the Billing Component and Security

Customer A Design Needs

- Allow for POPs located in 5 cities
- Traffic needs
  - 18,000 BHCA for each POP
  - 5 CPS Calls Per Second for each POP
- Enable network to scale to allow addition of 5 new POPs in next 6 months
- Increase availability of core components
- **Allow for billing of VoIP calls**
- **Allow for security**

Case Study Adding Redundancy

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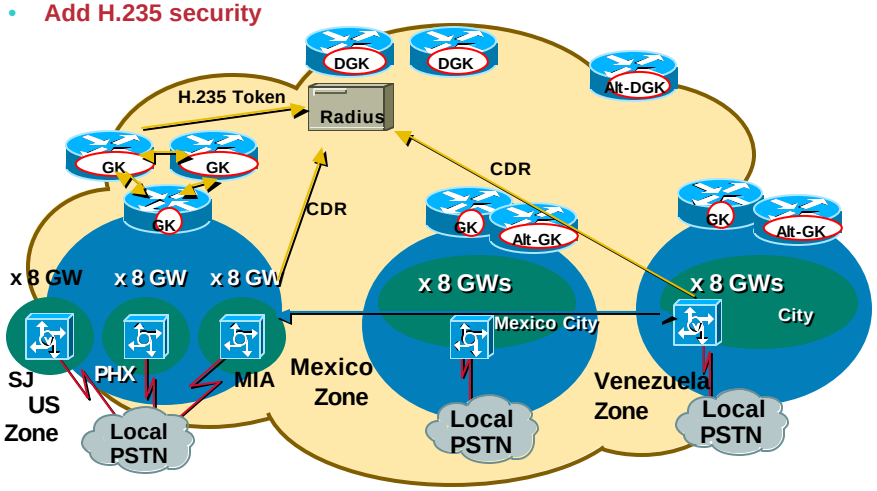
- Add RADIUS/AAA/billing application
- Add H.235 security



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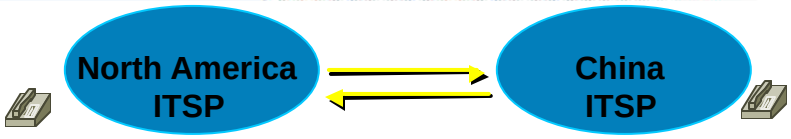
Expanding the Coverage Area

Increasing Traffic with Partnerships

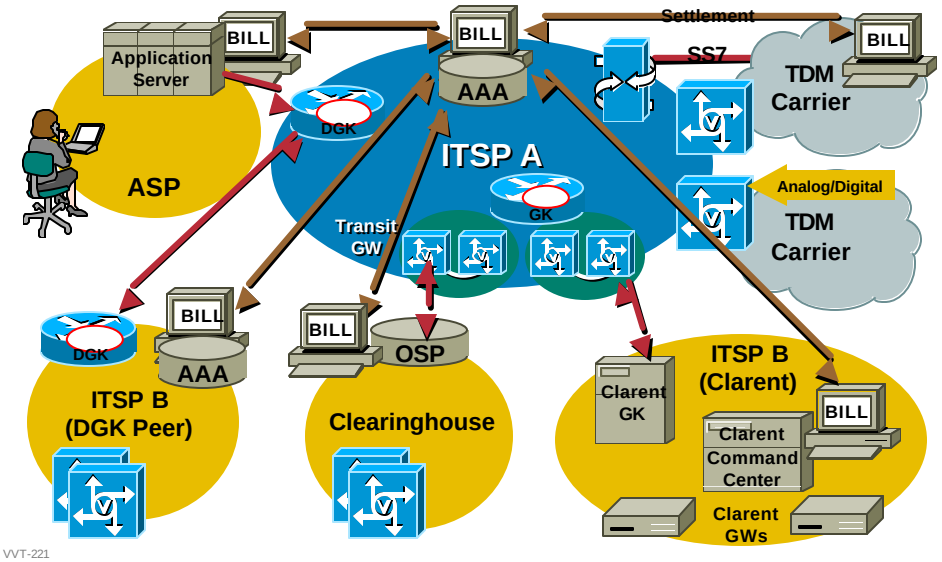


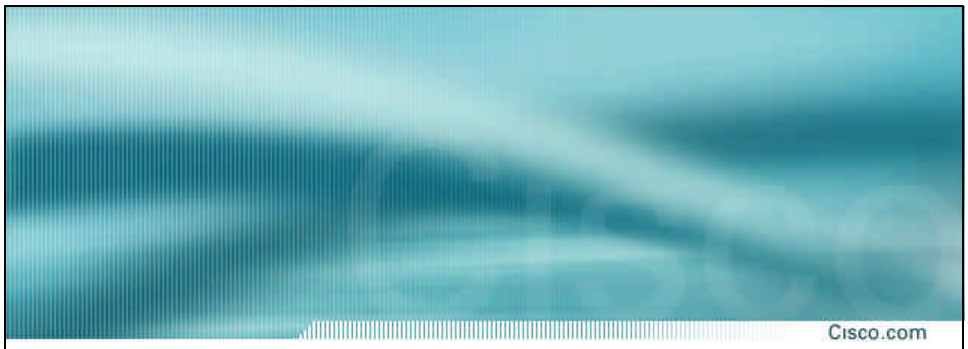
"I service North America.."

" I service China…"

- Partnerships made between both TDM based and IP based telephony carriers to increase traffic volume, subscriber base, and revenue generation. Minimizes investment.
- For IP interconnections, Cisco provides high performance call routing using standards-based methods (e.g. OSP and H.323v2 LRQ) and also flexibly accommodates non-standards based networks
-

Interconnection with Other Carriers (TDM and IP)





Interconnecting to TDM-Based Carriers

Solution Components

Diagram	Description	Details	Purpose
Cisco SC2200 Host	Signaling Controller AKA: Cisco SC2200 Host	Based on Sun Netra 1120s, 1400s and 1800s	Supports Over 60 Different ISUP Variants Into Q.931+ over IP
Cisco SC2200 Node / SLT	Signaling Link Terminal AKA: SLT	Based On 2611 with Special Cisco IOS Image for the SLT	Supports Terminating A or F Links and Encapsulating MTP 3 Layers and Above Over IP; Provides Muxing F Links Off E1s
AS5x00	Cisco Voice Gateway	Based On AS5300, AS5300	H.323 Voice-Over-IP Media Gateway Responsible for Voice Packetization, H.323 Signaling

SS7 POPs

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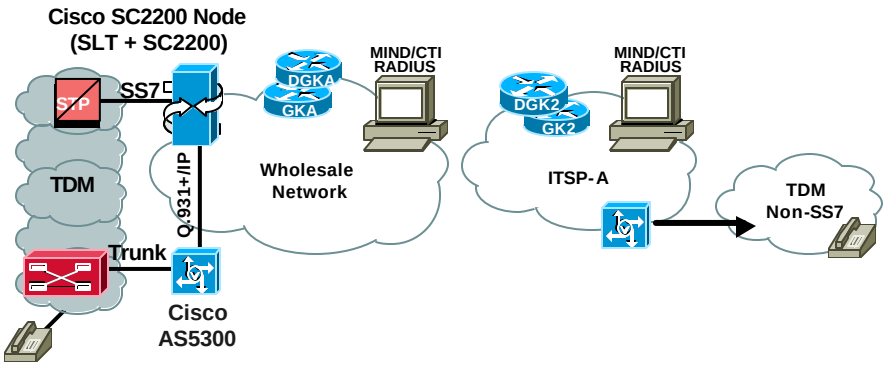

Cisco SC2200 Node Added for SS7 Interconnect; When a New SS7 POP Is Added, No Additional Changes to H.323 Network Needed

Non-SS7 POPs

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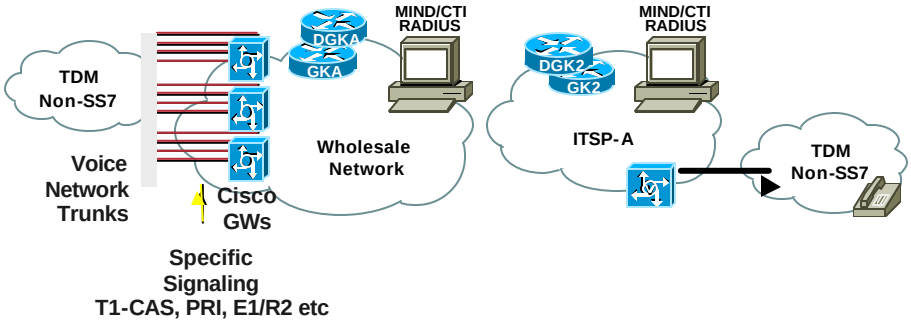

Specific Signaling T1-CAS, PRI, E1/R2 etc

Non-SS7-based POPs Receive Signaling from TDM Network On Same Interface that Supports Bearer Traffic; Use Cisco GW that Supports Signaling Type Offered By TDM Interconnect

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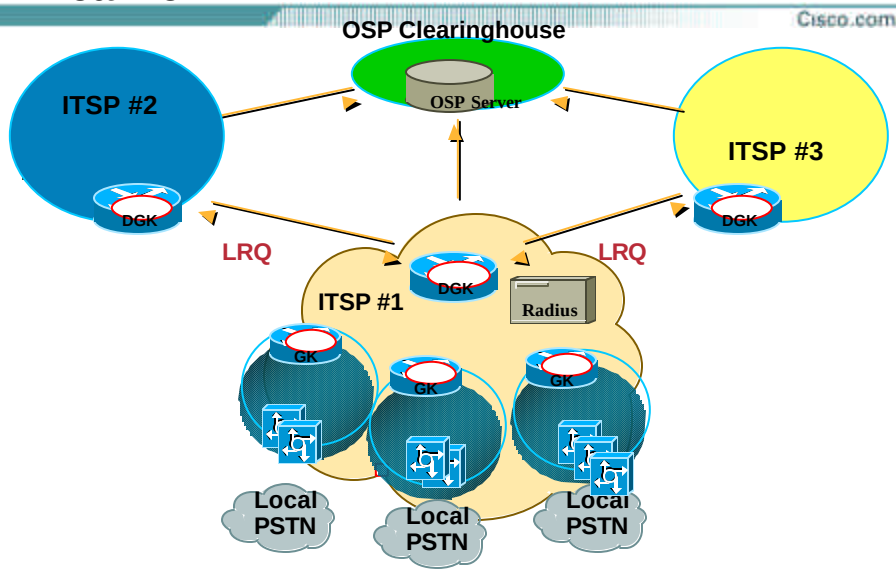
Interconnecting to IP-Based Carriers

Interconnecting to another IP based carrier

Cisco.com



H.323 LRQ Forwarding

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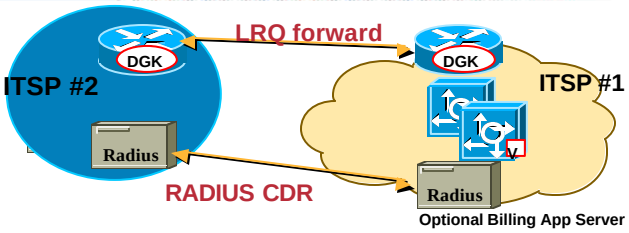

- LRQ from Directory Gatekeeper
  - Trusted Peer relationship needed between carriers
- Call Routing
  - Routes queried by LRQ forwarding on each DGK
- Billing
  - Billing settled by exchange of CDRs from dedicated RADIUS Server
  - Optional mediation server
- Security
  - H.235 Token Security, Access Control Lists, Class of Restriction

Open Settlements Protocol

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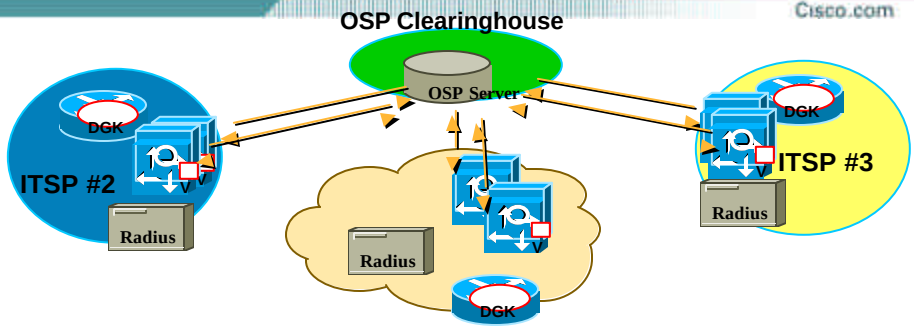
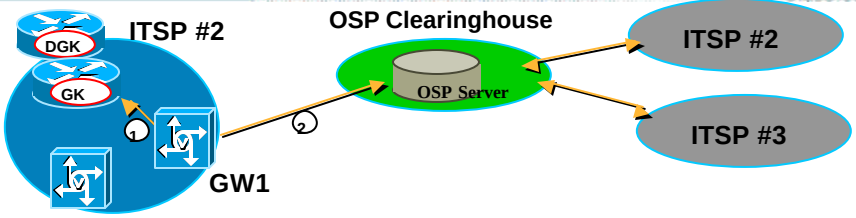


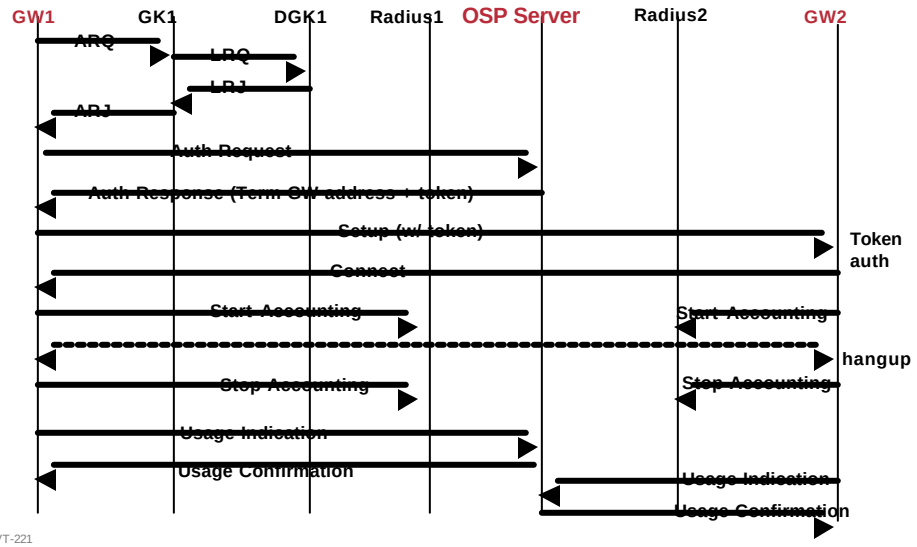
- Open Settlements Protocol (OSP) - server used in clearinghouse for interdomain call routing, billing, and security
- Call Routing - Routes configured centrally on OSP Server
- Billing - Billing settled centrally on OSP Server
- Security - Token based
  - Each GW in wholesale network need to have OSP client.
  - Transit GW needed to integrate existing DGK based network

OSP Configuration Example

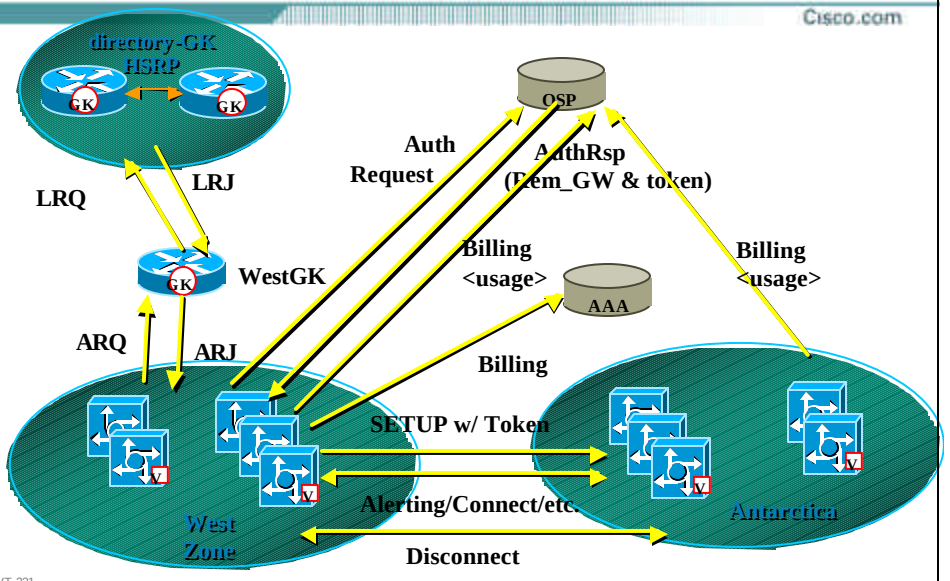



```
hostname GW1
!
crypto ca identity OSPserv
enrcrypto ca identity OSP_clear
enrollment url http://10.1.1.1:80/81
crl optional
crypto ca certificate chain OSP_clear
certificate 54
30820206 3082016F A0030201 02020154 300D0609...
!
settlement 0
type osp
url http://10.1.1.1
encryption des-cbc-sha
!
dial-peer voice 1 voip
destination-pattern 1*
session target ras
Preference 1
!
dial-peer voice 2 voip
destination-pattern 61*
session target settlement:0
Preference 2
!
```

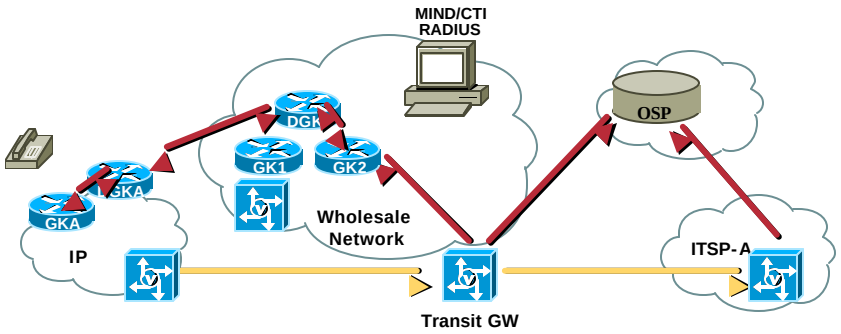

OSP Call Flow – GW1 to GW2



OSP Based Interconnect



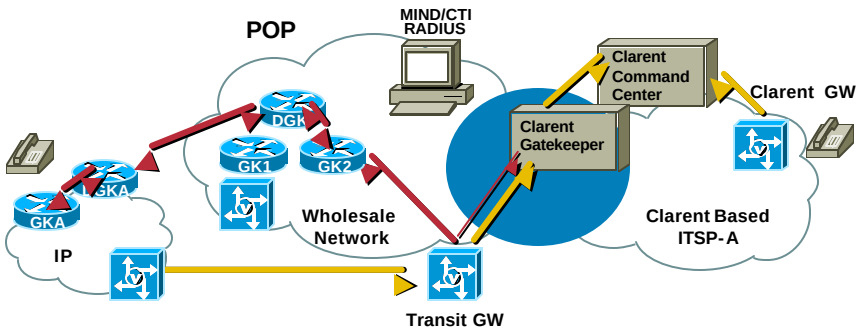
Adding the Transit GW for OSP Interconnect



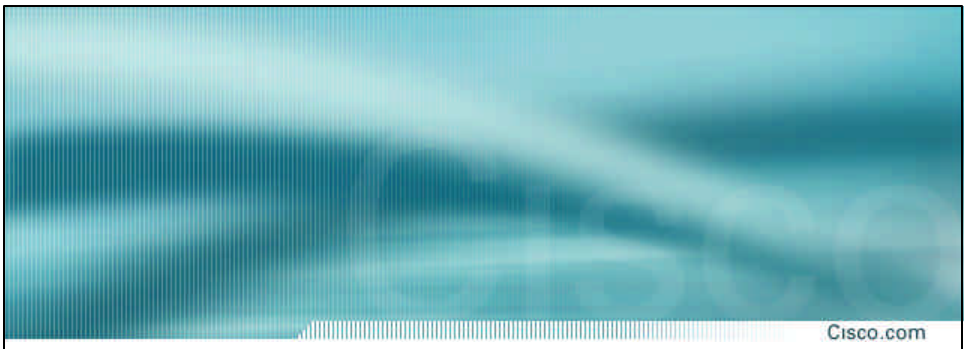
- Used when ITSP-A is OSP-based, Wholesaler/Partner SP is DGK RAS-based
- Create a Transit Zone with Transit GWs
- Only one GW registers to OSP server, dedicated to OSP
- Only OSP-based calls go through the Transit GW
- No additional overhead (OSP) on other GWs required

Interconnecting to Non-Cisco-Based Carriers

Adding the Transit GW for Clarent Interconnect

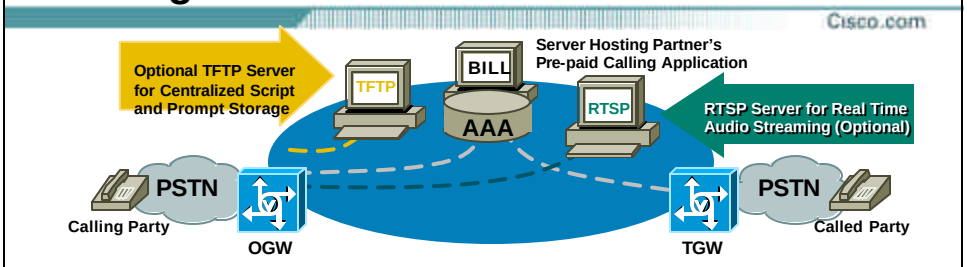


- A single GW can only register to one GK
- Clarent Command Center does not support H.323, only proprietary Clarent protocol
- Clarent Gatekeeper supports H.323 on one side, proprietary Clarent on other side
- Transit zone created with Transit GWs, to allow Clarent Interconnect
- Transit GW sends SETUP message to Clarent Command Center, since it uses gatekeeper routed call signaling method

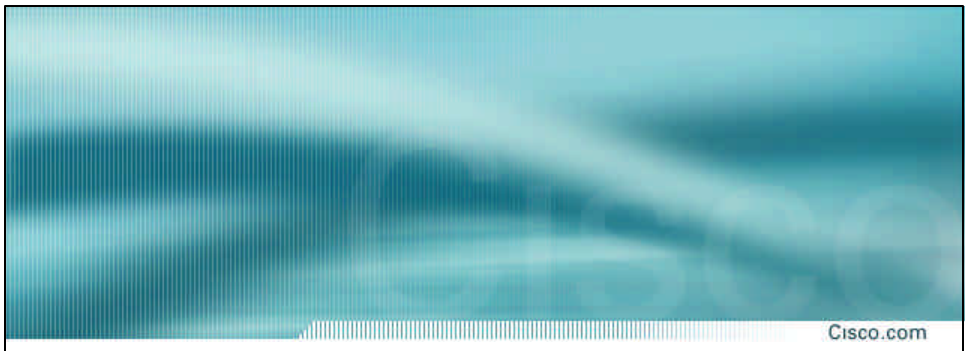


Other Services: Card Services

Distributed Phone-to-Phone Calling Card Solution



- **Originating GW supports IVR capabilities**
  - Provides user authentication before entering network
  - Processing associated with IVR functions pushed to the edge
  - Customizable scripts using TCL
  - Multi-language support
  - Individual service branding to simultaneously host multiple retail applications on a single network
- **AAA server**
  - Provides real-time billing for pre-paid applications
- **RTSP server**
  - Provides audio announcement streaming
- **TFTP server**
  - Stores IVR scripts and prompts for centralized distribution



Network Management Solutions

Network Management Tools

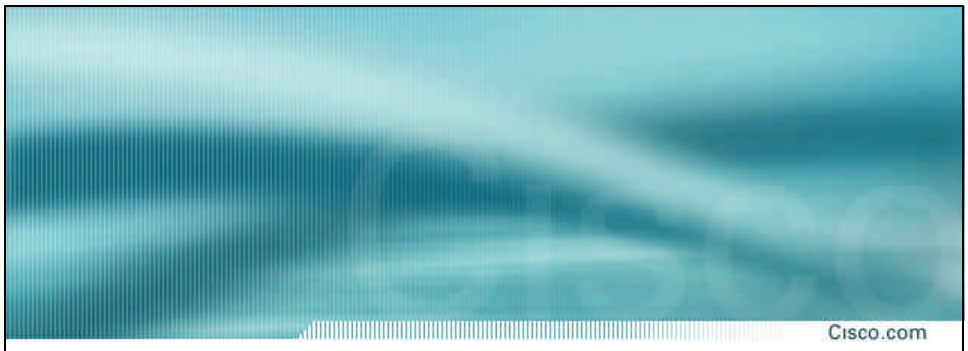
Cisco.com

- CiscoWorks 2000—Cisco Voice Manager
  - SNMP element management
  - Performance reporting with 3rd-party application
- CiscoWorks 2000—Internet Performance Monitor
  - Real-time network quality-of-service monitoring
  - IOS Service Assurance Agent
- CiscoWorks 2000—Remote Manager Essential
  - IOS upgrade and release management
- Cisco Info Center
  - SNMP trap correlation
- Standards-based SNMP Applications
  - HP OpenView

Network Management Tools

Cisco.com

- For more info see additional backup NMS slides
- Also, visit the World of Solutions for more information



What Next?

GKTMP on GK

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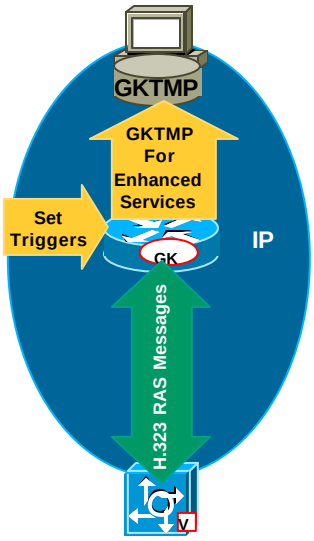
- GKTMP interface on GK for enhanced services
  - Northbound interface extends Cisco's Open Packet Telephony architecture philosophy to GK and DGK platforms
  - Allows more flexibility and quicker development of new services using third party partners opposed to closed systems
  - Can customize specific RAS messages to trigger up to the GKTMP server for enhanced service logic
- GK supported on various platforms depending upon desired performance
  - 3660 (IP/H.323 feature set)
  - 7200 (Enterprise feature set)



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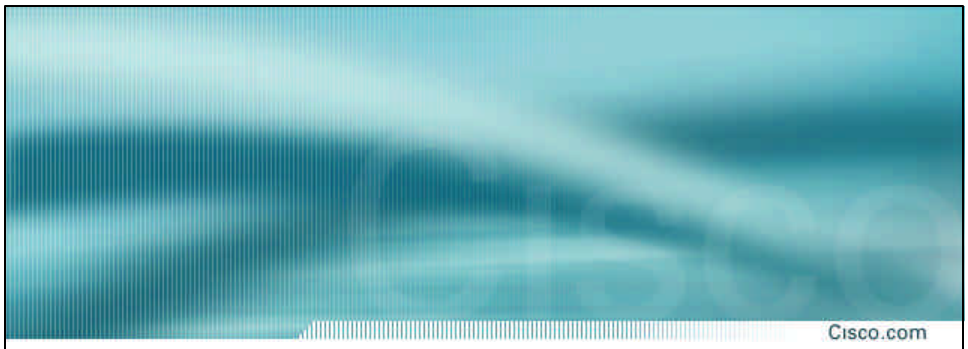
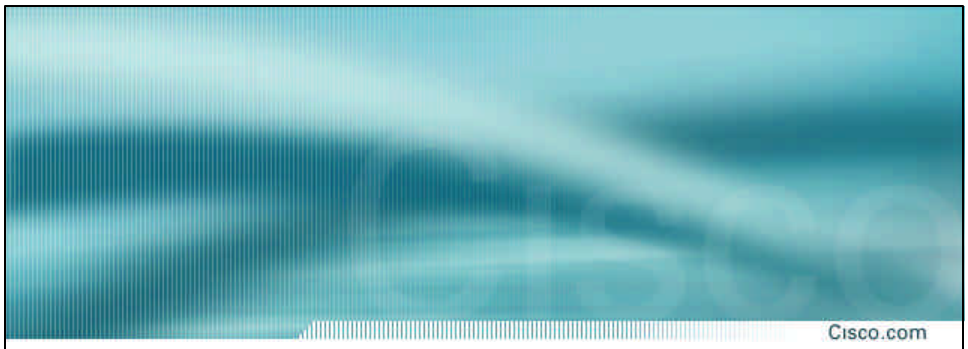
Questions



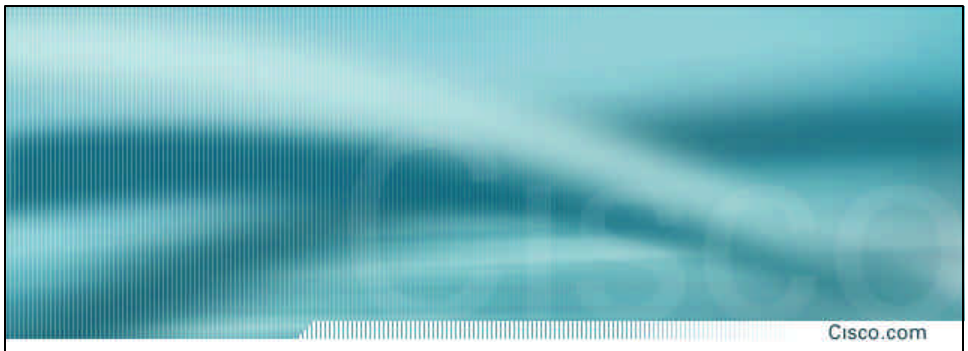
Deploying Large-Scale H.323 VoIP SP Networks

Session VVT-221



Please Complete Your Evaluation Form

Session VVT-221



BACKUP

CiscoWorks—Cisco Voice Manager v2.02

Cisco.com

- **Network Performance Reporting**
  - Stand alone product not suited to service provider scaling needs
  - Requires integration with third party partner for effective distributed reporting solution
  - CVM polls GWs for call history statistics and provides an open interface for third party management systems to gather and correlate data
  - CVM provides a clean, well-formatted VoIP call history file to third party applications to obscure Cisco platform specifics
  - Reporting data is useful for troubleshooting and traffic forecasting
  - Example reports include answer seizure rate, call success rate, call volumes, and disconnect reasons
  - Models hierarchical GK design for scalability; CVM resources may be inserted on demand as capacity and network coverage area grows

Cisco Voice Manager v2.02 (Cont.)

Cisco.com

- **Element management**
  - Supports basic VoIP configuration parameters (e.g. interface signaling types, dial-peers, H.323 registrations)
  - Simple dial plan provisioning within a local region only
  - Supports SNMP MIB management of any SNMP capable device
- **SNMP trap viewing and forwarding**
  - Can receive and collect traps from GWs via SNMP
  - Traps may be forwarded onto Cisco Info Center for event correlation

NMS Architecture Using CVM

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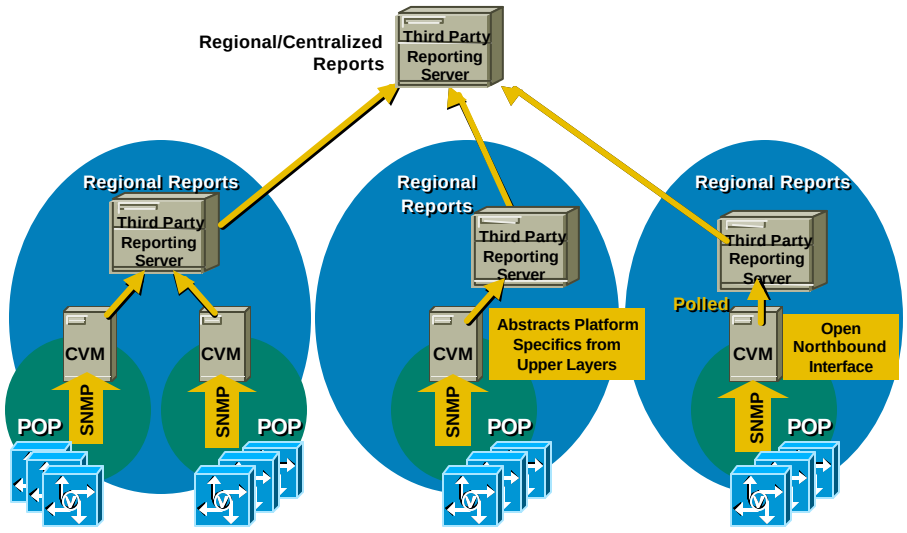

Cisco Info Center

Cisco.com

- **Fault management and event correlation**
  - **Optimizes fault management by reducing alarm information overload through de-duplication and fault correlation to enable faster problem solving and better operations scaling**
  - **Flexibly manages and monitors faults and in multi-vendor, multi-technology, and multiservice environments**
  - **Correlates faults received from multiple sources (e.g., SNMP traps, syslog events)**
  - **Supports distributed operational environments to reduce the number of NOCs, provide centralized and regional monitoring, and eliminate costly, inefficient "console farms" of scrolling alarms**
  - **Can translate faults and events into actions to quickly resolve problems (e.g. paging capability, issue a trouble ticket, send alarms for critical events)**
  - **Distributed and redundant architecture for scaling and reliability**

CIC Deployment Architecture

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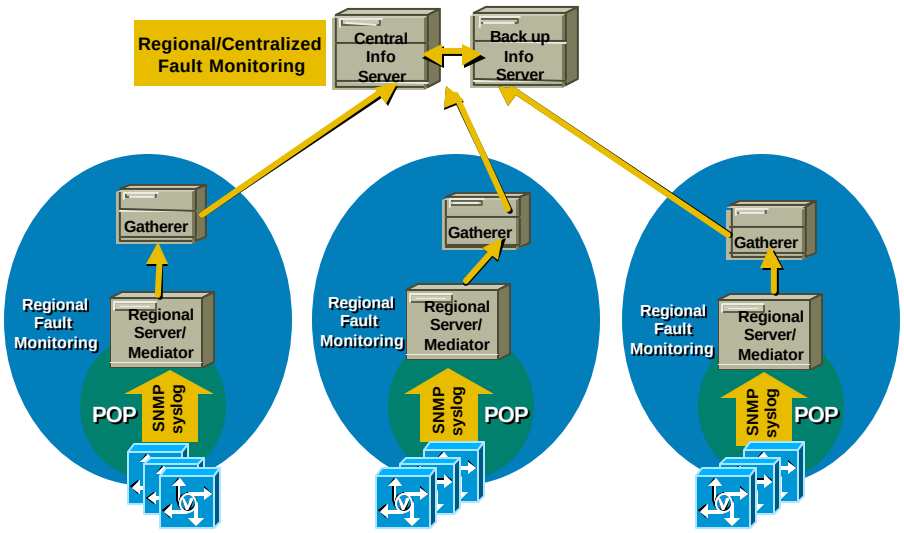
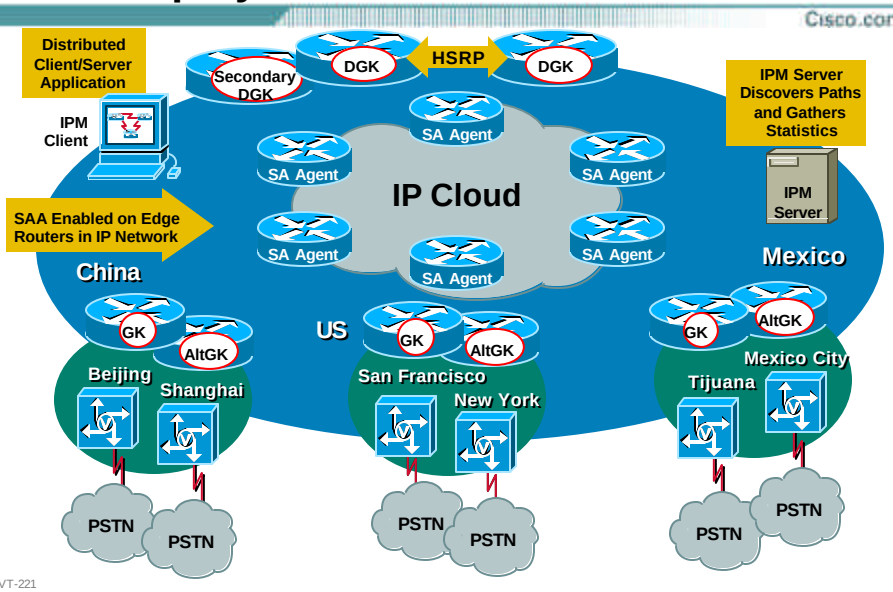


Cisco Internet Performance Manager (IPM)

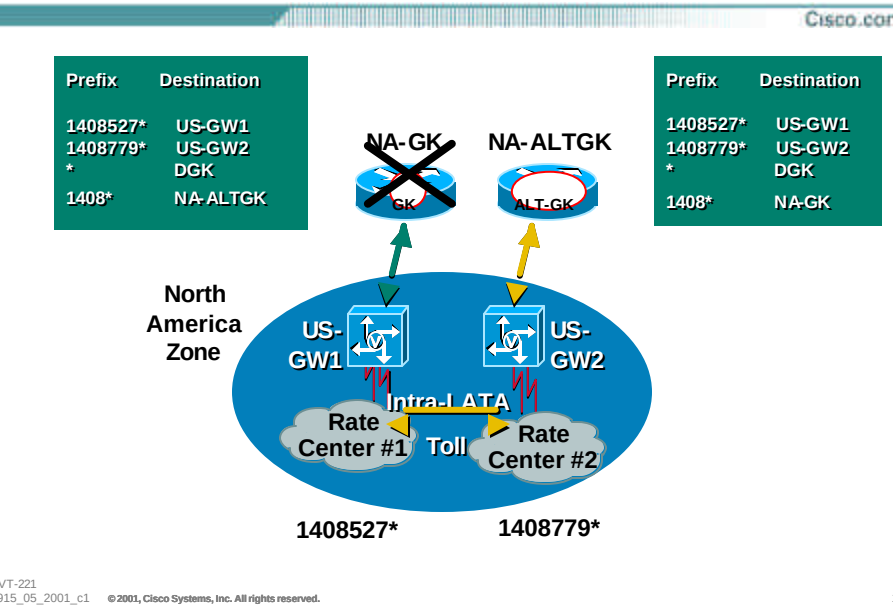
Cisco.com

- Provides real-time and historical network performance reports on VoIP characteristics such as latency, jitter, packet errors, and packet loss for all available IP paths
- Measures network performance on a hop-by-hop basis to pinpoint latency and jitter causes and reduce problem isolation and resolution time
- Generates traps based on response time thresholds to provide real-time alerting of potential problems
- Works with Cisco IOS Service Assurance Agent (SAA) to support service level measurement

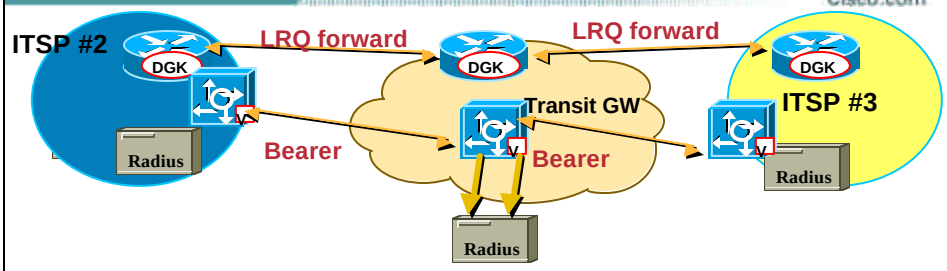
IPM Deployment Architecture



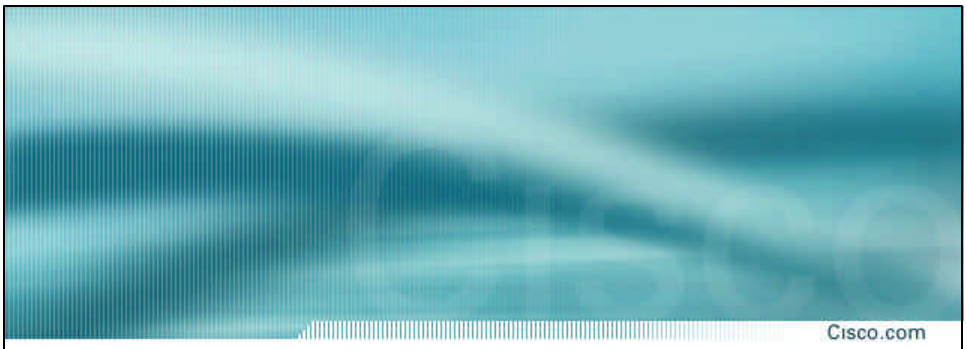
Adding an Alternate Gatekeeper at North America Zone



Interconnecting 2 ITSPs through Wholesaler



- Transit GW in Wholesaler
  - Inserted into call signaling path
- Billing
  - Both originating and terminating call legs accounted on RADIUS server



References