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Leveraging SIP to Simplify Dial Plans Both Inside and Outside the Enterprise

BRKUCC-2008

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#clmel

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Agenda

- URI dialling in Unified CM
- ILS/Global Dial Plan Replication in Unified CM
- Routing SIP requests in Unified CM
- Key concepts of recommended +E.164 dial plan design
- Directory lookups in Jabber for Windows
- Topologies for Inter-Cluster ILS/GDPR Routing
- GDPR Applications
- ExpressWay for B2B
- Conclusion

URI Dialling in Unified CM

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SIP URI

What Is It?

- SIP URIs identify communications resources
- general form: sip:user:password@host:port;uri-parameters?headers
- user is optional, but Cisco UCM does not support URIs w/o user
- uri-parameters and headers are optional
- password not recommended
- host: fqdn, ipv4 or ipv6; Cisco UCM does not support ipv6
- user is case sensitive, host is case insensitive (per RFC 3261)*:
  Jkrohn@cisco.com != jkrohn@cisco.com
- 7 bit ASCII only
- example: sip:jkrohn@cisco.com:5060

*In Cisco UCM 9.1 this behaviour is configurable

URI Routing/Dialling

- Why
  - Native dialling method in SIP based video equipment
  - Extend support for SIP video endpoints registered with Cisco UCM
  - Unambiguous dialling from directories
  - better integration with other call controls where URI dialling is the native dialling habit (e.g. VCS)
  - Enables easier B2B video call routing
- Limitations
  - URIs can not be used for PSTN calls (as long as there's no mapping to E.164)
  - Limited endpoint support (+E.164/numbers might still be the native format)

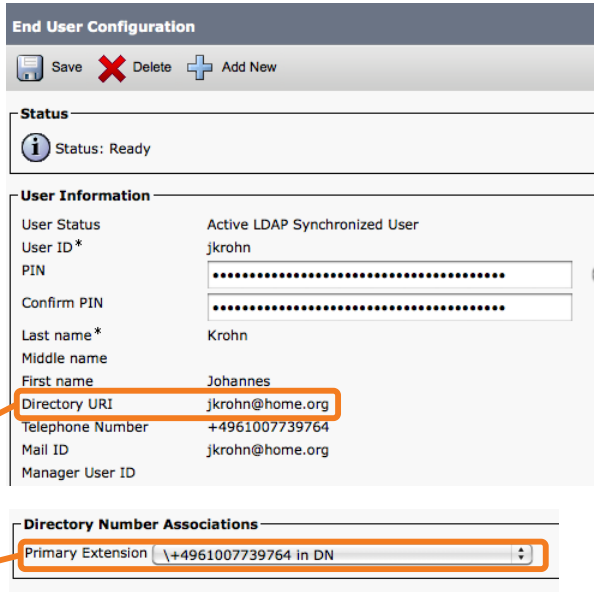
URI Dialling

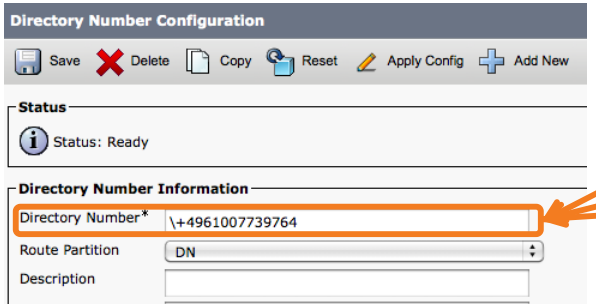
The Concept

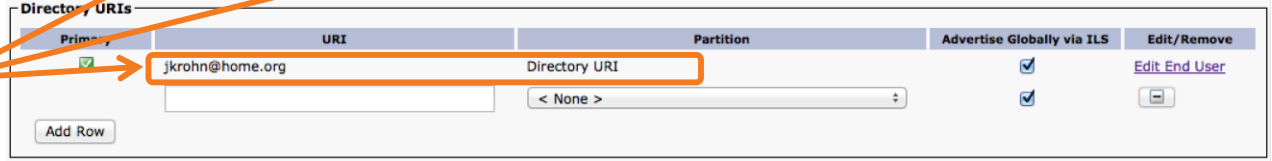
- In Cisco UCM all endpoints will still have a DN
- Alpha URI can be associated with DN on any device (not only SIP)
- Phones always register via the DN (do not necessarily even know that there is an associated alpha URI)

URIs and Directory Numbers

- Up to 5 URIs can be configured per DN
- Enduser's directory URIs are assigned to directory numbers based on enduser's primary extension; partition "Directory URI" (cannot be changed/deleted)
- other URIs can be in any partition; no need to have them in the same partition as the DN



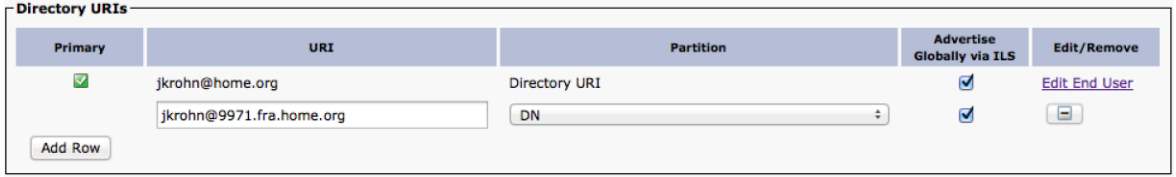




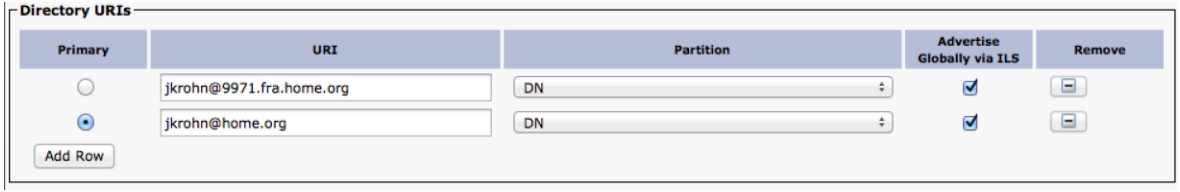
URIs and DNs

Primary URI

- One URI associated with DN is marked the primary URI
- Auto-generated URI based on user's primary extension will always be the primary URI



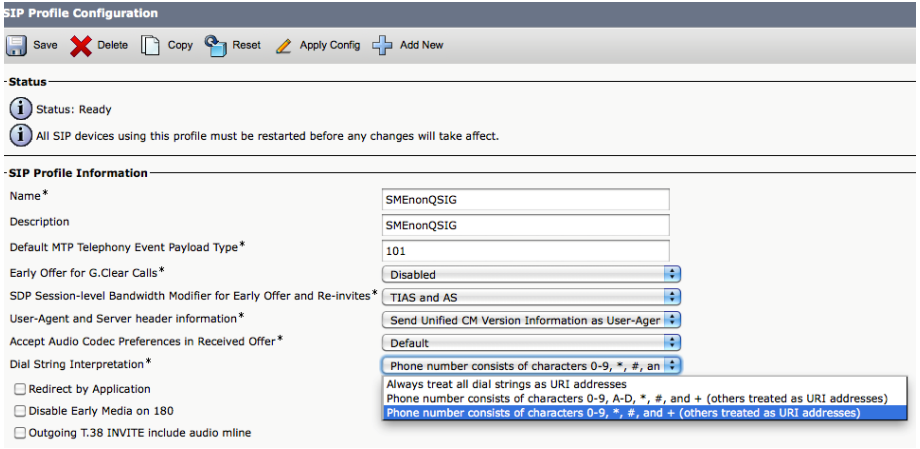
- If no auto-generated URI exists one of the other URIs can be marked "primary"
- Primary URI will be used as URI identity for calls from/to this line



Alpha URI vs. Number

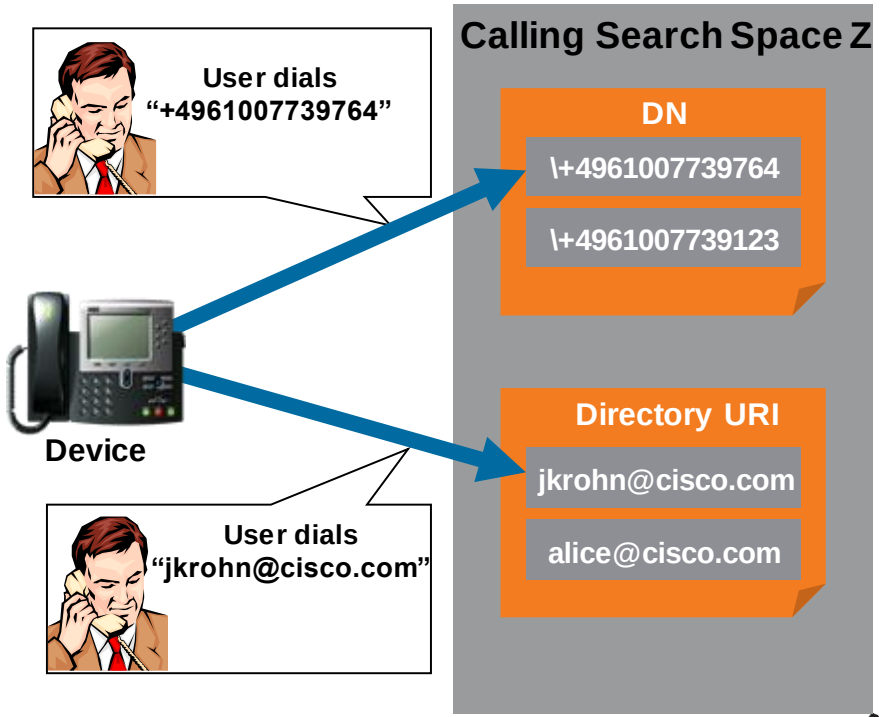
How to Differentiate Between a Number and an Alpha URI

- Dialled “numbers” can contain: +, 0-9, *, A-D
- SIP Profile now has “Dial String Interpretation” setting
- relevant for calls from endpoints and trunks
- Default: 0-9, * and + (Recommended)
- Recommendation: use un-ambiguous alpha URIs
- “user=phone” tag in request URI forces treatment as numeric URI

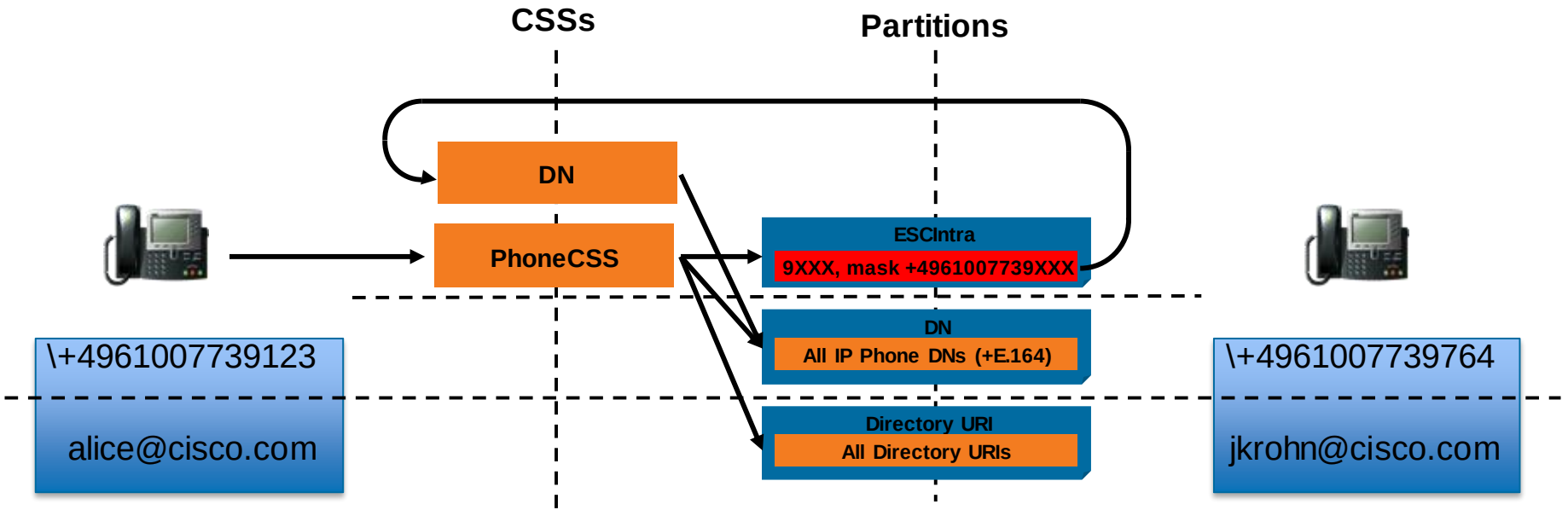


Calling URIs

- URIs can be called if the URIs' partition is member of calling CSS
- CSSs can contain DN and URI partitions
- partitions can contain DNs and URIs
- CSS/partition logic for URIs is identical to DN logic



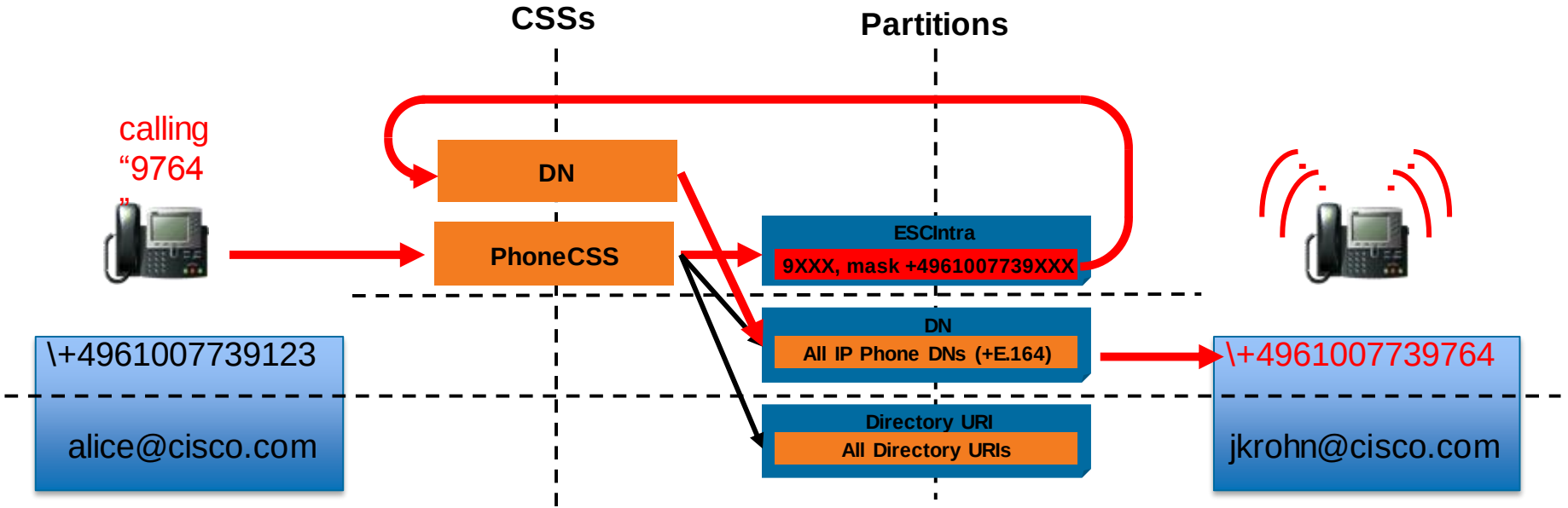
Independent Call Routing



- Typical dial plan e.g. has translation patterns to transform intra-site dialling to DN format
- This translation pattern might also have calling party transformations

Independent Call Routing

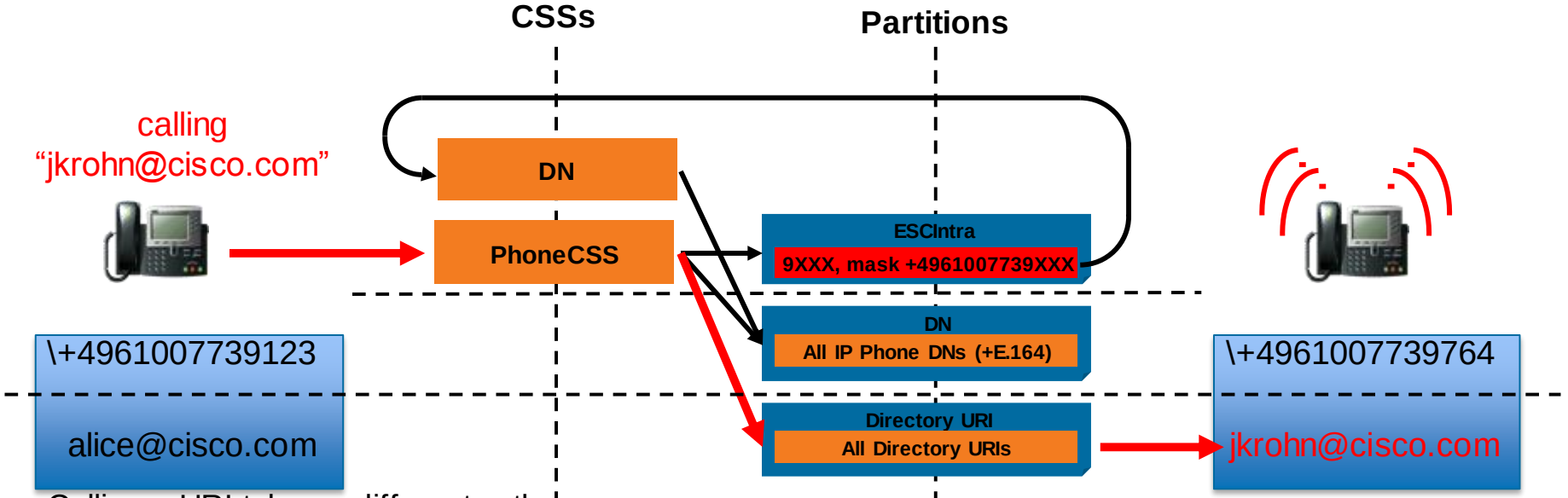
Dialling a Number



- Intra-site dialling is a two-step process (normalise and route)
- Normalisation translation pattern might impose calling party transformations (in addition to called party transformations)

Independent Call Routing

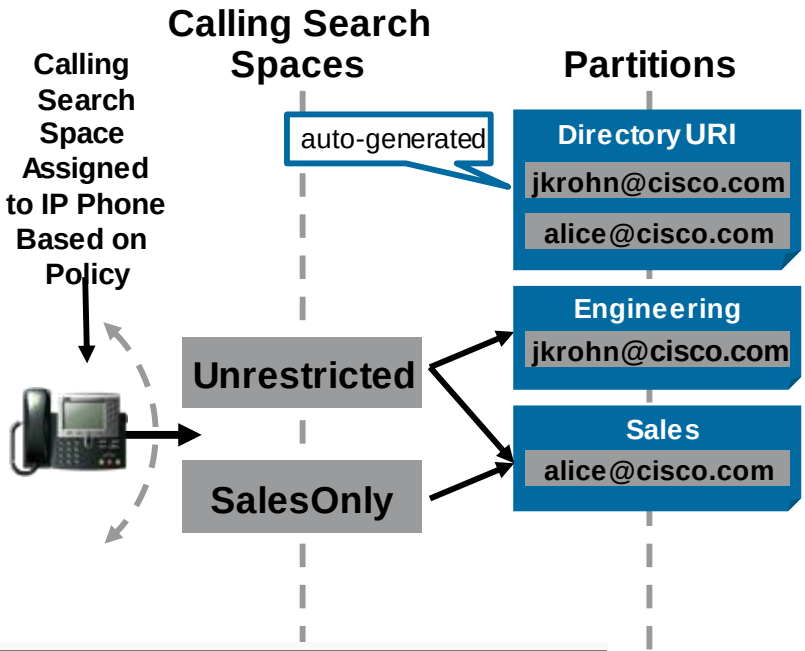
Dialling an Alpha URI

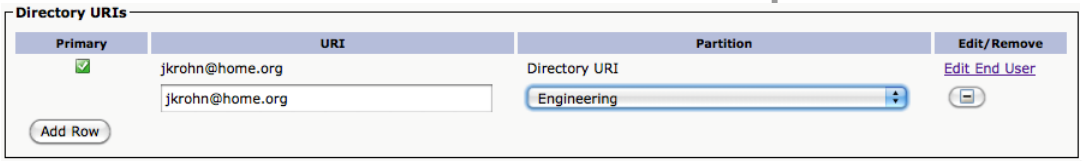


- Calling a URI takes a different path
- URI routing does not have the concept of translation patterns; no equivalence to block patterns
- Only option for calling party transformation is the outbound calls calling party transformation CSS on calling endpoint or calling endpoint’s device pool

Building CoS for URIs

- Default "Directory URI" partition will have ALL auto-generated user based URIs
- No way to differentiate different user groups based on auto-generated user based URIs
- If different user groups are required you need to explicitly provision the URIs in user group specific partitions and create appropriate CSSes



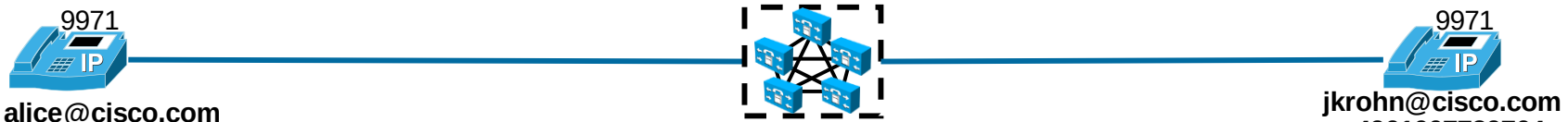


Identities

- In CUCM alpha URIs are assigned to DNs
- DNs are the “primary” identity
- devices register using DNs
- DN or alpha URI? What is the “correct” identity to be presented during calls?
  - mainly depends on the capabilities of devices involved in the call
- “Blended Identity”: combination of DN and alpha URI
- CUCM can build missing piece:
  - DN → alpha URI: look at primary URI configured on DN
  - alpha URI → DN: search for DN that has the alpha URI as primary URI

Blending Identity

URI dialling to URI enabled phone



2) jkrohn is an alpha URI!

3) blend DN for calling party:
+4961007739123 → "alice@cisco.com"

4) look up "jkrohn@cisco.com" in DA

5) blend called party:
jkrohn@cisco.com → +4961007739764

6) INVITE w/ RPID
<sip:alice@cisco.com;x-cisco-number: +4961007739123>

7) RINGING

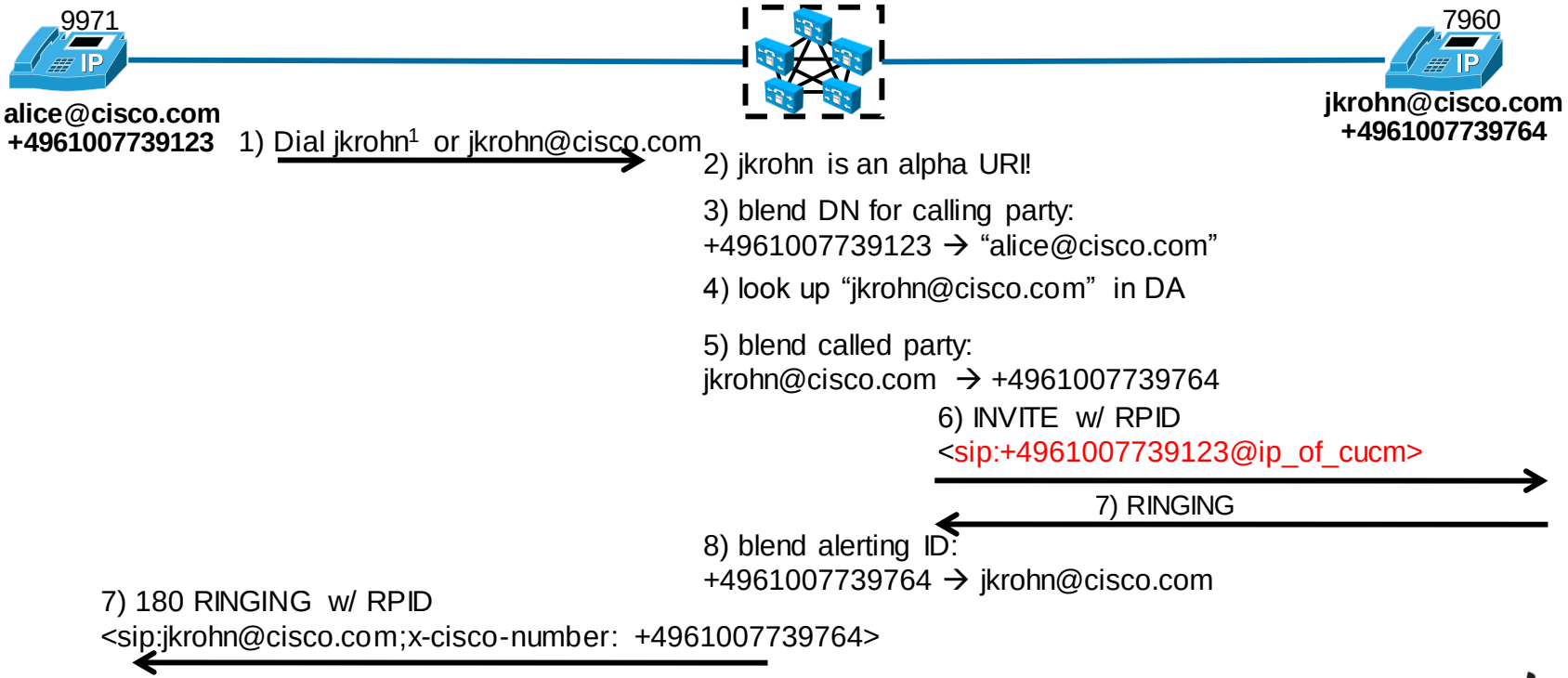
8) blend alerting ID:
+4961007739764 → jkrohn@cisco.com

7) 180 RINGING w/ RPID
<sip:jkrohn@cisco.com;x-cisco-number: +4961007739764>

[1]if domain is missing CUCM will add OTLD configured in CUCM enterprise parameters

Blending Identity

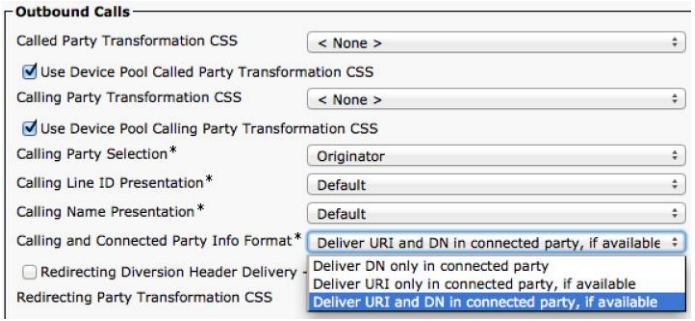
URI dialling to non URI enabled phone



[1]if domain is missing CUCM will add OTLD configured in CUCM enterprise parameters

Blended Identity Delivery

- RPID carries both: alpha URI and number
  - Remote-Party-ID:<sip:jkrohn@cisco.com;x-cisco-number=+4961007739764>
- Headers affected:
  - Remote-Party-ID, Diversion, P-Asserted-ID (trunk only), P-Preferred-Identity (trunk only).
- Trunk setting to define what should be sent as identity on trunks (calling/connected ID)



Blended Identity Delivery for Registered Phones

- Blended identity on trunk only sent if URI and DN provisioned and trunk is configured appropriately:

Trunk calling and connected party format	DN and URI provisioned	Only DN provisioned
Deliver DN only	DN	DN
Deliver URI only	URI	DN
Deliver URI and DN	URI and DN	DN

Blended Identity Delivery on SME

Incoming ID	Outgoing trunk setting	Sent ID
Blended	DN only	Numeric
Blended	URI only	URI
Blended	URI and DN	URI and DN
URI	*	URI (no incoming x-cisco-number tag available)
Numeric only	*	Numeric

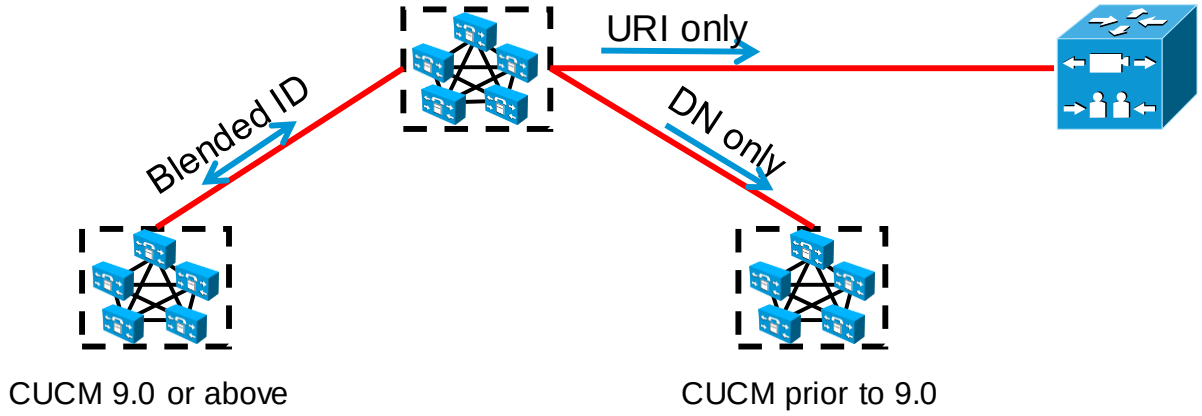
- Basically incoming RPID is sent on unchanged.
- Exception: incoming blended ID available and outgoing trunk forces DN or URI

Blended Identity Delivery to Endpoints

- CUCM tries to only deliver alpha identity to endpoints that support this
- Alpha URI identity problematic on endpoints that don't support URI dialling:
  - no call-back
  - "strange" display
- This can happen when CUCM only has alpha ID for a given call leg
  - Originating system only sent alpha ID (VCS registered endpoint)
  - Numeric ID blocked on transit ("URI only" on trunk)

Blended ID in Complex Topologies

- Always send blended ID (as long as receiving side supports blended ID)
- If receiving side does not support blended ID (VCS) use “DN only” or “URI only” to set the preferred ID method



Global Dial Plan Replication in Unified CM

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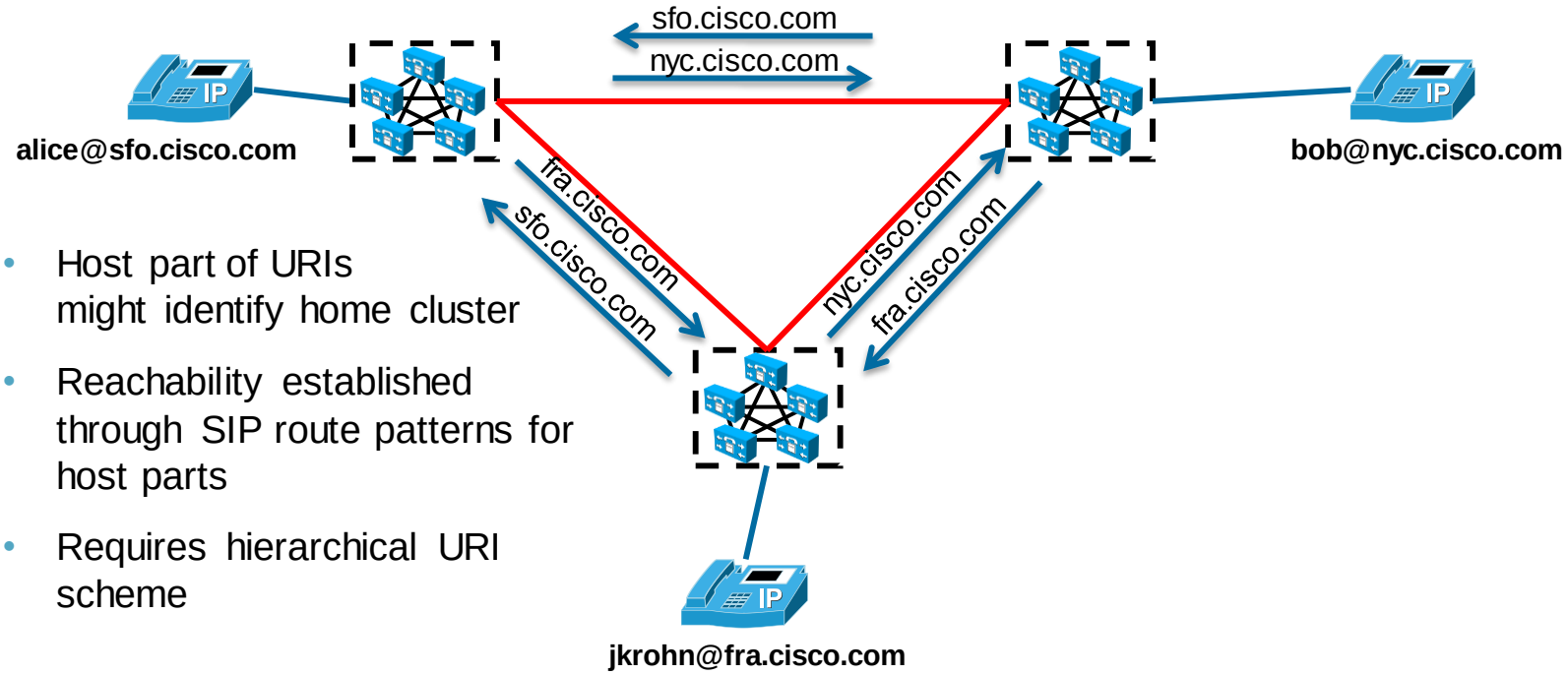
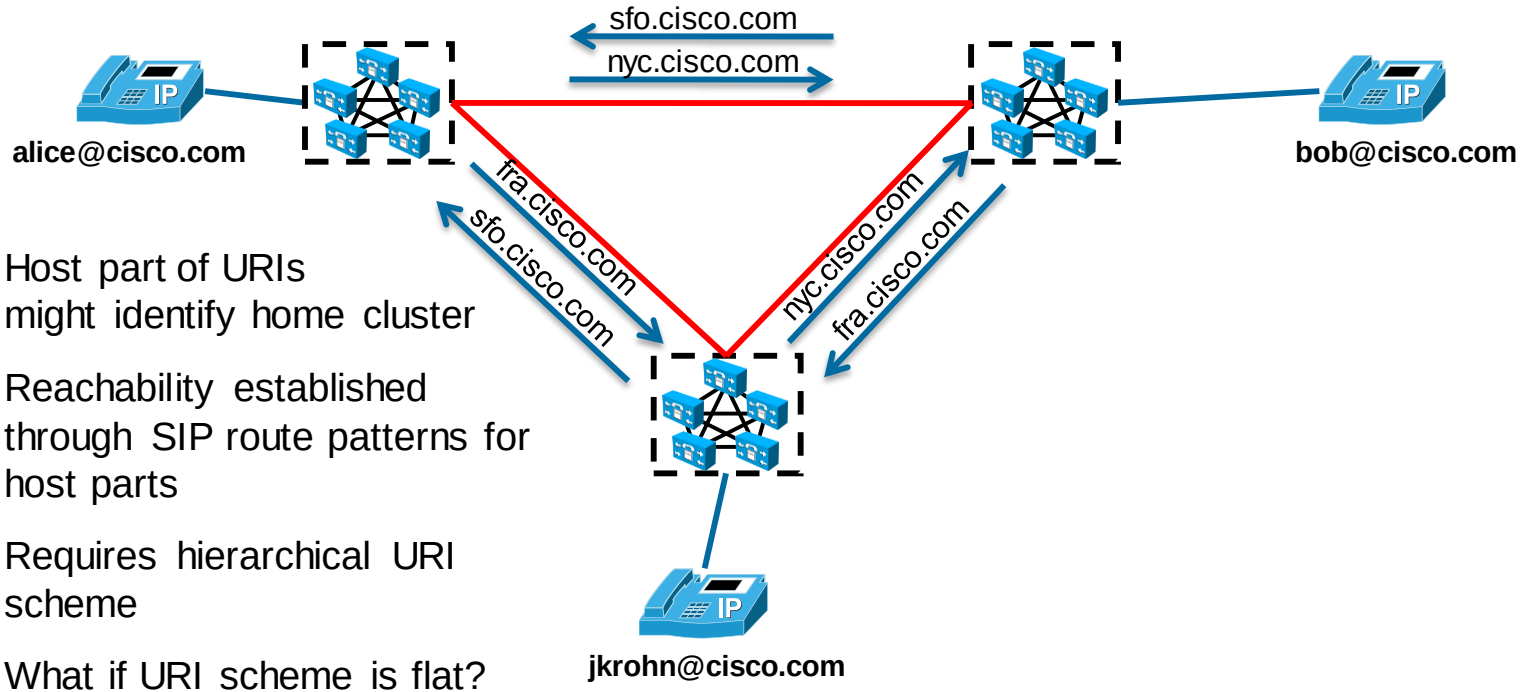
Multicluster URI Routing



- Host part of URIs might identify home cluster
- Reachability established through SIP route patterns for host parts
- Requires hierarchical URI scheme

Multicluster URI Routing



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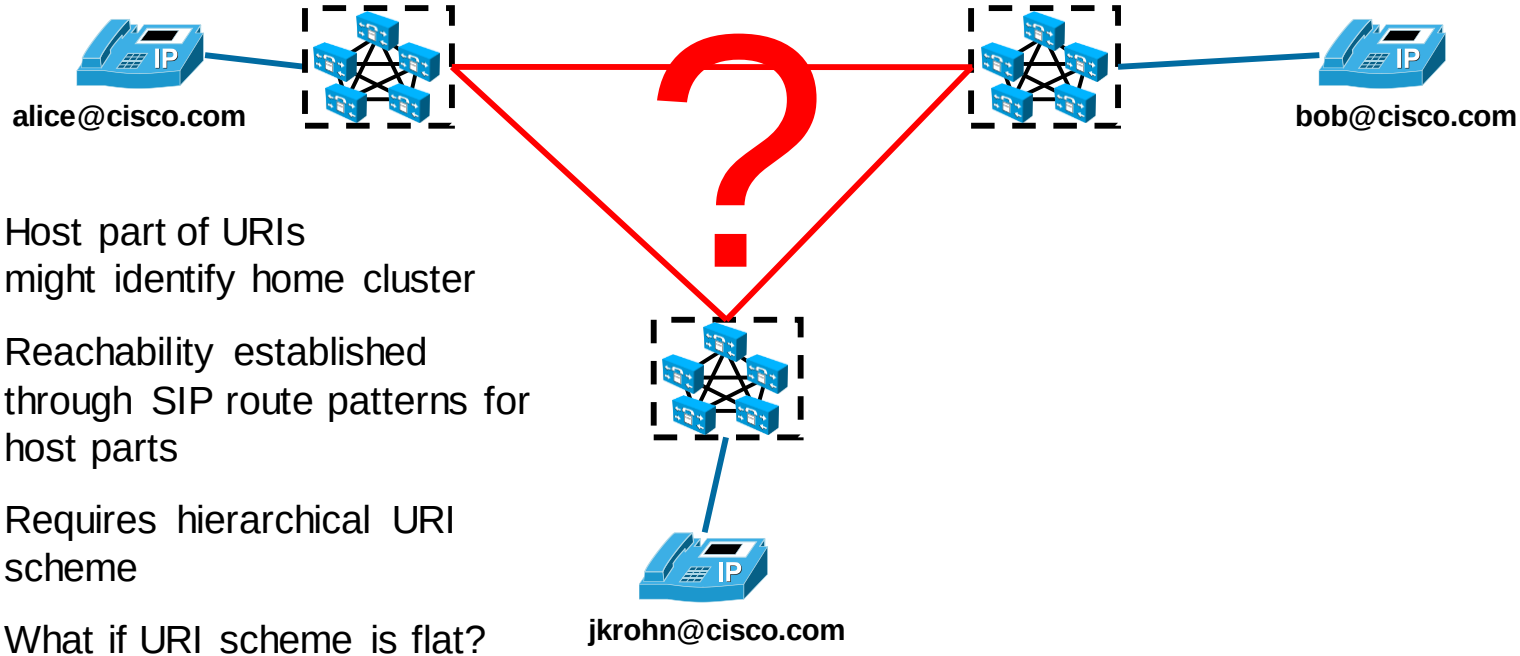
- Requires hierarchical URI scheme
- What if URI scheme is flat?

Multicluster URI Routing

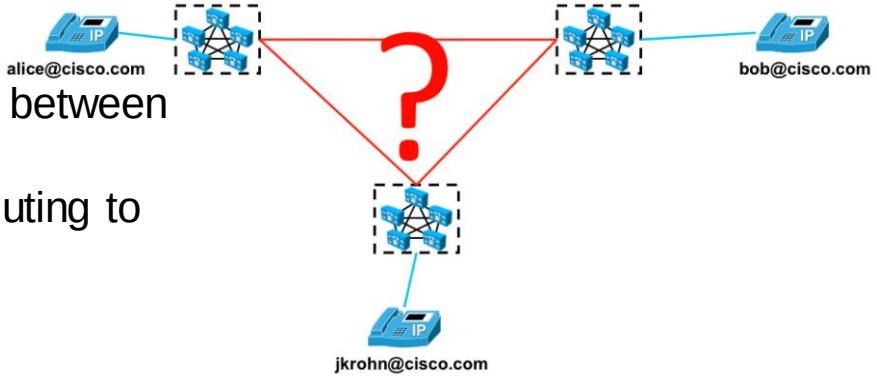


- Host part of URIs might identify home cluster
- Reachability established through SIP route patterns for host parts
- Requires hierarchical URI scheme
- What if URI scheme is flat?

Intercluster Lookup Service (ILS)

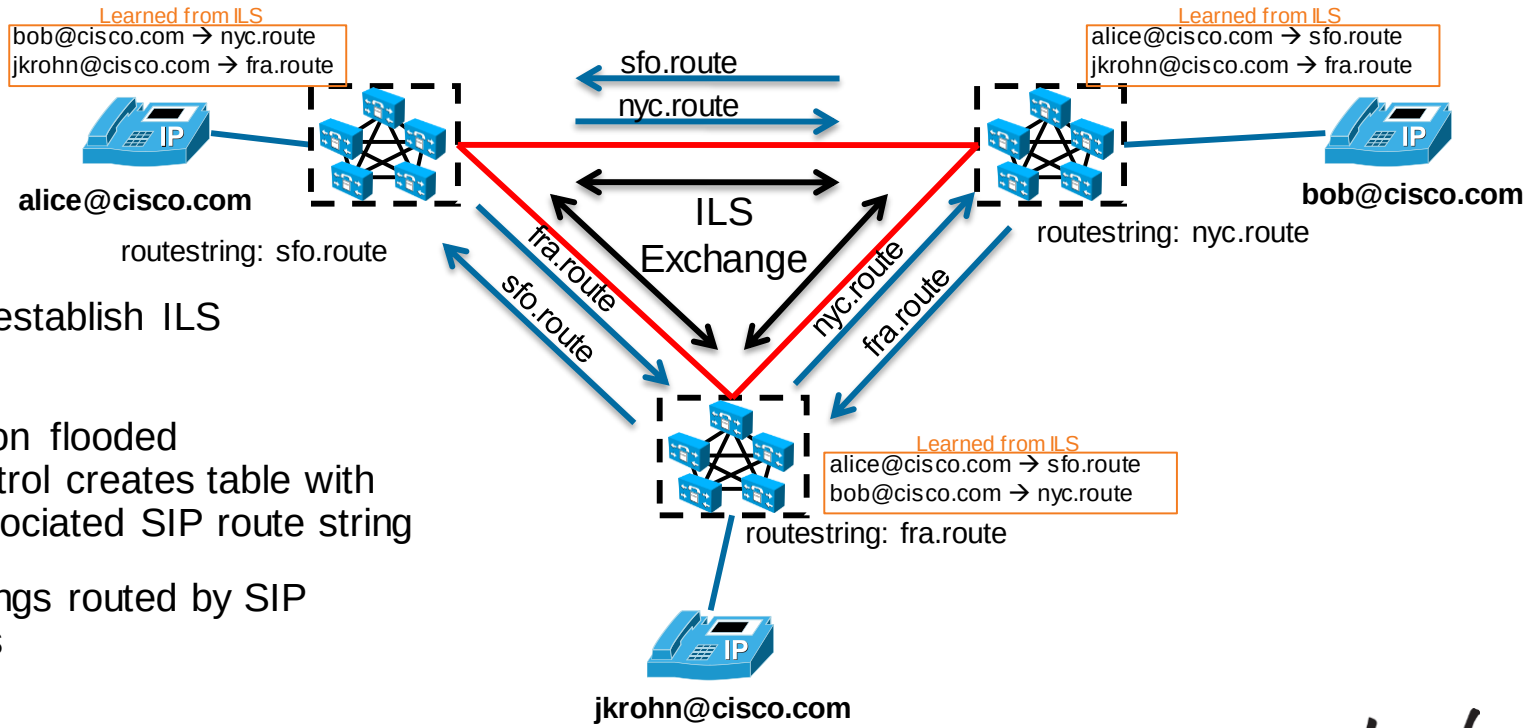
Fundamental idea

- Need mechanism that
  - allows propagation of individual alpha URIs between call controls
  - binds alpha URI with attribute that allows routing to URI's home cluster



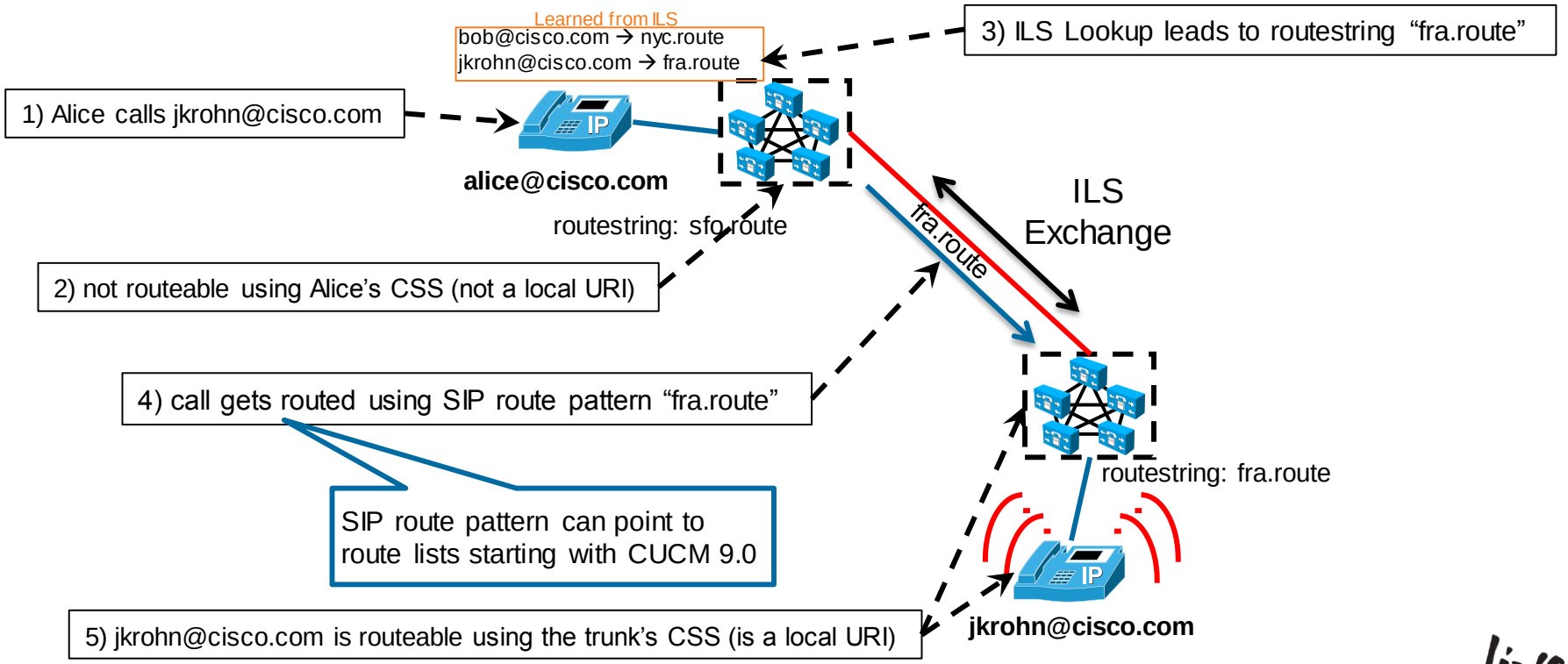
- ILS
  - each call control replicates it's alpha URIs to it's neighbours
  - each call control also announces "SIP route string" together with the alpha URIs
  - "SIP route string" can be routed based on SIP route patterns → intercluster routing of alpha URIs not based on URIs' host part, but on SIP route string

ILS Learning



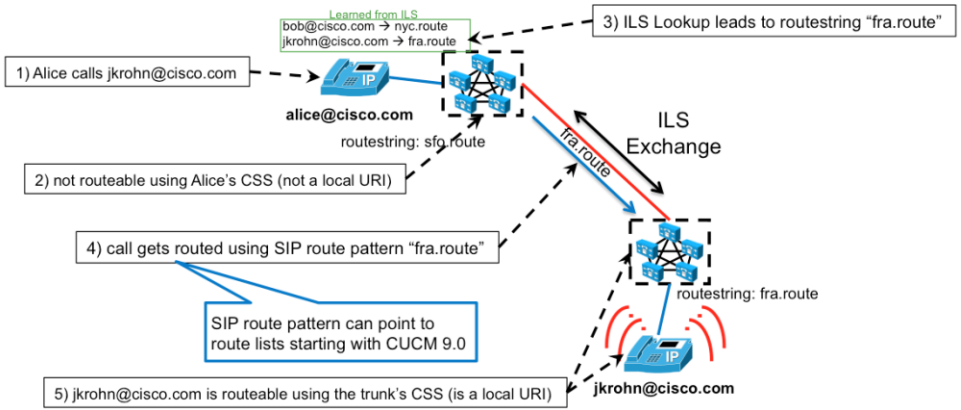
- Call controls establish ILS Exchange
- URI information flooded
  Each call control creates table with URIs and associated SIP route string
- SIP route strings routed by SIP route patterns

Routing Alpha URI Using ILS Information



Inter-cluster URI Routing Recap

- URIs (especially flat URIs) can not be used as “addresses”; they only are identifiers
- Introduce a location attribute (SIP route string)
- Bind set of identifiers (URIs) to a common location attribute (SIP route string)
- Indirect routing: route identifiers (URIs) according to learned location attribute (SIP route string)



GDPR Concept

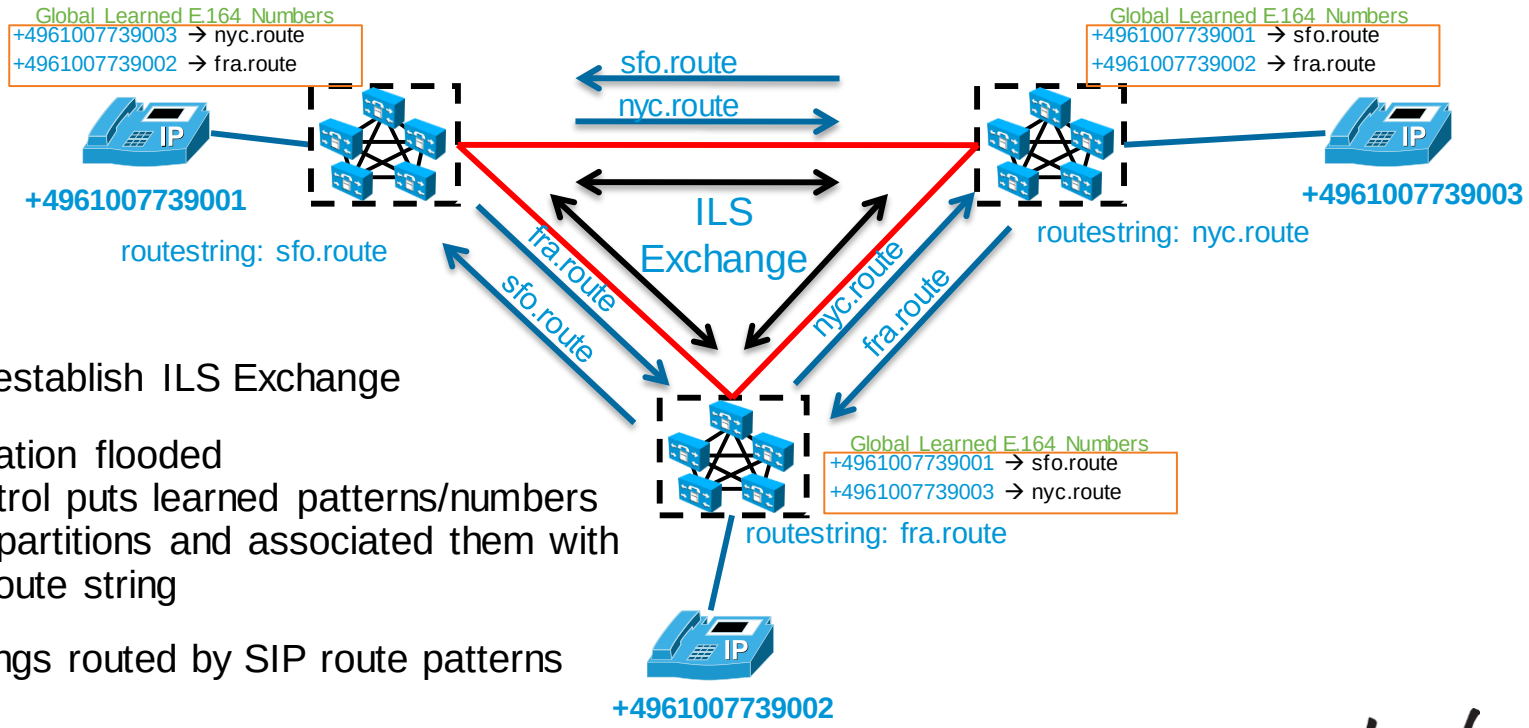
New in release 10.0

- Split identity of (E.164) numbers
  - Identifier: non-wildcarded number identifies a callable endpoint
  - Address: number/pattern used to identify the location (typically prefix based)
- Global Dial Plan Replicaton (GDPR) allows to route numeric destinations based on locaton attribute (SIP route string)
- Reachability information associated with SIP route string (location information)
  - Arbitrary topology of SIP trunks,
  - arbitrary SIP route string address space structure
- Think of splitting location from identity for +E.164 numbers
  - Location of +E.164 identifier now determined based on SIP route strings (locators)
  - “LISP” for +E.164 ☺
- DN is the key identity (address) in Communications Manager

GDPR Concept

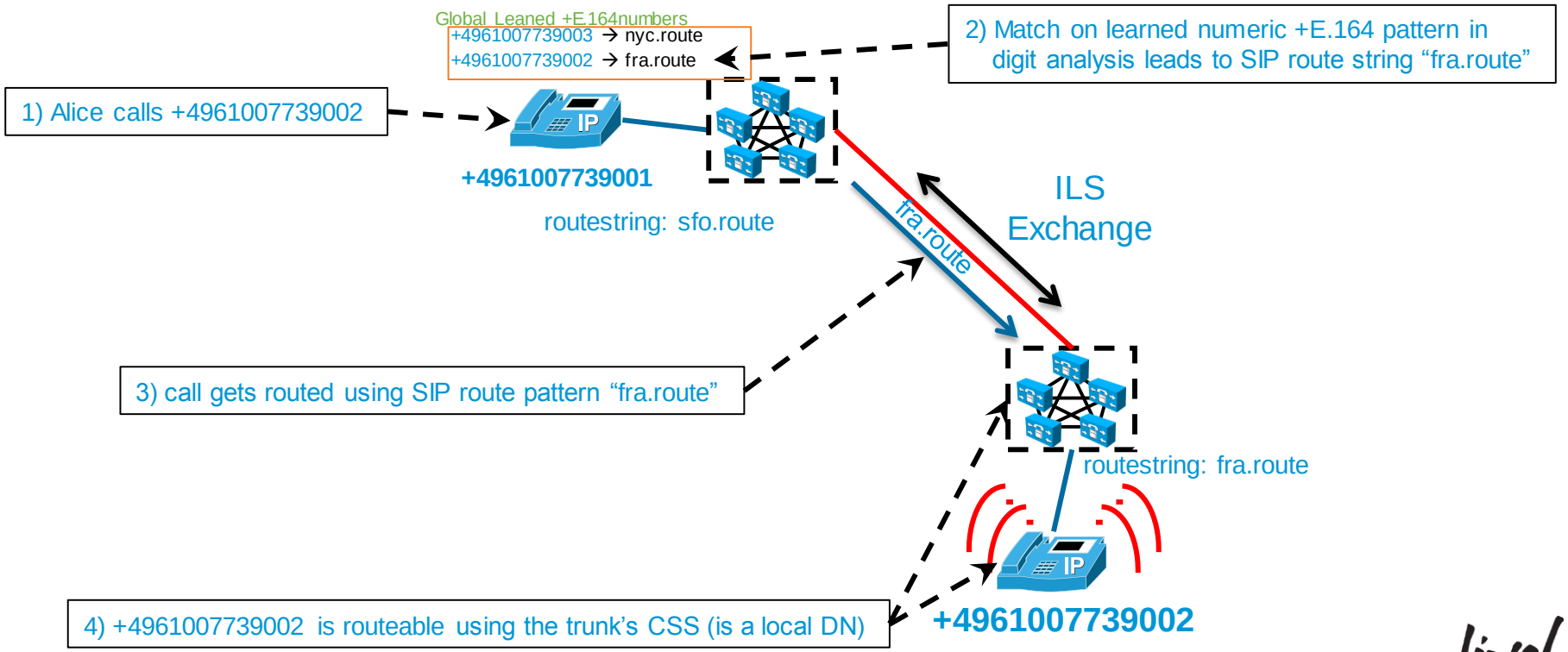
- New per DN attributes:
  - +E.164 alternate number and/or Enterprise alternate number (one can be assigned as PSTN fallback number)
  - Defined using a mask
  - Can be put into local partition (to implement alternate dialling habit)
  - Can be advertised via ILS
- Advertised patterns
  - +E.164 or enterprise number pattern
  - PSTN failover: use pattern directly (+E.164) or strip/prefix instruction
- Differentiated partitions for learned numbers and patterns

GDPR Learning and Routing



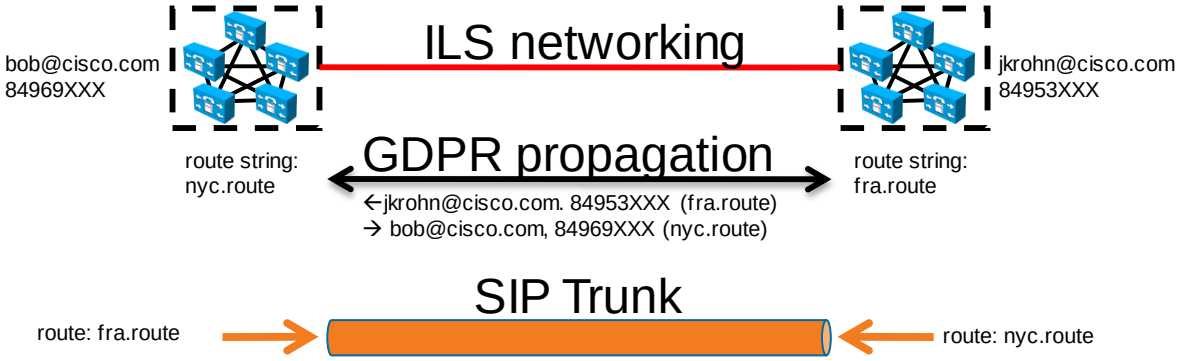
- Call controls establish ILS Exchange
- GDPR information flooded
  Each call control puts learned patterns/numbers in respective partitions and associated them with learned SIP route string
- SIP route strings routed by SIP route patterns

Routing Call to Remote Number Using ILS Information



ILS Networking, URI Learning and Routing

- Components of end-to-end dialling/routing
  - ILS networking
  - GDPR propagation
  - SIP trunk
  - SIP route pattern



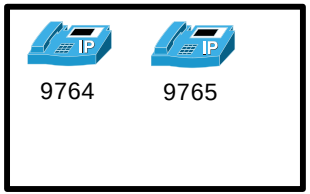
- SIP connectivity is foundation for call routing based on SIP route patterns
- ILS networking is foundation for exchange or GDPR reachability information
- GDPR propagation/exchange is enabled independent of ILS networking

GDPR Number Types

- "Enterprise Alternate Number": Enterprise specific dialling habit (abbreviated on-net dialling, e.g. 8-496-9764)
- "+E.164 Alternate Number": +E.164 number (e.g. +4961007739764)
- "Enterprise Pattern": Wildcarded Enterprise specific dialling habit (e.g. 8-496-9XXX)
- "+E.164 Patterns": Wildcarded +E.164 (e.g. +4961007739XXX)
- Example:

  DN 9764 (not recommended, but …)
  +E.164 Alternate +4961007739764
  Enterprise Alternate: 84969764

  Enterprise Pattern: 84969XXX
  +E.164 Pattern: +4961007739XXX



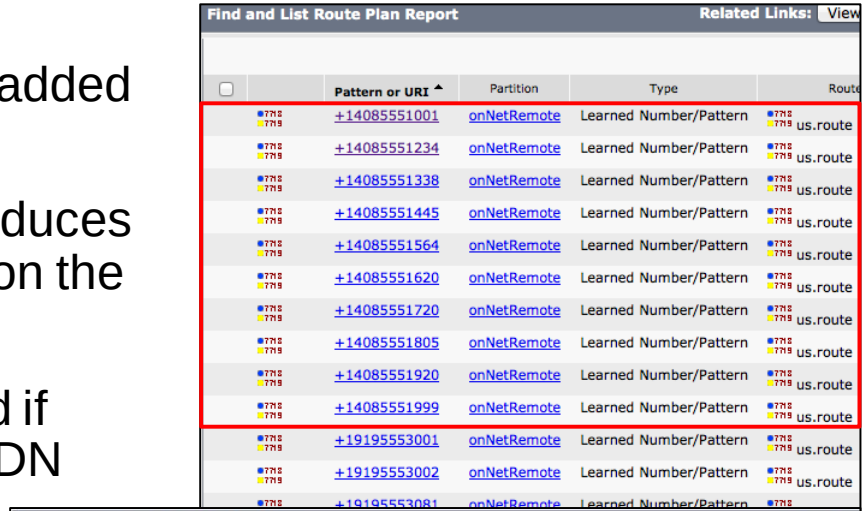
Site ESC:
+E.164 range +49 6100 773 9XXX
Enterprise range: 84969XXX

GDPR Information Exchange

- Single Catalog per ILS cluster can contain:
  - Per DN GDPR information
    - Up to 5 URI aliases
    - Enterprise alternate number (abbreviated inter-site dialling)
    - +E.164 alternate number
    - PSTN failover number (for numeric and URI dialling)
  - DN independent GDPR information
    - Enterprise pattern (abbreviated inter-site dialling): summary per DID range
    - +E.164 pattern: summary per DID range
- Additional catalogs: imported GDPR catalogs
  - Individual SIP route string per imported catalog
  - Advertised into GDPR by cluster the catalog is imported on
  - Use case: “proxy” for systems not supporting GDPR/ILS

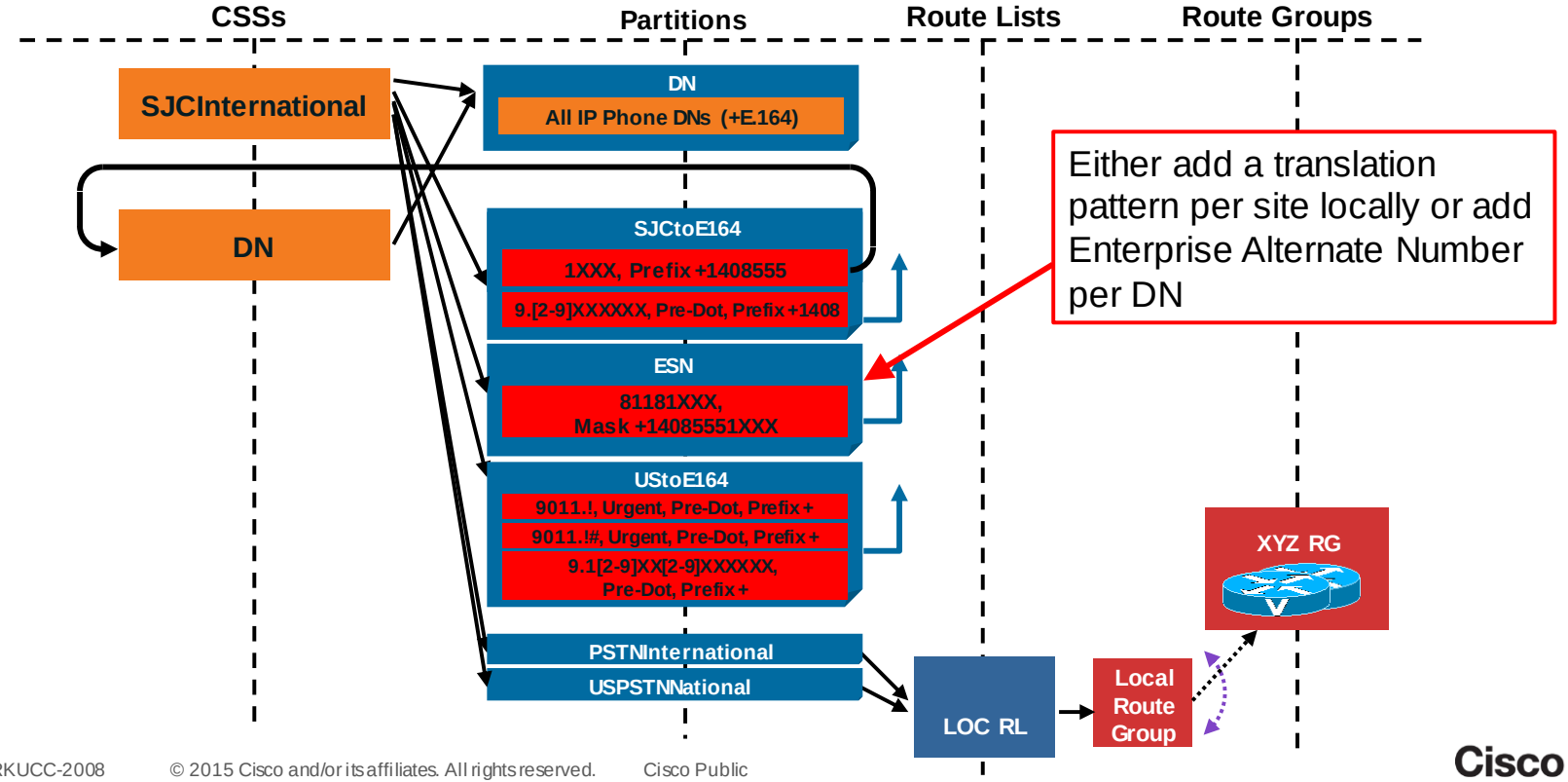
Advertising Patterns vs. Individual Alternate Numbers

- All advertised numbers and patterns are added to digit analysis on the receiving cluster
- Only advertising summaries (patterns) reduces the numbers of entries to be considered on the receiving side
- Individual numbers need to be advertised if numbers can't be summarised (e.g. one DN from range moved to different cluster)
- … or local on/off-net decision is absolutely required!
  - Otherwise call to unassigned DN in +E.164 range might be sent to remote cluster only to be blocked there (Shouldn't really be a problem)



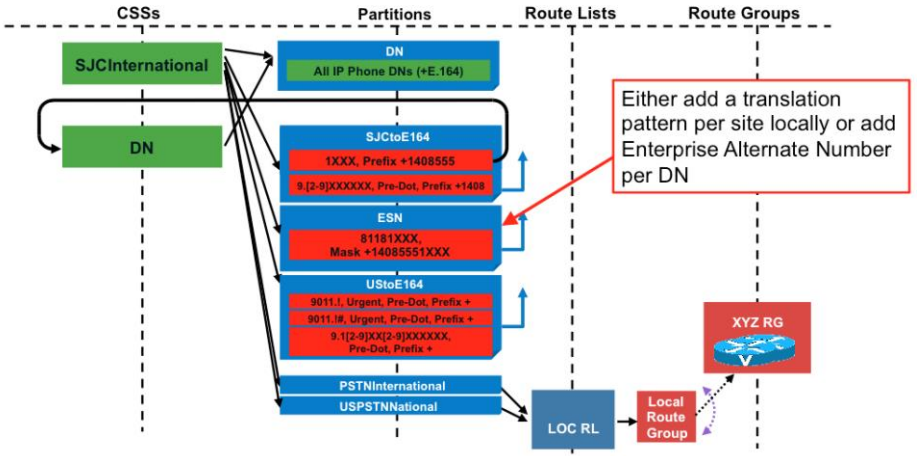
To Add or not to Add to Local Partition

Dialling Enterprise Alternate Numbers



To Add or not to Add to Local Partition

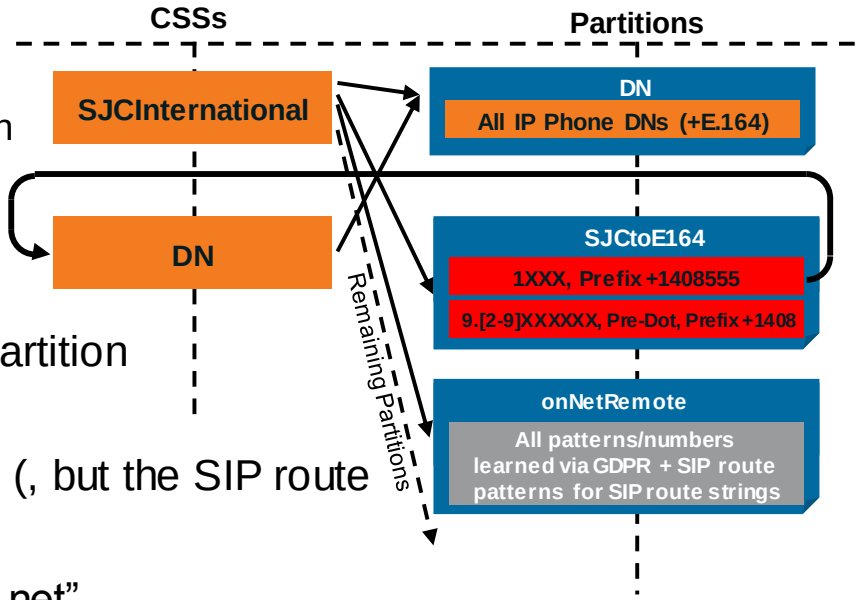
- Adding individual Enterprise Alternate Numbers adds complexity to dial plan.
- Individual Enterprise Alternate Numbe only required if summarisation is not possible
- Summary and individual remote advertisements can coexist
  - Individual remote number will always override local summary; best match still applies!



GDPR in an Enterprise Dial Plan

Dialling learned numbers

- Up to three intercluster dialling habits to reach remote DN:
  - Enterprise (8+7) based on enterprise alternate/pattern
  - +E.164 based on +E.164 alternate/pattern
  - URI
- Assuming that CoS does not depend on dialling habit all remote patterns can be put into single partition onNetRemote
- ILS learned URIs are reachable from any device (, but the SIP route patterns potentially are not)
- onNetRemote added to all CSSes with CoS “On-net”
- Also make sure to add SIP route pattern matching on SIP route strings to onNetRemote partitions



Imported Global Dial Plan Catalogues

- In addition to local numbers, patterns and URIs a GDPR cluster can also advertise imported catalogues
- Use case: “Proxy” for systems not participating in ILS/GDPR
- BAT File format (example):
  - PatternType,PSTNFailover,Pattern
  - pattern,0:,+4961501234XX@de.example.org
  - pattern,0:,+494012345@de.example.org
  - uri,+49510012345,bob@de.example.org
- Patterns and URIs are advertised to remote clusters
- Patterns added to local partition for +E.164 patterns
- URIs added equivalent to URIs learned from remote clusters

“pattern” or “uri”

Pattern (potentially wildcarded) or URI

For type “uri” has to be a fully qualified PSTN failover number (+E.164 recommended).
For type “pattern” is a toPSTN instruction (digits to strip, “:”, digits to prefix).

Routing SIP Requests in Unified CM

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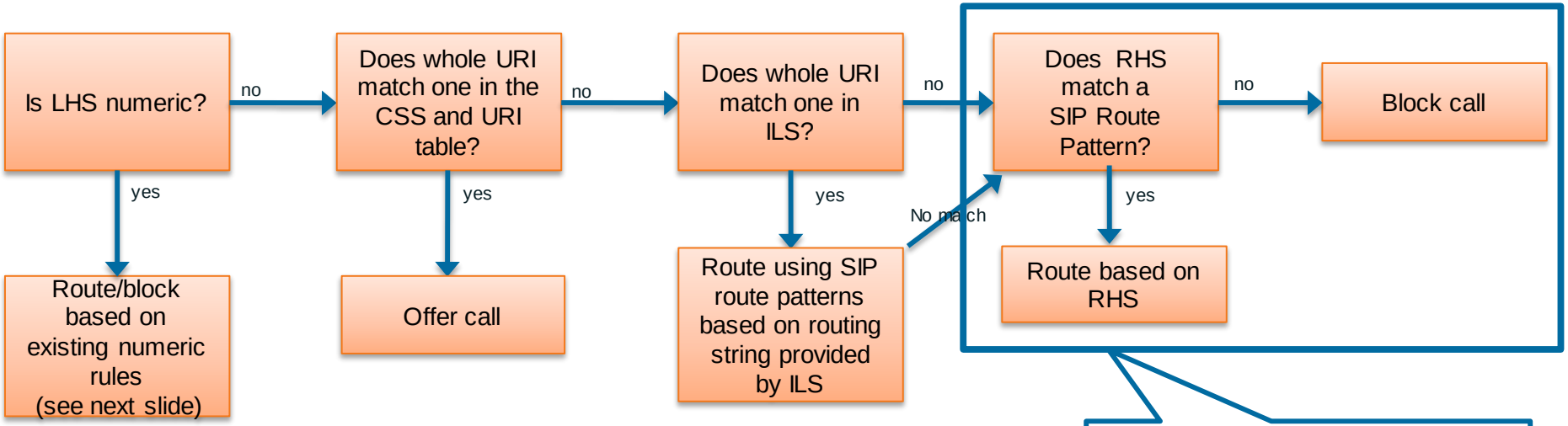
SIP Request Routing Flowchart



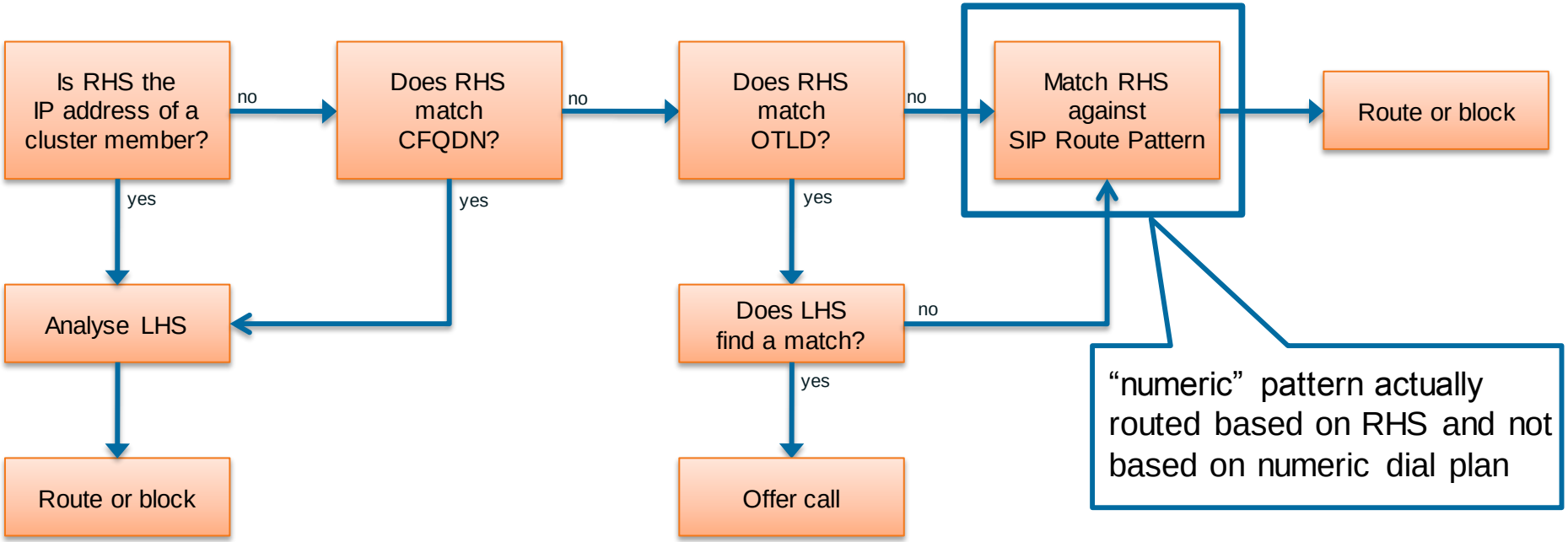
Note:
Assume only alice@cisco.com is in URI table,
1) alice@CUCM IP address will not route.
2) alice@CFQDN will not route

Fallback for alpha-URIs not local and not found in ILS! e.g. default routing

user @ example.org

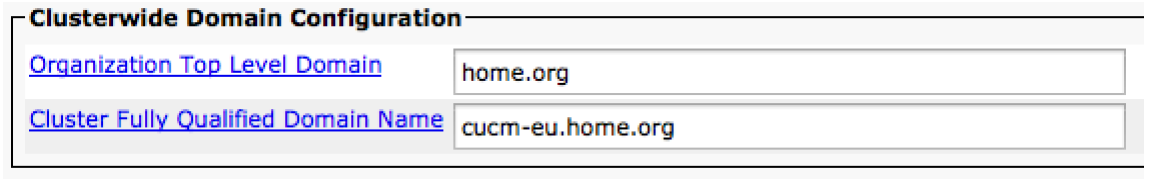
left-hand-side (LHS) right-hand-side (RHS)

Numeric SIP Request Routing Flowchart

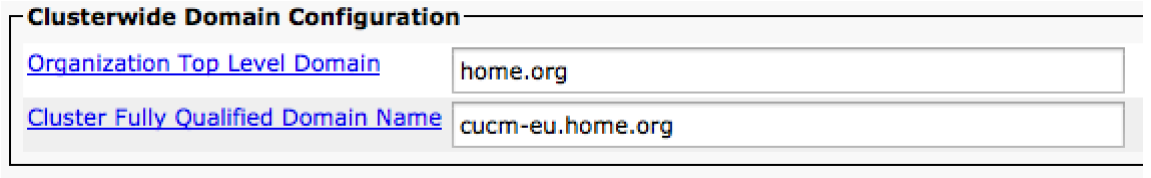


Clusterwide Domain Configuration

- OTLD:
  - single domain
- CFQDN:
  - one or more names separated by spaces
  - Max 255 chars
  - Allows wildcards; e.g. *.eu-cluster.home.org



Always Set CFQDN and OTLD



- Set OTLD to match single(!) corporate domain name
- Make sure to set the CFQDN to match host names of all cluster nodes
  - DNS naming structure might help
  - e.g.: *.cucmeu.home.org for pub.cucmeu.home.org, sub1.cucmeu.home.org, …
- Keep in mind that fallback routing based on RHS is implemented for:
  - Alpha URIs not found locally
  - Numeric URIs with RHS = OTLD not found in numeric lookup

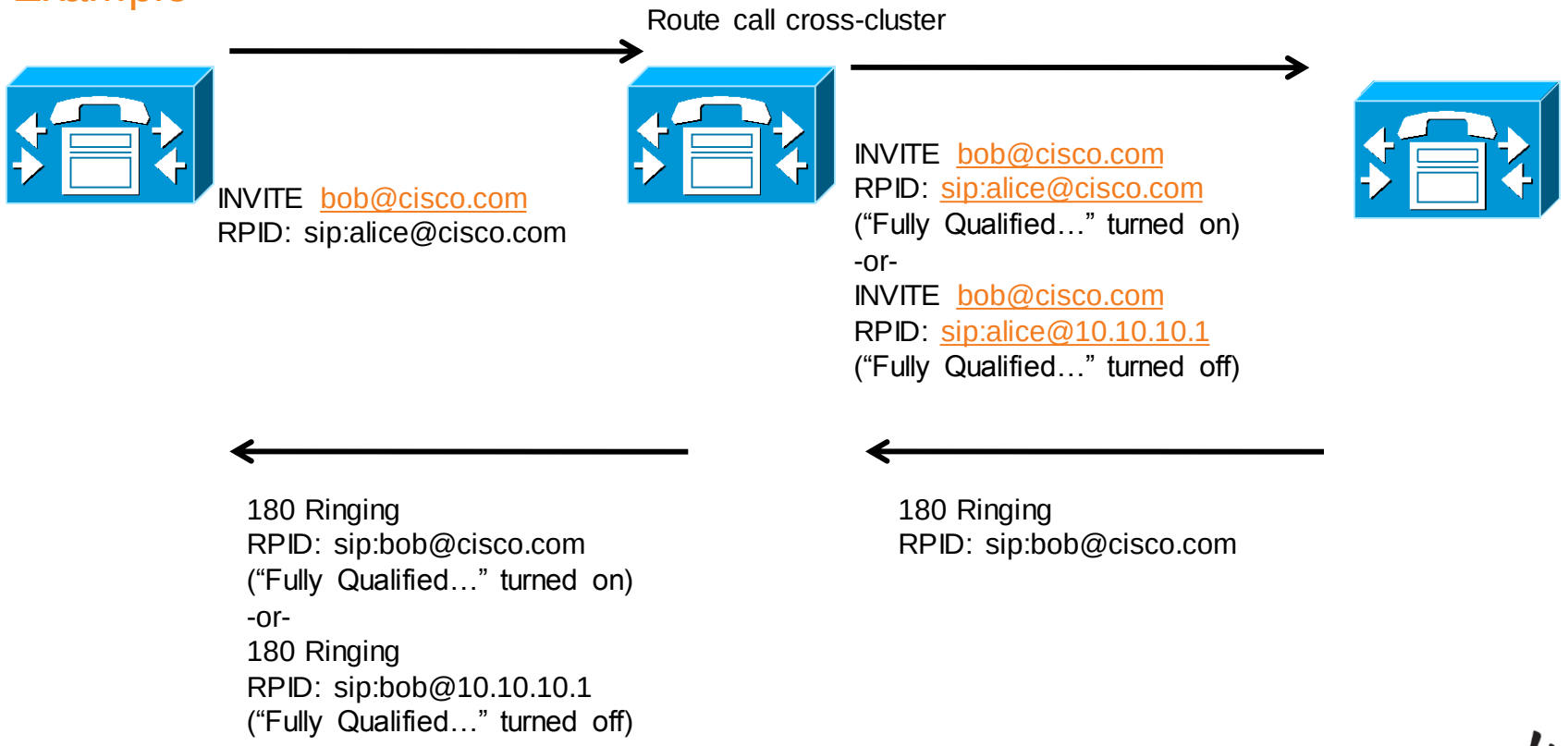
Fully Qualified Domain Name in SIP Requests

- Always set “Use Fully Qualified Domain Name in SIP Requests” in SIP profile of all SIP trunks and endpoints involved: 

- CUCM will relay an alphanumeric hostname of a caller to the called endpoint as a part of the SIP header information. This enables the called endpoint to return the call using the received or missed call list
- Mainly important for numeric IDs, but in mixed environments where numeric and alpha URIs exist, it’s important to always have FQDNs in SIP requests for all calls
- For endpoints registered with CUCM the FQDN in SIP requests will be set to the OTLD configured in the enterprise parameters

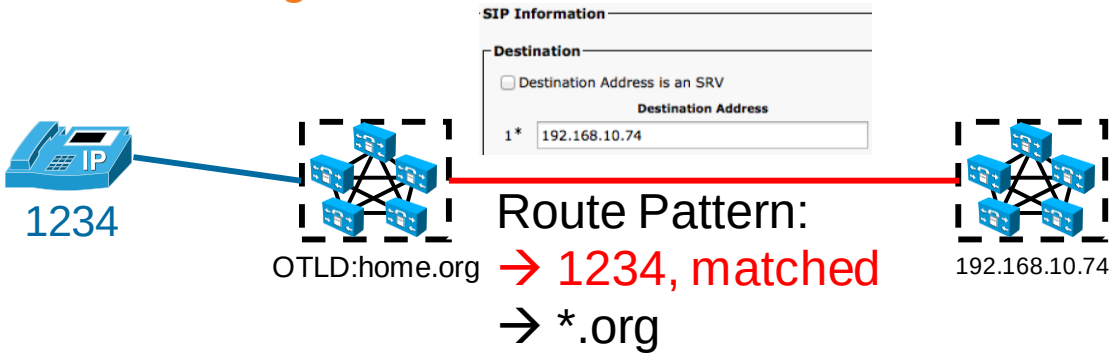
Use Fully Qualified Domain Name in SIP Requests

Example



RHS of Numeric URIs on SIP Trunks

Numeric Dialling

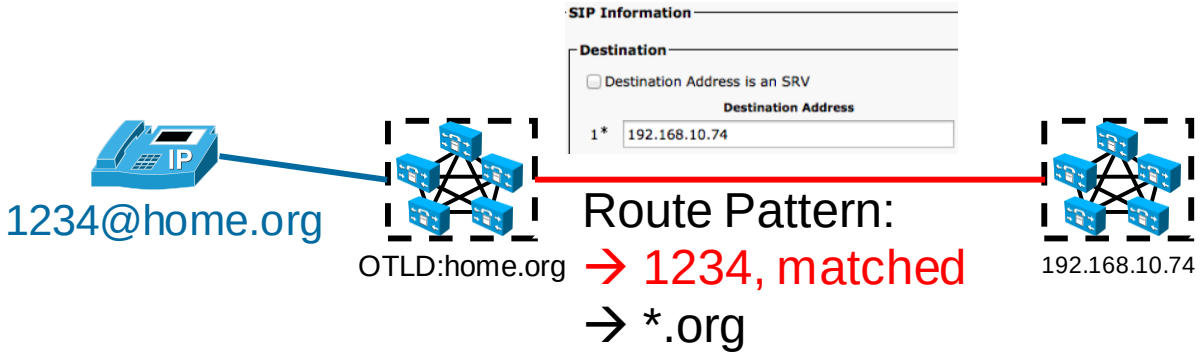


INVITE sip:1234@192.168.10.74:5060
To: <sip:1234@192.168.10.74>

- CUCM builds RHS of request and To: URI for numeric destinations based on configured SIP trunk destination
- Constructing RHS of To: and request URI makes perfect sense in pure numeric dialling environment where no concept of a URI host portion exists on the user side

RHS of Numeric URIs on SIP Trunks

RHS of numeric URI matches OTLD, numeric match

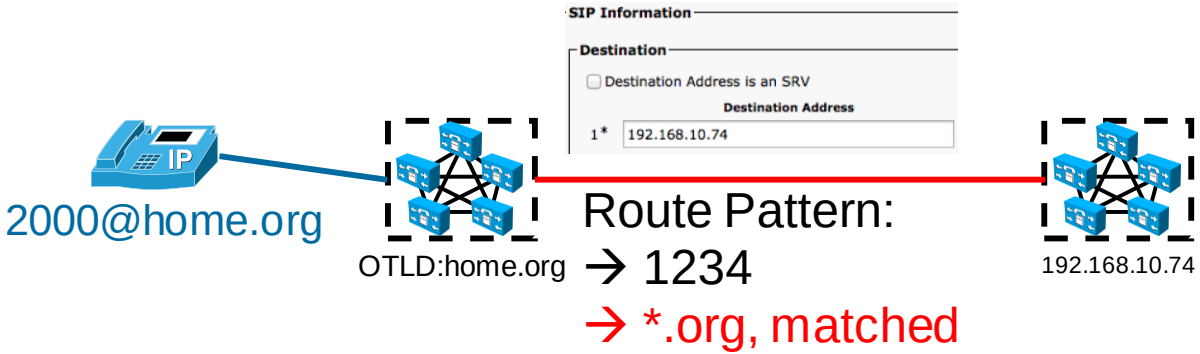


INVITE sip:1234@192.168.10.74:5060
To: <sip:1234@192.168.10.74>

- CUCM still builds RHS of request and To: URI for numeric destinations based on configured SIP trunk destination
- Numeric destination matched against numeric dial plan (OTLD match) and matches against configured route pattern
- When routed through a numeric route pattern RHS of To: and request URI are rewritten
- "use FQDN in SIP requests" setting on SIP trunk has no impact; only applied to calling/connected ID

RHS of Numeric URIs on SIP Trunks

RHS of numeric URI matches OTLD, no numeric match

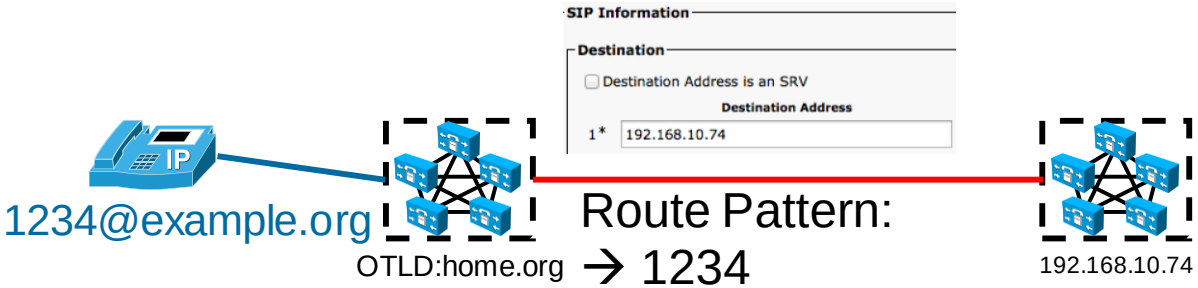


INVITE sip:2000@home.org:5060
To: <sip:2000@192.168.10.74>

- CUCM maintains original request URI but still rewrites RHS of To: URI based on configured SIP trunk destination
- Numeric destination matched against numeric dial plan (OTLD match), but no numeric match found
- Fallback to routing based on SIP route patterns
- RHS of To: URI not critical for routing (routing based on request URI), but possibly problematic if remote entities evaluate the To: URI for some reason

RHS of Numeric URIs on SIP Trunks

RHS of numeric URI does not match OTLD



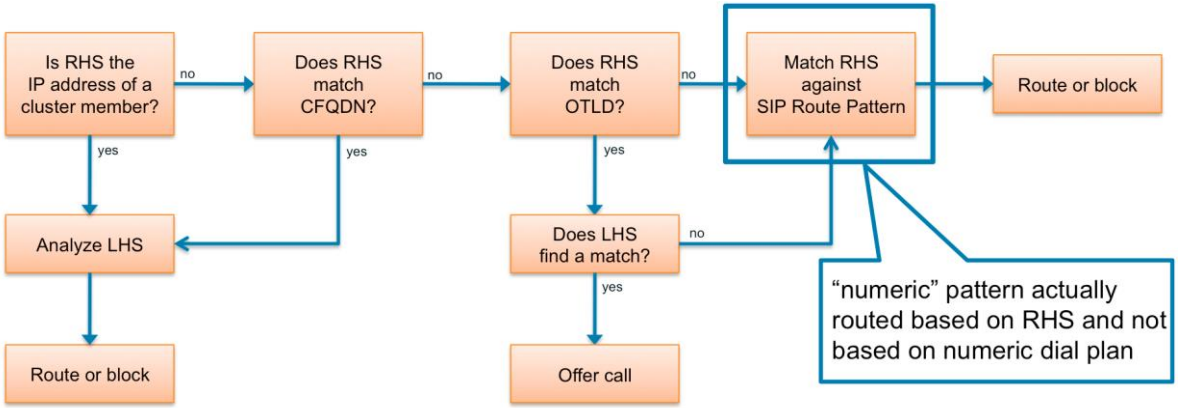
INVITE sip:1234@example.org
To: <sip:1234@192.168.10.74>

- CUCM maintains original request URI but still rewrites RHS of To: URI based on configured SIP trunk destination
- RHS of request URI does not match OTLD; hence only routed based on SIP route patterns
- RHS of To: URI not critical for routing (routing based on request URI), but possibly problematic if remote entities evaluate the To: URI for some reason

RHS of Numeric URIs on SIP Trunks

Summary

- For “numeric” destinations the RHS of the To: URI is always(!) rewritten
- RHS of request URI is only rewritten, if session is routed by match on numeric pattern
- Keep in mind that some “numeric” URIs are actually not routed “numerically”
  - For these cases CSCtr30922 changes the behaviour so that the To: URI is identical to request URI (check defect for integrated release, currently only 10.x and 9.1(2) ES)



Recommended +E.164 Dial Plan

Reference Dial Plan

Key Characteristics

- Deploy +E.164 addresses (DNs)
  - Non-DIDs, hunt pilots, pick-up, ...: use addresses equivalent to intended dialling habit
- +E.164 Core routing
- Separate dialling habits from call routing
- Dialling normalisation using translation patterns with CSS inheritance
- Globalised Caller ID everywhere (globalise on ingress, localise on egress)

+E.164 DNs and Non-DIDs (1)

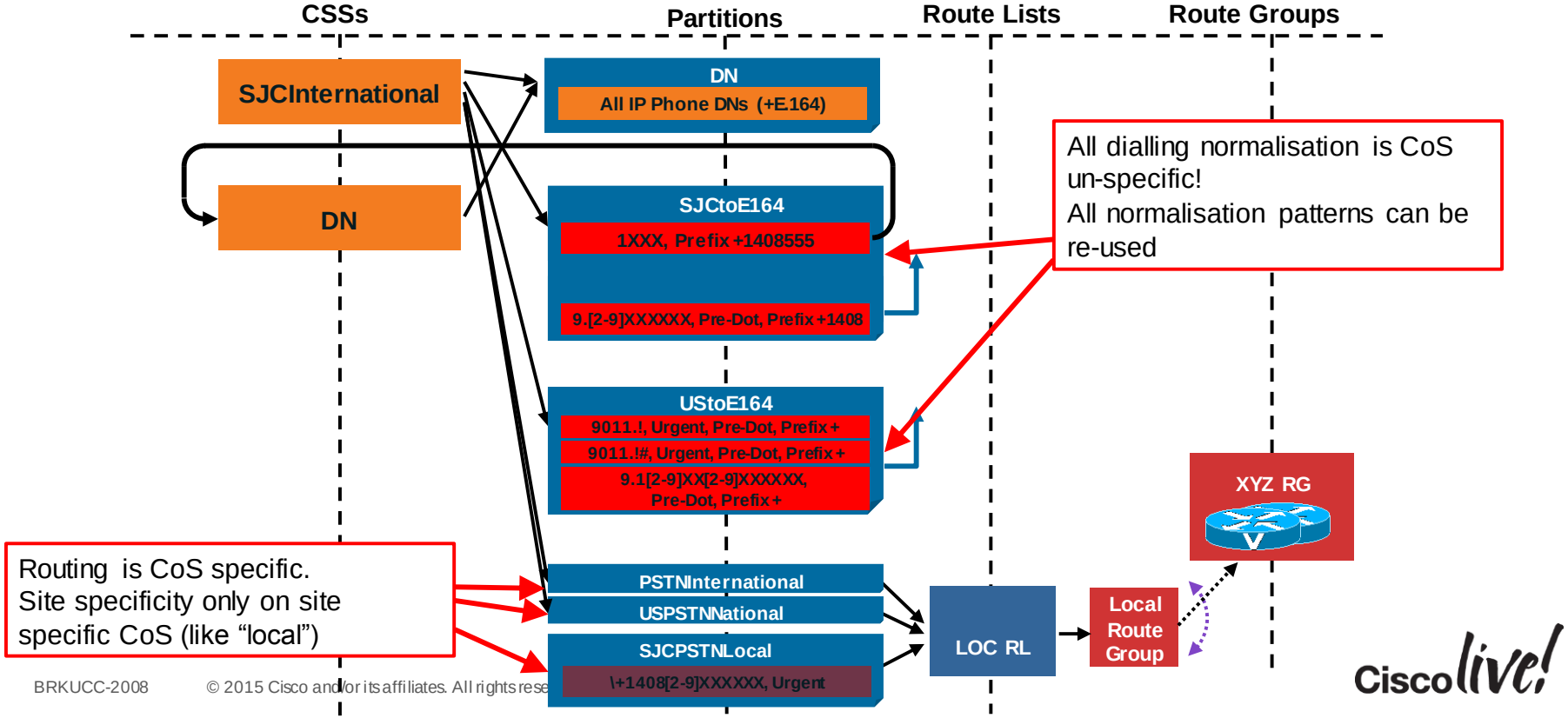
- Non-DIDs for
  - Lobby phones
  - Services (call park, call pick-up, VM pilot, ...)
- +E.164 DNs for “regular” phones provide
  - Unique address (by definition)
  - One on-net dialling habit for free (+E.164 dialling)
  - Correct globalised caller ID for all call-flows originating from internal endpoints
- “pseudo” +E.164 DNs (e.g. +0....) don’t have any of the above

+E.164 DNs and Non-DIDs (2)

- Better: start with the question “how do I want my users dial these destinations?”
- ... And add the appropriate patterns as addresses directly
- Local:
  - site specific partion with site-unique patterns (e.g. 6XXX)
  - caution with exposing non-DID inter-site (e.g. 6XXX might overlap with intra-site dialling in other site)
- Global
  - global partition with unique DNs
  - need to come up with enterprise specifc numbering scheme (e.g. 8-<site code>-XXXX)
- On egress (specifically gateways) make sure to filter non-DID caller IDs
  - For example map to main trunk number

Reference +E.164 Dial Plan (10.x)

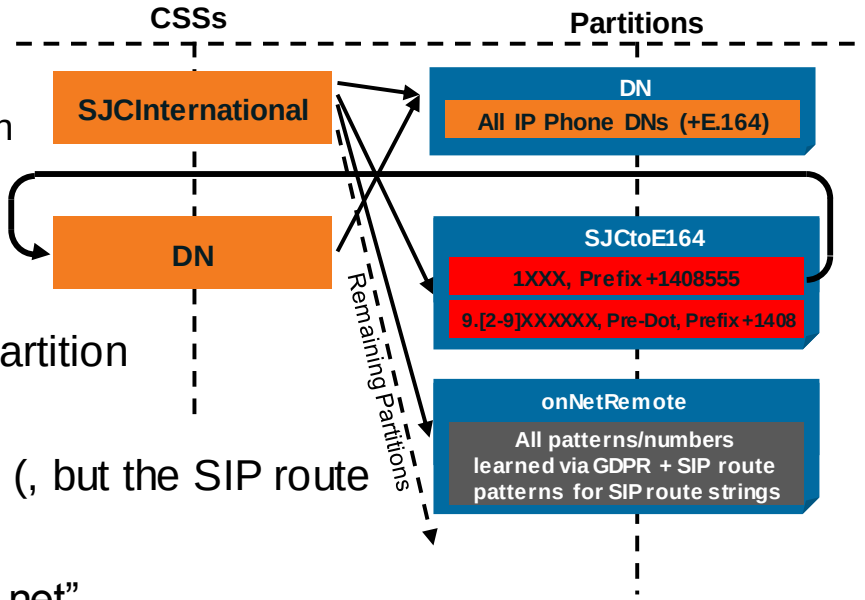
With CSS inheritance

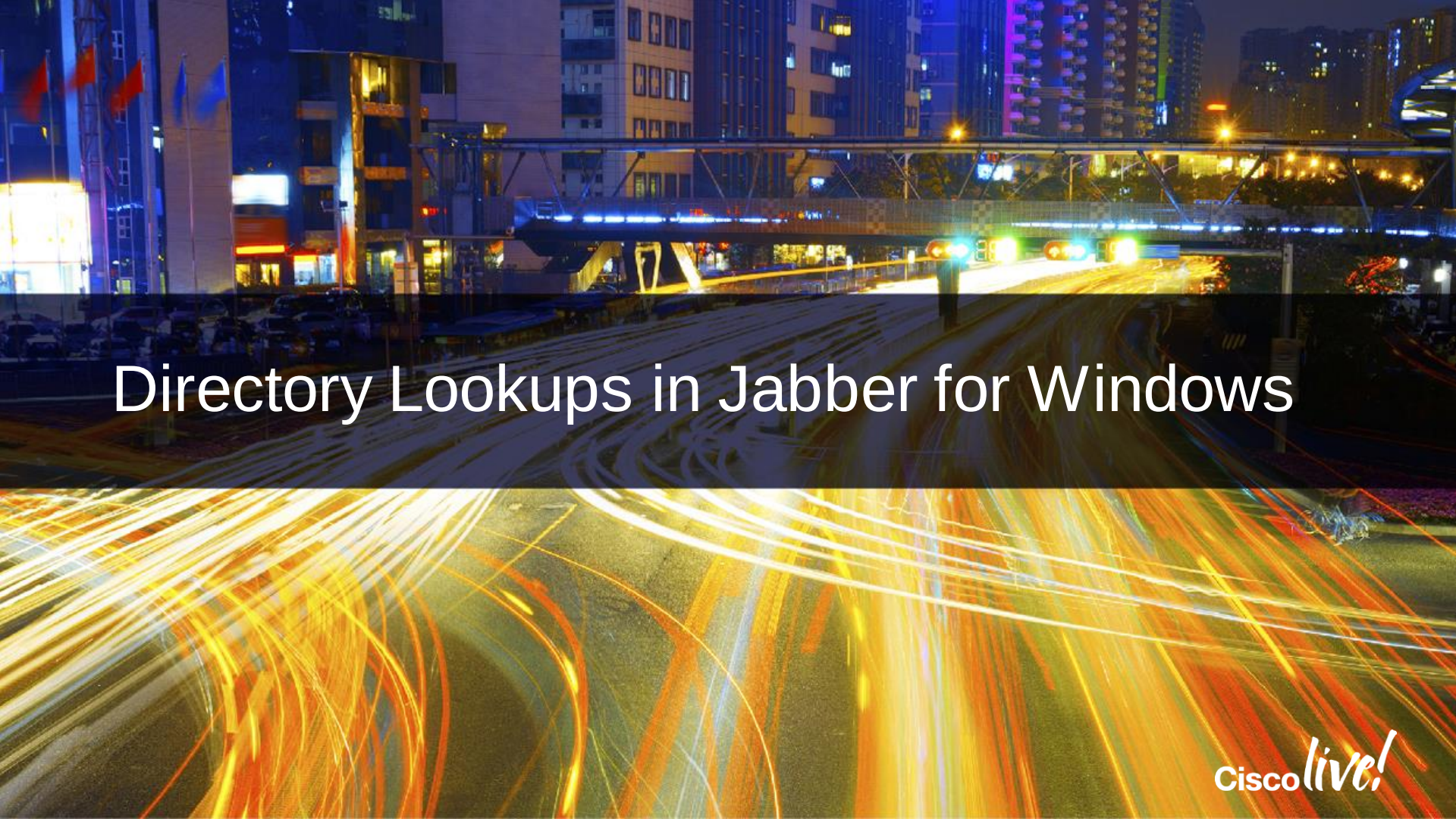


GDPR in an Enterprise Dial Plan

Dialling learned numbers

- Up to three intercluster dialling habits to reach remote DN:
  - Enterprise (8+7) based on enterprise alternate/pattern
  - +E.164 based on +E.164 alternate/pattern
  - URI
- Assuming that CoS does not depend on dialling habit all remote patterns can be put into single partition onNetRemote
- ILS learned URIs are reachable from any device (, but the SIP route patterns potentially are not)
- onNetRemote added to all CSSes with CoS “On-net”
- Also make sure to add SIP route pattern matching on SIP route strings to onNetRemote partitions




Directory Lookups in Jabber for Windows
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Identities Provided to Jabber by UCM

- INVITE sent to Jabber includes multiple forms of caller ID
  - Pre-transformation number: globalised number before applying remote number calling party transforms
  - Post-transformation number: localised numbers after applying remote number calling party transfroms
  - URI: URI only if URI is available/provisioned for remote caller
- Without URIs provisioned:

```
From: "Eleanor Petty" <sip:00014085551001@home.org>;tag=24627~139097fa-73c8-40e2-baa2-
ece127d568a0-33244131
Remote-Party-ID: "Eleanor Petty" <sip:00014085551001@home.org;
      x-cisco-callback-number=+14085551001>;party=calling;screen=yes;privacy=off
```

- With URIs provisioned:

```
From: <sip:epetty@home.org>;tag=33806~139097fa-73c8-40e2-baa2-ece127d568a0-33244152
Remote-Party-ID: <sip:epetty@home.org;x-cisco-number=00014085551001;
      x-cisco-callback-number=+14085551001>;party=calling;screen=yes;privacy=off
```

Identities used by Jabber for Lookup

- No URI provided:
  - Search for pre-transformation number in telephoneNumber attribute
  - Search for pre-transformation number in mobile, homePhone, otherTelephone
- URI provided:
  - Search for **post**-transformation number in telephoneNumber attribute
  - Search for **post**-transformation number in mobile, homePhone, otherTelephone
  - Search for URI in mail attribute

Directory Lookup

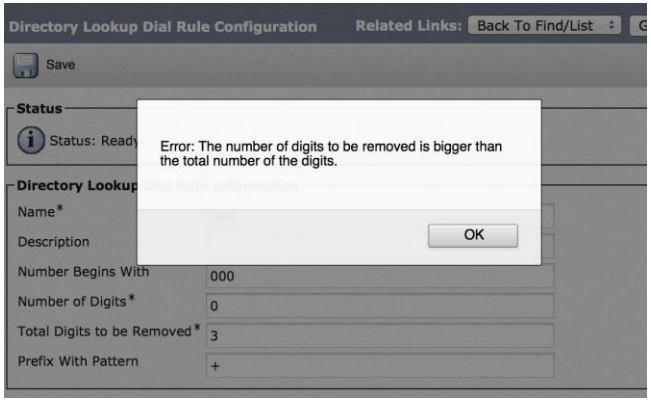
Fixed Length, No way to configure length 0 to match any length

Directory Lookup Dial Rule Information

Name*	000_12
Description	
Number Begins With	000
Number of Digits*	12
Total Digits to be Removed*	3
Prefix With Pattern	+

Directory Lookup Dial Rule Priority

Name	Number Begins With	Number of Digits	Total Digits to be Removed	Prefix With Pattern	Up	Down
000_12	000	12	3	+		
000_13	000	13	3	+		
000_14	000	14	3	+		
000_15	000	15	3	+		
000_16	000	16	3	+		
000_17	000	17	3	+		
000_18	000	18	3	+		



Directory Lookup Rules

Summary

- Directory Lookup Rules problems:
  - Assume fixed length
  - Configuration of Lookup Rules with variable length (len = 0) is not supported
  - Multiple rules with varying lengths have to be configured for each transform
  - Directory Lookup Rules can not be used to globalise numbers if overlapping localised representations exists (how to globalise 1001 if we have 1XXX dialling in two different sites)
- To be safe: avoid directory lookup rules

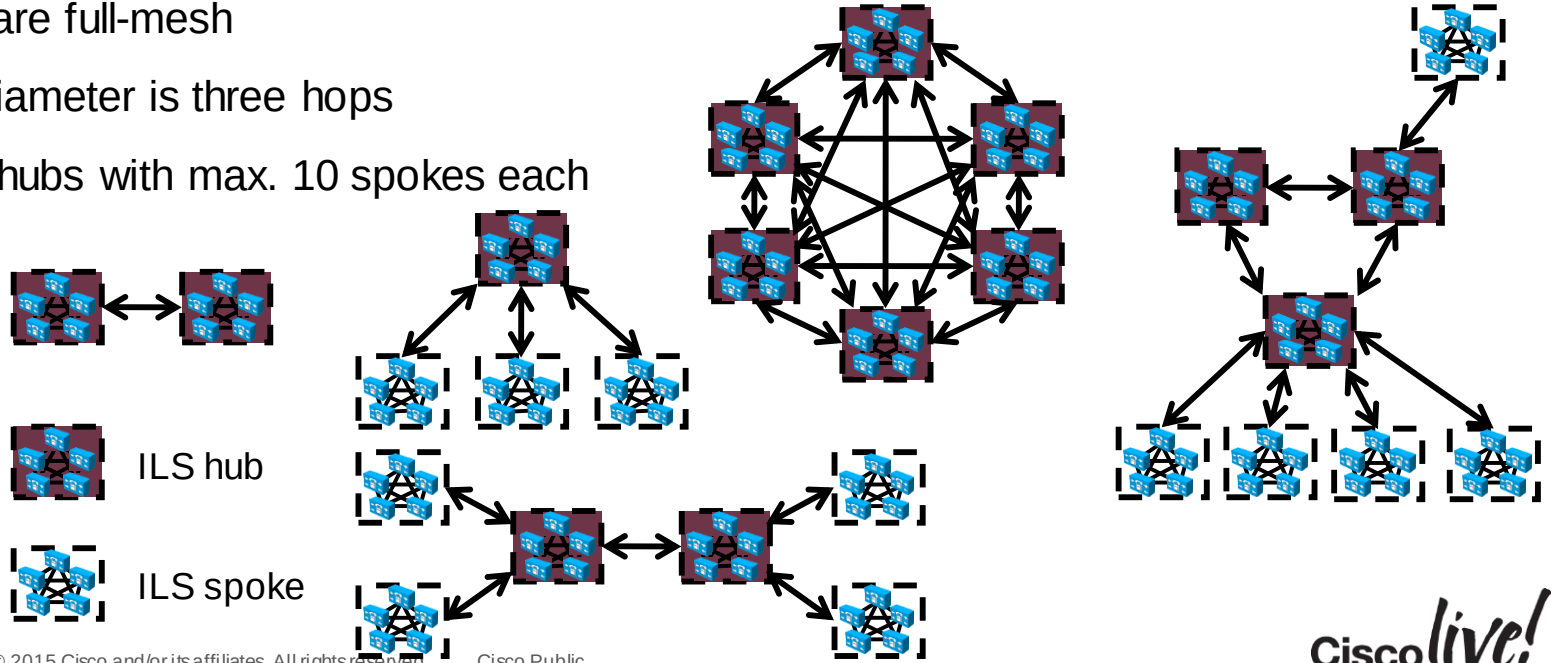
Recommendations

- Make sure to have plain globalised +E.164 numbers in directories
  - No delimiters +1-408-555-1234
  - No conditional trunk access codes: +44 (0)208 ....
  - Just plan +E.164 numbers
- To avoid lookup inconsistencies when URIs are provisioned:
  - Don’t localise calling party number on Jabber
  - External calls from unknown parties are displayed as +E.164 in that case
- Avoid directory lookup rules

Topologies for Inter-Cluster GDPR Routing

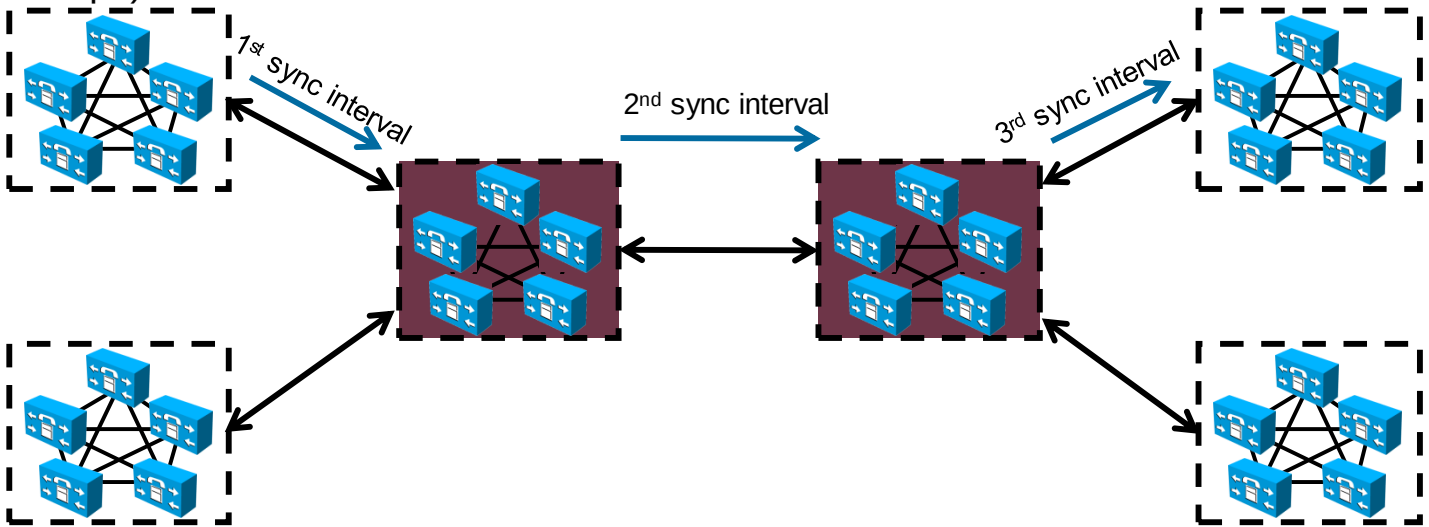
ILS Networking

- Call Controls participating in ILS network form a hub & spoke topology
- Each Call Control is hub or spoke
- all hubs are full-mesh
- largest diameter is three hops
- max. 10 hubs with max. 10 spokes each



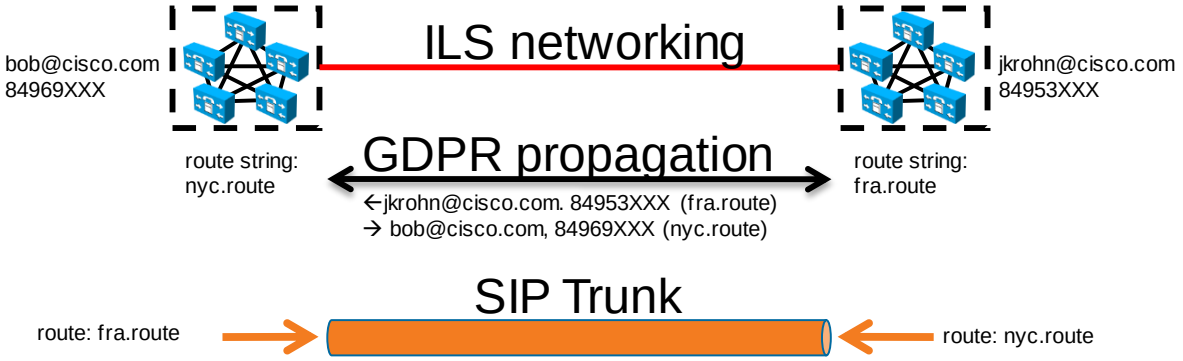
GDPR Information Propagation

- Each call control keeps local copy of all GDPR catalogs advertised by all other entities in the network
- Each call control periodically pulls in all changes of all GDPR catalogs from GDPR neighbours (interval 1-1440 minutes)
- GDPR catalog updates propagate through the network hop-by-hop (remember: maximum diameter is three hops)



ILS Networking, GDPR Learning and Routing

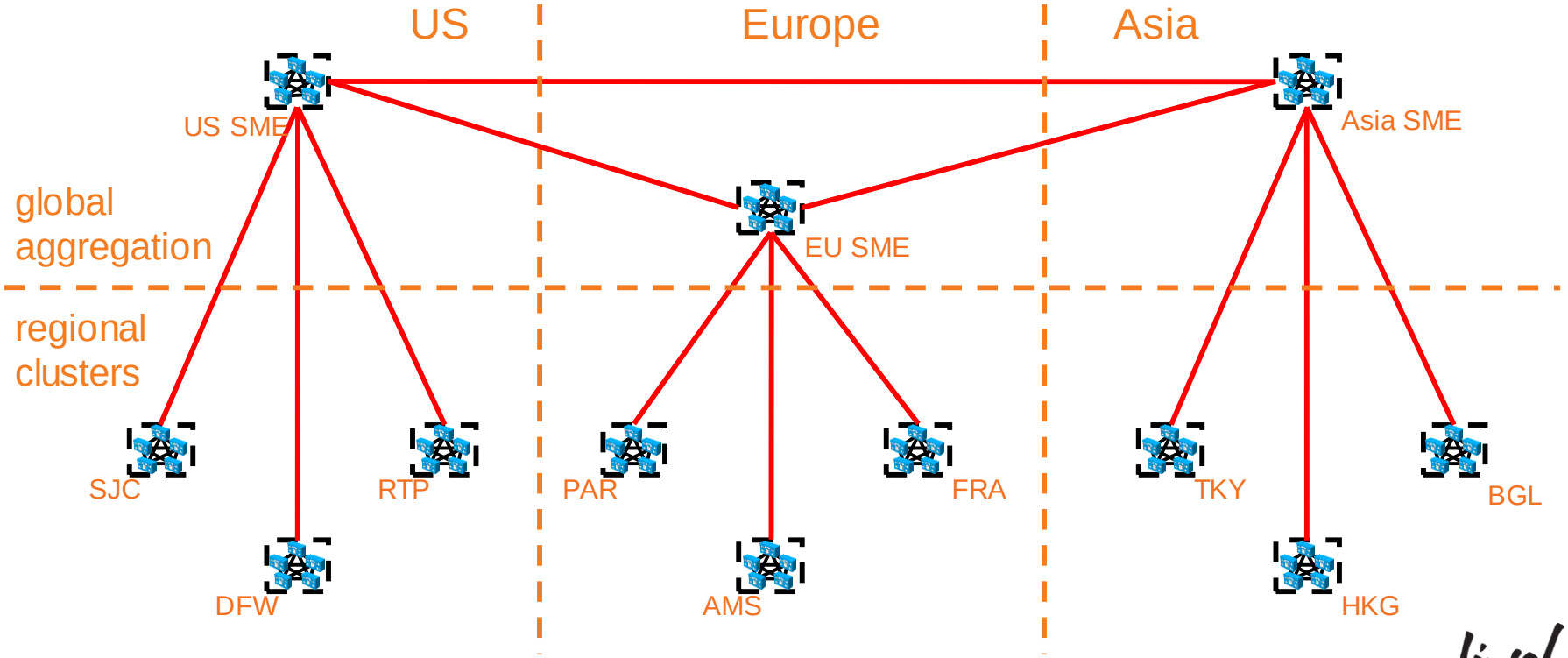
- Components of end-to-end dialling/routing
  - ILS networking
  - GDPR propagation
  - SIP trunk
  - SIP route pattern



- SIP connectivity is foundation for call routing based on SIP route patterns
- ILS networking is foundation for exchange or GDPR reachability information
- GDPR propagation/exchange is enabled independent of ILS networking

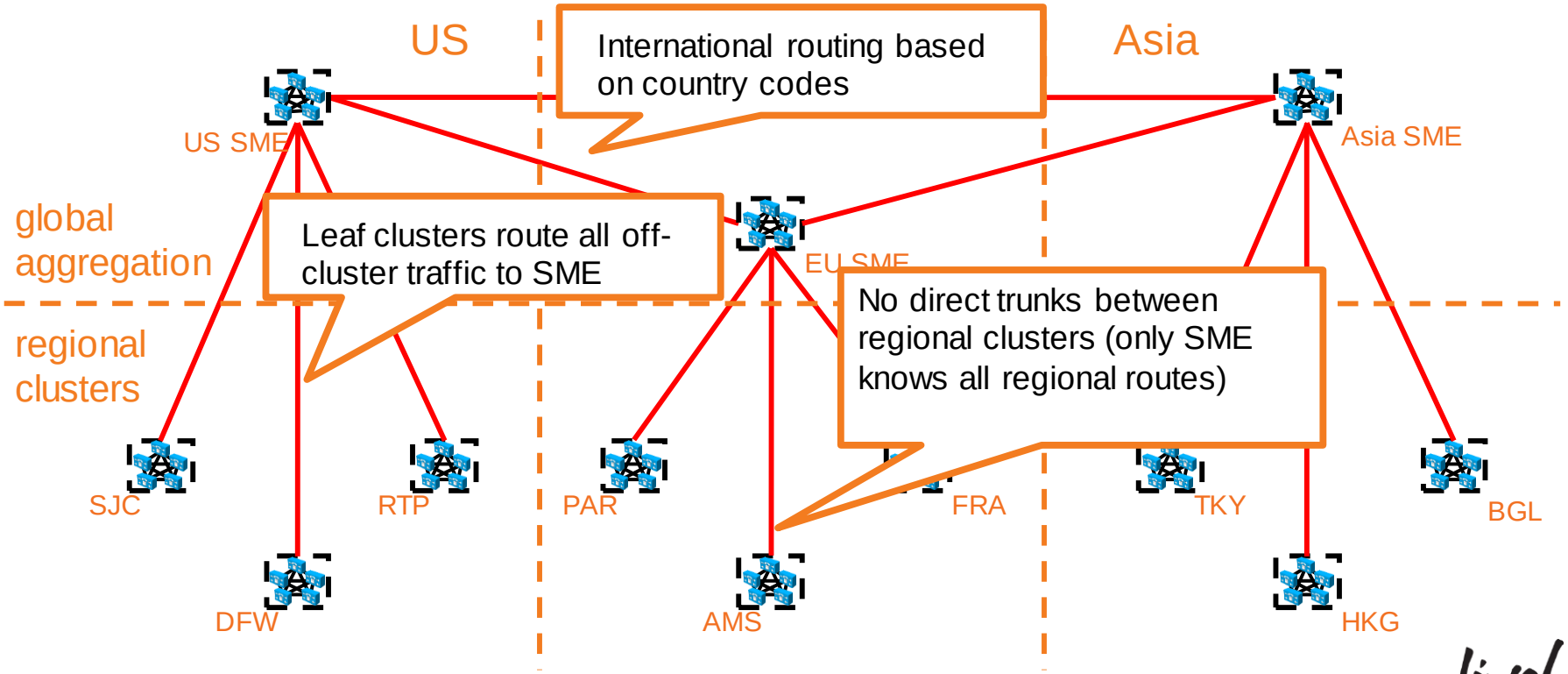
Example Global Topology using SME

SIP Trunking



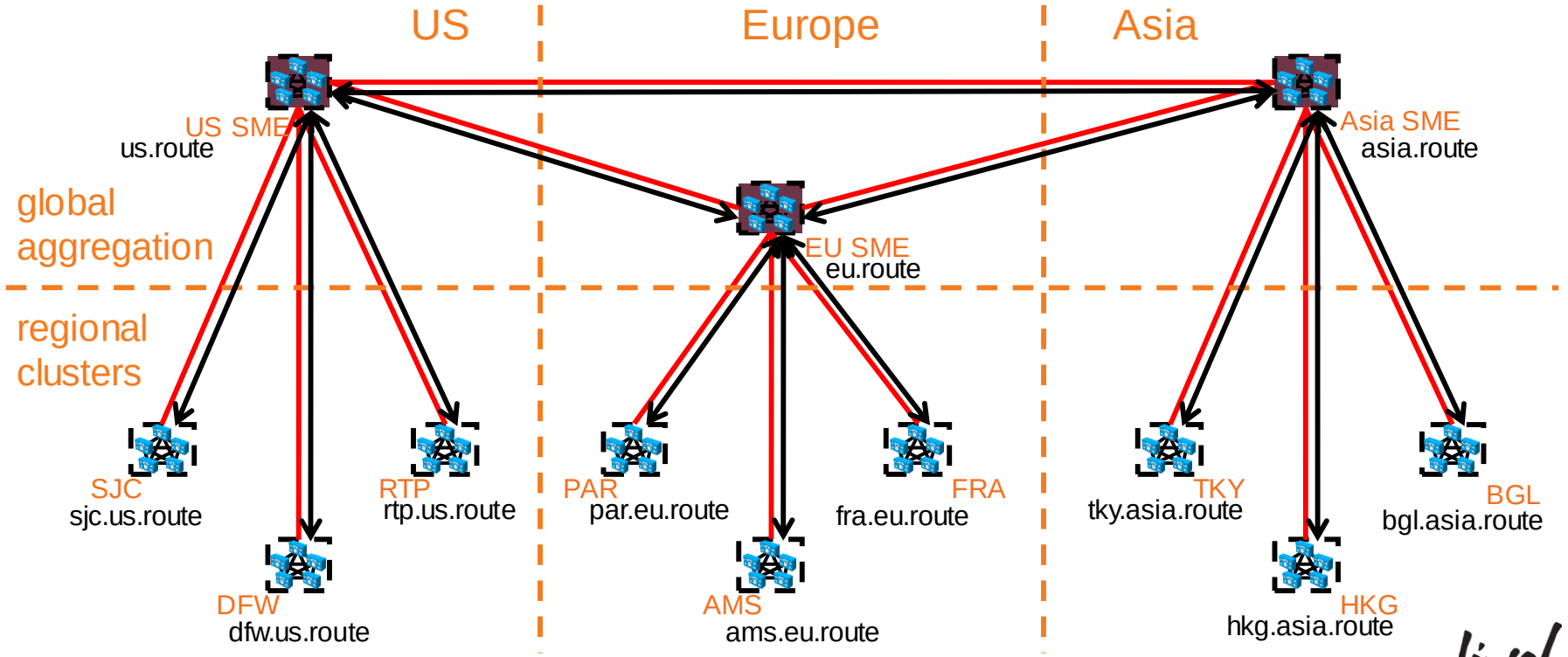
Example Global Topology using SME

SIP Trunking



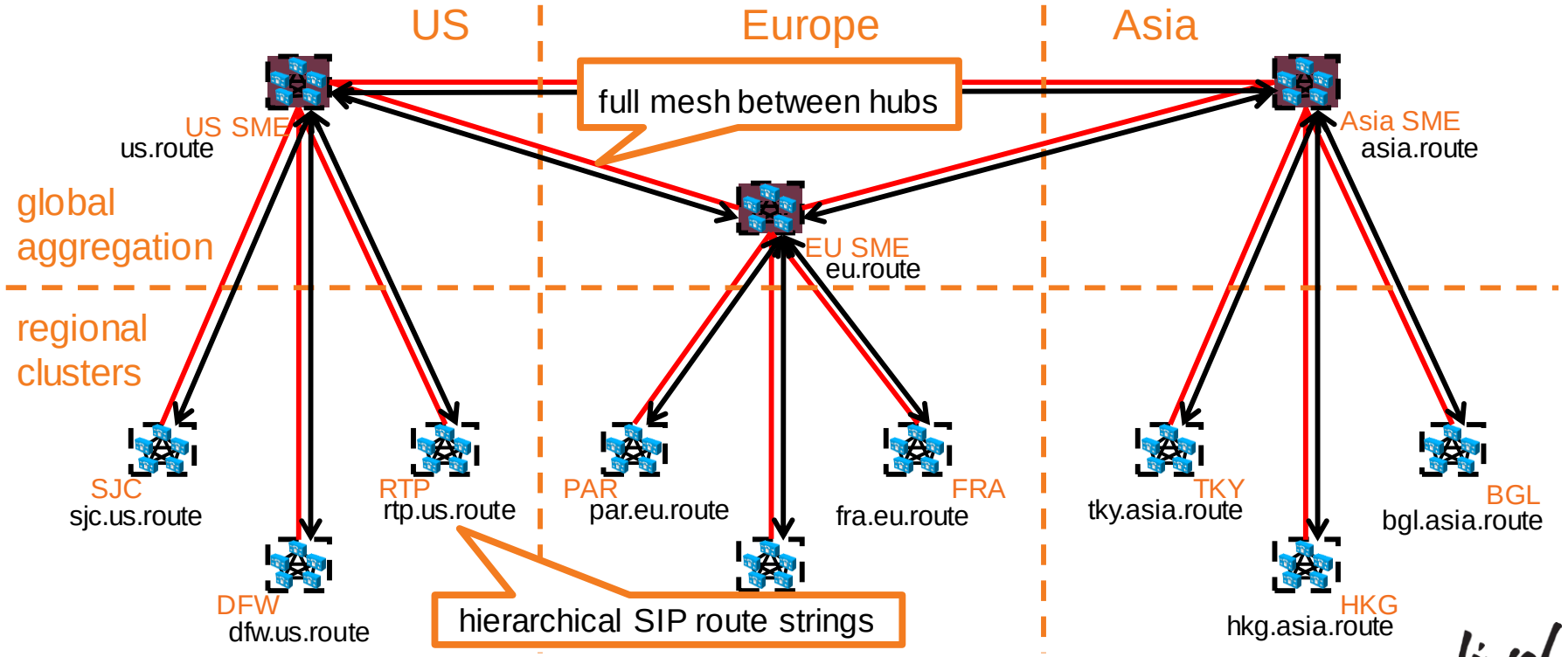
Example Global Topology using SME

Adding ILS for GDPR dialling (following SIP trunk topology)



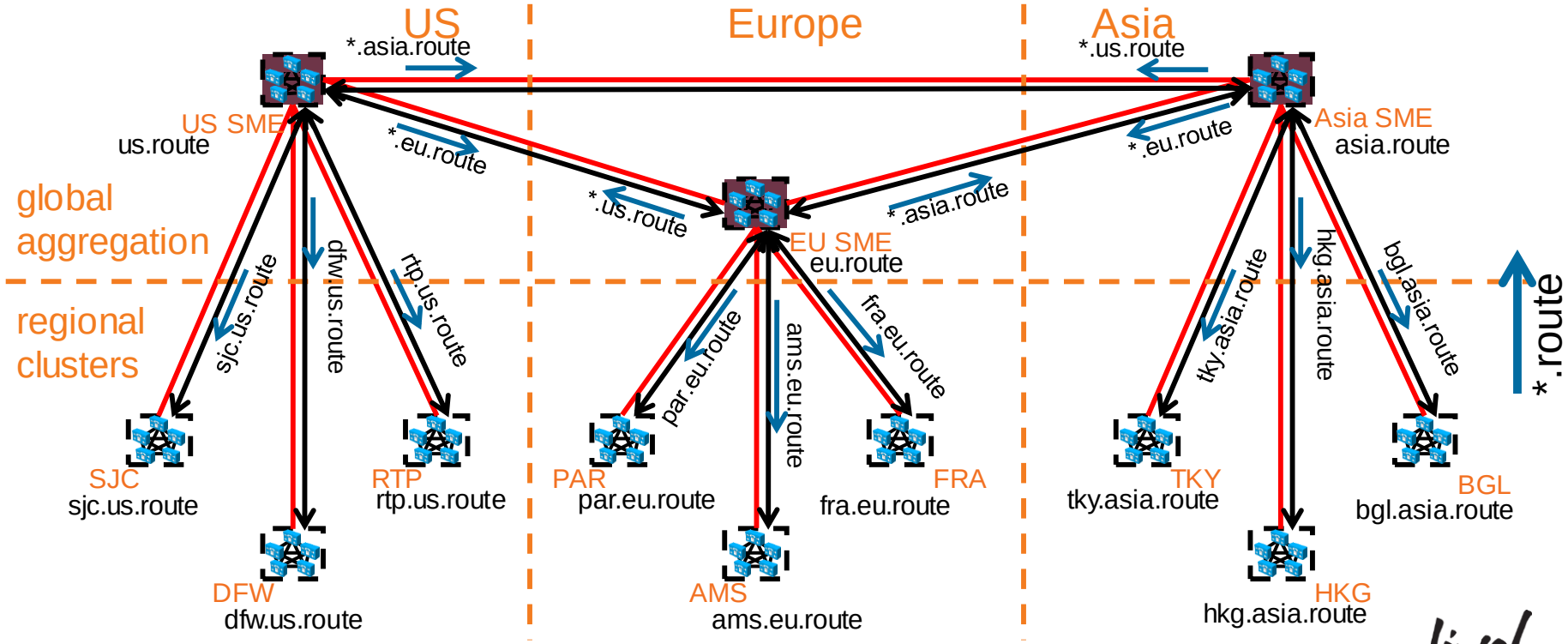
Example Global Topology using SME

Adding ILS for GDPR dialling (following SIP trunk topology)



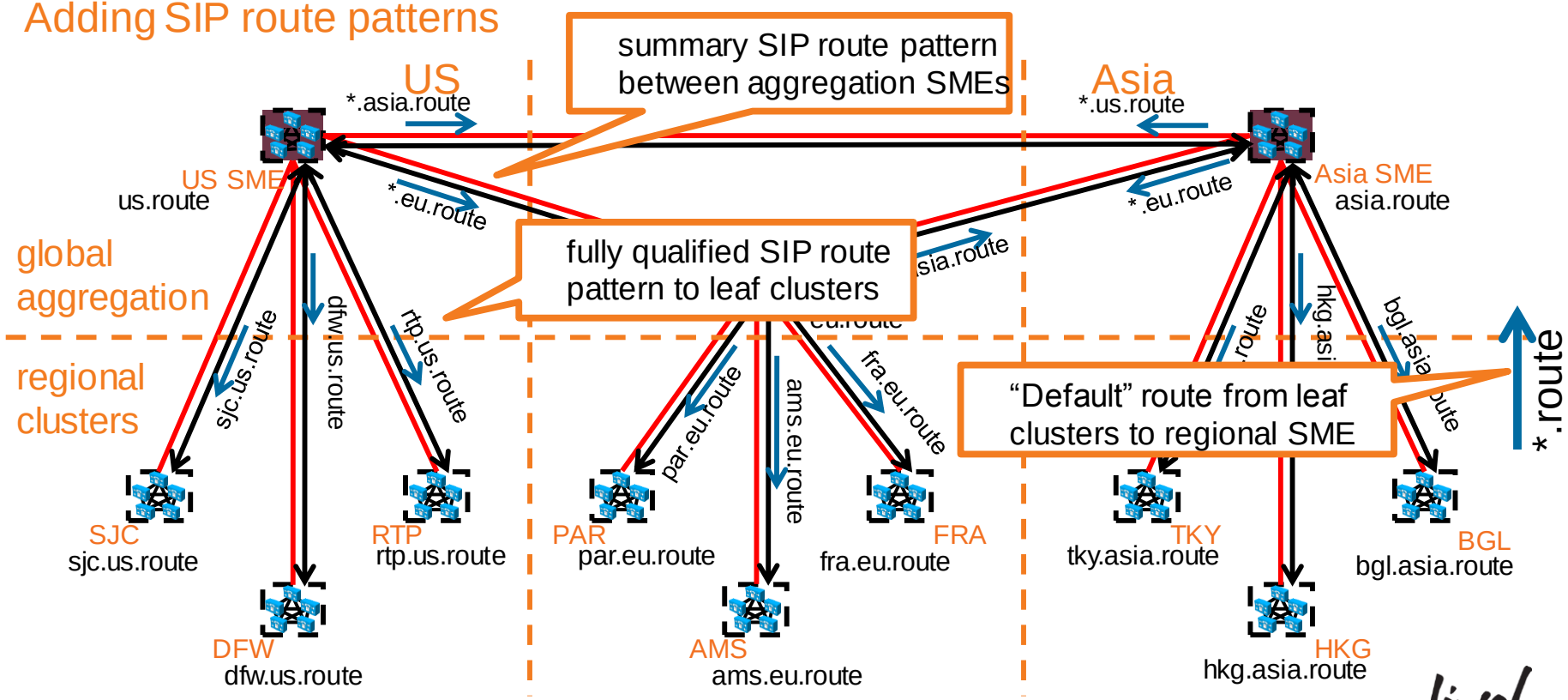
Example Global Topology using SME

Adding SIP route patterns



Example Global Topology using SME

Adding SIP route patterns

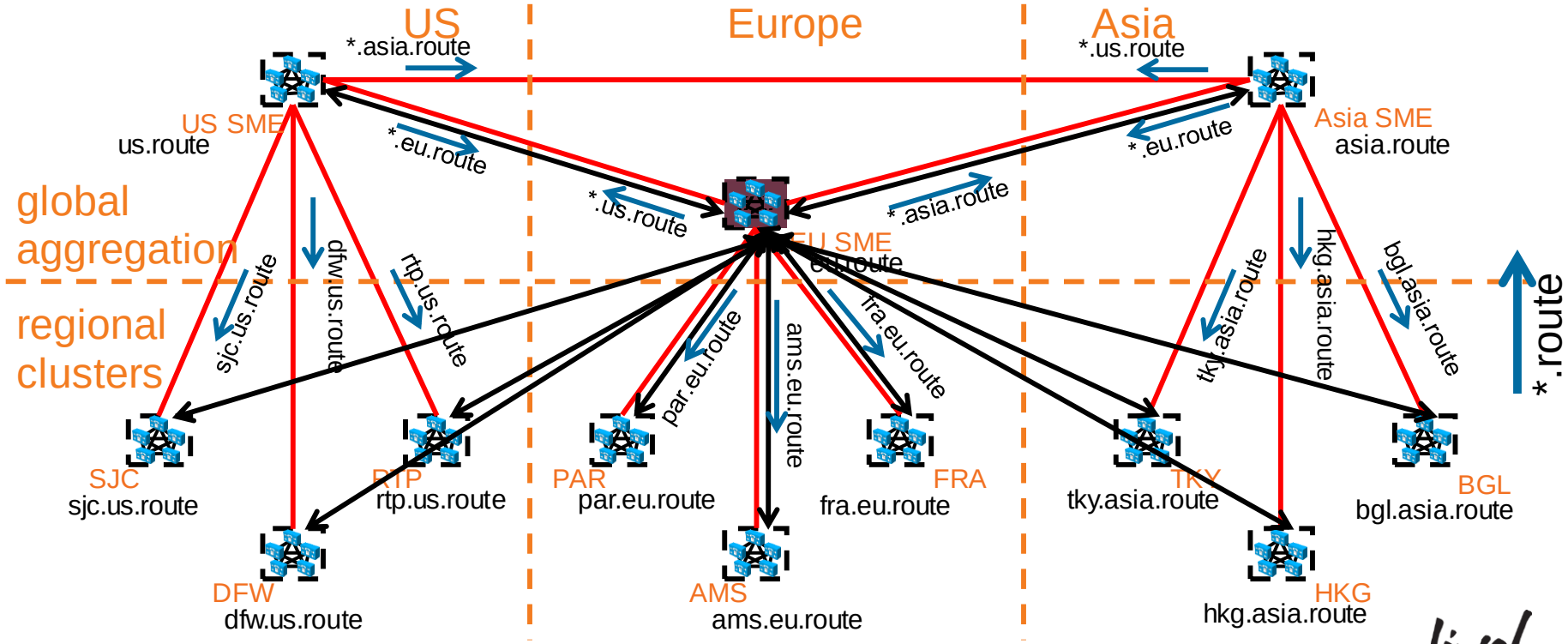


ILS/SIP Topology Equivalency

- Two topology layers:
  - SIP trunks/SIP route pattern
  - ILS topology
- In the example both topology layers are equivalent
- This does not necessarily has to be the case!
- ILS topology has to follow some restrictions that don't apply for SIP topology (full mesh of hubs)
- SIP topology might be dictated by geographic +E.164 summarisation which does not apply to ILS

Example Global Topology using SME

Alternative ILS Topology (single hub)



Example Global Topology using SME

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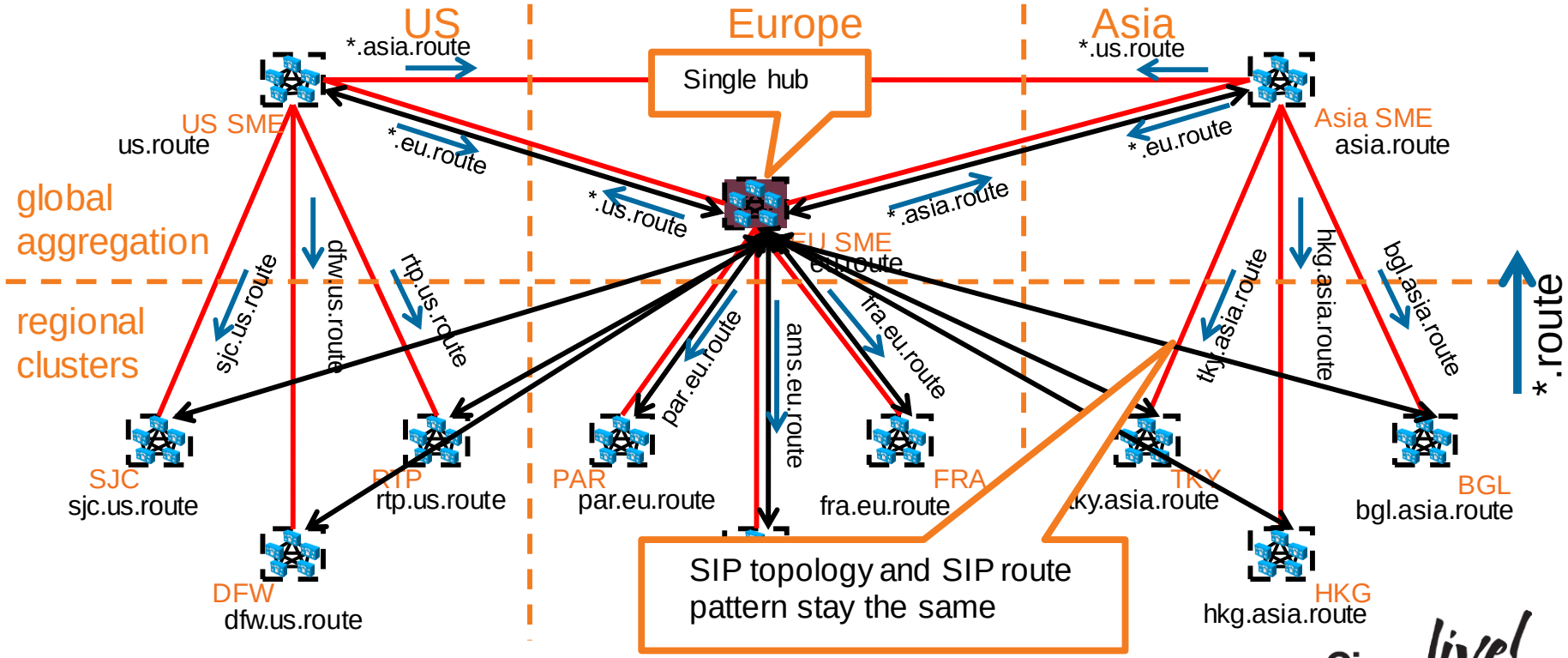

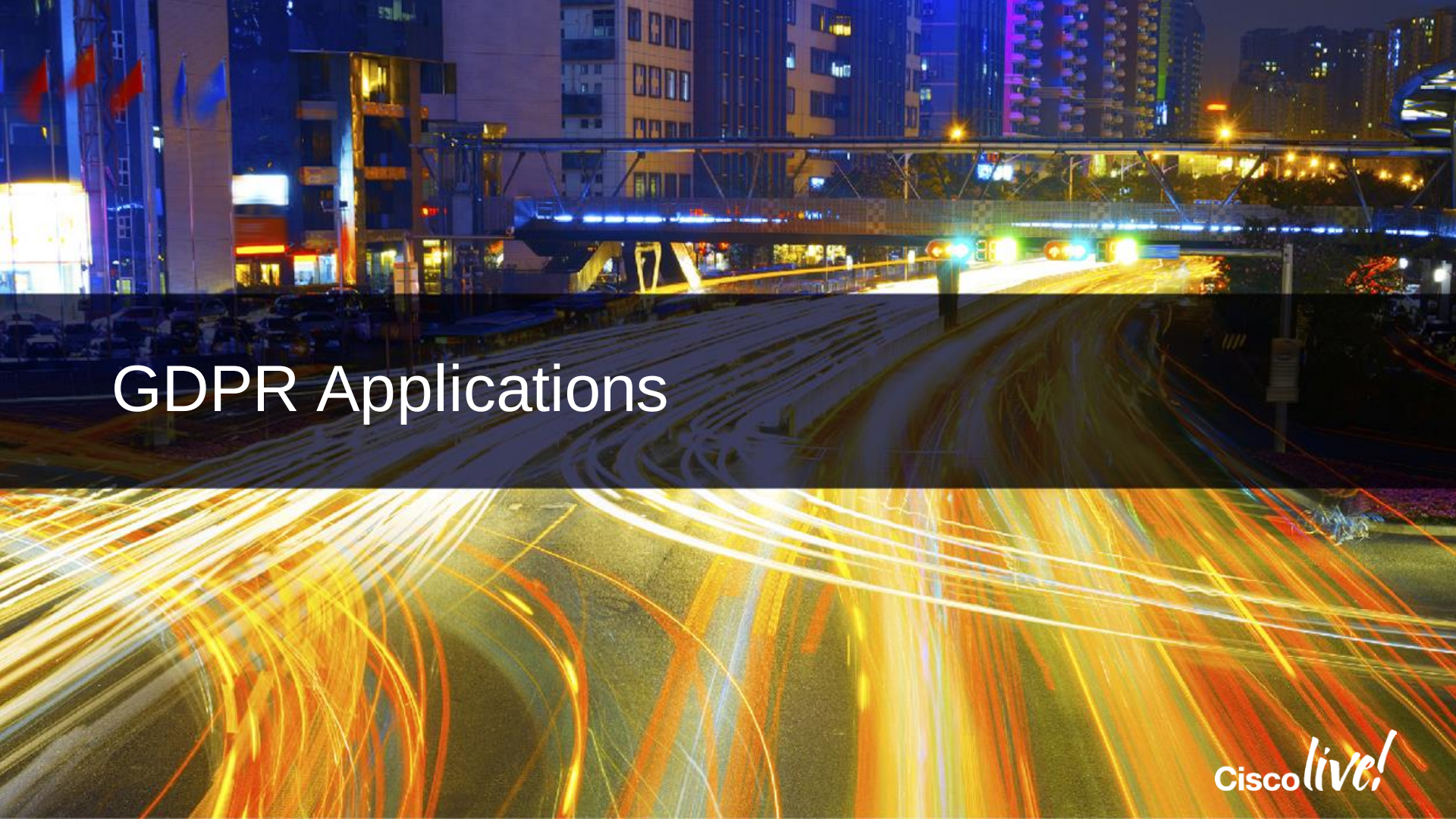

GDPR Applications

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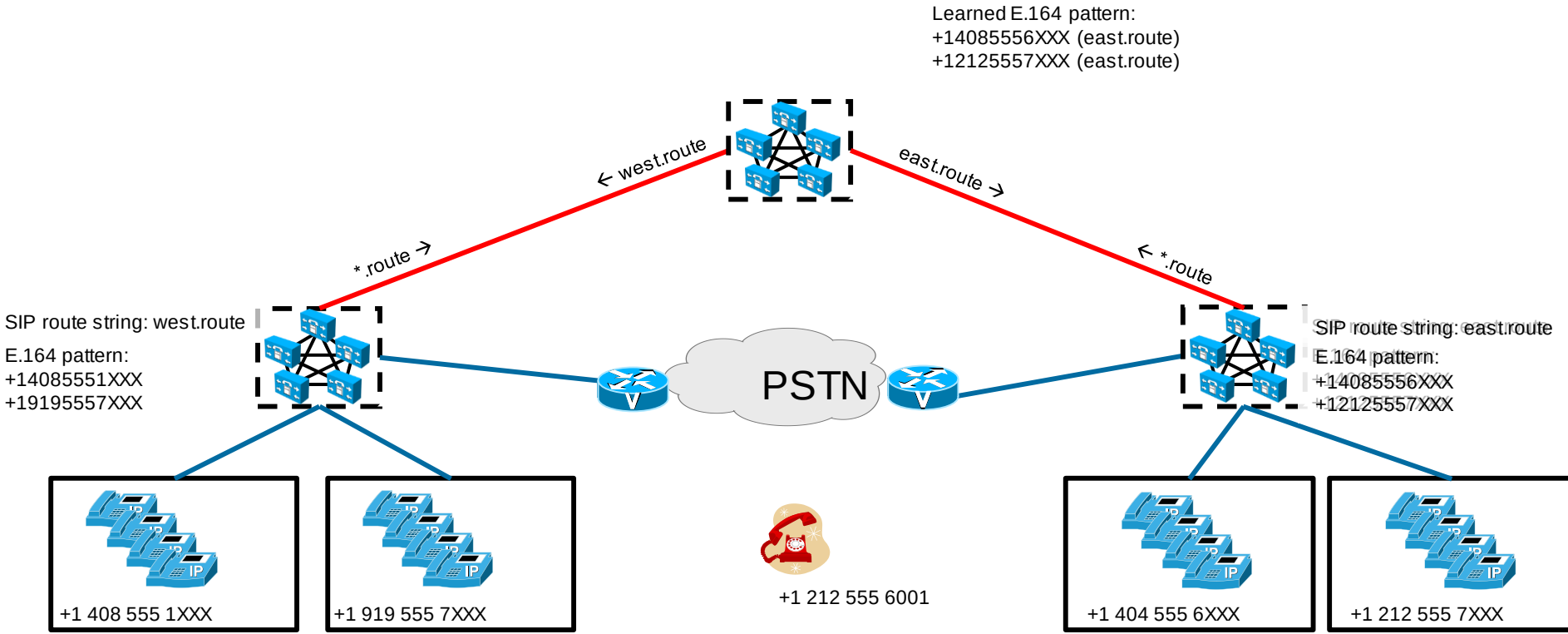
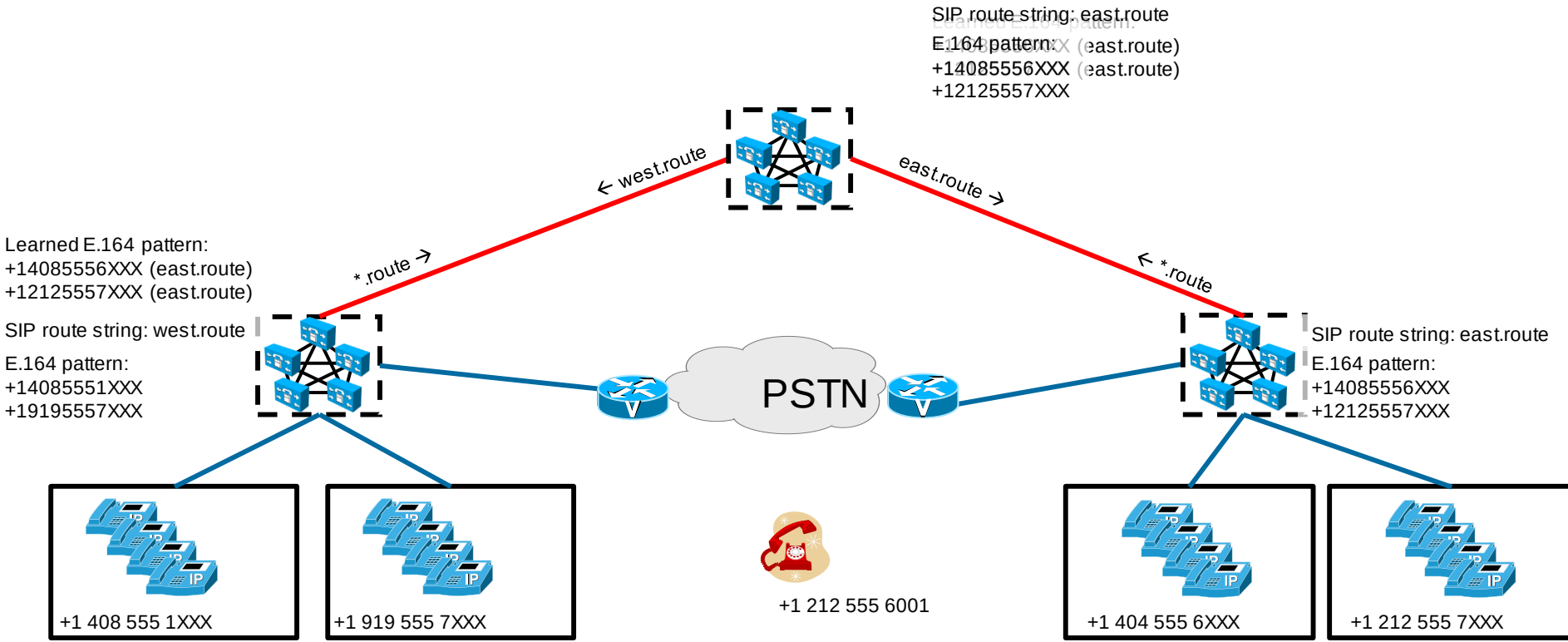
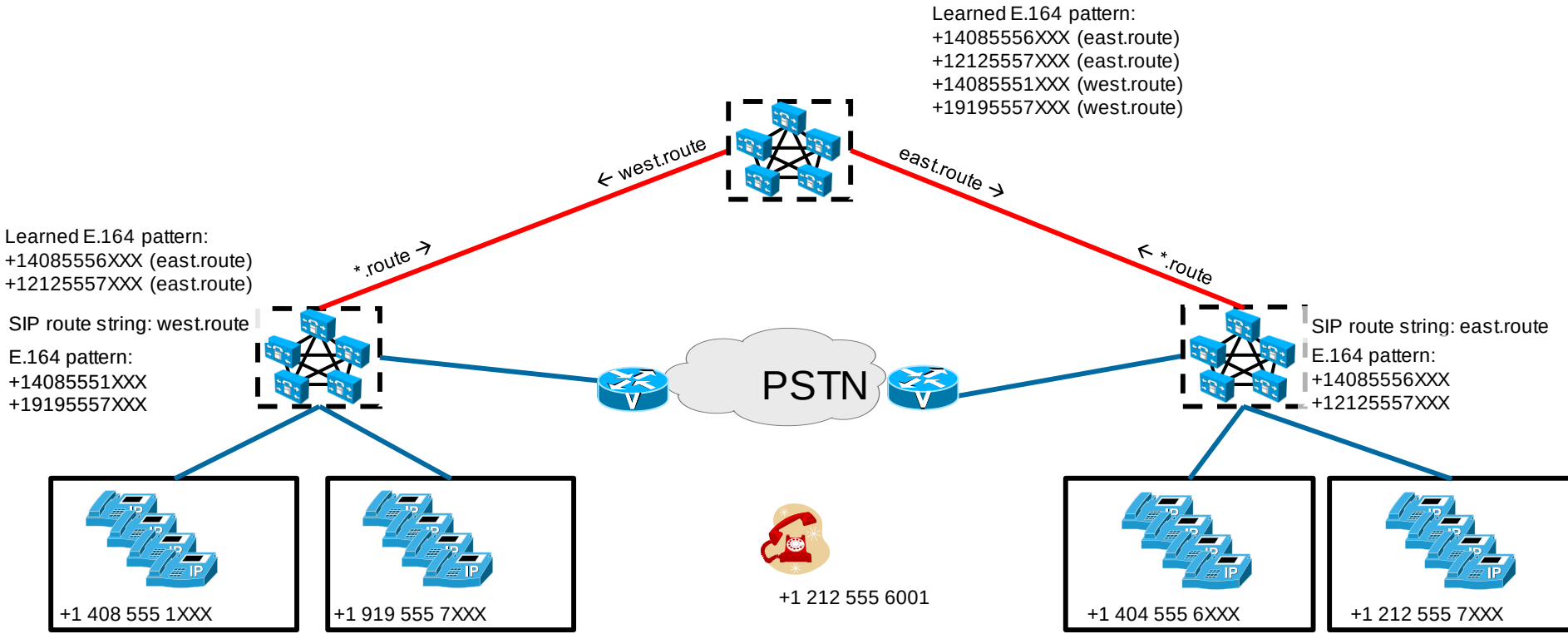
Local On-Net/Off-Net w/ GDPR



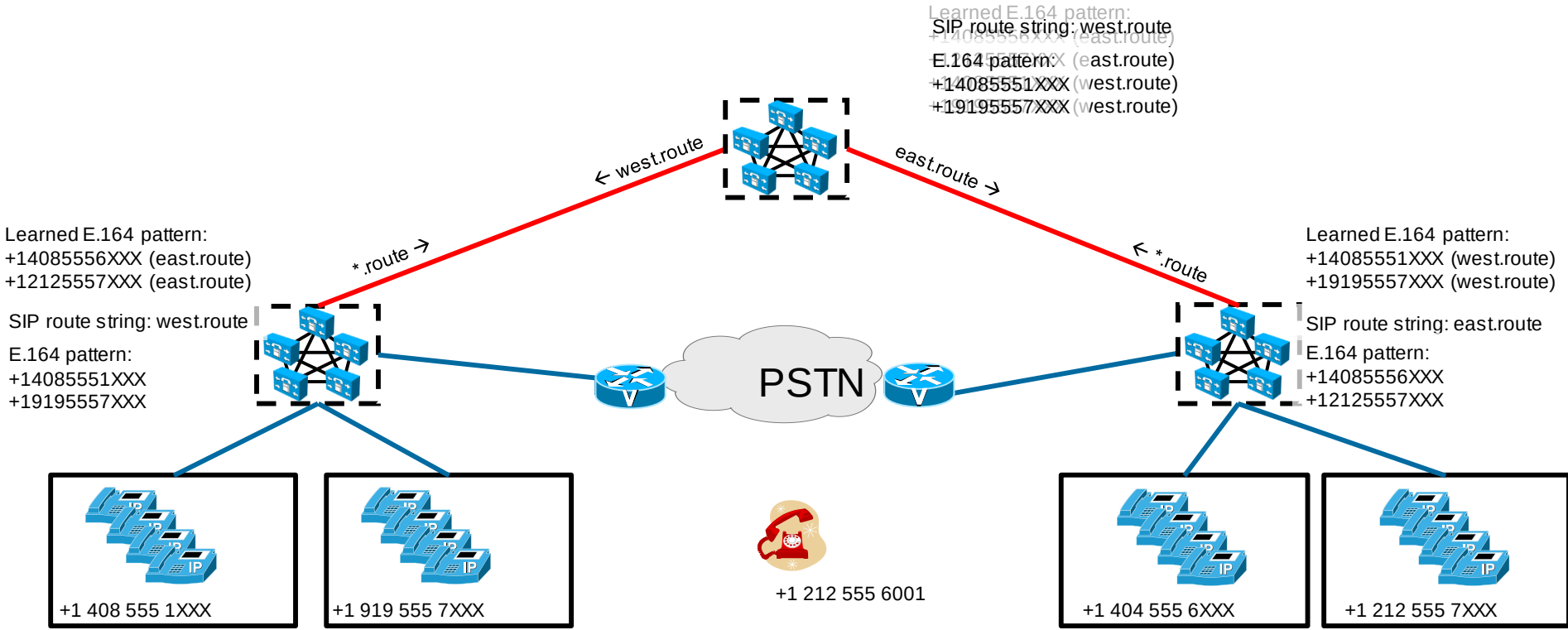
Local On-Net/Off-Net w/ GDPR



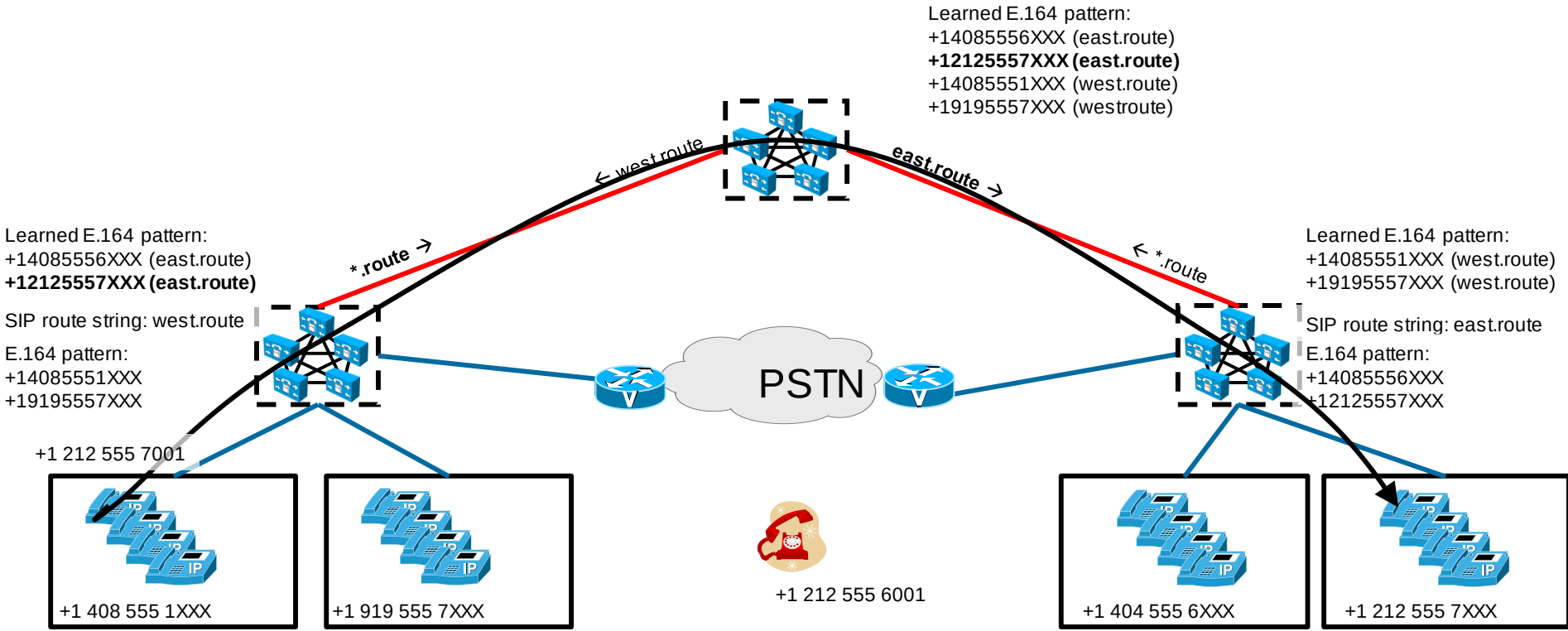
Local On-Net/Off-Net w/ GDPR



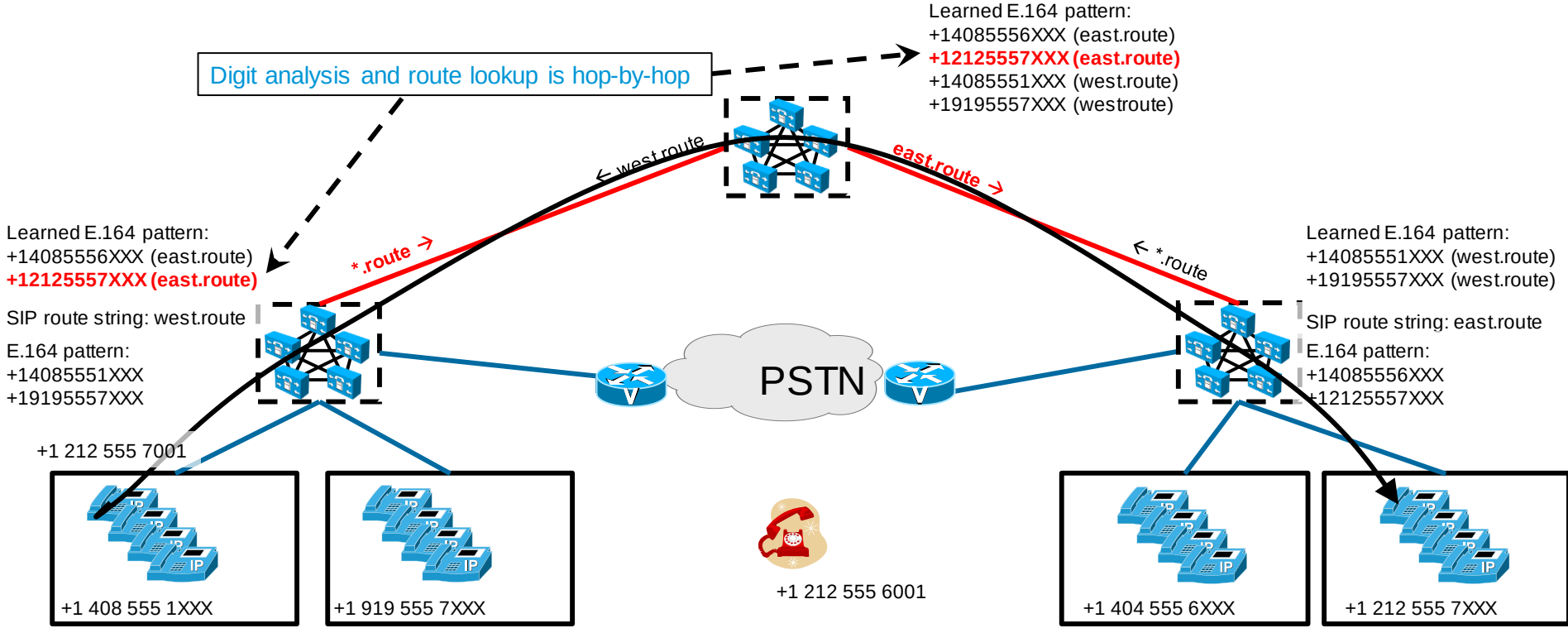
Local On-Net/Off-Net w/ GDPR



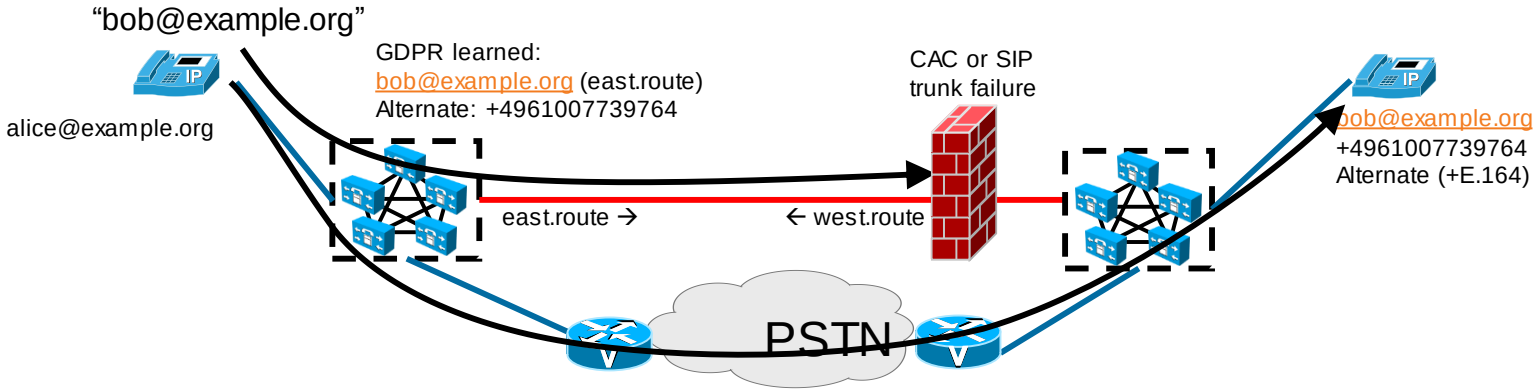
Local On-Net/Off-Net w/ GDPR



Local On-Net/Off-Net w/ GDPR



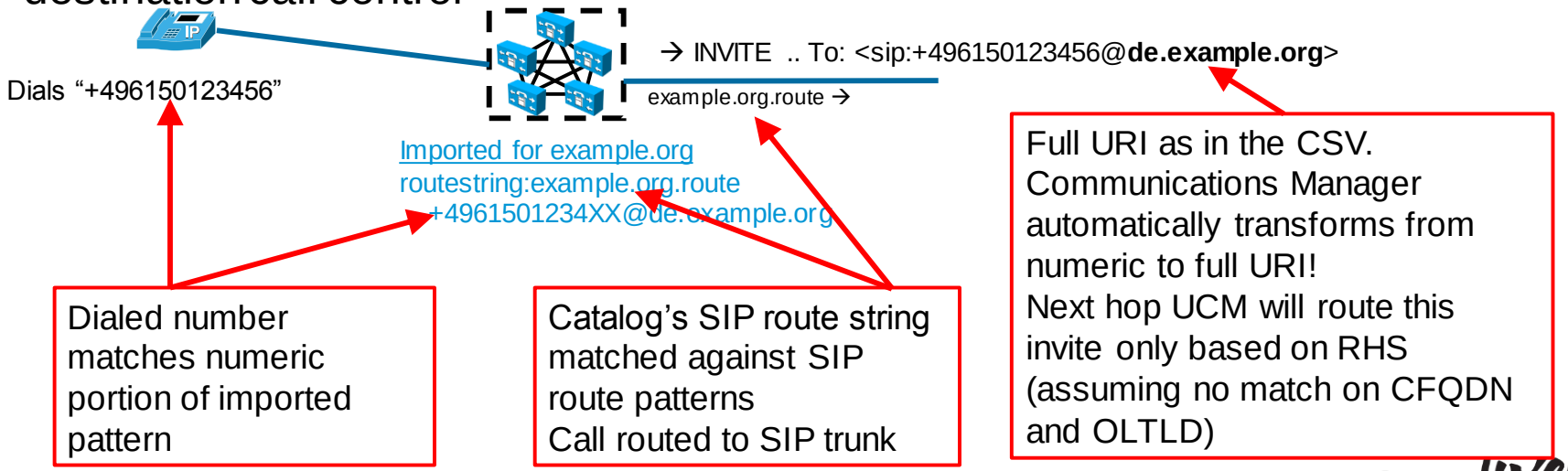
PSTN Failover for URI Dialled Calls with GDPR



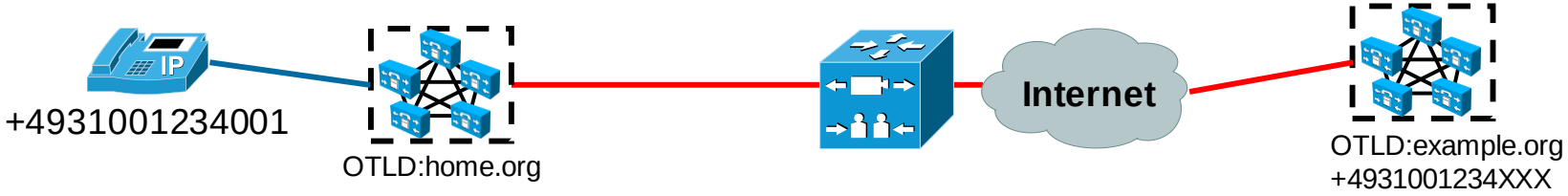
- GDPR provides PSTN alternate number for learned URIs
- If primary call fails (CAC failure or SIP trunk failure) reroute to PSTN using PSTN alternate number and AAR CSS of calling device

Dialling an Imported Pattern

- User portion of imported pattern is added to numeric digit analyis
- Host portion is automatically appended on routed call
- Enables transformation of numeric dialling to URI format required by destination call control

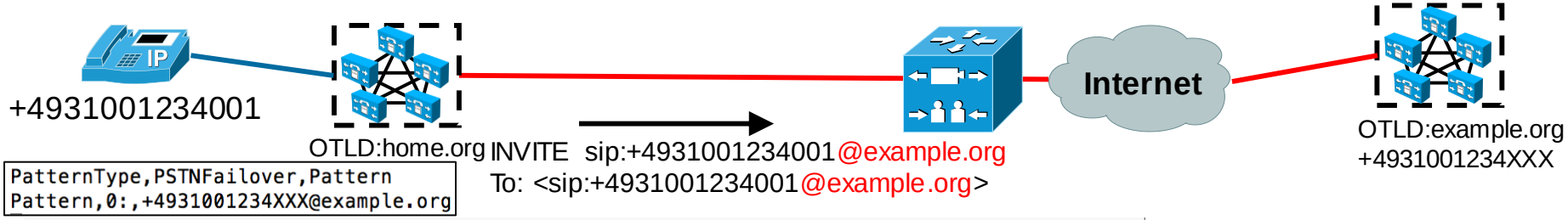


Numeric Inter-Domain Dialling



- Problem: for a given +E.164 when dialled numerically the appropriate RHS has to be inserted into To: and request URI to make sure that B2B connectivity can be established solely based on host piece routing
- Example: when dialling +4931001234001 the request and To: URI should have “example.org” as RHS
- Solution based on GDPR imported patterns

Numeric Inter-Domain Dialling (the solution)




```
PatternType,PSTNFailover,Pattern
Pattern,0:,+4931001234XXX@example.org
```

Route Plan Report *(1 - 1 of 1)* — *Rows per Page* 50

Find: All Patterns and URIs | Route Plan Report where: Pattern or URI | begins with | +4931001234 | Find | Select item or enter search text

Pattern or URI	Partition	Type	Route Detail
+4931001234XXX@example.org	onNetRemote	Learned Number/Pattern	us.route

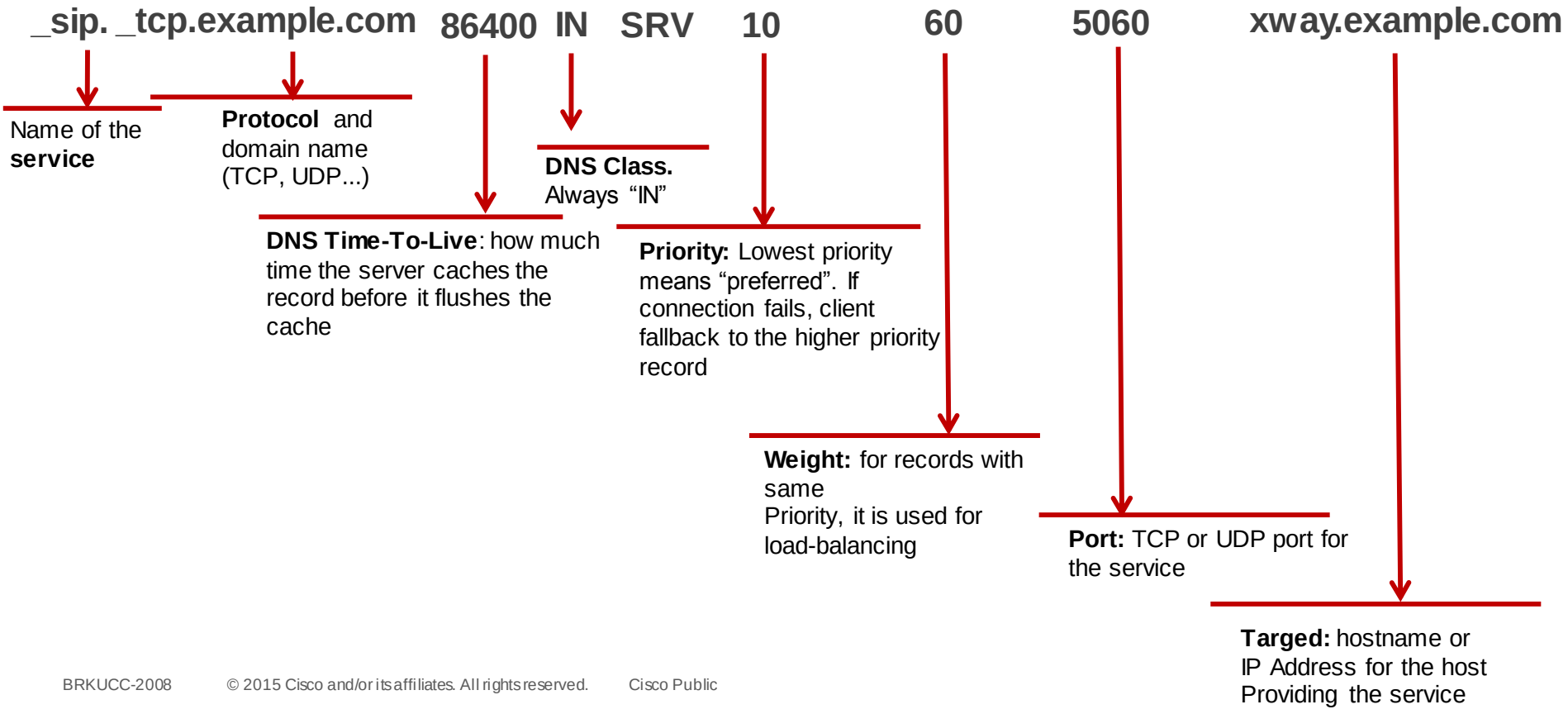
- Dialled numeric destination matches numeric portion (LHS) of pattern in imported GDPR catalog
- Outgoing INVITE has RHS of request and To: URI set to RHS of pattern in imported GDPR catalog
- Benefit: edge component can route solely based on RHS (host portion) of URIs even for numeric destinations

ExpressWay for Business-to-Business

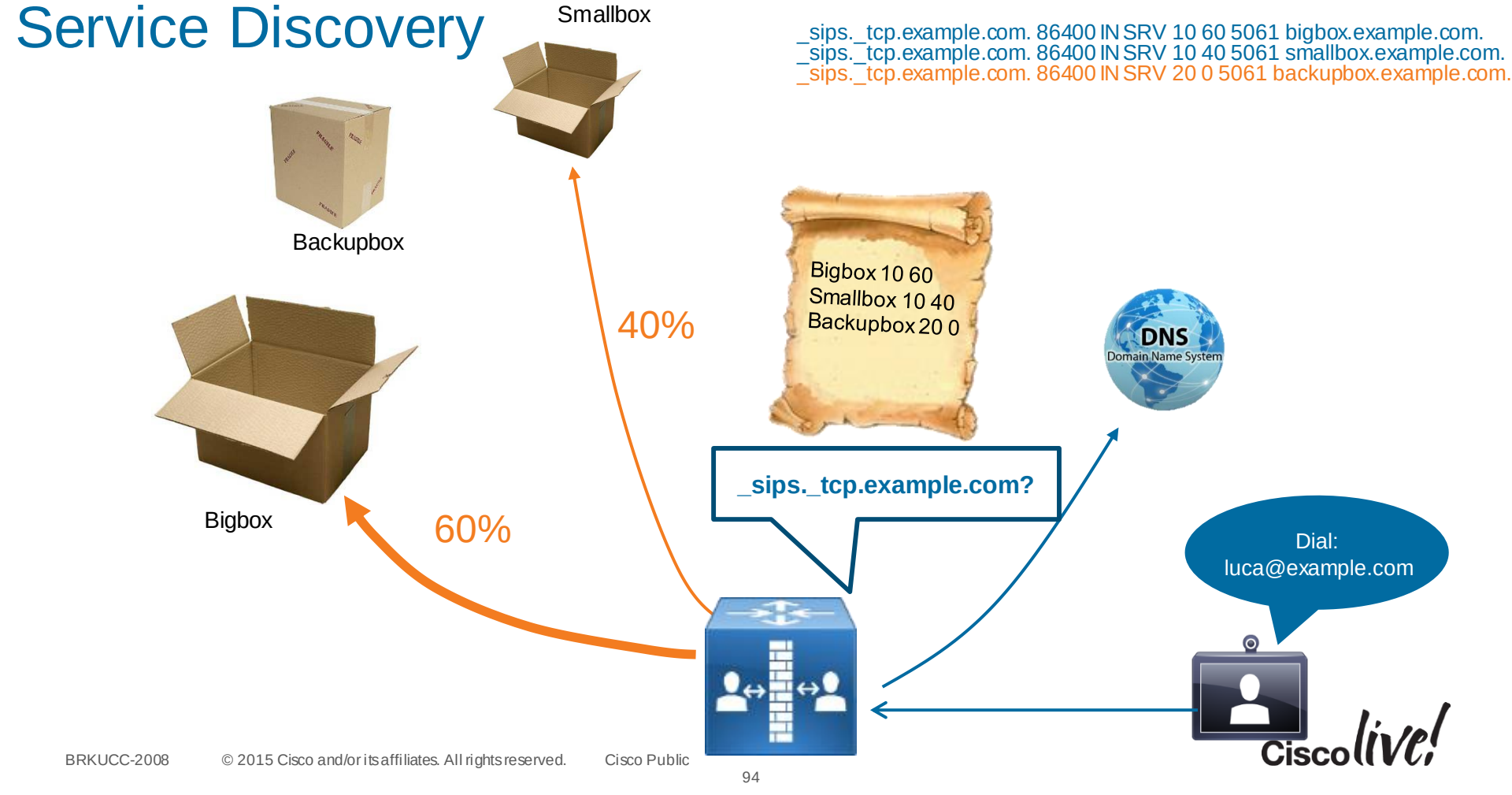
Cisco live!

Business-to-Business Call Scenarios

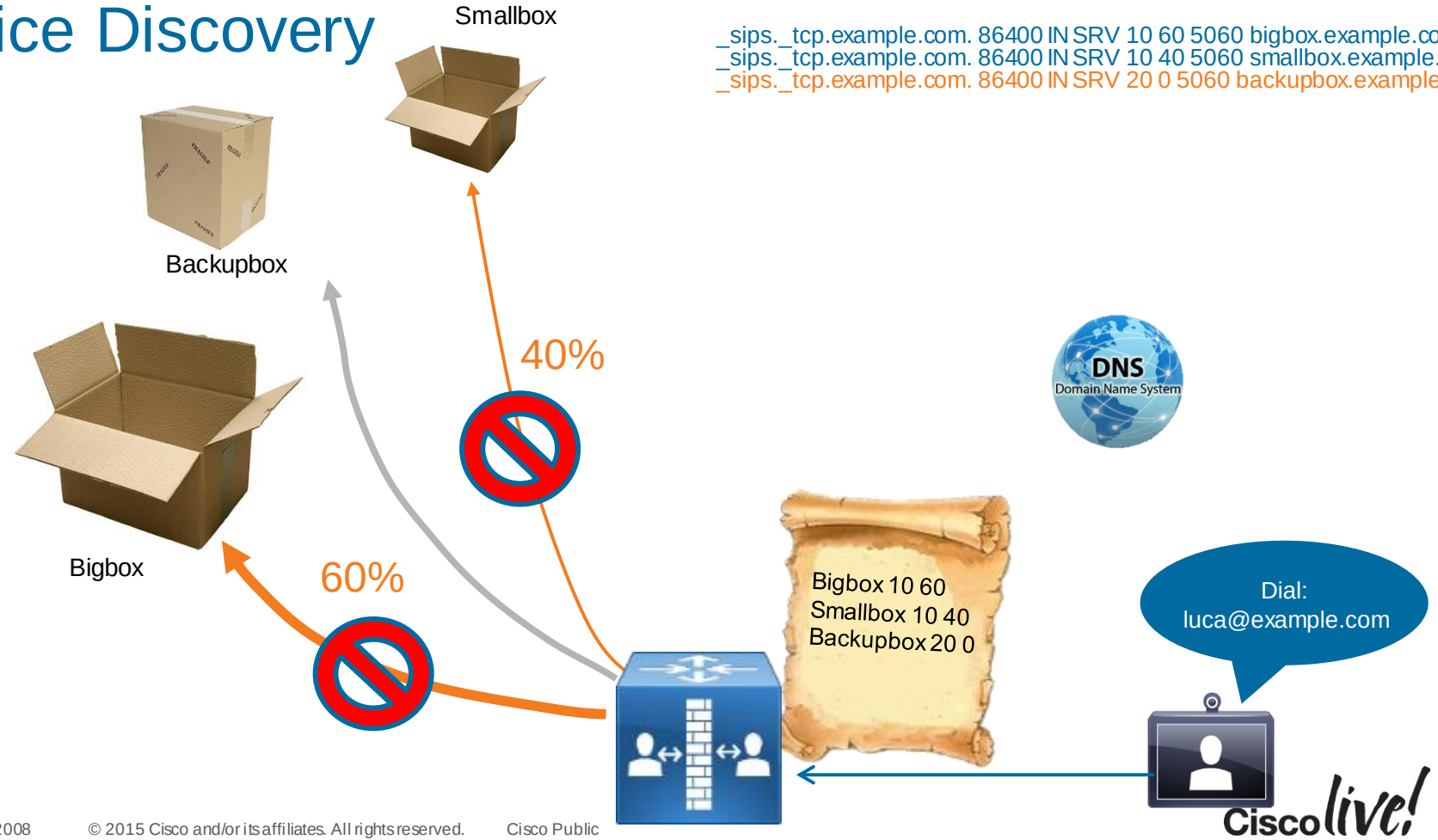
Format SRV records for SIP and H.323 (RFC 2782)



Service Discovery



Service Discovery

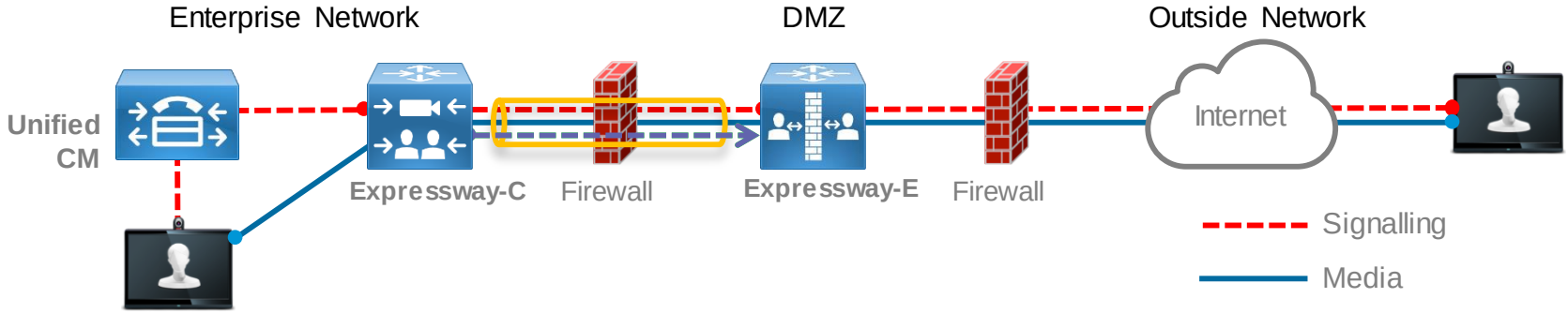


Business-to-Business Call Scenarios

Format SRV records for SIP and H.323 (RFC 2782)

- SIP
  - _sips._tcp.<fully.qualified.domain> 5061
  - _sip._tcp.<fully.qualified.domain> 5060
  - _sip._udp.<fully.qualified.domain> 5060
- H.323
  - _h323ls._udp.<fully.qualified.domain> 1719 - RAS
  - _h323cs._tcp.<fully.qualified.domain> 1720 - Call Signalling
- Example
  - _service._protocol.<f.q.dn>. TTL Priority Weight Port Target Host
  - _sips._tcp.company.com. 86400 20 5 5061 expe.company.com
  - _h323ls._udp.company.com. 86400 20 5 1719 expe.company.com

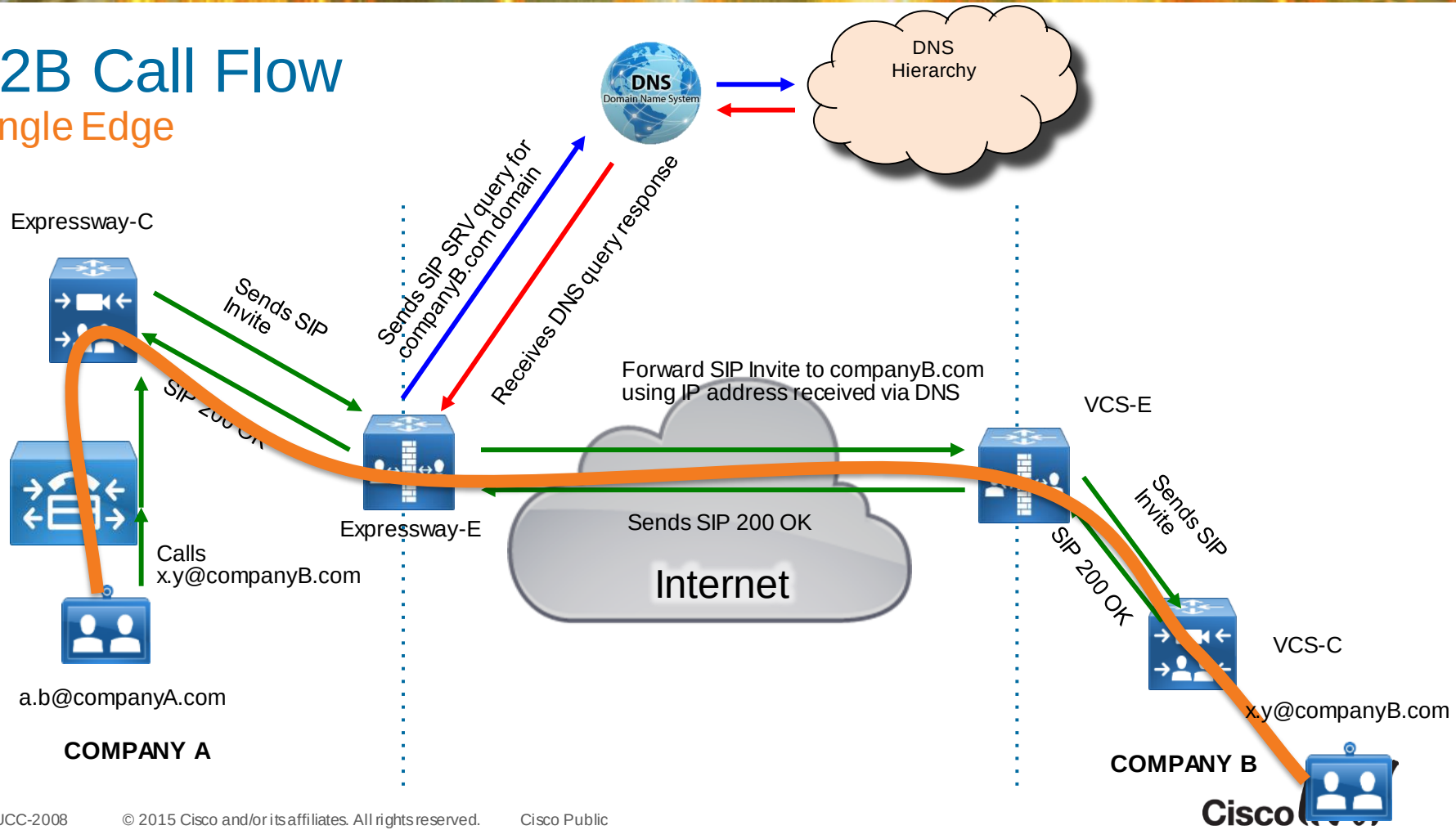
Expressway Firewall Traversal Basics



1. **Expressway-E** is the traversal server installed in DMZ. **Expressway-C** is the traversal client installed inside the enterprise network.
2. **Expressway-C** initiates traversal connections outbound through the firewall to specific ports on **Expressway-E** with secure login credentials.
3. Once the connection has been established, **Expressway-C** sends keep-alive packets to **Expressway-E** to maintain the connection
4. When **Expressway-E** receives an incoming call, it issues an incoming call request to **Expressway-C**.
5. **Expressway-C** then routes the call to **Unified CM** to reach the called user or endpoint
6. The call is established and media traverses the firewall securely over an existing traversal connection

B2B Call Flow

Single Edge



References

References

- Cisco Collaboration Solutions Design Guidance: http://www.cisco.com/go/ucsrnd
  - Cisco Collaboration Systems 10.x Solution Reference Network Designs (SRND)
  - Cisco Preferred Architecture for Enterprise Collaboration CVD
- BRKUCC-3000, Advanced Dial Plan Design for Unified Communications Networks (2015 Milan) https://www.ciscolive.com/online/connect/sessionDetail.ww?SESSION_ID=82082
- ... and other BRKUCC-3000 sessions from earlier Cisco Live events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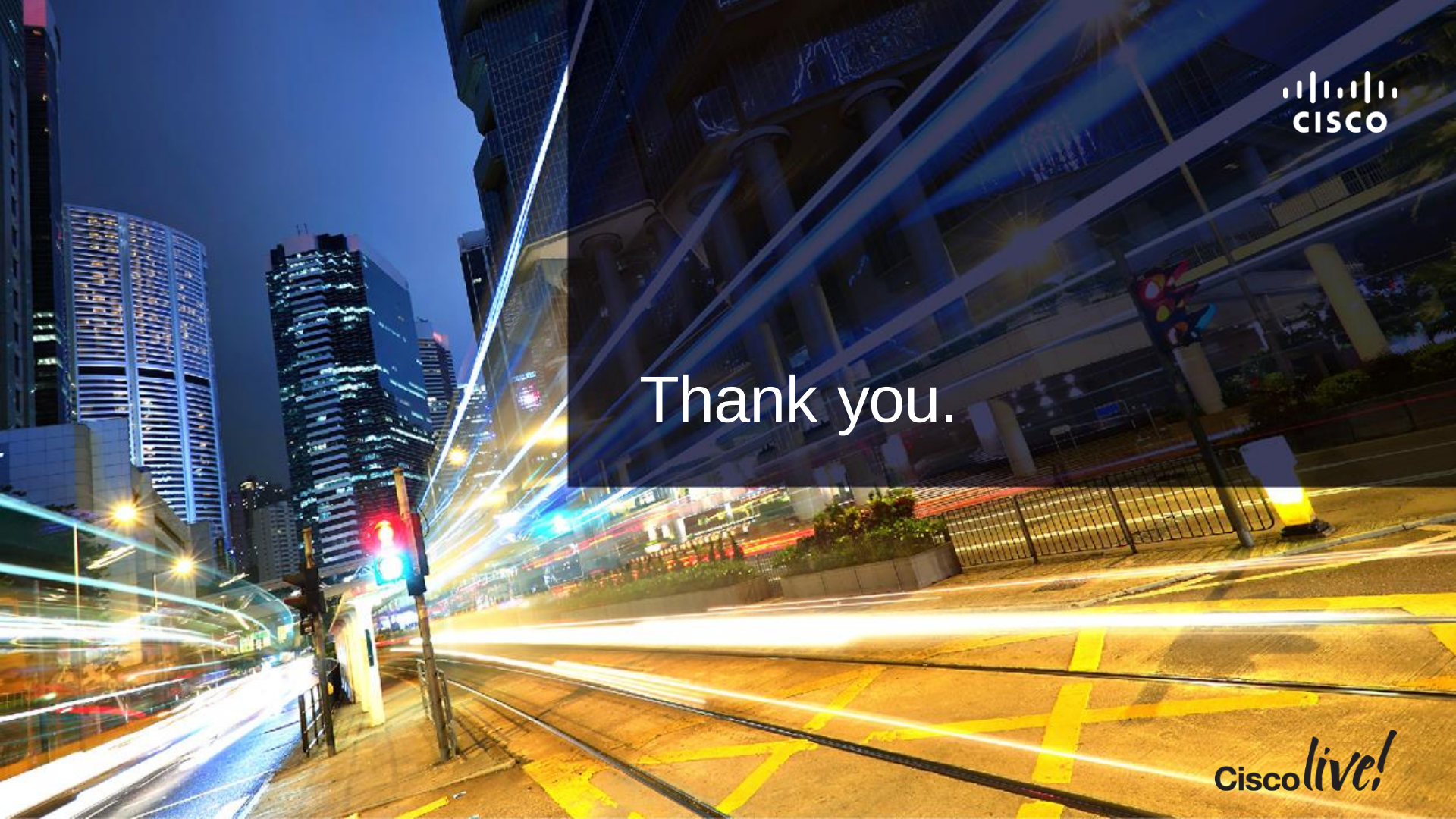
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