Cisco Networkers 2008

Advanced Dial Plan Design

BRKUCT-3007

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Session Scope and Objectives

- To explore the various architectural challenges of planning an IP-based telephony network because it can do more than a traditional telephony system, because it breaks all the common boundaries (few, if any, PBX's have hundreds of sites)
- To explore the design and implementation possibilities of Cisco's IP telephony system
  - Design based on Cisco Unified Communications Manager 4.X, 5.X and 6.X
- Aspects we will cover:
  - Design guidelines (Classes of service, multisite deployments, extension mobility…)
  - Integration of multiple UCMs in a single system (e.g. inter-UCM call routing, device mobility)

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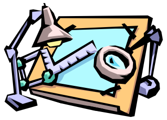
Overall Agenda

- Planning Considerations

- Design Guidelines



- Conclusions

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Planning Considerations

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Planning Considerations

The Fundamentals

A few things we all like in a good dial plan:

- Not reprinting business cards (i.e. not changing numbers because we change phone systems)
- Having abbreviated dialing within a site (e.g. five digit dialing)
- Having a simple, direct correspondence between someone's DID number (i.e. business card) and their internal extension
- Keeping it simple, where even the new guy can use the phone system (i.e. dial "9" or "0" for an outside line, or five digits to reach colleagues)

Note: this presentation uses some examples based on north-american dialing habits: season to taste…

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Planning Considerations

The Fundamentals (Cont.)

A few things we all like in a good dial plan:

- Keeping it simple, where even the new system administrator can maintain the phone system (an area code split would not destroy the plan)
- Future proofing, such that when the new office opens, we do not have to redo it all
- Have a good user experience (e.g. not having to wait for interdigit timeout when calling the guy in the next cube over)

Remember: The best tool to start with i...

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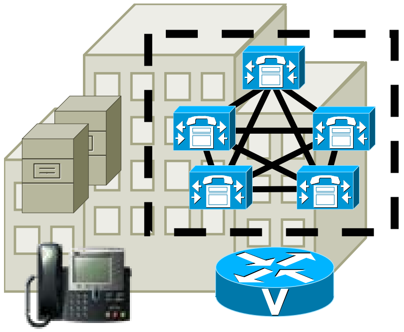
Planning Considerations

Uniform Dial Plans Are Simple



Anchorage
907 507 18XX

Q: Could this system use a **uniform** three digit dial plan?

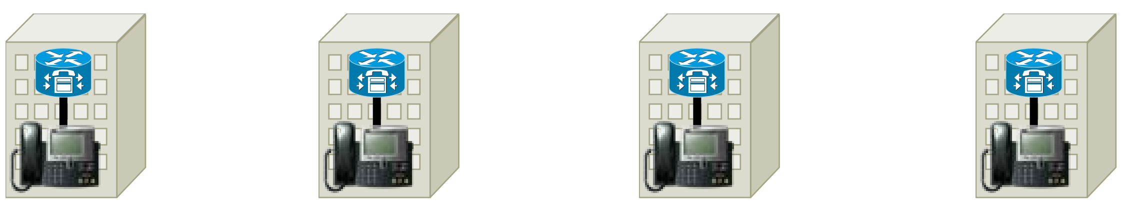
A: No! Chicago and Dallas' DID ranges overlap in the last three digits

Q: Ok, how about four digit uniform dial plan?

A: No! overlaps again!

Because each time you call extensions 9110 through 9119 in Chicago, you get the police department (by calling 911)

And: Because the system cannot off-hand tell the difference between calling Al Capone at 9141, and calling long distance to a Toronto number (e.g. 9 1 416 555 1234) you will have to wait for interdigit timeout, even when calling from Anchorage!



New York	Chicago	Birmingham	Dallas
212 555 75XX	708 552 91XX	205 937 54XX	972 553 11XX

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Planning Considerations

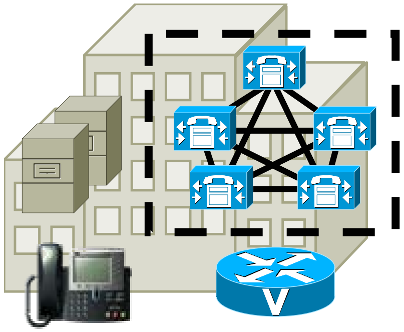
Uniform Dial Plans Are Simple (2)

Q: Fine! How about a five digit uniform dial plan?

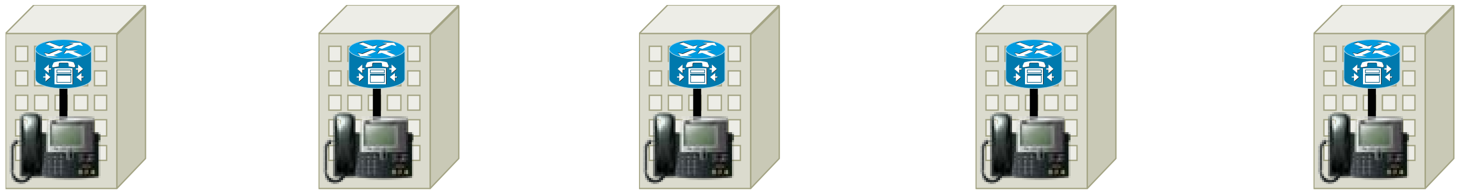
A: Currently, yes! No overlap in the current ranges of DID numbers assigned

Q: Great! How about that new office we want to get in Hawaii? Room for it in our dial plan?

A: Sure. Well, maybe: it cannot use a DID range where the third digit of the office code is 9 or 0, and cannot overlap with 575XX, 291XX, 754XX, 311XX, or 718XX…



Anchorage
907 507 18XX



New York **212 555 75XX** | **Chicago** **708 552 91XX** | **Birmingham** **205 937 54XX** | **Dallas** **972 553 11XX** | **Hawaii** **808 ??? ????**

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Planning Considerations

Uniform Dial Plans Are Simple (3)

Q: If all I could get from Hawaii's telco is a DID range of 808 557 54XX, could I not dial six digits to reach a Hawaii phone, and five digits anywhere else? That way, I avoid the overlap between Hawaii and Birmingham

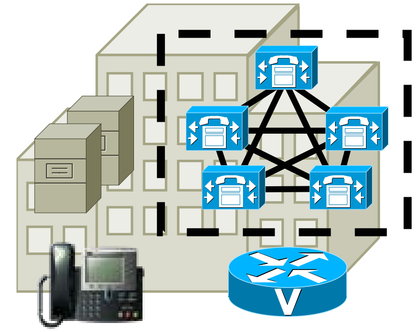
A: No! Because calls to New York (e.g. 57540) will sometimes overlap with calls to Hawaii's phones e.g. 575403), forcing the interdigit timeout to occur before the call is routed (and a few other reasons: can you spot them?)

Q: What do I do now? Go to six digits?

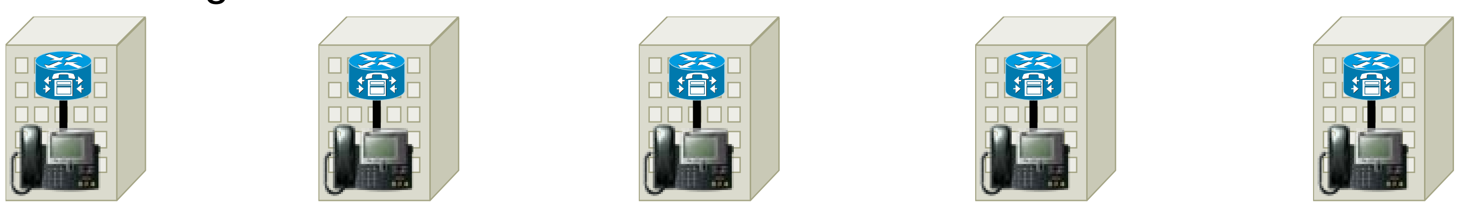
A: No: Anchorage's second NXX digit is 0. Overlaps with the operator code…

Q: Seven digits?

A: No: Birmingham starts with a 9!



Anchorage
907 507 18XX



New York **212 555 75XX** | **Chicago** **708 552 91XX** | **Birmingham** **205 937 54XX** | **Dallas** **972 553 11XX** | **Hawaii** **808 557 54XX**

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Planning Considerations

Uniform Dial Plans Are Simple (or So We Hoped)

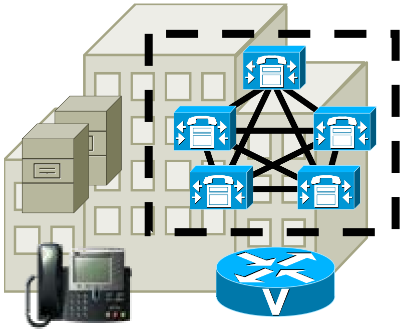
Q: Eight digits?

A: Ok for now: but you’ll never open an office in Raleigh (area code 919)

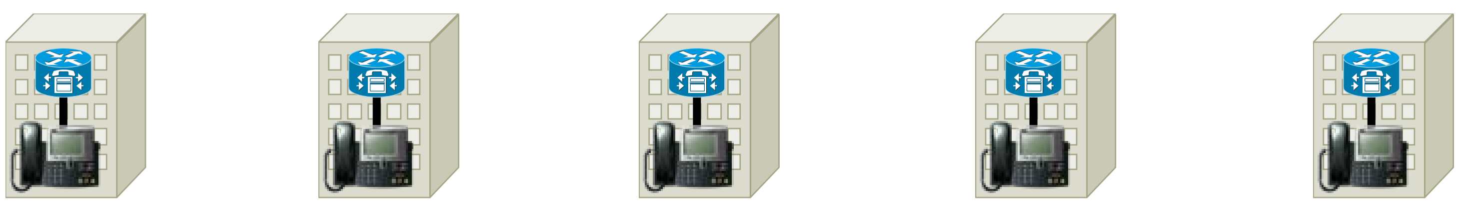
Q: Nine digits? Oops. Forget about it! That 0 again (Four cases, no less)

Q: Ten digits?

A: Great idea! The North American dial plan will make sure that it never overlaps. You can even give up the outside access code. It is not really abbreviated dialing anymore though…



Anchorage
907 507 18XX



New York **212 555 75XX** | **Chicago** **708 552 91XX** | **Birmingham** **205 937 54XX** | **Dallas** **972 553 11XX** | **Hawaii** **808 557 54XX**

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Planning Considerations

How About an On-Net, Intersite Access Code?

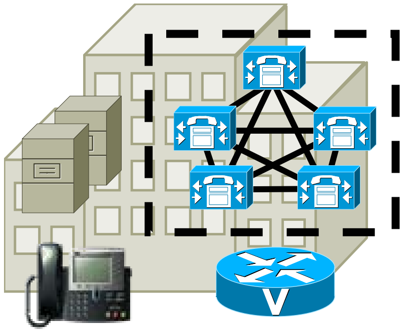
Q: What about 0 for operator, 9 for outside line, and 8 for intersite calls?

A: Great idea

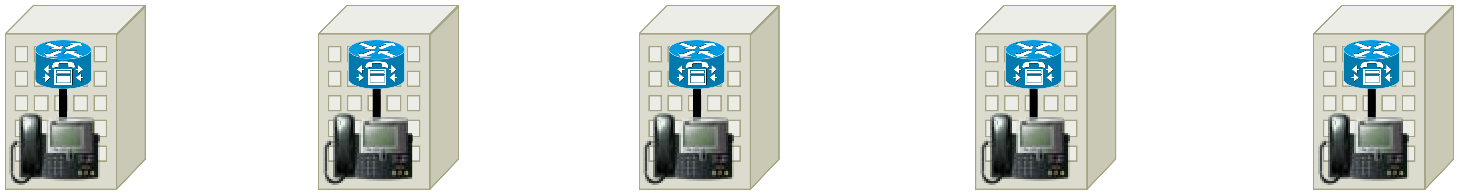
Q: How many digits for intrasite calls, though?

A: Not 3 (4XX and 1XX overlap)

- Not 4 either (911!)
- 5 would work!



Anchorage
907 507 18XX



New York	Chicago	Birmingham	Dallas	Hawaii
212 555 75XX	708 552 91XX	205 937 54XX	972 553 11XX	808 557 54XX

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Planning Considerations

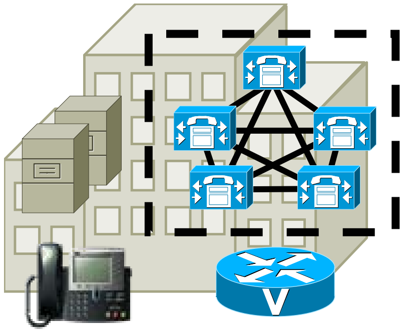
How About an On-Net, Intersite Access Code?

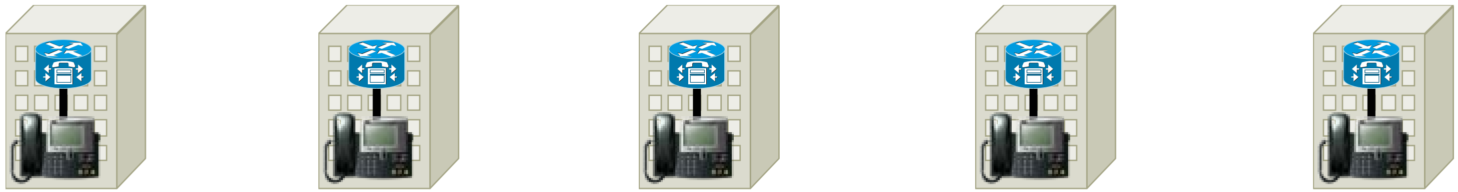
Q: Ok: now I have it:

- 0 = operator
- 8 + 5 digits: intersite on-net
- 9 + 7 digits, 9 + 10 digits , 9 + 1 + 10 digits, 9 + 011… all off-net patterns
- And then any five digits that begin with 1 though 7 is an on-net, intrasite call
- Am I good to go?

A: Yes

…for now





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Planning Considerations

What If I Have Many, Many More Sites? More Users?

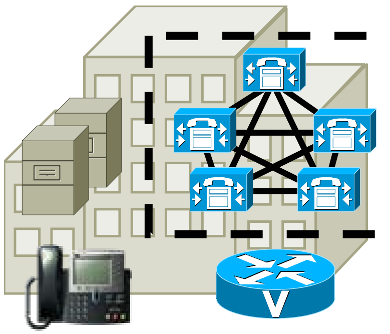
Q: I have 250 branches, with over 90 with 100+ users, and a dozen with more than 1000 users, and a headquarter with 12000 users. Can I still use eight + five digits for on-net, intersite calls?

A: No!

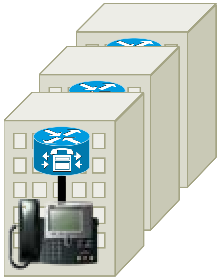
You essentially have the following to play with:

1XXXX, 2XXXX, 3XXXX, 4XXXX, 5XXXX, 6XXXX, 7XXXX

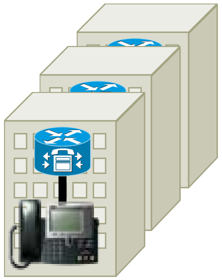
250 phone companies' DID ranges, the need for more than a whole five digit range for a single site, and dividing the rest into 250 unequal parts. Future planning, area code splits, new office codes, etc…



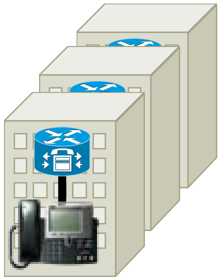
San Jose
408 526 XXXX
408 853 XXXX
Site Codes 123 and 124



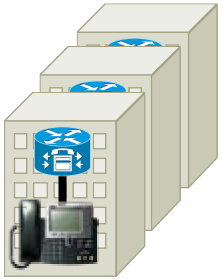
Baltimore
240 555 XXXX
Site Code 012



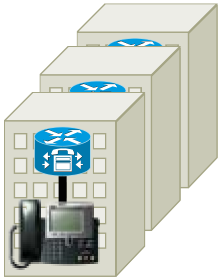
Oakland
510 555 51XX
Site Code 345



New Orleans
504 555 5XXX
Site Code 256



Philadelphia
267 555 1XXX
Site Code 390



Hawaii
808 557 54XX
Site Code 822

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Planning Considerations

What if I Have Many, Many More Sites? More Users? (2)

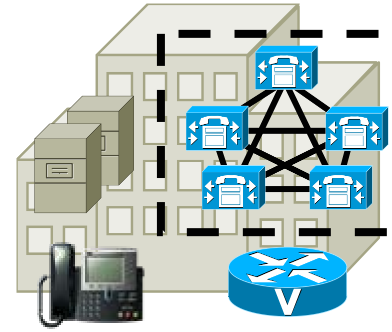
Q: What to do?

A: Site codes are a good idea

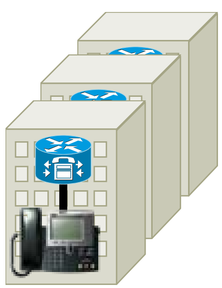
- 0 = operator
- 9 = outside line, all combinations
- 8 + site code (three digits would work up to 1000 sites), followed by a four digit extension
- [1-7]XXX: on-net, intrasite dialing

Q: But I have a site with more than 10000 users?

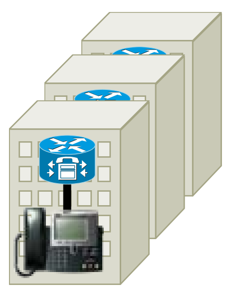
A: Would you be OK with using two site codes for that site? And having that site use five digit on-net?



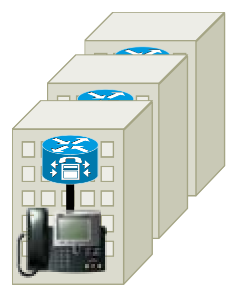
San Jose
408 526 XXXX
408 853 XXXX
Site Codes 123 and 124



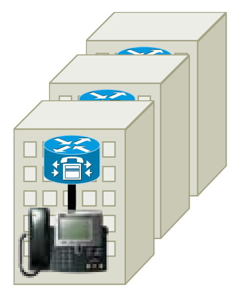
Baltimore
240 555 XXXX
Site Code 012



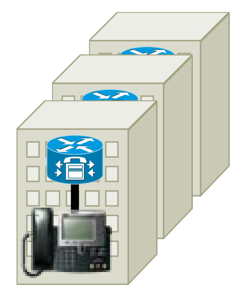
Oakland
510 555 51XX
Site Code 345



New Orleans
504 555 5XXX
Site Code 256



Philadelphia
267 555 1XXX
Site Code 390



Hawaii
808 557 54XX
Site Code 822

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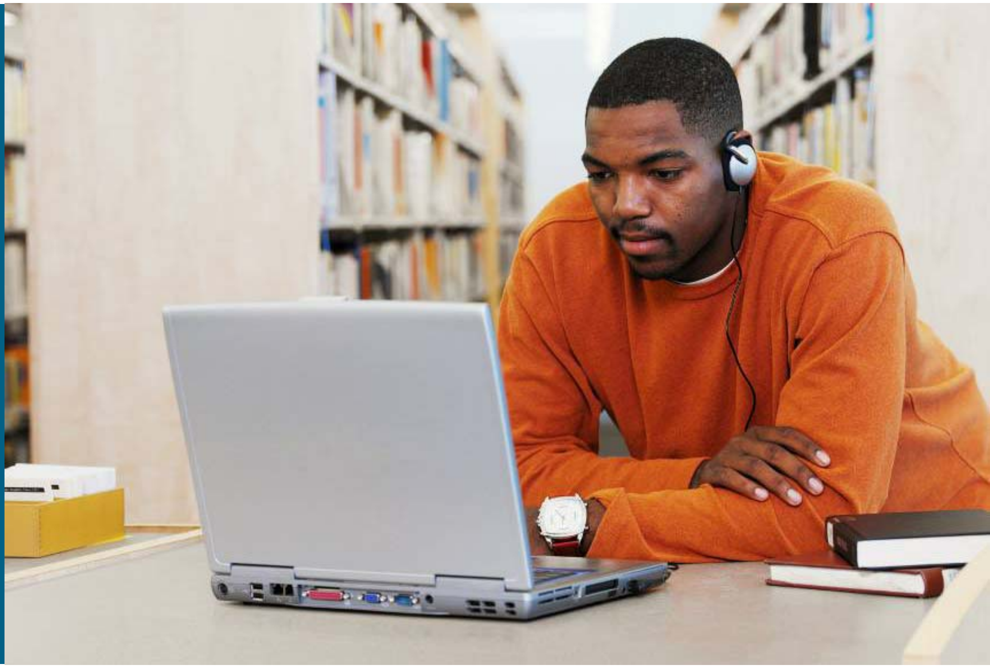
Design Guidelines



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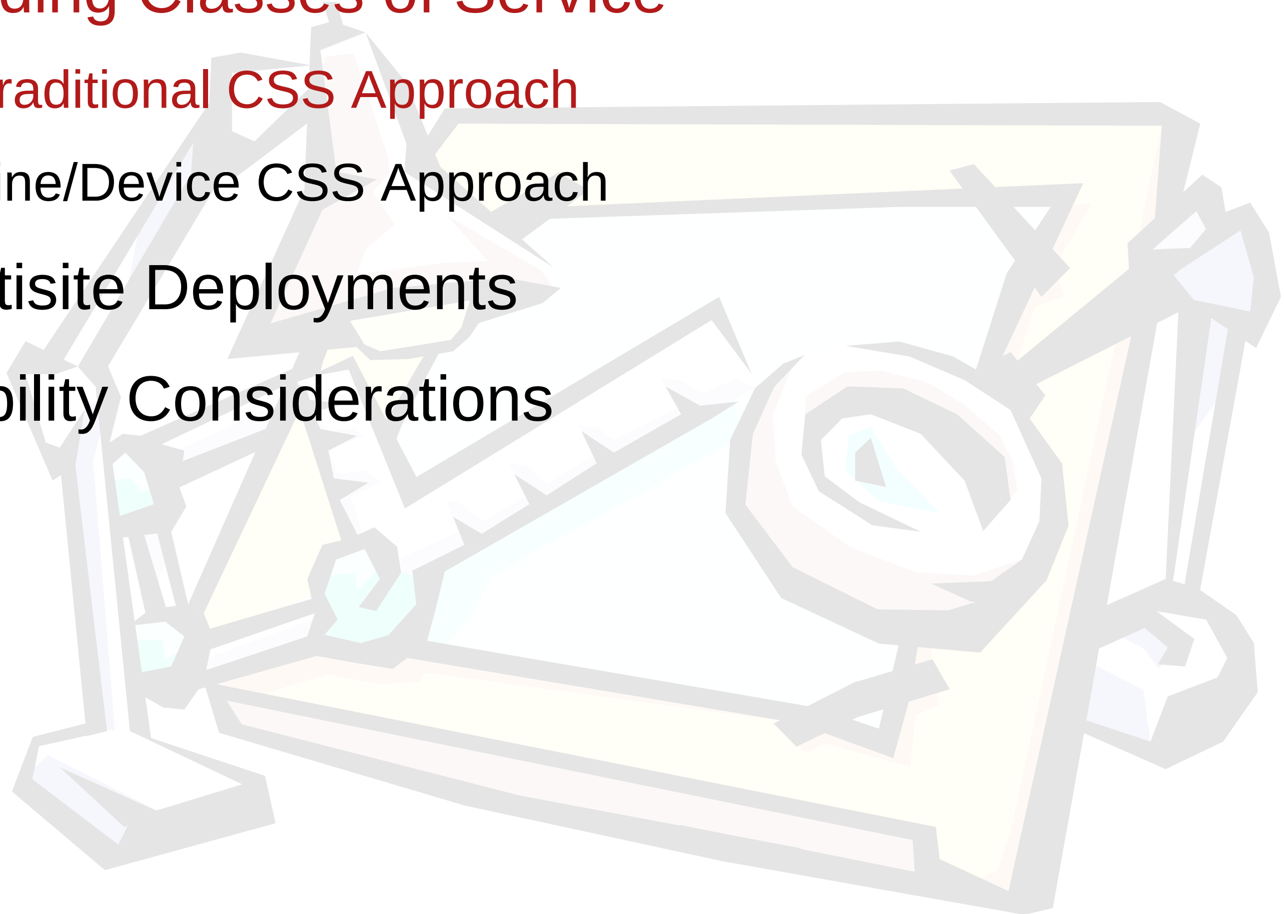
Design Guidelines Agenda

- Building Classes of Service
  - Traditional CSS Approach
  - Line/Device CSS Approach
- Multisite Deployments
- Mobility Considerations



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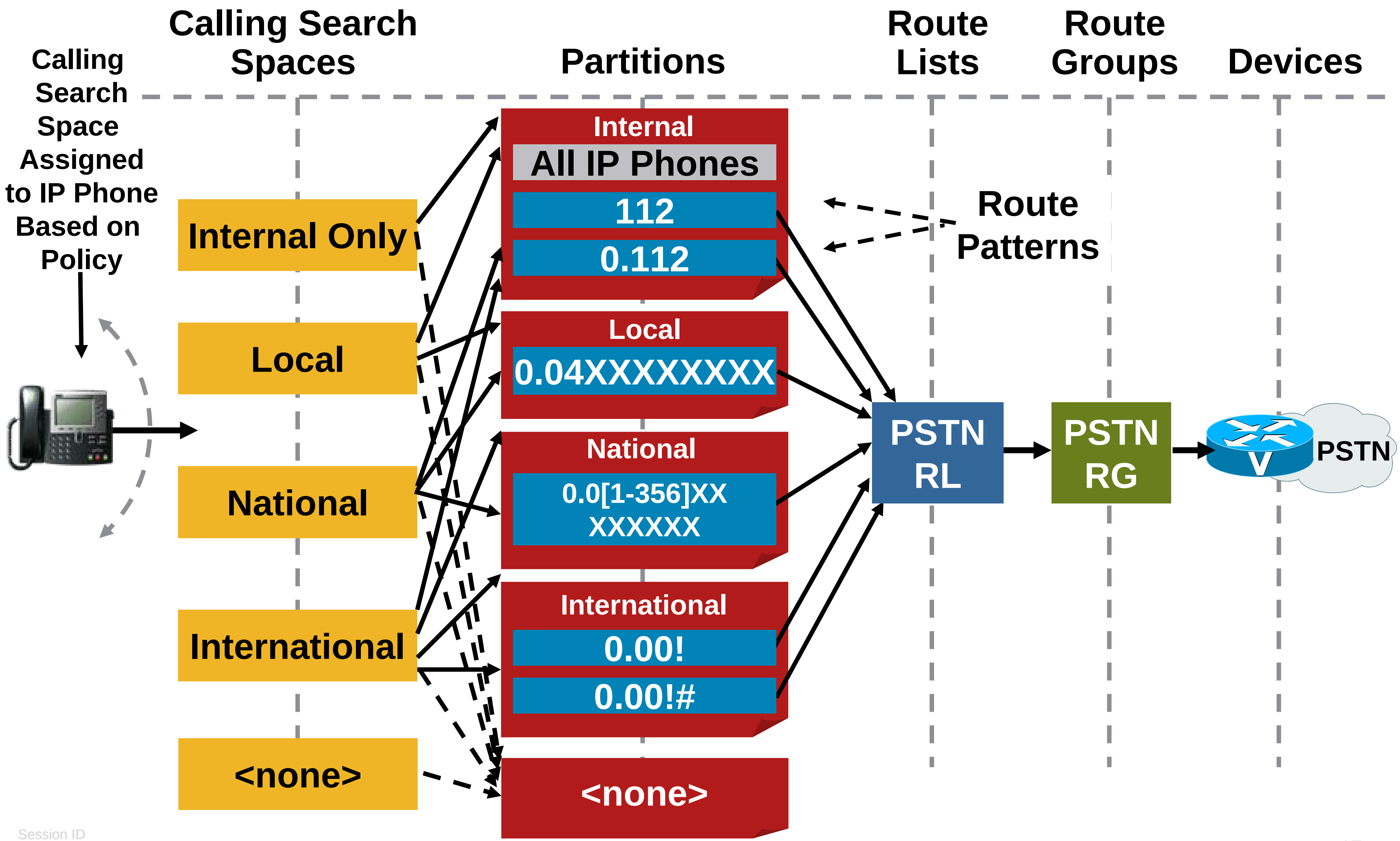
Traditional CSS Approach
Example of Composite View—France



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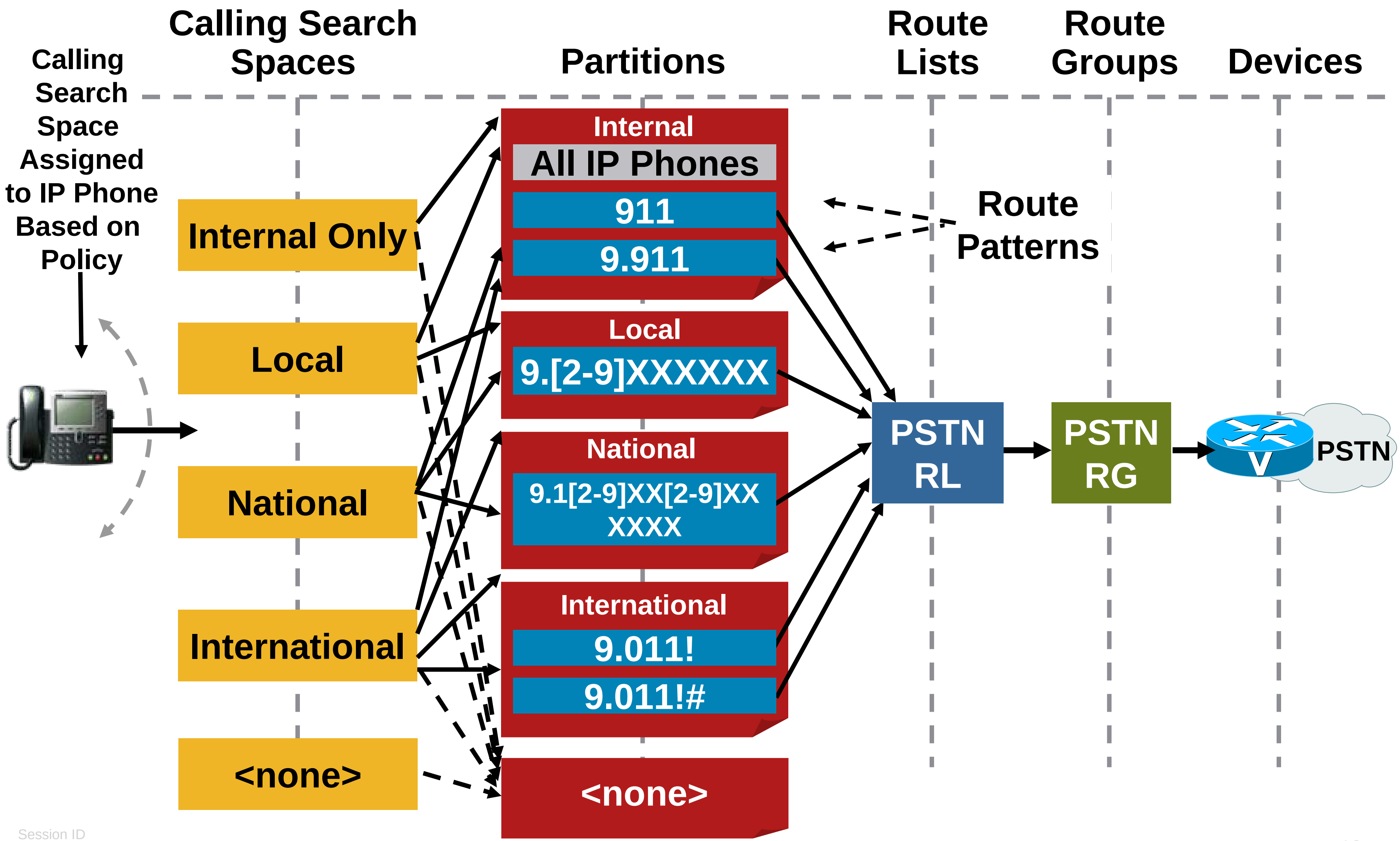
Traditional CSS Approach

Example of Composite View—North America



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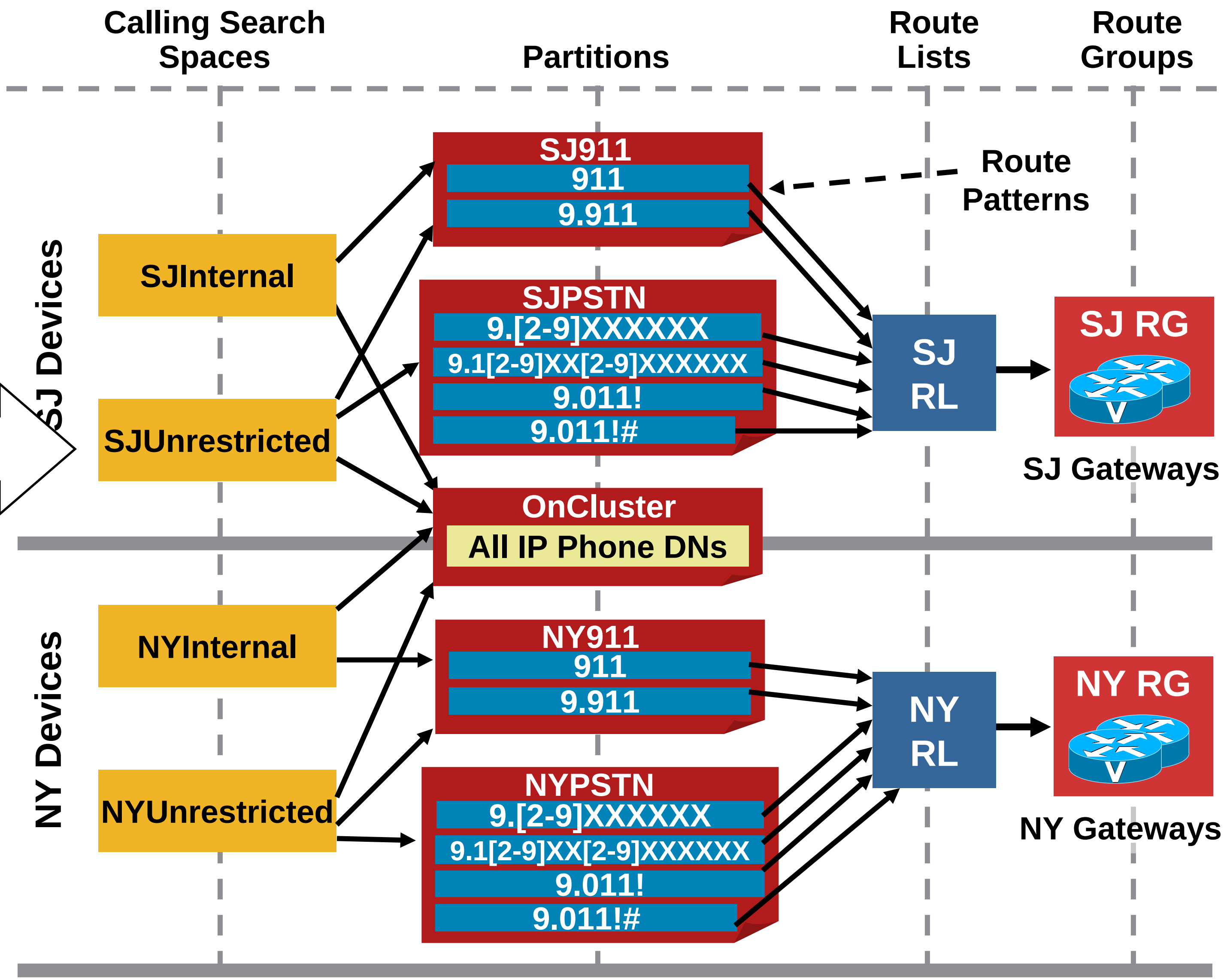
Traditional CSS Approach

Scalability for Centralized Deployments



Device CSS Dictates:

- Class of Service
- Path Selection

 # CSS = N x C

N = # of Sites
C = # of Classes of Service

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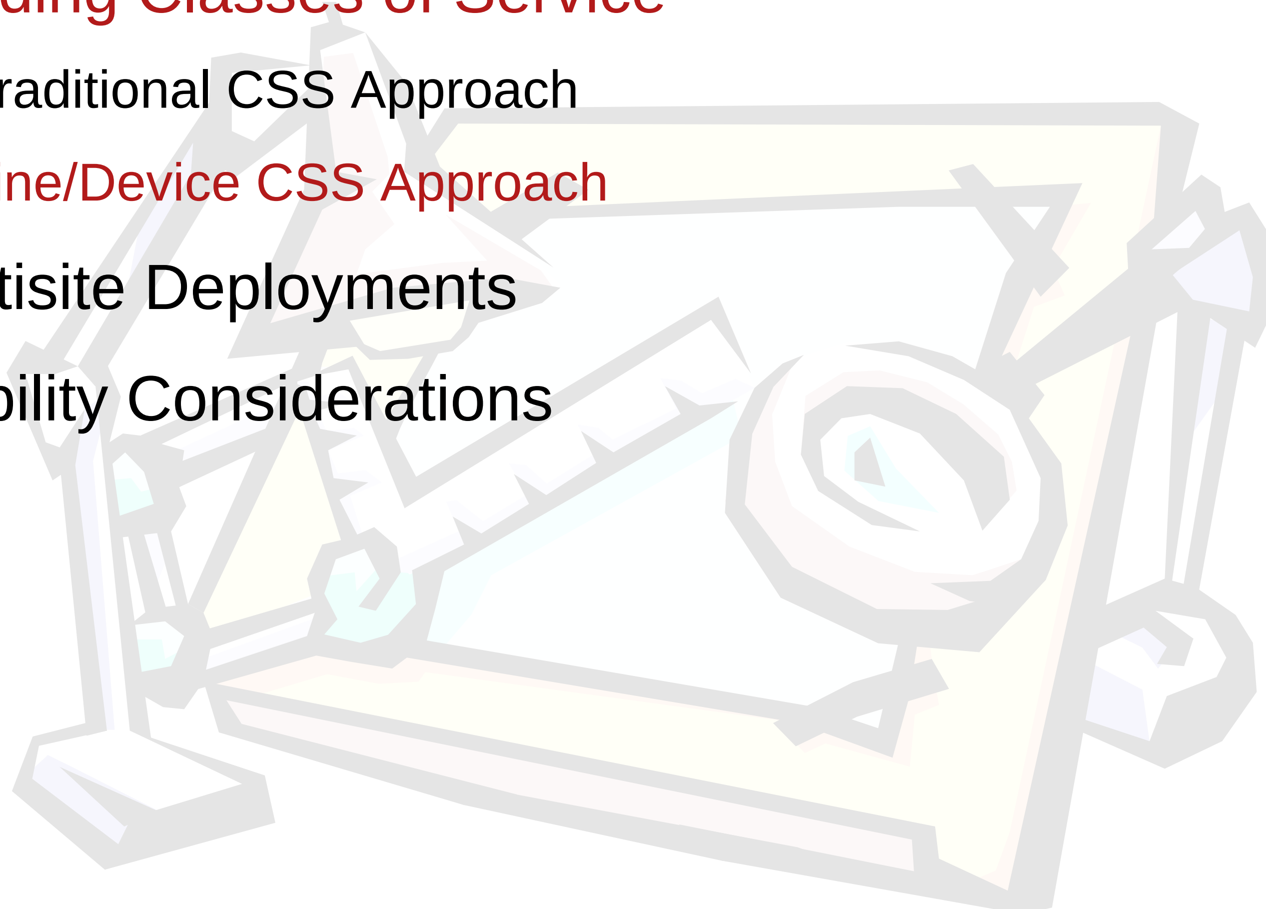
Design Best Practices Agenda

- Building Classes of Service
  - Traditional CSS Approach
  - Line/Device CSS Approach
- Multisite Deployments
- Mobility Considerations



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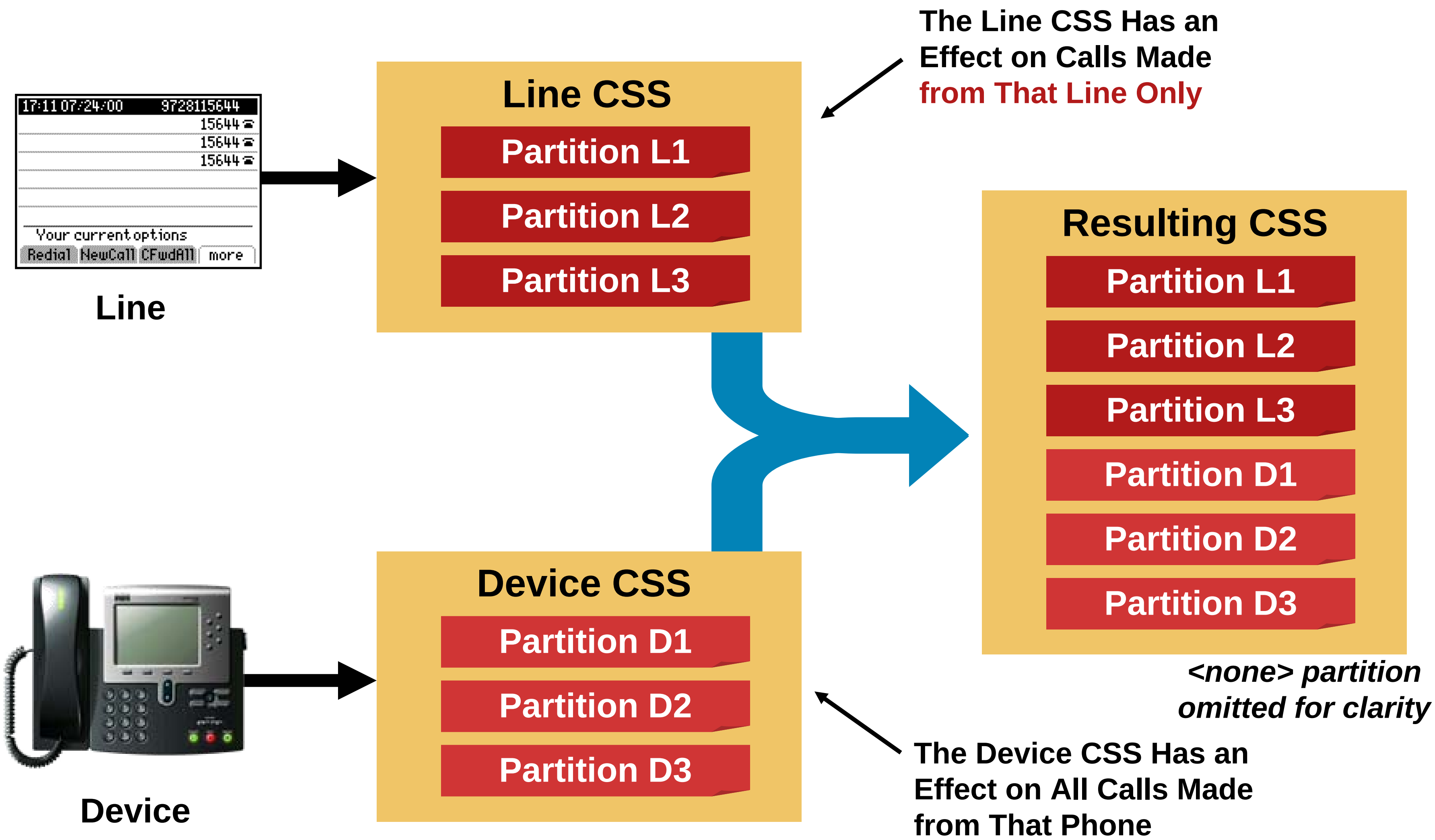
The Line/Device CSS Approach

Line CSS vs. Device CSS



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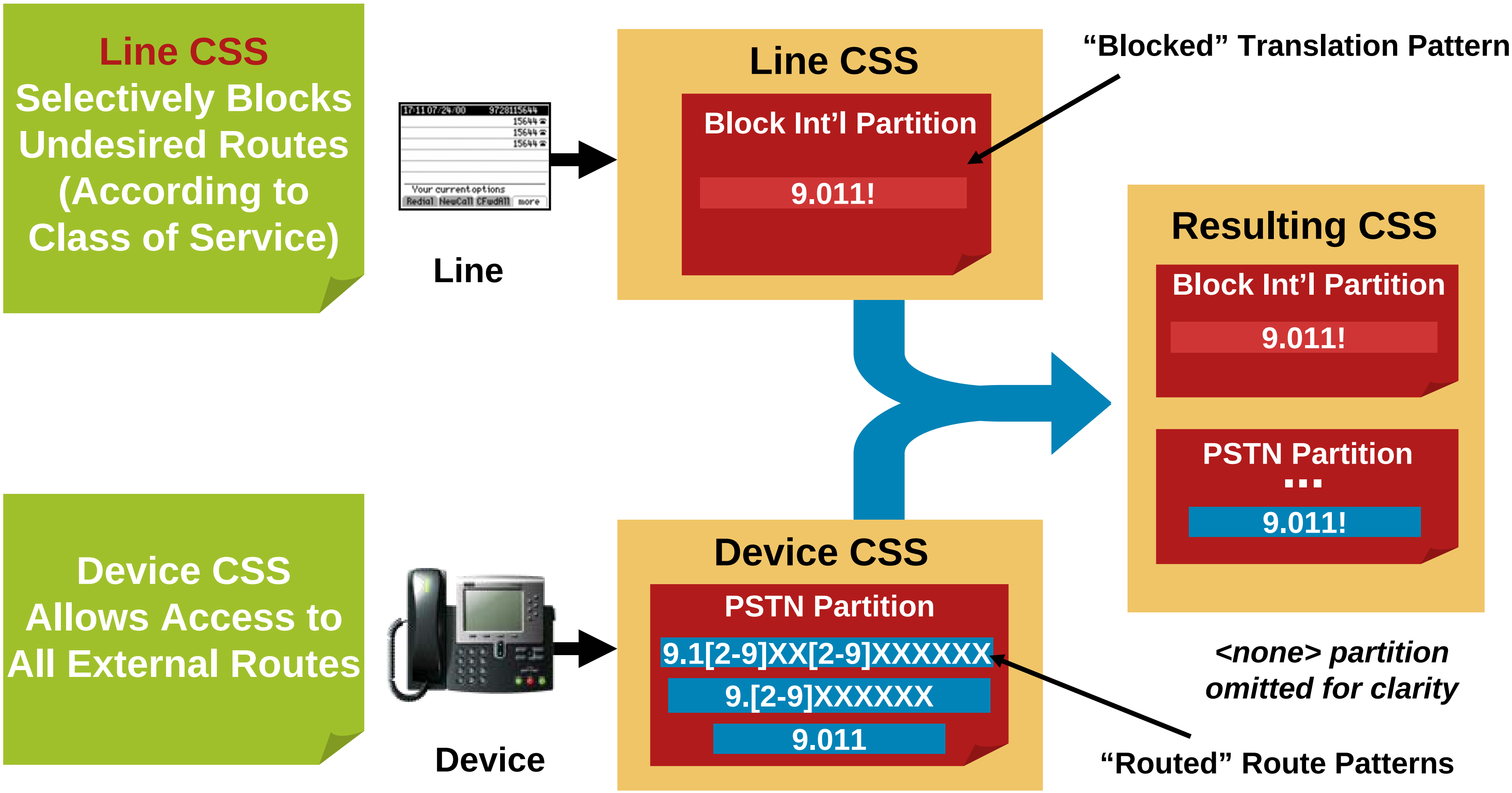
The Line/Device CSS Approach

Key Idea



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The Line/Device CSS Approach

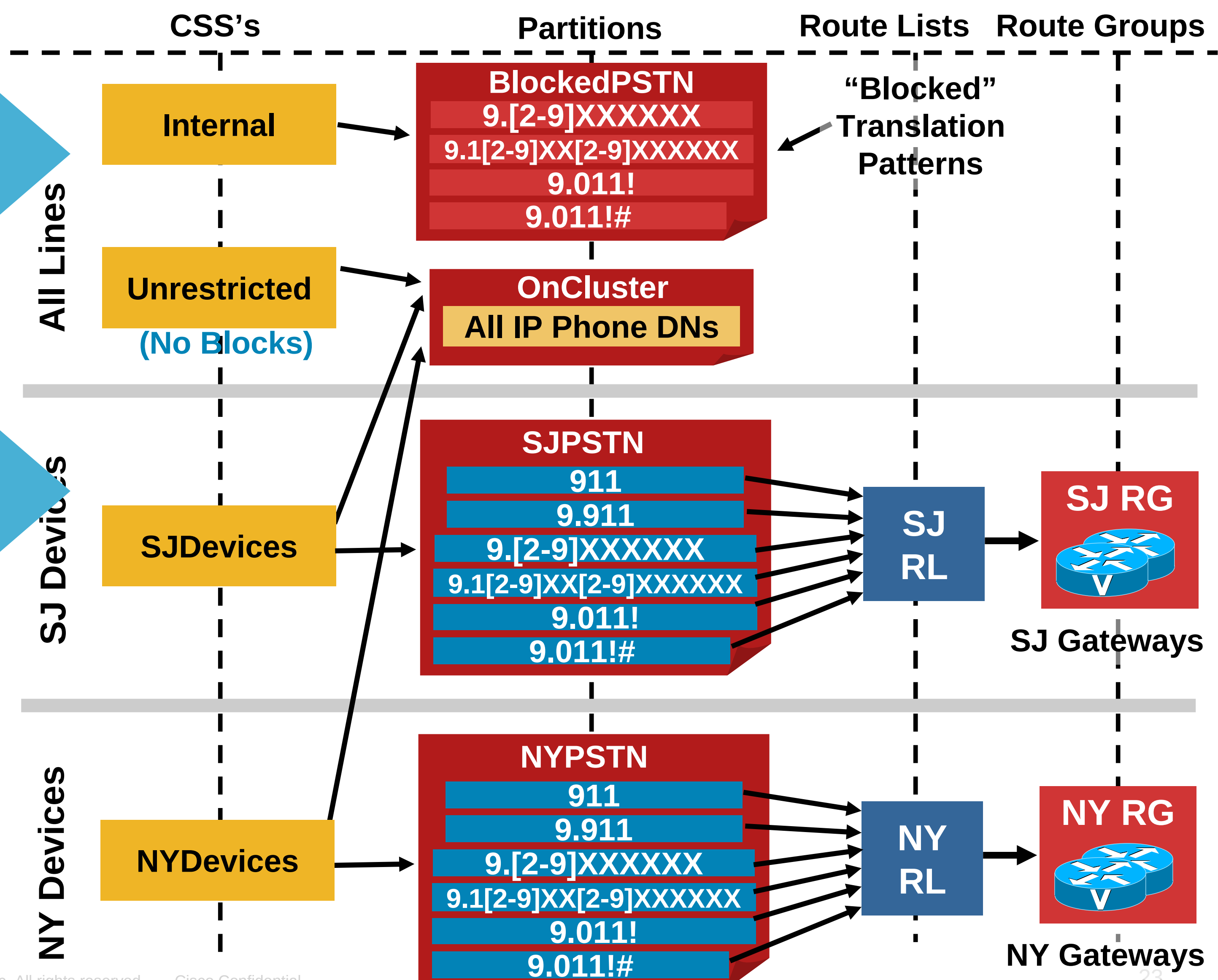
Scalability for Centralized Deployments

Line CSS Dictates:
- Class of Service

Device CSS Dictates:
- Path Selection

 # CSS = N + C

N = # of sites
C = # of classes of service



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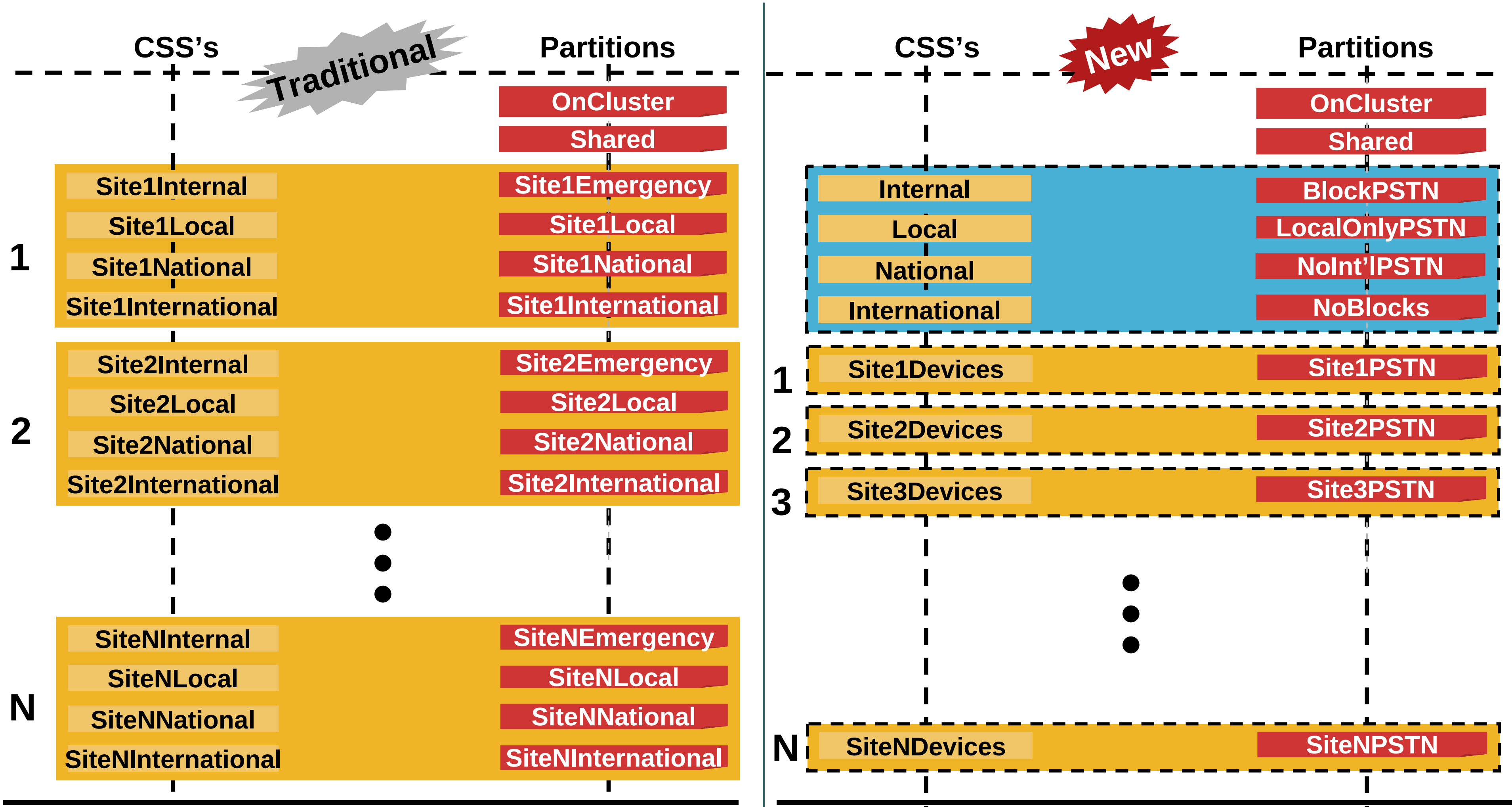
The Line/Device CSS Approach

Comparison of the Two Methods



(N*4) CSS's **((N*4) + 2) Partitions** **(N + 4) CSS's** **(N + 6) Partitions**

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The Line/Device CSS Approach

CallForward Caveats (1 of 2)

- Forwarded calls use the CallFwdxxx CSS's only; these values are not concatenated with Line or Device CSS
- If forwarded calls must have unrestricted privileges, set the CallFwdxxx CSS's to the site-specific Device CSS
- If forwarded calls must be restricted to internal numbers only, set the CallFwdxxx CSS's to a single, global CSS with only internal partitions
- In 4.X, If forwarded calls must have some intermediate restriction (e.g., no international calls), this approach may loose efficiency, as additional site-specific CSS's will be needed
- New In CUCM 5.X and 6.X, a new CSS [Secondary Calling Search Space for CallForwardAll] has been added, allowing for CFA to have all the classes of service afforded by the line/device approach

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The Line/Device CSS Approach

CallForward Caveats (2 of 2)

New

- Calling Search Space Activation policy (6.X only)

  Use system Default

  the CFA CSS Activation Policy cluster-wide service parameter determines which Forward All Calling Search space will be used.

  With Configured CSS

  The configures CFAll and Secondary CSS for CFAll are used

  With Activating Device/Line CSS

  the Forward All Calling Search Space and Secondary Calling Search Space for Forward All automatically gets populated with the Directory Number Calling Search Space and Device Calling Search Space for the activating device.

- When a device is roaming in the same device mobility group, Cisco Unified Communications Manager uses the Device Mobility CSS to reach the local gateway. If a user sets Call Forward All at the phone, the CFA CSS is set to None, and the CFA CSS Activation Policy is set to With Activating Device/Line CSS, then:

  The Device CSS and Line CSS get used as the CFA CSS when the device is in its home location.

  If the device is roaming within the same device mobility group, the Device Mobility CSS from the Roaming Device Pool and the Line CSS get used as the CFA CSS.

  If the device is roaming within a different device mobility group, the Device CSS and Line CSS get used as the CFA CSS.

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The Line/Device CSS Approach

Other Caveats

- Blocking translation patterns configured within the Line CSS must be **at least as specific** as the route patterns configured within the Device CSS

    (Watch for the "@" wildcard, as its patterns are very specific)

- AAR uses a different CSS for rerouted calls; in most cases, this CSS can be the same as the unrestricted site-specific Device CSS
- Priority order between line and device is reversed for CTI route points and CTI ports; therefore, the Line/Device CSS approach cannot be *directly* applied to CTI devices, such as Softphone (not Communicator)

    In this case, it is viable only if blocked patterns are more specific than the routed ones (i.e. not relying on order of the partitions)

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Design Best Practices Agenda

- Building Classes of Service
- Multisite Deployments
  - Choosing a Dial Plan Approach
  - Uniform On-Net Dialing
  - Variable-Length On-Net Dialing with Partitioned Addressing
  - Variable-Length On-Net Dialing with Flat Addressing
  - Tail End Hop Off (a.k.a. toll bypass)
- Mobility Considerations

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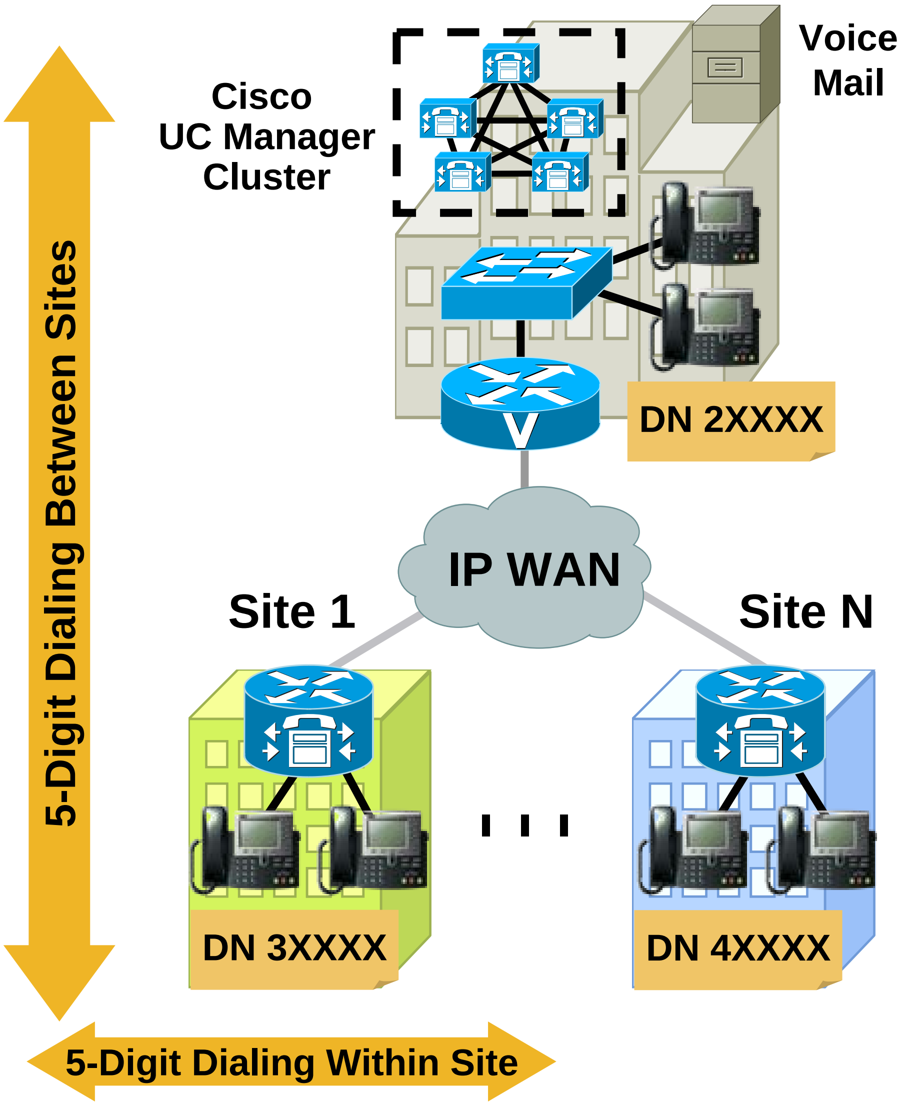
Choosing a Dial Plan Approach

Uniform On-Net Dialing

- Dialing within a site and across sites with same number of digits (e.g., 5)
- Extensions are globally unique
- Easy to design and configure
- Limited scalability of the addressing method (number of sites, number of extensions)



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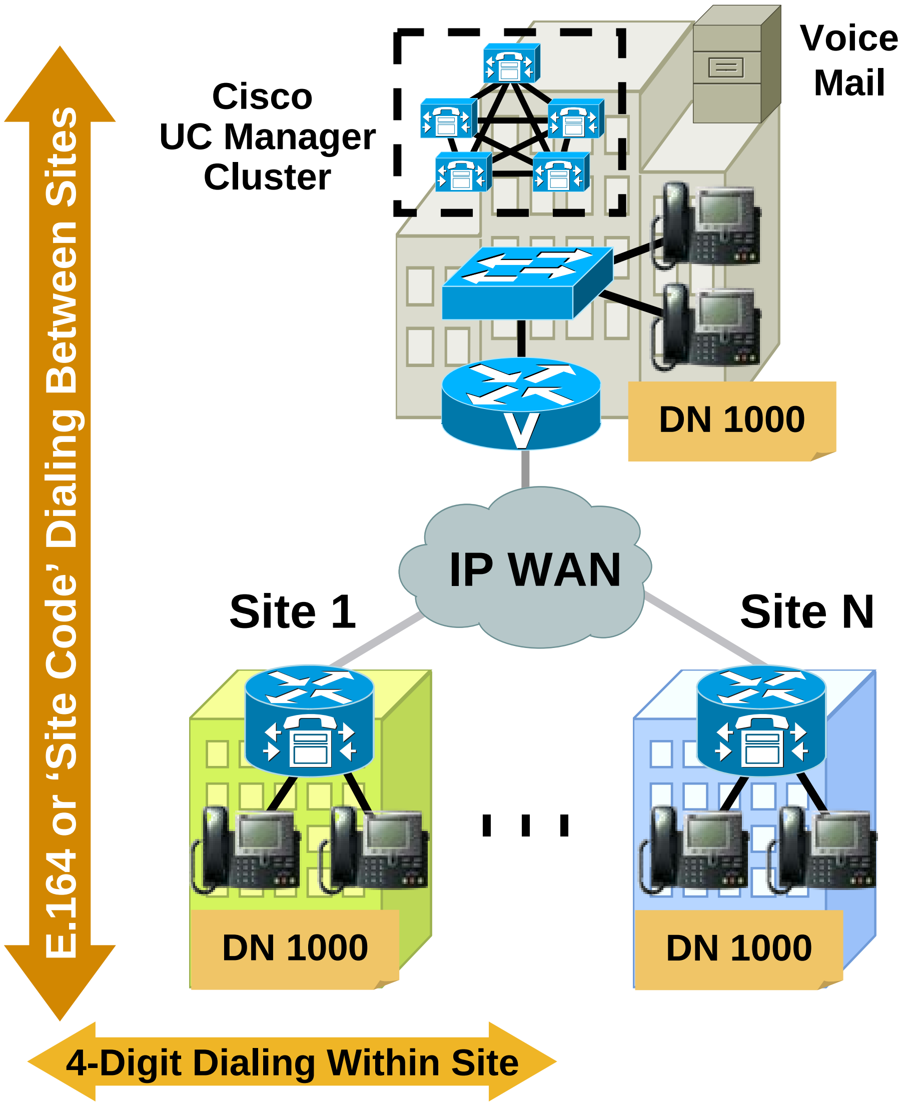
Choosing a Dial Plan Approach

Variable-Length On-Net Dialing (VLOD)

- Abbreviated dialing within a site (four or five digits)
- Identical extensions (e.g., 1000) may appear at different sites
- Intersite calls use an "escape code" (e.g., "9 + full E.164", or "8 + site code + extension")
- Easier scalability for large numbers of extensions and sites



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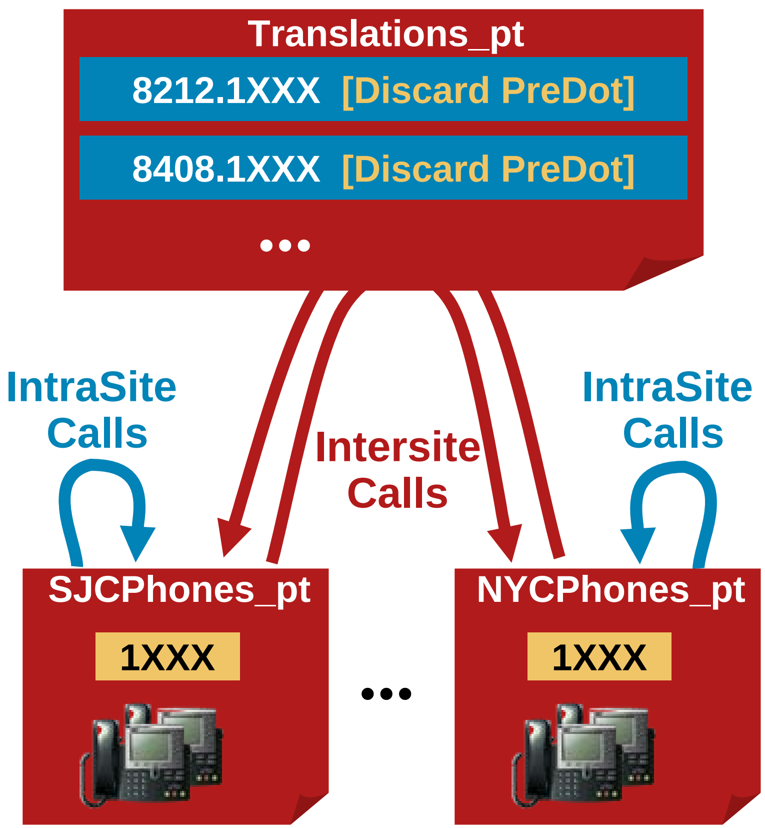
Choosing a Dial Plan Approach

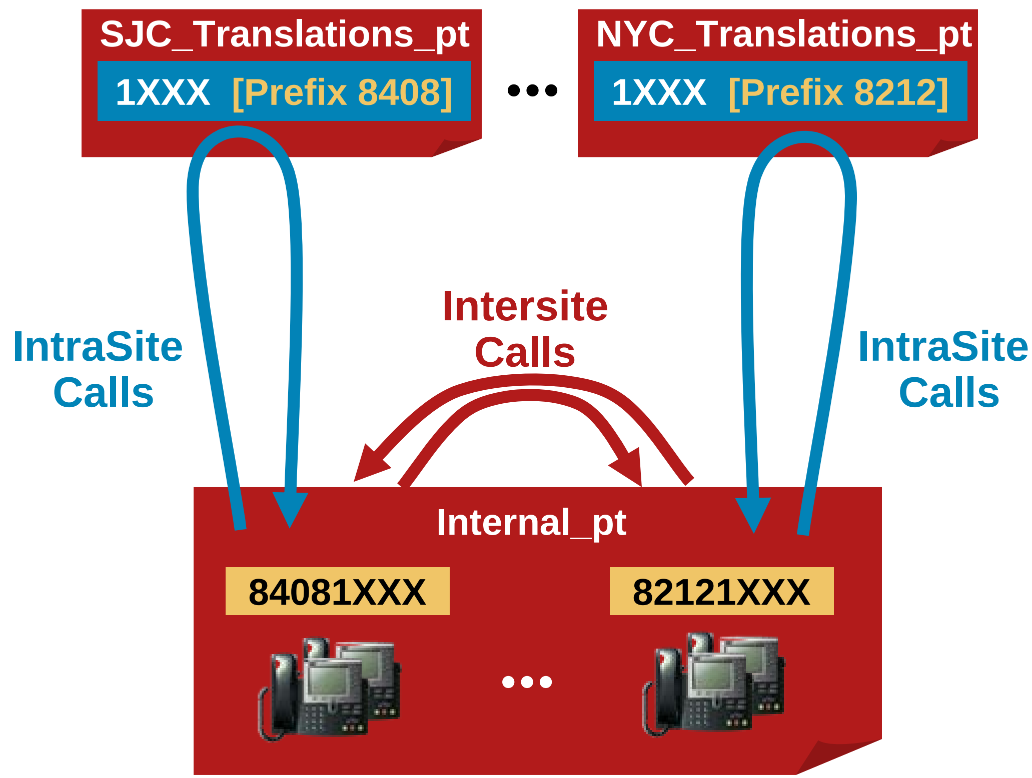
Addressing Methods for VLOD

Partitioned Addressing



- Phone DN’s in different partitions
- Global Xlations for intersite calls

Flat Addressing



- Phone DN’s in same global partition
- Per-site translations for intrasite calls

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Choosing a Dial Plan Approach

Preliminary Design Questions

- How many sites are going to be part of the system?
- What are the calling patterns between sites?
- What do users dial within a site and to reach another site?
- What transport network is going to be used for intersite calls (PSTN or IP WAN)?
- What (if any) CTI applications are being used?
- Is there a desire for a standardized on-net dialing structure (e.g., using site codes)?

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Design Best Practices Agenda

- Building Classes of Service
- MultiSite Deployments
  - Choosing a Dial Plan Approach
  - Uniform On-Net Dialing
  - Variable-Length On-Net Dialing with Partitioned Addressing
  - Variable-Length On-Net Dialing with Flat Addressing
  - Tail End Hop Off (a.k.a. toll bypass)
- Mobility Considerations

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Uniform On-Net Dialing

Use This Model If…

- DID ranges do not overlap (based on chosen quantity of digits for internal calls)
- Number of sites is small
- Number of sites is not expected to grow significantly in the future
- DID ranges are deemed to be predictable (can anyone make that assumption??? One area code split, and you may be back to the drawing board!!!)

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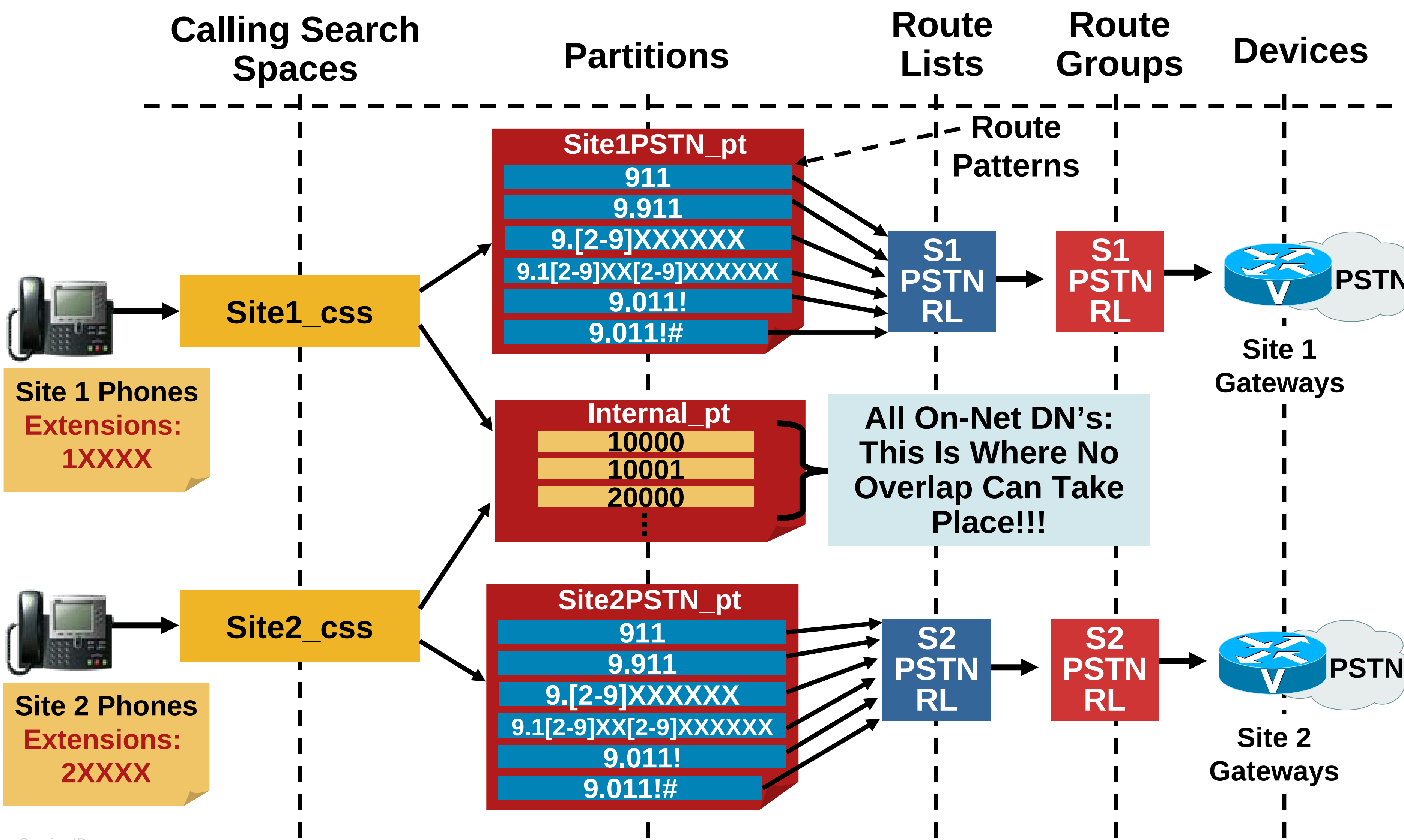
Uniform On-Net Dialing
Composite View



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Design Best Practices Agenda

- Building Classes of Service
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  - Choosing a Dial Plan Approach
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- Mobility Considerations

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VLOD with Partitioned Addressing

Use This Model If…

- A global on-net numbering plan using site codes is not desired (or possible)
- Policy restrictions must be applied to on-net intersite calls (that is, some or all users are not allowed to dial other sites on-net)
- Intersite calls are always routed over the PSTN
- CTI applications are not used across sites
- You have to because the system was built this way from the start…

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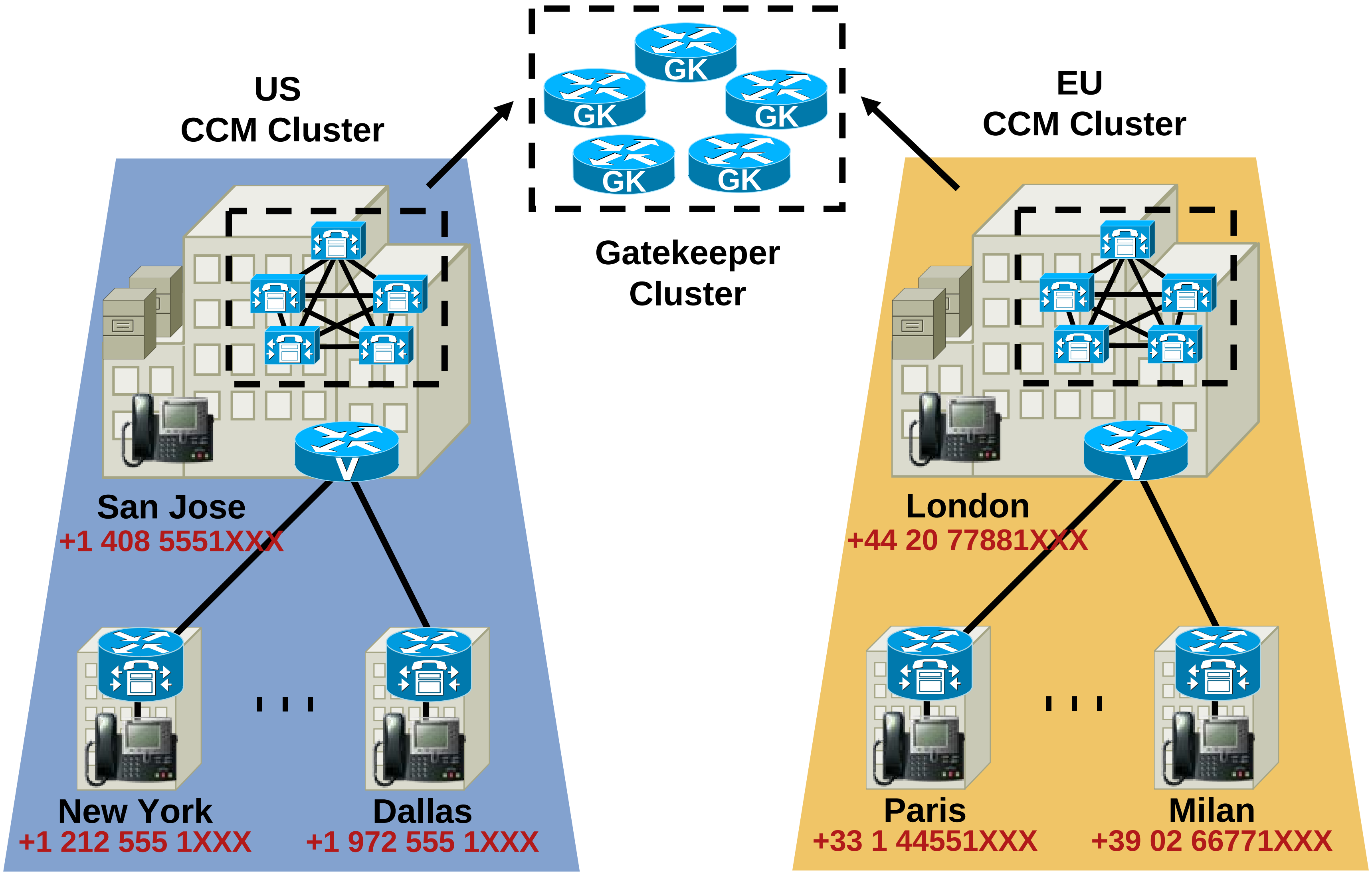
VLOD with Partitioned Addressing

Hypothetical Customer Example



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VLOD with Partitioned Addressing

Partitions and Calling Search Spaces

Partitions	OnCluster_pt			
	SJC_Phones_pt	NYC_Phones_pt		DFW_Phones_pt
Calling Search Spaces	SJC_Internal_css	NYC_Internal_css		DFW_Internal_css
	SJC_Local_css	NYC_Local_css	. . .	DFW_Local_css
	SJC_LD_css	NYC_LD_css		DFW_LD_css
	SJC_Intl_css	NYC_Intl_css		DFW_Intl_css

*** Note: If Using the Line/Device CSS Approach, the Number of CSS's Can Be Reduced**

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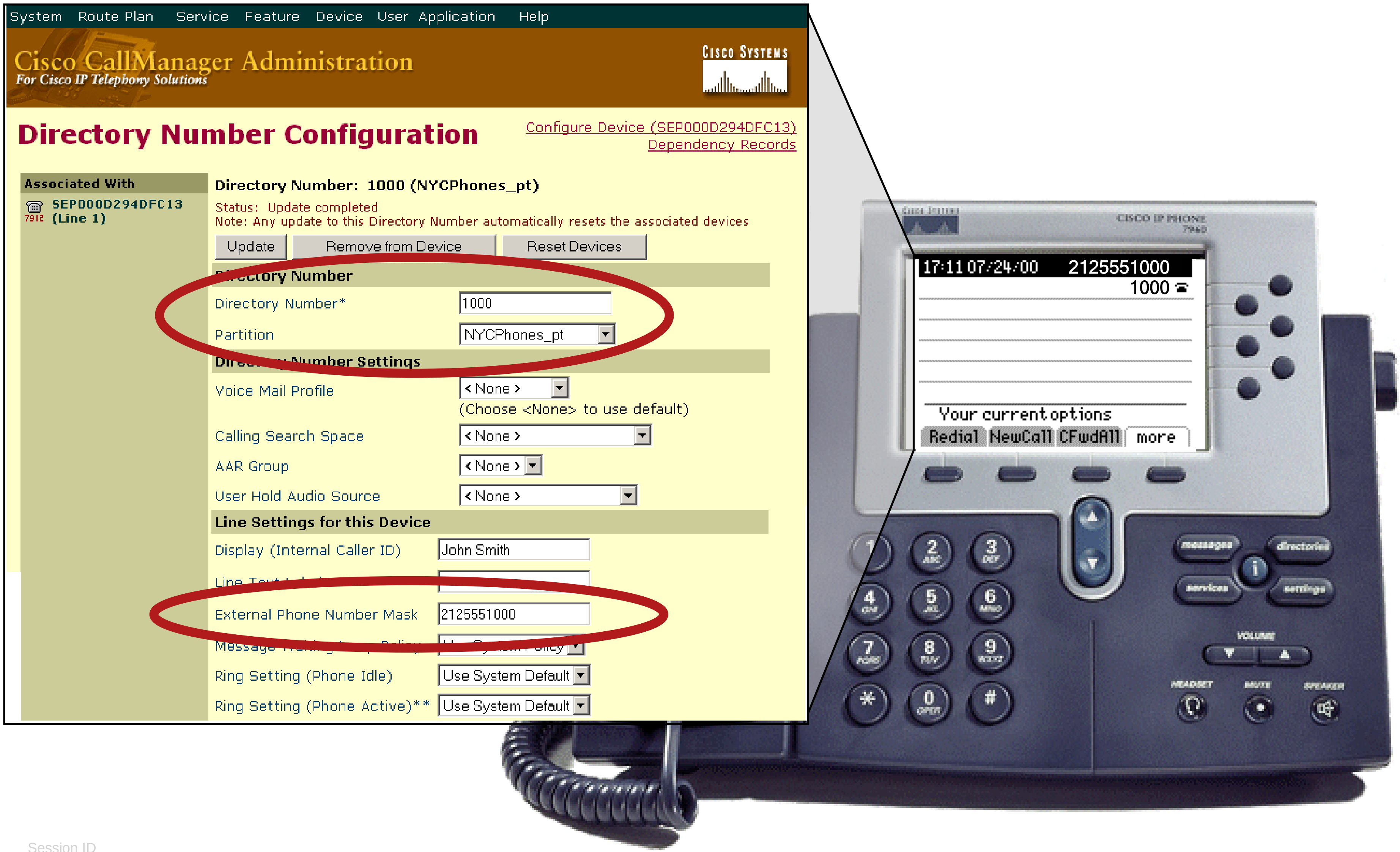
VLOD with Partitioned Addressing

Line Configuration



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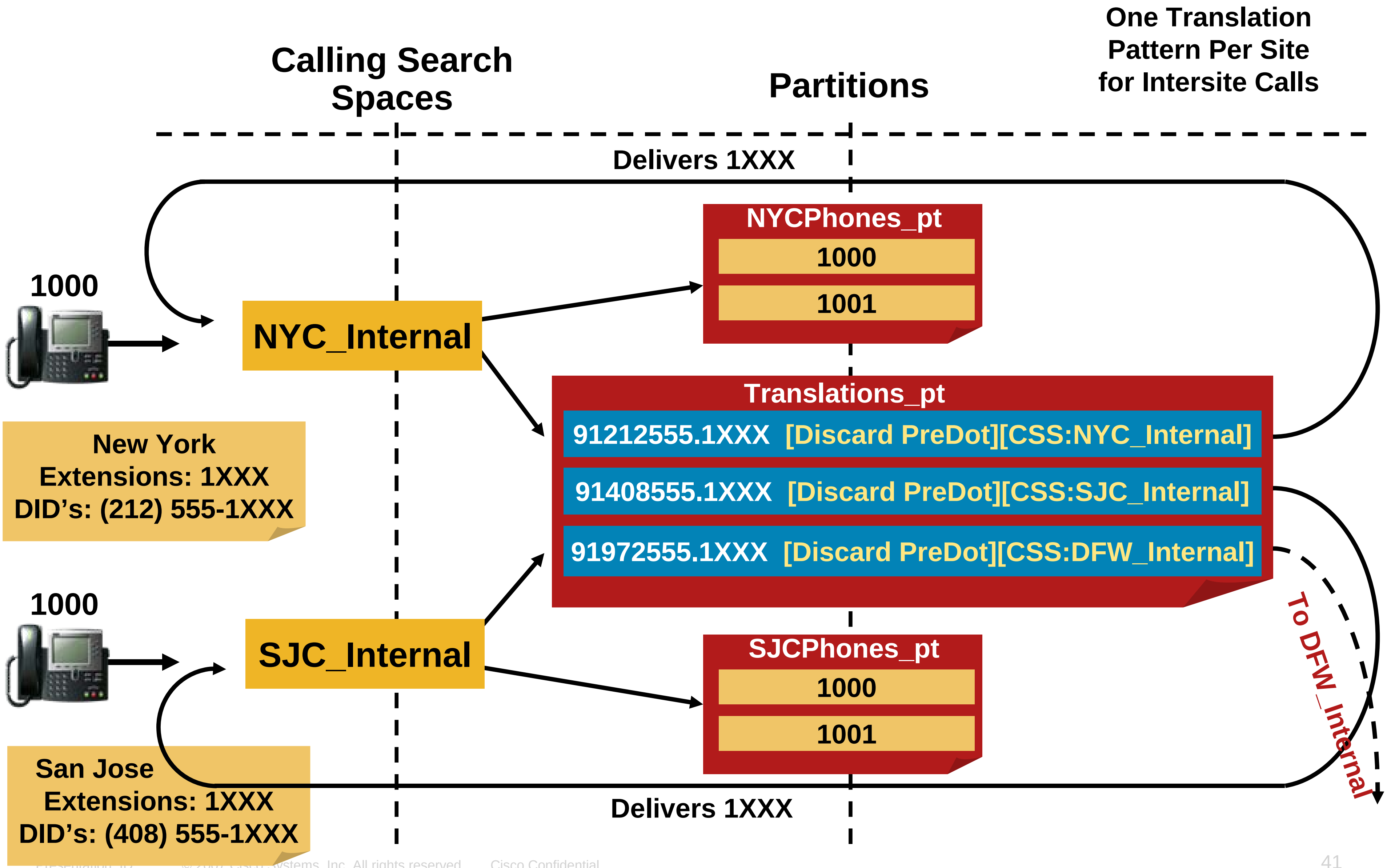
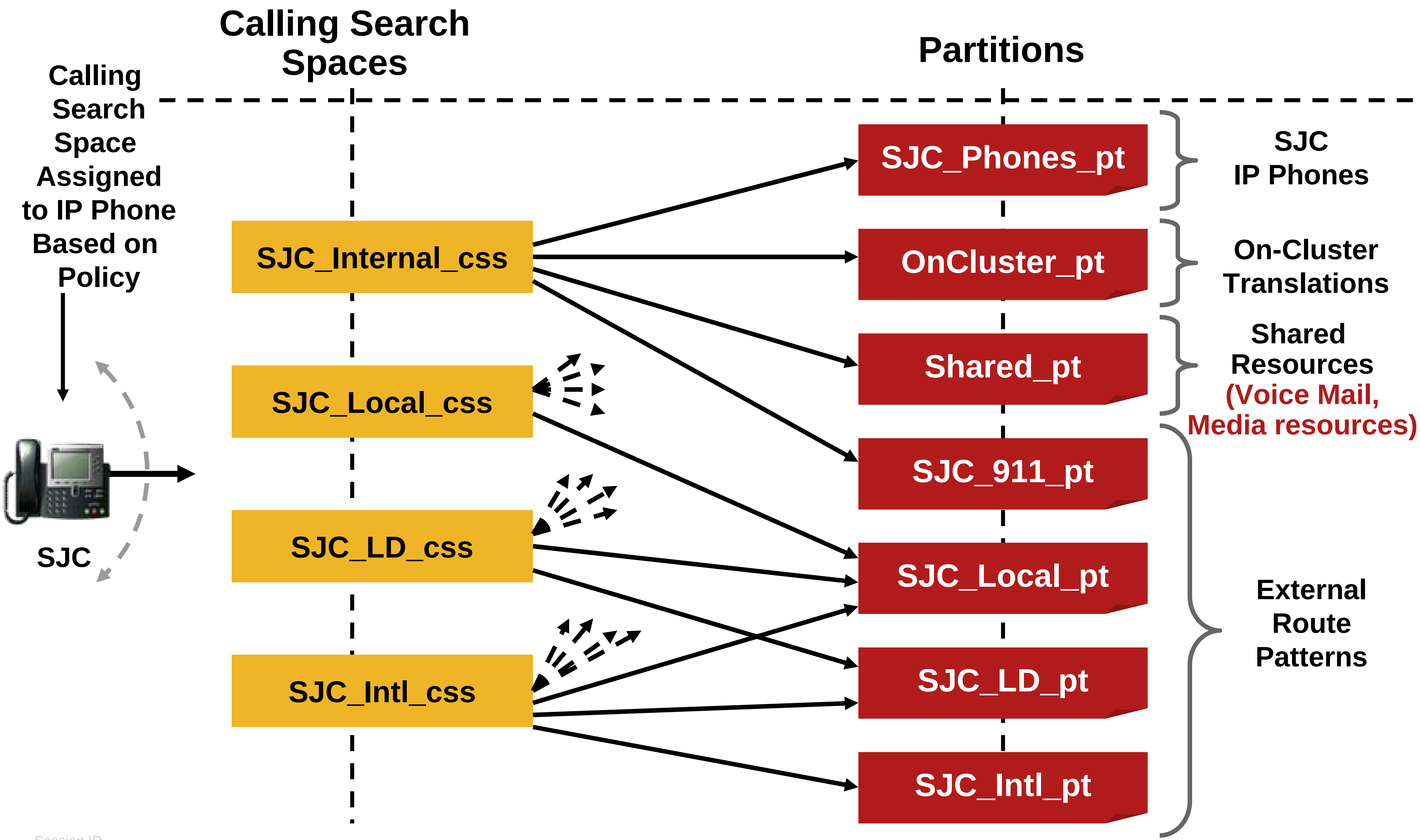
VLOD with Partitioned Addressing

Intersite Calls Within a Cluster



VLOD with Partitioned Addressing

View of Partitions/Calling Search Spaces



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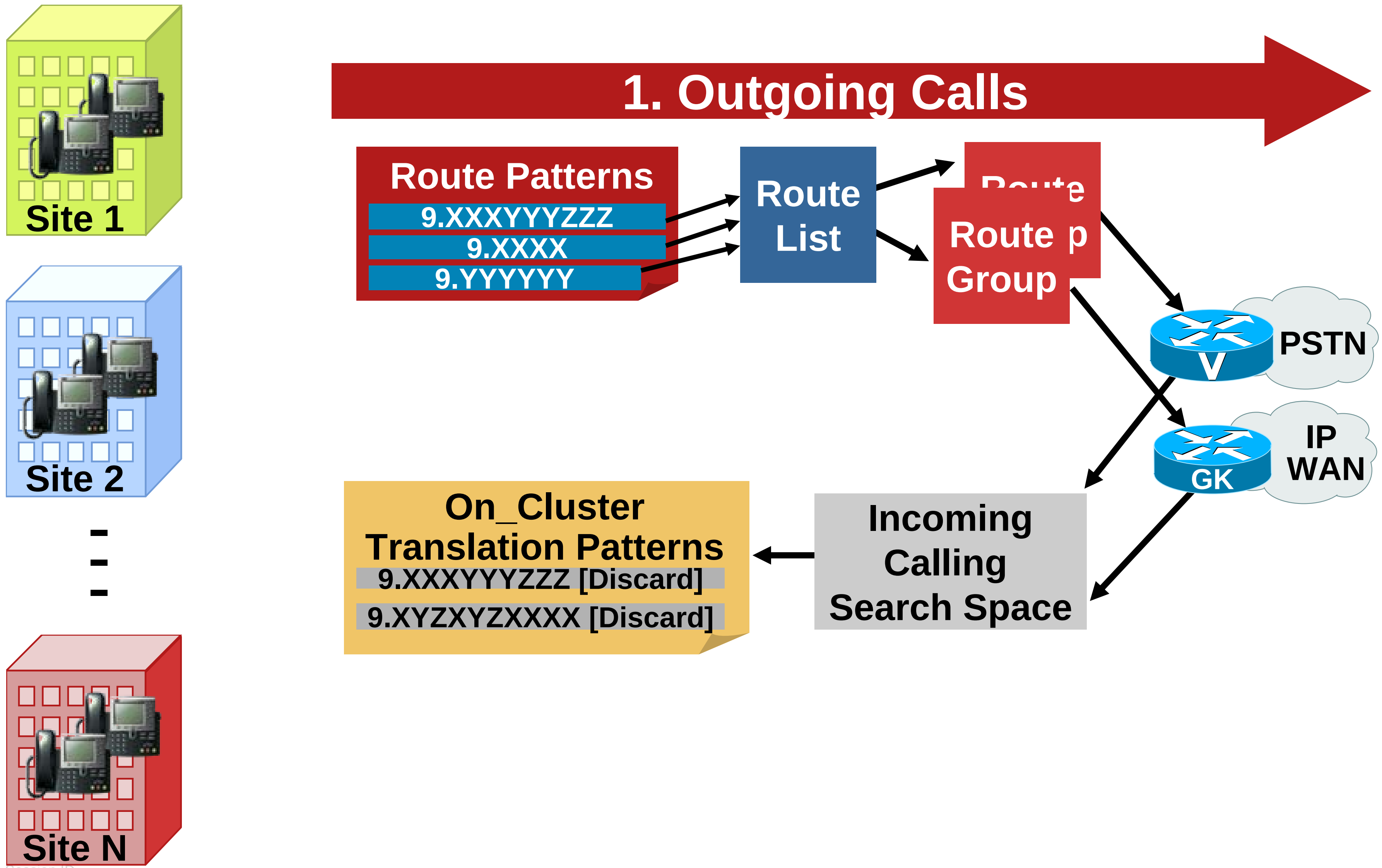
VLOD with Partitioned Addressing

Outgoing PSTN/Gatekeeper Calls



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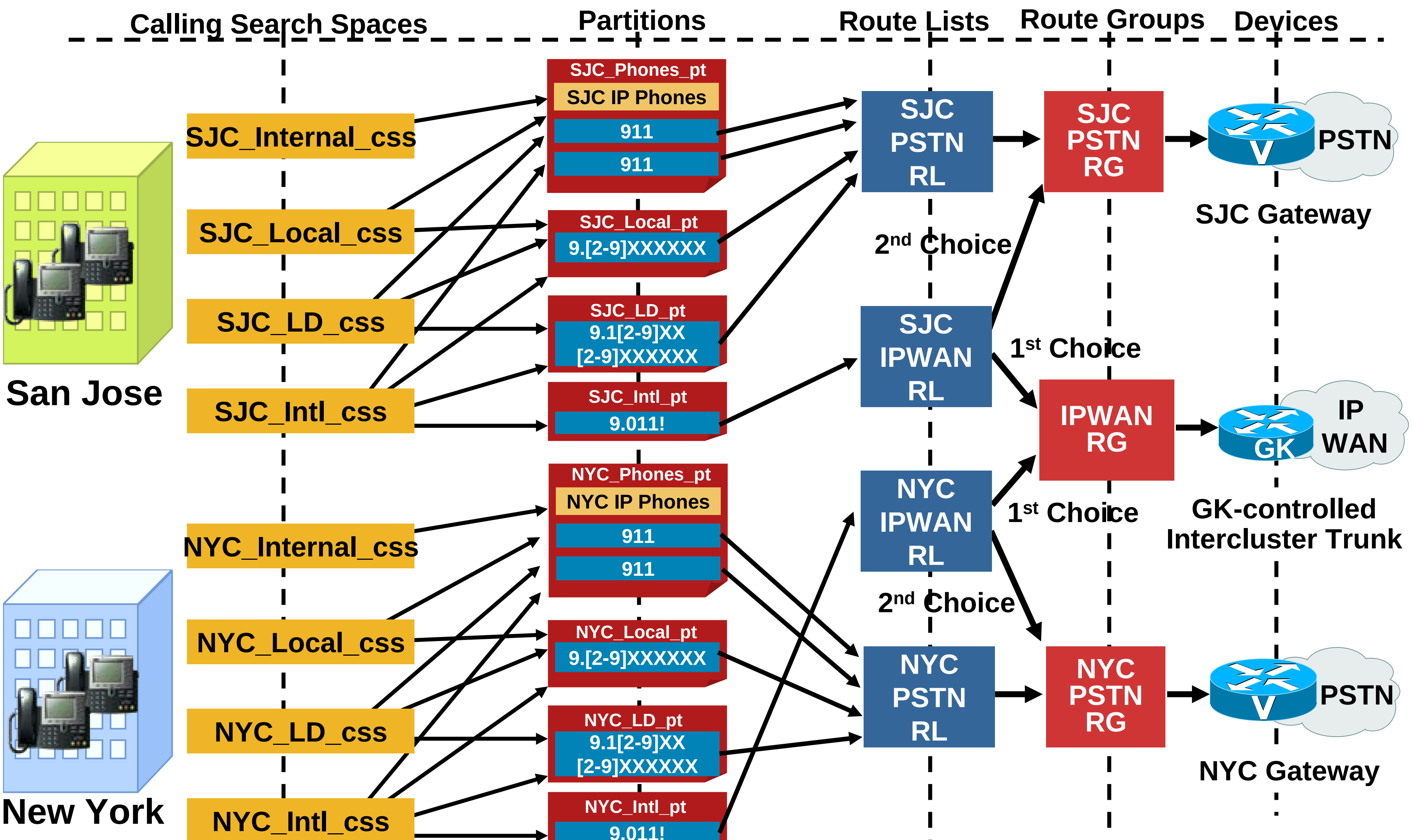
VLOD with Partitioned Addressing

Outgoing PSTN/Gatekeeper Calls



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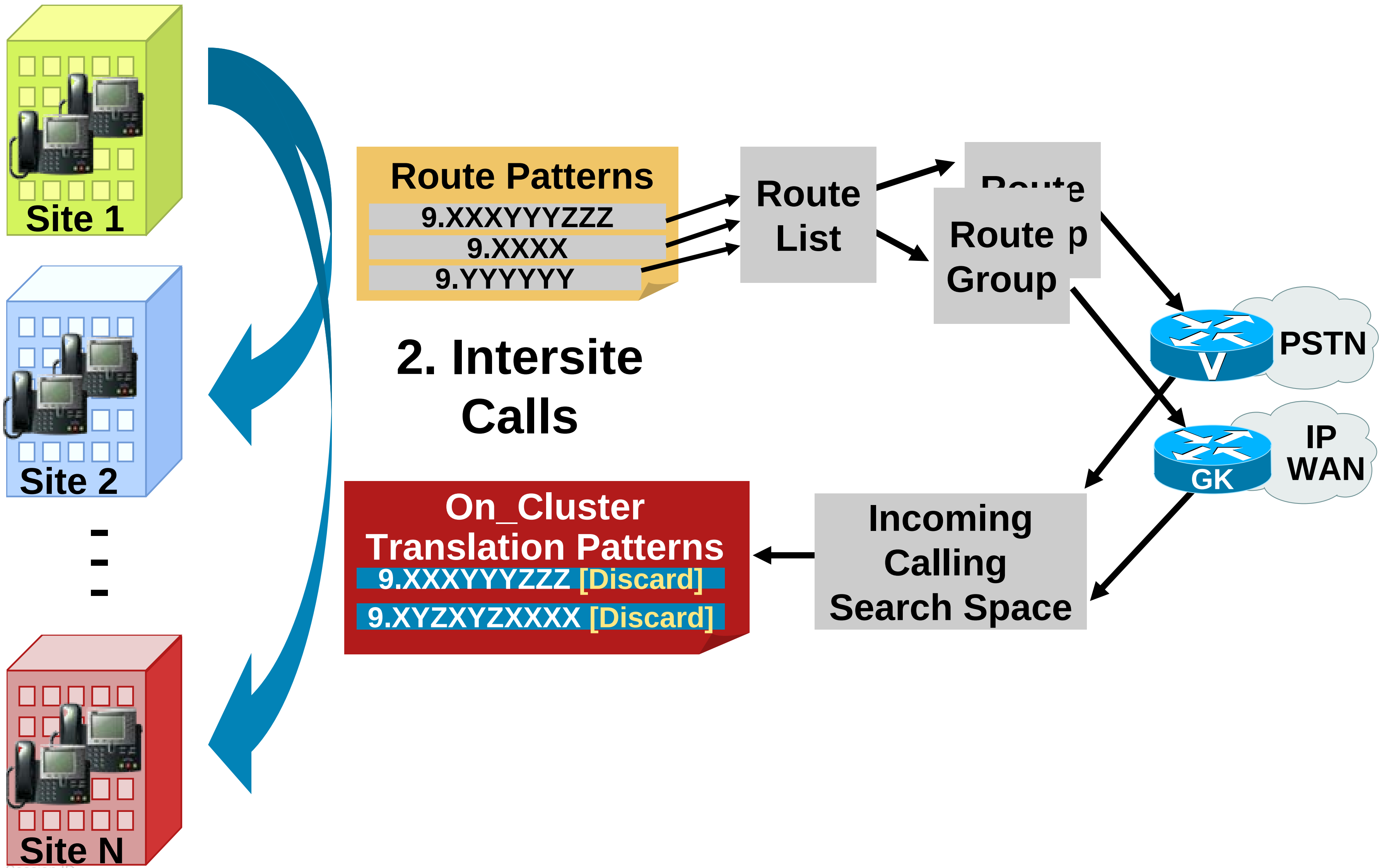
VLOD with Partitioned Addressing

Intersite Calls Within a Cluster



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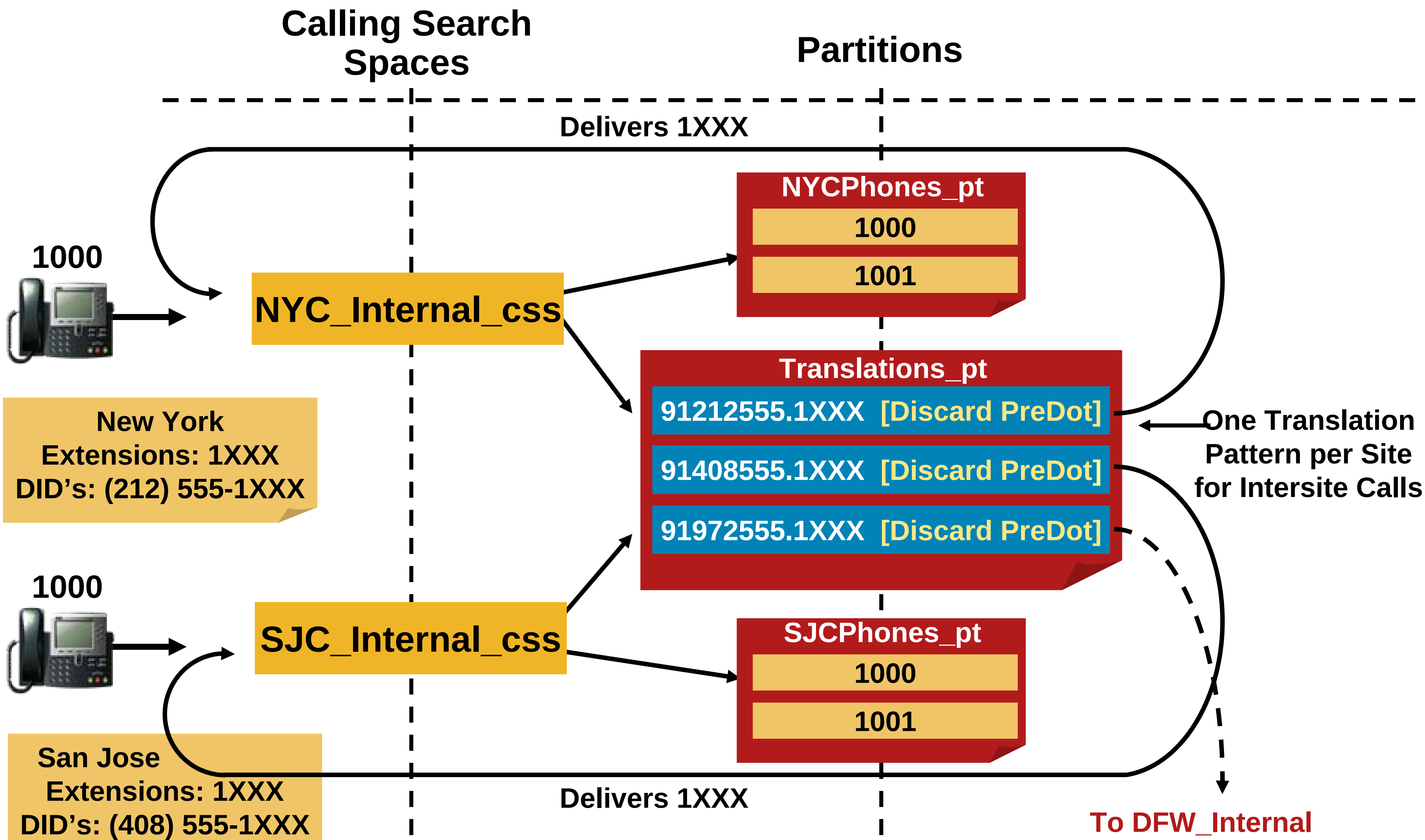
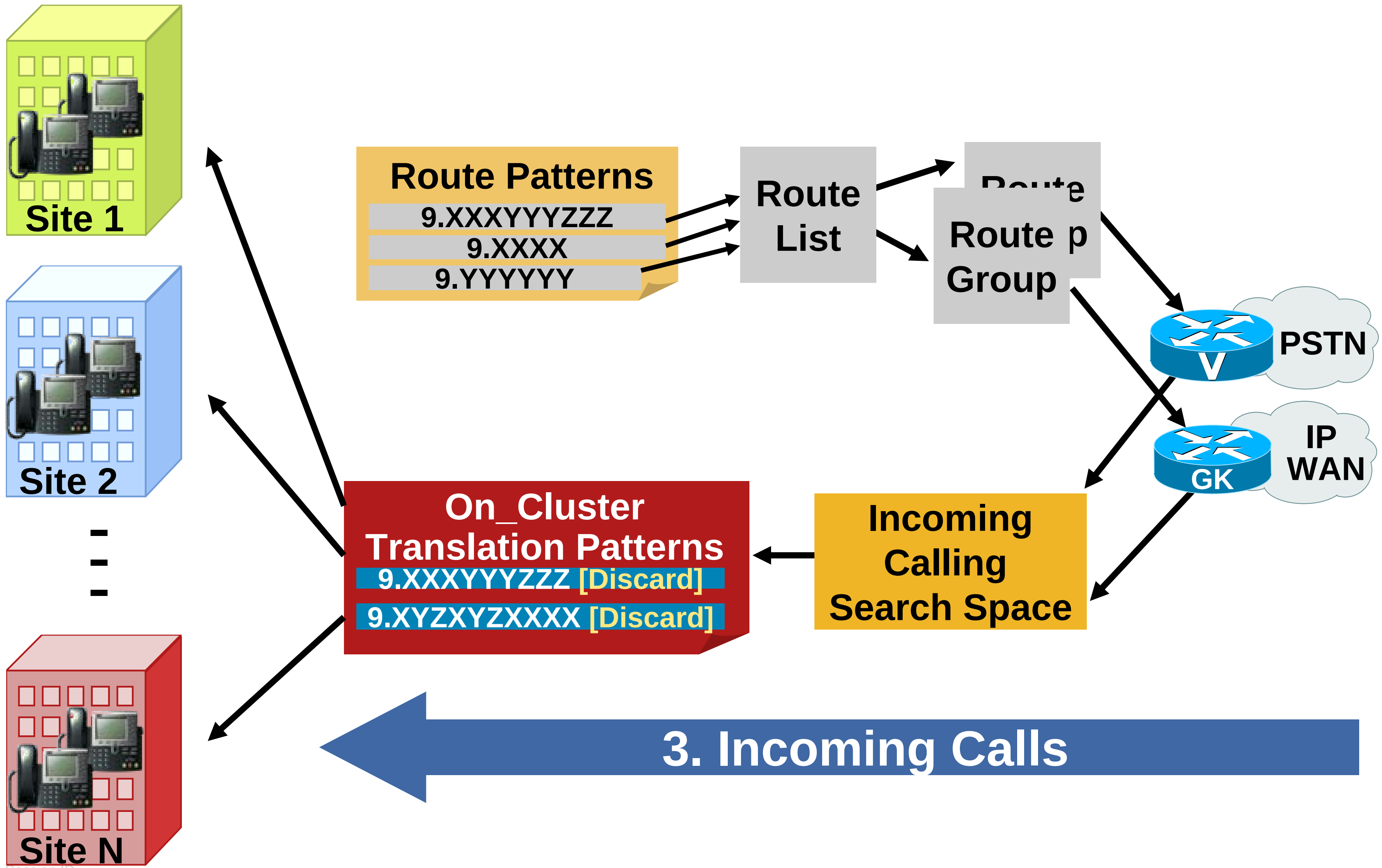
VLOD with Partitioned Addressing

Intersite Calls Within a Cluster



VLOD with Partitioned Addressing

Incoming PSTN/Gatekeeper Calls



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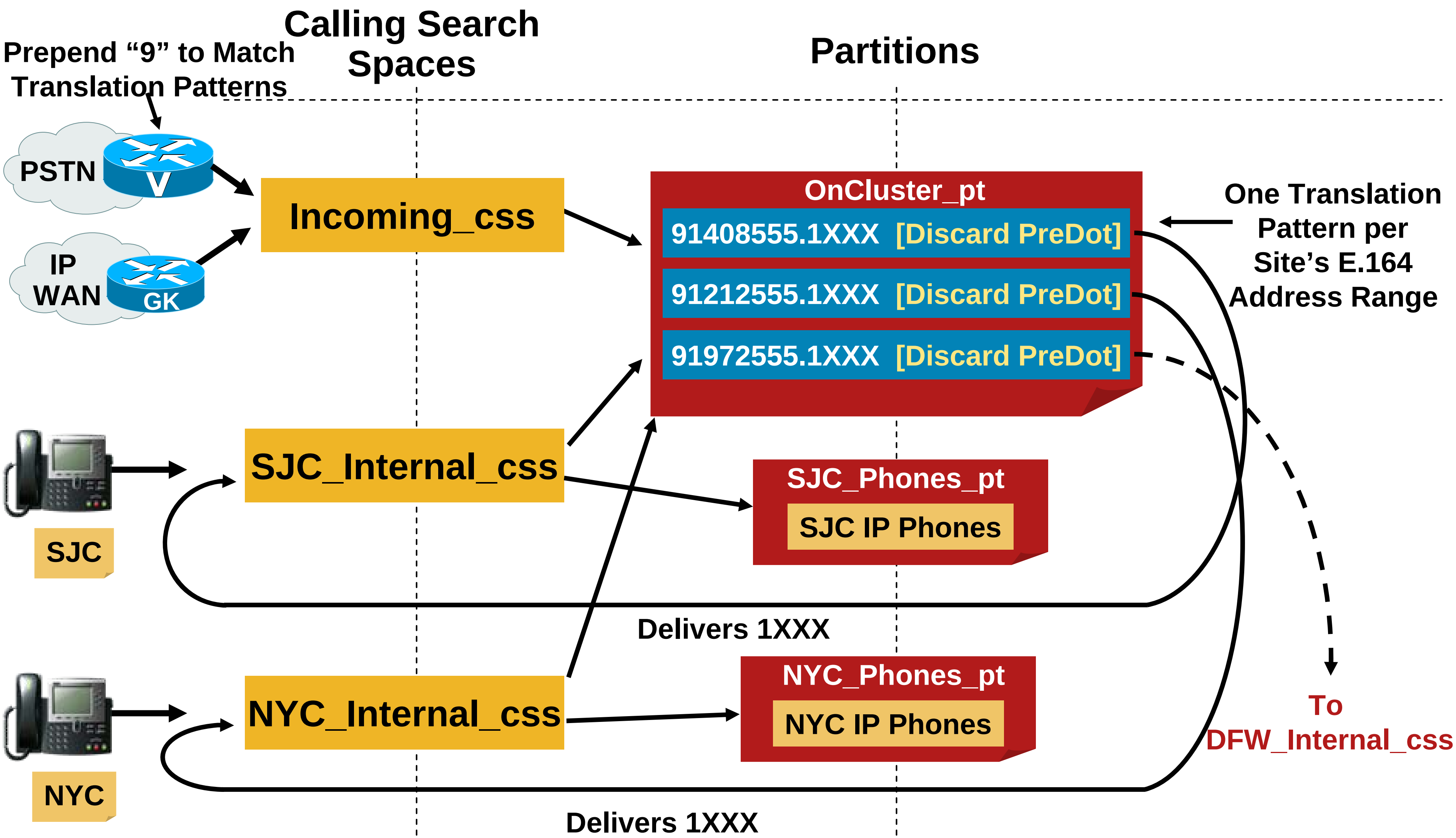
VLOD with Partitioned Addressing

Incoming PSTN/Gatekeeper Calls



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VLOD with Partitioned Addressing

Gatekeeper Configuration

```
gatekeeper
  zone local US cisco.com 10.9.11.1
  zone local EU cisco.com 10.20.1.1
  no zone subnet US default enable
  no zone subnet EU default enable
  zone subnet US 10.9.11.2/32 enable
  zone subnet US 10.9.11.3/32 enable
  zone subnet EU 10.20.1.2/32 enable
  zone subnet EU 10.20.1.3/32 enable
  zone prefix US 14085551...
  zone prefix US 12125551...
  zone prefix US 19725551...
  zone prefix EU 442077881...
  zone prefix EU 33144551...
  zone prefix EU 390266771...
  gw-type-prefix 1#* default-technology
  bandwidth interzone zone US 256
  bandwidth interzone zone EU 256
  arq reject-unknown-prefix
  no shutdown
```


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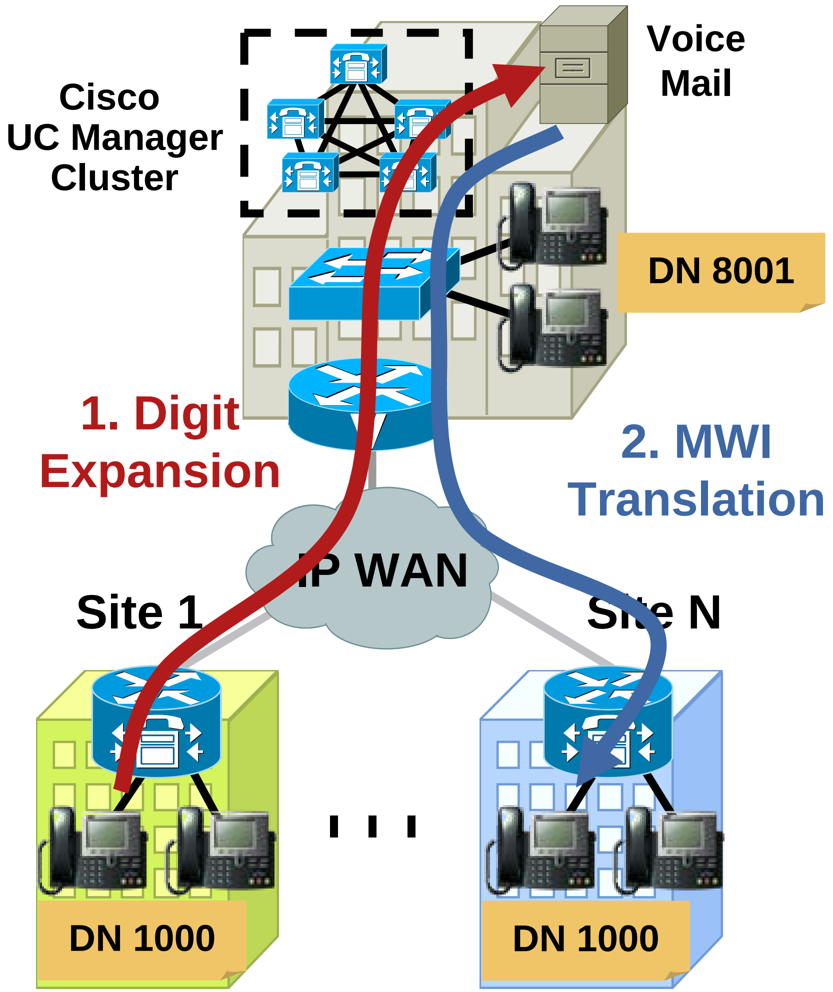
VLOD with Partitioned Addressing

Voice Mail Integration

- Both SCCP—(Unity) and SMDI-based Voice Mail systems can be used
- Voice mail boxes need a unique DN
- Need to “expand” DNs when accessing VM
- MWI messages from VM system need to be “translated” to match appropriate DN/partition



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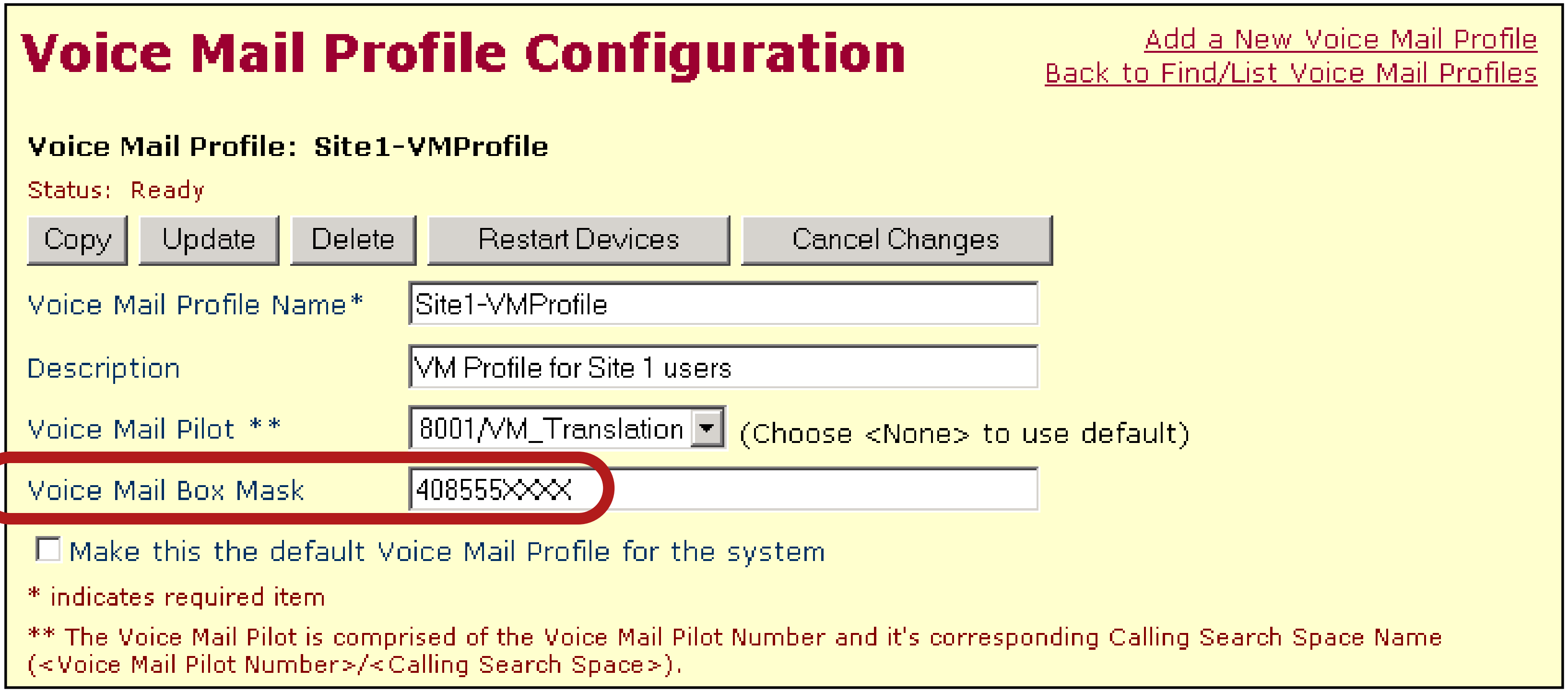
VLOD with Partitioned Addressing

Voice Mail Integration: Digit Expansion



Use the “Voice Mail Box Mask” Field in Each Vm Profile to Uniquely Identify the Voice Mail Boxes (E.G., Using the Full E.164 Number)

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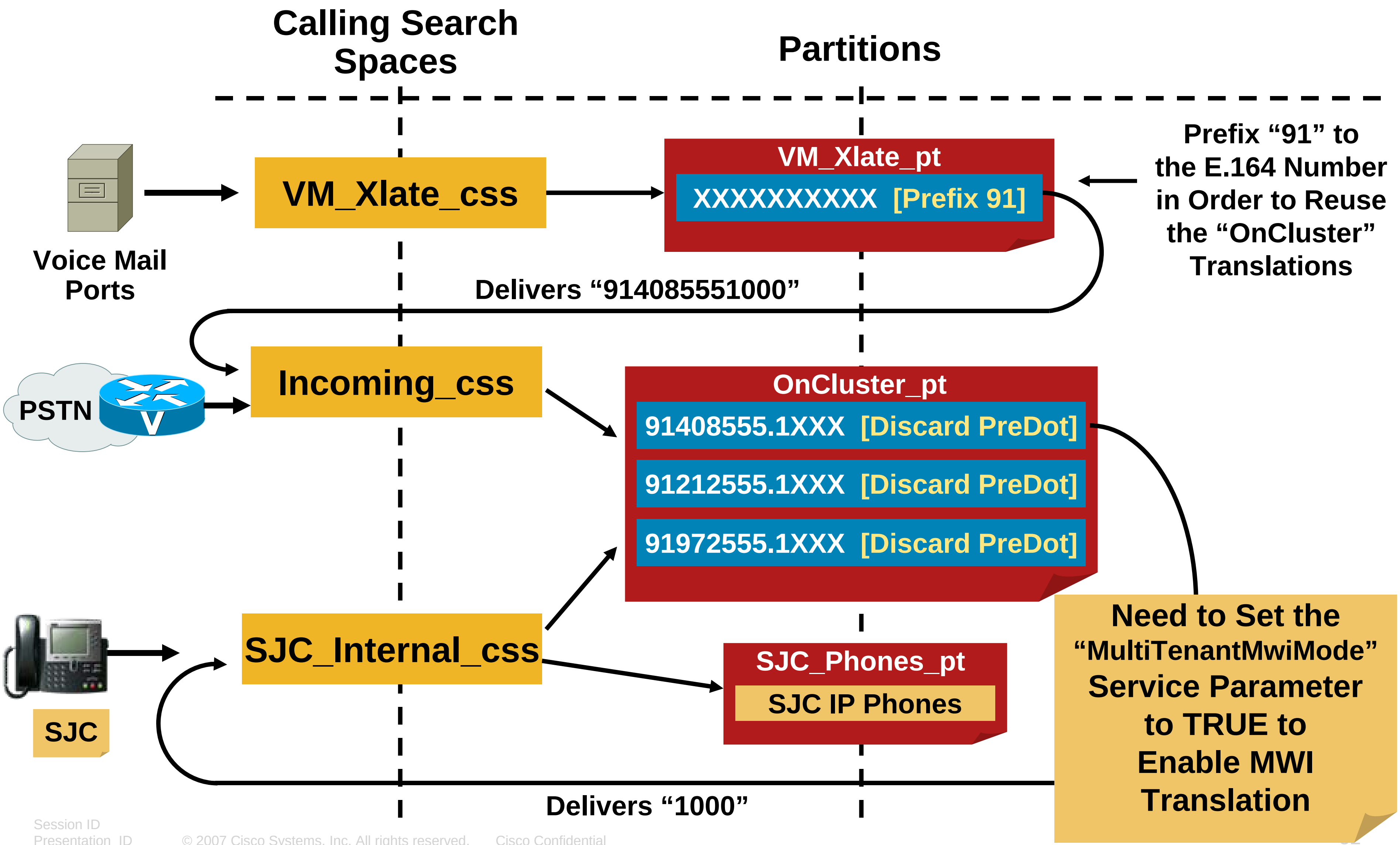
VLOD with Partitioned Addressing

Voice-Mail Integration: MWI Translation



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VLOD with Flat Addressing

Use This Model If…

- Branches interact often
- Users dial a ‘site code’ for intersite calls
- Intersite calls go over IP WAN
- CTI applications are used across sites
- International deployment
- A global on-net dial plan is needed
- This approach is presumed by many upcoming features’ design guidance. *If you can start with this approach, you will most likely be future-proofed.*

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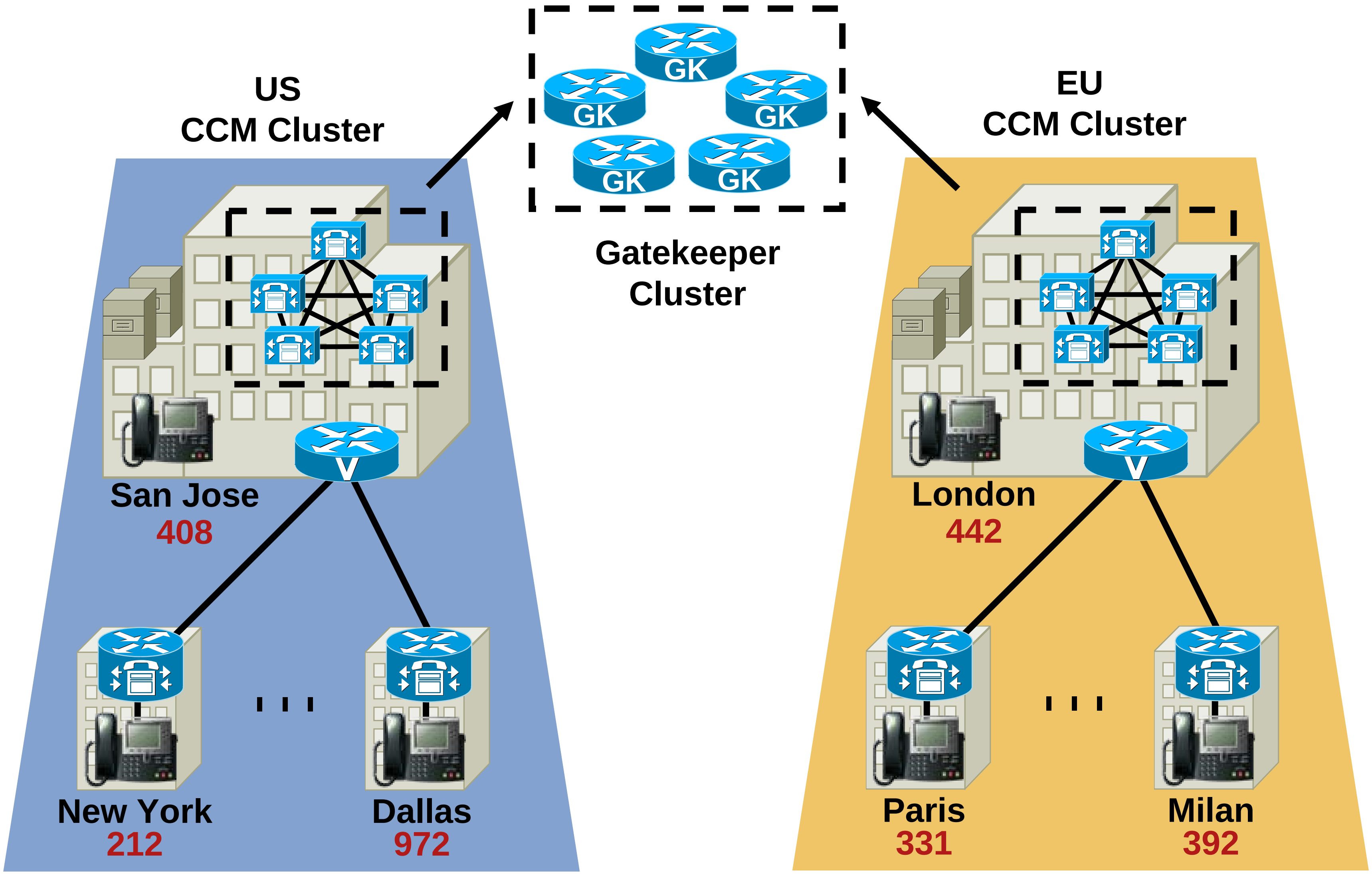
VLOD with Flat Addressing

Site Code Assignment



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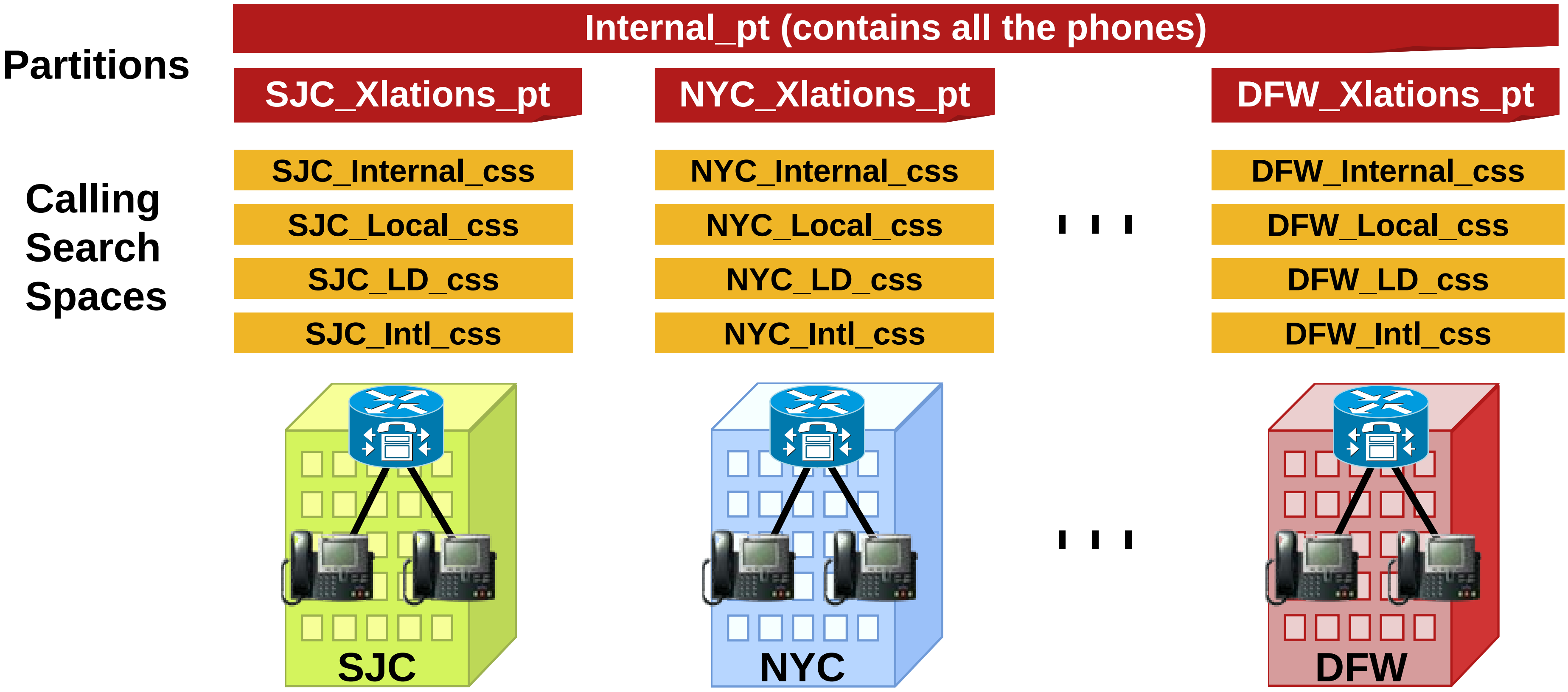
VLOD with Flat Addressing

Partitions and Calling Search Spaces



*** Note: If Using the Line/Device CSS Approach, the Number of CSS's Can Be Reduced**

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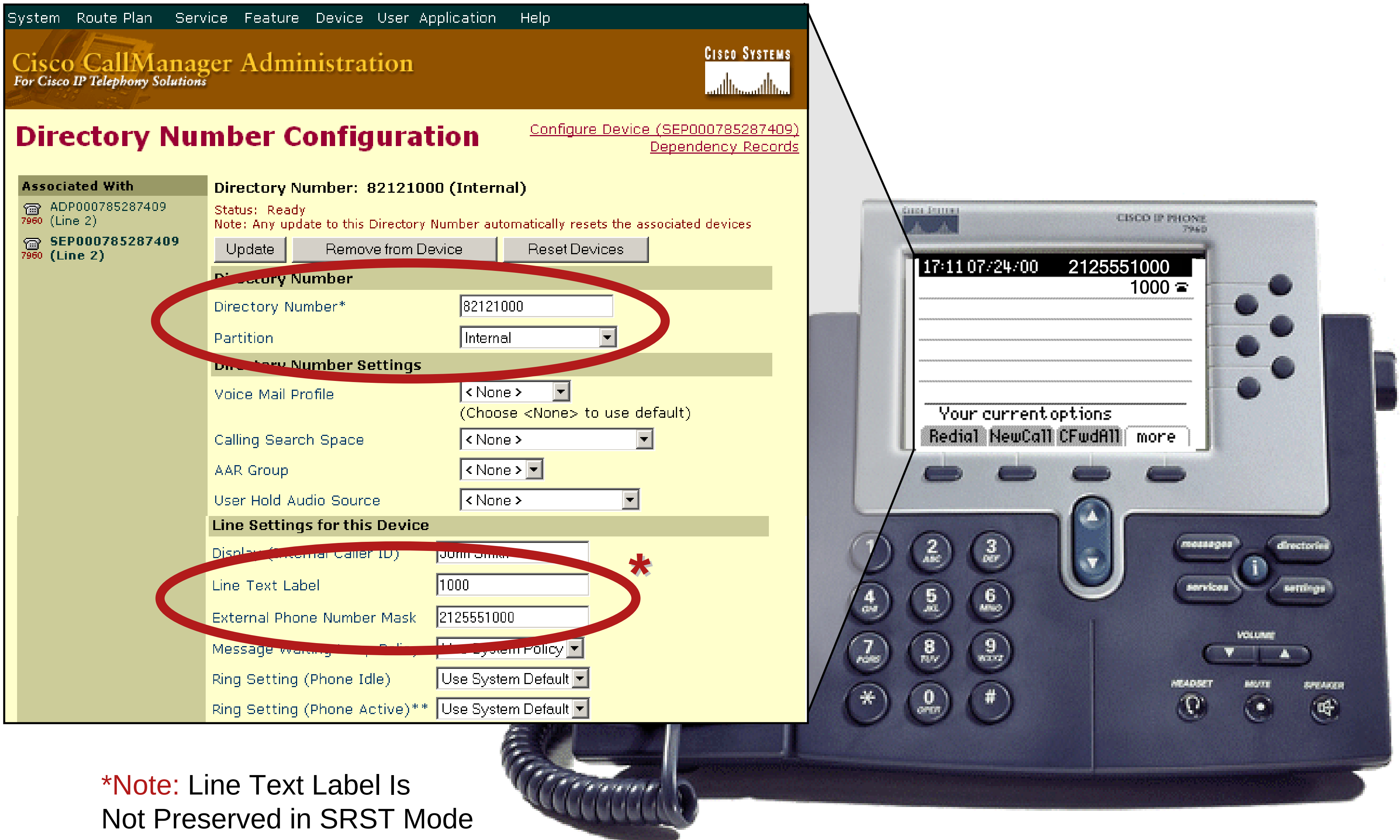
VLOD with Flat Addressing

Line Configuration



*Note: Line Text Label Is Not Preserved in SRST Mode

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VLOD with Flat Addressing

Outgoing Inter-cluster WAN/PSTN Calls

- Option 1: Eight digit only
  - Simple, easy to maintain
  - No automatic PSTN failover (manual redial)
- Option 2: Eight digit + E.164 with centralized PSTN failover
  - A little more configuration and maintenance
  - Automatic PSTN failover using central gateway
    - (**SJC in our example**)
  - Possibility to place calls on-net even when dialed as PSTN
- Option 3: Eight digit + E.164 with distributed PSTN failover
  - A lot more configuration and maintenance
  - Automatic PSTN failover using local gateway

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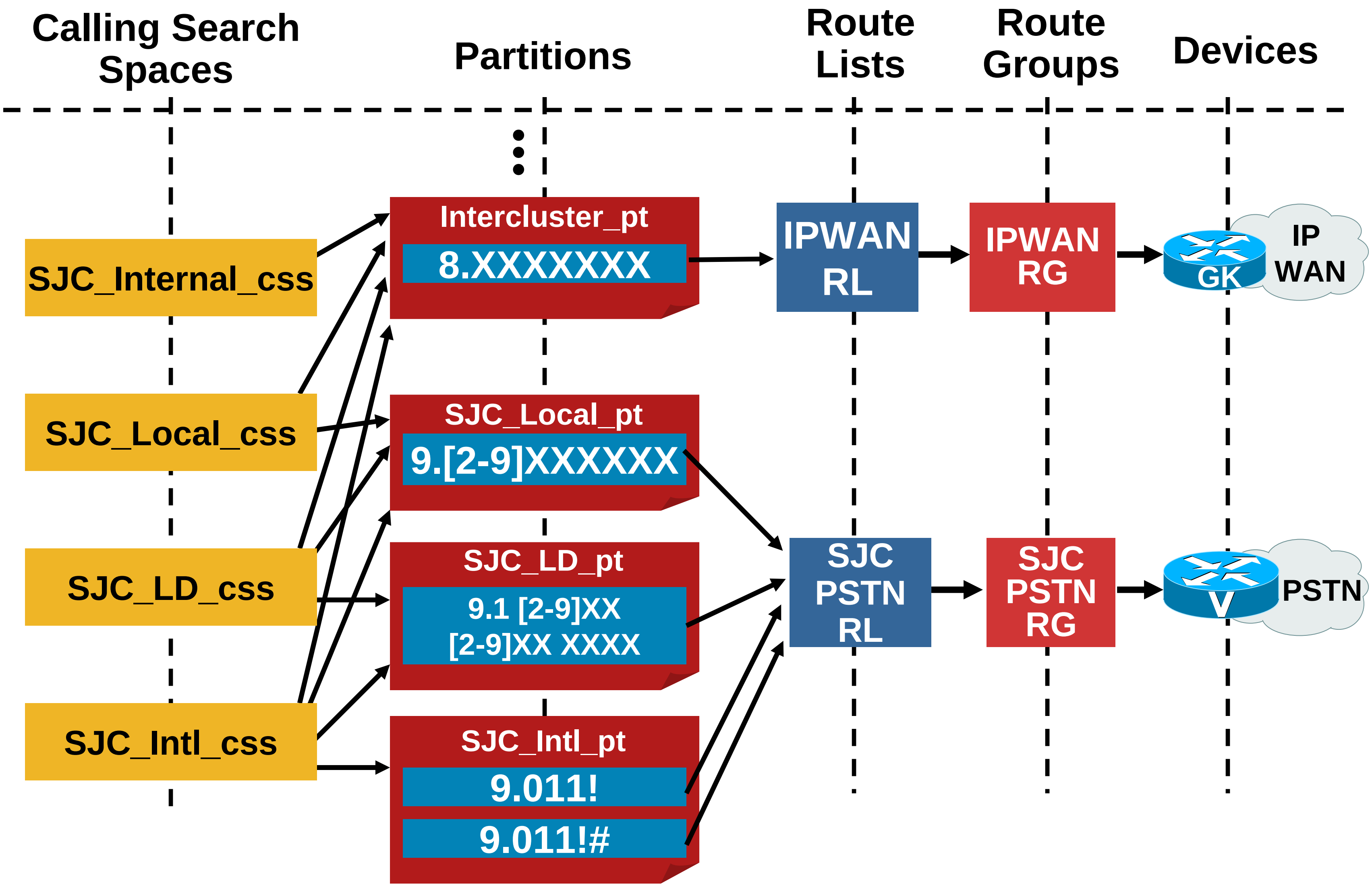
VLOD with Flat Addressing

Outgoing PSTN/IP WAN Calls: Option 1



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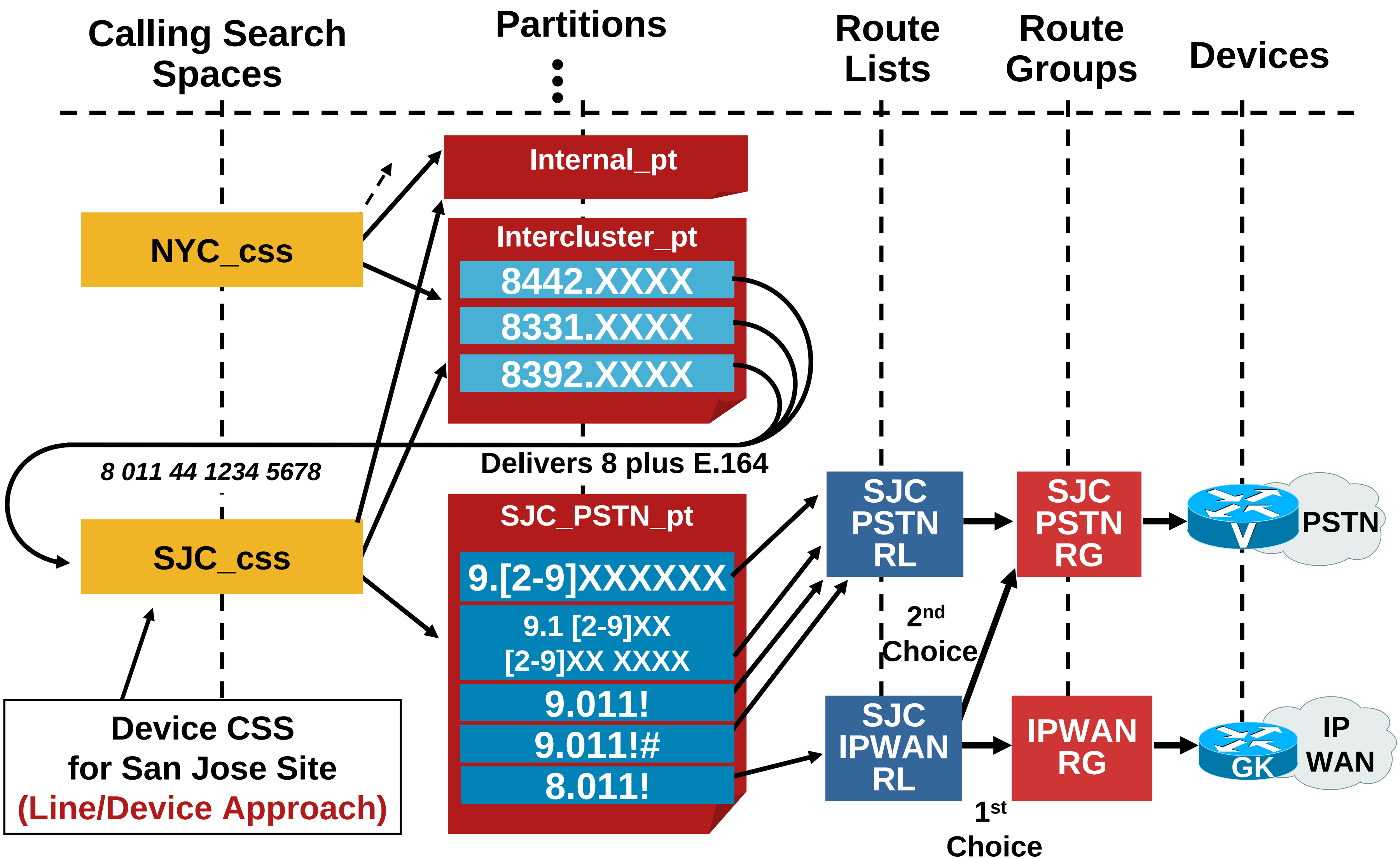
VLOD with Flat Addressing

Outgoing PSTN/IP WAN Calls: Option 2



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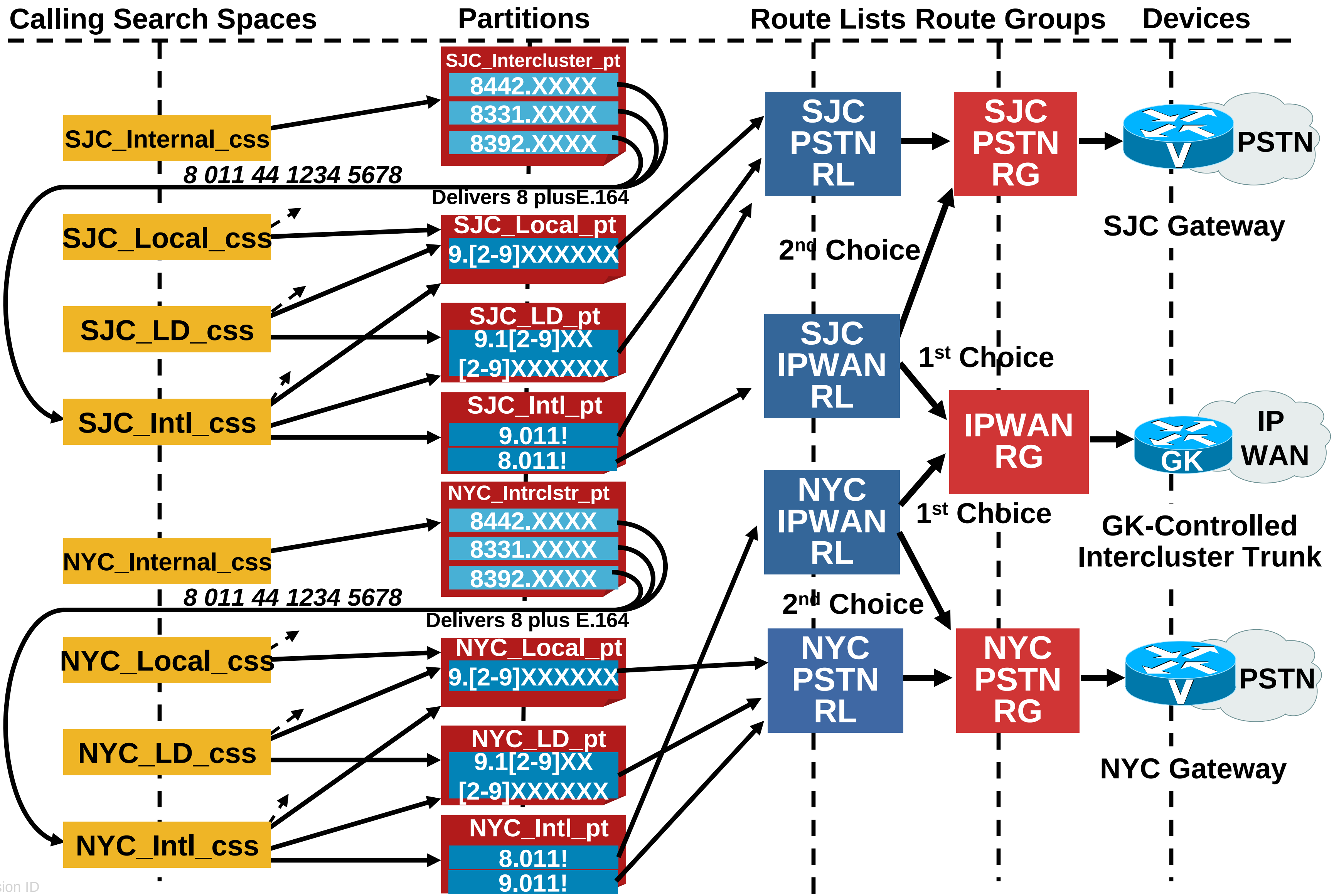
VLOD with Flat Addressing

Outgoing PSTN/IP WAN Calls: Option 3



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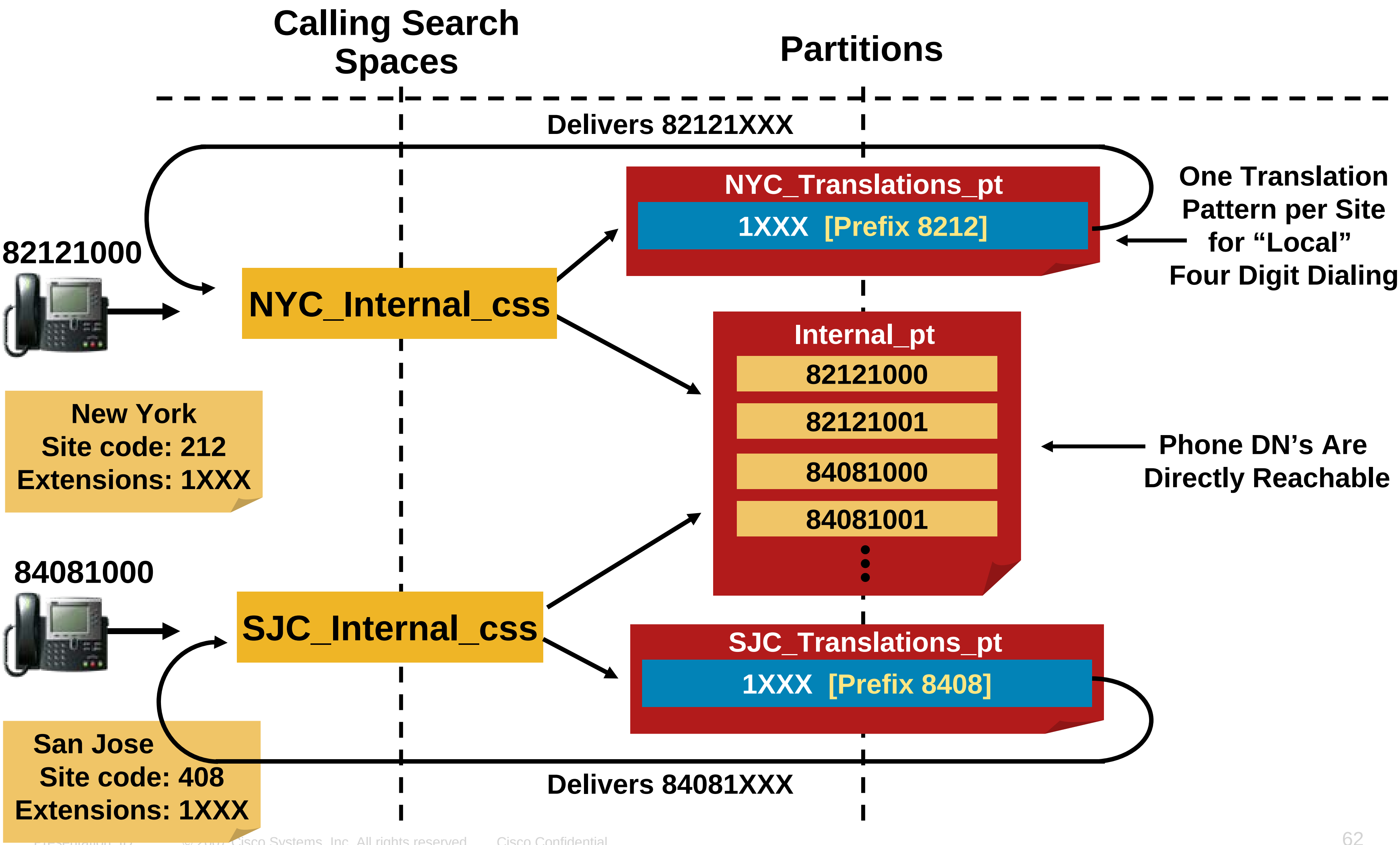
VLOD with Flat Addressing

Intra/Inter-site Calls Within a Cluster



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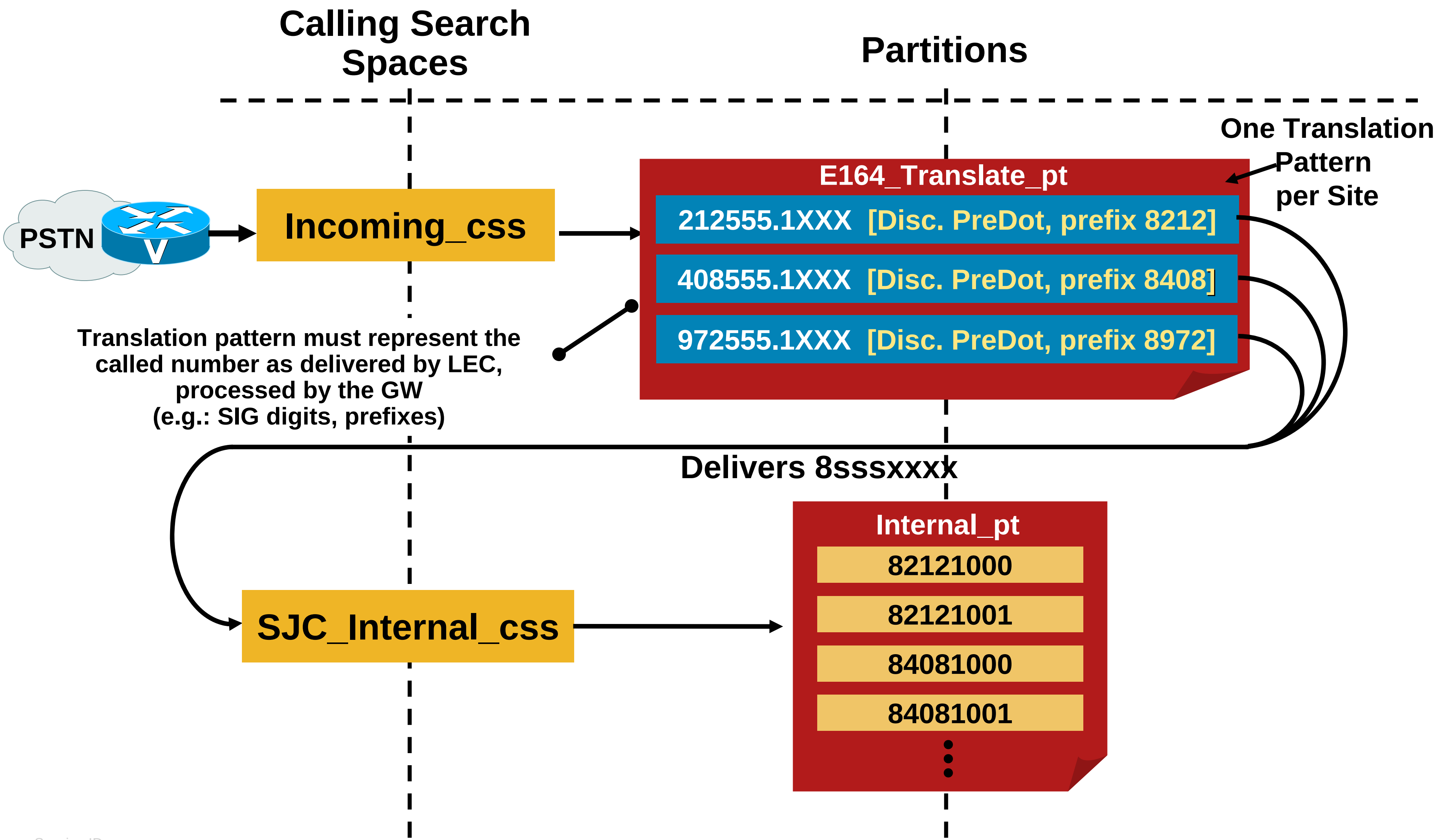
VLOD with Flat Addressing

Incoming PSTN/IP WAN Calls



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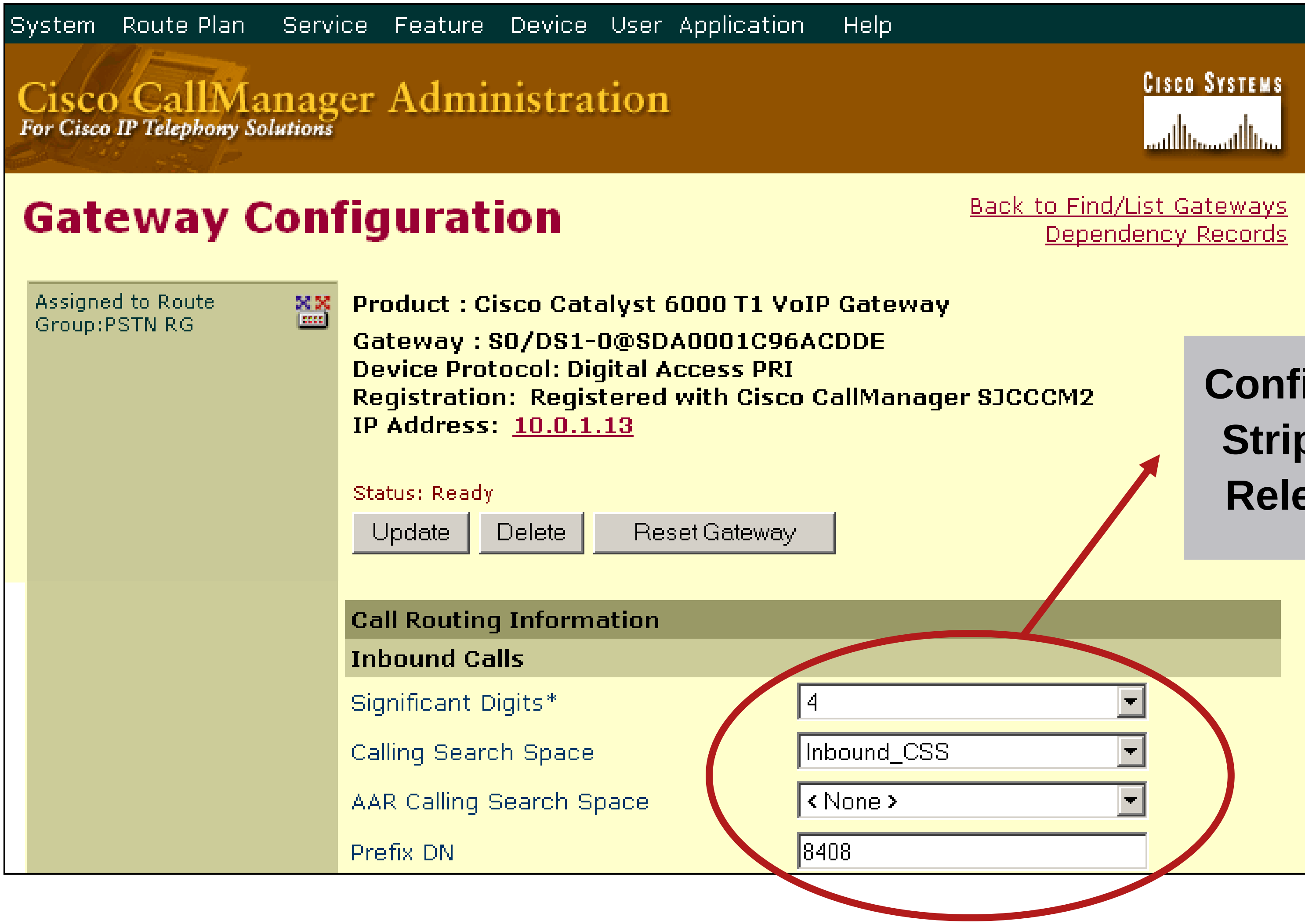
VLOD with Flat Addressing

Incoming PSTN/ IP WAN Calls



Configure GW to Strip and Prefix Relevant Digits

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VLOD with Flat Addressing

Gatekeeper Configuration

```
gatekeeper
  zone local US cisco.com 10.9.11.1
  zone local EU cisco.com 10.20.1.1
  no zone subnet US default enable
  no zone subnet EU default enable
  zone subnet US 10.9.11.2/32 enable
  zone subnet US 10.9.11.3/32 enable
  zone subnet EU 10.20.1.2/32 enable
  zone subnet EU 10.20.1.3/32 enable
  zone prefix US 14085551...
  zone prefix US 12125551...
  zone prefix US 19725551...
  zone prefix EU 442077881...
  zone prefix EU 33144551...
  zone prefix EU 390266771...
  gw-type-prefix 1#* default-technology
  bandwidth interzone zone US 256
  bandwidth interzone zone EU 256
  arq reject-unknown-prefix
  no shutdown
```

```
! Replace E.164's with 8-digit
! numbers for Option 1
!
  zone prefix US 84081...
  zone prefix US 82121...
  zone prefix US 89721...
  zone prefix EU 84421...
  zone prefix EU 83311...
  zone prefix EU 83921...
!
```


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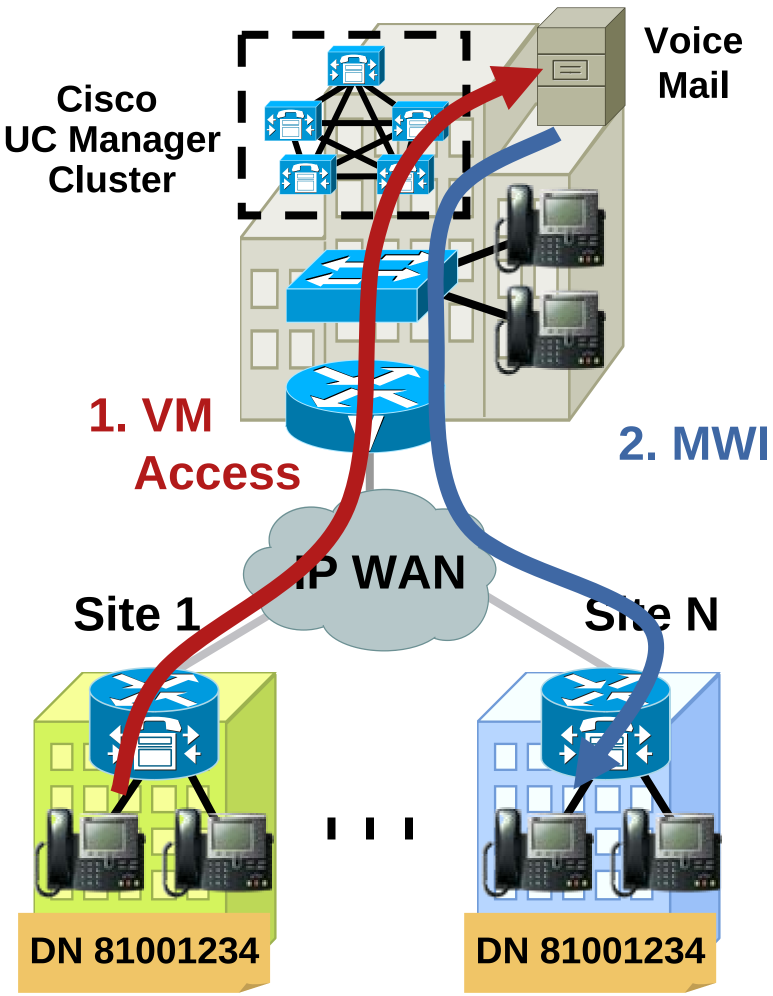
VLOD with Flat Addressing

Voice Mail Integration

- Each eight digit extension is unique ➔ it can be used to identify a voicemail box
- No need to use masks in voicemail profile
- No translations necessary for MWI



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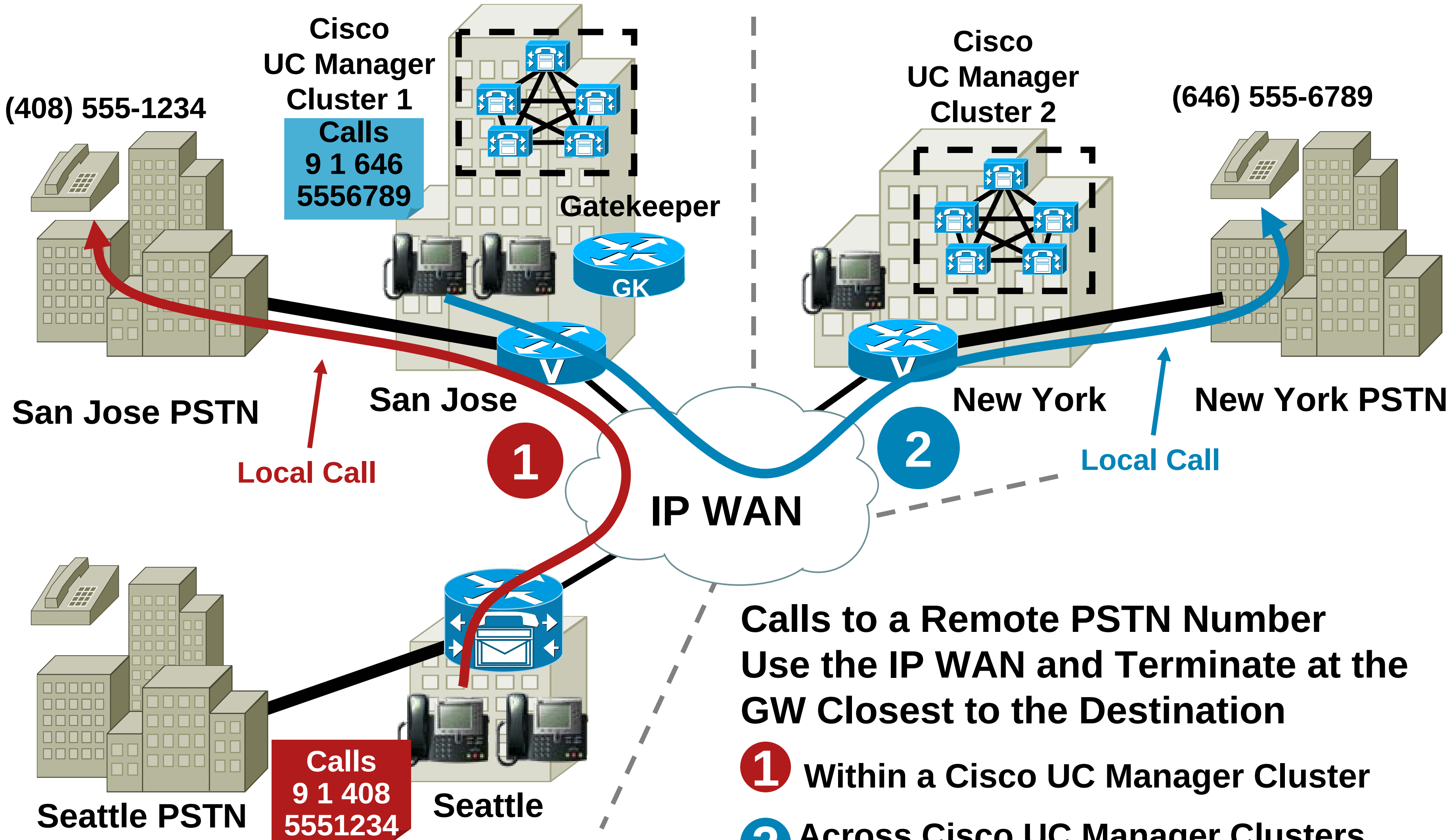
Tail-End Hop-Off (TEHO)

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 Cisco UC Manager Cluster
2. Across Cisco UC Manager Clusters

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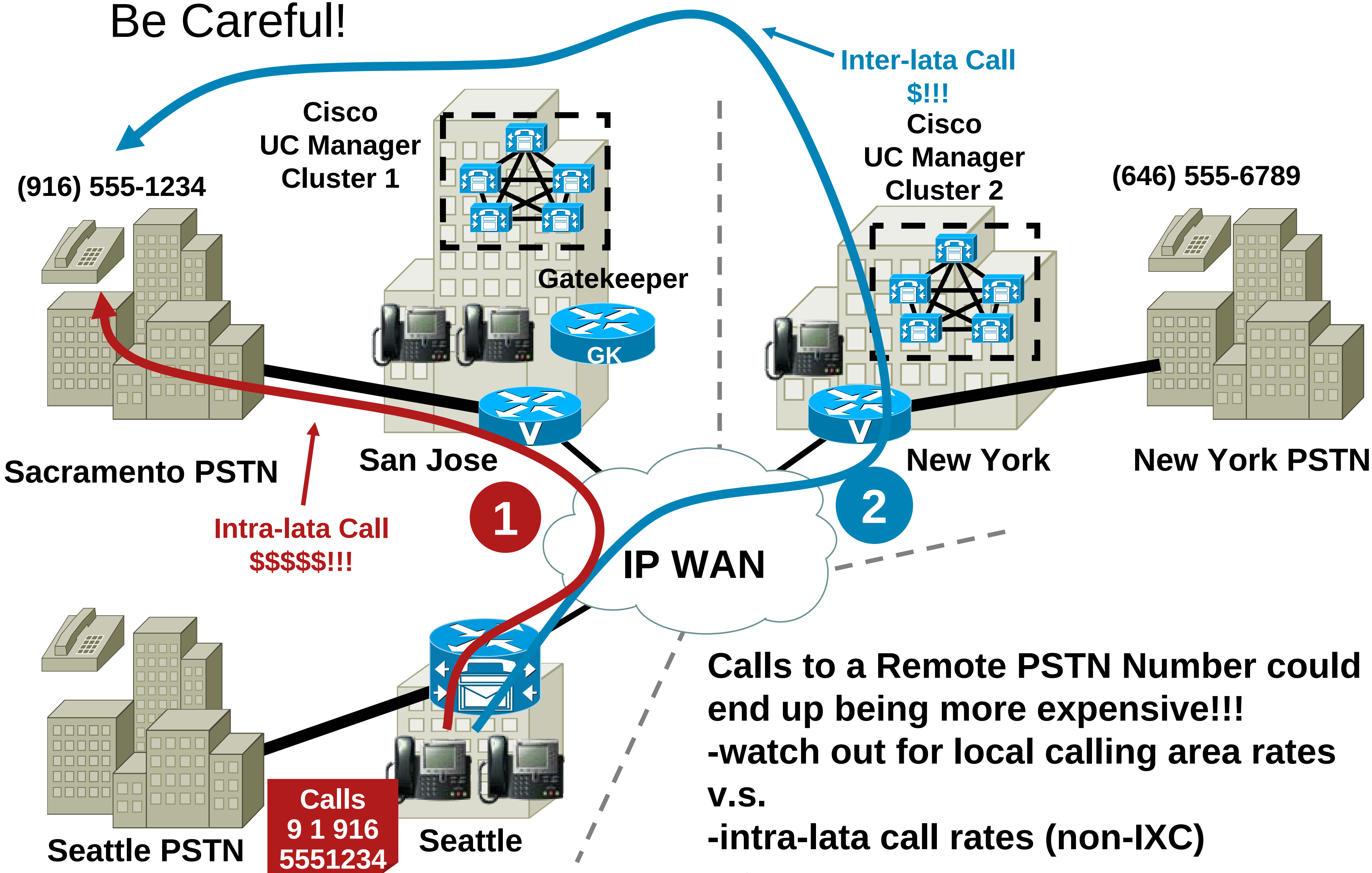
Tail-End Hop-Off (TEHO)

Be Careful!



Calls to a Remote PSTN Number could end up being more expensive!!!
-watch out for local calling area rates
v.s.
-intra-lata call rates (non-IXC)
v.s.
-inter-lata call rates (IXC)

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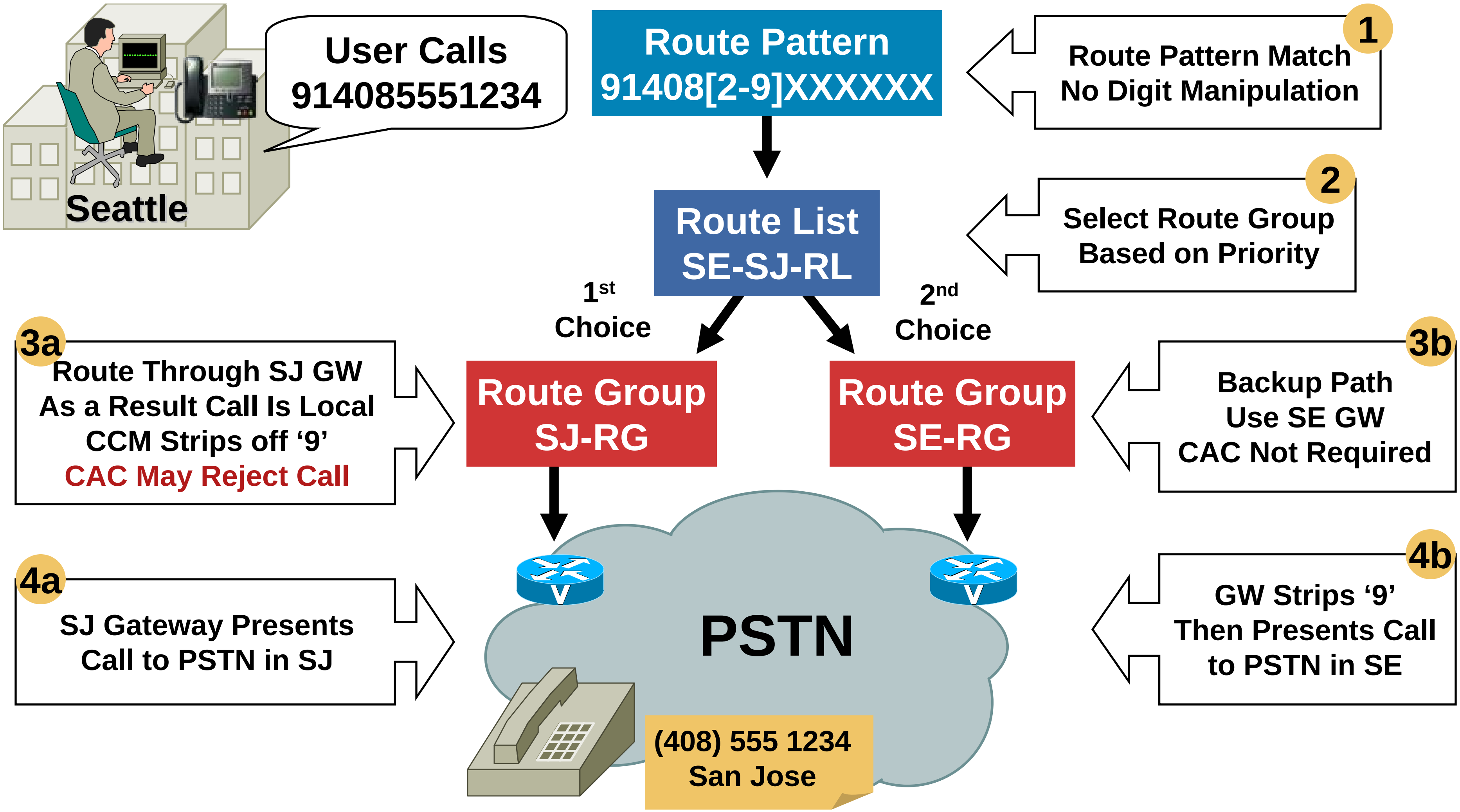
Tail-End Hop-Off (TEHO)

Intracluster: Seattle to San Jose



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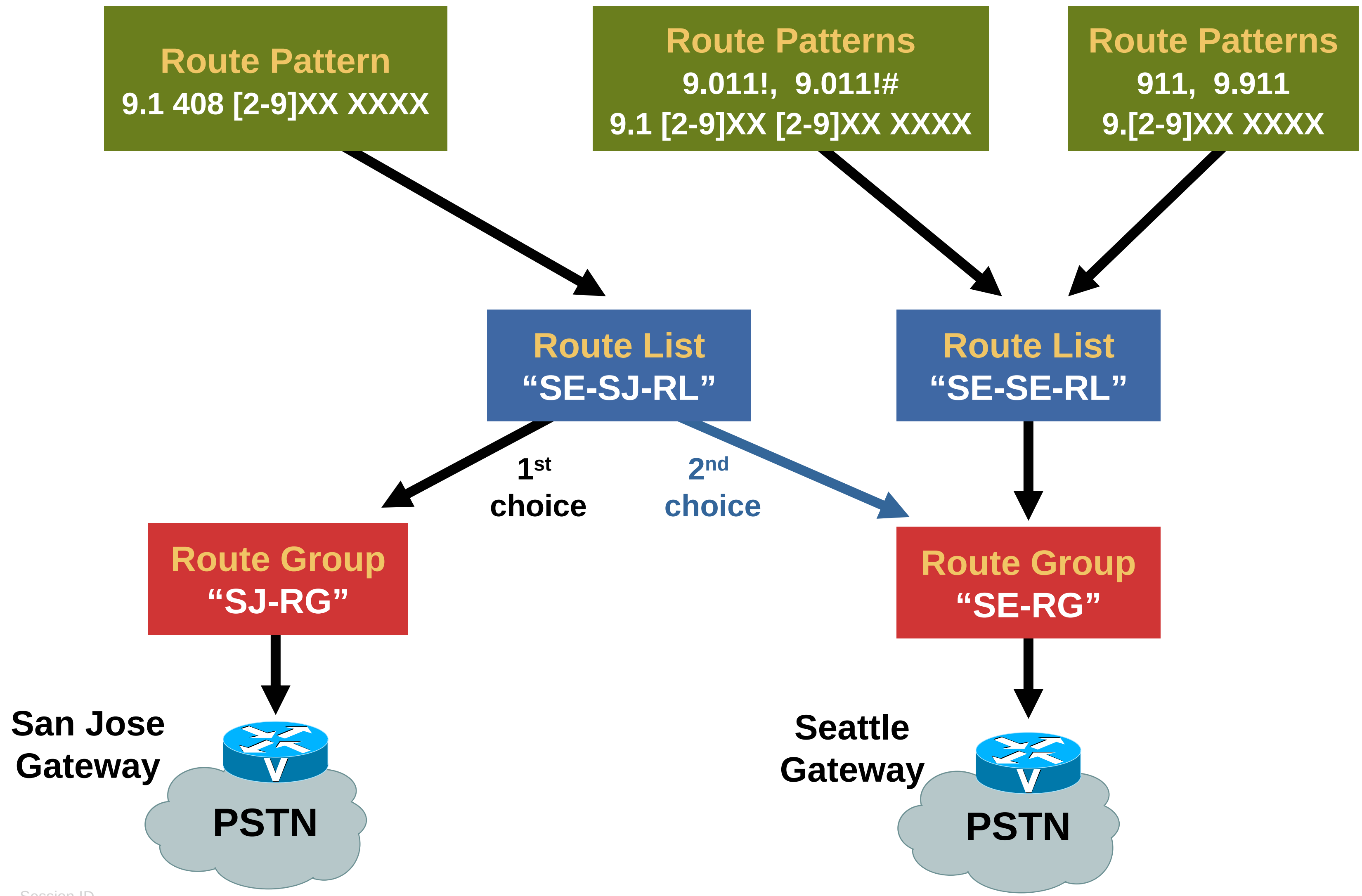
Tail-End Hop-Off (TEHO)

Intracluster: Route Patterns for Seattle



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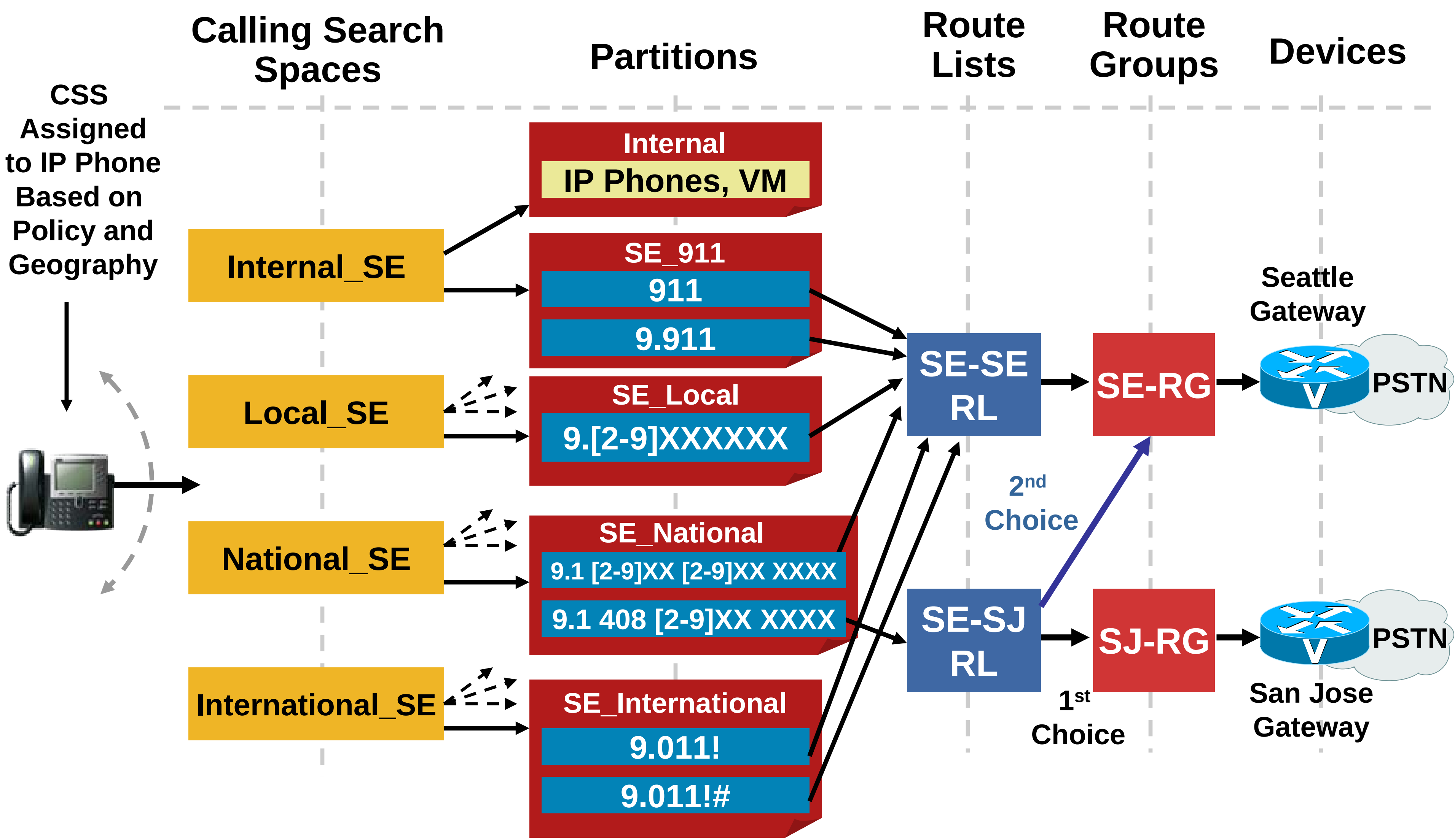
Tail-End Hop-Off (TEHO)

Intracluster: Composite Dial Plan for Seattle



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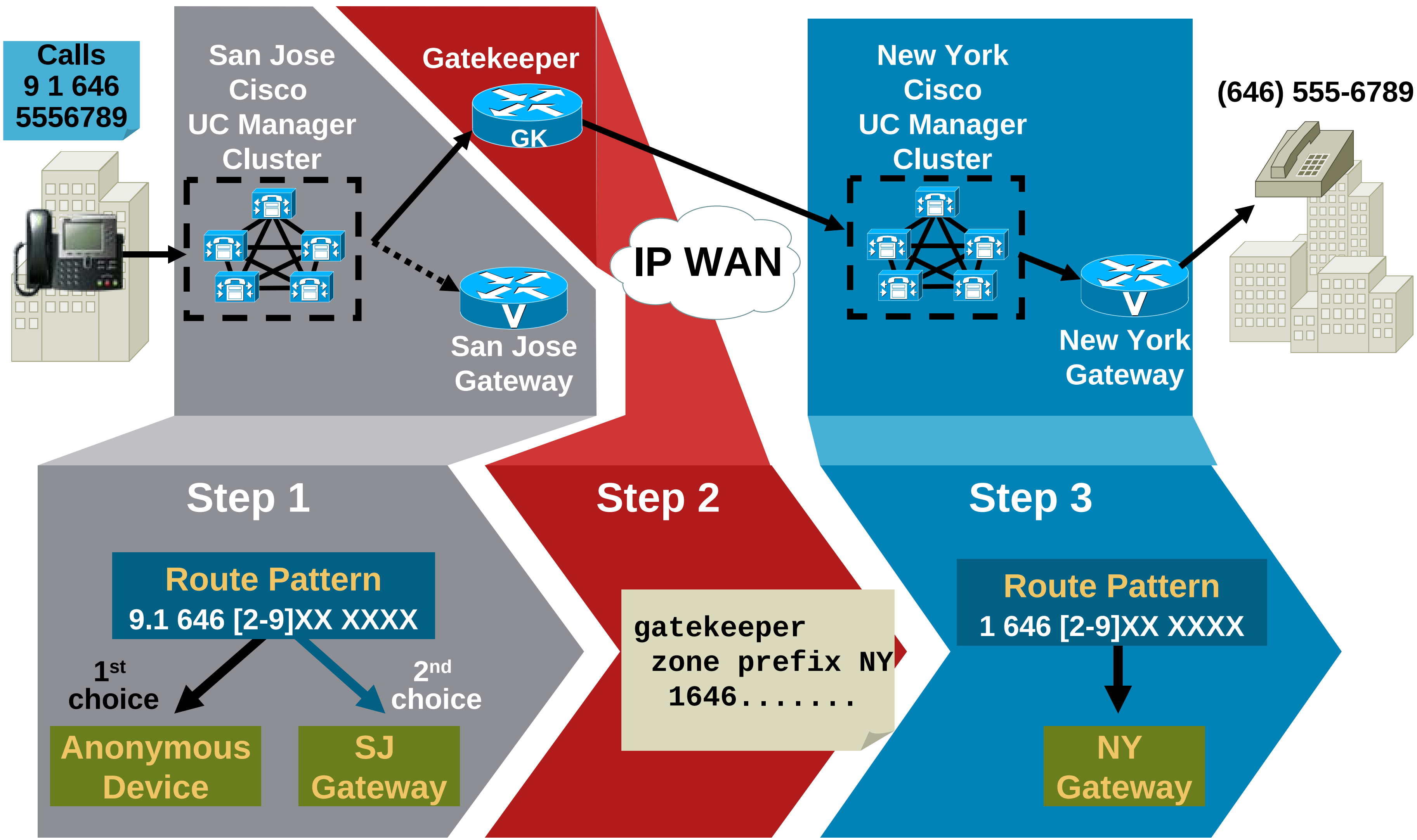
Tail-End Hop-Off (TEHO)

Intercluster: San Jose to New York



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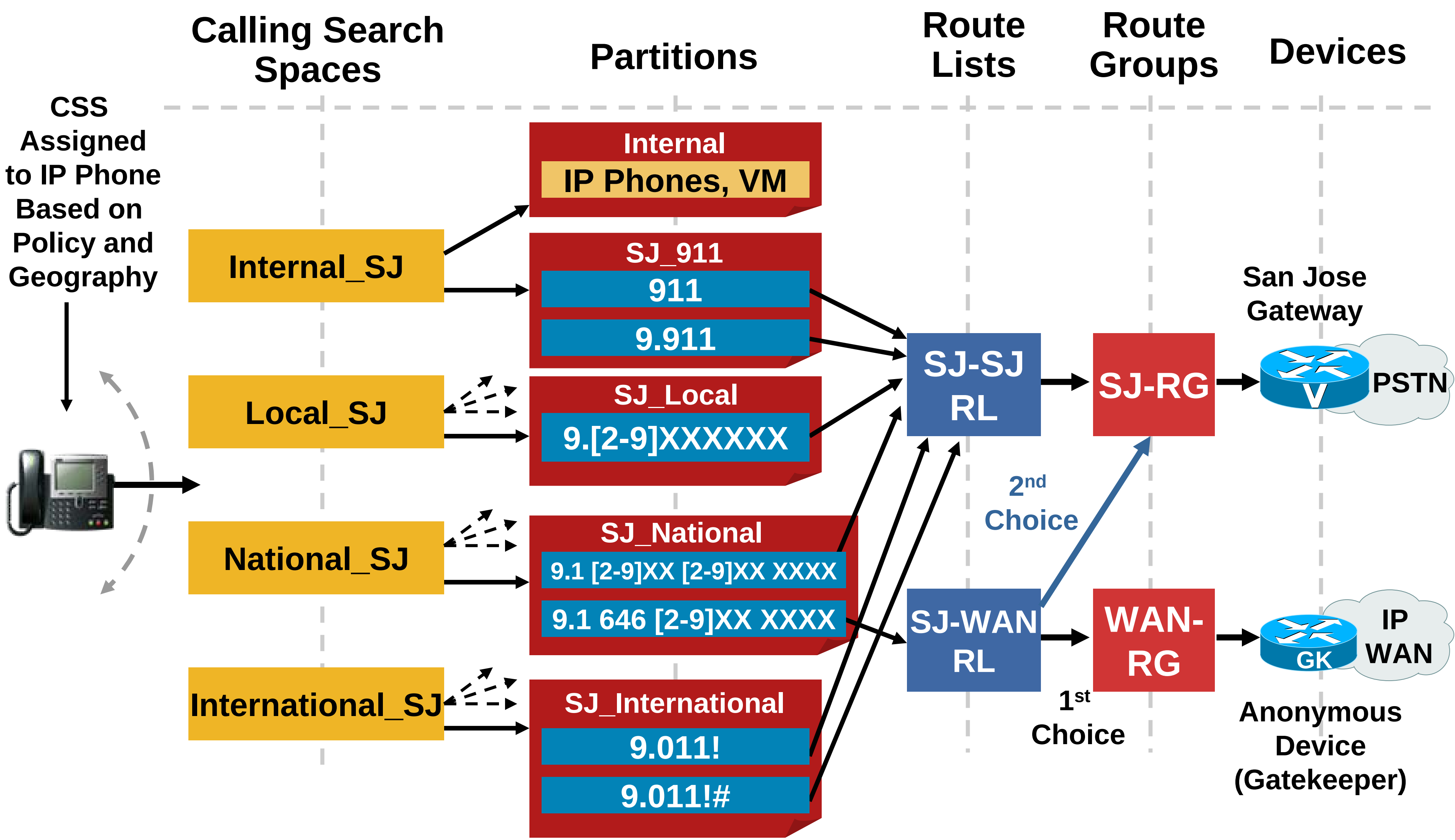
Tail-End Hop-Off (TEHO)

Intercluster: Composite Dial Plan for San Jose



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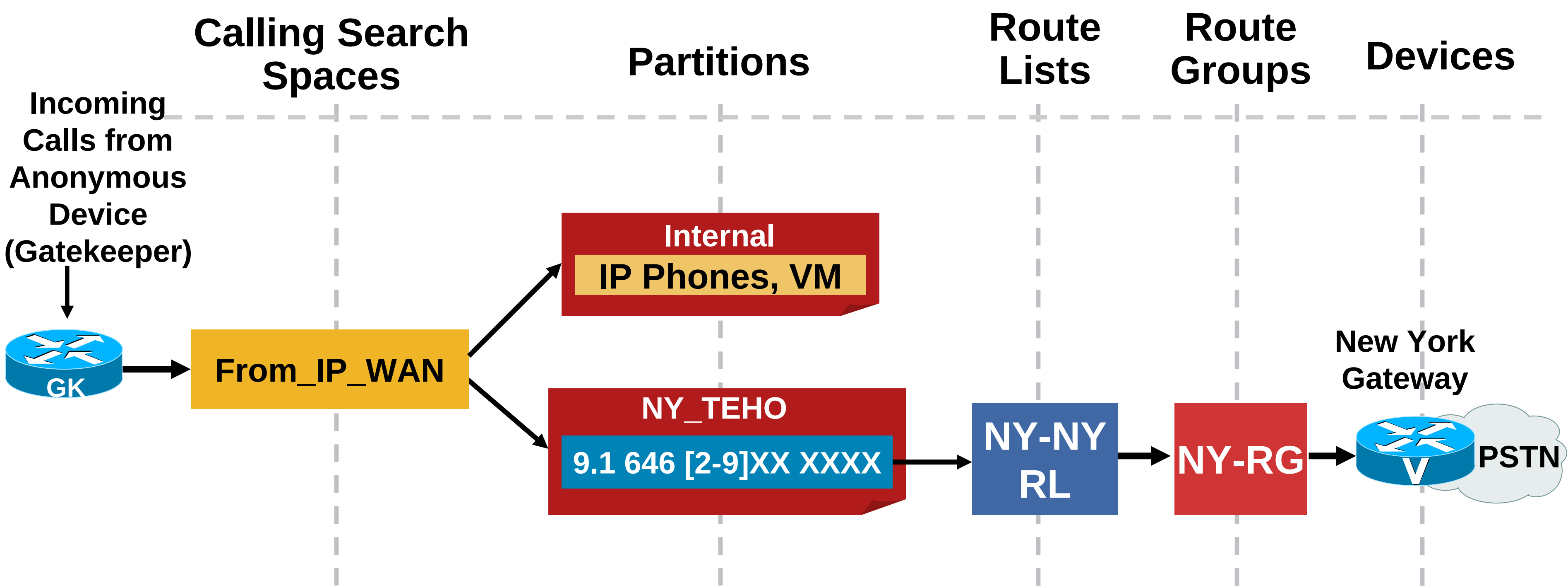
Tail-End Hop-Off (TEHO)

Intercluster: 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

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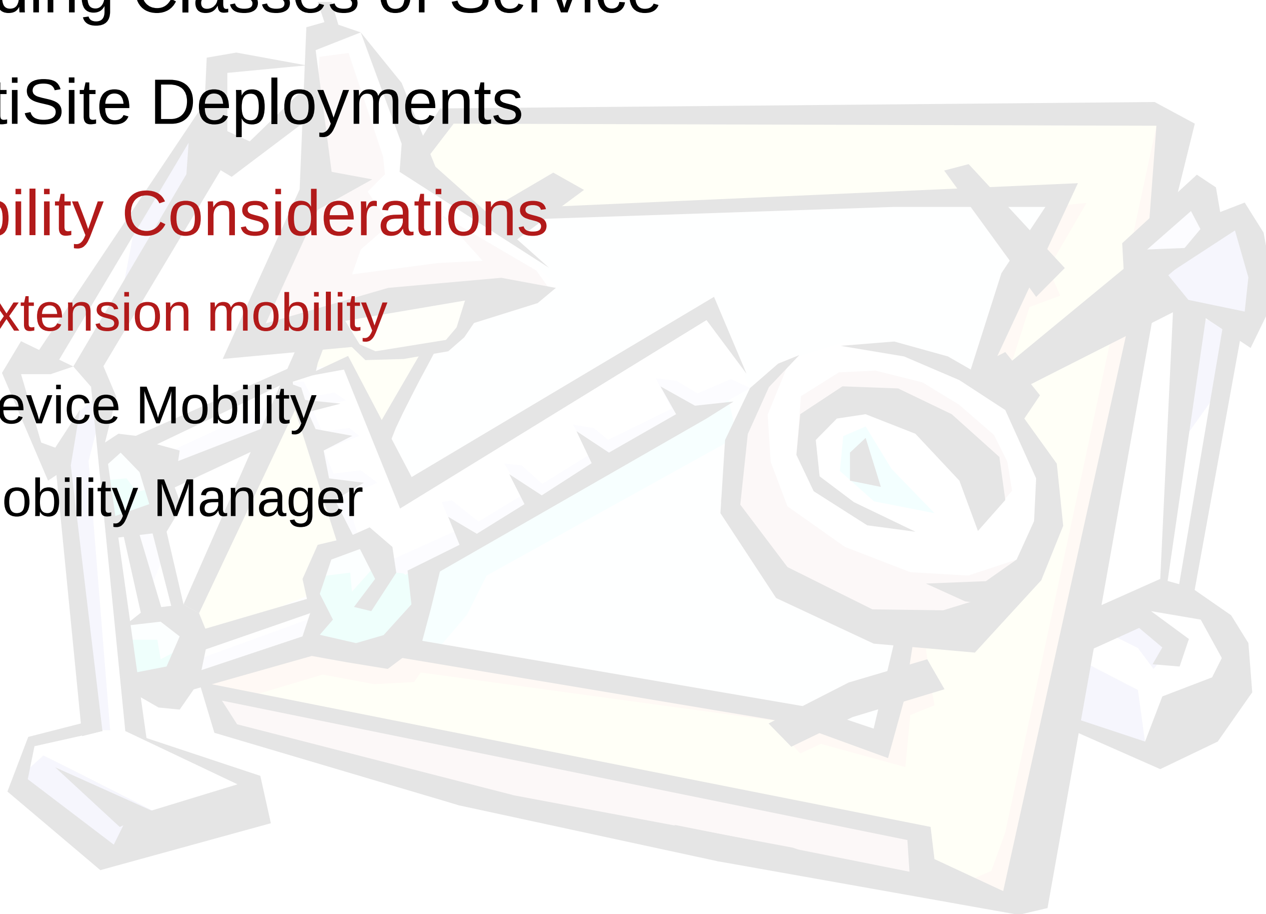
Design Best Practices Agenda

- Building Classes of Service
- MultiSite Deployments
- Mobility Considerations
  - Extension mobility
  - Device Mobility
  - Mobility Manager



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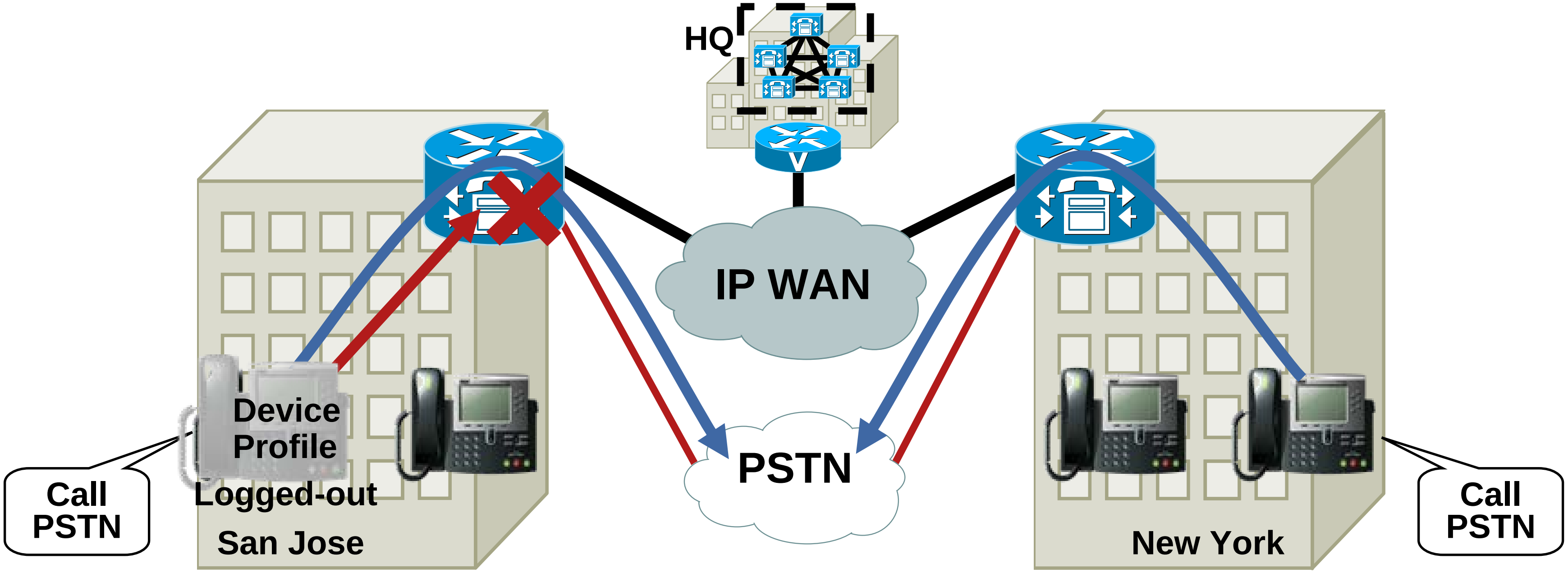
Extension Mobility Considerations

Requirements



- Allow users to log in at different sites with a single device profile
- Restrict PSTN calls when logged out
- Always route emergency calls via local gateway
- Optional: route all PSTN calls via local gateway

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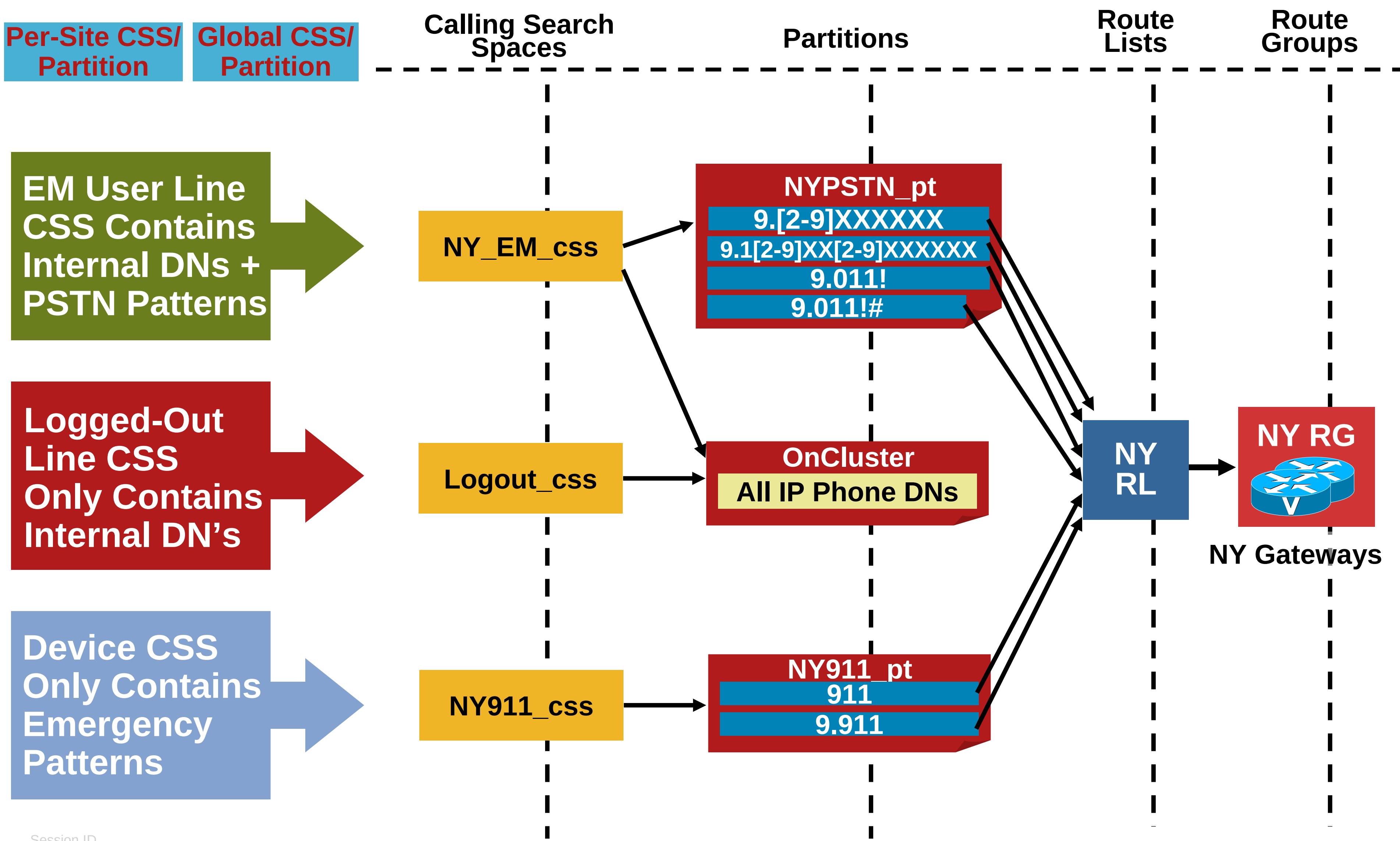
Extension Mobility Considerations

Traditional Dial Plan Approach



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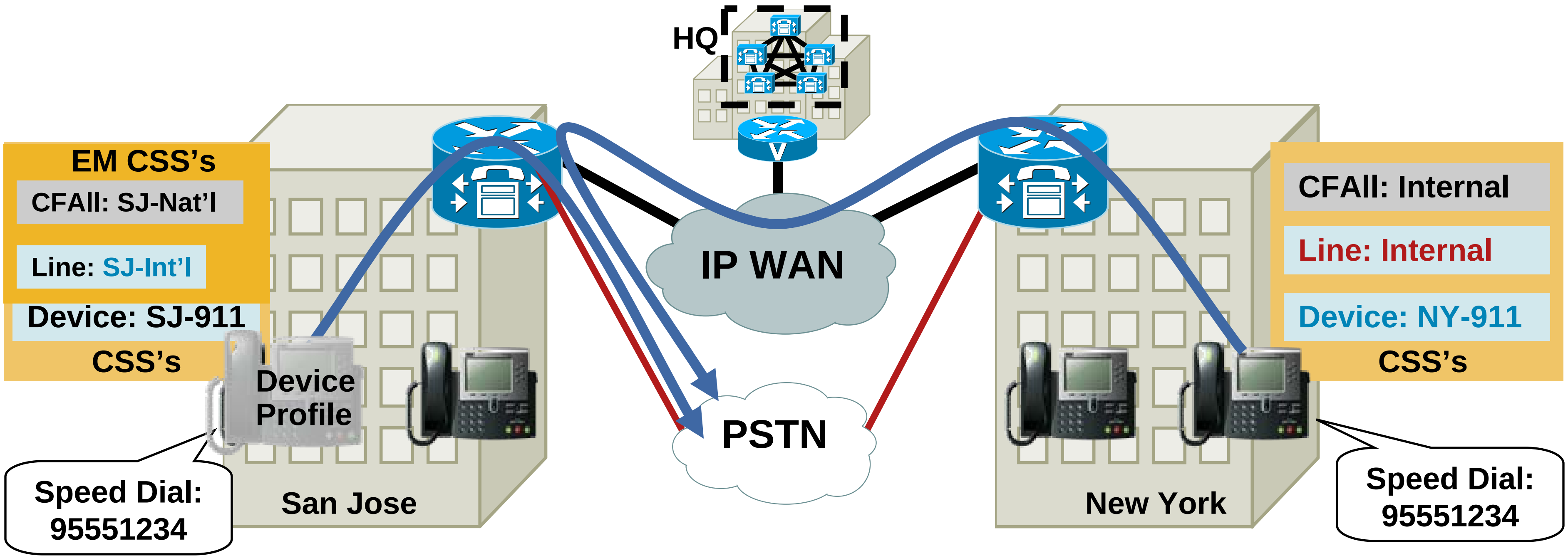
Extension Mobility Considerations

Traditional Dial Plan Approach: Behavior



- Emergency calls routed via local gateway
- Other PSTN calls routed via "home" gateway
- User dialing habits and speed dials are automatically preserved

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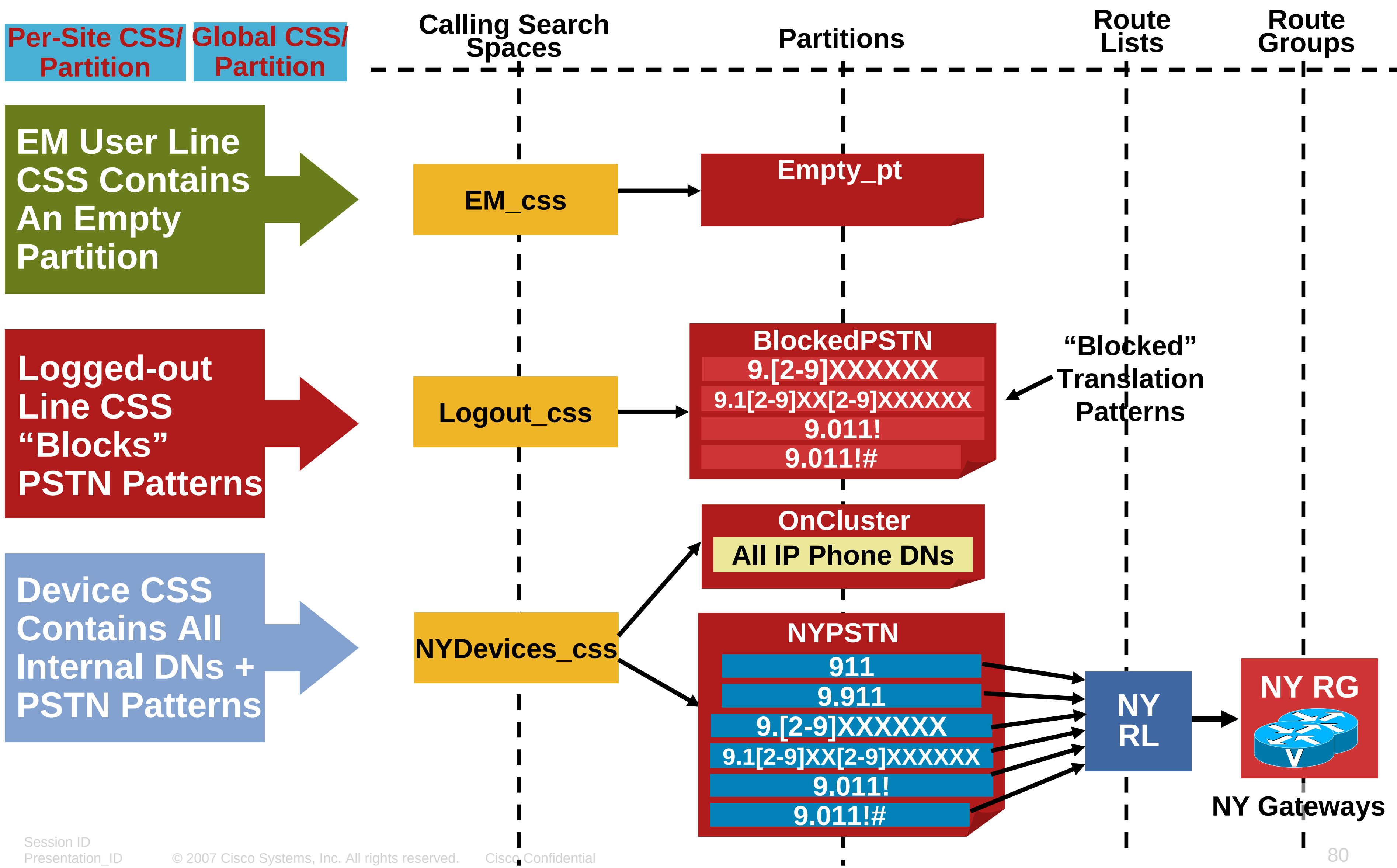
Extension Mobility Considerations

Line/Device Dial Plan Approach



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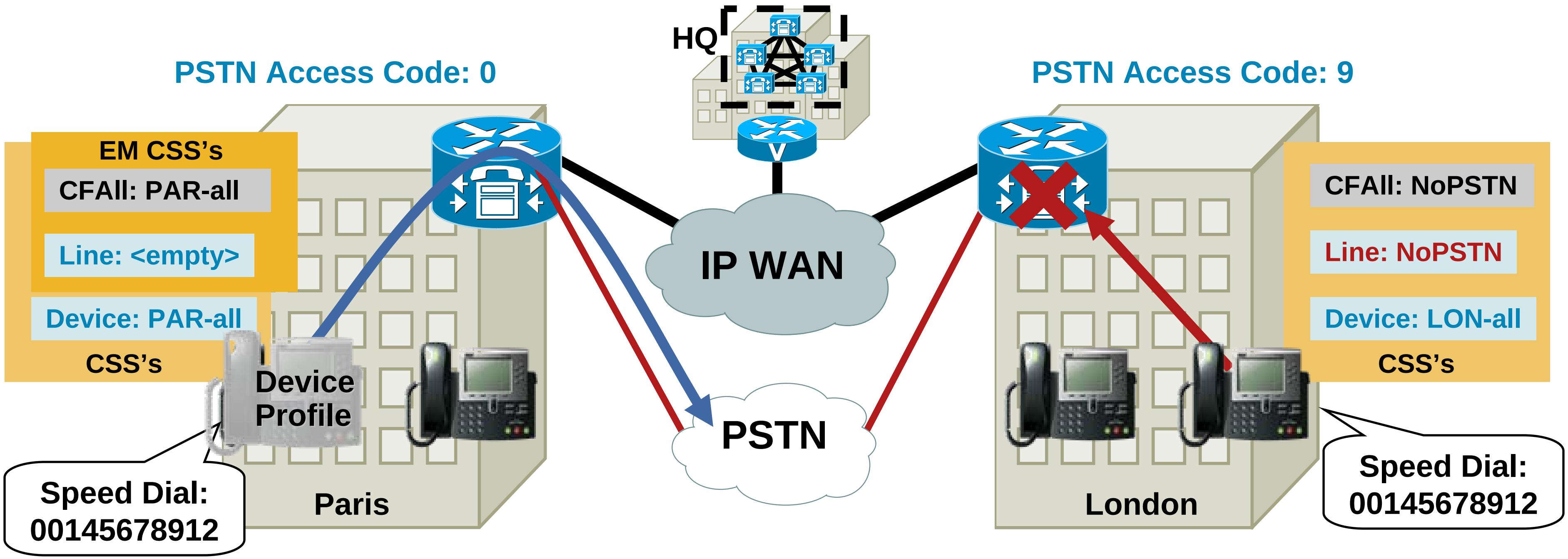
Extension Mobility Considerations

Line/Device Dial Plan Approach: Behavior



- All PSTN calls are routed via local gateway
- User dialing habits and speed dials are not preserved across different dialing "domains"
- Forwarded calls are routed via "home" gateway

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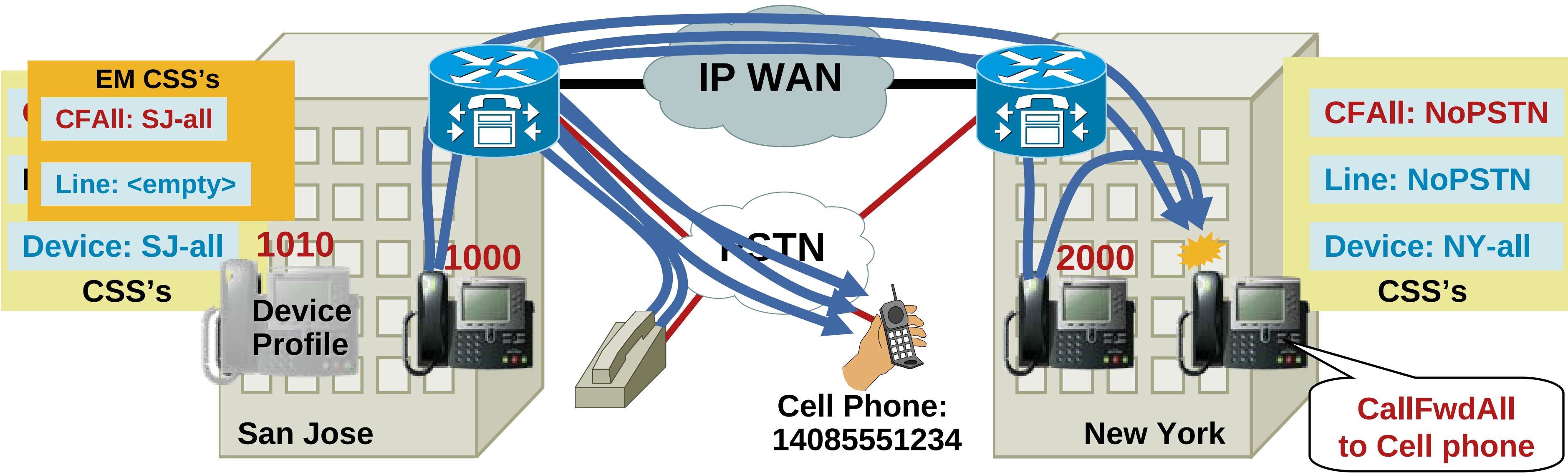
Extension Mobility Considerations

Line/Device Dial Plan Approach: Forwarded Calls



When a SJ User Logs in at NY Site and Forwards His Phone to a PSTN Number:

- Calls from SJ IP phones use SJ PSTN GW
- Calls from PSTN users get hairpinned at the SJ PSTN GW
- Calls from NY IP phones cross the WAN and use SJ PSTN GW

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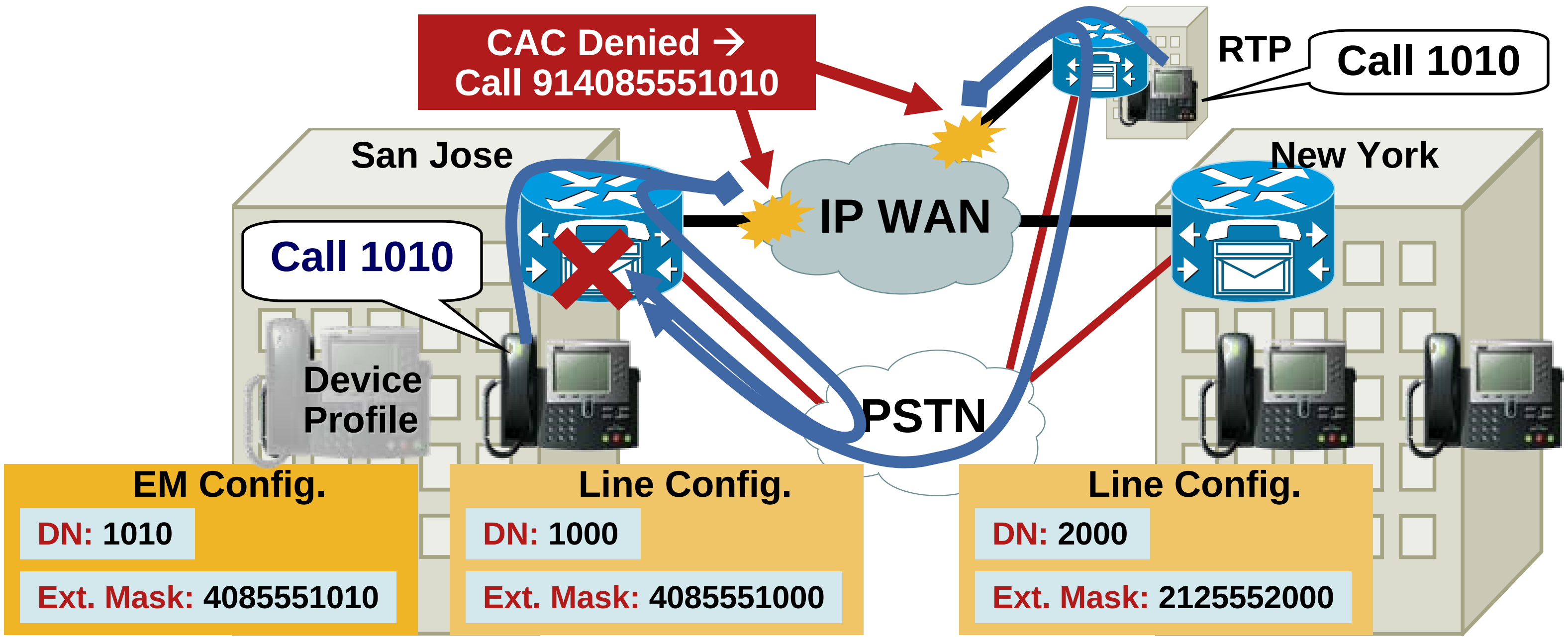
Extension Mobility Considerations

AAR Interaction



- AAR is inherently incompatible with EM users moving across branch sites (regardless of approach)
- When EM users log in at a different site, they cannot be reached via AAR from other sites (DIDs don't move!)
- Ensure that GW CSS's contain internal numbers only to prevent routing loops

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- Mobility Considerations
  - Extension mobility
  - Device Mobility
  - Mobility Manager

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Device Mobility Considerations

High-Level Behavior—UCM 4.2 and 6.0 Only!

- Determines that the device has moved to new location based on the device's IP subnet
- Dynamically associates "roaming" device pool to devices that move to a different site
- Message displayed on phone screen for a few seconds when it registers with UC Manager:

    Device in Home Location

    Device in Roaming Location

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Device Mobility

Device Pool Changes

Device Pool

UC Manager Group
Auto-reg CSS

Roaming Sensitive Settings

Impacts CAC, Media Resource & SRST

Date/Time Group
Region
MRGL
Network Locale
SRST Reference
Location
Physical Location
Device Mobility Group

Device Mobility Related Information

Impacts Dial Plan

Device CSS
AAR Group
AAR CSS

Common Profile *(new)*

Softkey Template
Network Hold MoH Audio Source
User Hold MoH Audio Source
MLPP Indication
MLPP Preemption
MLPP Domain

Device

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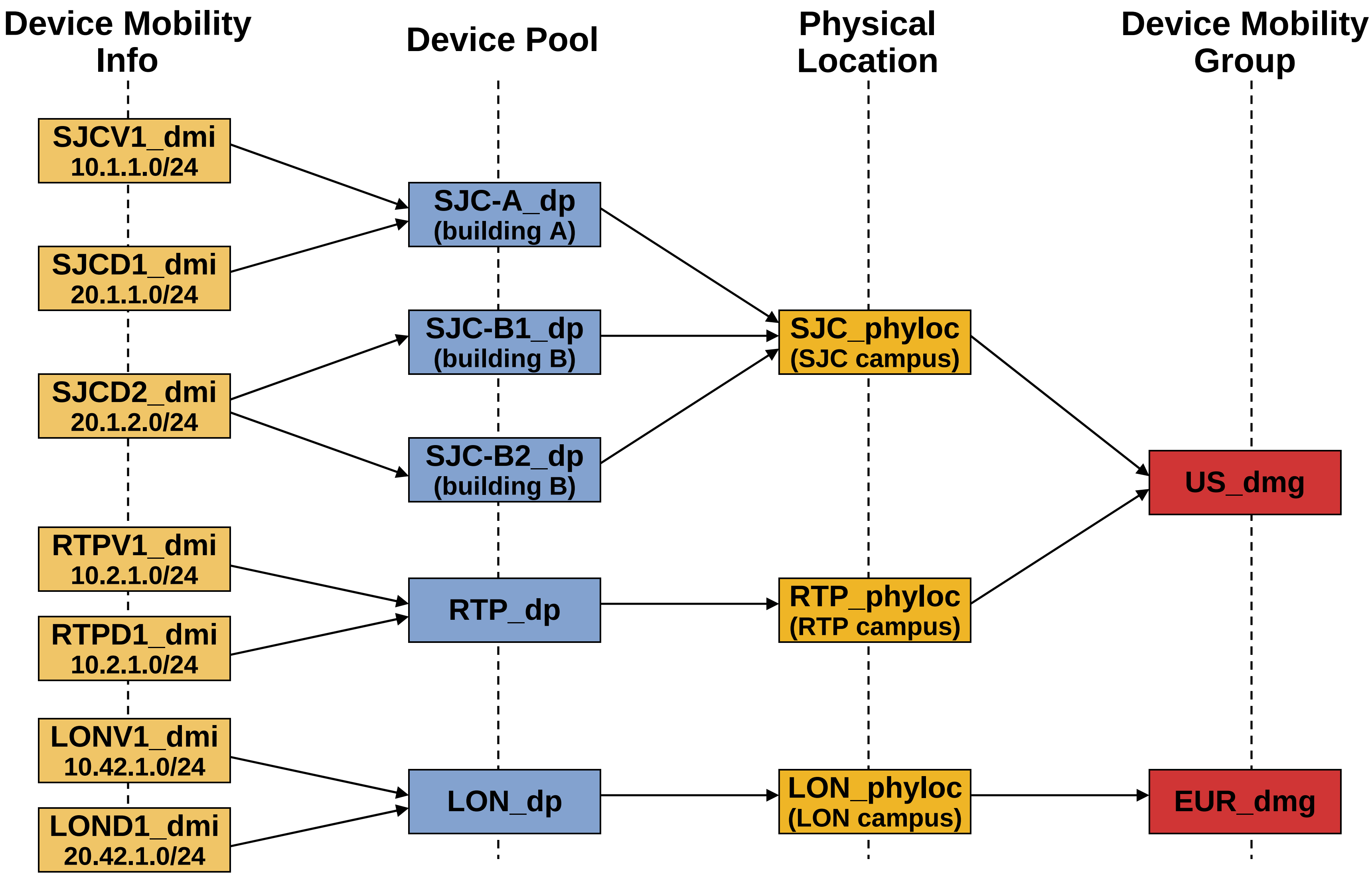
Device Mobility

New Concepts



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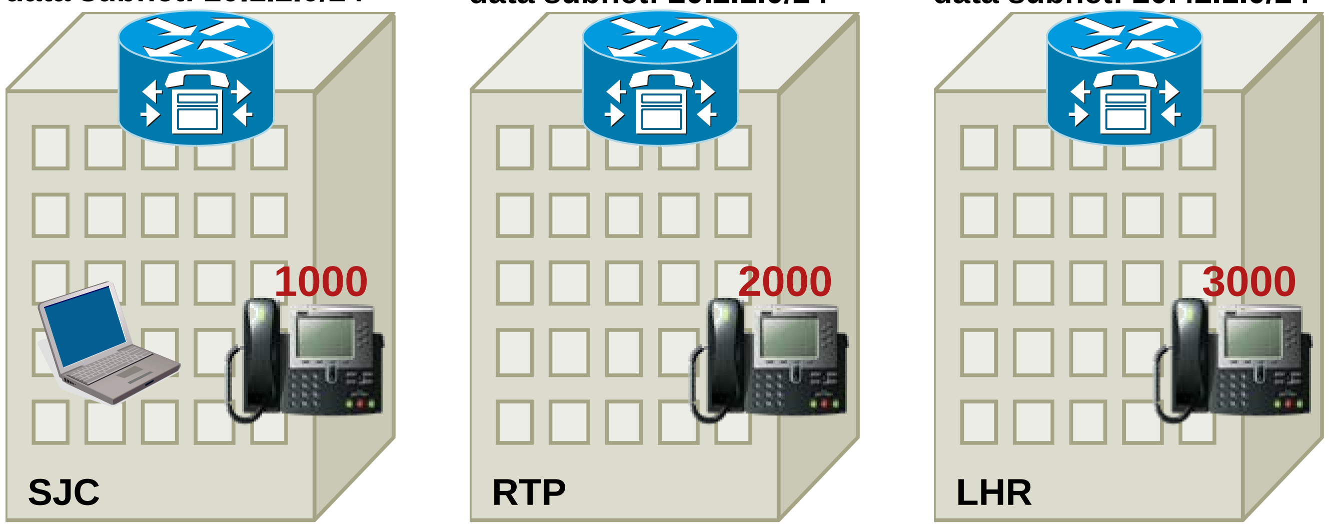
Device Mobility Considerations

The Big Idea Is to Track Phones Based on Subnets

voice subnet: 10.1.1.0/24
data subnet: 20.1.1.0/24
data subnet: 20.1.2.0/24

voice subnet: 10.2.1.0/24
data subnet: 20.2.1.0/24

voice subnet: 10.42.1.0/24
data subnet: 20.42.1.0/24



Note: When roaming from SJC to LHR, we are crossing DMGs Dial Plan-related information does not change.

Cisco CallManager Group	CM GroupLHR
Roaming Device Pool	LHR_DP
Location	LHR_Location
Region	LHR_Region
Network Locale	UK
AAR Group	SJC_AAR
AAR Calling Search Space	SJC_CSS
Device Calling Search Space	SJC_CSS
Media Resource Group List	LHR_MRGL
SRST	LHR_SRST

Roaming Sensitive Settings
Change when roaming between physical locations. DMG not a factor.

Device Mobility Related Information
Changes only when roaming <u>within the same DMG.</u>

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Device Mobility Considerations

RTP Mobile User at Home Location

Phone: SEP00059BF19AA5 (Phone1- SEP00059BF19AA5)
Registration: Registered with Cisco CallManager CLUSTER3-1
IP Address: 10.1.110.1

Status: Ready

Copy | Update | Delete | Reset Phone

Phone Configuration (Model = Cisco 7960)

Device Information

MAC Address*	00059BF19AA
Description	Phone1- SEP00059BF19AA5
Owner User ID	(Select User ID)
Device Pool*	RTP_DP (View Details)
Common Profile	< None > (View Details)
Calling Search Space	RTP_CSS
AAR Calling Search Space	RTP_CSS
Media Resource Group List	< None >
User Hold Audio Source	< None >
Network Hold Audio Source	< None >
Location	RTP_Location
AAR Group	RTP_AAR
User Locale	English United States
Network Locale	United States
Device Security Mode	Use System Default Device security mode only takes effe parameter Cluster Security Mode is s
Signal Packet Capture Mode	None
Packet Capture Duration	60
Built In Bridge	Default
Privacy	Default
Device Mobility Mode	Default (View Current Settings)

Cisco CallManager Group	CM Group 1
Roaming Device Pool	(None Selected)
Location	RTP_Location
Region	RTP-Region1
Network Locale	United States
AAR Group	RTP_AAR
AAR Calling Search Space	RTP_CSS
Device Calling Search Space	RTP_CSS
Media Resource Group List	(None Selected)
SRST	RTP_SRST

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Device Mobility Considerations

RTP Mobile User at “SJC Roaming” Location

Phone: SEP00059BF19AA5 (Phone1- SEP00059BF19AA5)
Registration: Registered with Cisco CallManager CLUSTER3-1
IP Address: 10.1.120.2

Status: Ready

Copy | Update | Delete | Reset Phone

Phone Configuration (Model = Cisco 7960)

Device Information

MAC Address*	00059BF19AA
Description	Phone1- SEP00059BF19AA5
Owner User ID	(Select User ID)
Device Pool*	RTP_DP (View Details)
Common Profile	< None > (View Details)
Calling Search Space	RTP_CSS
AAR Calling Search Space	RTP_CSS
Media Resource Group List	< None >
User Hold Audio Source	< None >
Network Hold Audio Source	< None >
Location	RTP_Location
AAR Group	RTP_AAR
User Locale	English United States
Network Locale	United States
Device Security Mode	Use System Default Device security mode only takes effe parameter Cluster Security Mode is s
Signal Packet Capture Mode	None
Packet Capture Duration	60
Built In Bridge	Default
Privacy	Default
Device Mobility Mode	Default (View Current Settings)

Cisco CallManager Group	CM Group 1
Roaming Device Pool	SJC_DP
Location	SJC_Location
Region	SJC-Region2
Network Locale	United States
AAR Group	SJC_AAR
AAR Calling Search Space	SJC_CSS
Device Calling Search Space	SJC_CSS
Media Resource Group List	(None Selected)
SRST	SJC_SRST

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Design Best Practices Agenda

- Building Classes of Service
- MultiSite Deployments
- Mobility Considerations
    - Extension mobility
    - Device Mobility
    - Unified Mobility

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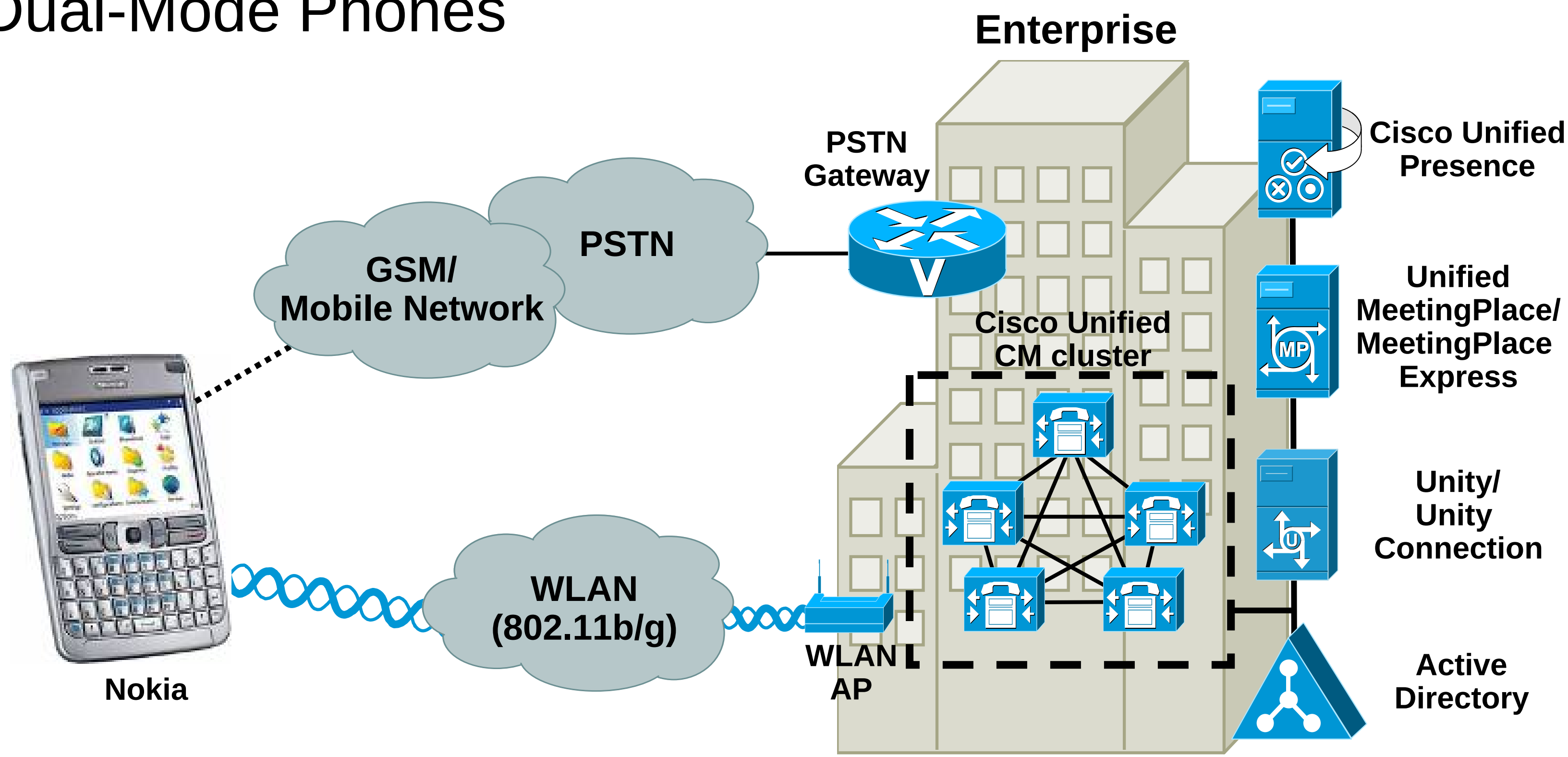
Campus Mobility

Dual-Mode Phones



Dual-mode phones provide the ability to use either PSTN/GSM or WLAN connectivity for making and receiving calls

- When on the WLAN, the mobile phone uses SCCP or SIP Cisco client to register with CUCM as a phone
- When the WLAN is unavailable, the mobile phone uses PSTN/GSM for calls
- Manual handoff of calls between the PSTN/GSM and WLAN network is possible

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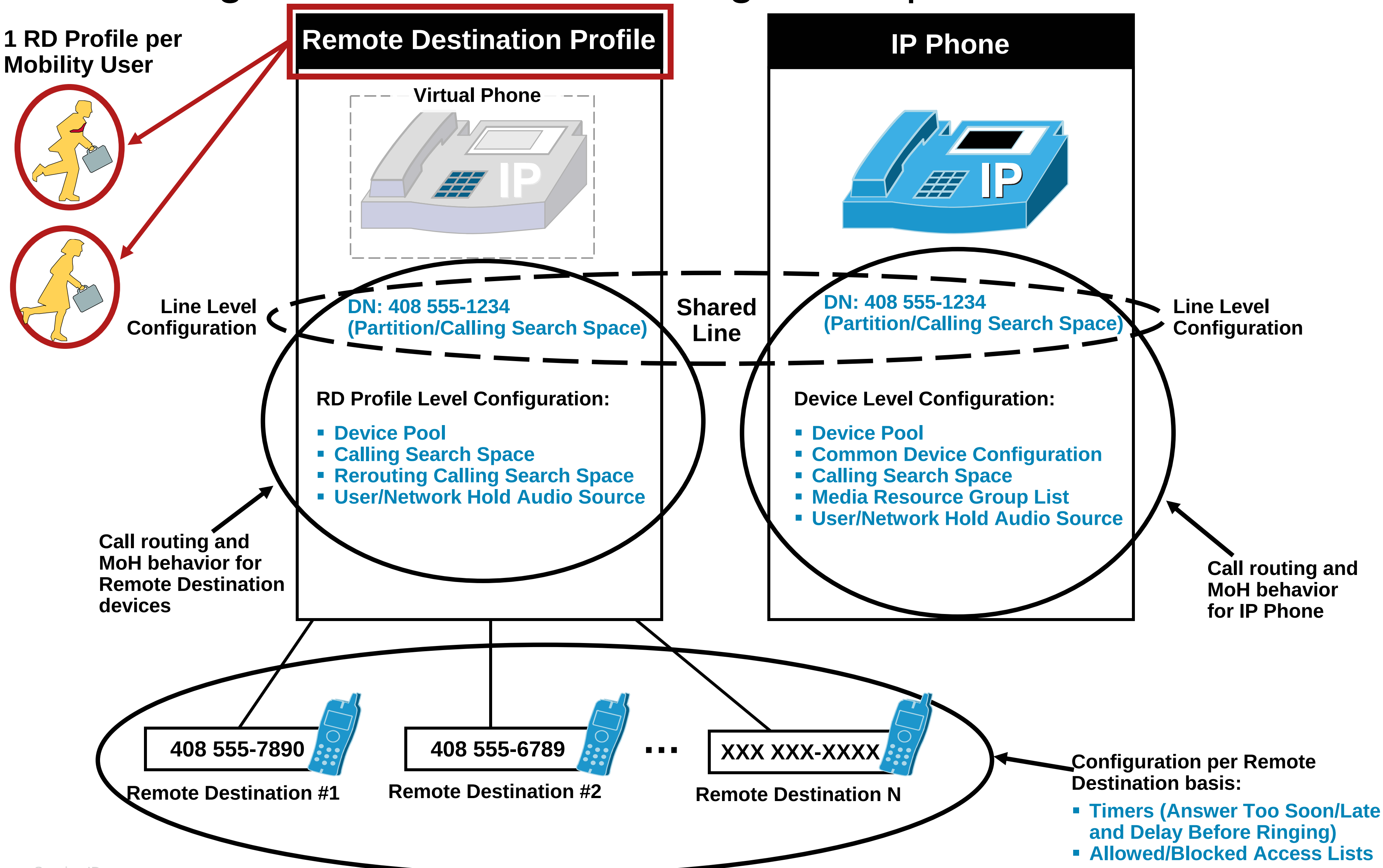
Unified Mobility

Configuration and Call Routing Concept



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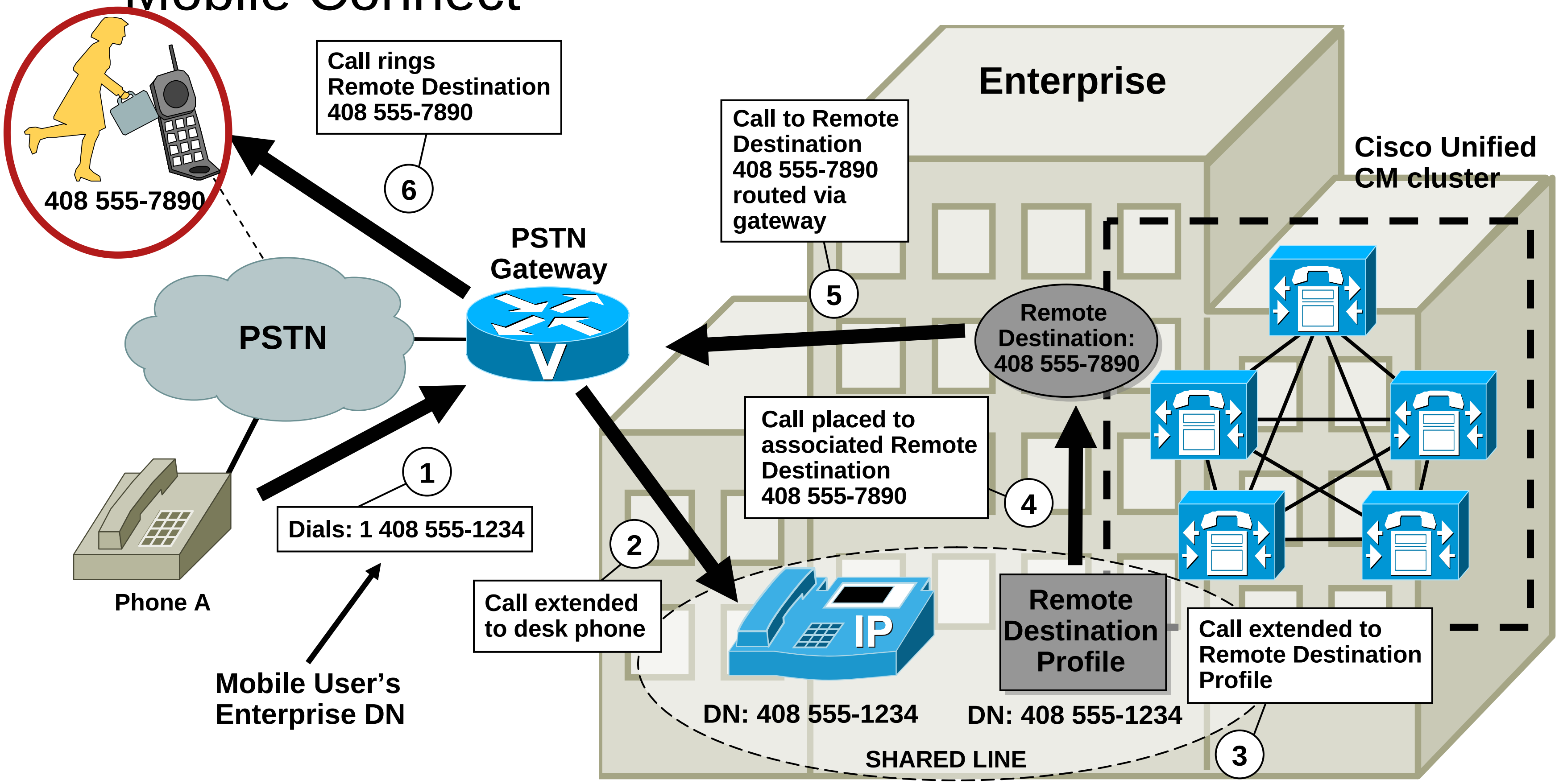
Unified Mobility

Mobile Connect



Call to mobile user's Enterprise directory number rings at desk phone and Remote Destination phone:

- Call can be answered at either phone
- Once answered all other call legs are cleared

Note: No changes are required on mobility user's Remote Destination phone

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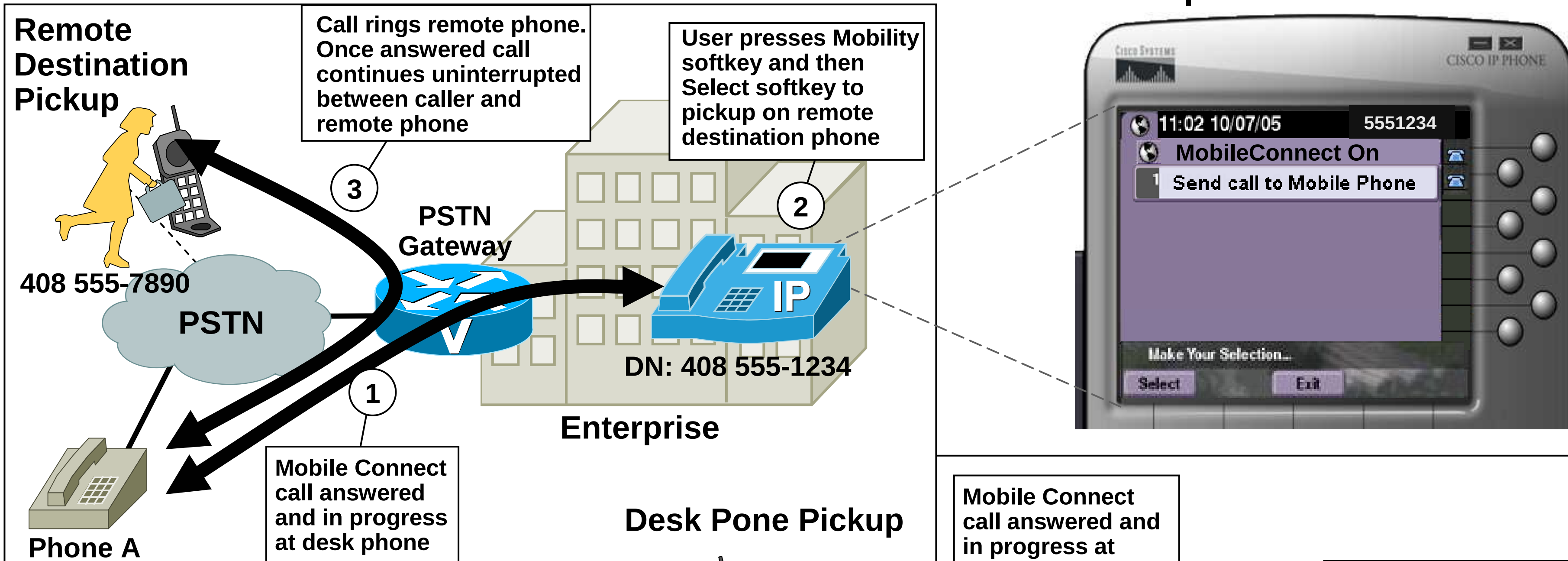
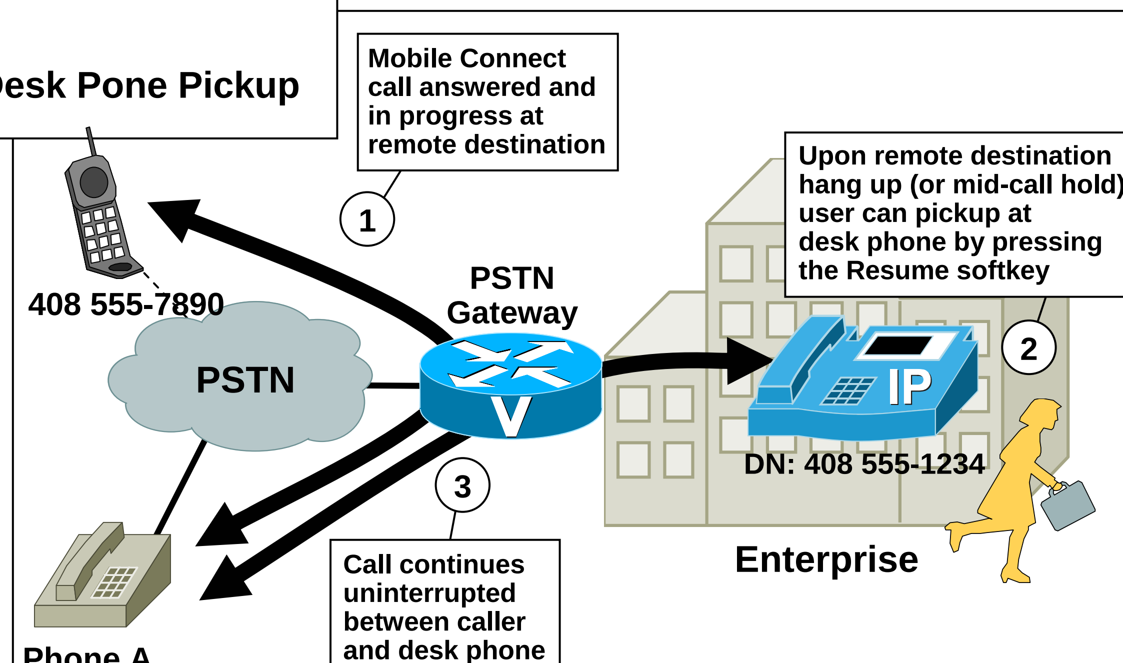
Unified Mobility

Remote Destination and Desk Phone Pickup





Once Mobile Connect call is in progress there are two types of pickup:

1. **Remote Destination Pickup**
   Mobile user can pickup in-progress desk phone call at Remote Destination phone
2. **Desk Phone Pickup**
   Mobile user can pickup in-progress remote phone call at desk phone

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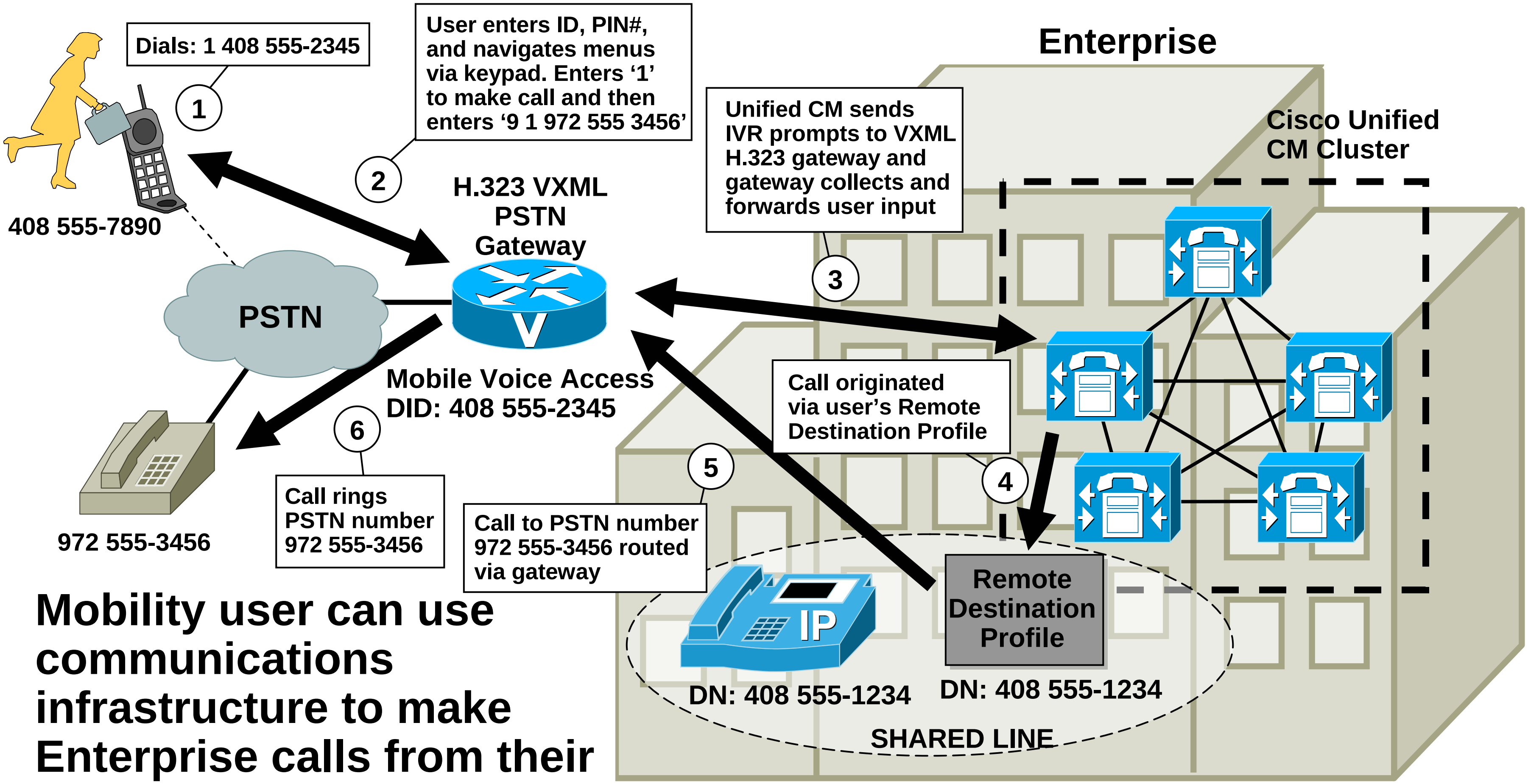
Unified Mobility

Mobile Voice Access



Mobility user can use communications infrastructure to make Enterprise calls from their remote destination phone

- Call made to Enterprise Mobile Voice Access number
- User follows IVR prompts and enters information to make call
- User can also disable and enable Mobile Connect on a per remote destination basis

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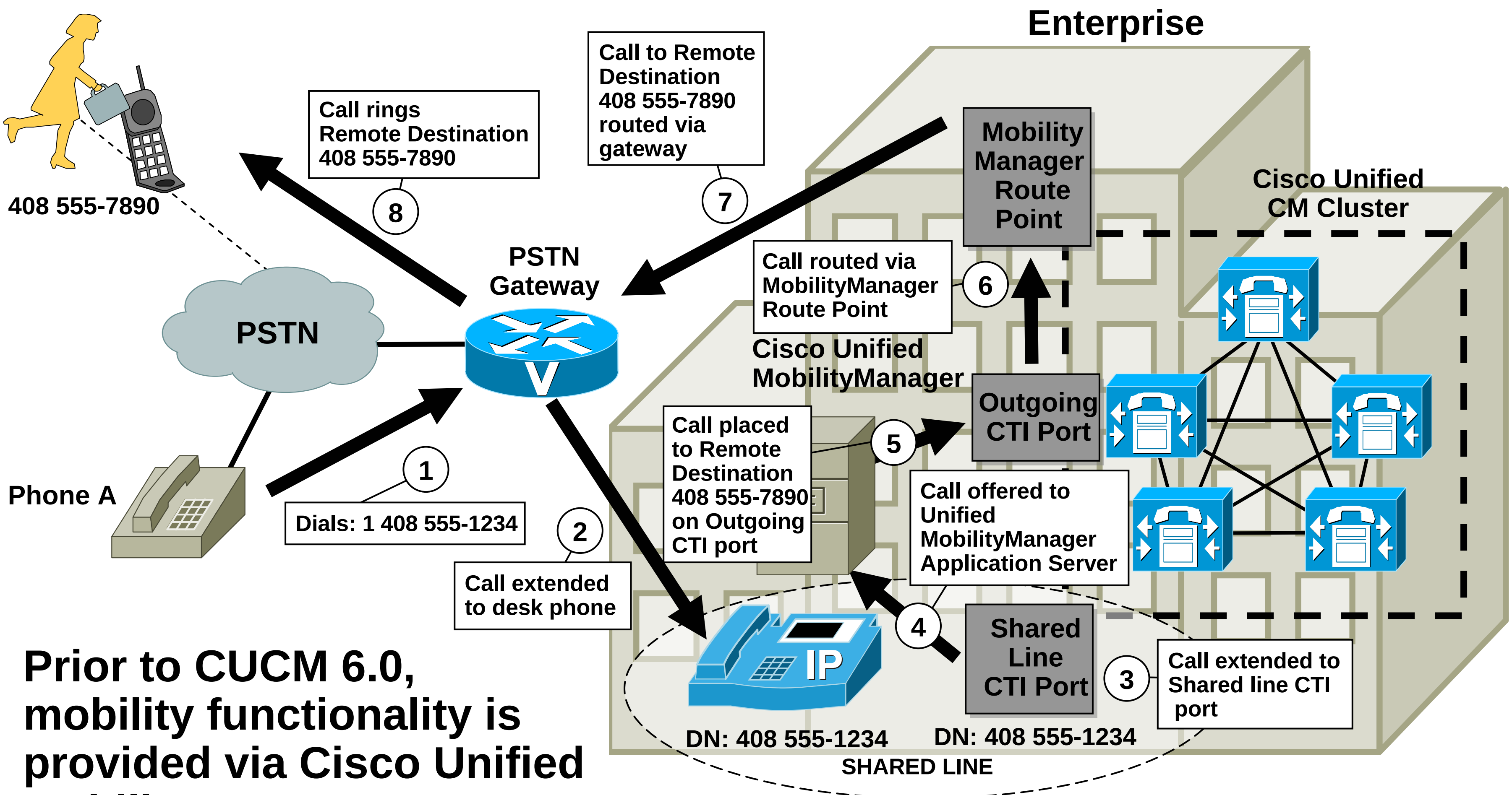
Unified Mobility

Off-Box Mobility with MobilityManager (CUCM 4.X/5.X)



Prior to CUCM 6.0, mobility functionality is provided via Cisco Unified MobilityManager

CTI is required for interaction between MobilityManager application server and Cisco Unified CM, but behavior is the same

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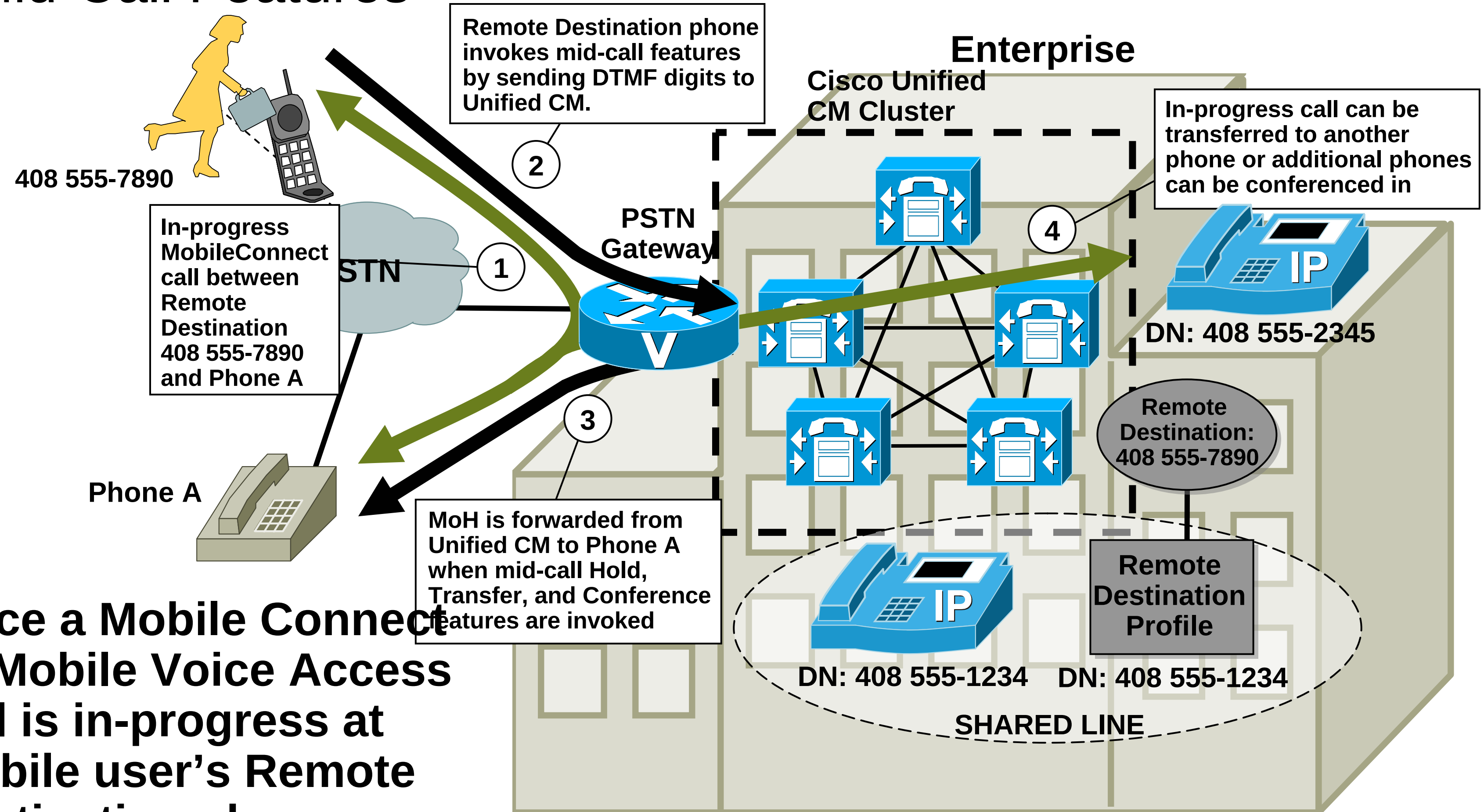
Unified Mobility

Mid-Call Features



Once a Mobile Connect or Mobile Voice Access call is in-progress at mobile user's Remote Destination phone:

- Mid-call features like Hold, Transfer, and Conference can be invoked via Smart Phone softkeys or manual key presses
- DTMF tones are sent from the Remote Destination phone to the CUCM via the Enterprise PSTN gateway

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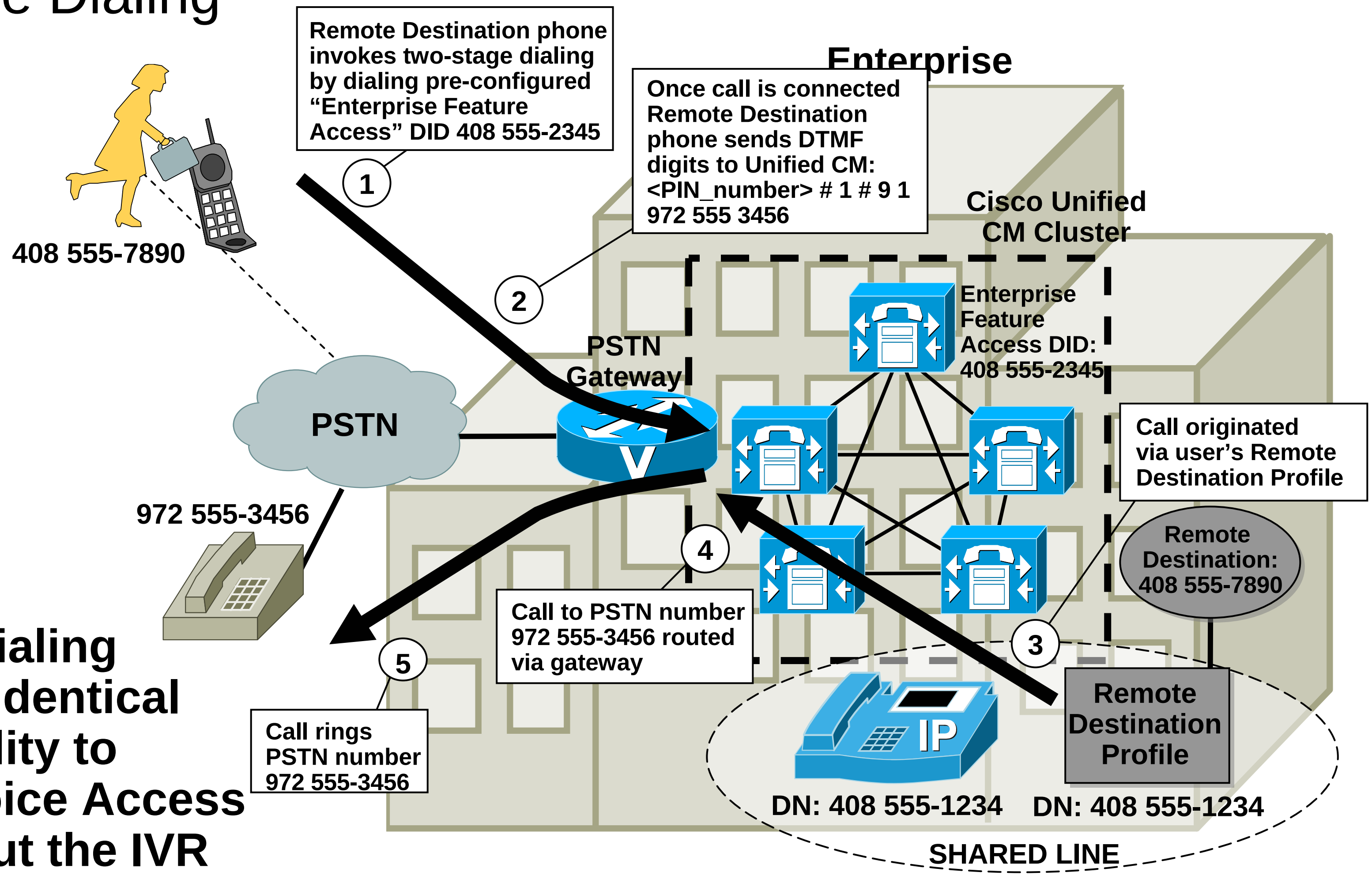
Unified Mobility

2 Stage Dialing



2 Stage Dialing provides identical functionality to Mobile Voice Access but without the IVR

- Call made to Enterprise Feature Access number
- User presses Smart Phone softkeys or manually keys digits (sent via DTMF) to make call
- User can also disable and enable Mobile Connect on a per remote destination basis

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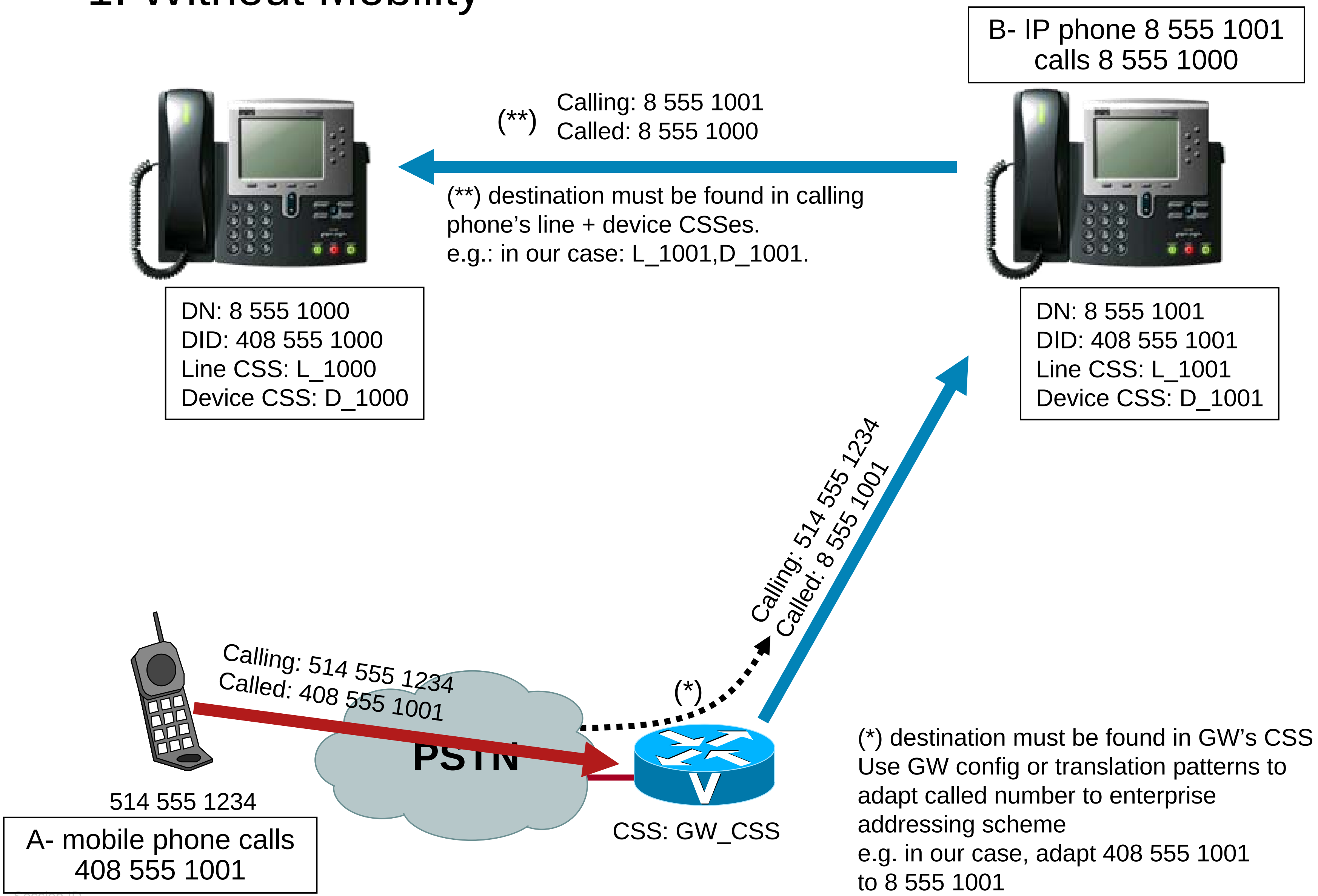
Mobility: Dial Plan Implications

1. Without Mobility



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Mobility: Dial Plan Implications

2. New Configuration

DN: 8 555 1000
DID: 408 555 1000
Line CSS: L_1000
Device CSS: D_1000

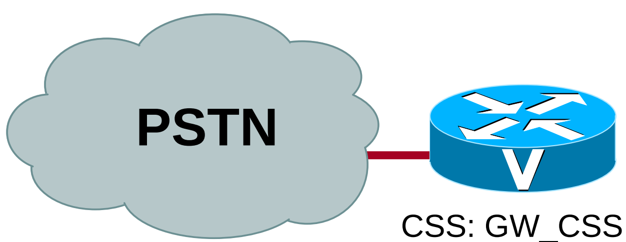
DN: 8 555 1001
DID: 408 555 1001
Line CSS: L_1001
Device CSS: D_1001

Remote Destination Profile
CSS: css_mrk_1
Reroute CSS: css_mrk_2
Calling party transformation css: css_mrk_3

Remote Destination Number: 5145551234

New configuration is tied to the DN of the phone

514 555 1234



CSS: GW_CSS

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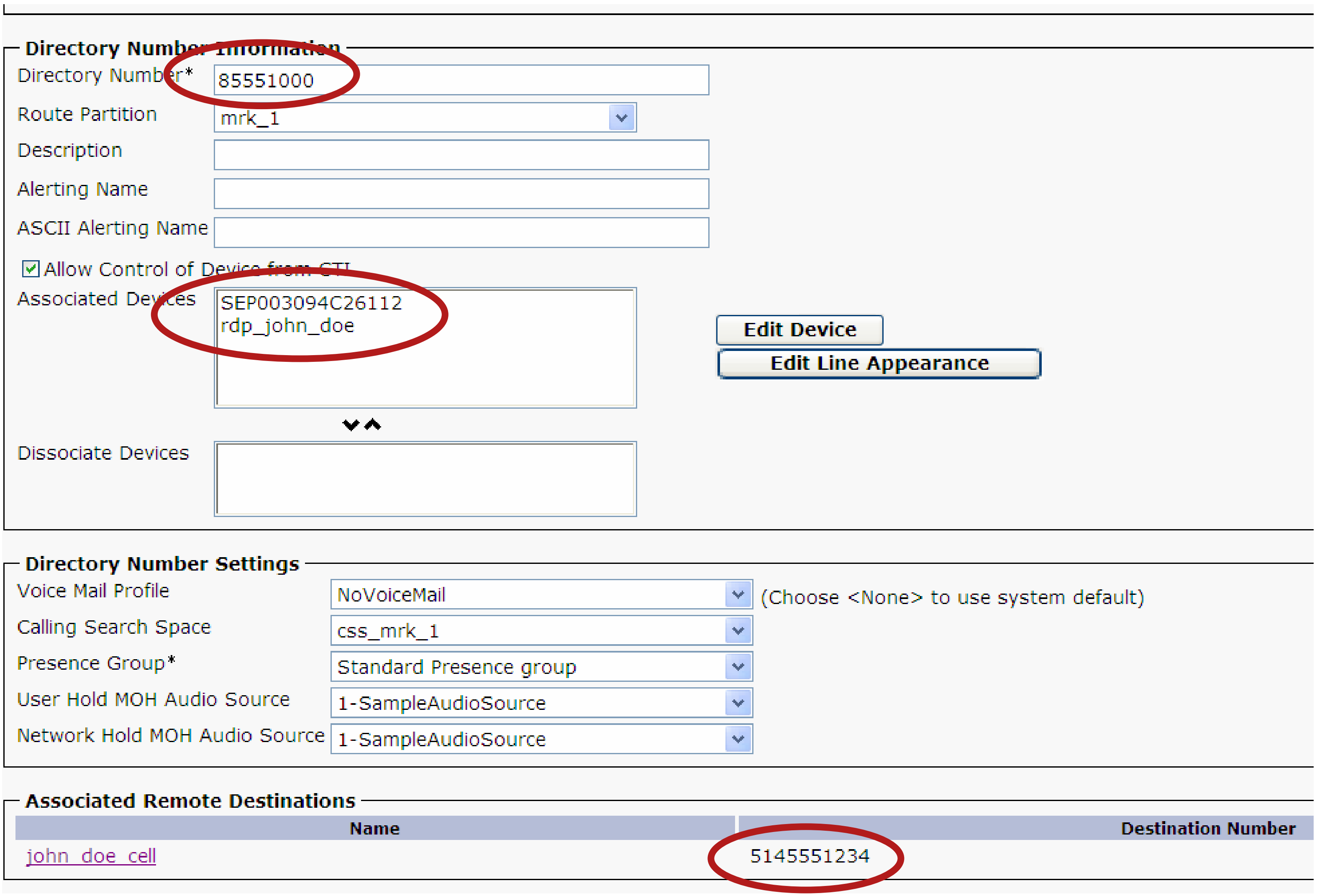
Mobility: Dial Plan Implications

RDP and Remote Destination Number Associated to DN



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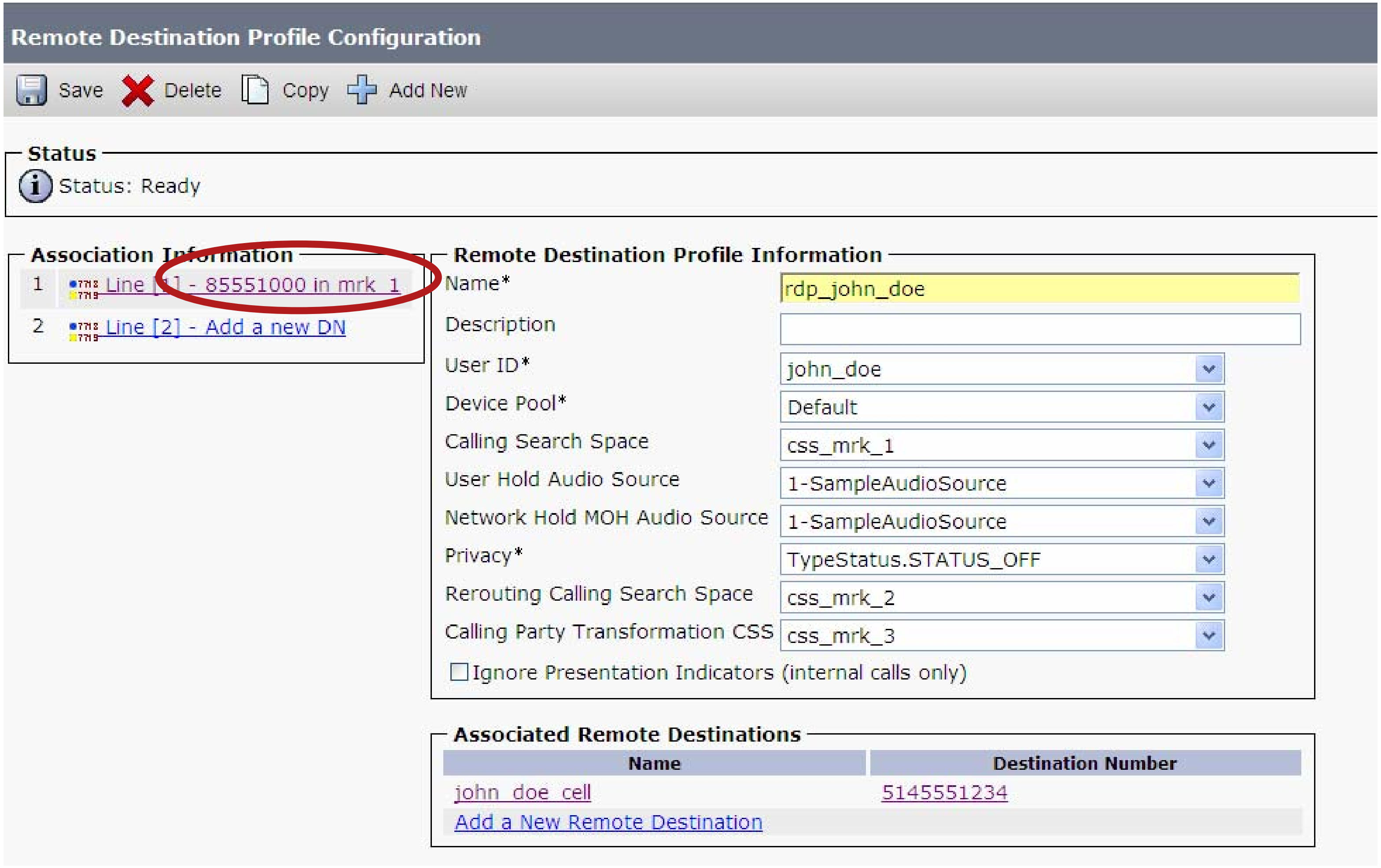
Mobility: Dial Plan Implications

RDP and Remote Destination Number Associated to DN



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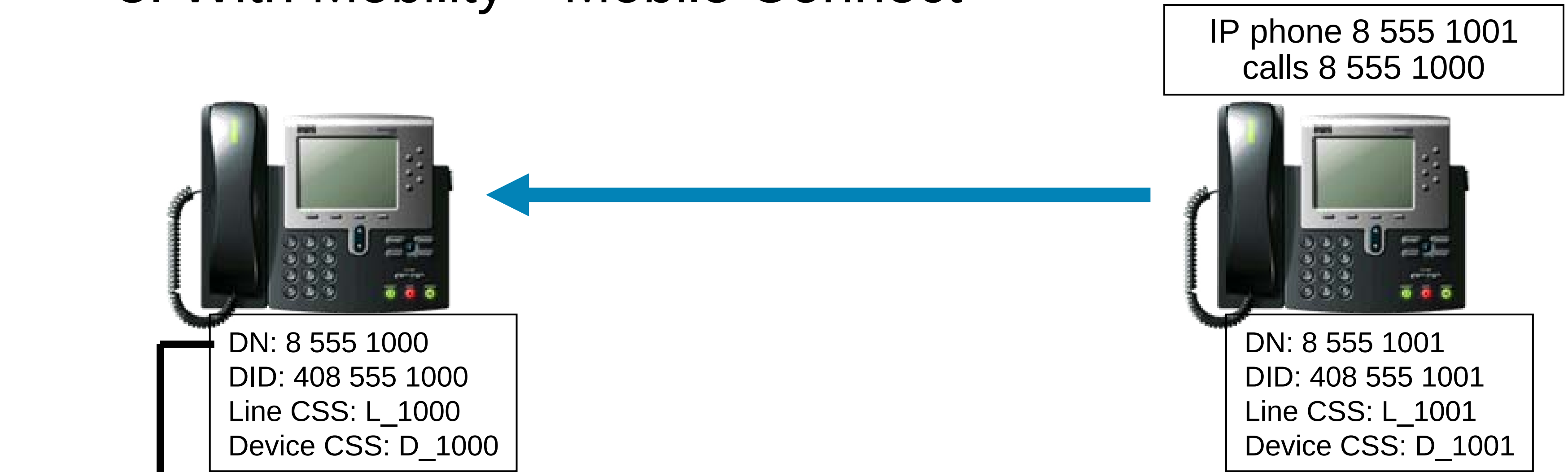
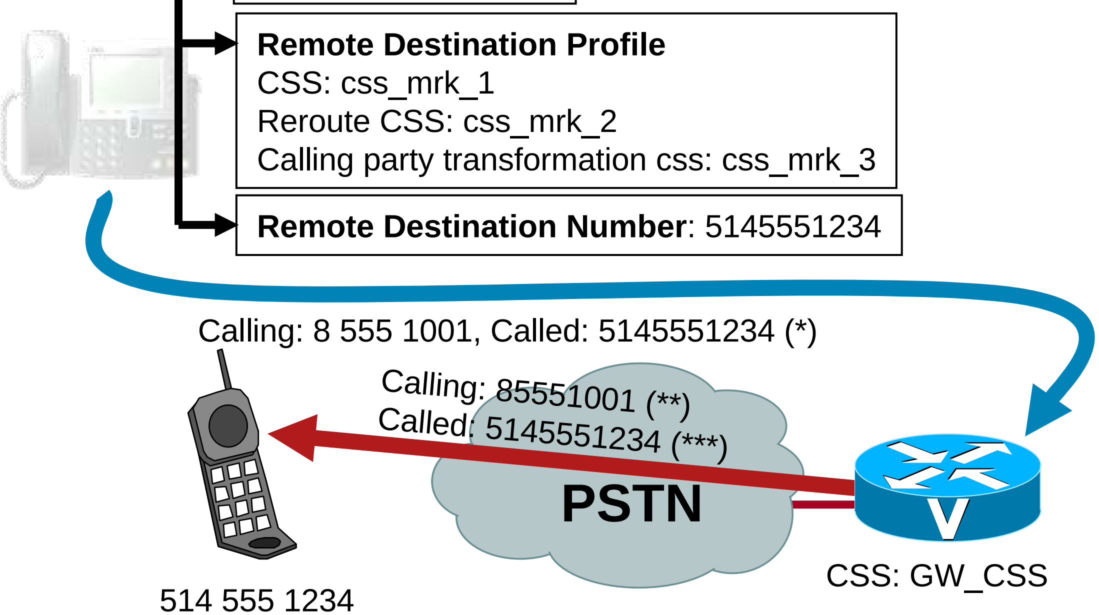
Mobility: Dial Plan Implications

3. With Mobility—Mobile Connect





(*) destination must be found in RDP's rerouting CSS
e.g.: in our case, css_mrk2
(**) calling party number may be changed by Calling Party Transformation patterns contained in the Calling Party Transformation CSS
e.g.: in our case, css_mrk3
(***) called party number can be changed by application dial rules
Note these are **not** contained in a CSS.

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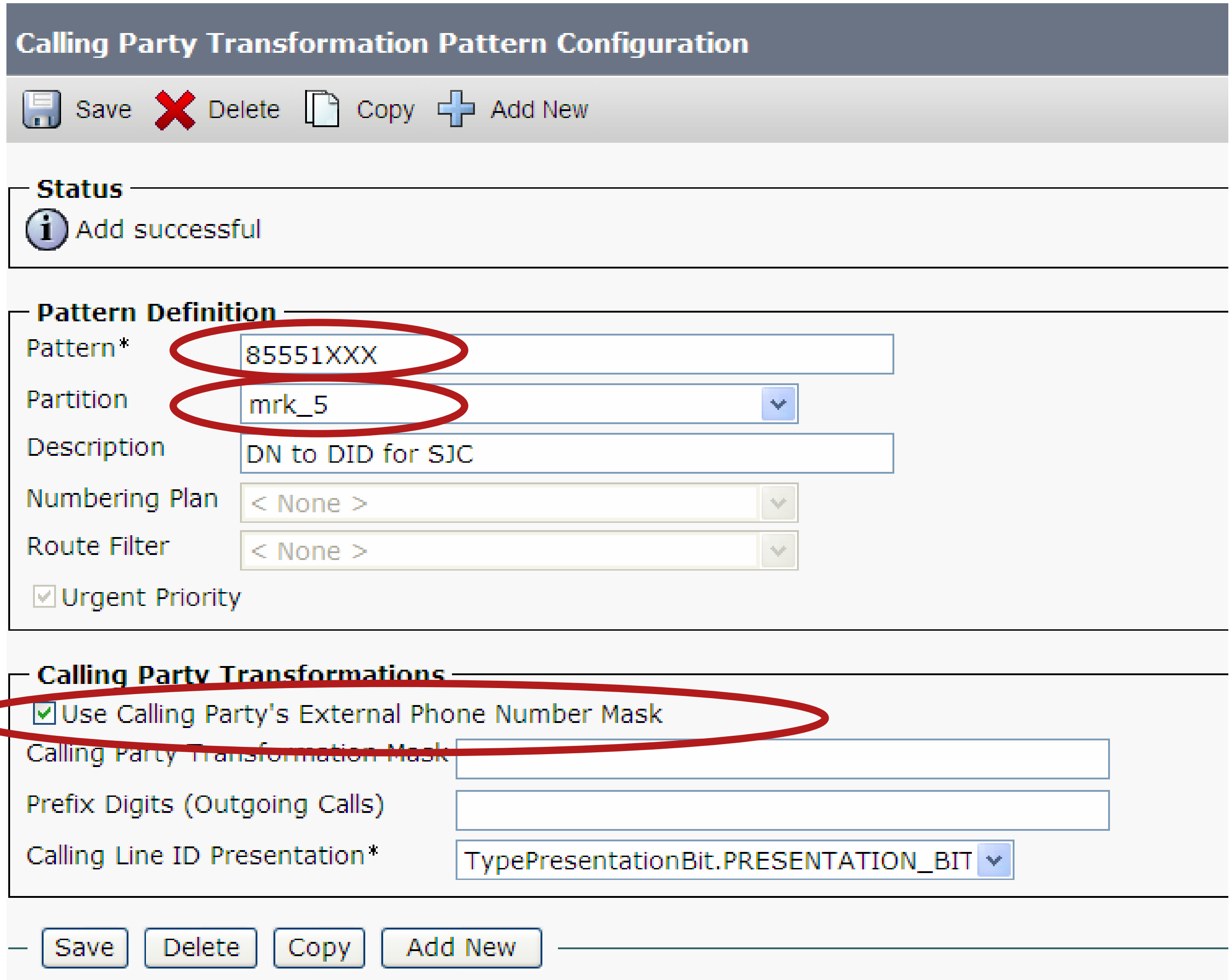
Mobility: Dial Plan Implications

3. With Mobility—Transformation Patterns



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Mobility: Dial Plan Implications

3. With Mobility—Application Dial Rules

Application Dial Rule Configuration

Save | Delete | Add New

Status

Status: Ready

Application Dial Rule Information

Name*	NPA415_NXX555
Description	
Number Begins With	514555
Number of Digits*	10
Total Digits to be Removed*	0
Prefix With Pattern	91

Application Dial Rule Priority

Name	Number Begins With	Number of Digits	Total Digits to be Remov
NPA415_NXX555	514555	10	0
CC1NPA514NXX555	1514555	11	1

Save | Delete | Add New

*- indicates required item.

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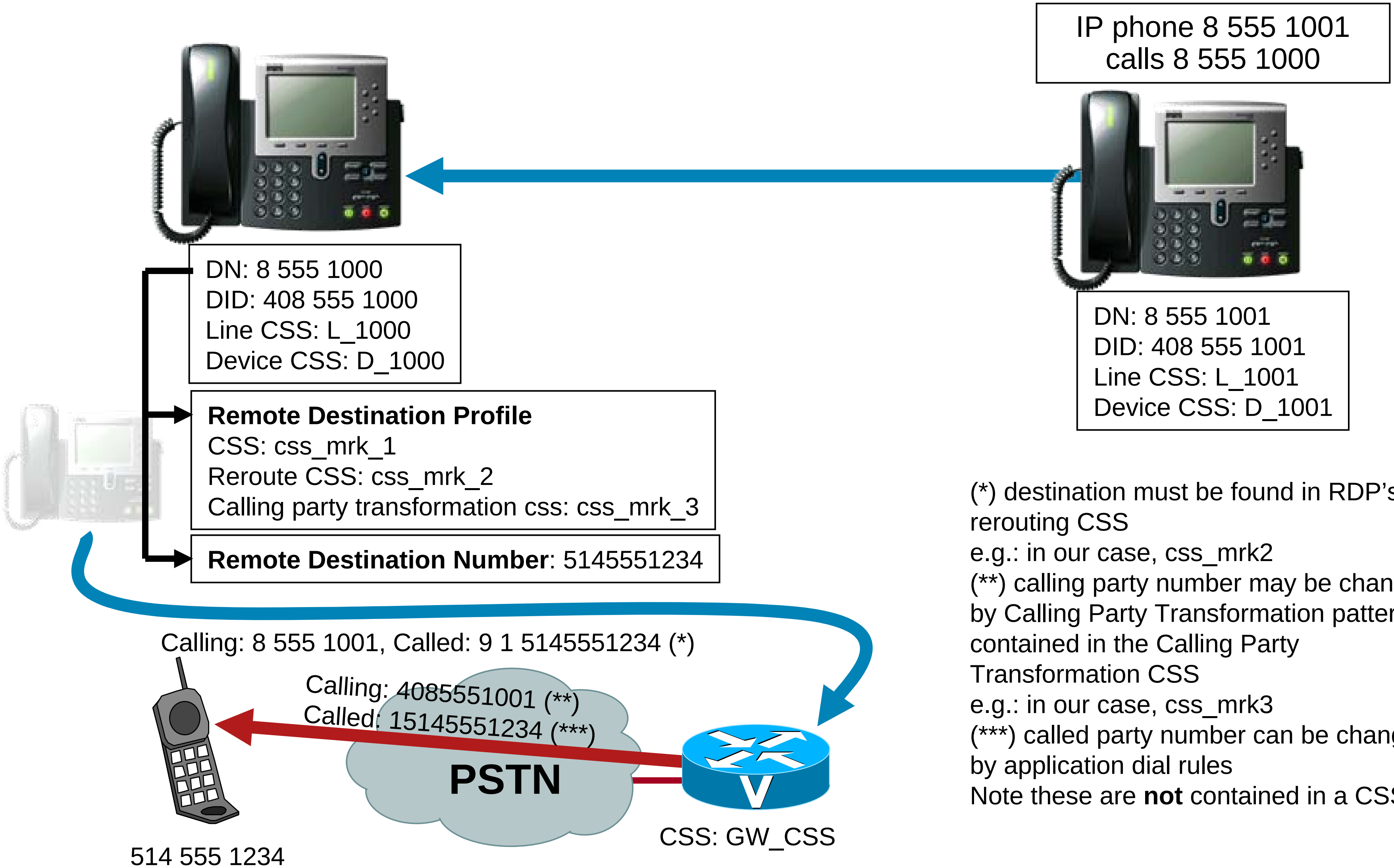
Mobility: Dial Plan Implications

4. With Mobility—Mobile Connect Enhanced



(*) destination must be found in RDP's rerouting CSS
e.g.: in our case, css_mrk2
(**) calling party number may be changed by Calling Party Transformation patterns contained in the Calling Party Transformation CSS
e.g.: in our case, css_mrk3
(***) called party number can be changed by application dial rules
Note these are **not** contained in a CSS.

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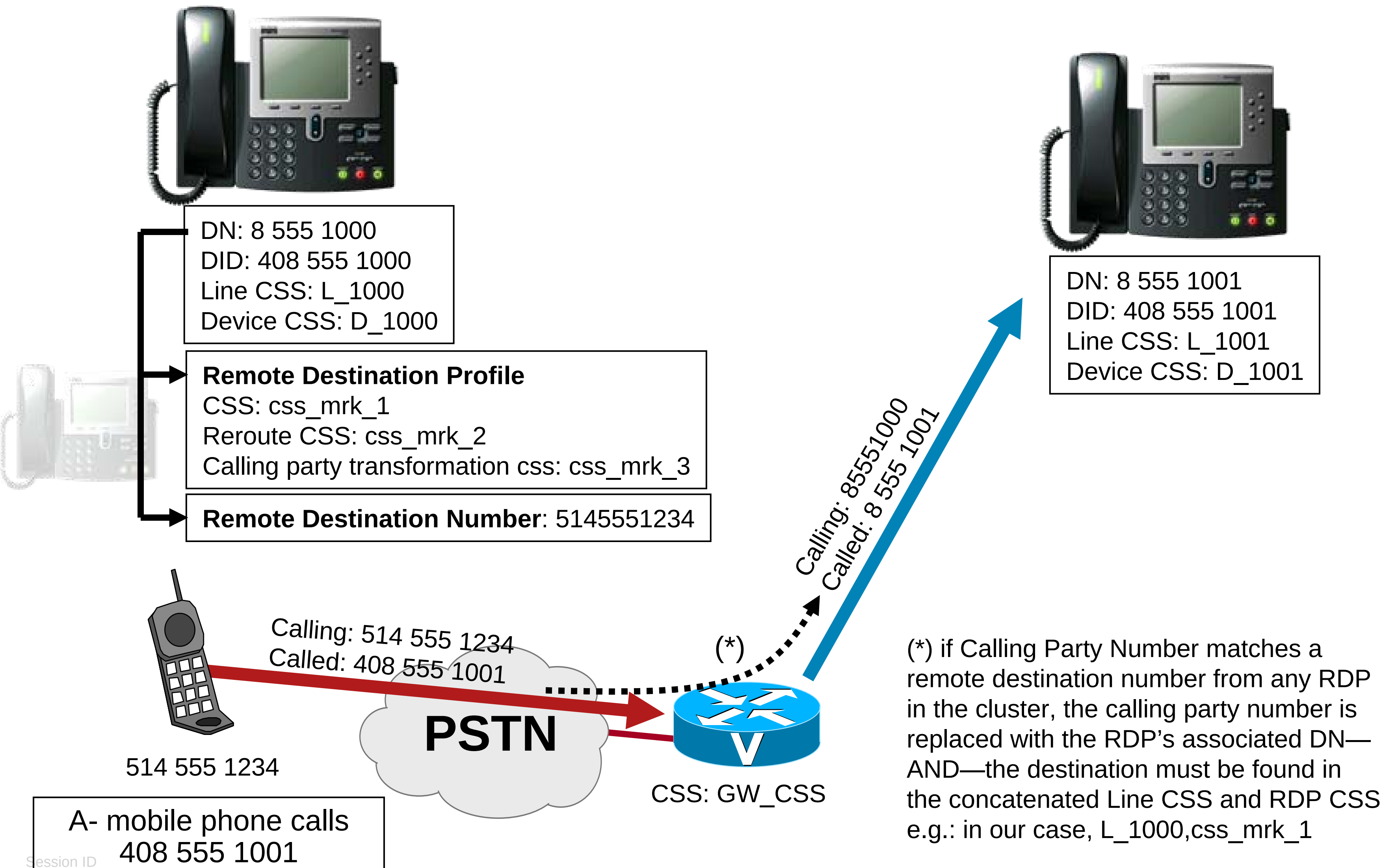
Mobility: Dial Plan Implications

5. With Mobility—Inbound Calls



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Conclusions

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Conclusions

General Recommendations

- **Keep It Simple!**

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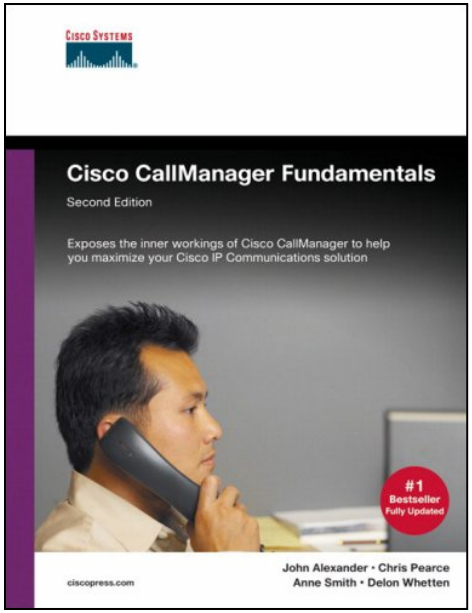
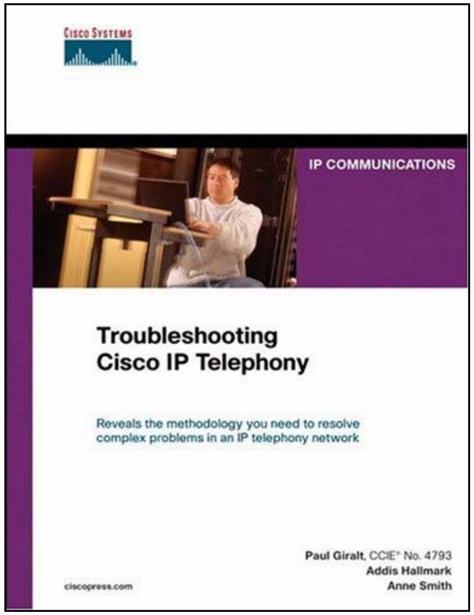
Recommended Reading





- Continue your Networkers at
  Cisco Live learning experience with further reading from Cisco Press
- Check the Recommended Reading flyer for suggested books
- A few suggestions:

  Cisco CallManager Fundamentals, Second edition

  Troubleshooting Cisco IP Telephony

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  Wednesday, June 21 at 12:15 p.m.

  Thursday, June 22 at 12:15 p.m. and 2:00 p.m.

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Appendix

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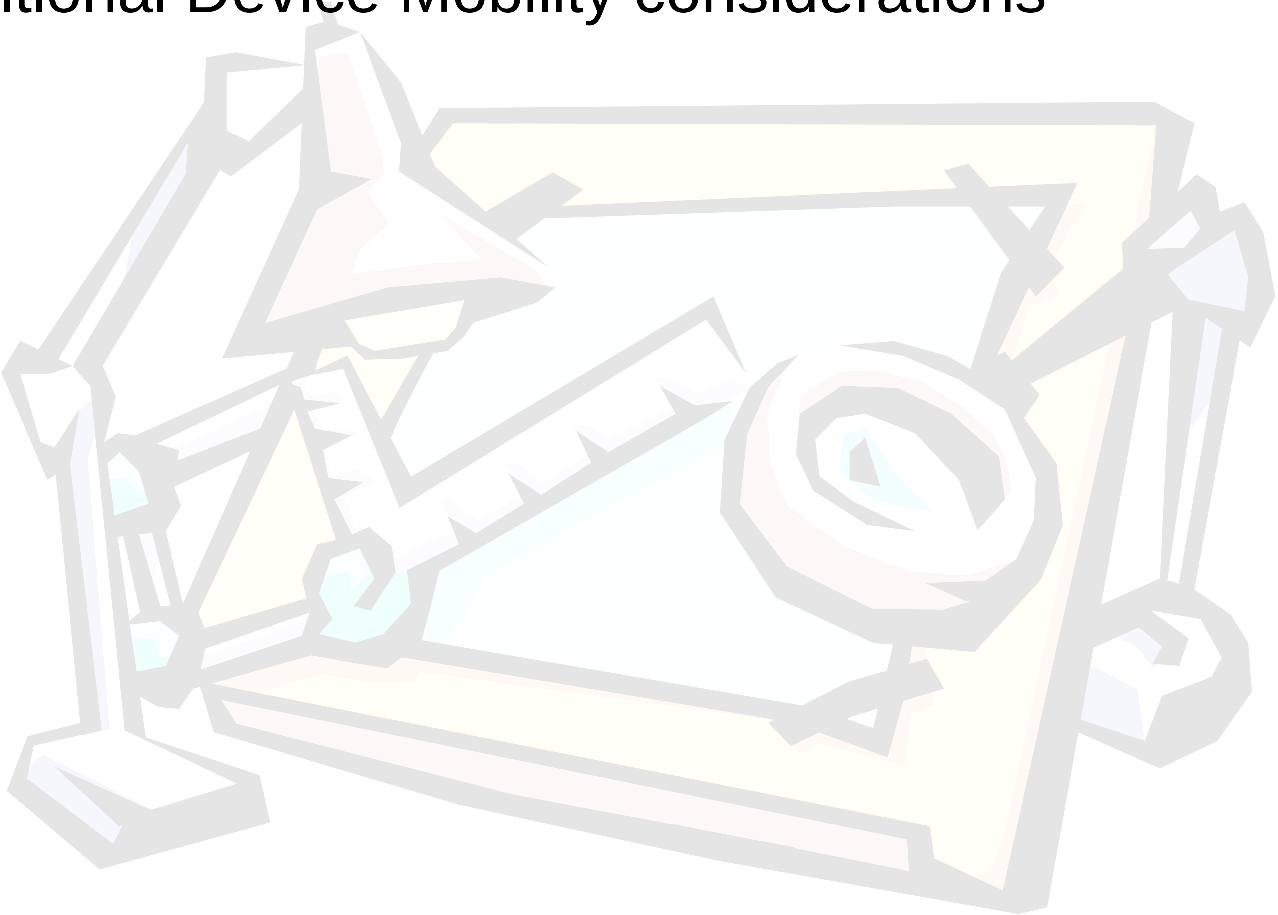
Appendix

- Additional Device Mobility considerations



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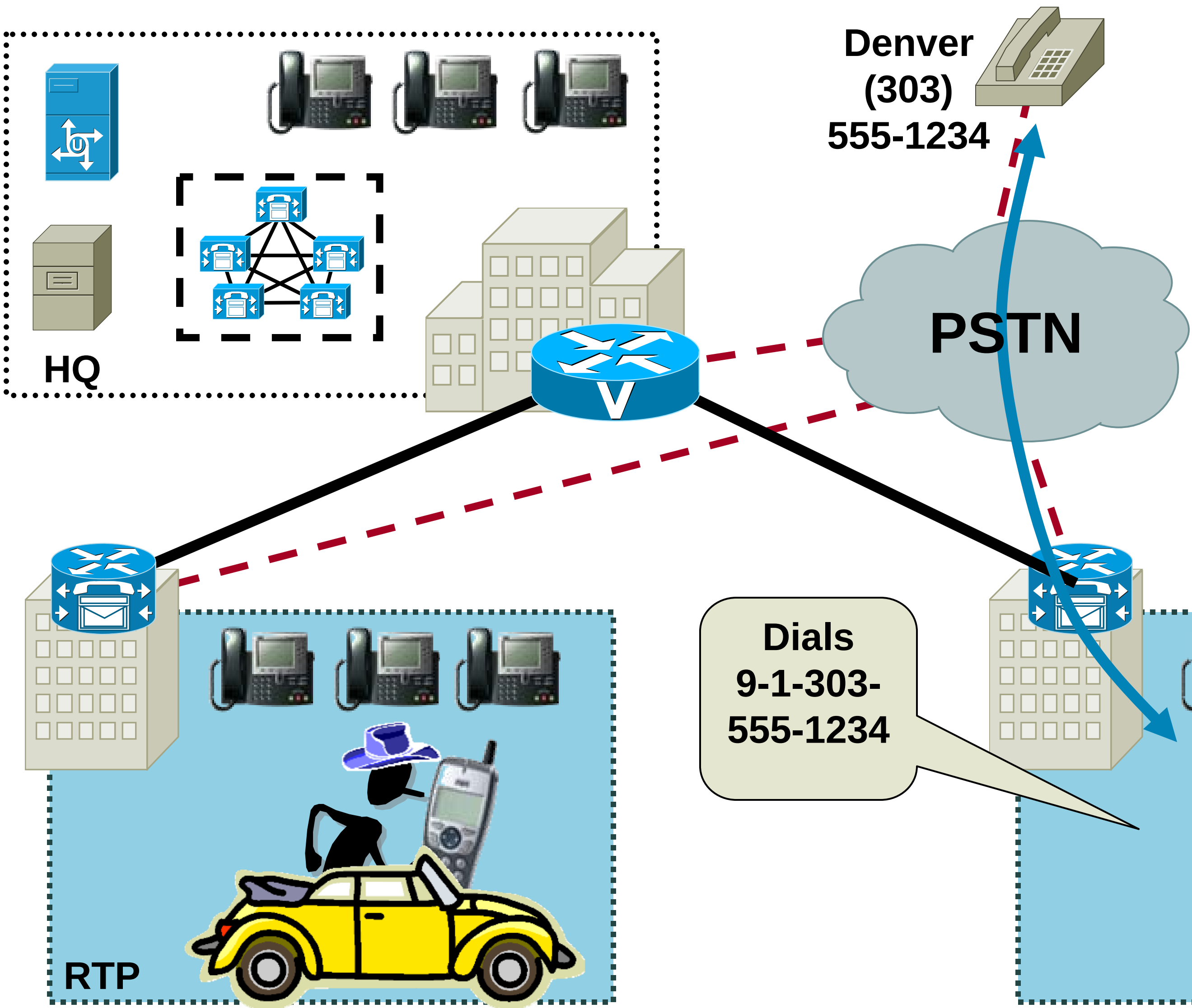
Device Mobility Considerations

Requirements



- PSTN call uses "roaming" gateway
- Location CAC is aware of the call
- WAN bandwidth not consumed

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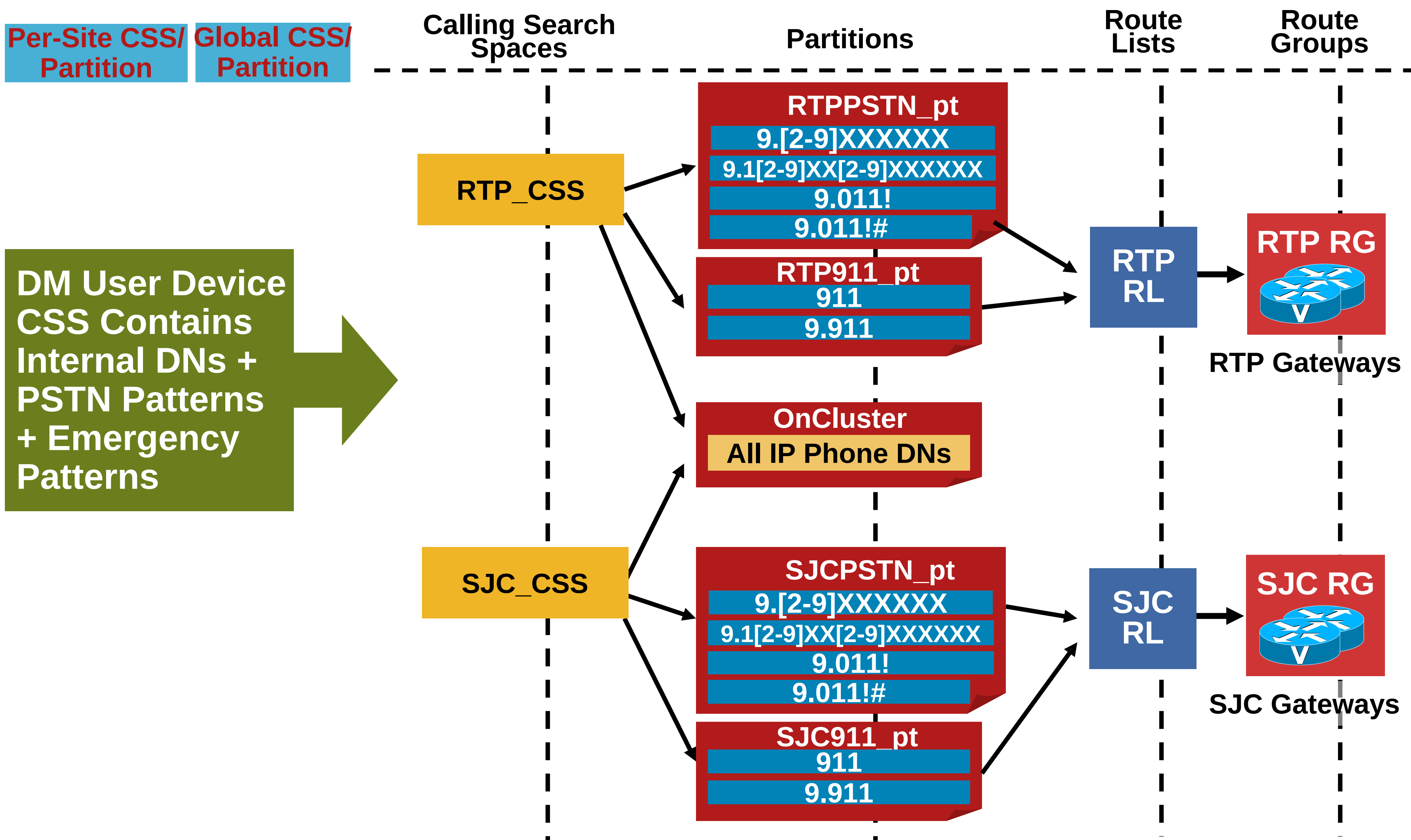
Device Mobility Considerations

Traditional Dial Plan Approach



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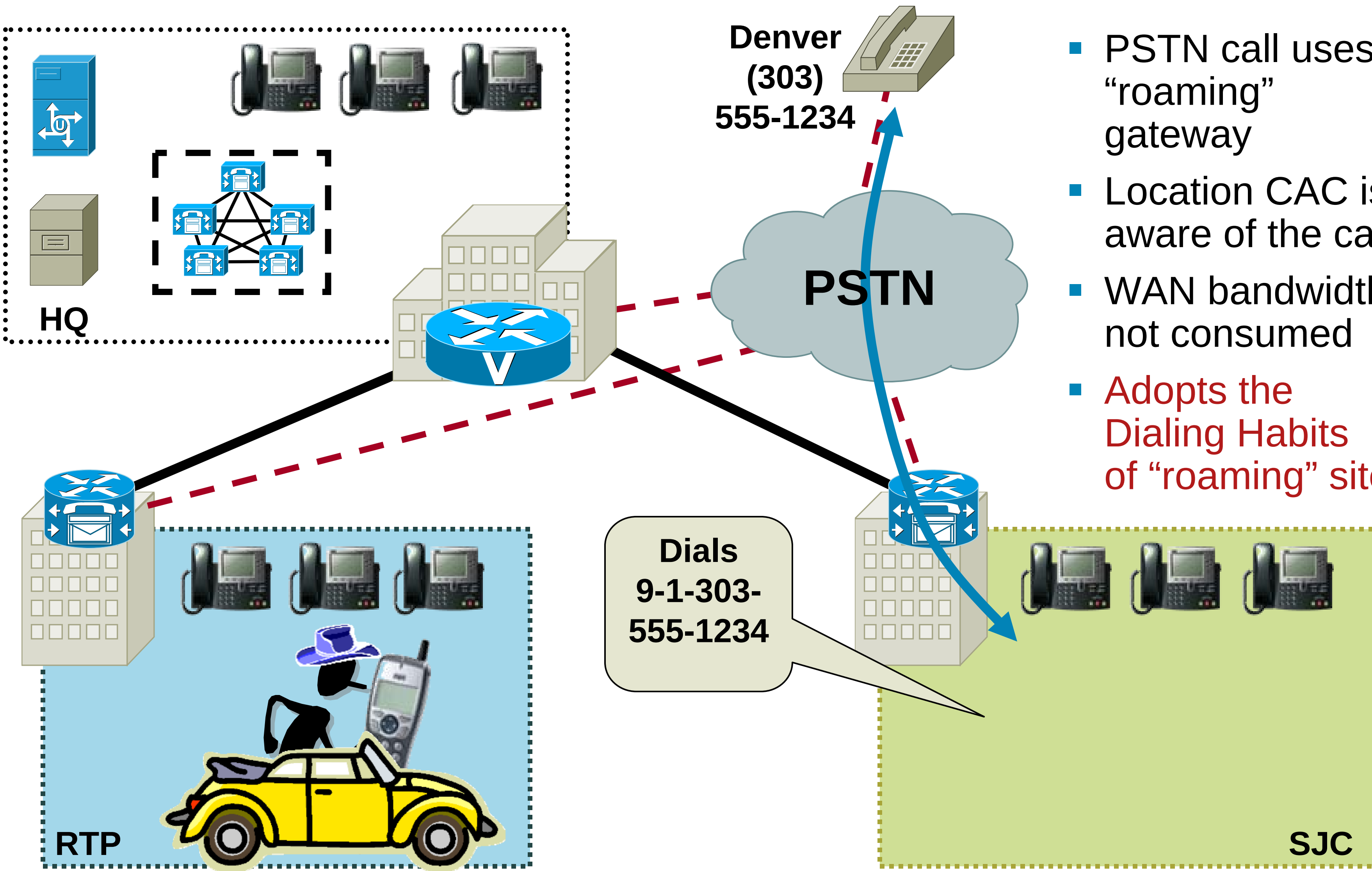
Device Mobility Considerations

Traditional Dial Plan Approach: Behavior



- PSTN call uses “roaming” gateway
- Location CAC is aware of the call
- WAN bandwidth not consumed
- Adopts the Dialing Habits of “roaming” site

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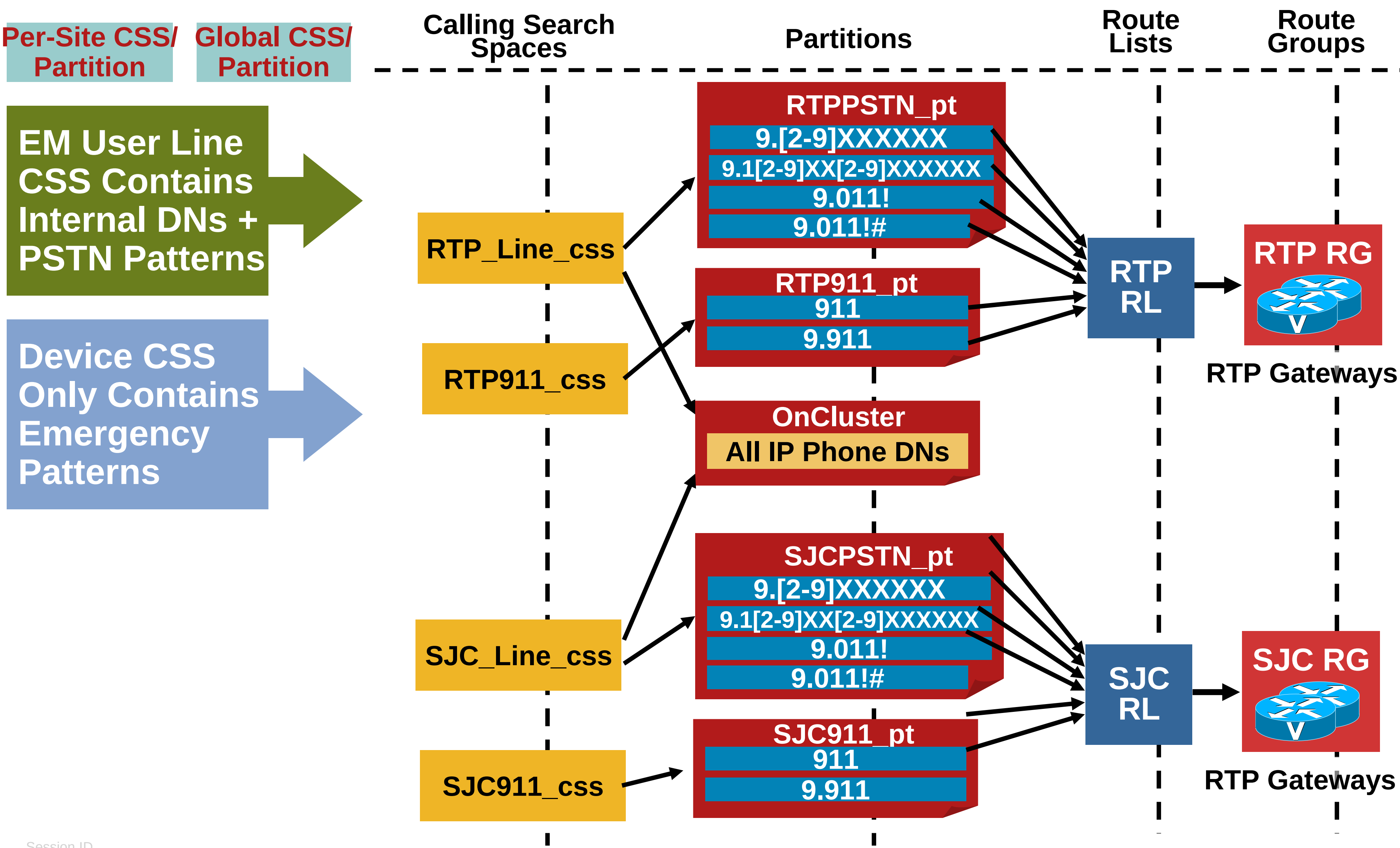
Device Mobility Considerations

Traditional Dial Plan Approach (EM Approach)



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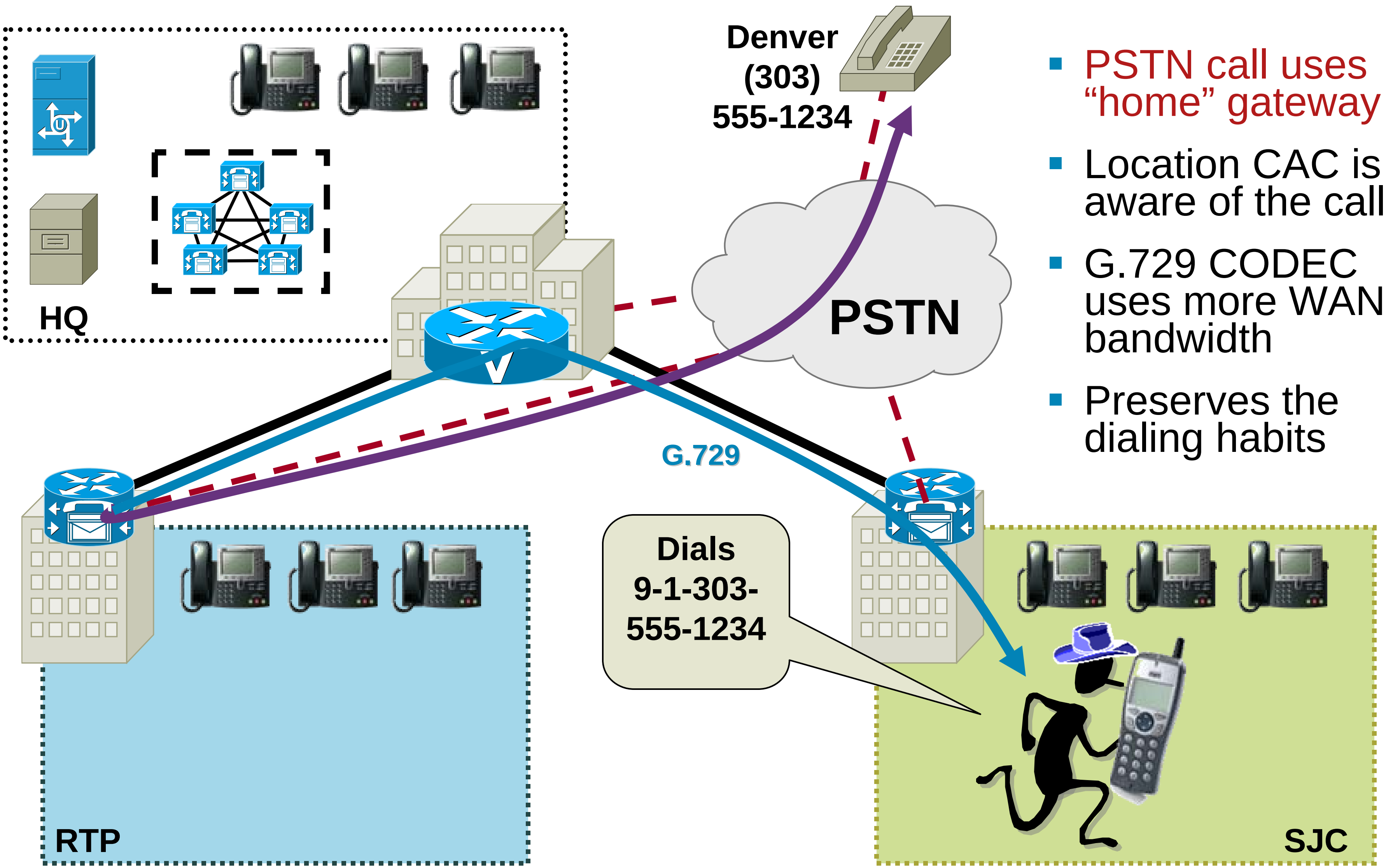
Device Mobility Considerations

Traditional Dial Plan (EM Approach): Behavior



- PSTN call uses "home" gateway
- Location CAC is aware of the call
- G.729 CODEC uses more WAN bandwidth
- Preserves the dialing habits

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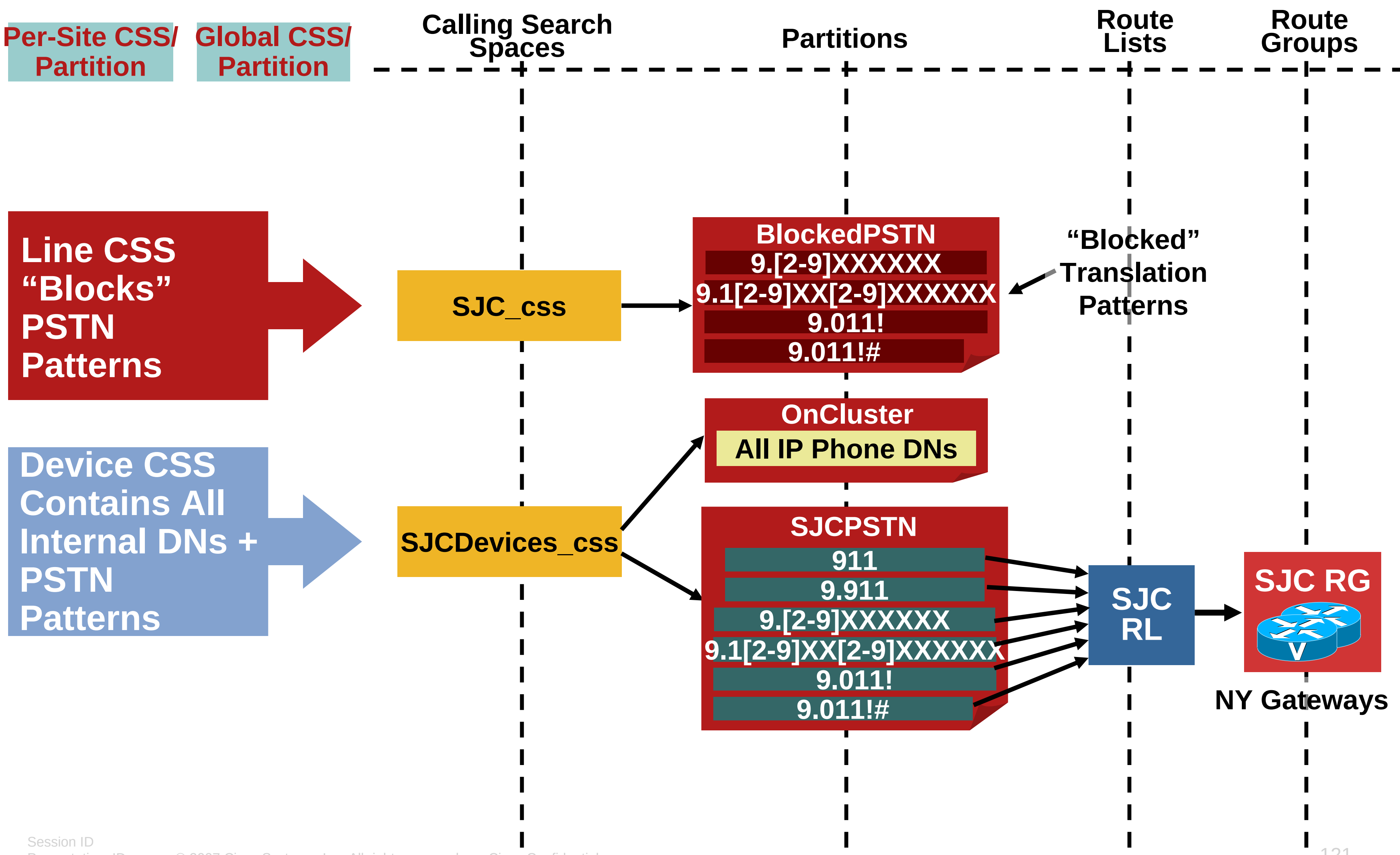
Device Mobility Considerations

Line/Device Dial Plan Approach



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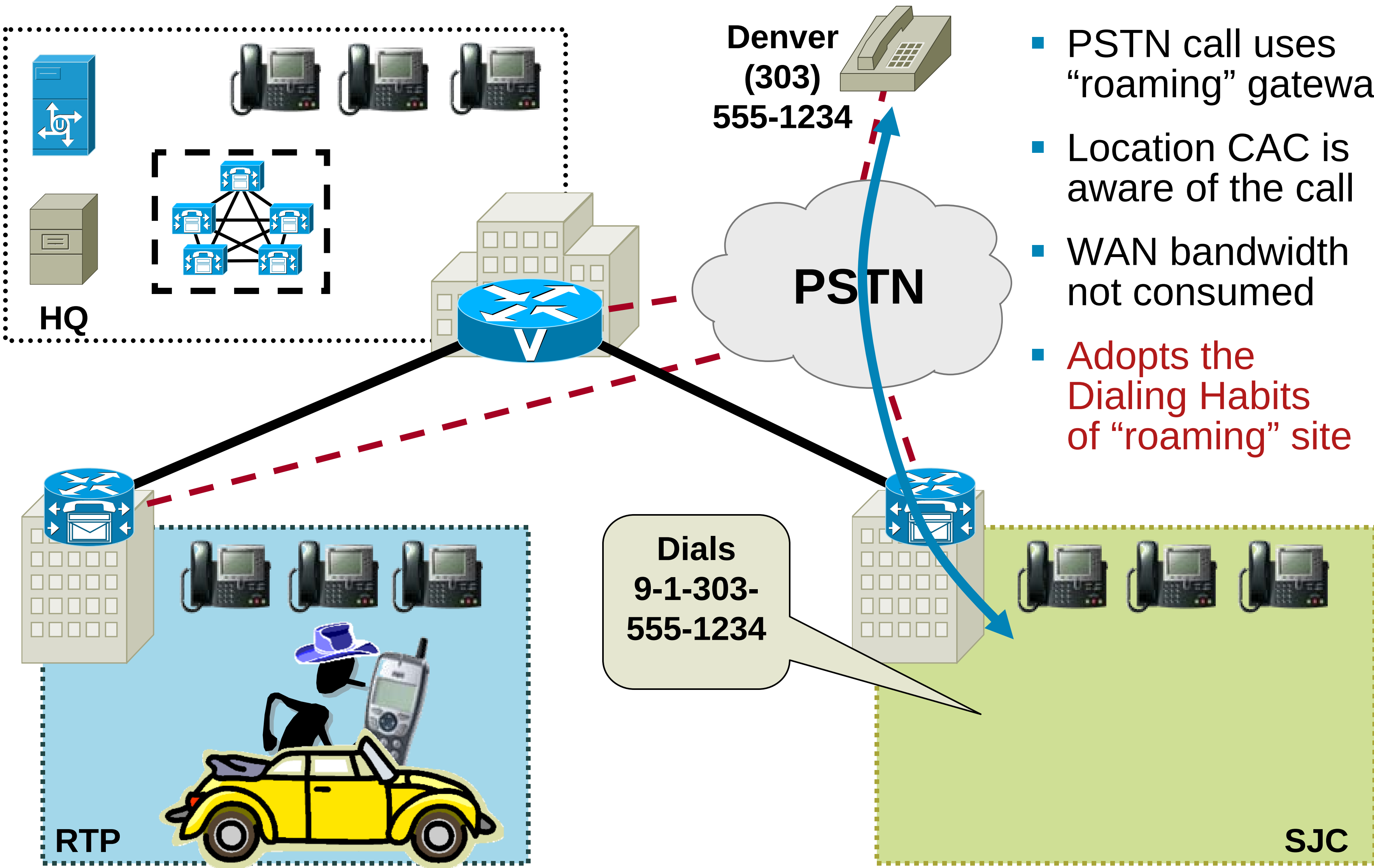
Device Mobility Considerations

Line/Device Dial Plan Approach: Behavior



- PSTN call uses “roaming” gateway
- Location CAC is aware of the call
- WAN bandwidth not consumed
- Adopts the Dialing Habits of “roaming” site

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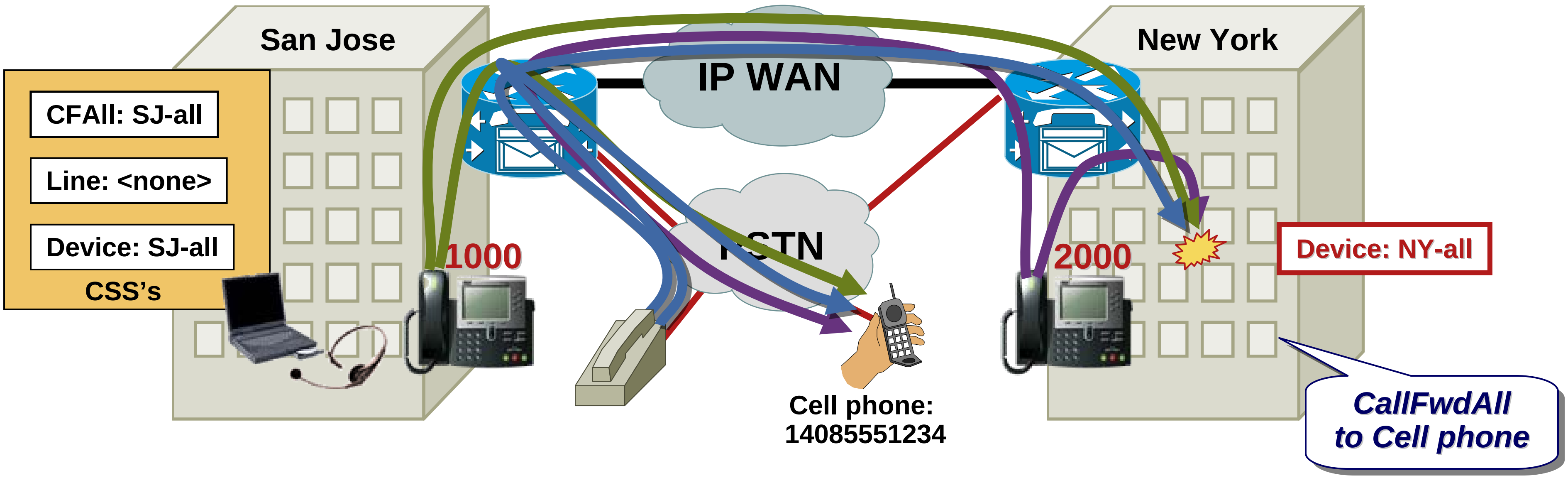
Device Mobility Consideration

Line/Device Dial Plan Approach: Forwarded Calls



- When a SJ user moves to NY site and forwards his phone to a PSTN number:

  Calls from SJ IP phones use SJ PSTN GW

  Calls from PSTN users get hairpinned at the SJ PSTN GW

  Calls from NY IP phones cross the WAN and use SJ PSTN GW

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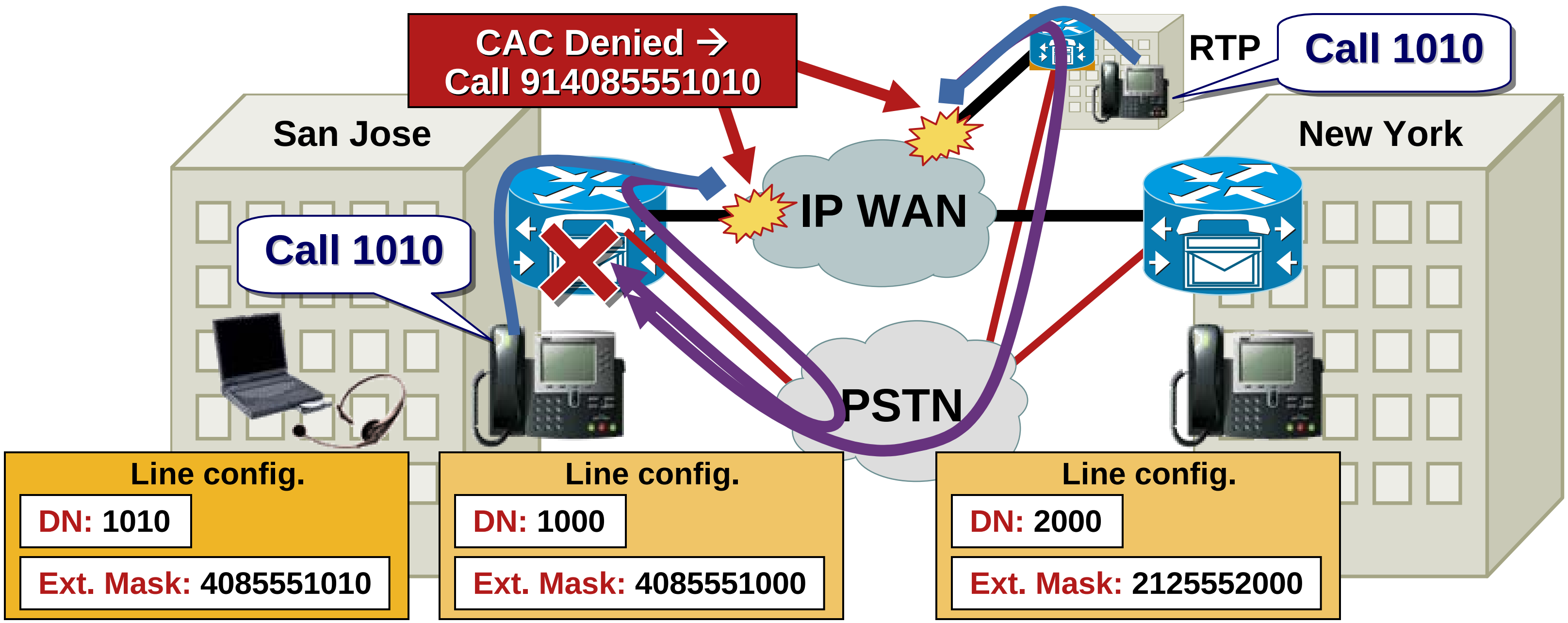
Device Mobility Considerations

AAR Interactions



- AAR is inherently incompatible with device mobility across sites (same as for EM across sites)
- When DM users move to different site, they cannot be reached via AAR from other sites (DIDs don't move!)
- Ensure that GW CSS's contain internal numbers only to prevent routing loops

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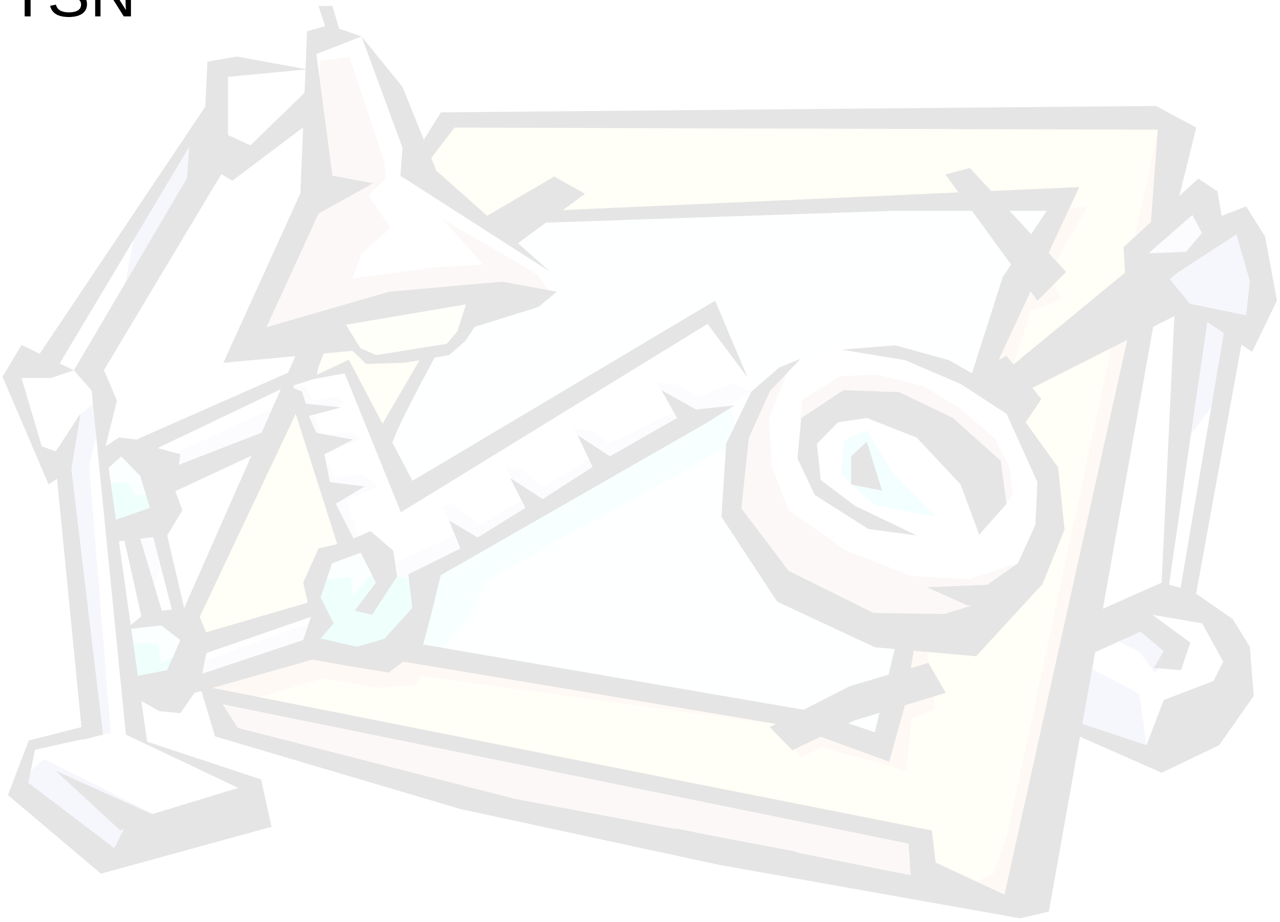
Appendix

- VoPTSN



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What Is Voice over the PSTN (VoPSTN)?

- A variation on the Centralized Call Processing deployment model, where all intersite voice goes over the PSTN (not the WAN)
- We are not “promoting it”: merely setting requirements and expectations
- There are several, fundamental limitations
- Relies on AAR configuration

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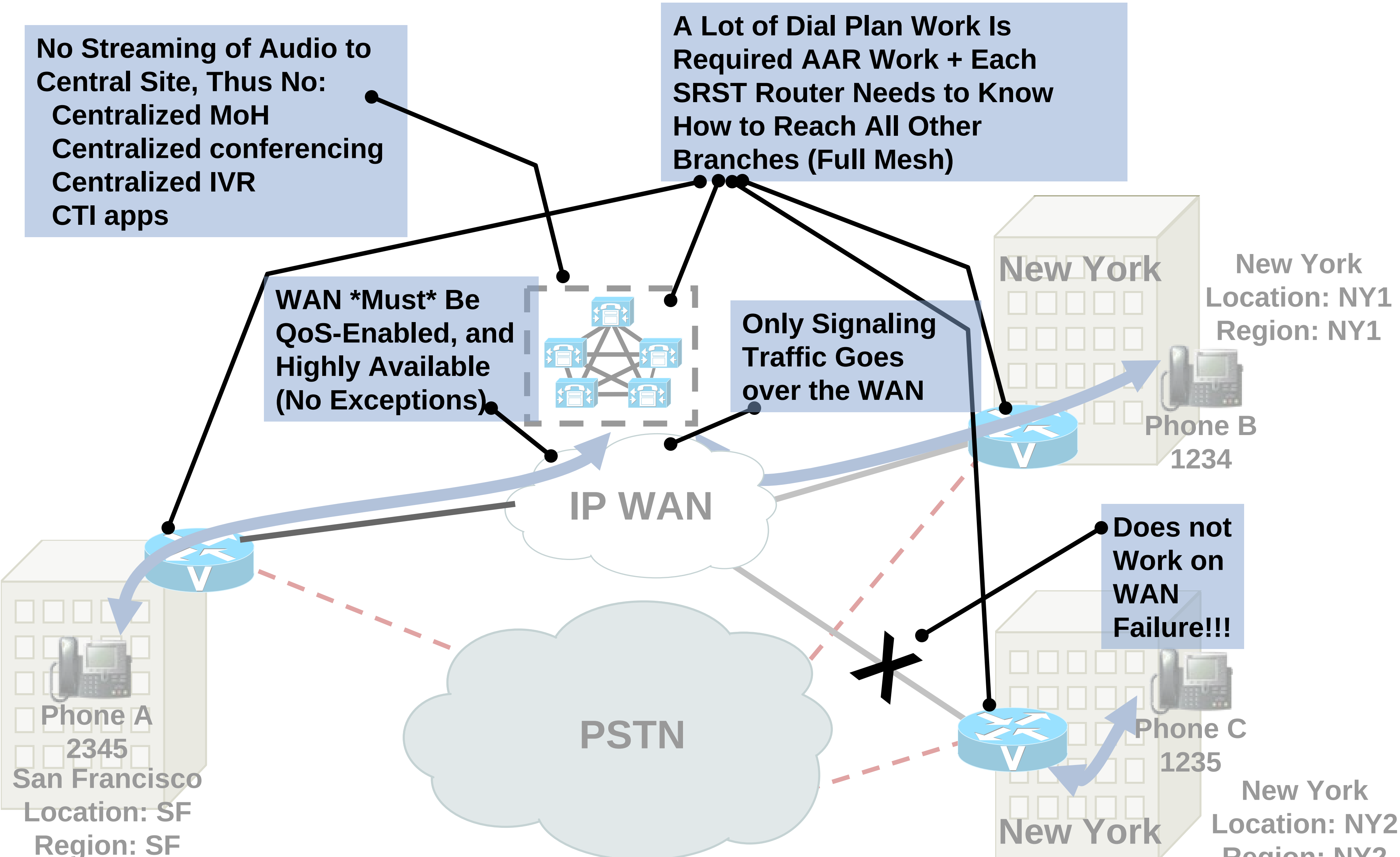
VoPSTN Using AAR

Global Considerations



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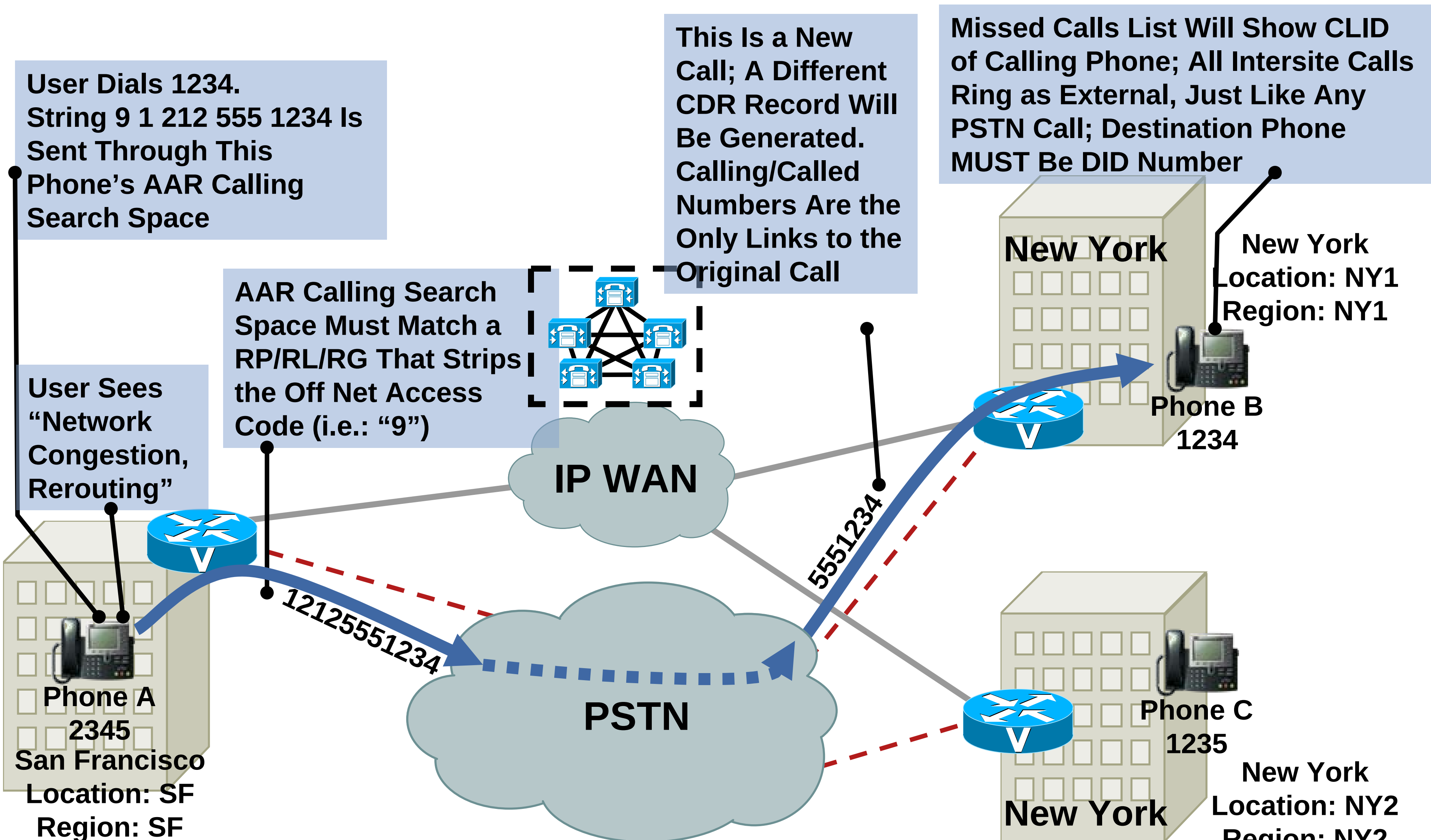
VoPSTN Using AAR

Intersite Calls



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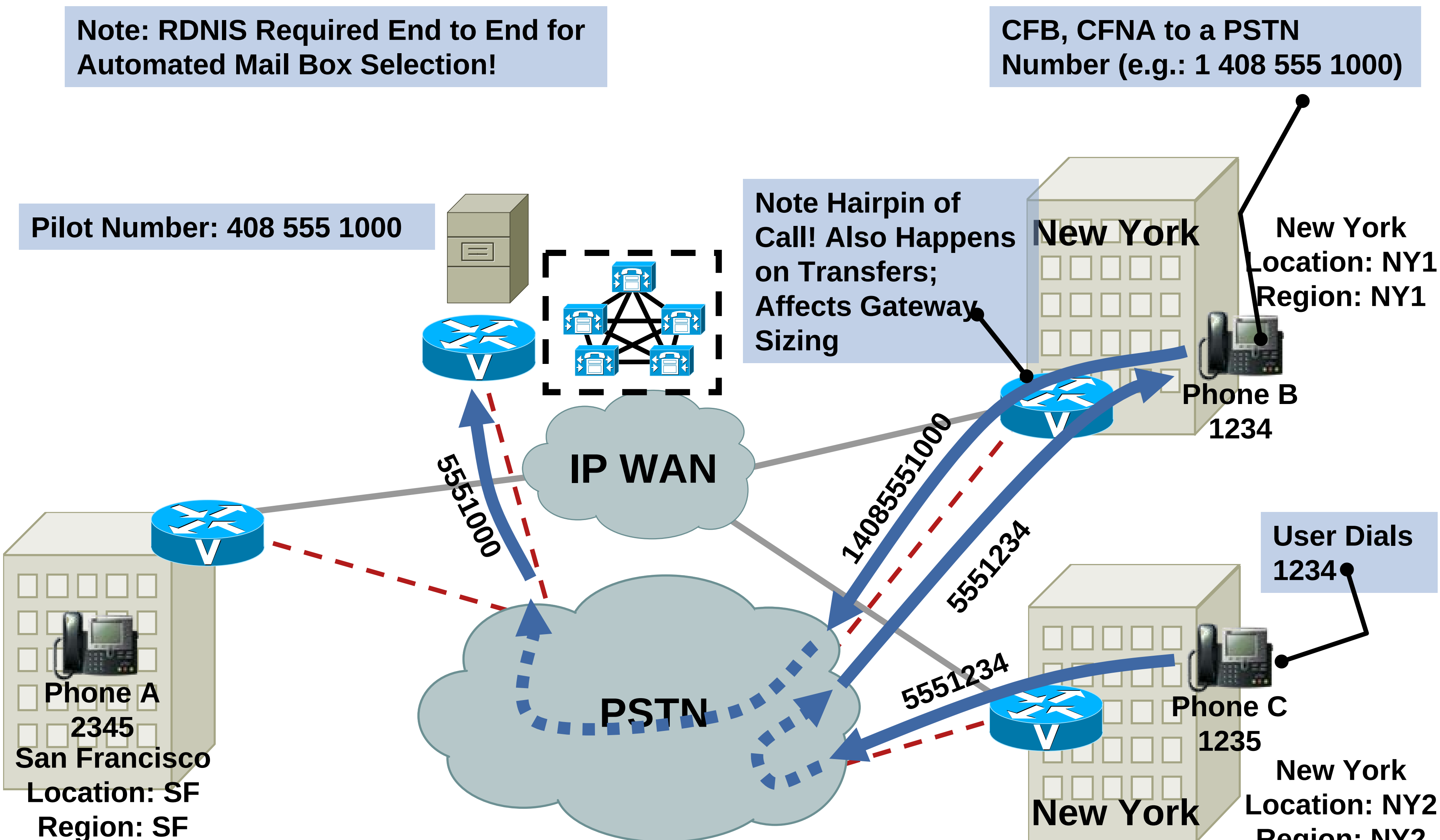
VoPSTN Using AAR
Centralized Voicemail



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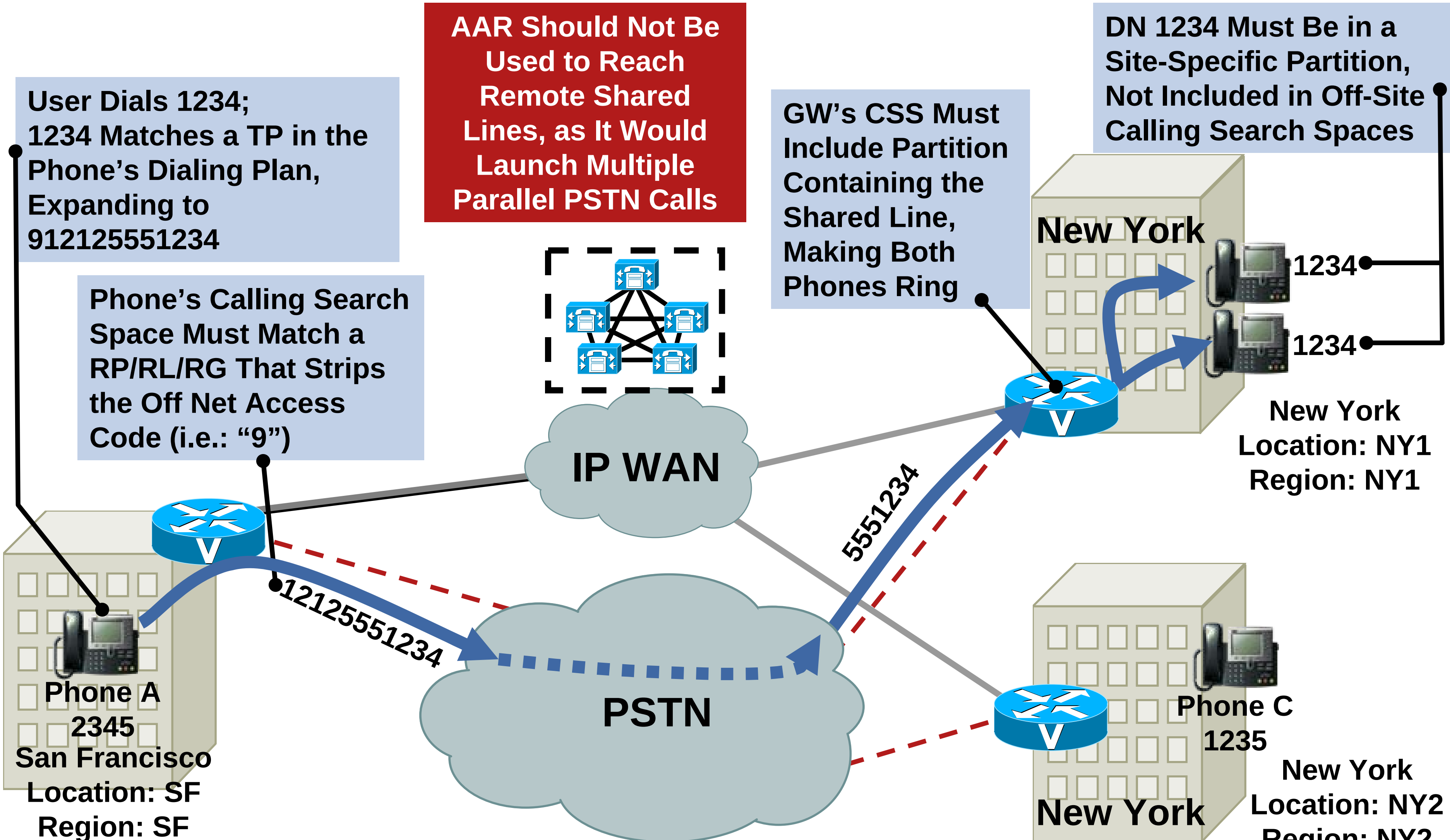
VoPSTN Using AAR

Shared Lines Considerations



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VoPSTN Using AAR

Summary

- Only accommodates SCCP destinations
- RDNIS required for centralized VMAIL
- Extension mobility not possible
- No difference between PSTN and Interbranch calls (one ring type)
- Two CDR records for every call (minimum); more if CallFwd invoked
- All intersite calls display Network Congestion, rerouting
- No shared line support across branches
- All destinations must be DID
- Does not work during WAN interruption
- No centralized MoH
- No centralized conferencing
- All transferred calls are hairpinned
- All calls forwarded to outside locations are hairpinned
- If you tailor the WAN for signaling only, no attendant console in remote sites, due to directory access BW
- QoS is REQUIRED on the WAN
- High availability is required on the WAN: SRST does not make up for a bad link, only a dead one

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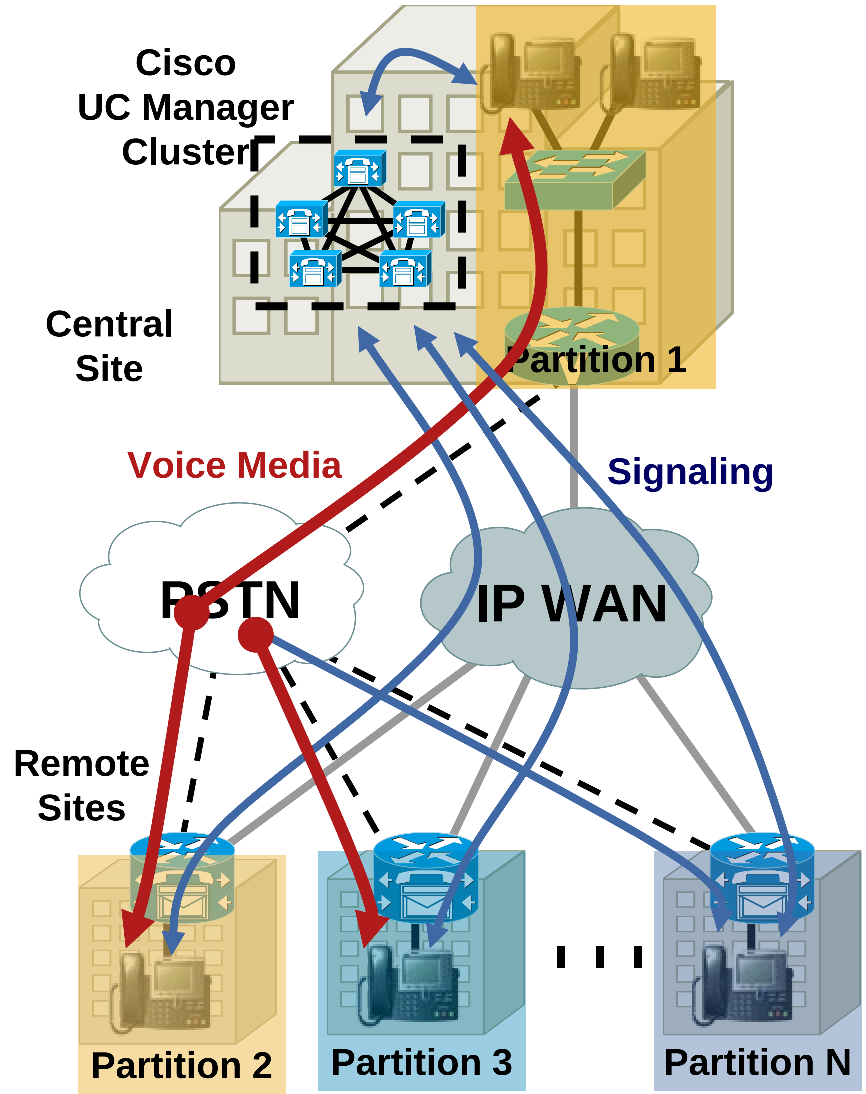
VoPSTN Using Dial Plan

Key Points

- DN's at each site are placed in different partitions
- Relies on PSTN route patterns to call other sites
- For Cisco UC Manager, all calls are external calls
- No "on-net" features across sites (e.g. CallBack)
- No easy migration to fullblown VoIP
- Note: Abbreviated dialing possible with translation rules on branch GW's



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