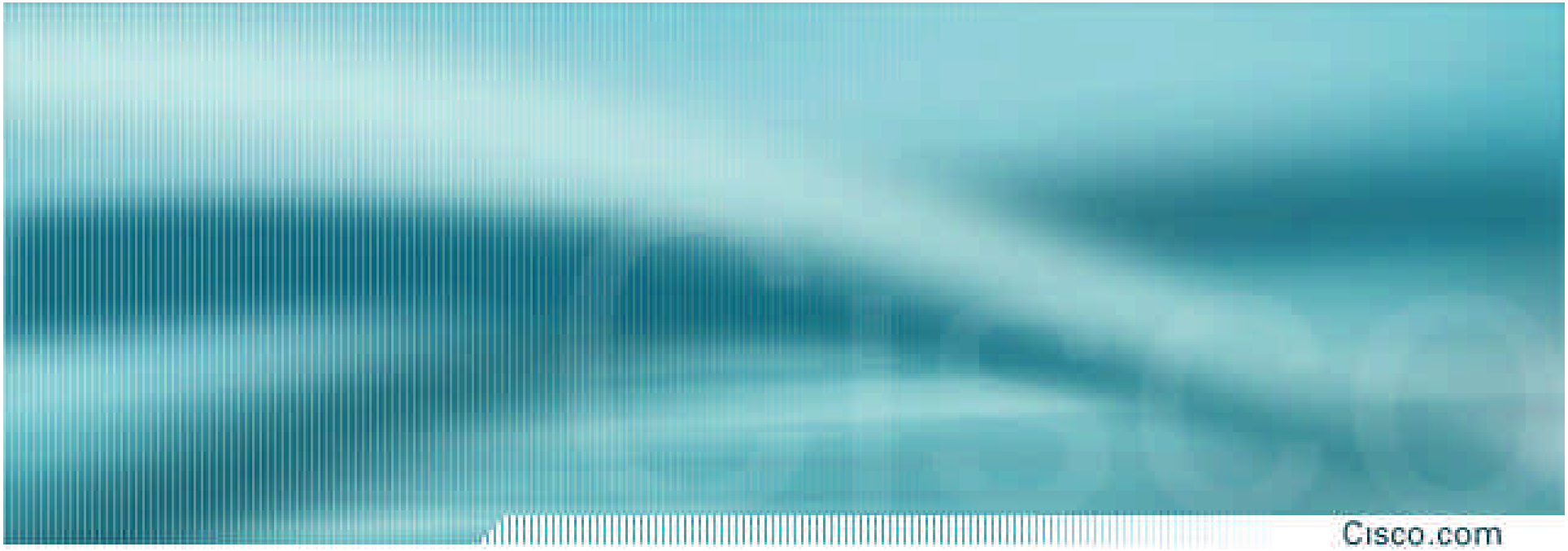



# Dial Plan Design for IP Telephony Networks

***(Based on Networkers 2003 Session VVT-4010)***

# $Q^3$: Quick Quiz Question



- **Please try to answer for yourself the following question**
- **We will immediately give you the answer**
- **And the rest of the presentation contains the information to back up our answer!**

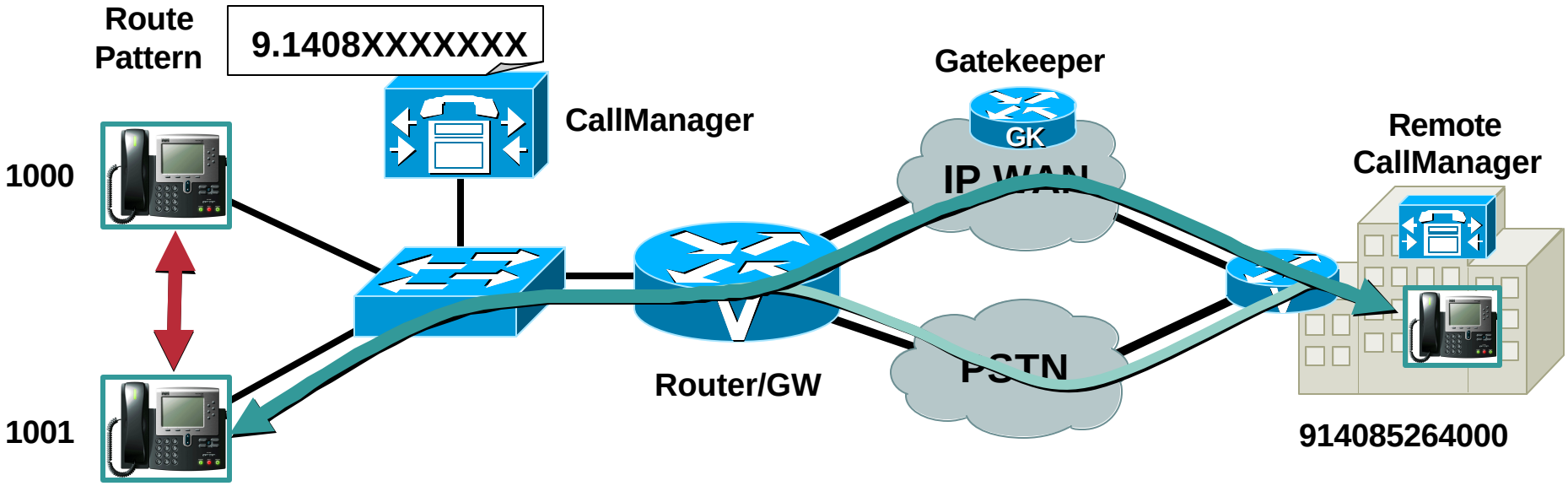
# $Q^3$: Quick Quiz Question



- **Let us consider phones A and B; both phones are registered in the same cluster; phone A is configured with extension 1000**
- **Phone B is configured with extension 2000**
- **[Q] Indicate which of the choices below is necessary and sufficient to allow phone A to be able to call phone B AND phone B to be able to call phone A**
  - **A. Both phones are in the same partition**
  - **B. Both phones are assigned the same calling search space**
  - **C. Both (A) and (B)**
  - **D. None of the above**

# Dial Plan—
# The “IP Routing” of IP Telephony






## CallManager Routes Two Basic Call Types:

**On-Cluster Calls:** Destination Directory Number (DN) is Registered with CallManager

**Off-Cluster Calls:** External Route Patterns Must Be Configured on CallManager

# Session Scope and Objectives

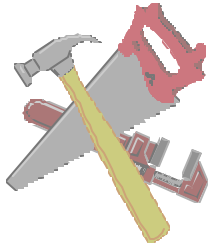


- **Learn how to build an enterprise IP telephony dial plan**
- **Design based on CallManager 3.2 or higher**
- **Aspects we will cover:**
  - **Dial plan operation**
  - **Design best practices**
  - **Caveats and recommendations**
- **Many US/Canada based examples were left in the preso (e.g. 911 v.s.: 080). We will highlight the differences as applicable.**

# Agenda



- **IP Telephony Deployment Models**



- **Cisco CallManager Dial Plan Toolkit**

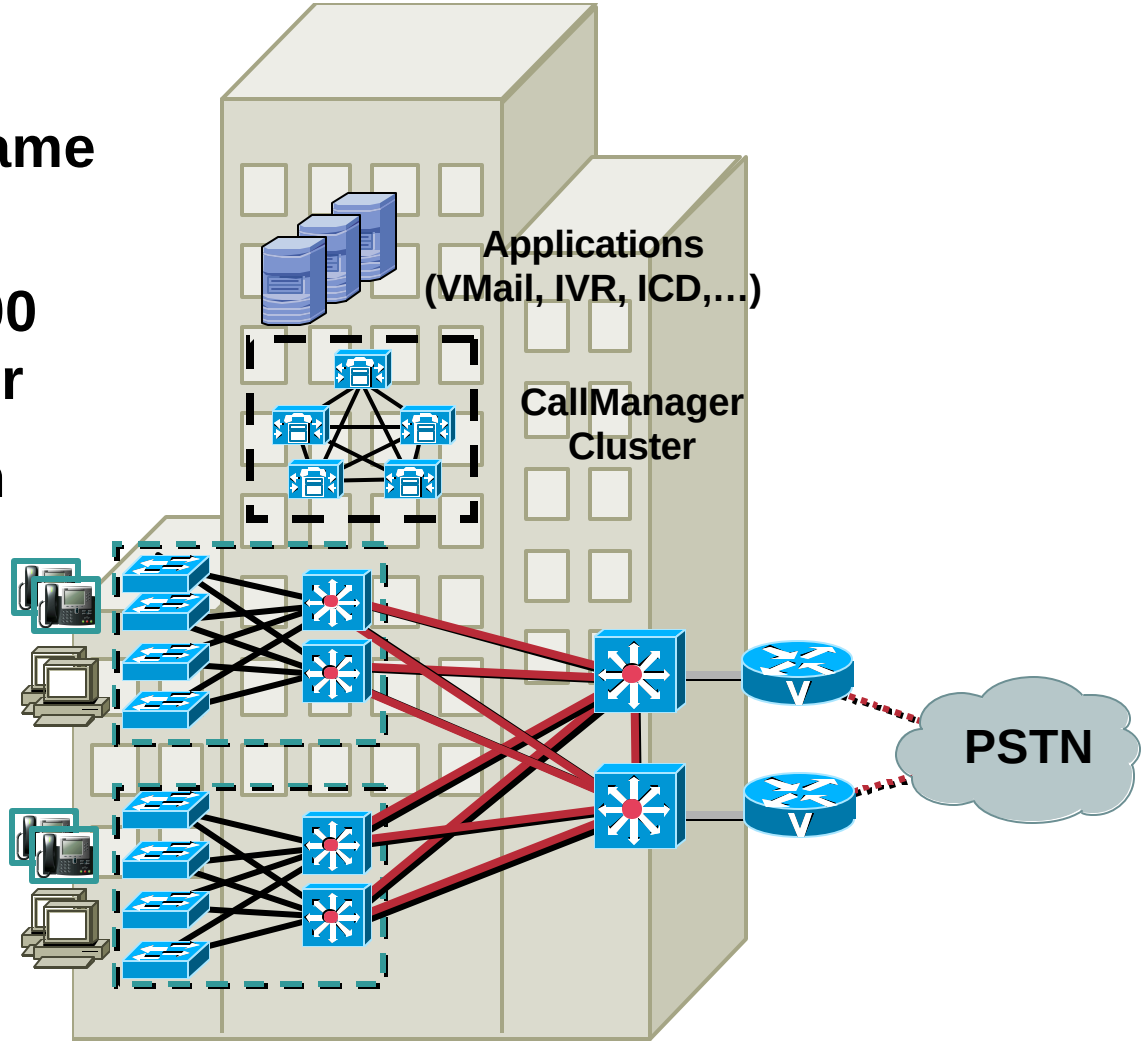
- **Dial Plan Design Guidelines**

- **Conclusions**

# IP Telephony Deployment Models
## Single Site

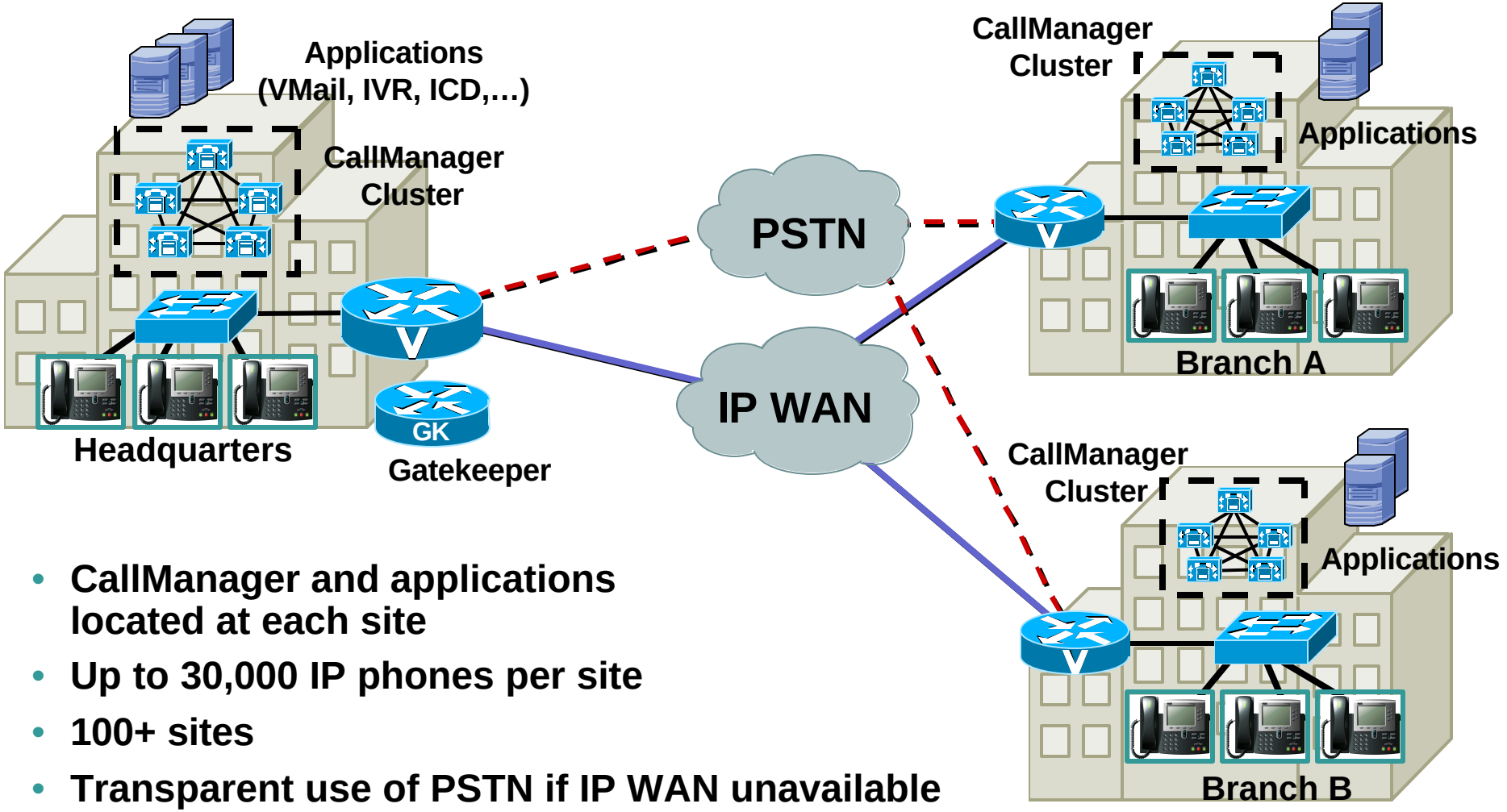


- Cisco CallManager, Applications and DSP Resources at same physical location
- Supports up to 30,000 IP phones per cluster
- Multiple clusters can be interconnected via Inter-Cluster trunks
- PSTN used for all external calls



# IP Telephony Deployment Models
## Distributed Call Processing

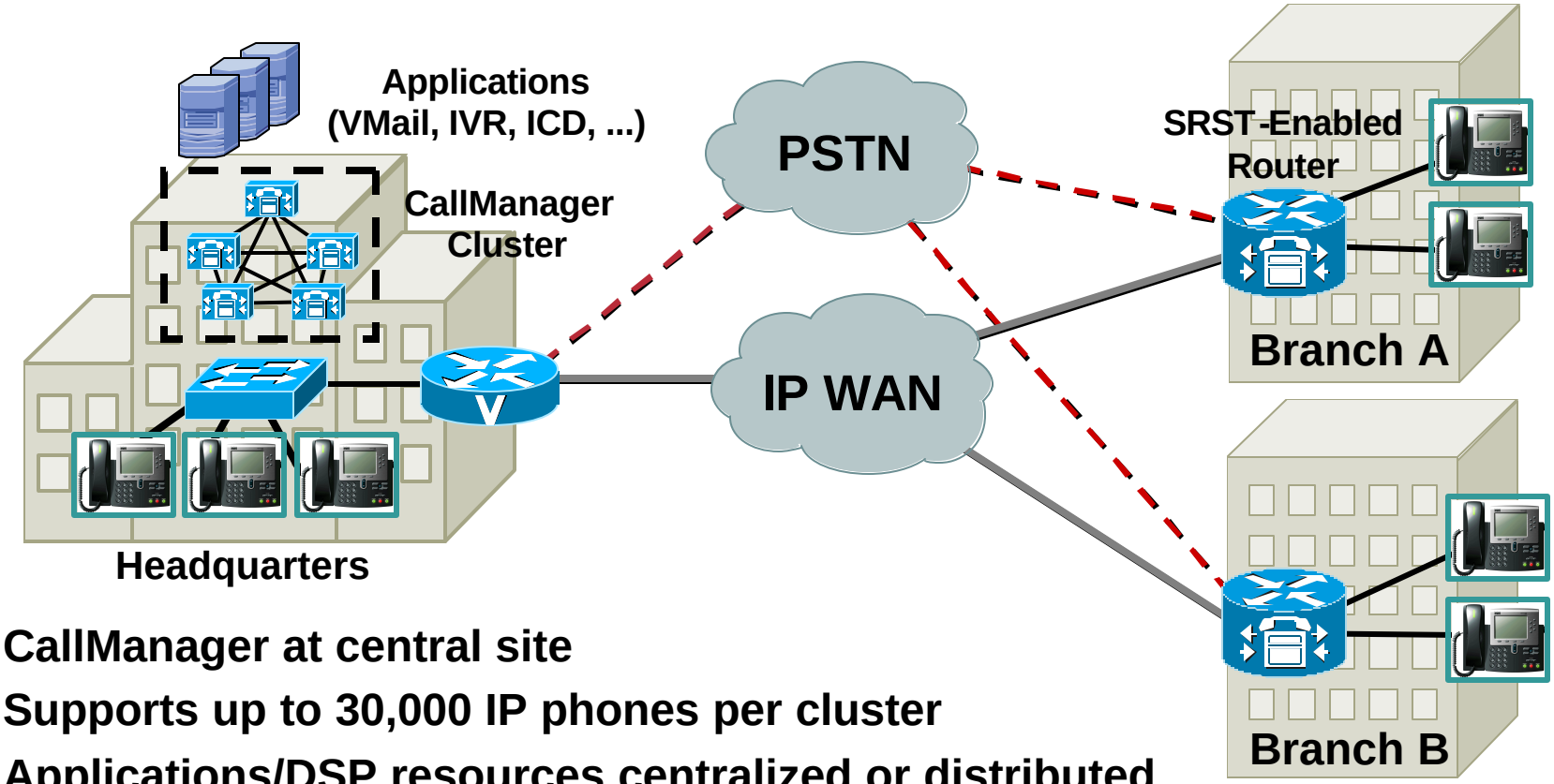





- CallManager and applications located at each site
- Up to 30,000 IP phones per site
- 100+ sites
- Transparent use of PSTN if IP WAN unavailable

# IP Telephony Deployment Models
## Centralized Call Processing



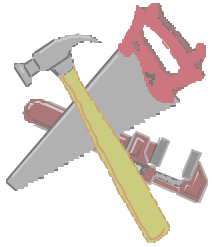



- CallManager at central site
- Supports up to 30,000 IP phones per cluster
- Applications/DSP resources centralized or distributed
- Survivable Remote Site Telephony for remote branches
- PSTN access at each remote branch and/or central site
- Transparent use of PSTN if IP WAN unavailable (CCM 3.3)

# Agenda



- IP Telephony Deployment Models



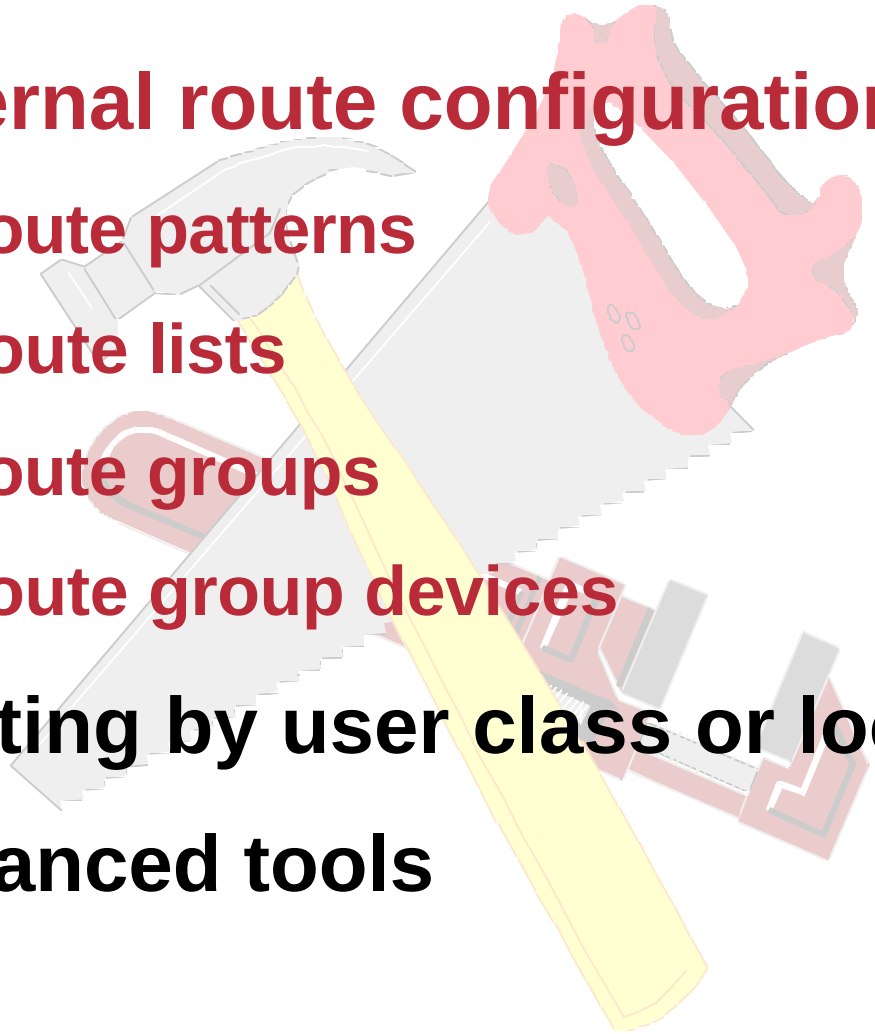
- Cisco CallManager Dial Plan Toolkit

- Dial Plan Design Guidelines

- Conclusions

# CallManager Dial Plan Toolkit





- External route configuration
  - Route patterns
  - Route lists
  - Route groups
  - Route group devices
- Routing by user class or location
- Advanced tools

# External Route Elements in CallManager

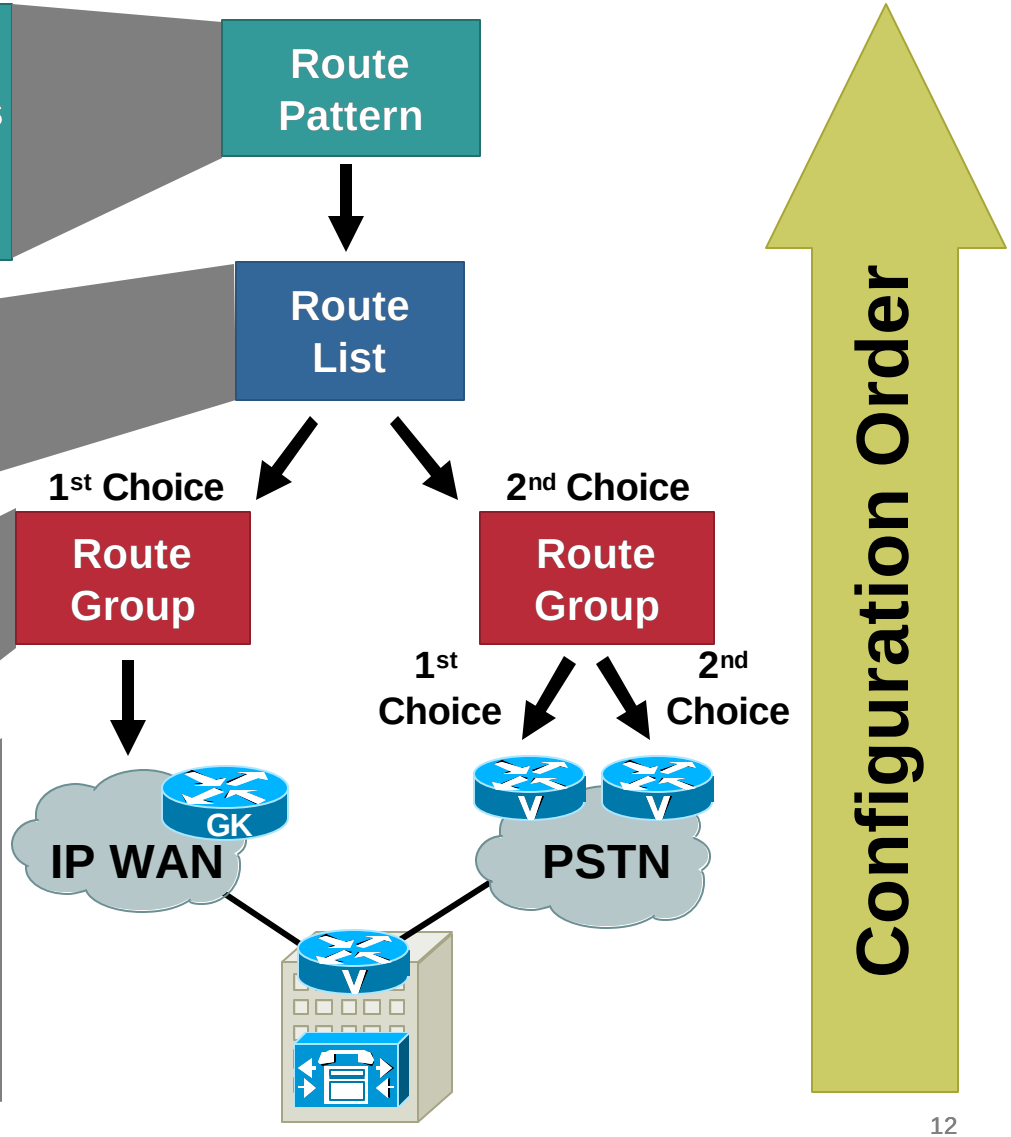


**Route Pattern**
- Matches dialed number for external calls
- Performs digit manipulation (optional)
- Points to a route list for routing

**Route List**
- Chooses path for call routing
- Points to prioritized route groups

**Route Group**
- Performs digit manipulation
- Points to the actual devices

**Devices**
- Gateways (H.323, MGCP)
- Gatekeeper
- Inter-cluster trunk (remote CM)



# External Route Example: PHL to SJ



Philadelphia

User Calls "526-4000"

Route Pattern "52.XXXXX"

1 Route Pattern Match No Digit Manipulation

Route List "SJ"

2 Select Route Group Based on Priority

1st Choice

2nd Choice

3a Discard Access Code "52" Point to Remote CM via Inter-Cluster Trunk + GK

Route Group "SJ-IPWAN"

Route Group "PHL-PSTN"

3b Prepend "1408" Point to Local PSTN Gateway

4a "64000" Sent over IP WAN to SJ CallManager

IP WAN

GK

PSTN

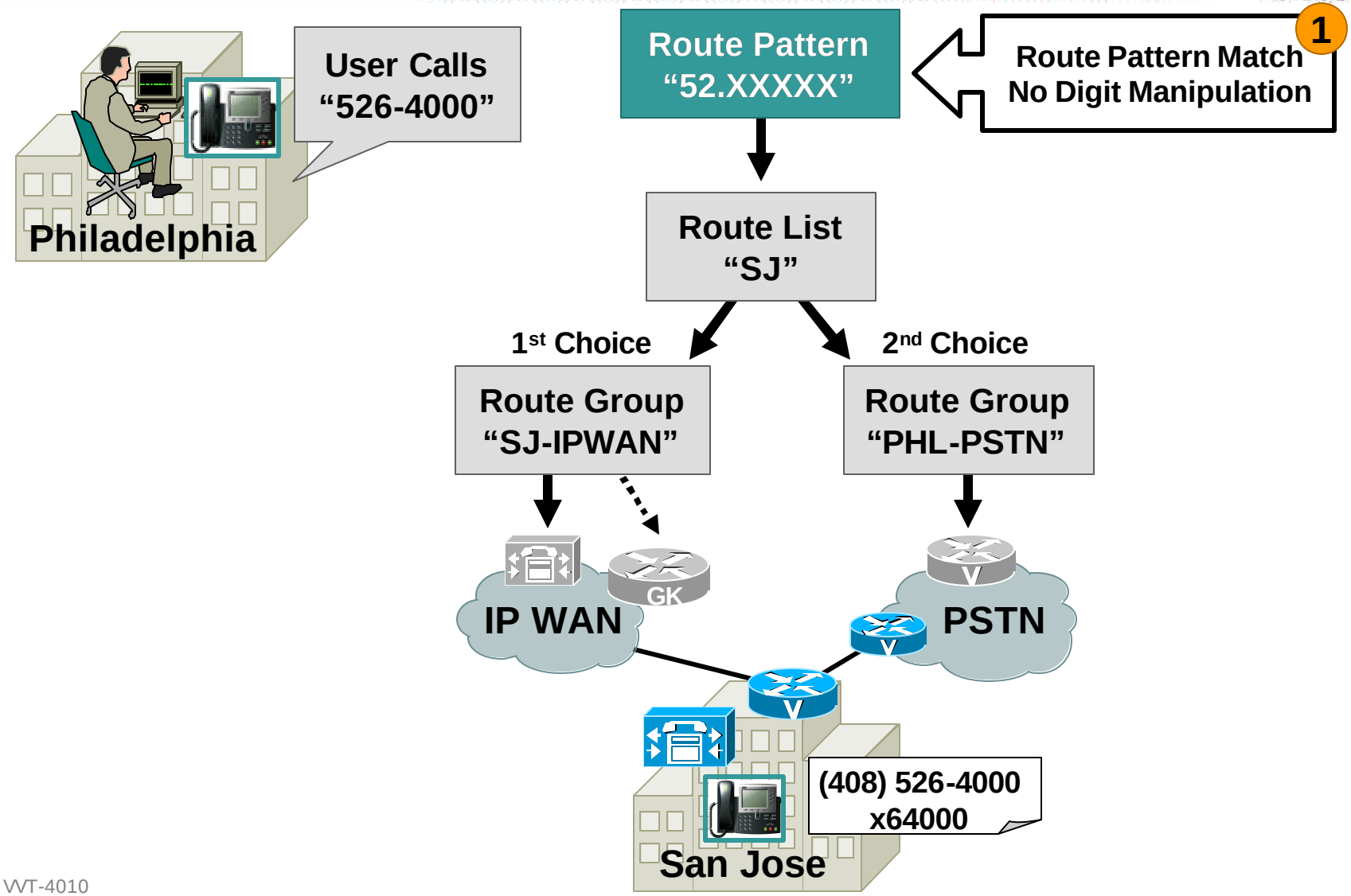
4b 1 (408) 526-4000 Sent over PSTN to San Jose

(408) 526-4000 x64000

San Jose

# Route Patterns





# Route Patterns
## Configuration




**Route Pattern**
Digits Left of "." Are the Access Code

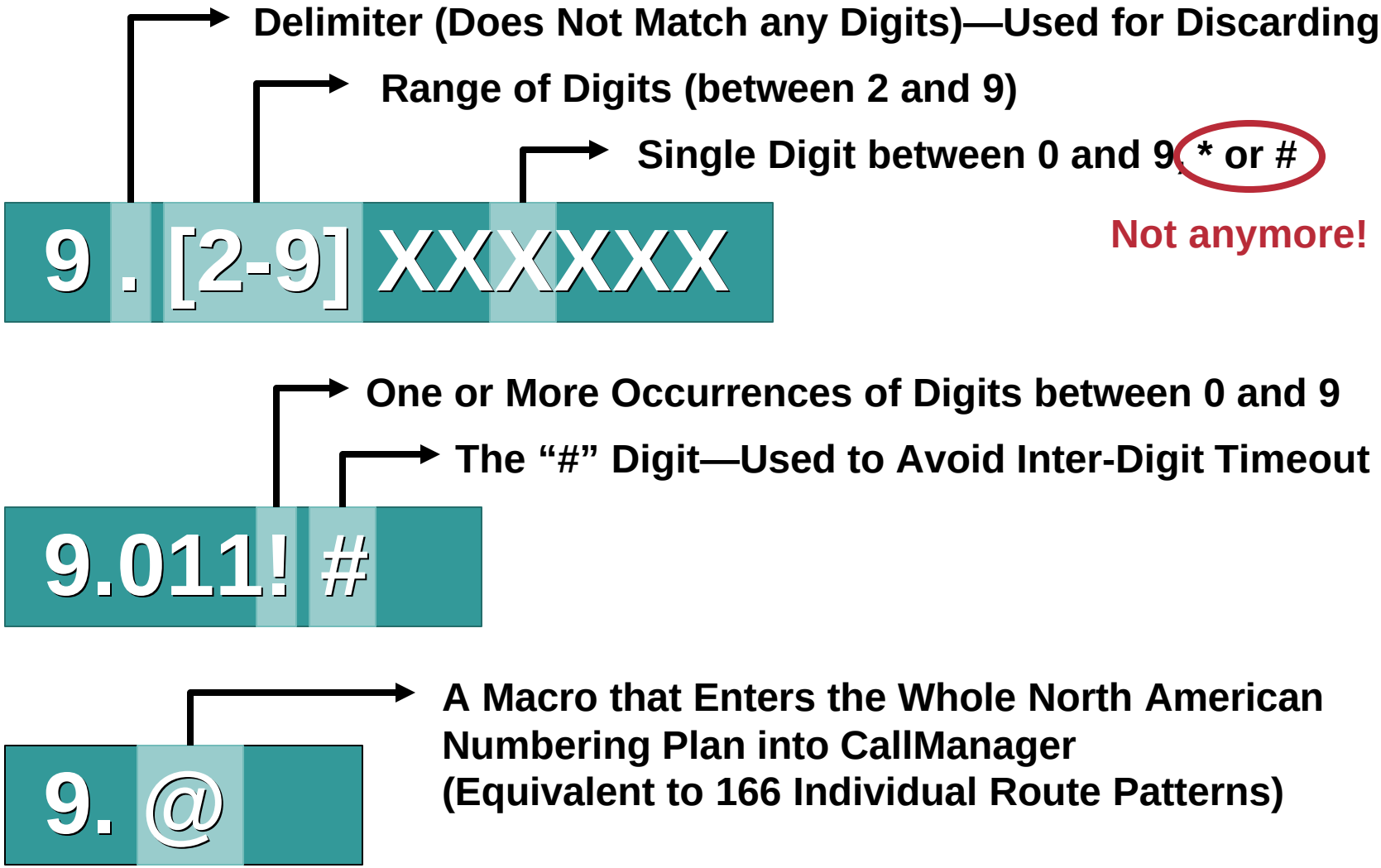
**Partition**
Determines WHO Can Reach 52.XXXXX

**Route List**
Defines HOW to Reach 52.XXXXX

**Digit Manipulation**
Not Recommended in Route Pattern

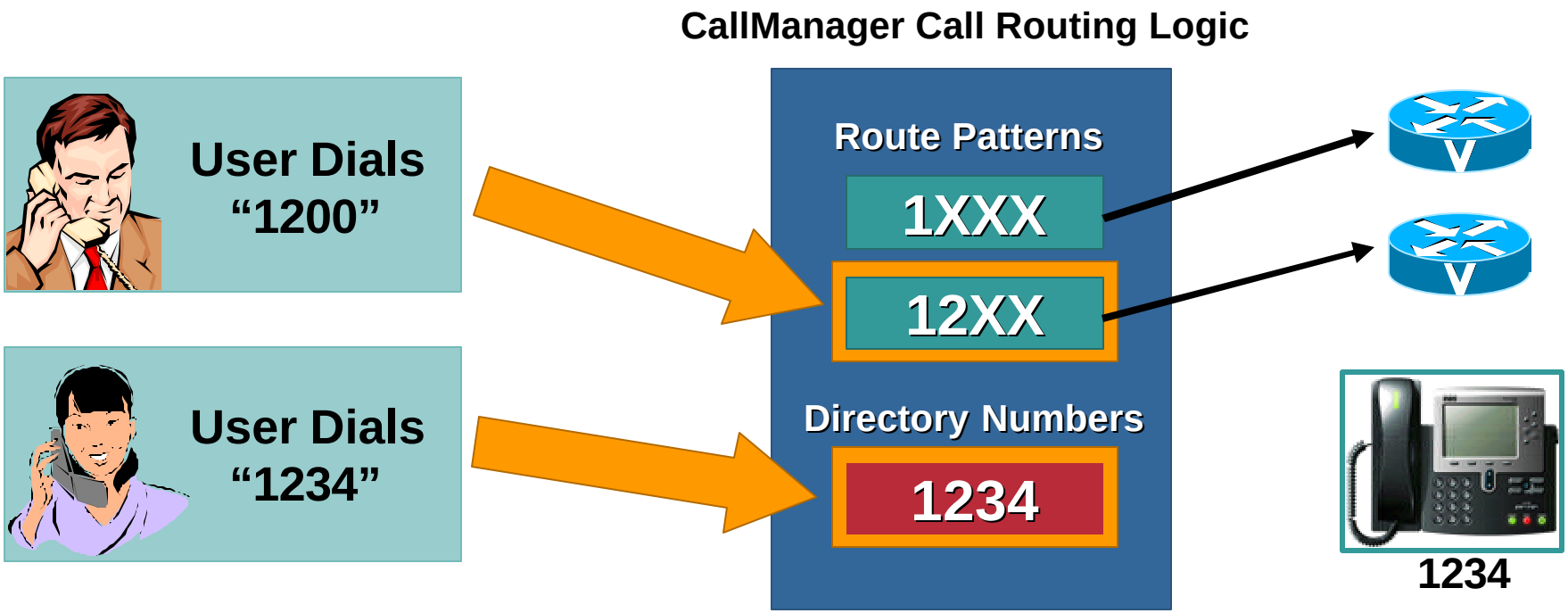
# Route Patterns
## Commonly Used Wildcards

Cisco.com



# Route Patterns
## CallManager Call Routing Logic






- CallManager matches the most specific pattern (longest-match logic)
- An IP phone directory number is a special case of route pattern that matches a single number

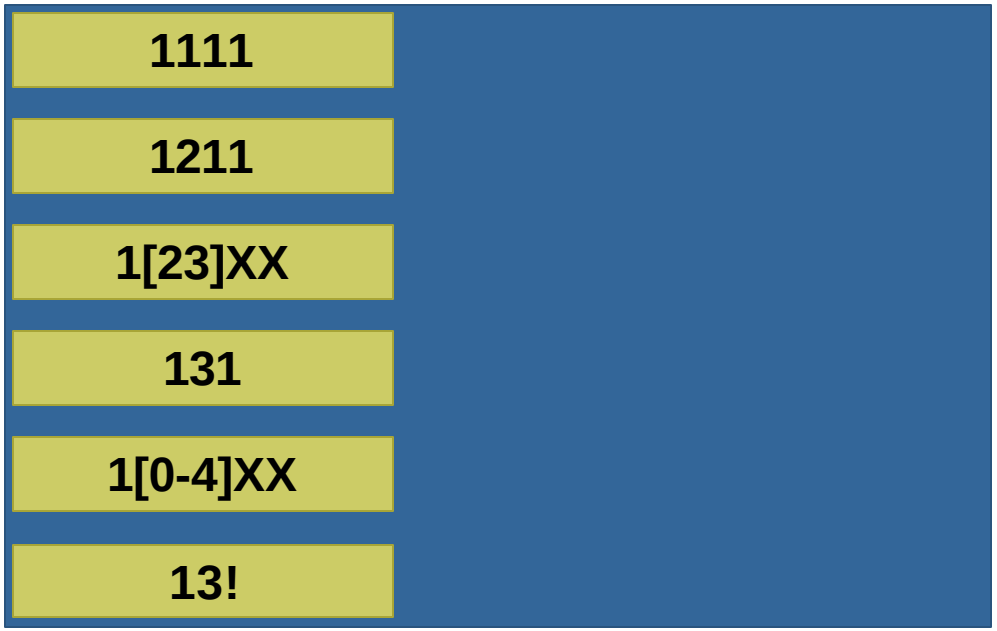
# Route Patterns
## CallManager Call Routing Logic

Cisco.com

**User's Dial String:**

**CallManager Actions:**

**Configured Route Patterns**



# Route Patterns
## CallManager Call Routing Logic

Cisco.com

**User's Dial String:**

**<Off Hook>**

**CallManager Actions:**

**Provide Dial Tone**
**Wait**

**Configured Route Patterns**

| | |
|---|---|
| 1111 | Might Match |
| 1211 | Might Match |
| 1[23]XX | Might Match |
| 131 | Might Match |
| 1[0-4]XX | Might Match |
| 13! | Might Match |

```
Digit analysis: match(fqcn="9195555644", cn="15644",
    pss="PA:Line1:Cisco:Local:Long Distance:International", dd="")
Digit analysis: potentialMatches=PotentialMatchesExist
```

# Route Patterns
## CallManager Call Routing Logic

Cisco.com

**User's Dial String:**

**1**

**CallManager Actions:**

**Break Dial Tone**
**Wait**

**Configured Route Patterns**

| | |
|---|---|
| 1111 | Might Match |
| 1211 | Might Match |
| 1[23]XX | Might Match |
| 131 | Might Match |
| 1[0-4]XX | Might Match |
| 13! | Might Match |

```
Digit analysis: match(fqcn="9195555644", cn="15644",
    pss="PA:Line1:Cisco:Local:Long Distance:International", dd="1")
Digit analysis: potentialMatches=PotentialMatchesExist
```

# Route Patterns
## CallManager Call Routing Logic

Cisco.com

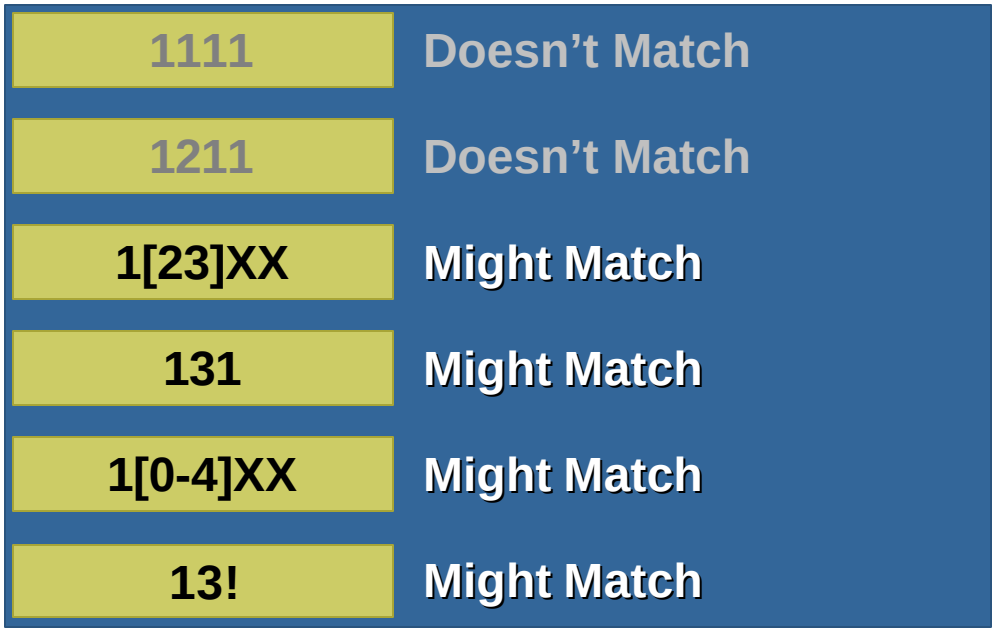
**User's Dial String:**

**13**

**CallManager Actions:**

**Wait**

**Configured Route Patterns**




```
Digit analysis: match(fqcn="9195555644", cn="15644",
    pss="PA:Line1:Cisco:Local:Long Distance:International", dd="13")
Digit analysis: potentialMatches=PotentialMatchesExist
```

# Route Patterns
## CallManager Call Routing Logic

Cisco.com

**User's Dial String:**

**131**

**CallManager Actions:**

**Keep Waiting; More Digits Might Cause a Different Pattern to Match**

**Configured Route Patterns**

| | |
|---|---|
| 1111 | Doesn't Match |
| 1211 | Doesn't Match |
| 1[23]XX | Might Match |
| 131 | Match! |
| 1[0-4]XX | Might Match |
| 13! | Match! and Might Match |

```
Digit analysis: match(fqcn="9195555644", cn="15644",
    pss="PA:Line1:Cisco:Local:Long Distance:International", dd="131")
Digit analysis: potentialMatches=PotentialMatchesExist
```

# Route Patterns
## CallManager Call Routing Logic



**User's Dial String:**

**1311**

**CallManager Actions:**

**Keep Waiting; More Digits Might Cause a Different Pattern to Match**

**Configured Route Patterns**

| | |
|---|---|
| 1111 | Doesn't Match |
| 1211 | Doesn't Match |
| 1[23]XX | Match! |
| 131 | Doesn't Match |
| 1[0-4]XX | Match! |
| 13! | Match! and Might Match |

```
Digit analysis: match(fqcn="9195555644", cn="15644",
    pss="PA:Line1:Cisco:Local:Long Distance:International", dd="1311")
Digit analysis: potentialMatches=PotentialMatchesExist
```

# Route Patterns
## CallManager Call Routing Logic



**User's Dial String:**

**1311<timeout>**

**CallManager Actions:**

**Extend Call to the Best Match**

**Configured Route Patterns**

| | |
|---|---|
| 1111 | Doesn't Match |
| 1211 | Doesn't Match |
| 1[23]XX | Match! |
| 131 | Doesn't Match |
| 1[0-4]XX | Match! |
| 13! | Match! |

**Can You Tell which Route Pattern Is the Best Match in This Case?**

**Hint: We Are Being Crafty to Make Sure You Remember Forever ☺**

# Route Patterns
## CallManager Call Routing Logic

Cisco.com

**Configured Route Patterns**

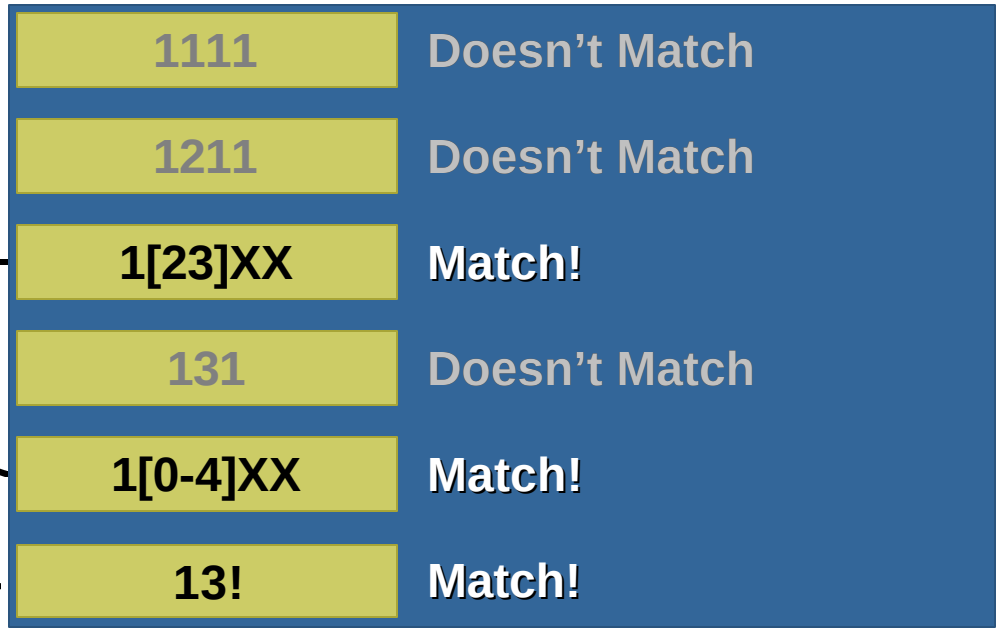
**User's Dial String:**

**1311<Timeout>**

**Matches 200 Digit Strings**

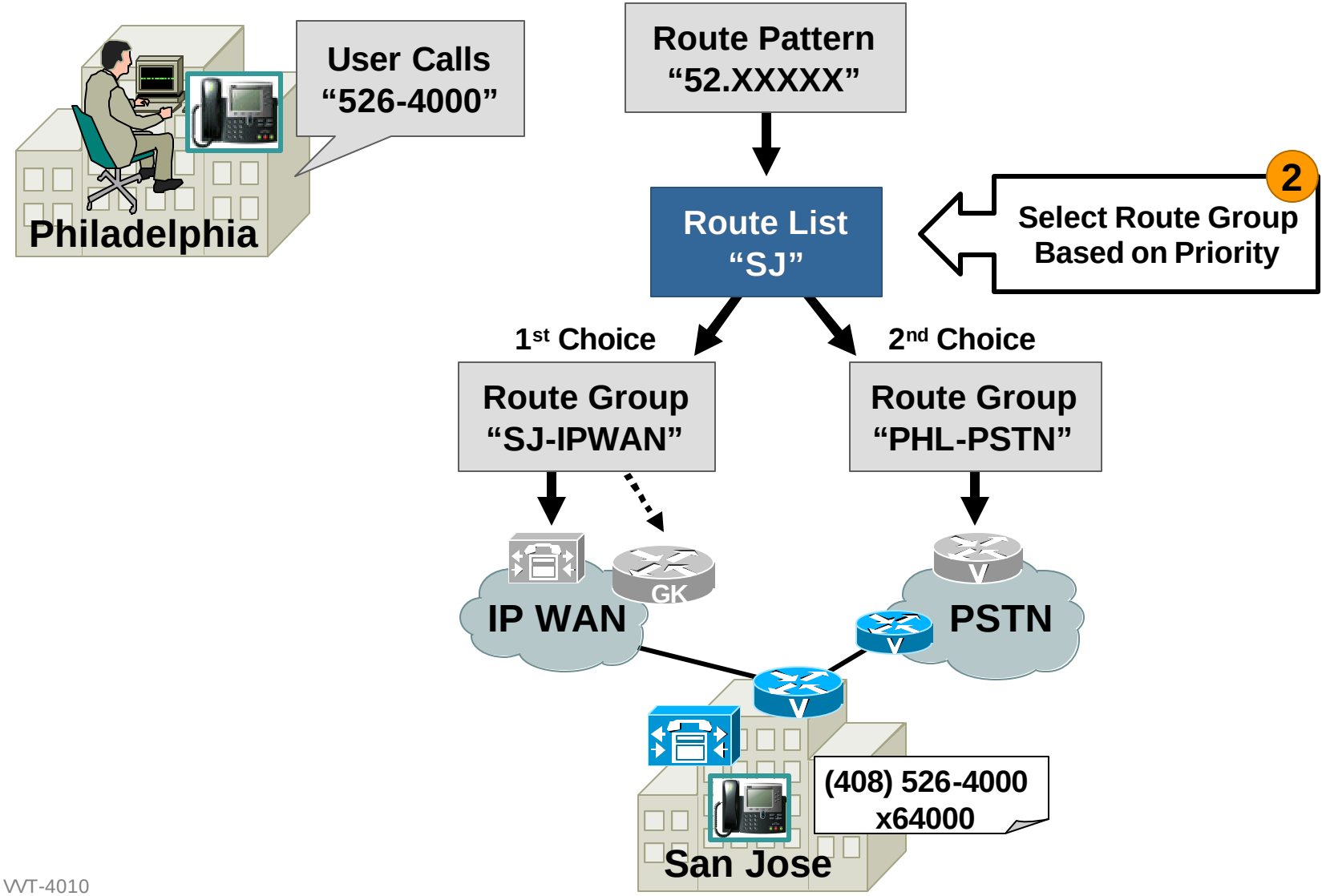
**Matches 500 Digit Strings**

**Matches ¥ Digit Strings, However for the Purposes of Closest Match Routing in this Case, this Matches 100 Digit Strings because You Only Consider the Number of Potential Strings Given the Number of Digits Dialed**



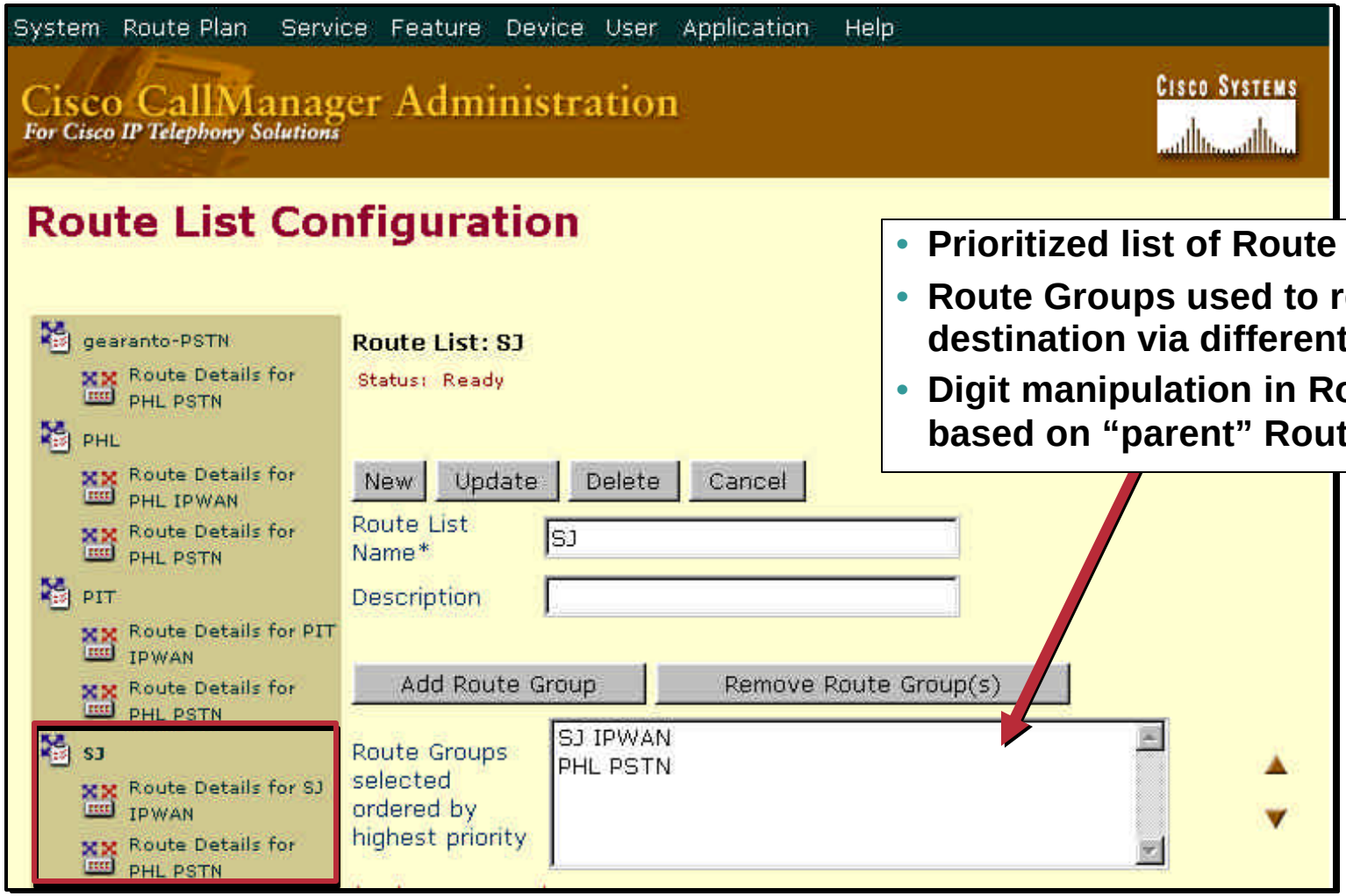
# Route Lists





# Route Lists
## Configuration

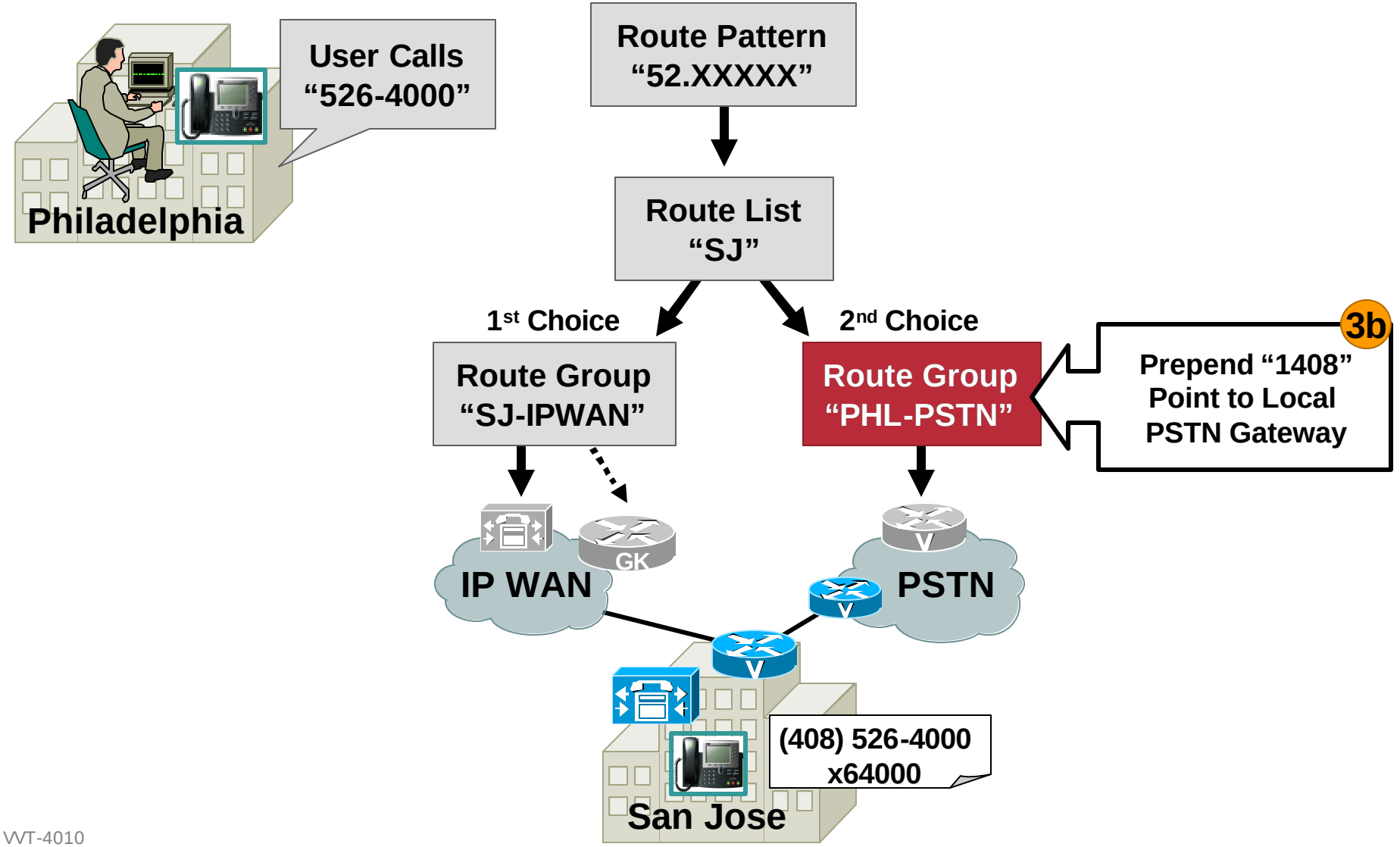





- **Prioritized list of Route Groups**
- **Route Groups used to reach destination via different paths**
- **Digit manipulation in Route Group based on “parent” Route List**

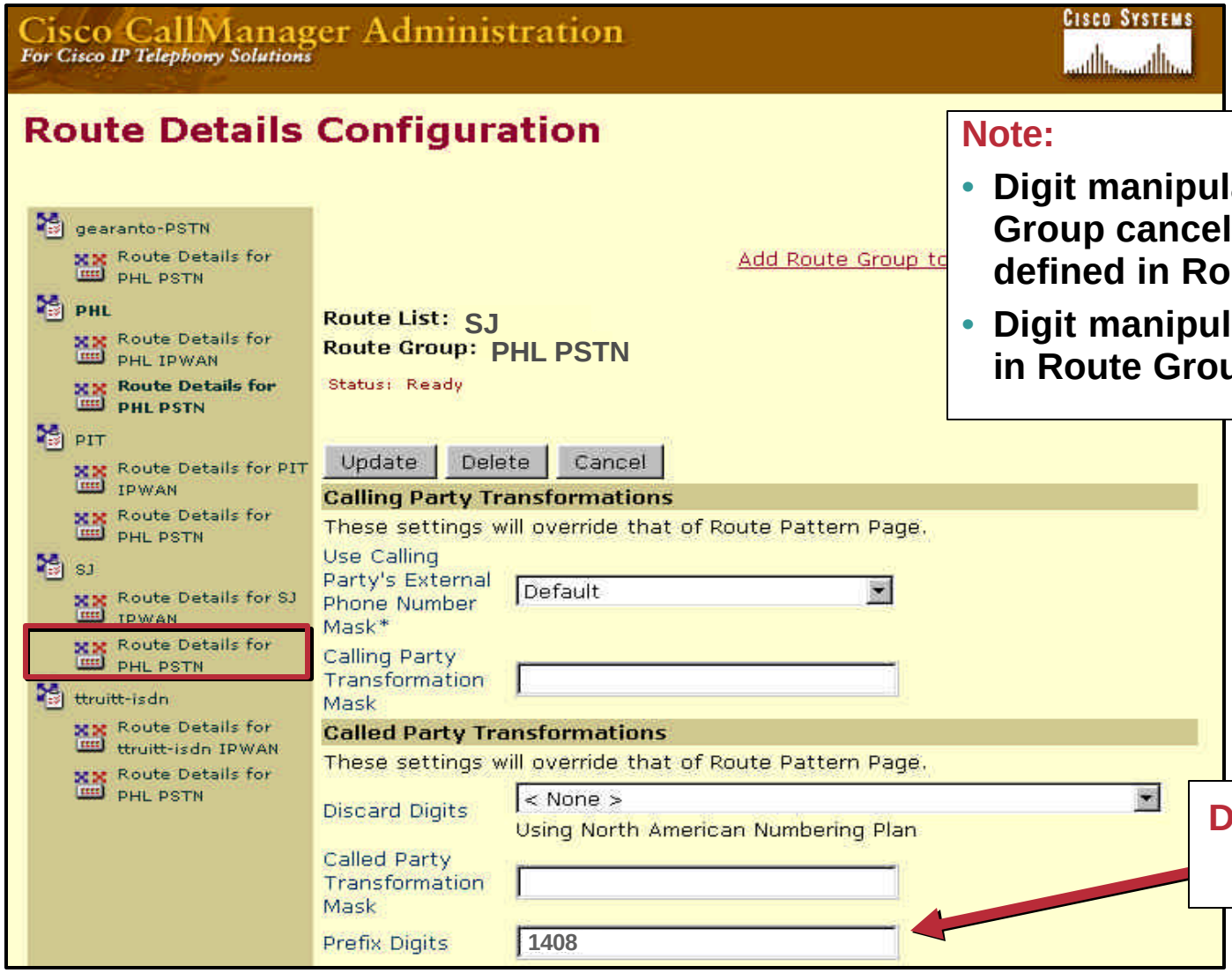
# Route Groups





# Route Groups
## Viewed from within the Route List





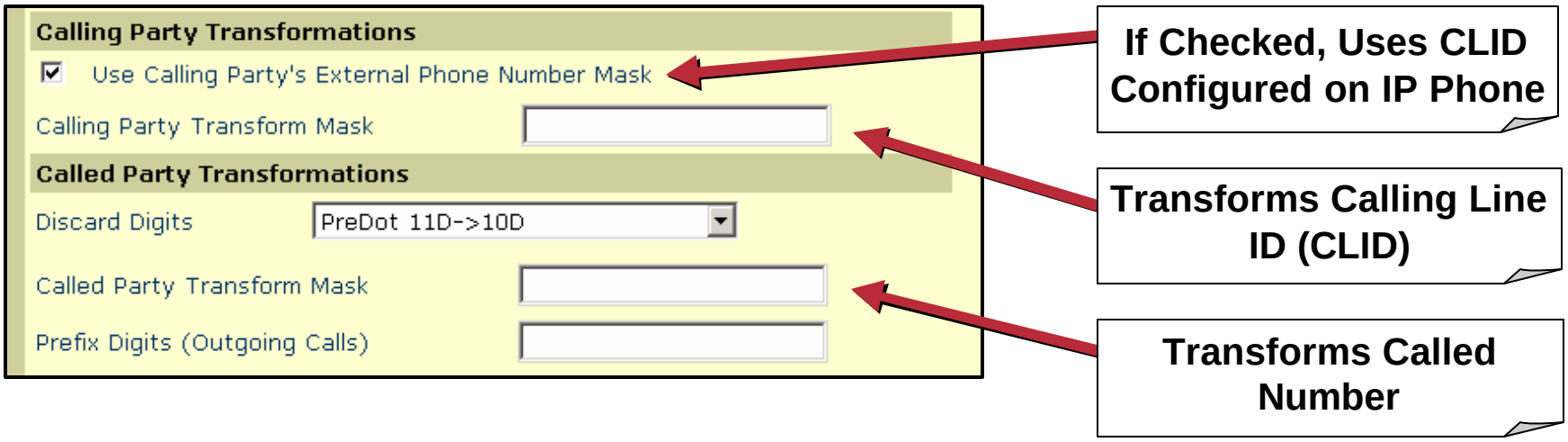

**Note:**

- **Digit manipulations in Route Group cancel and override those defined in Route Pattern**
- **Digit manipulation recommended in Route Group**

**Digit Manipulation**
**Prepend "1408"**

# Route Groups
## Digit Manipulation Notes

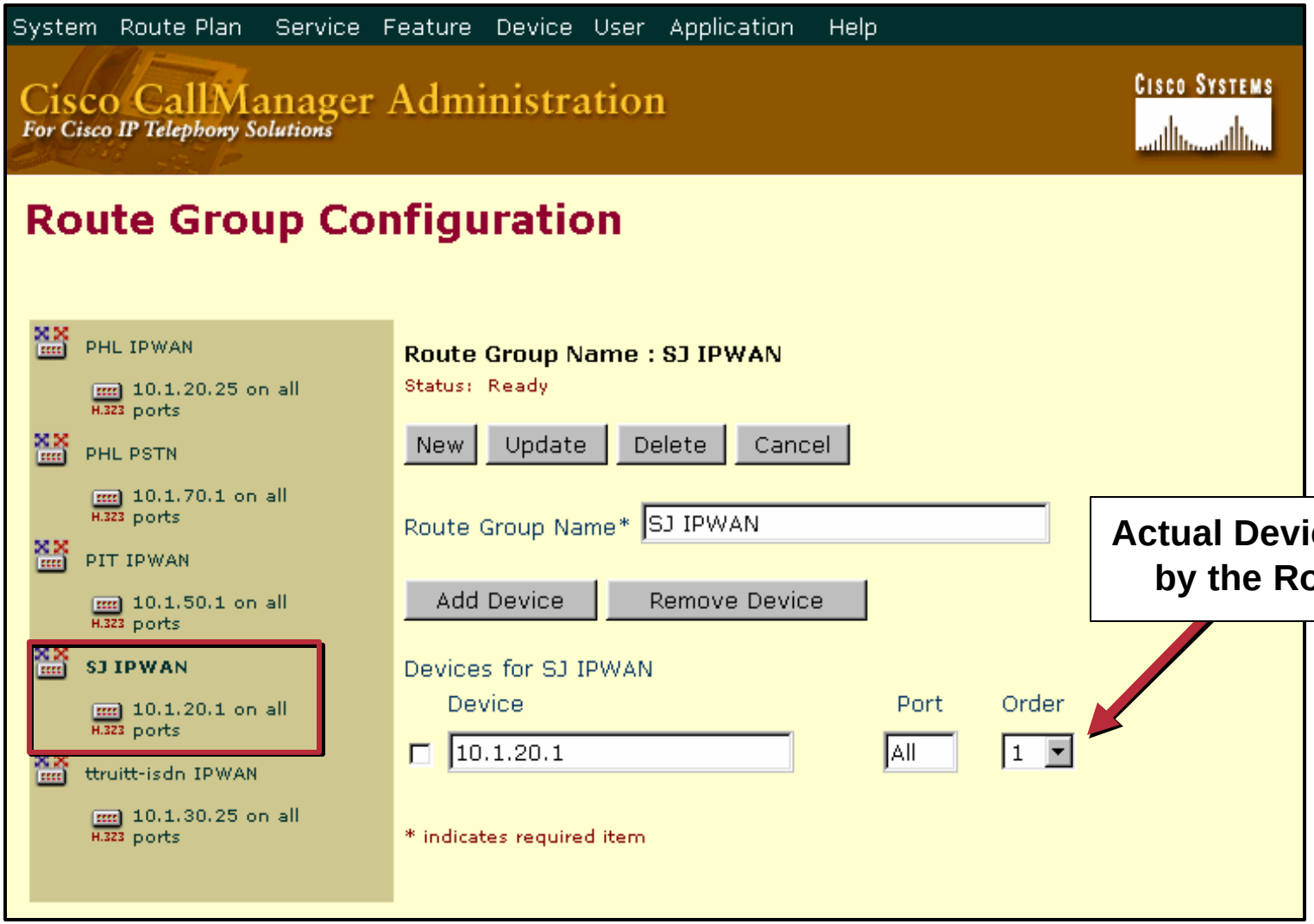





- **Order used to apply digit manipulations:**
  1. **Discard digits instructions**
  2. **Called party transformation mask**
  3. **Prefix digits**

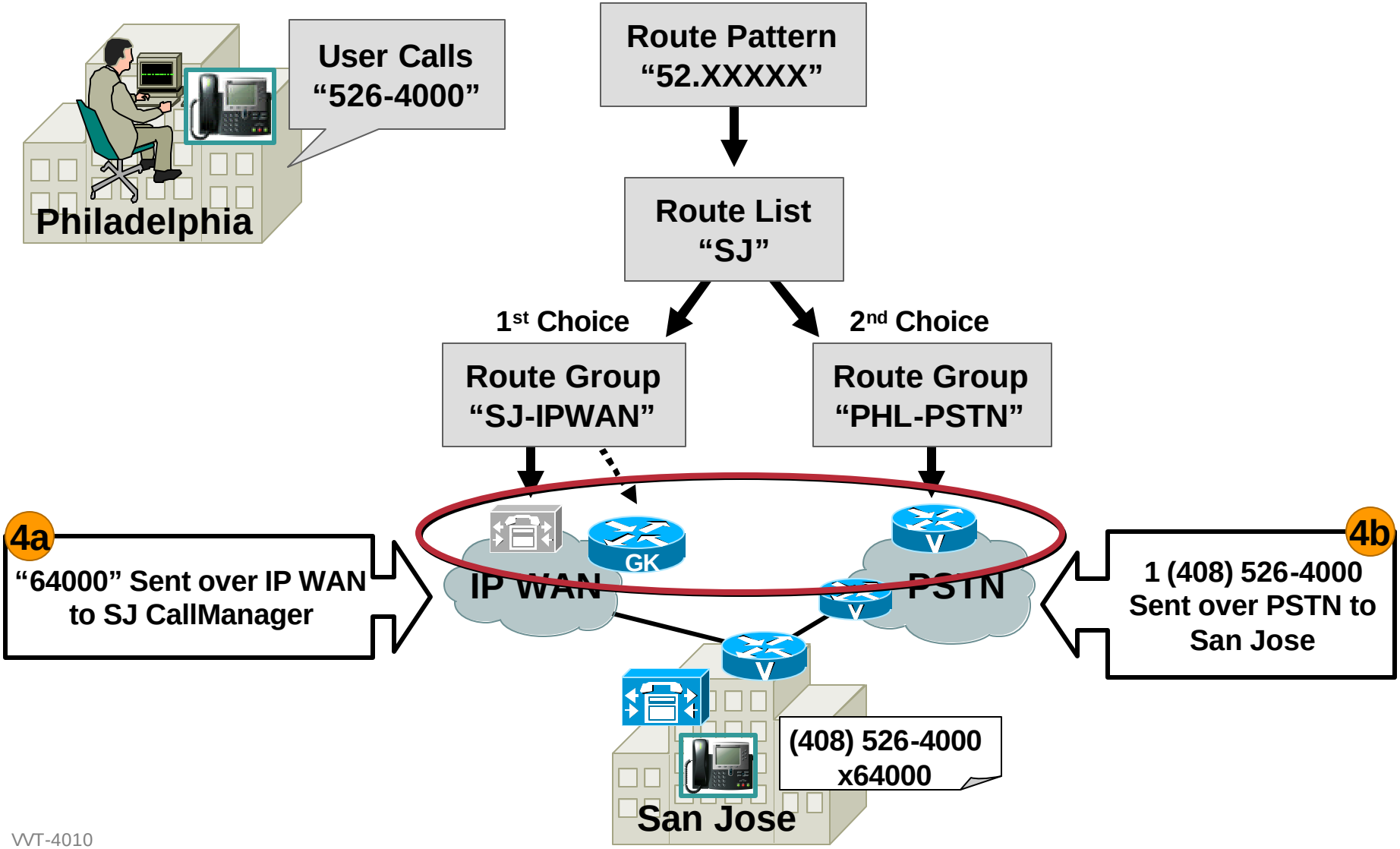
# Route Groups
## Standalone View





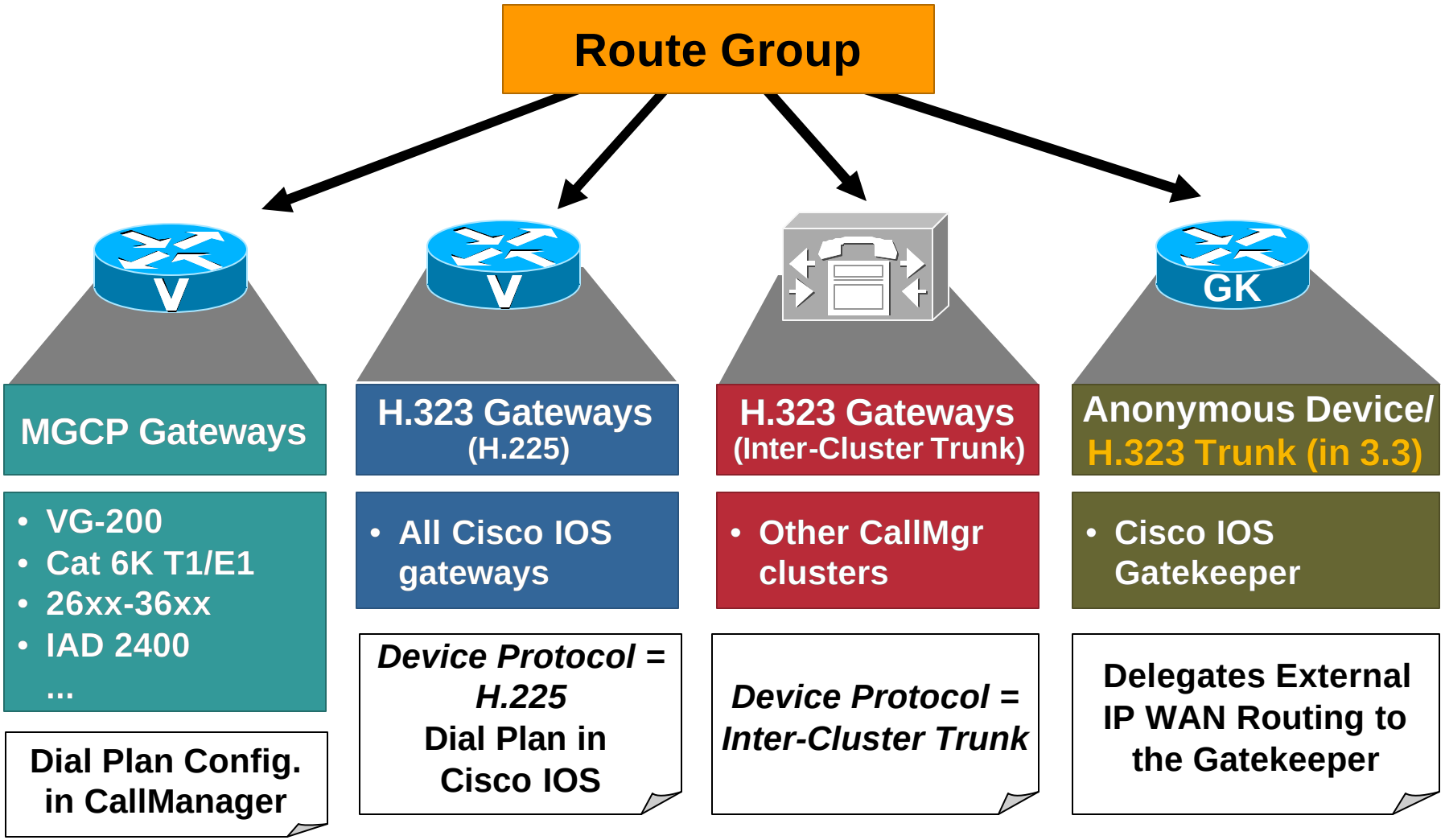
# Route Group Devices





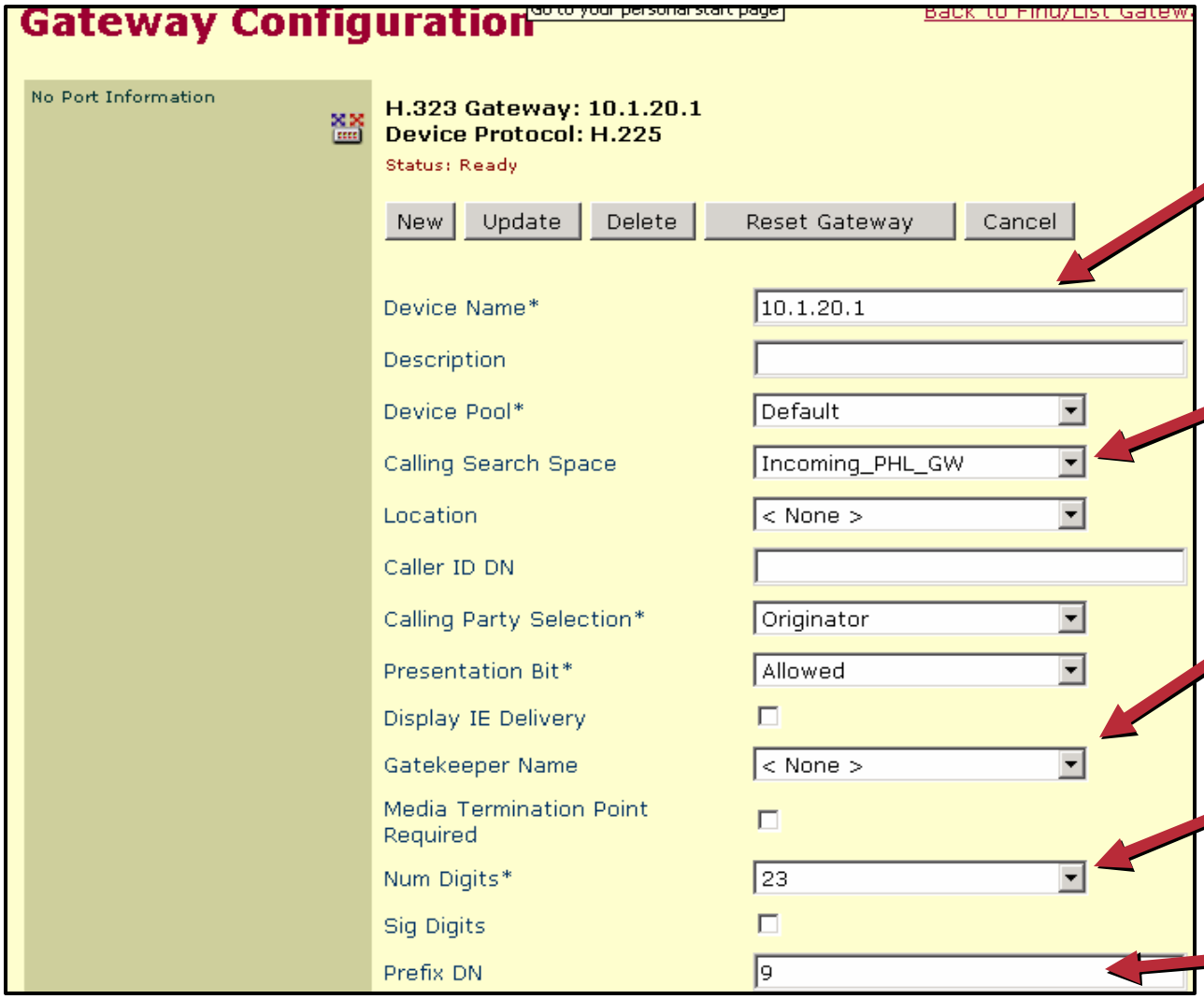
# Route Group Devices
## Device Types





# Route Group Devices
## H.323 Gateway Configuration (CallManager)






**Device Name**
**IP Address of H.323 GW**

**Calling Search Space**
**Defines Where this Device May Place Inbound Calls**

**Is Gatekeeper Needed to Call this Device?**

**To Strip All But Significant Digits for Incoming Calls**

**To Prefix Incoming Calls**

# Route Group Devices
## H.323 Gateway Configuration (Cisco IOS)

Cisco.com

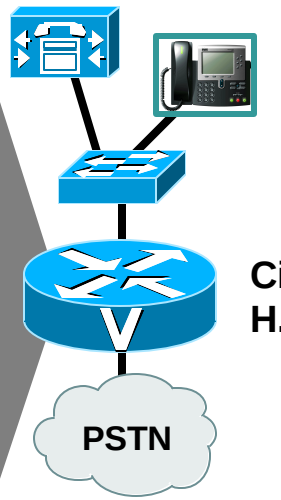
```
dial-peer voice 101 voip
 destination-pattern ..........
 session target ipv4:10.1.20.25
 dtmf-relay h245-alphanumeric
 codec g711ulaw
 ip qos dscp af31 signaling
 ip qos dscp ef media
!
dial-peer voice 1 pots
 destination-pattern 1..........
 port 3/1/1
 prefix 1
!
dial-peer voice 2 pots
 destination-pattern 911
 port 3/1/1
 prefix 911
!
dial-peer voice 5 pots
 destination-pattern .......
 port 3/1/1
!
dial-peer voice 6 pots
 destination-pattern 011T
 port 3/1/1
 prefix 011
```

(Long Distance)

(Emergency)

(Local 7 Digit Dialing)

(International Dialing)

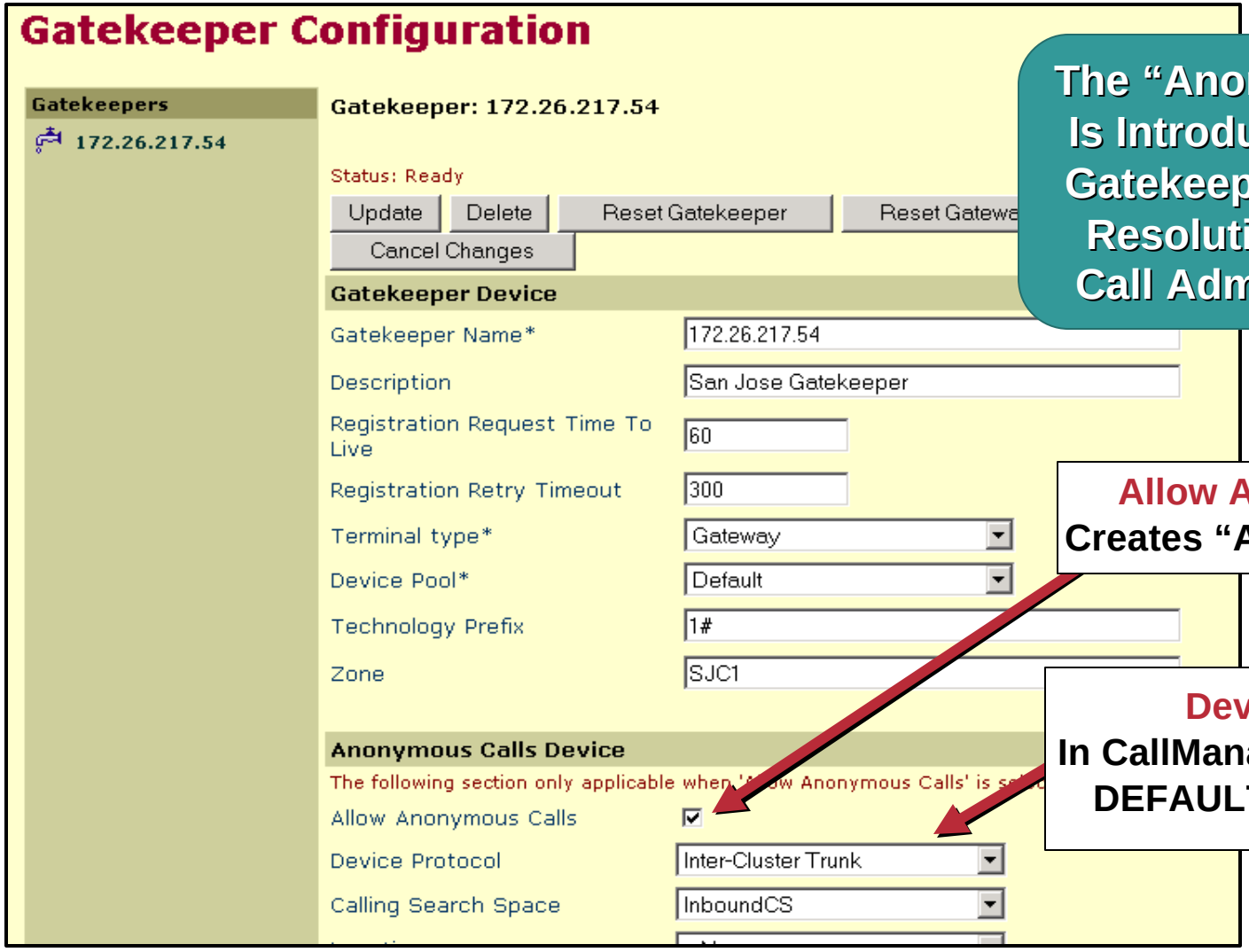



**Incoming Dial Peer(s)**
Point to CallManager Cluster
(CM Redundancy Not Shown)

**Outgoing Dial Peer(s)**
- Must match outgoing string lengths
- May need to prefix digits for PSTN

# Route Group Devices
## "Anonymous Device" Configuration (Pre-3.3)






The "Anonymous Device" Is Introduced to Use the Gatekeeper for Dial Plan Resolution (as Well as Call Admission Control)

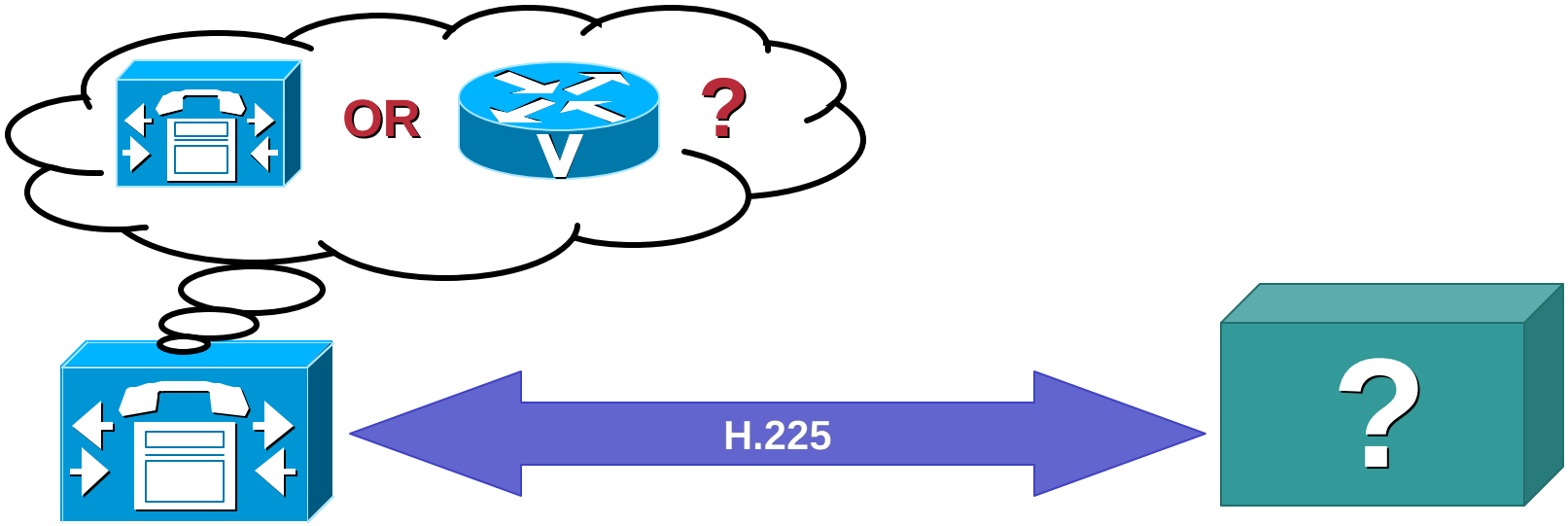
**Allow Anonymous Calls**
**Creates "Anonymous Device"**

**Device Protocol**
**In CallManager 3.2, this Is the DEFAULT Device Protocol**

# Route Group Devices
## Anonymous Device—Auto-Discovery

Cisco.com

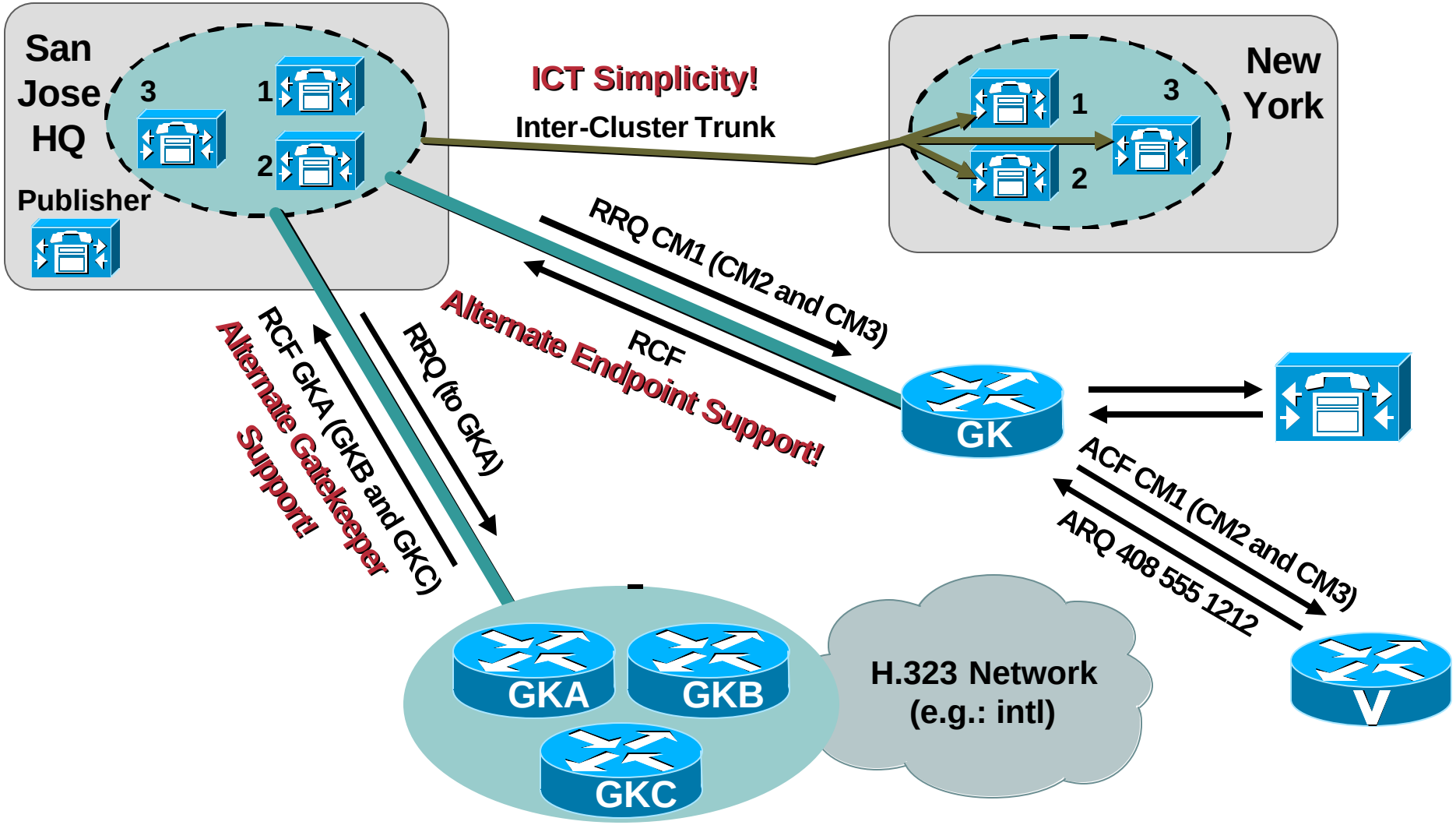
- During H.225 setup, CallManager identifies itself to the remote device
- If the remote device identifies itself as another CallManager, supplementary services can be used
- Otherwise, the default Device Protocol is used




**Use H.225 as Default Device Protocol if all CallManagers Are 3.2 or Later**

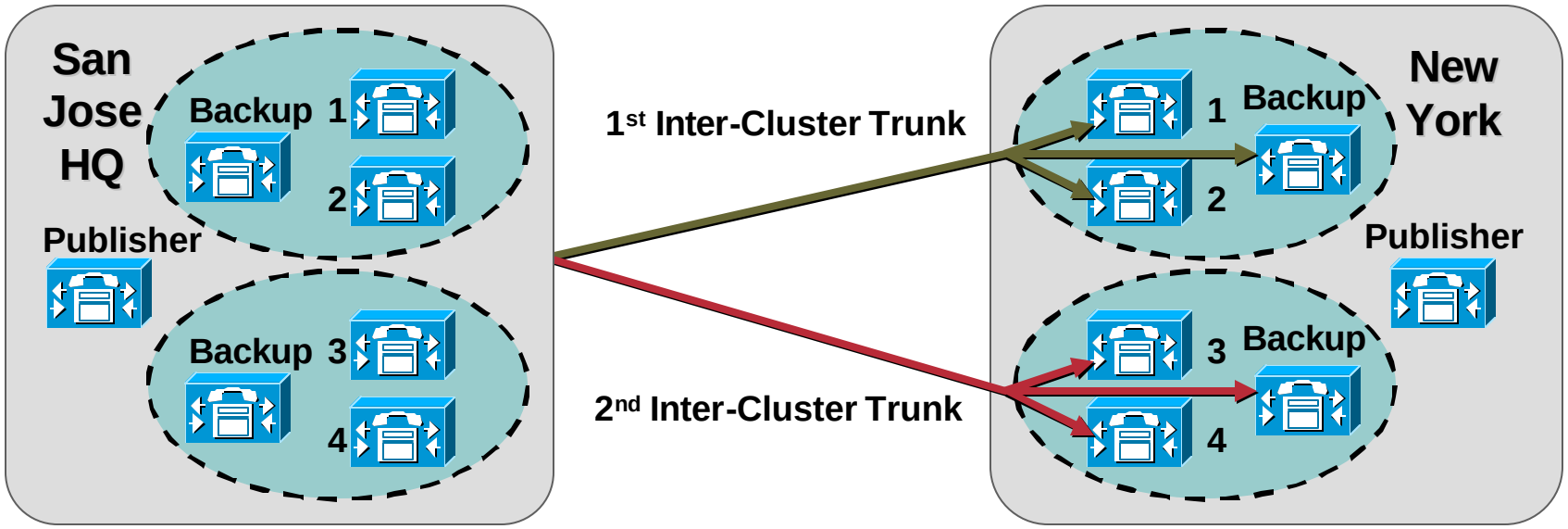
# Route Group Devices
## H.323 Trunks (3.3)—New Simplicity and Possibilities

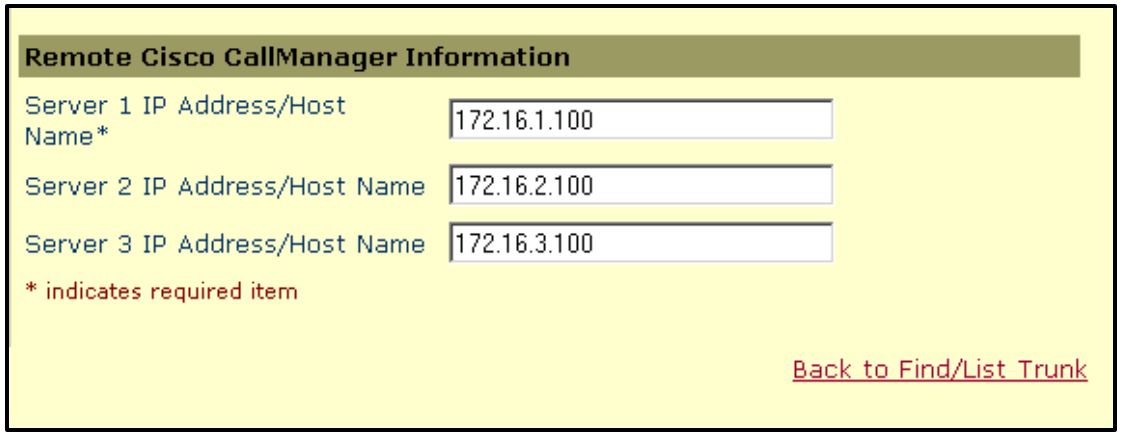




# Inter-Cluster Trunks—Redundancy






**As of CallManager 3.3, Redundancy Is Built into the Inter-Cluster Trunk**

***(2 ICTs instead of 6)***

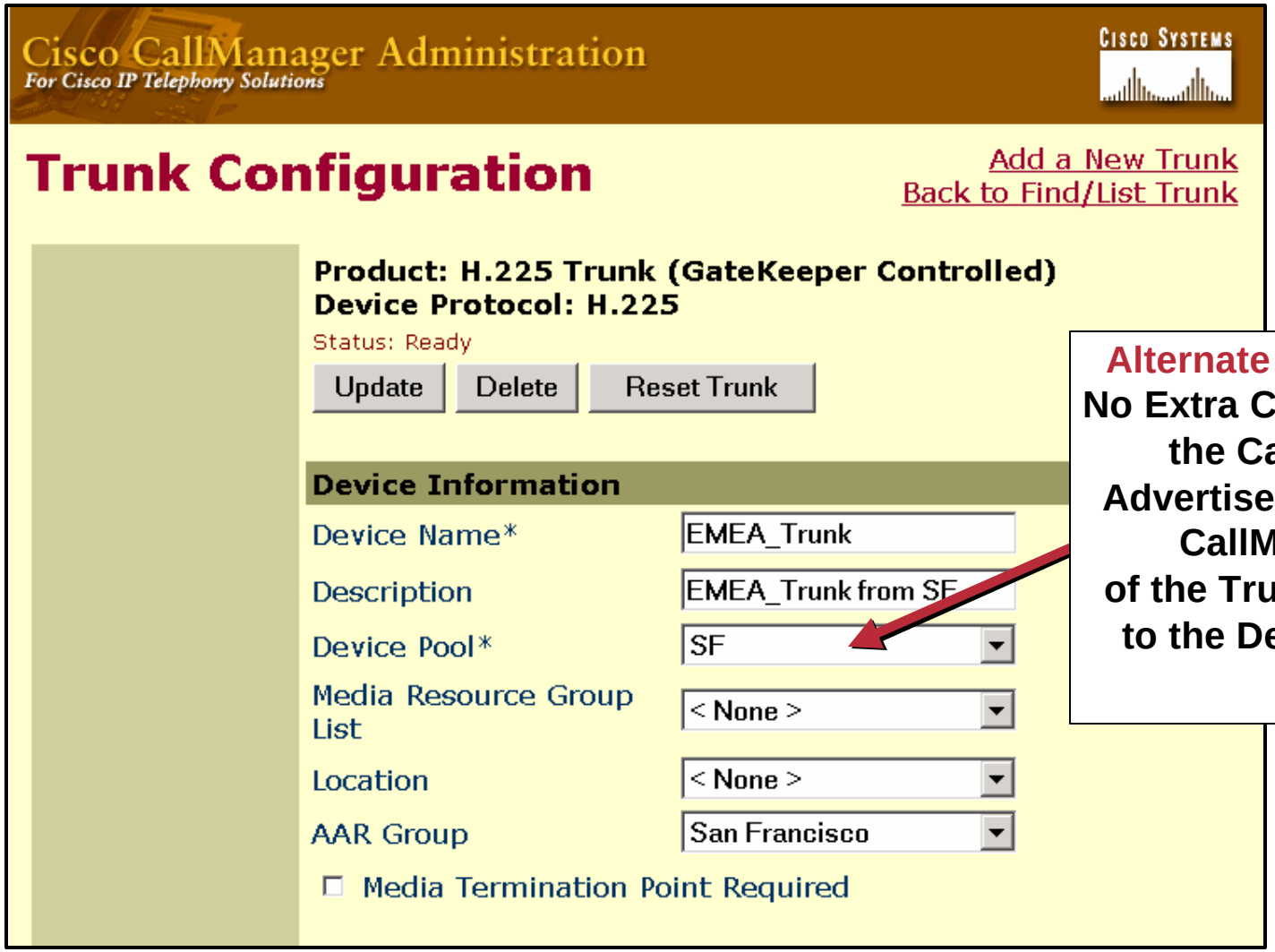
# Configuration—Inter-Cluster Trunk



- Calls to an inter-cluster trunk without GK-control are load shared in a round robin fashion among the configured peer signaling addresses
- For example, the first call is routed to peer transport address 1, next call to peer transport address 2, 3rd call to transport address 3, 4th call to transport address 1, and so forth

# Alternate Endpoint Support






**Alternate Endpoint Support**

**No Extra Config Needed Here; the CallManager Will Advertise All Servers in the CallManager Group of the Trunk (as Associated to the Device Pool) in the RRQ**

# Alternate GK Support




**Up to 10 Gatekeepers Can Be Defined in CallManager 3.3**

**Alternate GK Support**

**No Extra Config Needed Here; the Alternate GK Addresses Will Be Returned in the RCF from this GK**

# H.323 Trunk Possibilities

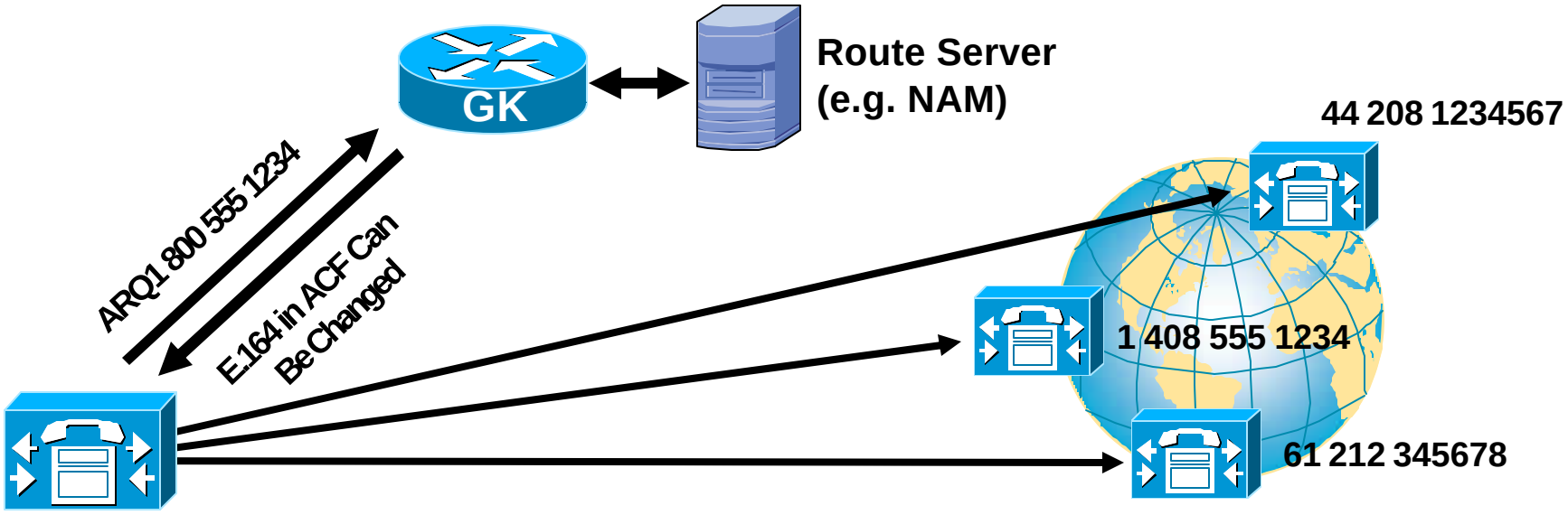
Cisco.com

- Up to 10 Gatekeepers can be defined
- Trunks allow multiple path into IP telephony networks: IP IXC, IP LEC, theaters, etc…
- When a GK-controlled trunk is configured with more than one CCM in the device pool, CCM will automatically send RRQ with alternate endpoints when backup CCM(s) come up in service
- If the given destination call signaling address is unreachable, all of the alternate CCMs in the device pool will be attempted before giving up
- No CLI configuration in Cisco IOS GK is needed
- Alternate endpoint is supported in IOS GK load 12.2T

# H.323 Enhancements
## CanMapAlias

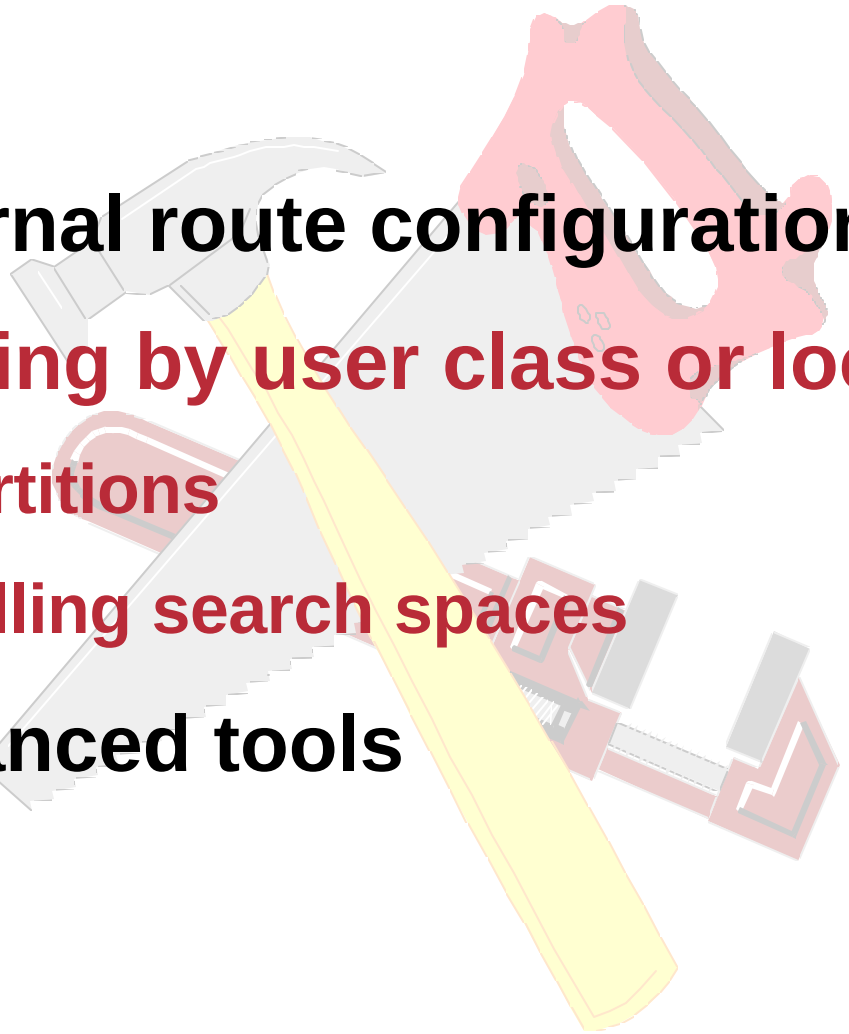


- Time of day routing (follow the sun)
- Follow me service (virtual phone number)
- “Number mobility” single point of administration
- Hotel “gold customer” 1-800-WhateverHotelRoomThisWeek



# CallManager Dial Plan Tool Kit



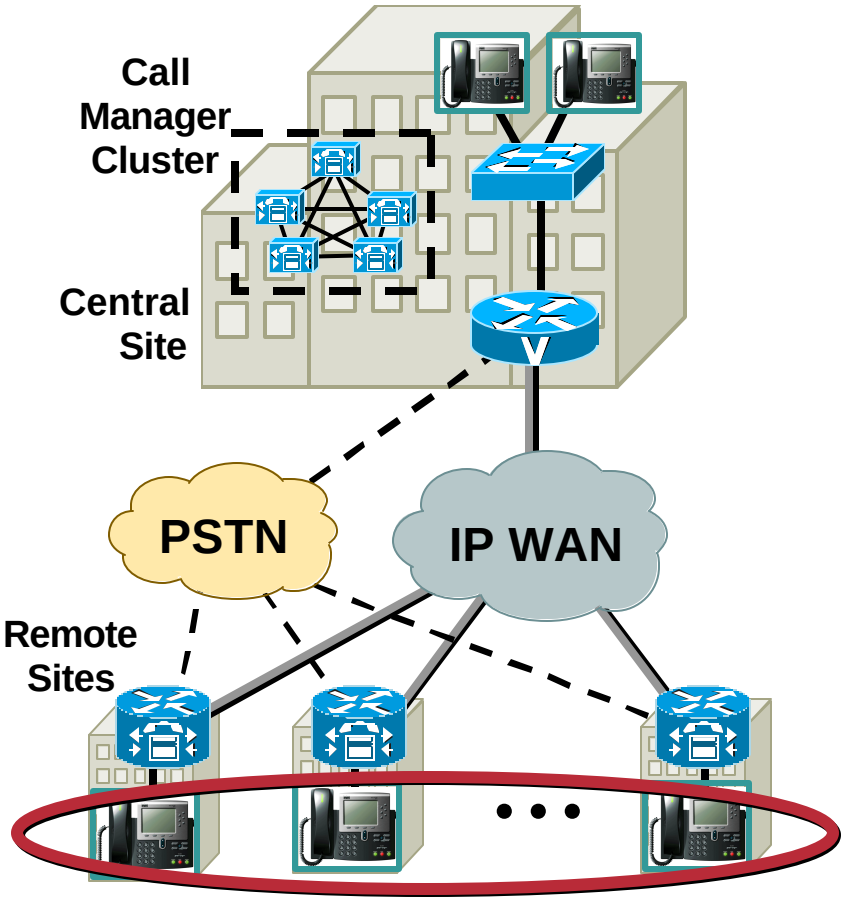


- External route configuration
- Routing by user class or location
  - Partitions
  - Calling search spaces
- Advanced tools

# Routing by User Class or Location



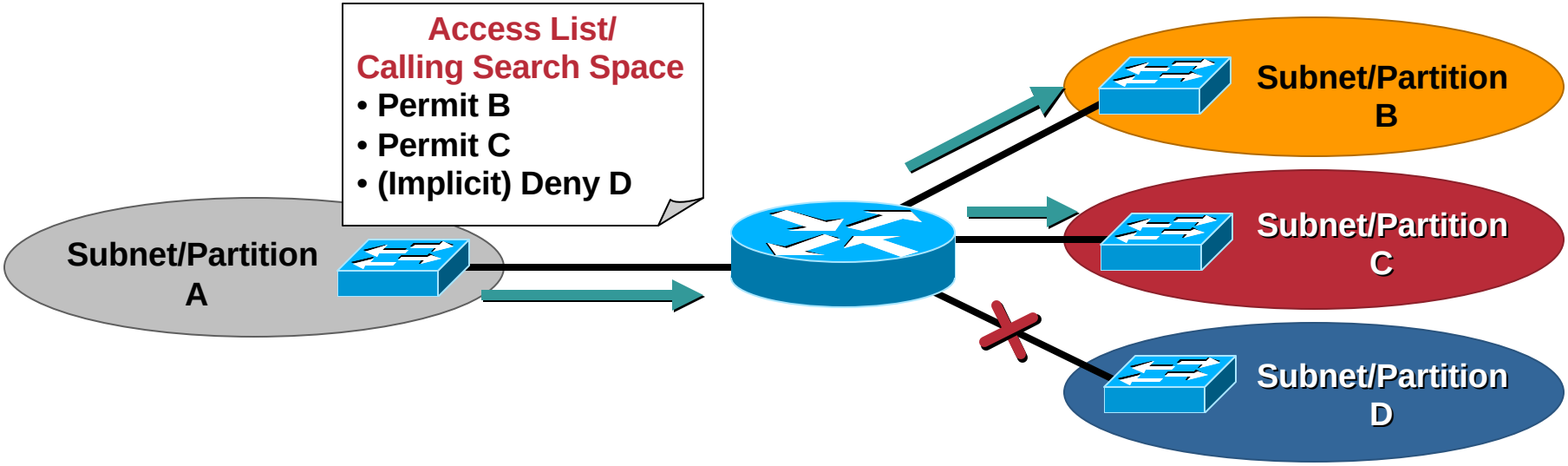

**Create "Classes of Service" to Define Calling Restrictions**




**Instruct Remote Phones to Use Their Local Gateway for PSTN Access**

# Partitions and Calling Search Spaces
## Analogy with Subnets/Access Lists






- **Partition—"where you are"**
  - Collects devices with similar "reachability" characteristics
  - Items placed in partitions: Directory Numbers (DN), route patterns, voice mail ports...
- **Calling Search Space—"where you may call"**
  - Set of rules to set call restrictions/permissions
  - Defines which partitions a device may search to reach a dialed number
  - Is assigned to IP phones, GWs

# Partitions and Calling Search Spaces



- Partitions and Calling Search Spaces cause the majority of call routing configuration errors
- Understanding Partitions and Calling Search Spaces is essential to understanding call routing in CallManager
- Allow toll bypass from one geographical region to another
- Allow different outside calling privileges by class of calling user
- Allow multiple tenants with overlapping dial plans to be served by the same CallManager

# Partitions and Calling Search Spaces Analogy

Cisco.com

Rita Wants to Call Dave

To Do So, She Needs to Know Dave's Number

Rita

Miami Yellow Pages

Dave 305 555 5000

Dave Lists His Number in a Directory

Dave

305 555 5000

# Partitions and Calling Search Spaces Analogy



To Look up Numbers, Rita Looks through the Directories She Owns

If She Doesn't Have the Right Directory…

Rita's List of Directories

- Dallas White Pages
- Outlook Address Book
- Little Black Book

…She Can't Place the Call

Rita

Miami Yellow Pages

Dave 305 555 5000

Dave

305 555 5000

# Partitions and Calling Search Spaces Analogy



**But if She Has the Directory Dave Has Listed His Number in…**


**Rita's List of Directories**

- Dallas White Pages
- Miami Yellow Pages
- Little Black Book

**Rita**

**…the Call Will Go Through**

**Dave**

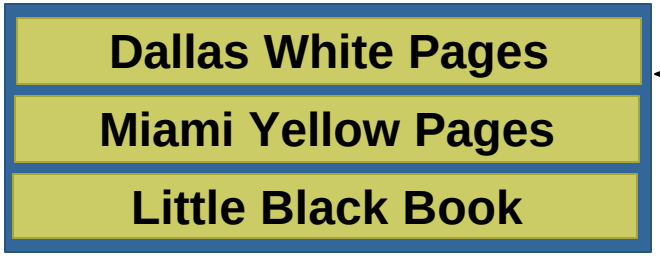
**305 555 5000**

# Partitions and Calling Search Spaces Analogy



The Directory in which Dave's Number Is Listed Is His Number's Partition


Rita's List of Directories




The List of Directories in which Rita Looks up Numbers Is Her Calling Search Space

Rita

Dave

305 555 5000

# Partitions and Calling Search Spaces
## Definition

Cisco.com

- **Partition:** **A logical grouping of patterns; all patterns in a partition are equally reachable**
- **Calling search space:** **An *ordered* list of partitions; digit analysis looks through the caller's list of partitions when searching for the closest match for the caller's dialed number**

# Partitions and Calling Search Space Rules



- Calling entities (phones, lines, gateways, applications) have calling search spaces
- Called entities (route patterns, translation patterns, directory numbers, feature codes) have partitions

# Partitions and Calling Search Space Rules



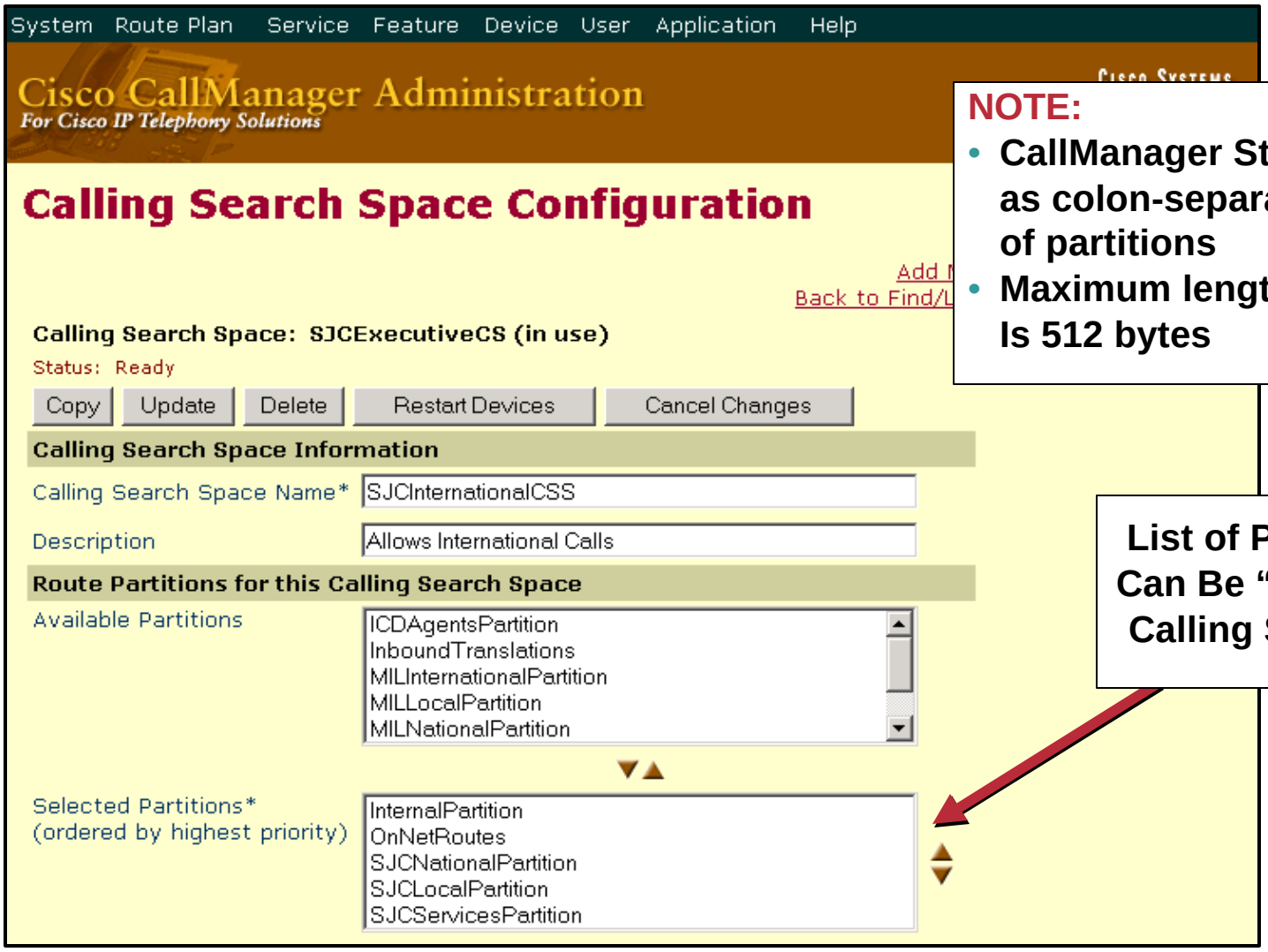
- Digit analysis looks through every partition in a calling search space and looks for the best match
- The order of the partitions listed in the calling search space is used only to break ties when there are equally good matches in two different partitions
- Contrary to popular belief, the partition the calling party's line is in has NO effect on where you can call from that line; only the Calling Search Space for that phone/device matters

# Partitions and Calling Search Space Rules



- If no partition is specified for a pattern, the pattern is listed in the null partition
- All callers look in the null partition (as well as any partitions specified in their calling search space) to resolve dialed digits
- The null partition is always the last partition in any Calling Search Space
- Closest-match routing takes precedence over the partition ordering in a Calling Search Space, so a closer match in the null partition will be used to route a call over a less-explicit match in a partition

# Partitions and Calling Search Spaces Configuration



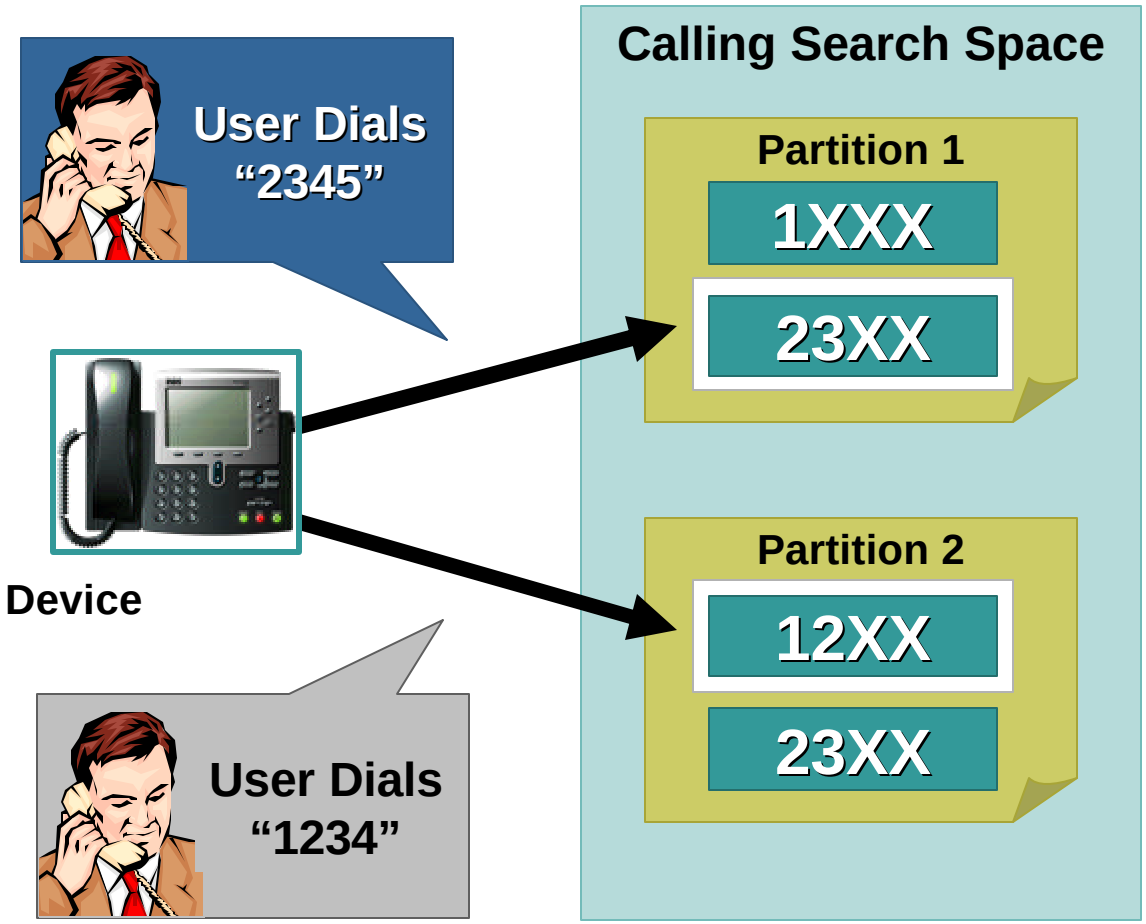

**NOTE:**

- **CallManager Stores a CSS as colon-separated list of partitions**
- **Maximum length of CSS Is 512 bytes**

**List of Partitions that Can Be "Seen" by this Calling Search Space**

# Partitions and Calling Search Spaces
## Impact of Partition Order

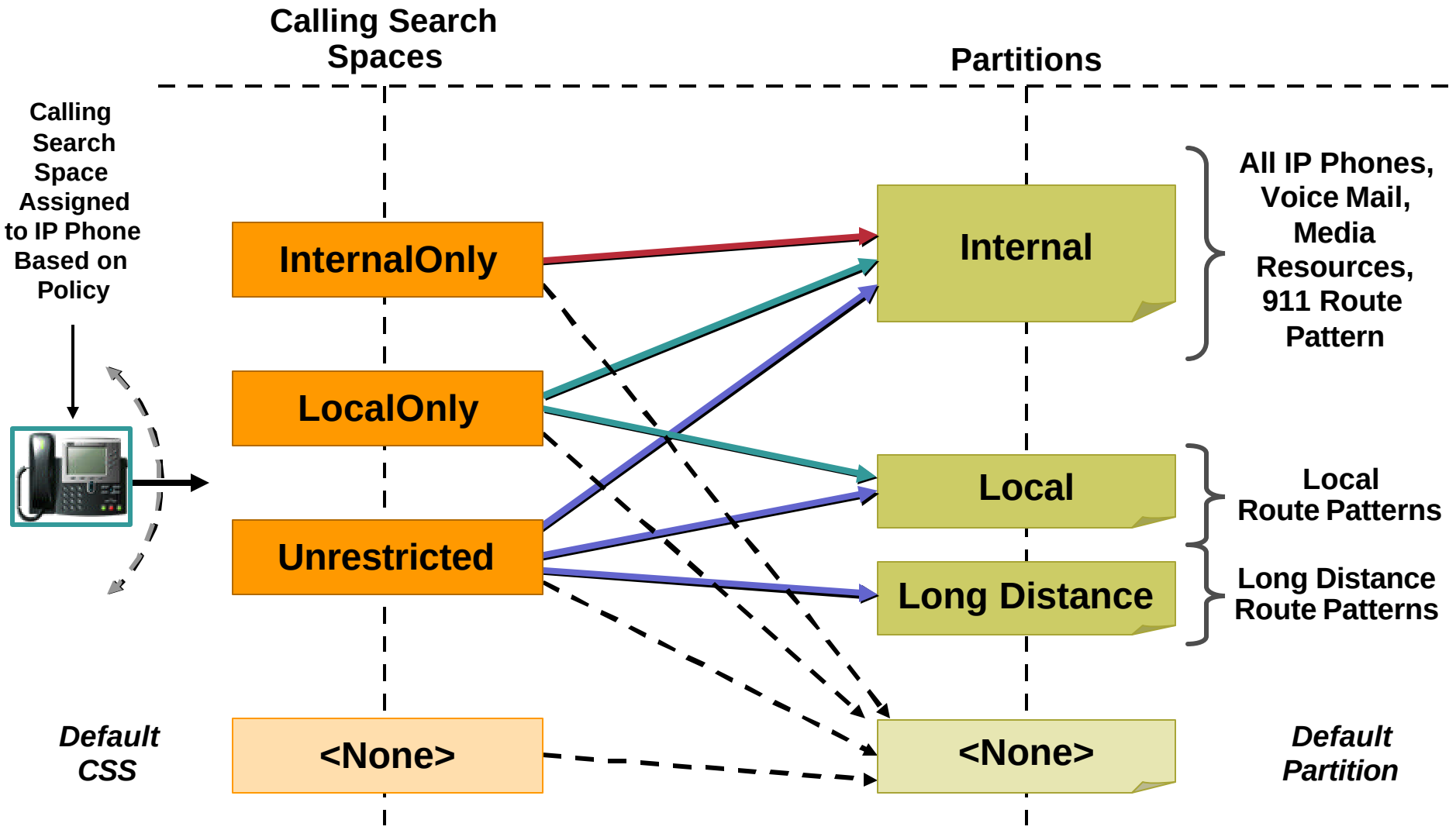




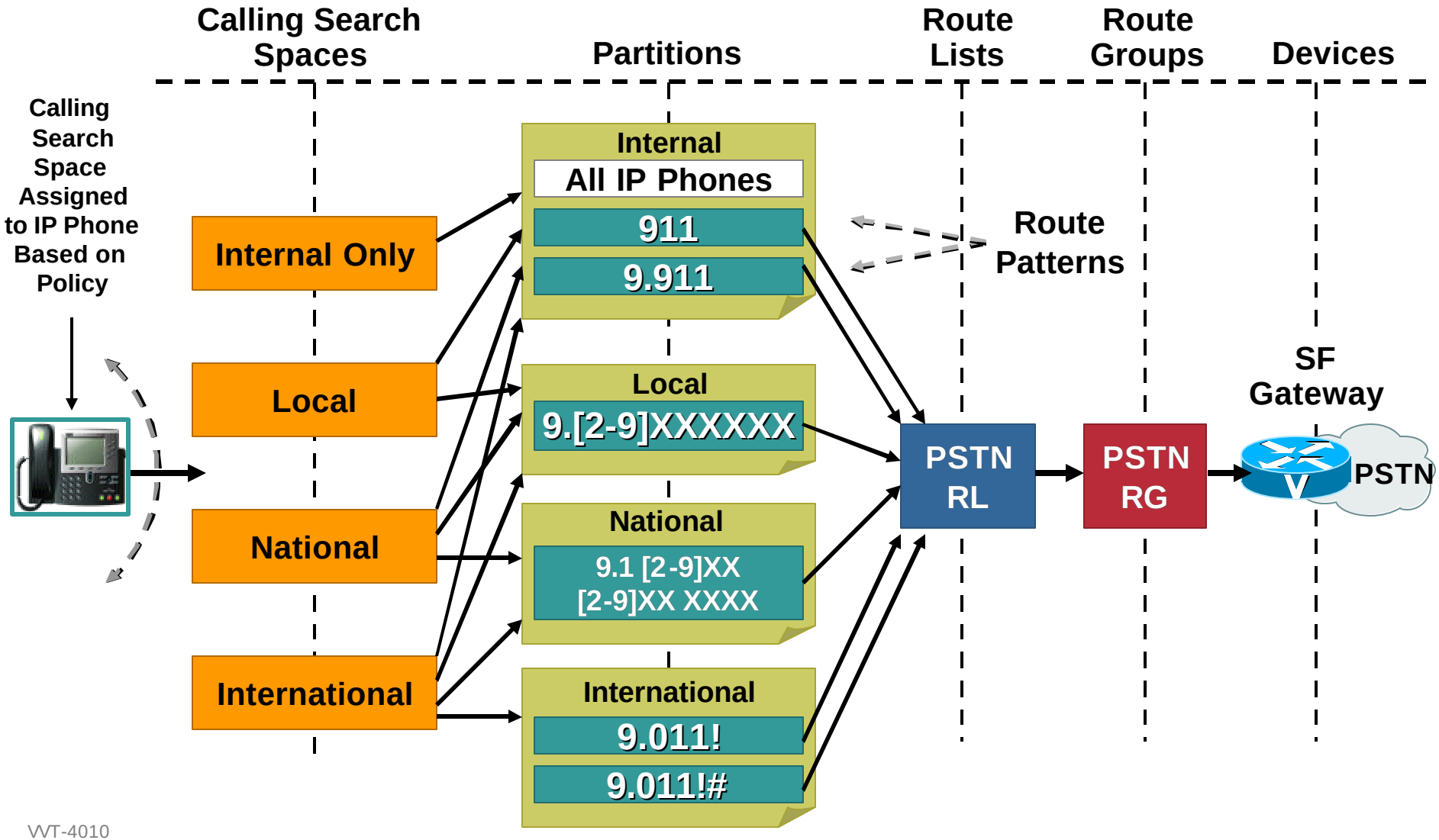

- Most specific patterns are chosen irrespective of partition order
- Partition order is only used as a tie-breaker in case of equal matches

# Partitions and Calling Search Spaces
## How to Build Classes of Service



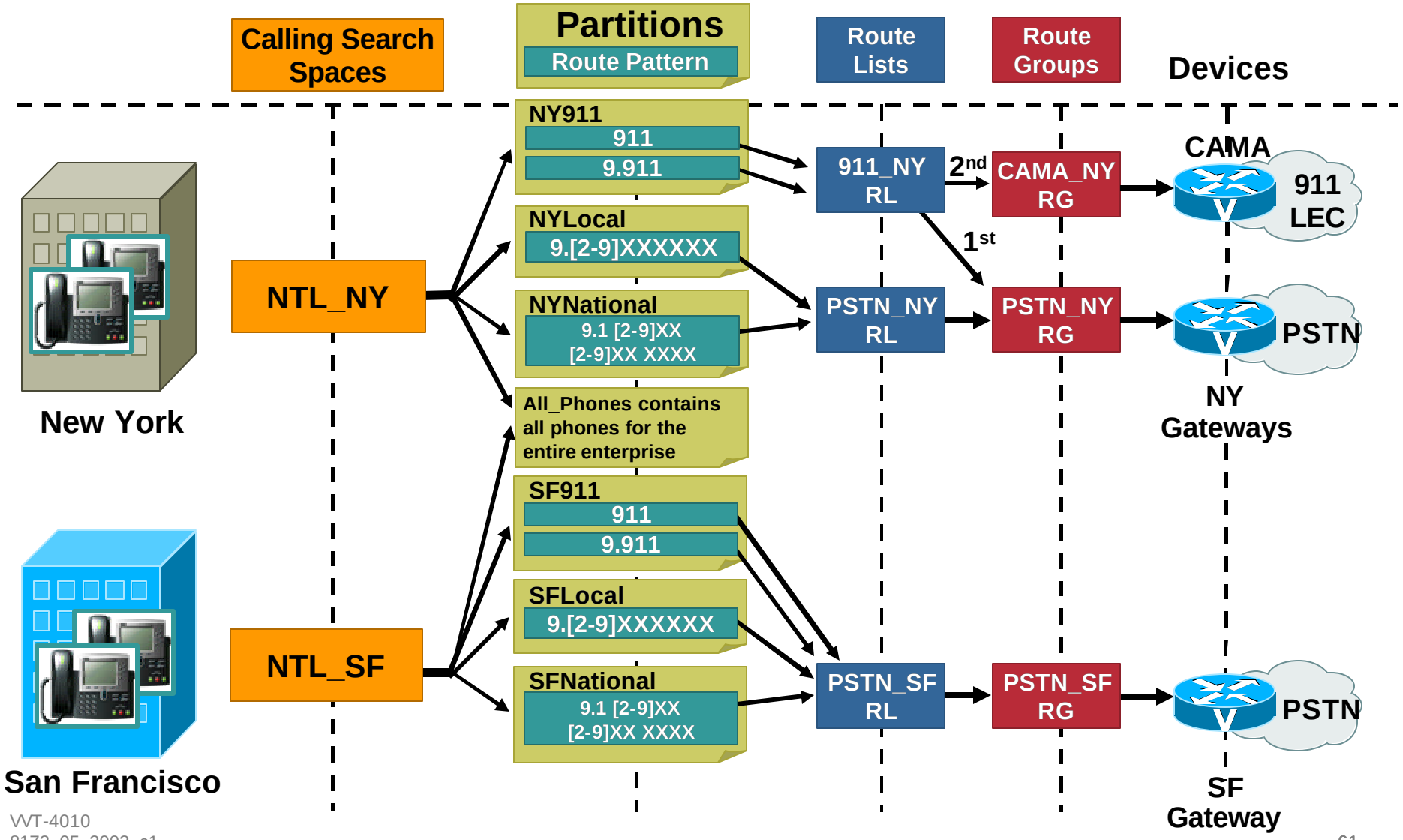


# Partitions and Calling Search Spaces
## Determine Class of Service AND Call Path (1/2)



# Partitions and Calling Search Spaces
## Determine Class of Service AND Call Path (2/2)





# Partitions and Calling Search Spaces



- **Previous slides have important implications:**

  **The Calling Search Space implements a "class of service" (e.g.: Local, National, etc…).**

  **AND**

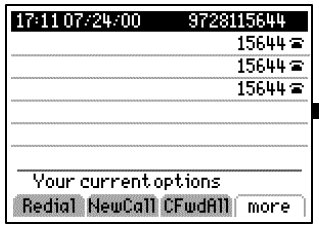
  **It ultimately chooses the path of the call, including the Gateway**

- **For these reasons, if you have N branches, and X classes of service, you need (N times X) Calling Search Spaces**

- **An alternative approach is possible!**

# Partitions and Calling Search Spaces
## Device-Line CSS Interaction






Line

Line CSS
- Partition L1
- Partition L2
- Partition L3

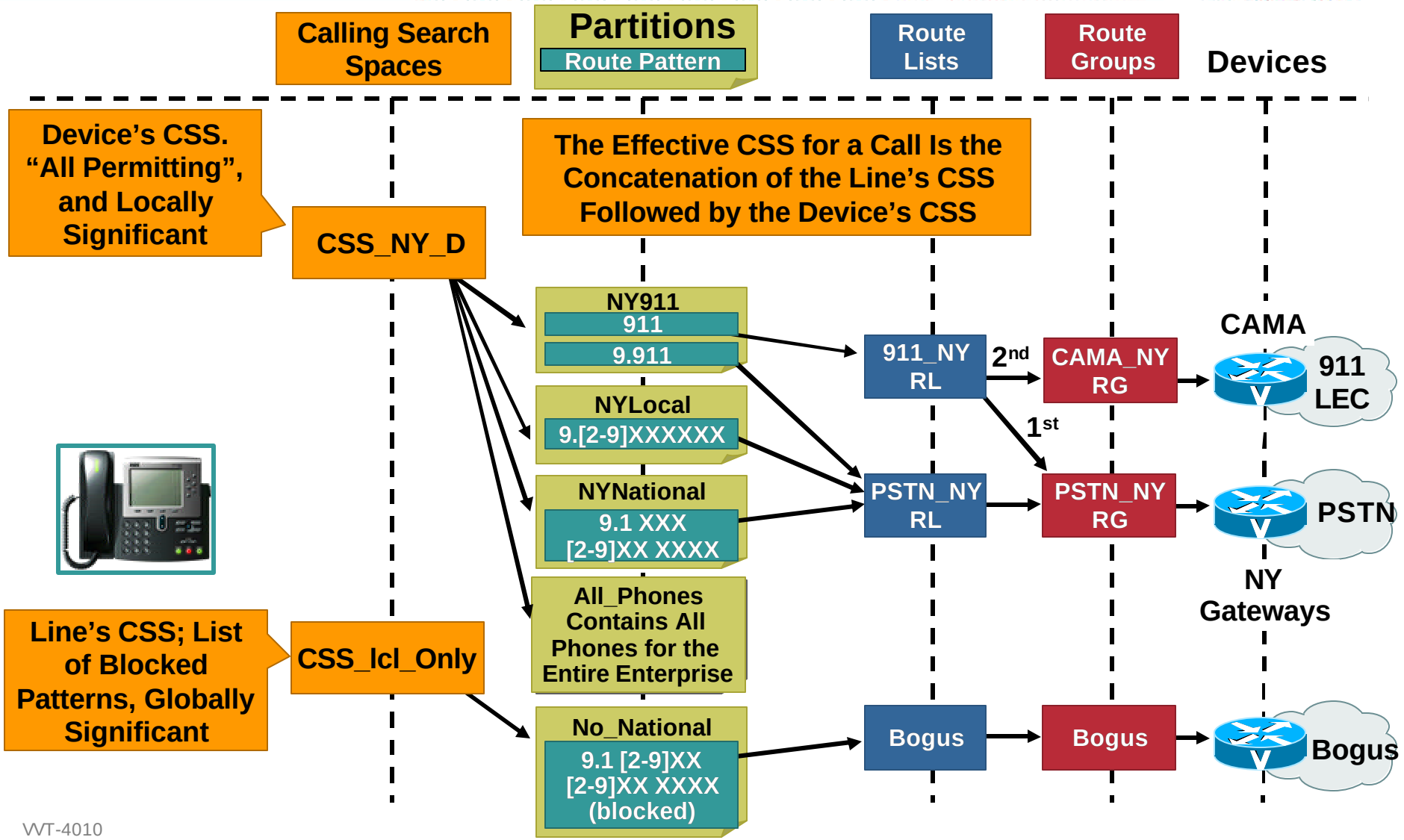
Resulting CSS
- Partition L1
- Partition L2
- Partition L3
- Partition D1
- Partition D2
- Partition D3

Device

Device CSS
- Partition D1
- Partition D2
- Partition D3

The CSS of the Device Has an Effect on All Calls Made from that Phone

# Partitions and Calling Search Spaces
## An Alternative Approach



# Partitions and Calling Search Spaces
## An Alternative Approach (Summary)



- **Create an unrestricted calling search space for each location and assign it to the phone's device calling search space; this calling search space should contain partitions featuring route patterns that route the calls to the appropriate gateway for the phone's location (e.g.: a co-located branch GW for emergency services and local calls, etc…)**
- **Create calling search spaces containing partitions featuring blocked route patterns for those types of calls not part of the user's dialing privileges, and assign them to the user's lines; for instance, if a user has access to all types of calls except international, his line (or lines) should be configured with a calling search space featuring a blocked route pattern for international dialing. Be as specific as possible!!! Make sure that the blocked pattern is a better match.**

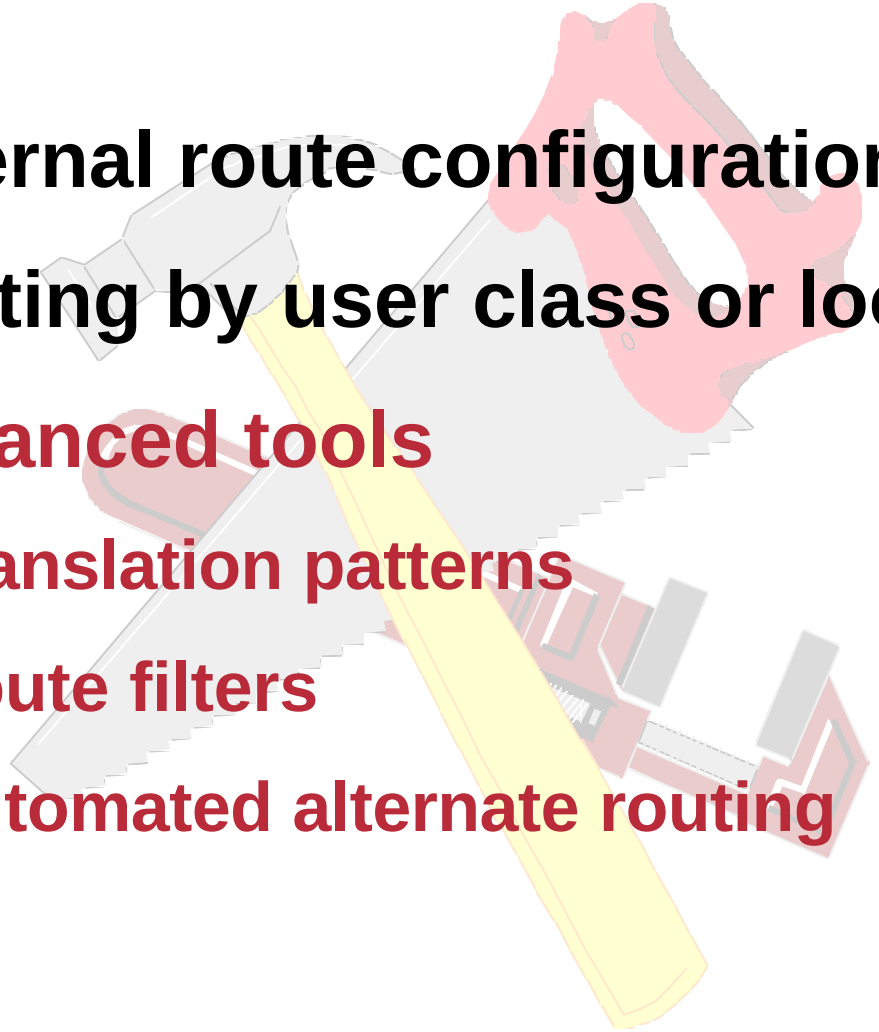
# Partitions and Calling Search Spaces
## An Alternative Approach (Summary)



- This approaches allows the enterprise with N locations and X classes of service to implement N + X Calling Search Spaces, as opposed to N times X
- This approach also allows Extension Mobility to work in a centralized call processing environment
- Call Forward functionality only uses a single CSS (no concatenation with the device's CSS): if you have specific CFNA, CFB or CFA needs, you may need to create more CSSes.

# CallManager Dial Plan Tool Kit

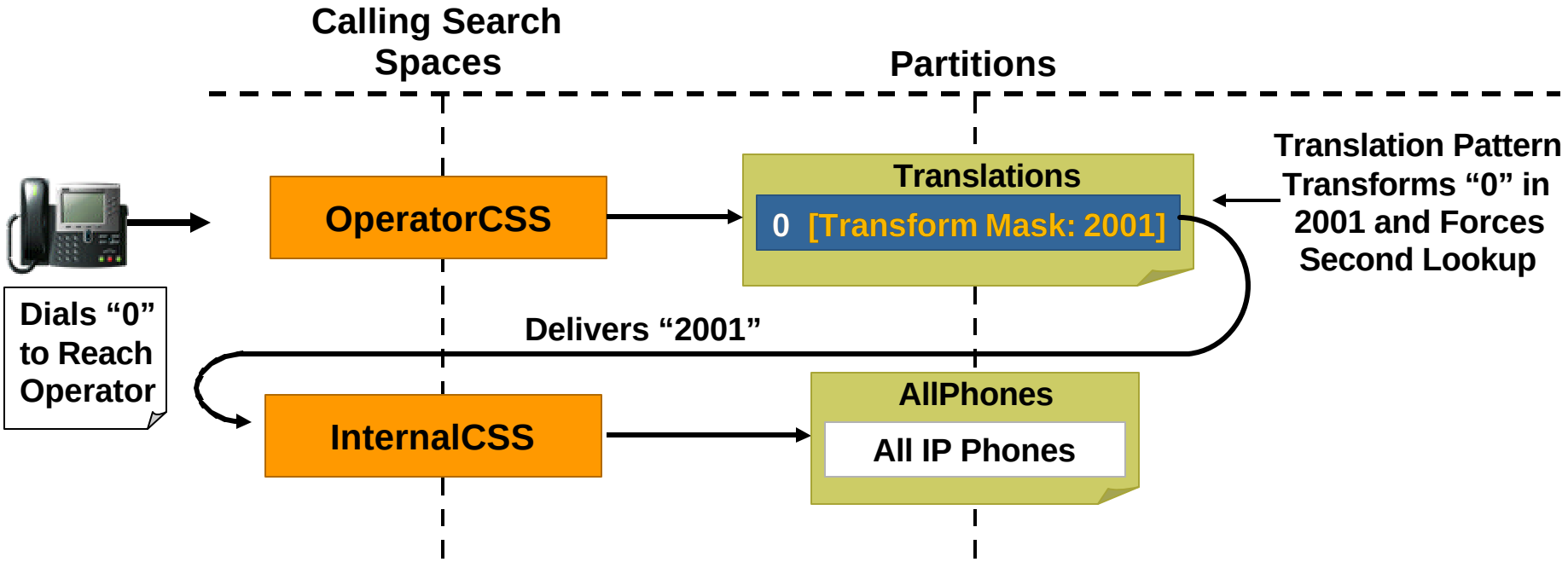




- External route configuration
- Routing by user class or location
- Advanced tools
  - Translation patterns
  - Route filters
  - Automated alternate routing

# Translation Patterns
## The Basics

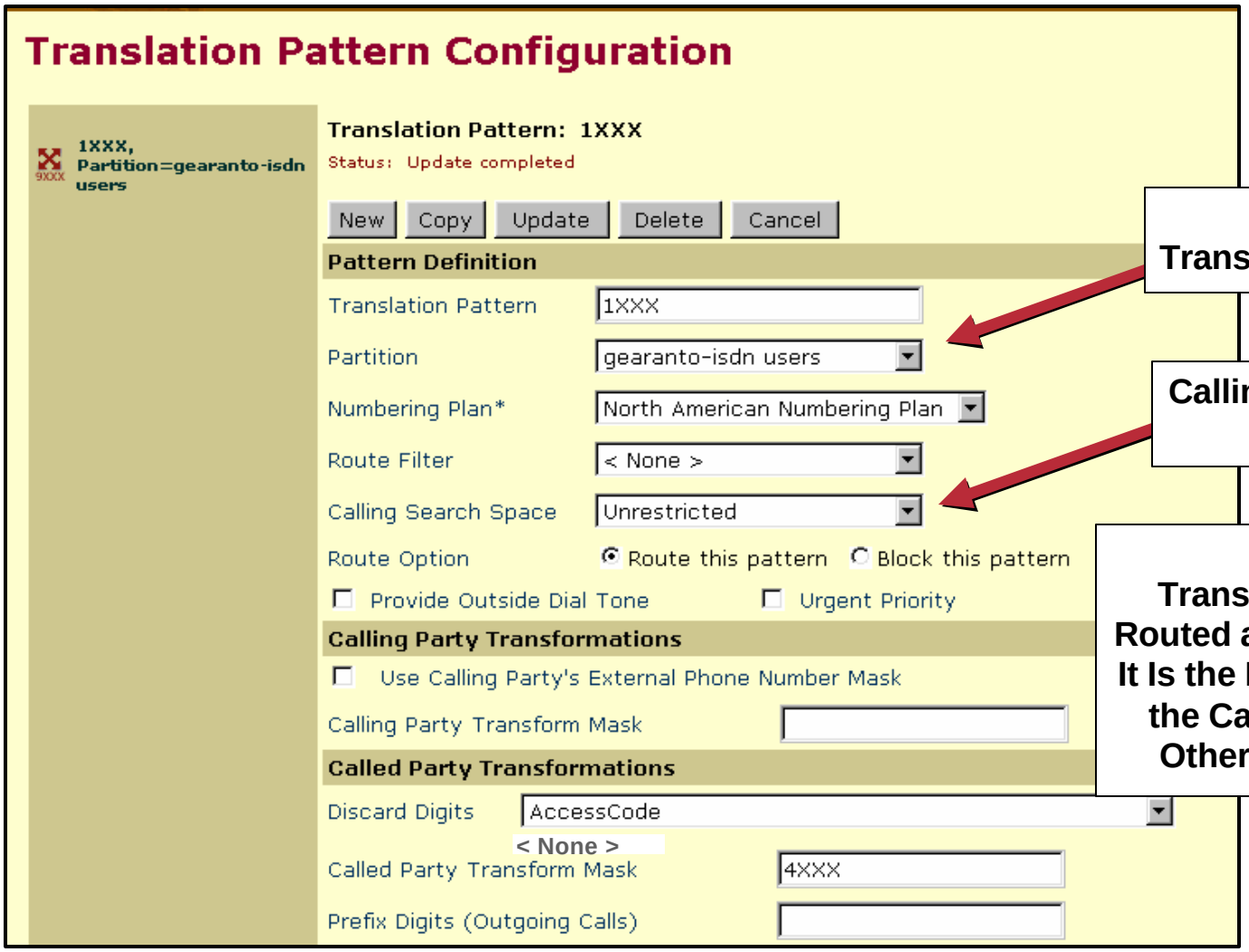





- Looks like a Route Pattern, allows digit manipulation
- Instead of sending calls outside via a route list, forces second lookup in CallManager, using a (possibly different) Calling Search Space

# Translation Patterns
## Configuration





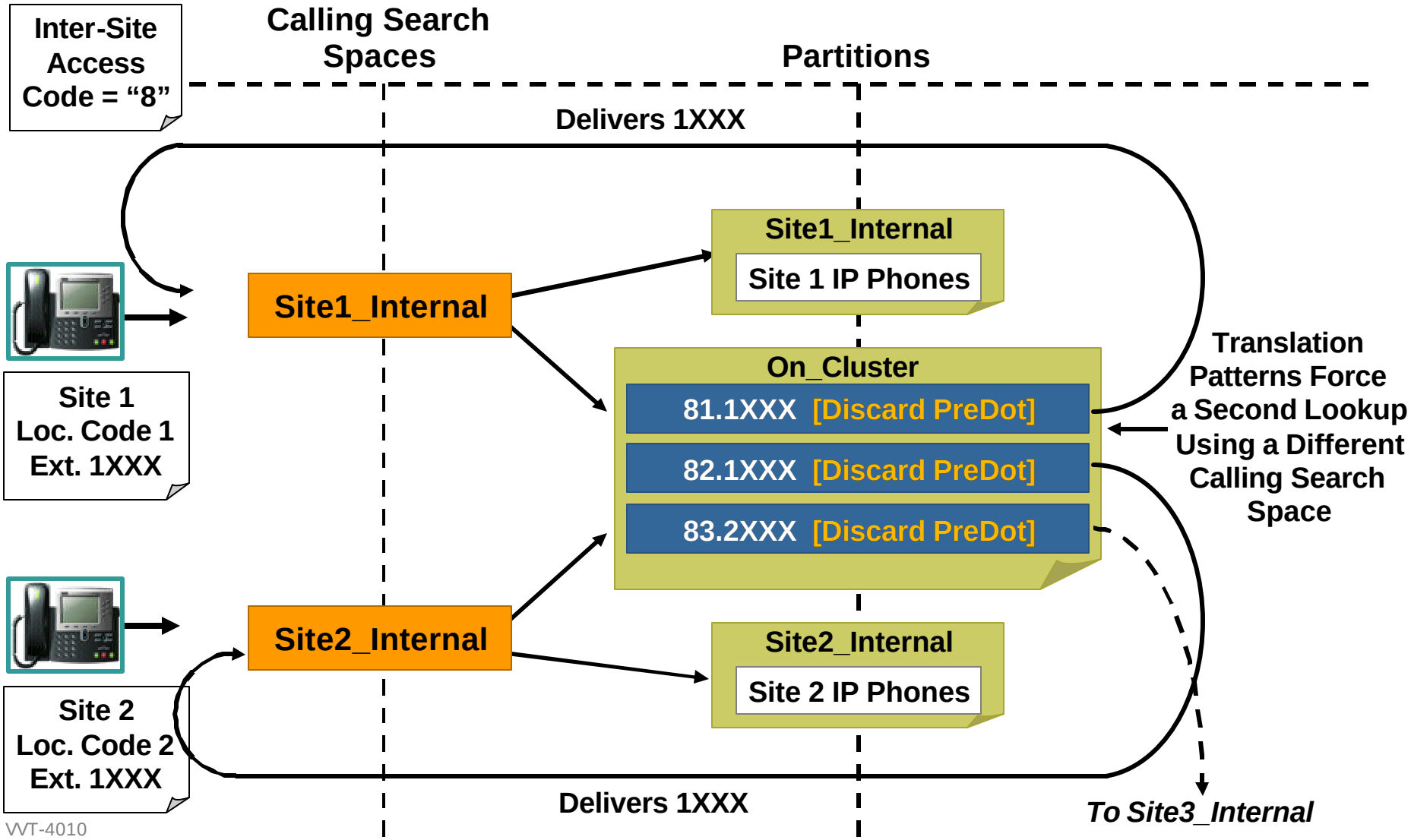

**Partition where Translation Pattern Resides**

**Calling Search Space after Translation**

**Note:**
**Translation Patterns Are Routed as Urgent; as Soon as It Is the Best Match, it Routes the Call Even if There Are Other Potential Matches**

# Translation Patterns
## Example—Overlapping Extensions

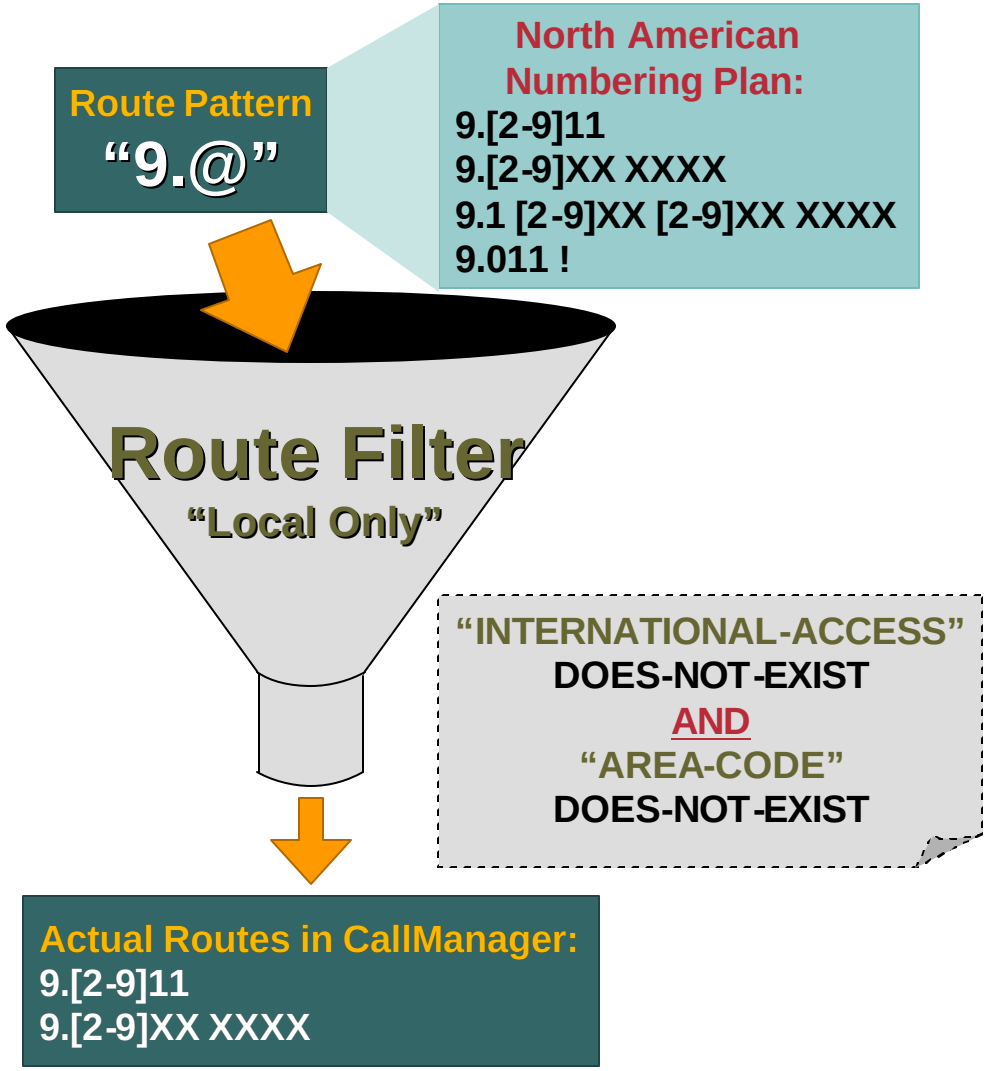




# Route Filters
## The Basics—"9.@" Route Pattern

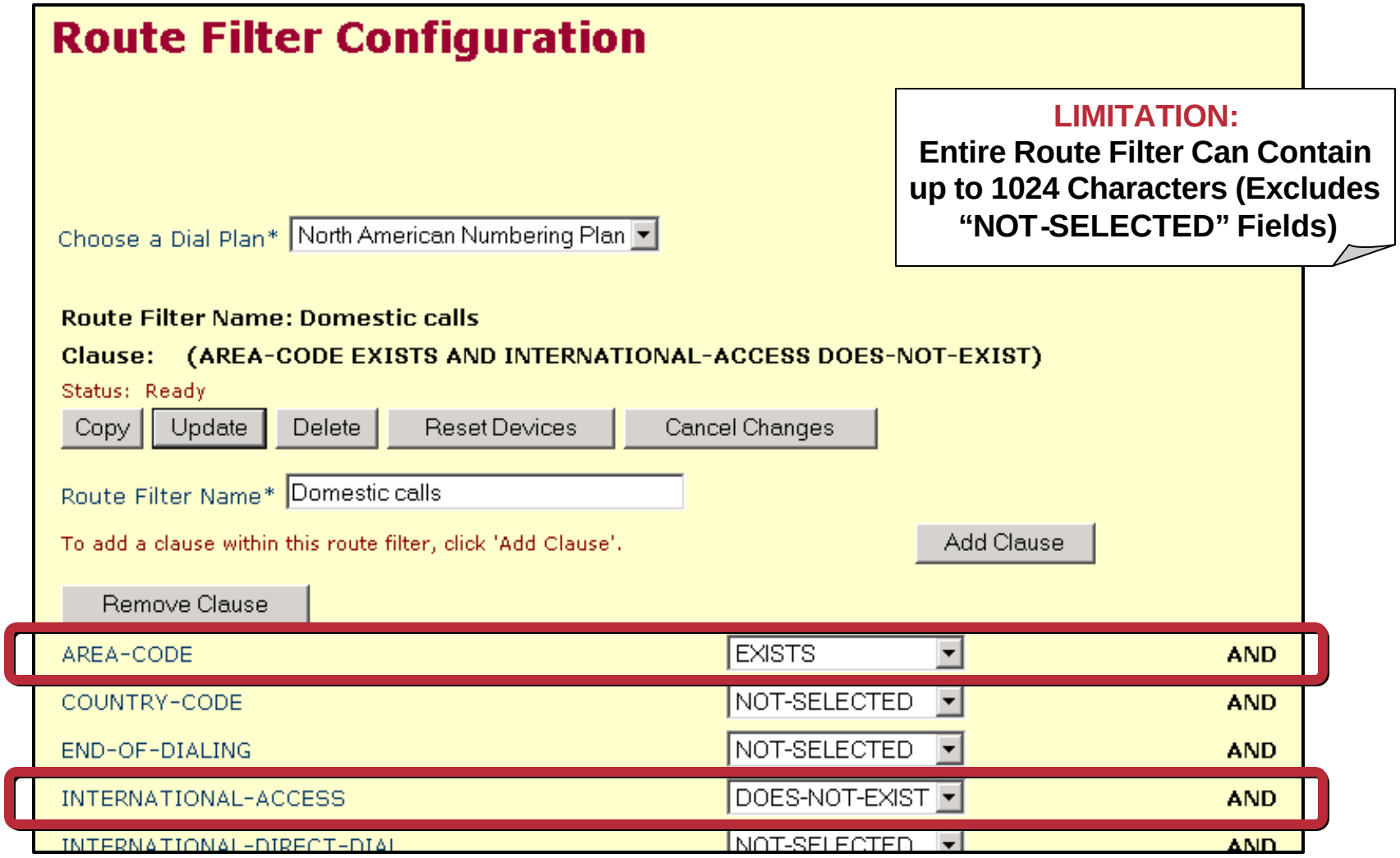


- The "@" wildcard represents all the routes defined in the national numbering plan
- CallManager identifies tags in each number:
  - INTERNATIONAL-ACCESS
  - AREA-CODE
  - OFFICE-NUMBER…
- Route filters are logical expressions that operate on these tags
- Useful for blocking 900, Caribbean, international…



# Route Filters
## Configuration





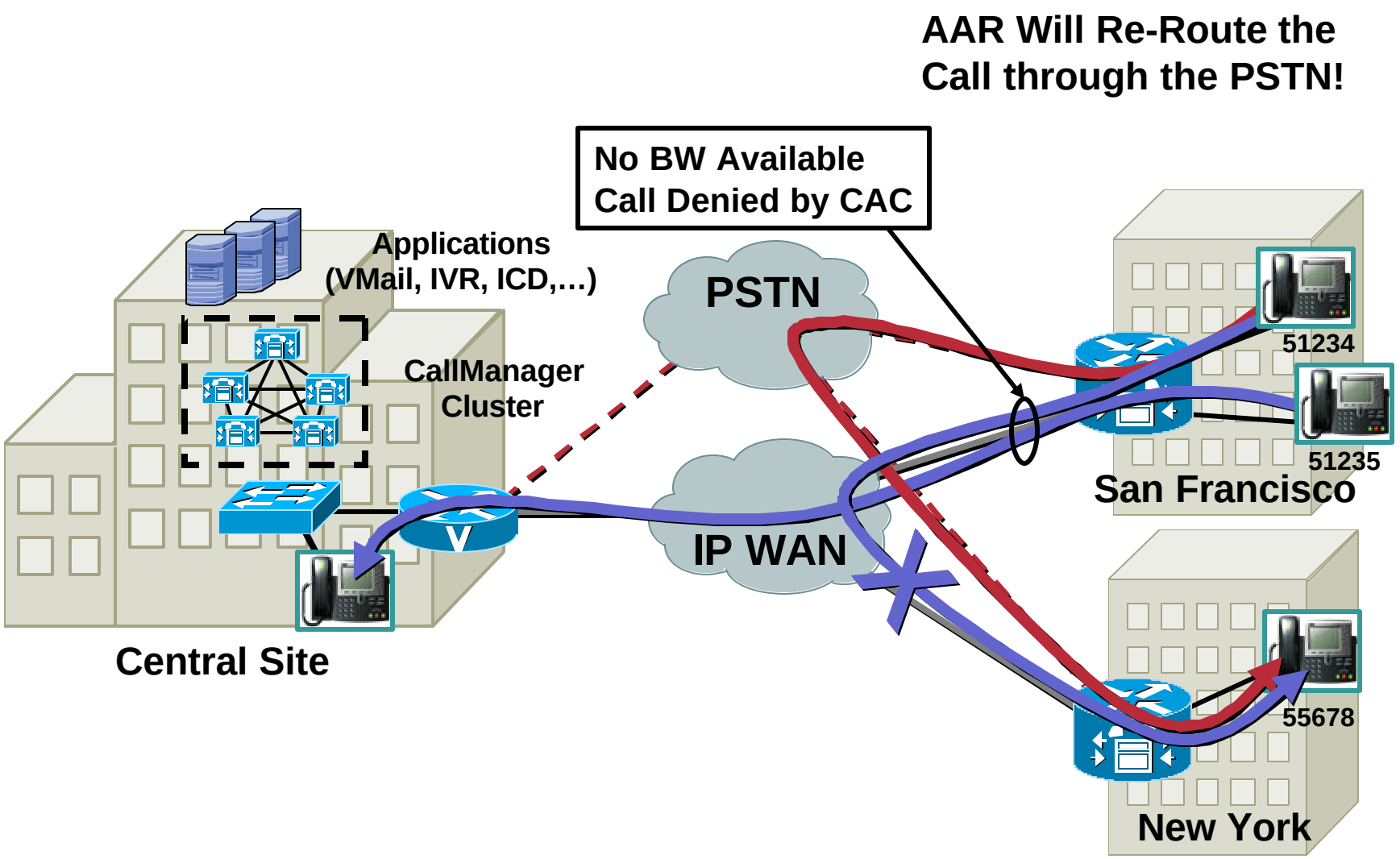
# AAR—Automated Alternate Routing

Cisco.com

- Allows for calls to DNs to be re-routed through an alternate network (e.g.: PSTN) if there is insufficient bandwidth to reach the destination
- Introduced in CCM 3.3
- Need to set “Automated Alternate Routing Enable” to True (default is False)

# AAR—Summary

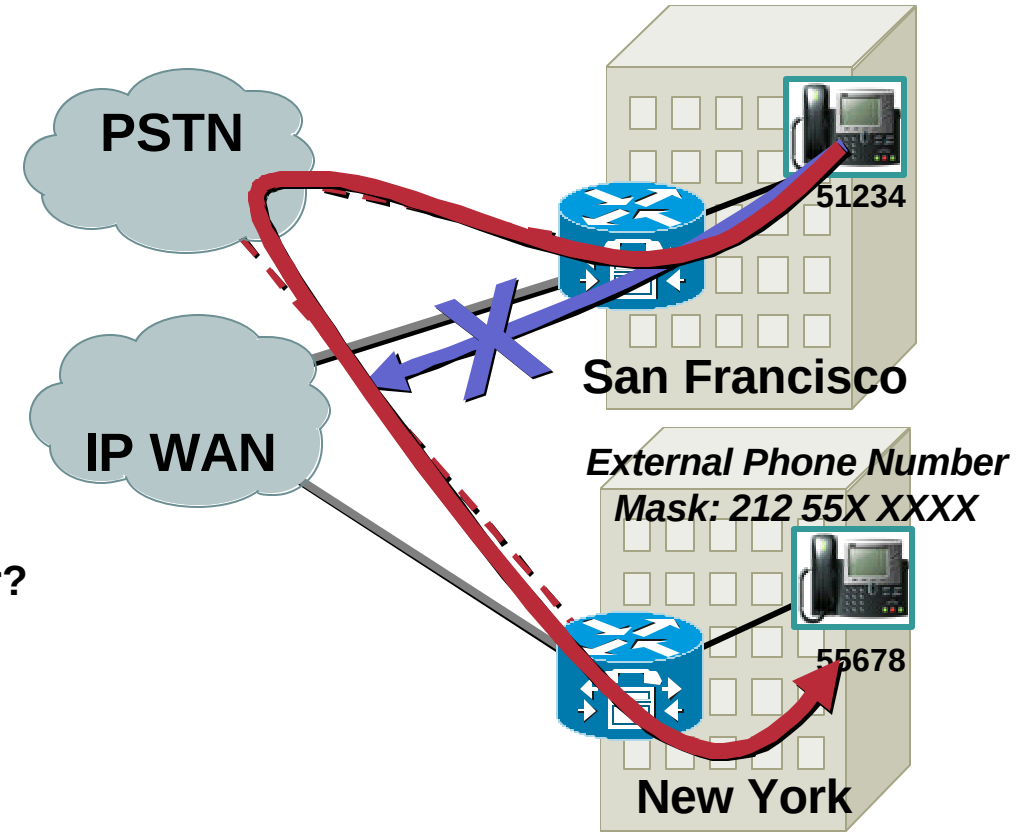




# AAR—Required Information



- **51234 dials 55678, and call is denied by CAC**
- **System needs to know how to reach 55678 through the PSTN**
  - **What is the PSTN-dialable number for extension 55678?**
    - ***Called phone's External Phone Number Mask: 212 555 5678!***
  - **How do I reach this number *from* San Francisco?**
    - ***Need to pre-pend 9 1; 9 1 212 555 5678!***
  - **What Gateway do I use from San Francisco to dial this number?**
    - ***San Francisco's local GW!***



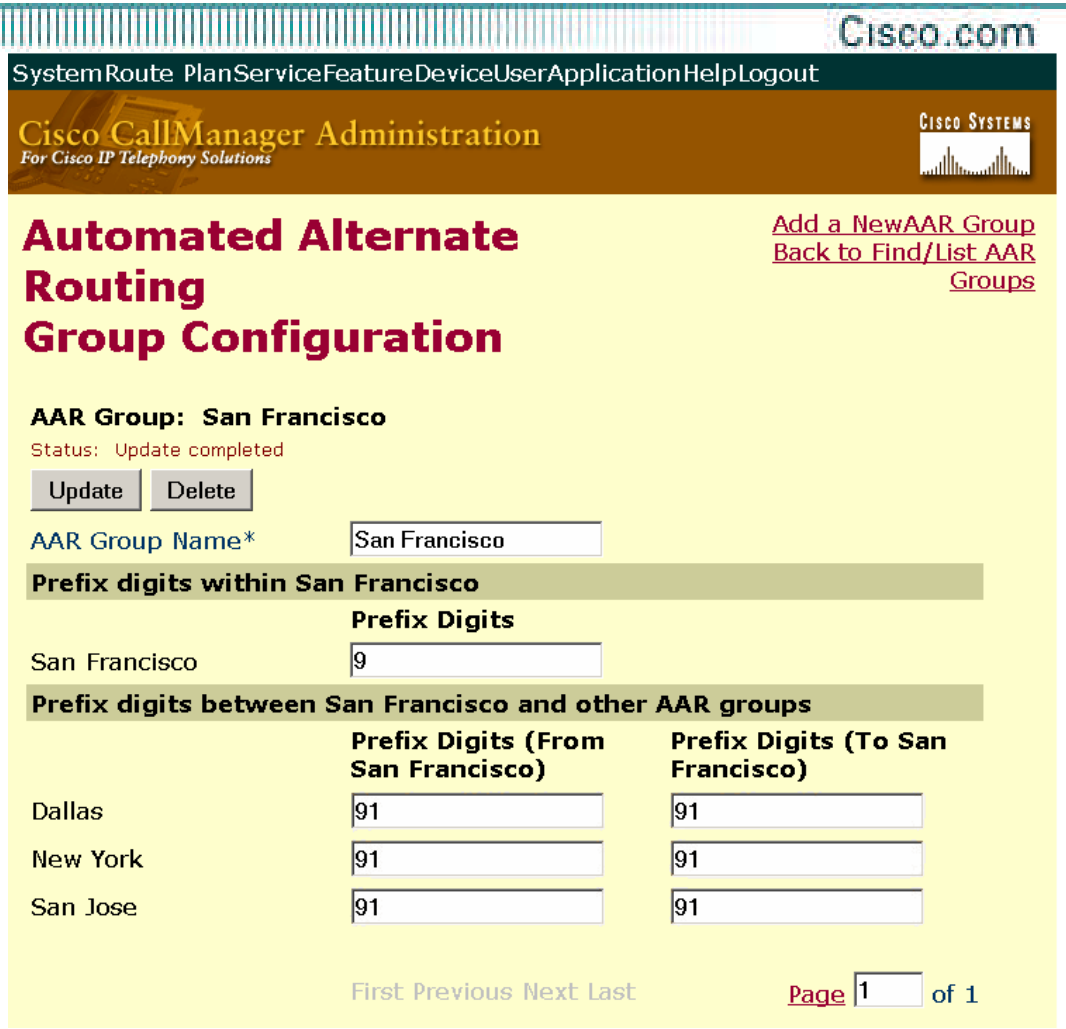
# AAR—Configuration

Cisco.com

- AAR calls are assigned their own independent Calling Search Space; gateway selection can thus be segregated to AAR calls (i.e.: central site GW for long distance normally, but local for AAR LD calls)
- DNs placed in AAR groups
- All AAR groups form a matrix, used to determine what prefixes are required to reach destination

# AAR Group—Any to Any Prefix Rules

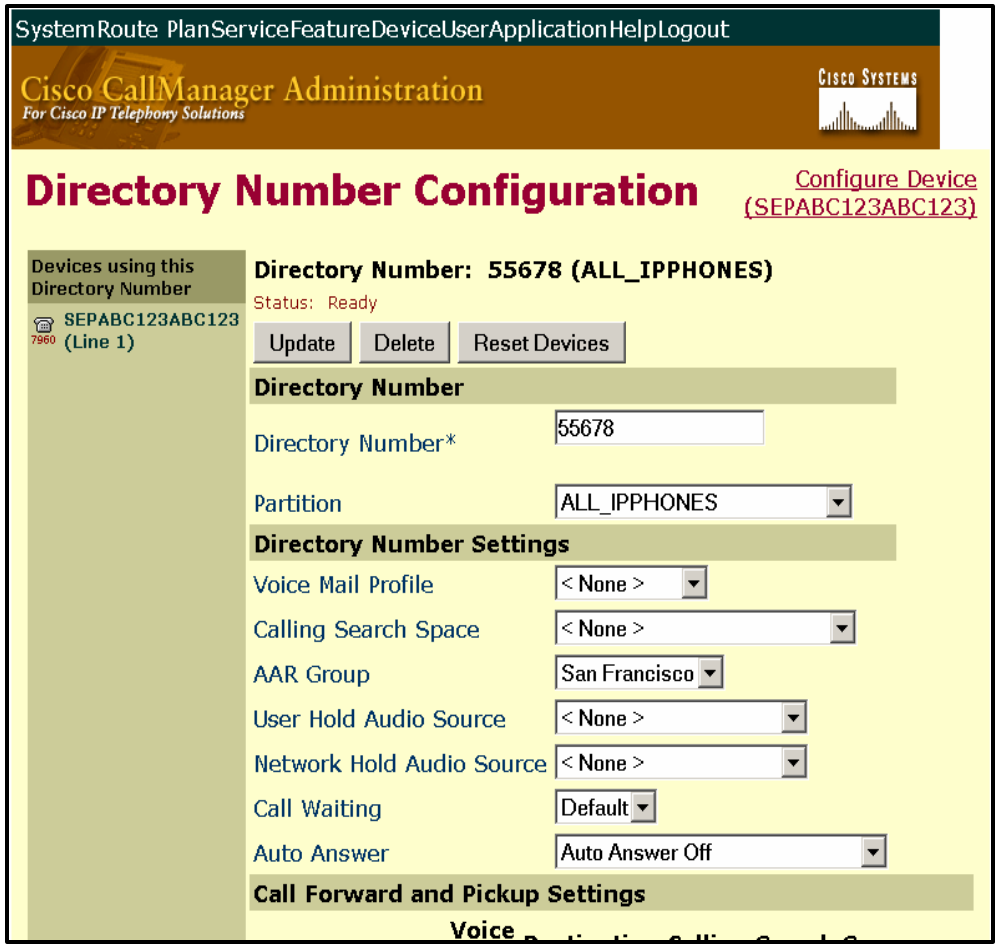
- Full prefix matrix between AAR groups
- Can have more than one branch within a region
  - e.g.: two branches in San Francisco
- Use “9”only between two San Francisco branches in the same AAR group



# AAR Group Assigned to DN!



- DNs are assigned to an AAR group
- But, the CSS used for AAR calls is on the device (see next slide)



# AAR Calling Search Space Assigned to *Device*



- Be mindful of this for Extension Mobility
- This is how an AAR-specific gateway can be chosen
- You could also, since this is a CSS, have a route list that matches the dialed number
- This would let you choose any combination of WAN or PSTN paths

# AAR Rules and Caveats

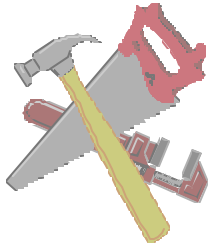
Cisco.com

- **Rule 1: The originating IP phone and the outgoing gateway should be at the same CAC location**
- **Rule 2: The terminating IP phone and the terminating gateway should be at the same CAC location**
- **Caveat 1: No AAR support for any call that originates from or terminates to Cisco CTI Route Point**
- **Caveat 2: This MAY not work with Extension Mobility; IF—the originating IP phone is in a separate location than the users 'normal' IP phone; why? the AAR group is on the line and the AAR CSS is on the device; so, the call will use the phone CSS to route out a local gateway but the prefixed digits will be according to the lines AAR group! works if dialing is same from any AAR group**

# Agenda



- IP Telephony Deployment Models



- Cisco CallManager Dial Plan Toolkit

- Dial Plan Design Guidelines

- Conclusions

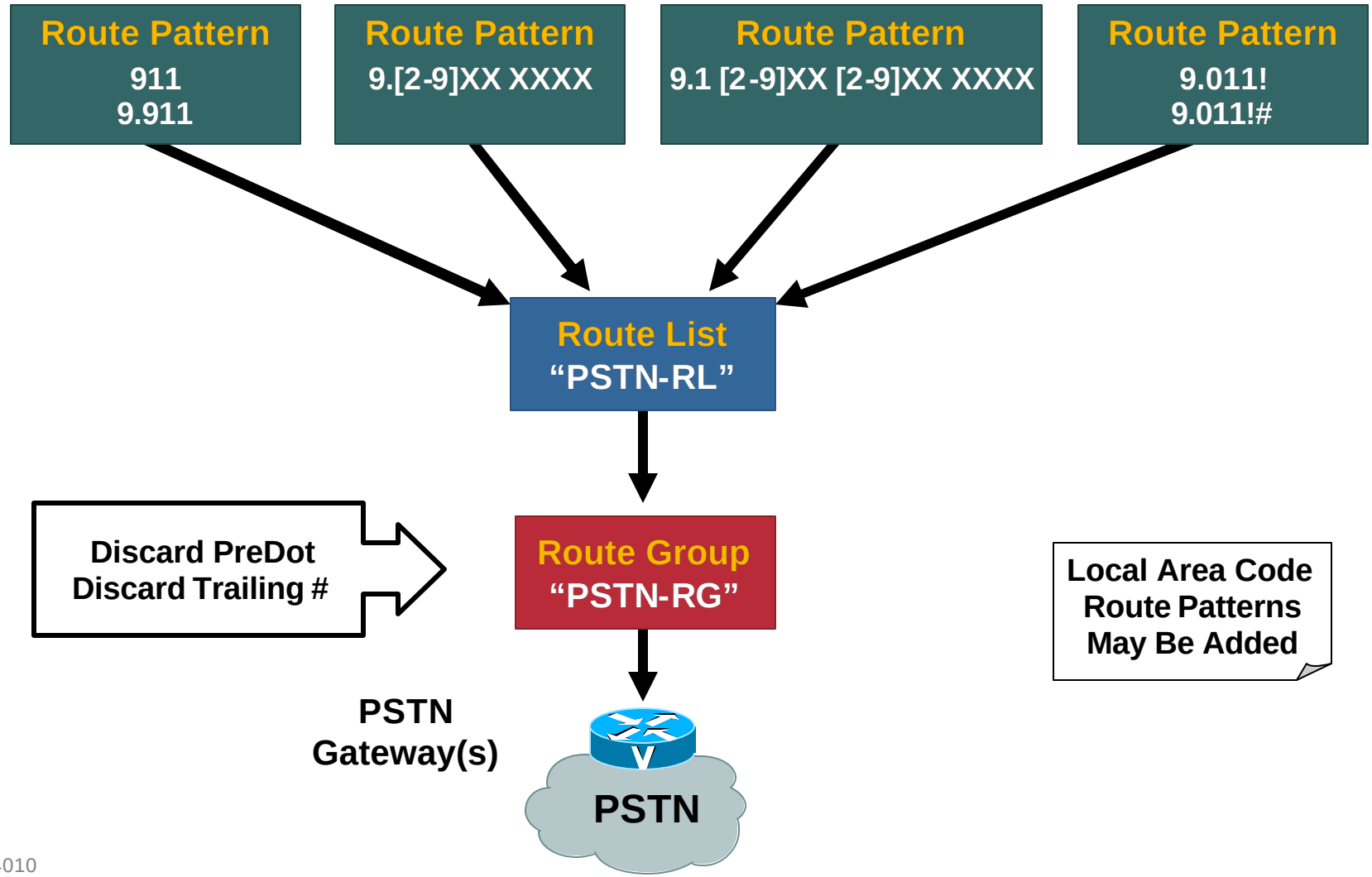
# Dial Plan Design Guidelines Agenda

Cisco.com

- **Single Site Enterprise**
- **Multi-Site with Distributed Call Processing**
- **Multi-Site with Centralized Call Processing**
- **Tail-End Hop-Off (TEHO)**
- **Useful Tidbits**

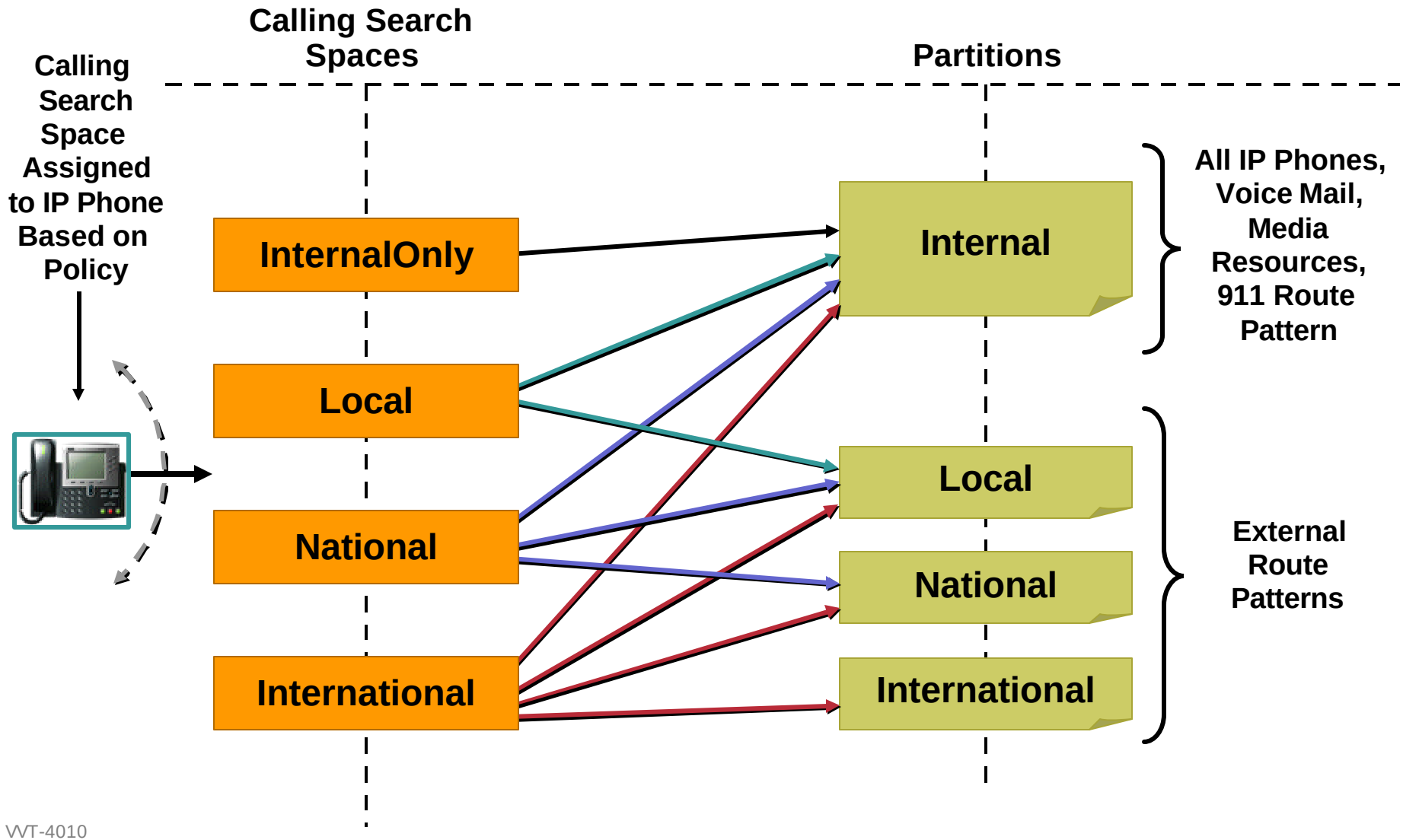
# Single Site
## Typical Route Patterns





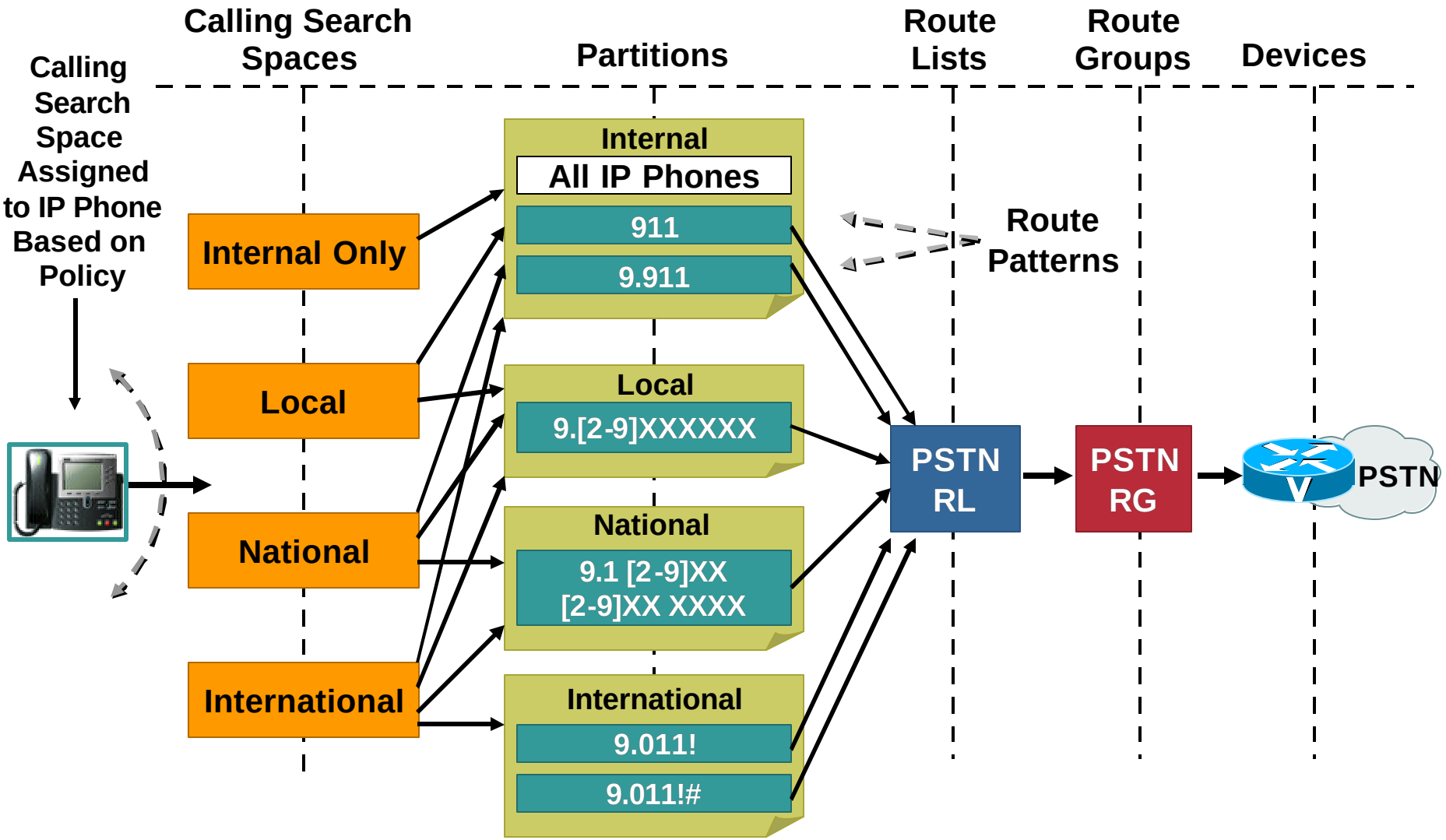
# Single Site
## View of Partitions/Calling Search Spaces





# Single Site
## Composite Dial Plan View





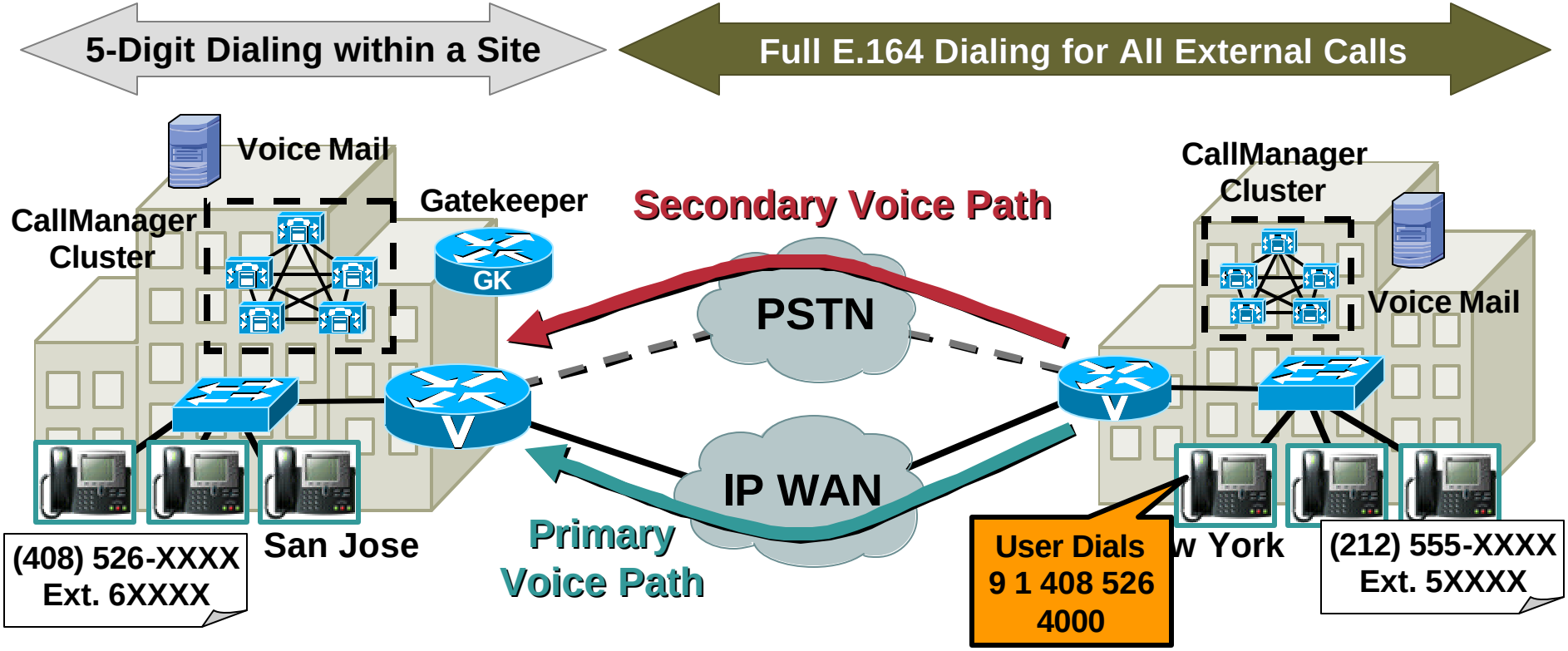
# Dial Plan Design Guidelines Agenda

Cisco.com

- Single Site Enterprise
- Multi-Site with Distributed Call Processing
- Multi-Site with Centralized Call Processing
- Tail-End Hop-Off (TEHO)
- Useful Tidbits

# Multi-Site with Distributed Call Processing
## Example of Dial Plan Requirements

Cisco.com




**Primary Voice Path: IP WAN**

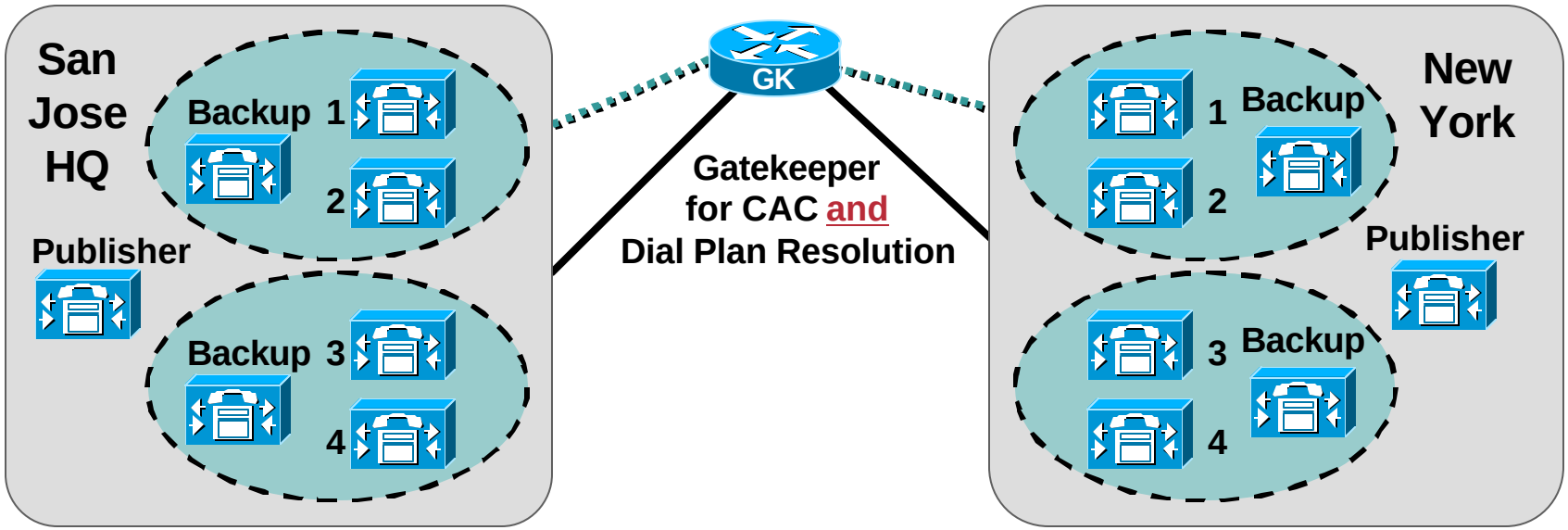
- Outgoing (NY cluster): Strip "9" and deliver "14085264000" to Gatekeeper
- Incoming (SJ cluster): Strip all but significant 5 digits

**Secondary Voice Path: PSTN**

- Outgoing (NY cluster): Strip "9" and deliver "14085264000" to the PSTN
- Incoming (SJ cluster): Strip all but significant 5 digits

# Multi-Site with Distributed Call Processing
## Gatekeeper for Dial Plan Resolution

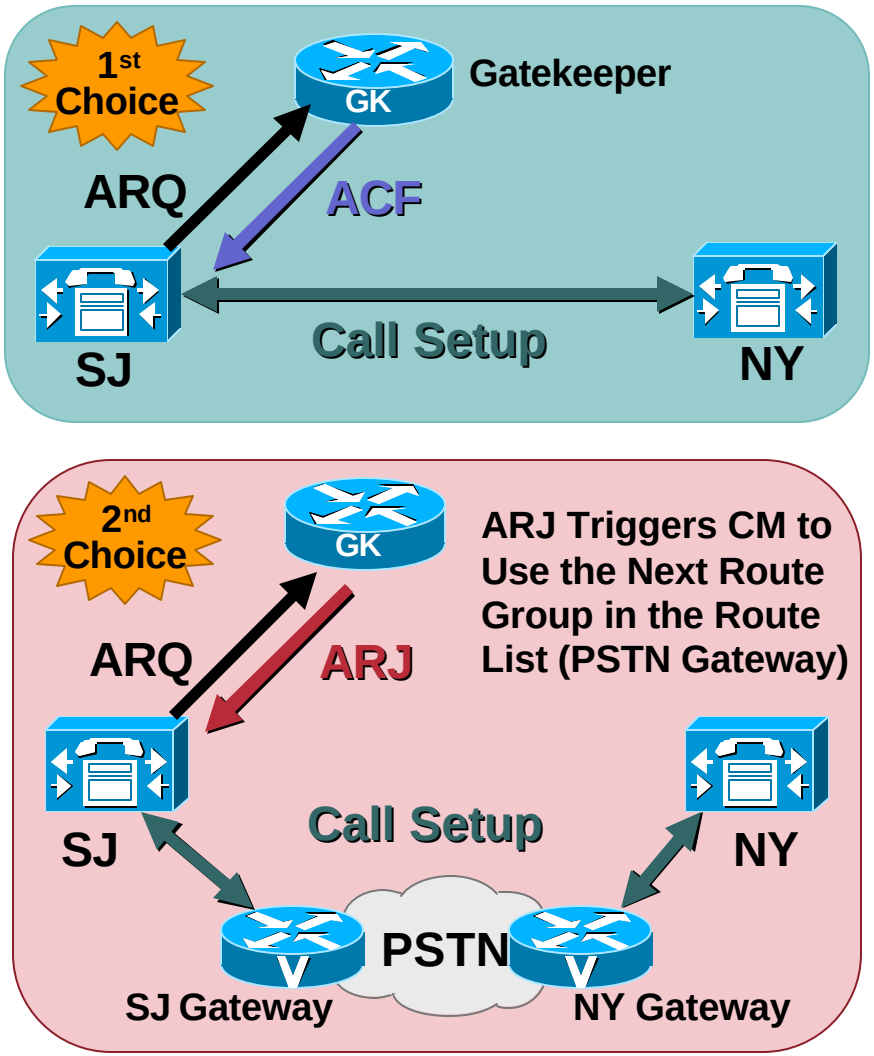





- Gatekeeper provides Call Admission Control in presence of multiple CallManager clusters (distributed call processing deployments)
- CallManager configured with “Anonymous Device”—uses Gatekeeper also to resolve E.164 addresses
- Lower dial plan administration, highly scalable distributed model

# Multi-Site with Distributed Call Processing
## Automatic Re-Route with Gatekeeper

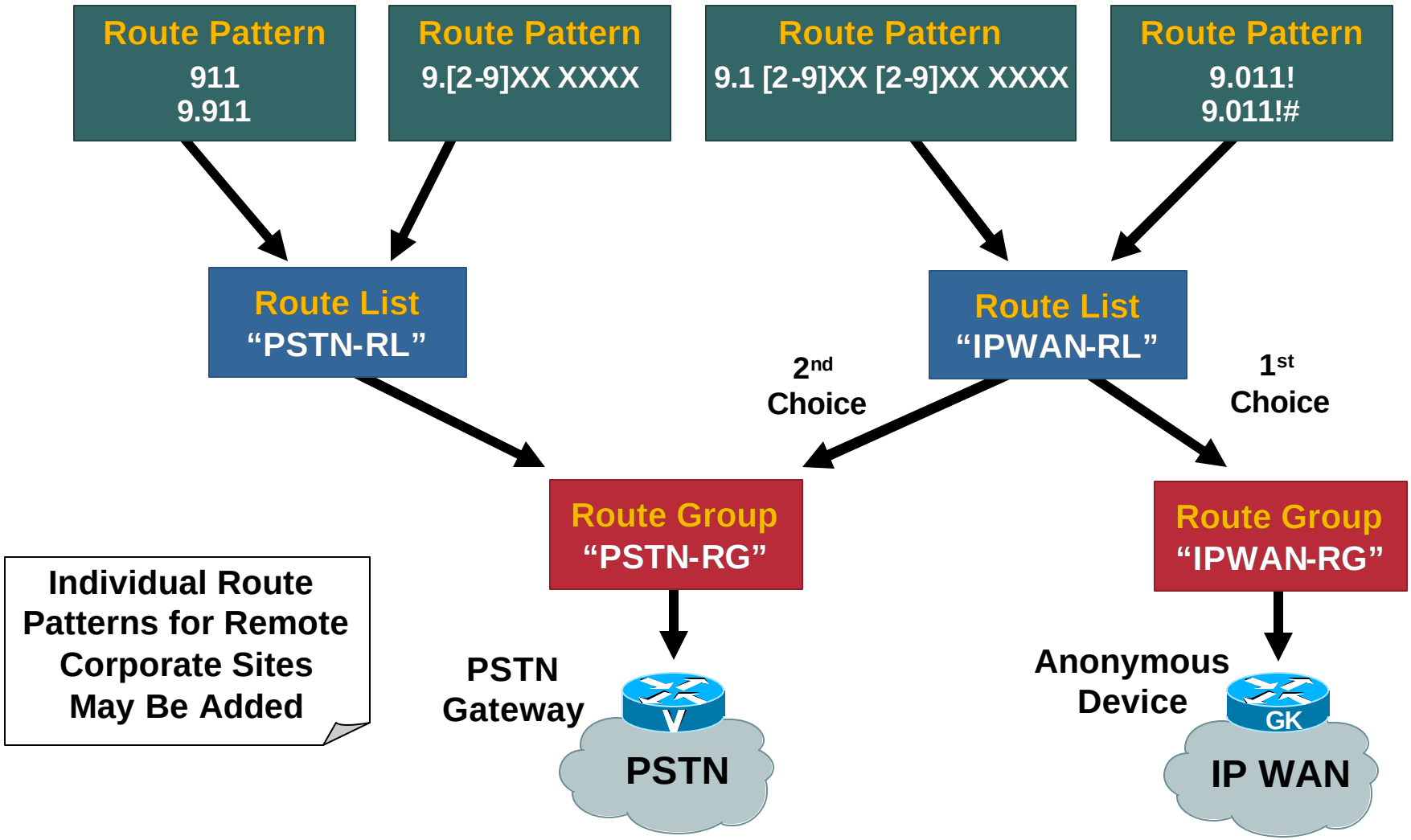





```
gatekeeper
  zone local SJC cisco.com
  zone local NYC cisco.com
  zone prefix SJC 140855534..
  zone prefix SJC 14085557...
  zone prefix SJC 131055598..

  [...]

  zone prefix NYC 16465551...
  zone prefix NYC 131255568..
  zone prefix NYC 120255524..

  [...]

  gw-type-prefix 1#* default-
                     technology
  bandwidth interzone zone SJC 480
```

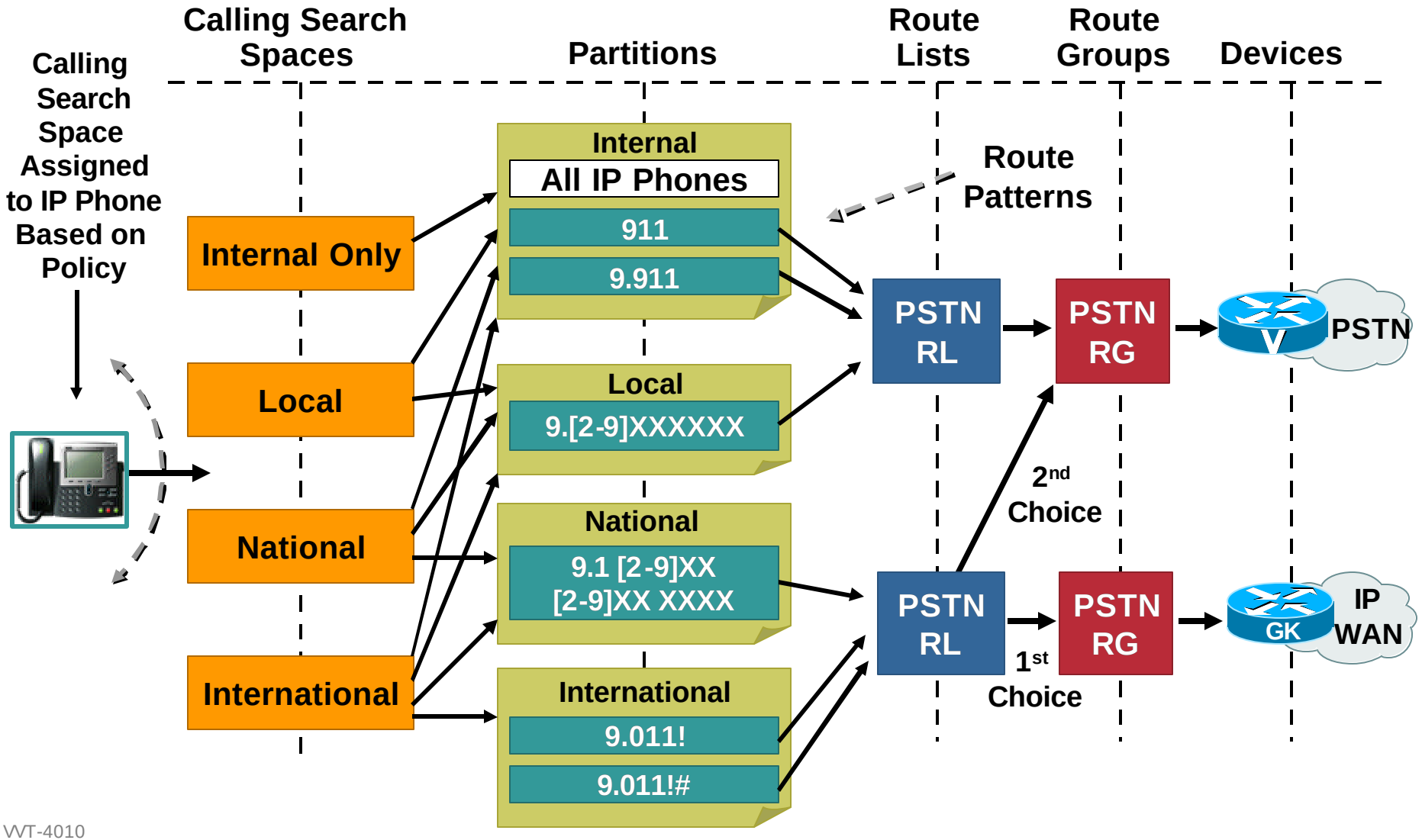
# Multi-Site with Distributed Call Processing
## Typical Route Patterns





# Multi-Site with Distributed Call Processing
## Composite Dial Plan View





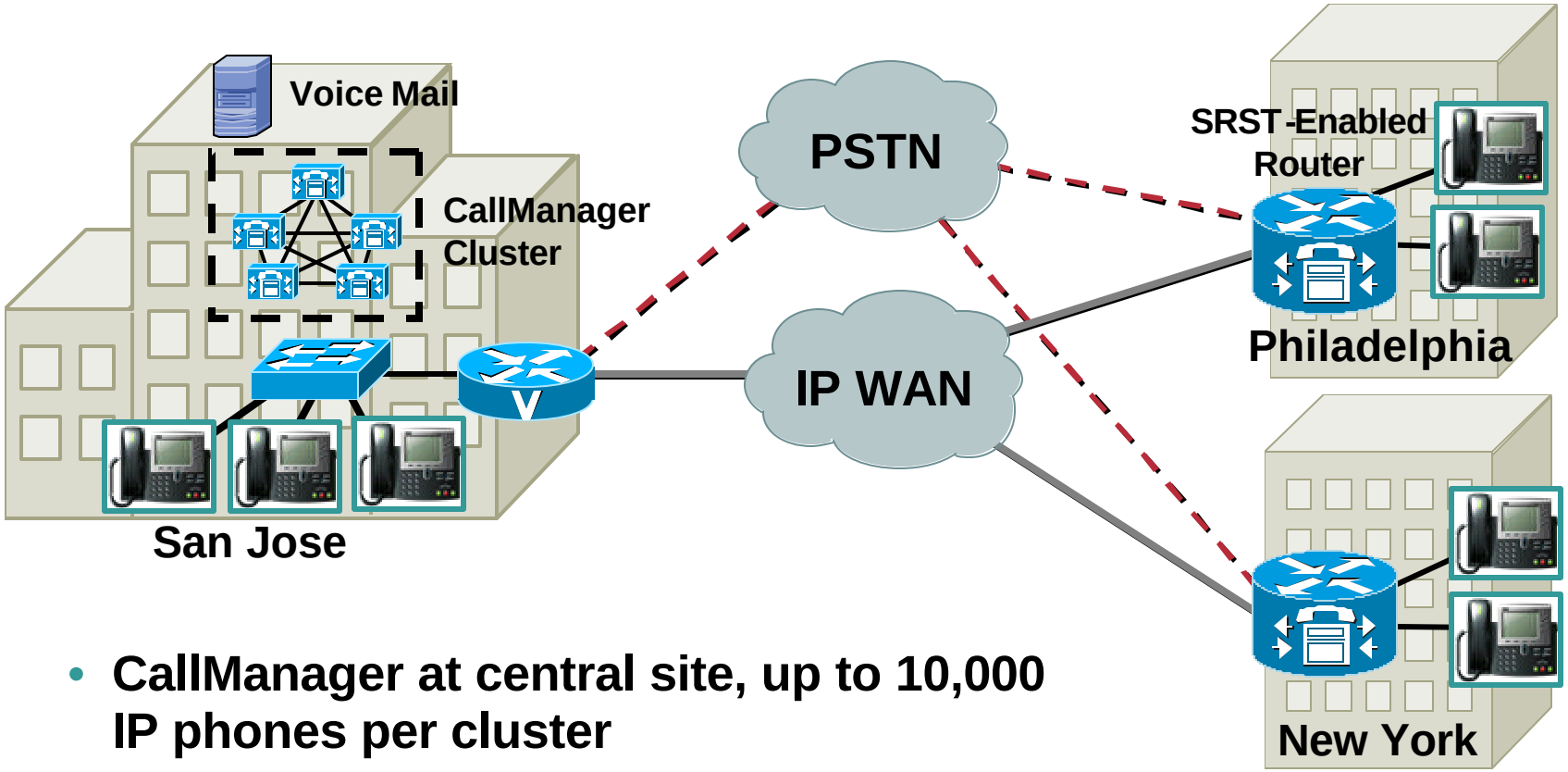
# Dial Plan Design Guidelines Agenda

Cisco.com

- Single Site Enterprise
- Multi-Site with Distributed Call Processing
- Multi-Site with Centralized Call Processing
- Tail-End Hop-Off (TEHO)
- Useful Tidbits

# Multi-Site with Centralized Call Processing
## Example of Dial Plan Requirements

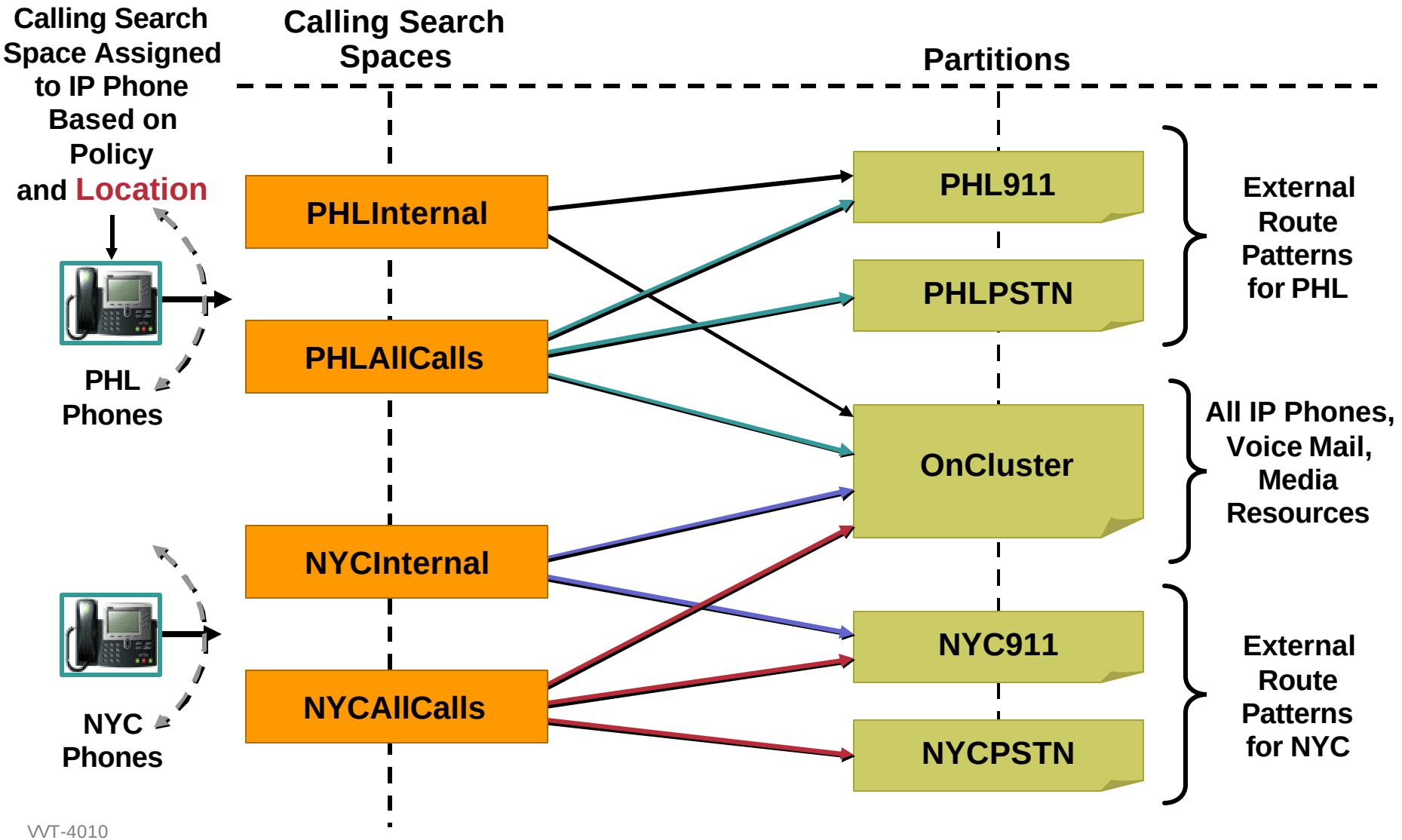





- CallManager at central site, up to 10,000 IP phones per cluster
- Common PSTN access code (“9”)
- 911 and PSTN calls use each site’s local gateway
- Non-overlapping extensions *(overlapping case covered later)*

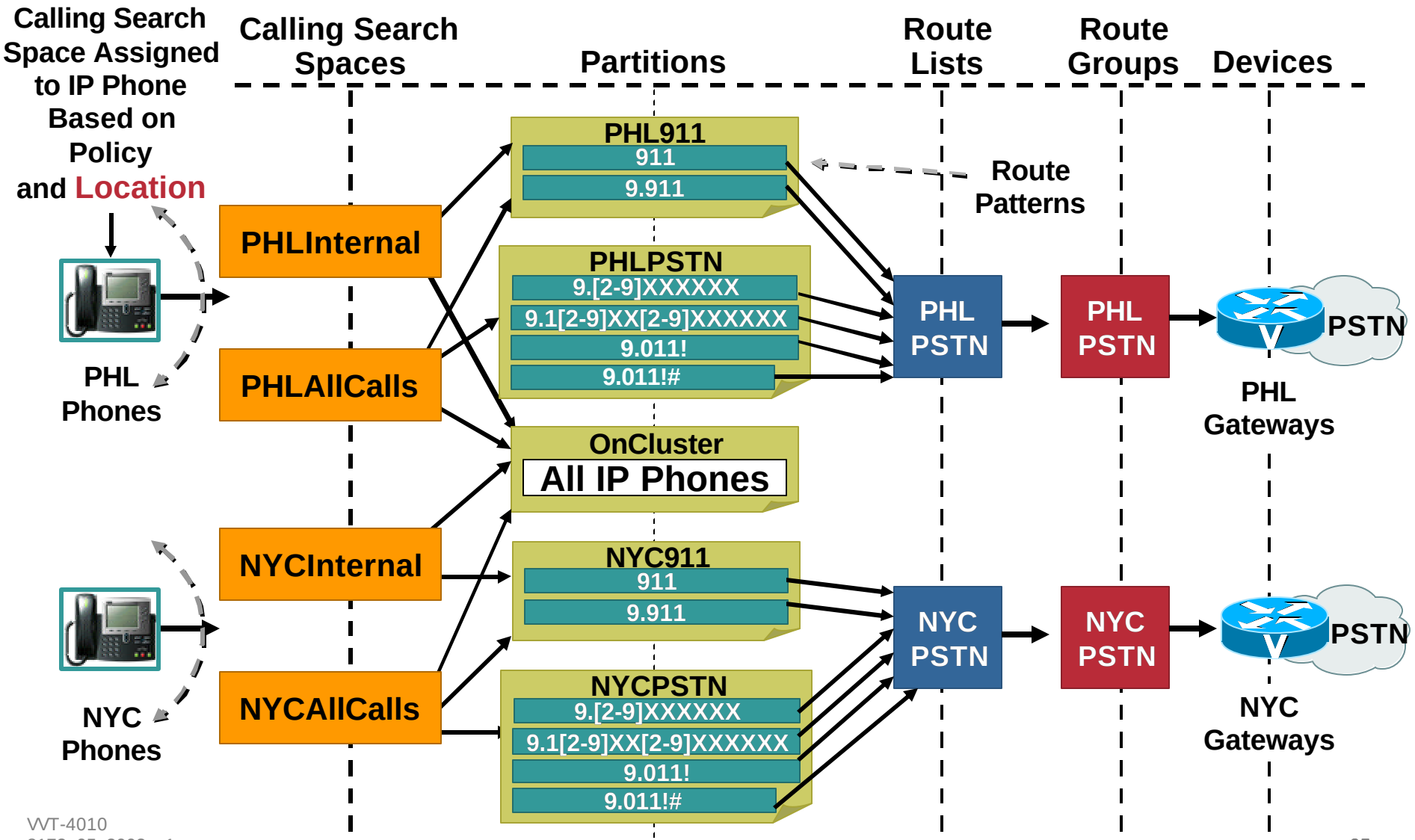
# Multi-Site with Centralized Call Processing
## View of Partitions/Calling Search Spaces





# Multi-Site with Centralized Call Processing
## Composite Dial Plan View





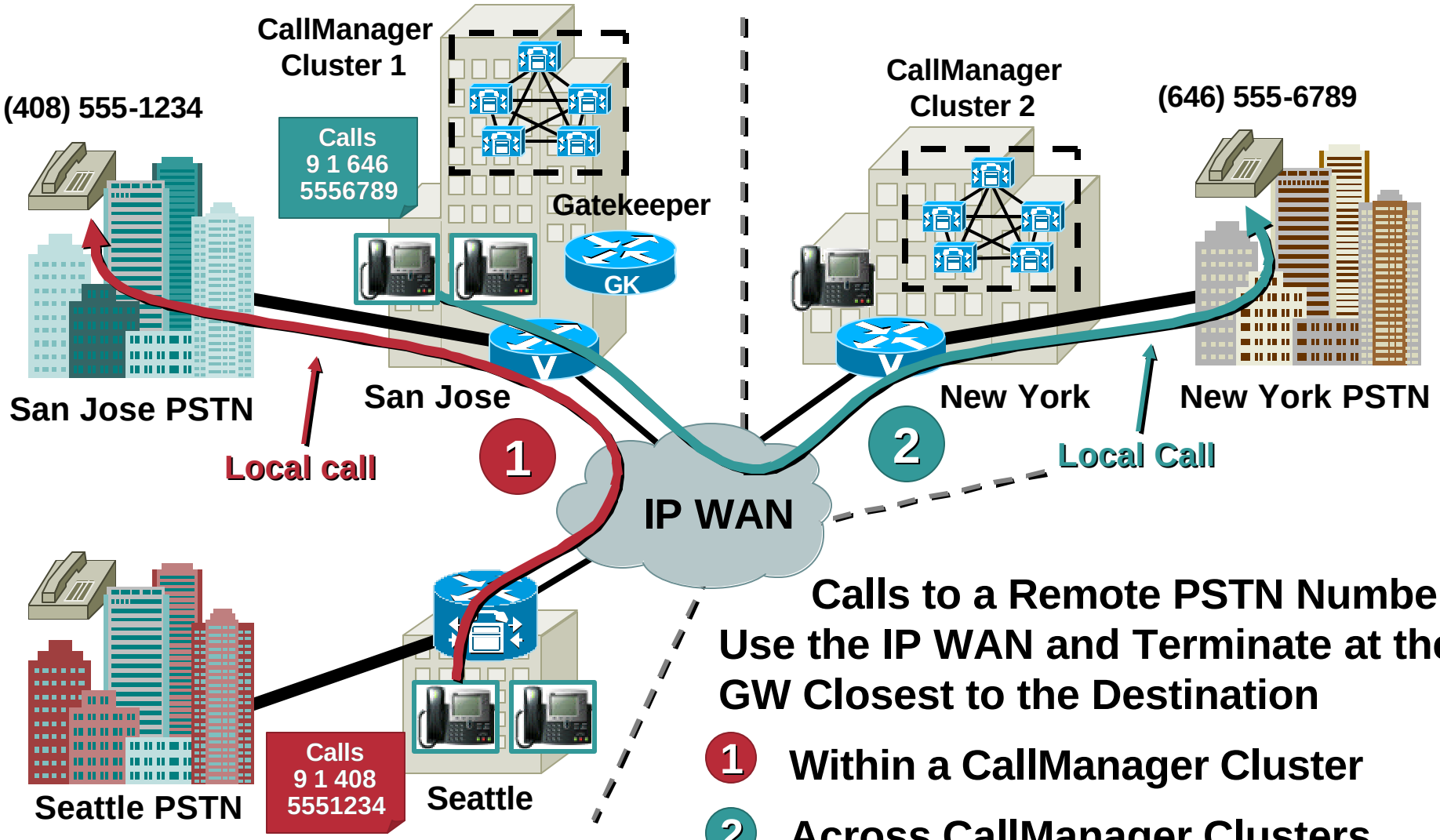
# Dial Plan Design Guidelines Agenda

Cisco.com

- Single Site Enterprise
- Multi-Site with Distributed Call Processing
- Multi-Site with Centralized Call Processing
- Tail-End Hop-Off (TEHO)
- Useful Tidbits

# Tail-End Hop-Off (TEHO)
## What Is it?



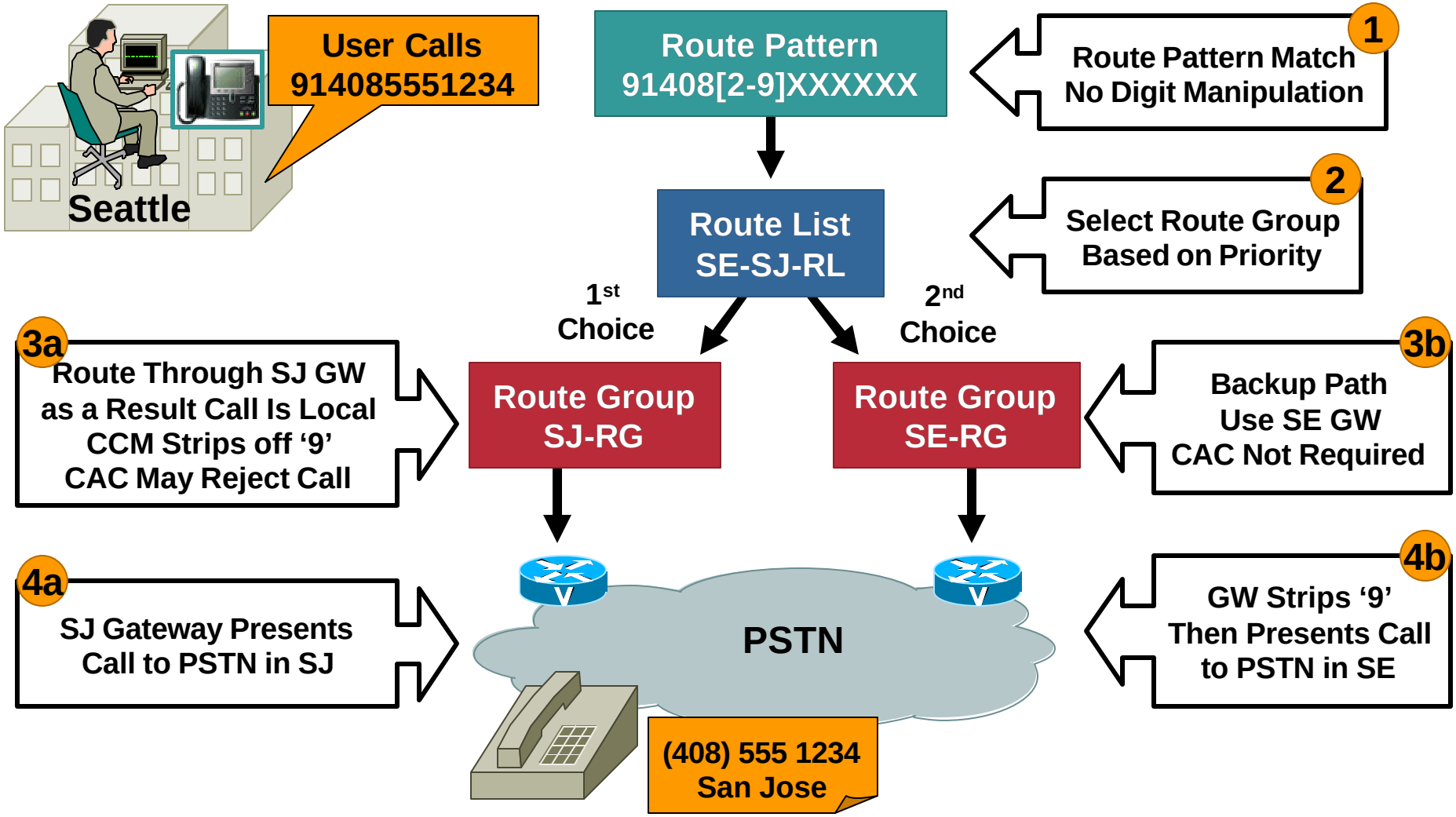



**Calls to a Remote PSTN Number Use the IP WAN and Terminate at the GW Closest to the Destination**

1. **Within a CallManager Cluster**
2. **Across CallManager Clusters**

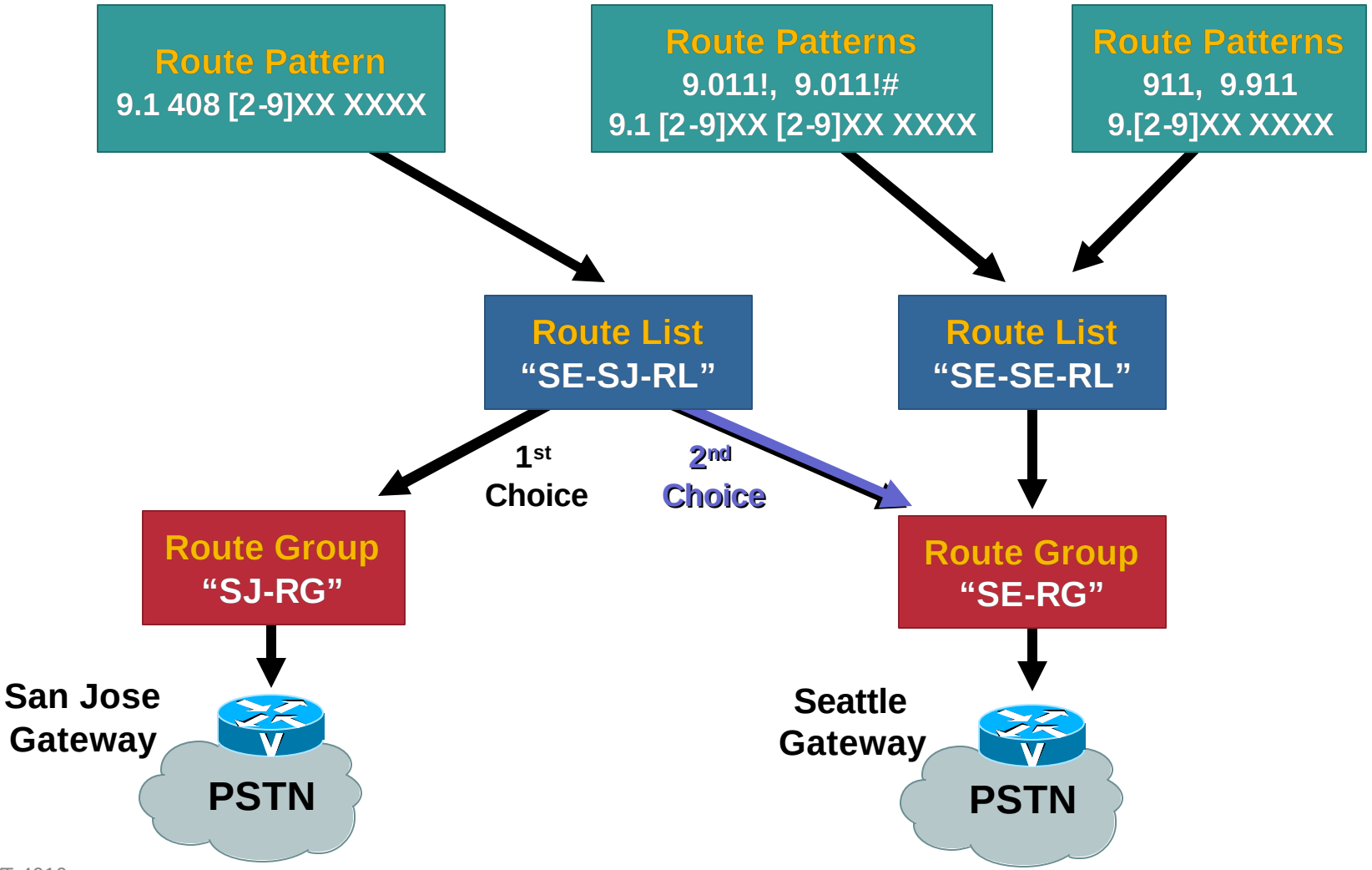
# Tail-End Hop-Off (TEHO)
## Intra-Cluster—Seattle to San Jose





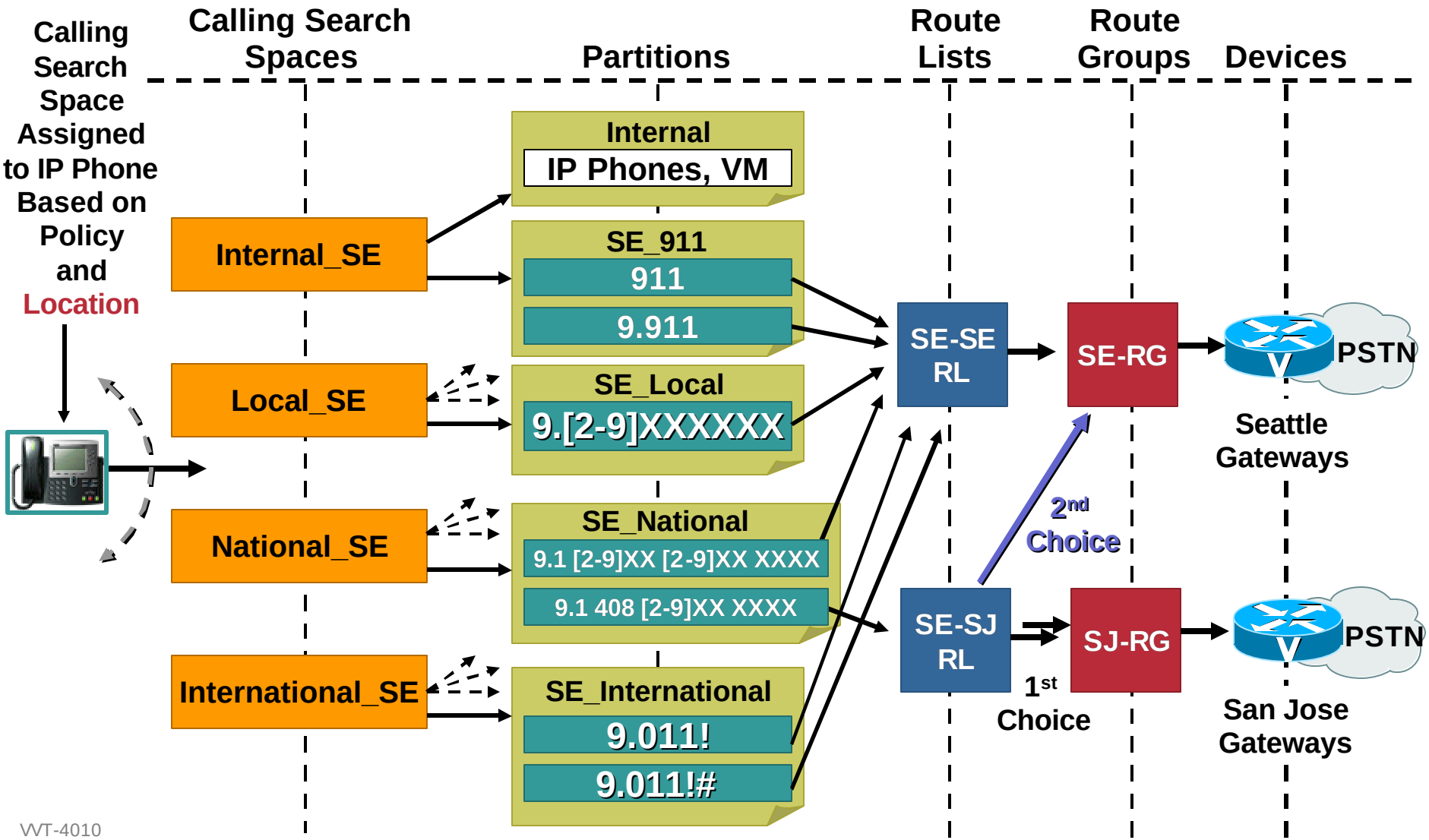
# Tail-End Hop-Off (TEHO)
## Intra-Cluster—Route Patterns for Seattle



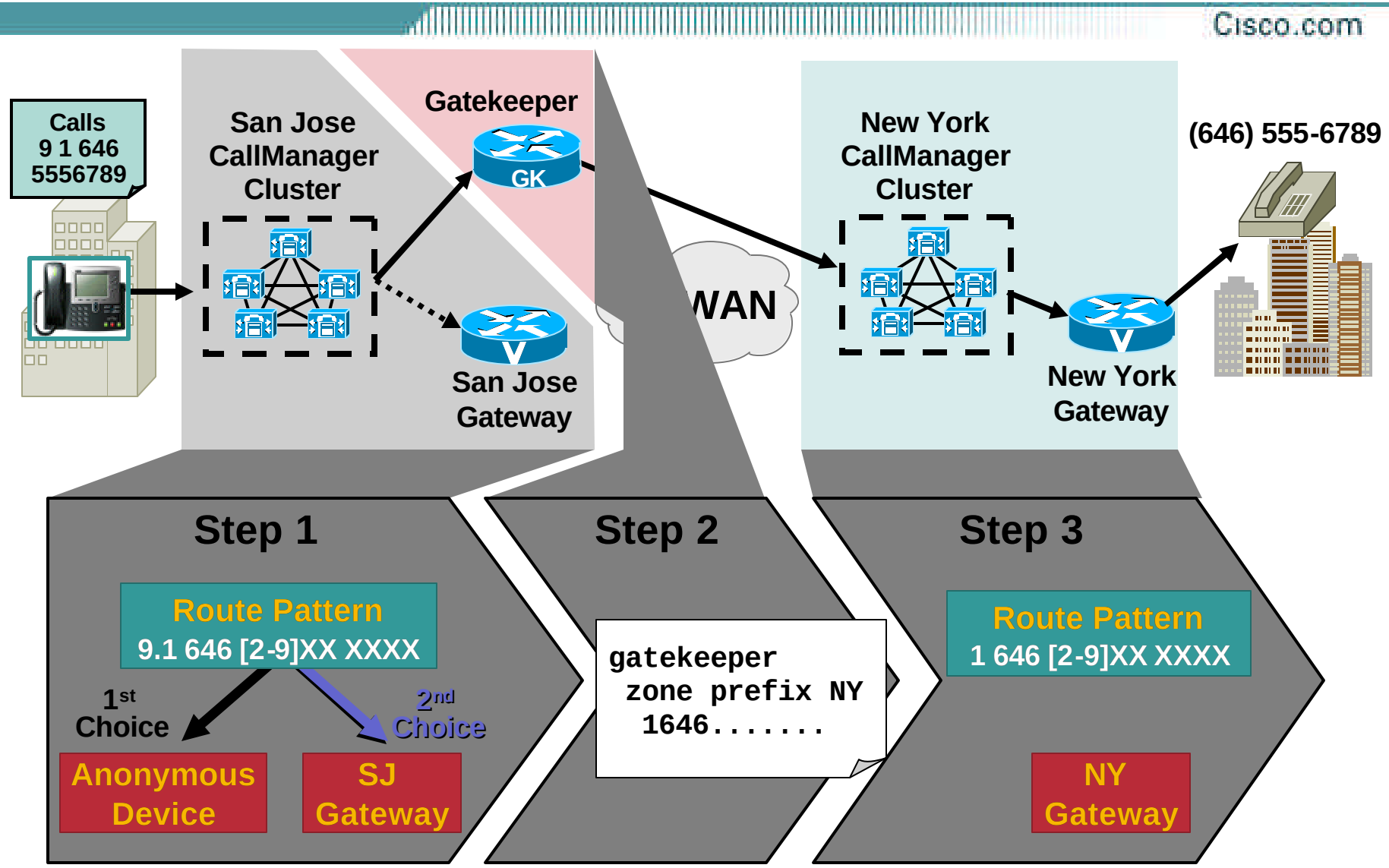


# Tail-End Hop-Off (TEHO)
## Intra-Cluster—Composite Dial Plan for Seattle



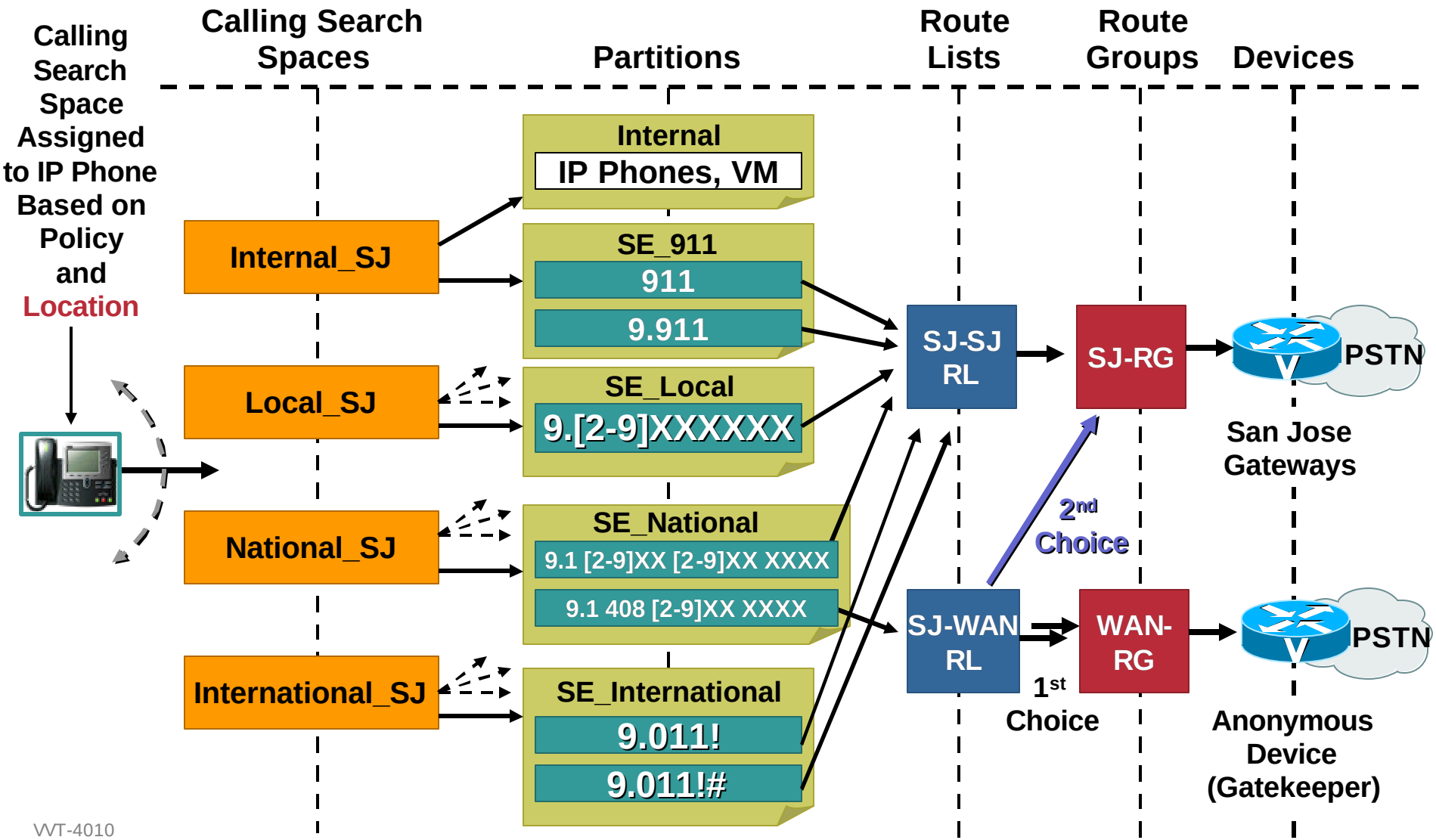


# Tail-End Hop-Off (TEHO)
## Inter-Cluster—San Jose to New York



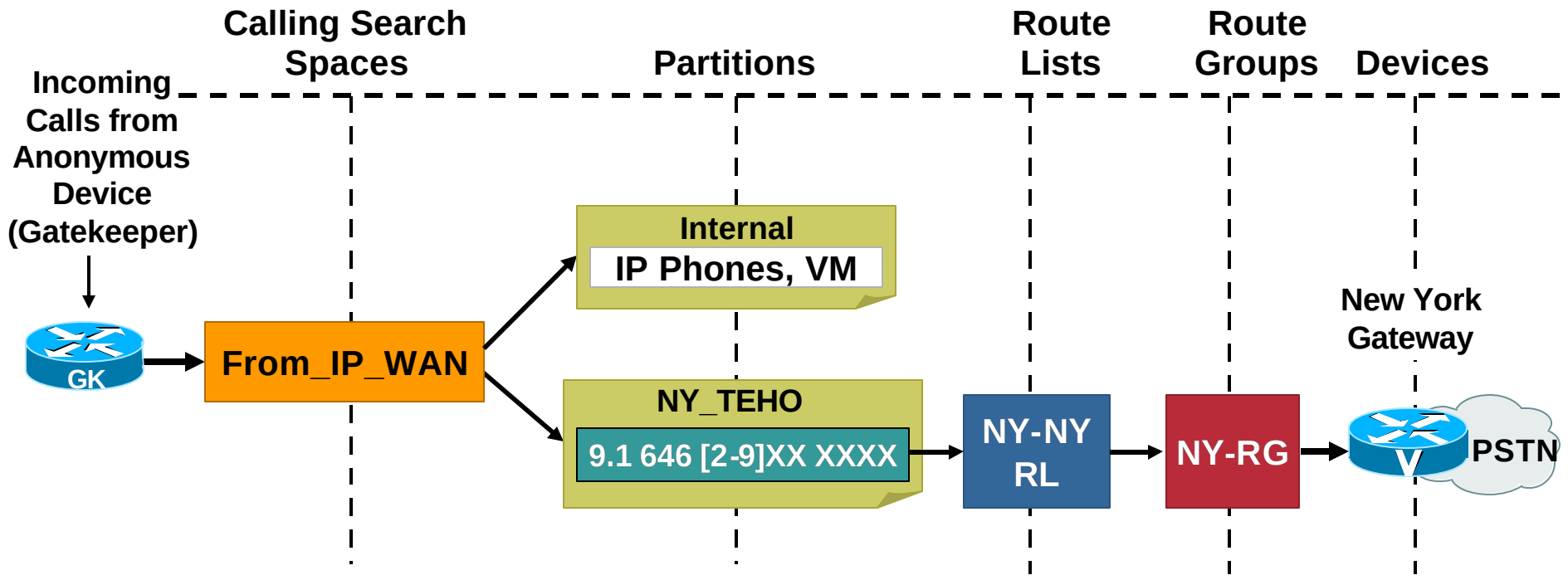
# Tail-End Hop-Off (TEHO)
## Inter-Cluster—Composite Dial Plan for San Jose





# Tail-End Hop-Off (TEHO)
## Inter-Cluster—Dial Plan for New York






- **Note: To avoid routing loops, do not include partitions that contain IP WAN routes in the "From_IP_WAN" Calling Search Space**

# Dial Plan Design Guidelines Agenda

Cisco.com

- **Single Site Enterprise**
- **Multi-Site with Distributed Call Processing**
- **Multi-Site with Centralized Call Processing**
- **Tail-End Hop-Off (TEHO)**
- **Useful Tidbits**

# Dial Plan Design Guidelines Agenda

Cisco.com

- Single Site Enterprise
- Multi-Site with Distributed Call Processing
- Multi-Site with Centralized Call Processing
- Tail-End Hop-Off (TEHO)
- Useful Tidbits

# Dial Plan Entries Have a Weight!



- Dial plan complexity is a factor to consider
- In essence, each DN, route pattern, translation pattern, etc…has a weight
- Each server platform has a maximum capacity (i.e.: can handle a maximum dial plan weight)
- This is another metric, separate from the device weights

# Weights per Entry

Cisco.com

- **Subscriber dial plan weights**
  - **IP phone or other dialable device (excluding line appearance) = 5**
  - **Unique line appearance = 5**
  - **Shared line appearance = 4**
  - **Reachability by line appearance = 3**
- **Global dial plan weights**
  - **Route pattern = 2**
  - **Translation pattern = 1**

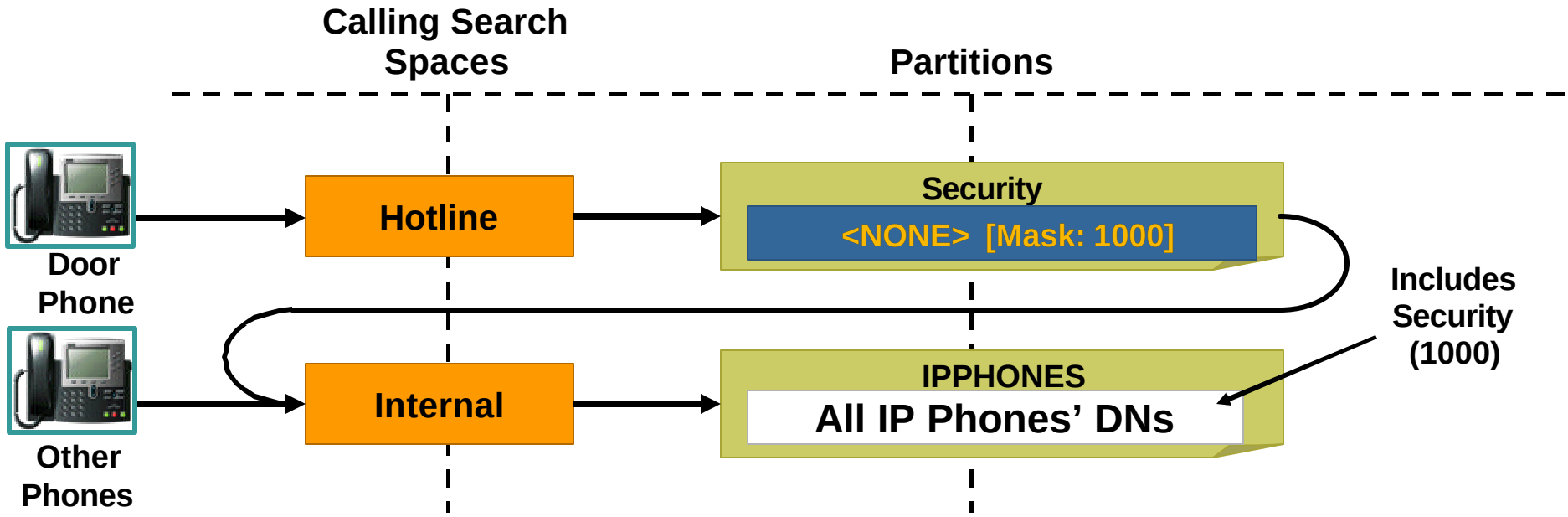
# Weight Capacities per Platform



| Total Dial Plan Weight Units on Subscriber Server | Server Memory Requirements |
|---|---|
| Up to 15,000 | 512 MB of RAM Installed |
| Up to 35,000 | 768 MB of RAM Installed |
| Up to 70,000 | 1 GB of RAM Installed |
| Up to 140,000 | 2 GB of RAM Installed |

# Useful Tidbits
## Configuring a Security Hotline (PLAR)






**Create Partition *SECURITY***

**Create *HOTLINE* CSS Containing SECURITY Partition**

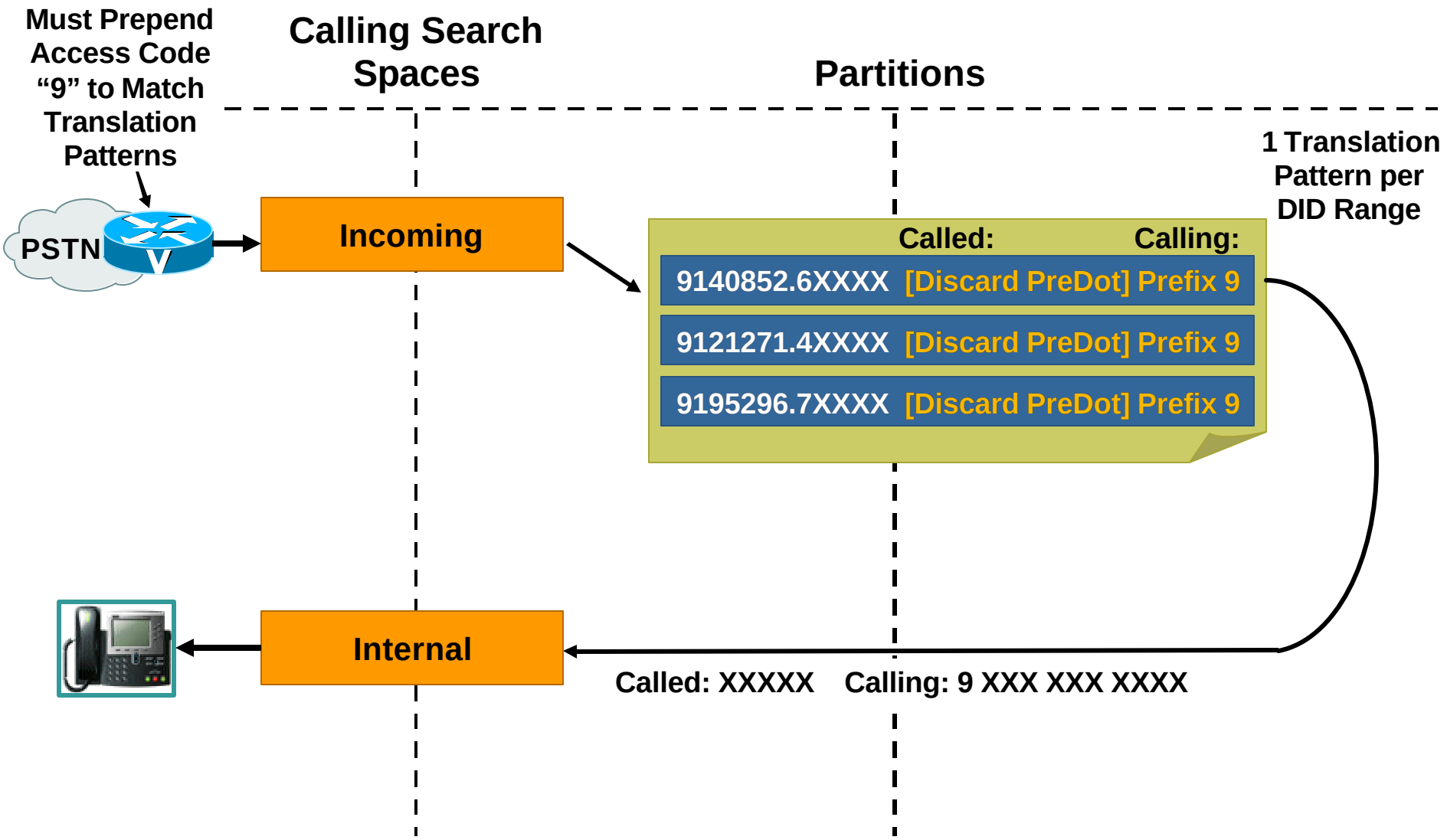
**Create Translation Pattern Matching <NONE>, Called Party Transformation Mask Equal to 1000, CSS Set for Internal. (Contains Partition with Security Phone)**

**Create Door Phone with CSS set to *HOTLINE***

# Useful Tidbits

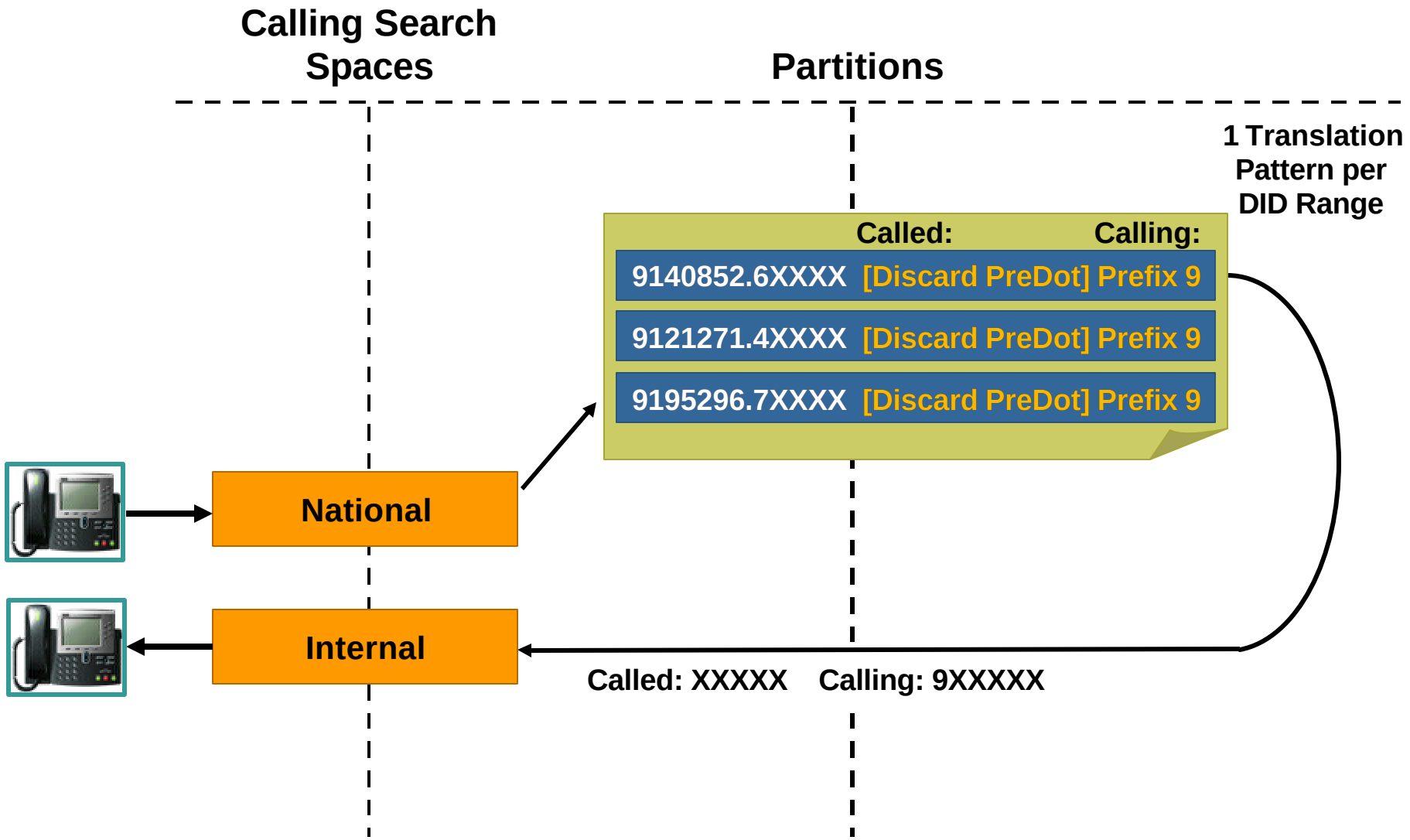
## Mapping DID to 5 Digit Extension—Prefix Calling # with 9





# Useful Tidbits
## Staff Calls Other Internal Staff Member via DID

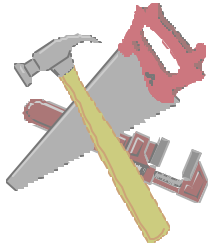




# Agenda



- IP Telephony Deployment Models



- Cisco CallManager Dial Plan Toolkit

- Dial Plan Design Guidelines

- Conclusions

# Conclusions
## General Recommendations



- **Keep it simple!**
- **Plan for future growth**
- **Use the Anonymous Device when more than 2 CallManager clusters are present**
- **Normalize DNs to the full E.164 when using Gatekeeper for dial plan resolution**

# Conclusions
## Summary—What Did We Cover?

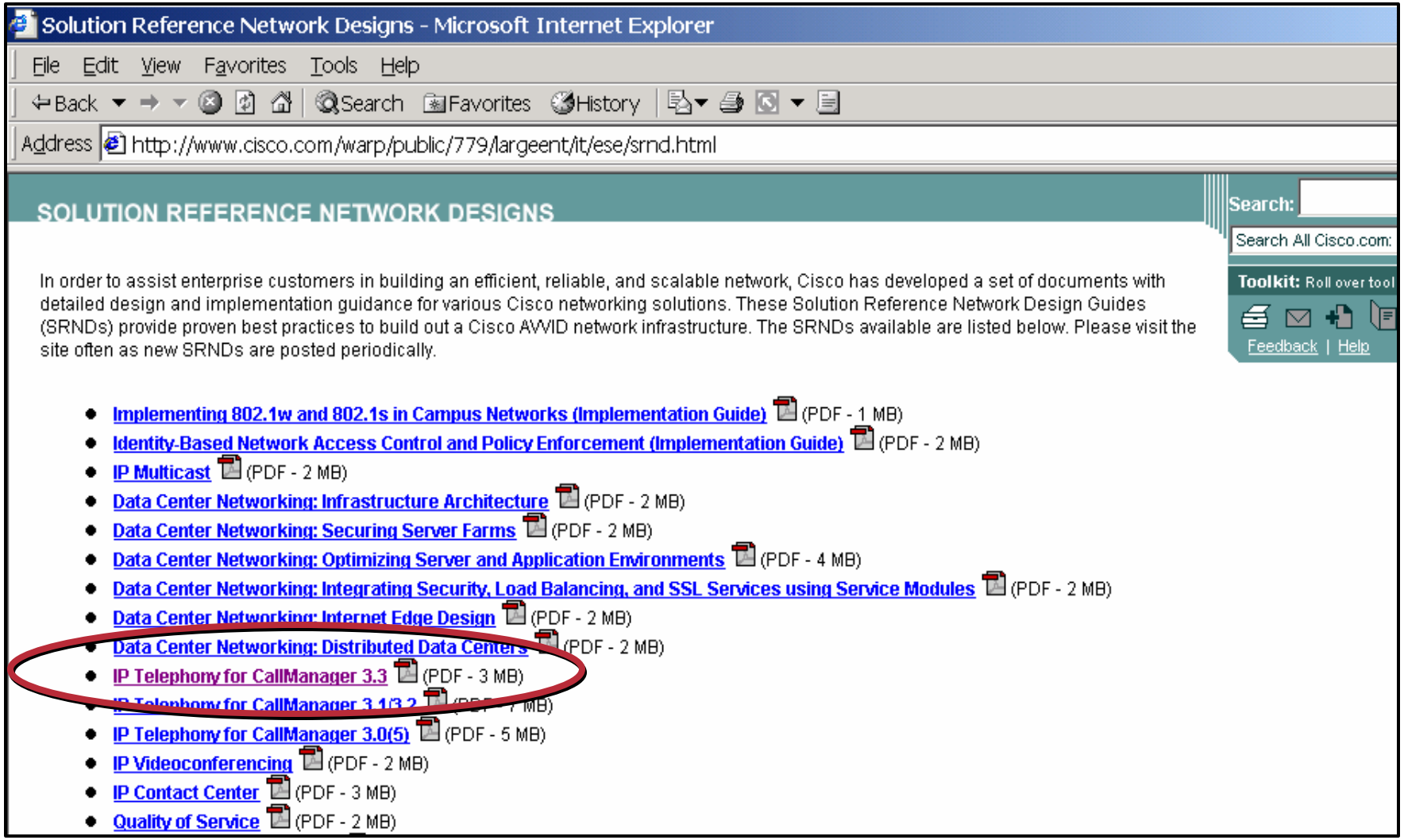
Cisco.com

- **Enterprise IP Telephony dial plan operation—the tools and how to use them**
- **Design recommendations for the different deployment models:**
  - **Single Site**
  - **Multi-Site WAN with Distributed Call Processing**
  - **Multi-Site WAN with Centralized Call Processing**

**For More Information:**
**www.cisco.com/go/srnd**

# For More Information about Dial Plan and IPT in General, See Latest SRND!

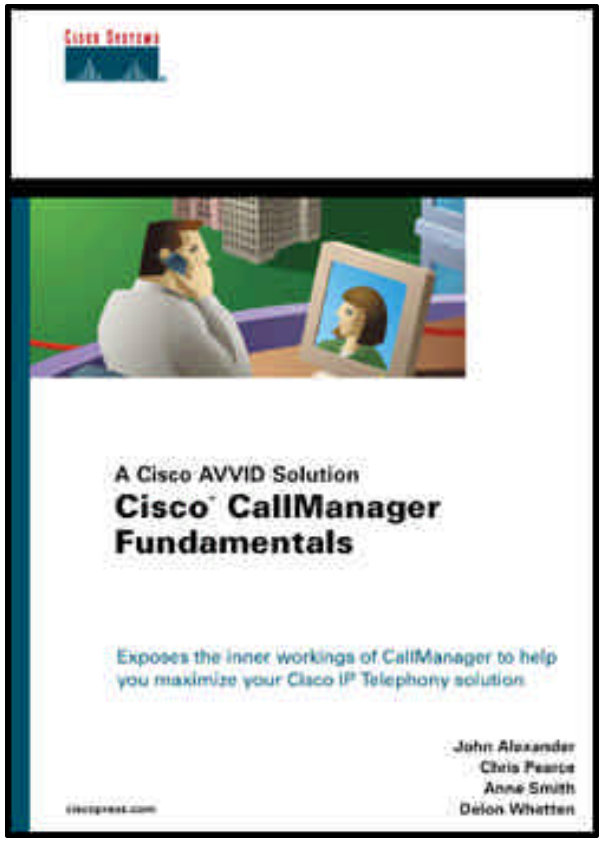
Cisco.com



# Recommended Reading

Cisco.com

**Cisco CallManager Fundamentals: A Cisco AVVID Solution**
**ISBN: 1-58705-008-0**



# Please Complete Your Evaluation Form

## Dial Plan Design