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Next Generation NP Solutions and ENUM

May 2011

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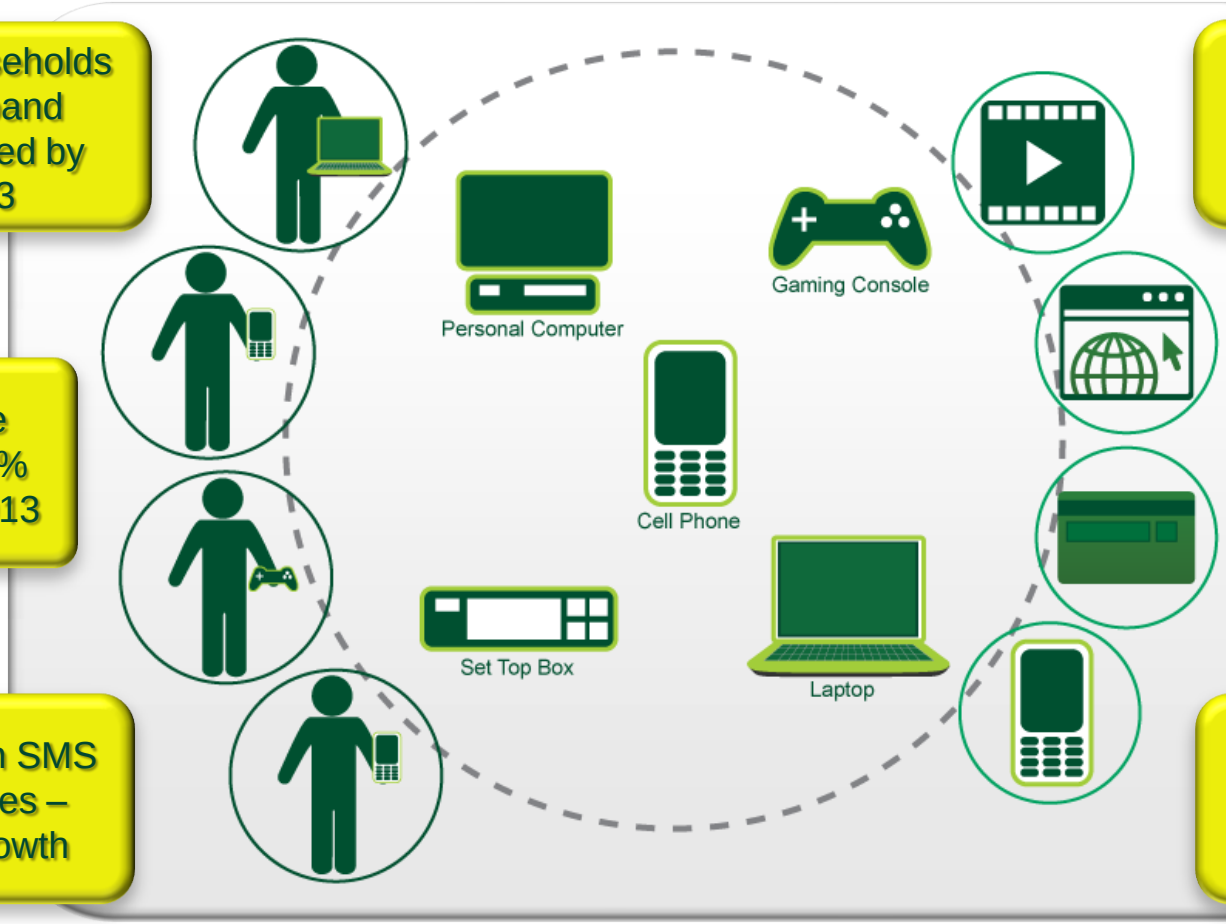
The Interconnection Environment

33% households broadband connected by 2013

4.6B Mobile Devices –35% Growth by 2013

4.1 Trillion SMS messages – 35% Growth



90% of all IP traffic on Mobiles within 3 years

400M IMS (RCS) Subscribers by 2013

2.2B TNs impacted by NP growing 50% by 2013

Increasing demand and complexity for IP Interconnection

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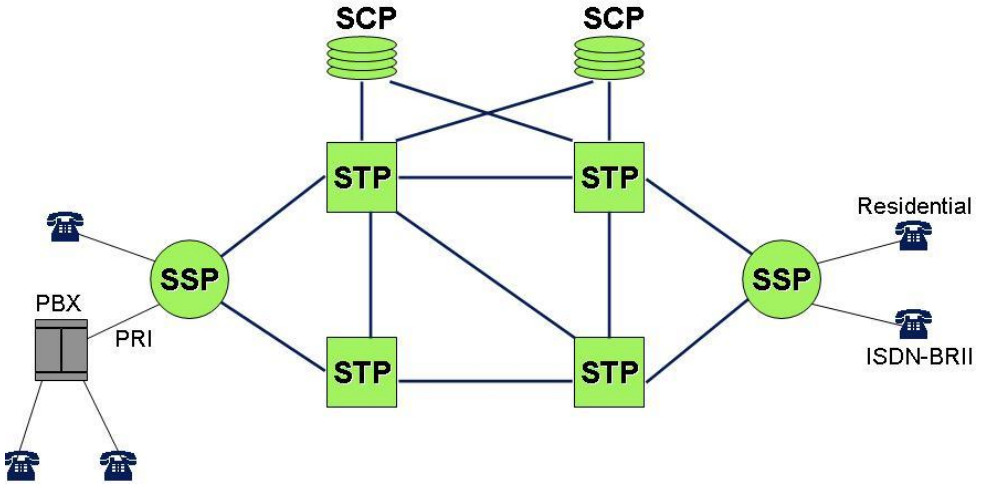
Centralized Routing Has Been a Long Term Goal of Most Carriers

- Labor efficiency of entry, updates, etc…
- Single entry accuracy and testing
- Common place for transport and services to access routing information

Routing Evolution - Circuit Switching

1970s – 1980s

- Switches break apart into:
  - **S**ervice **S**witching **P**oints
  - **S**ervice **T**ransfer **P**oints
  - **S**ervice **C**ontrol **P**oints
- SS7-based standard
- Evolves into AIN and INAP



Pluses

- Single standard for NA and Intl
- Good features/performance for voice networks
- Implemented everywhere

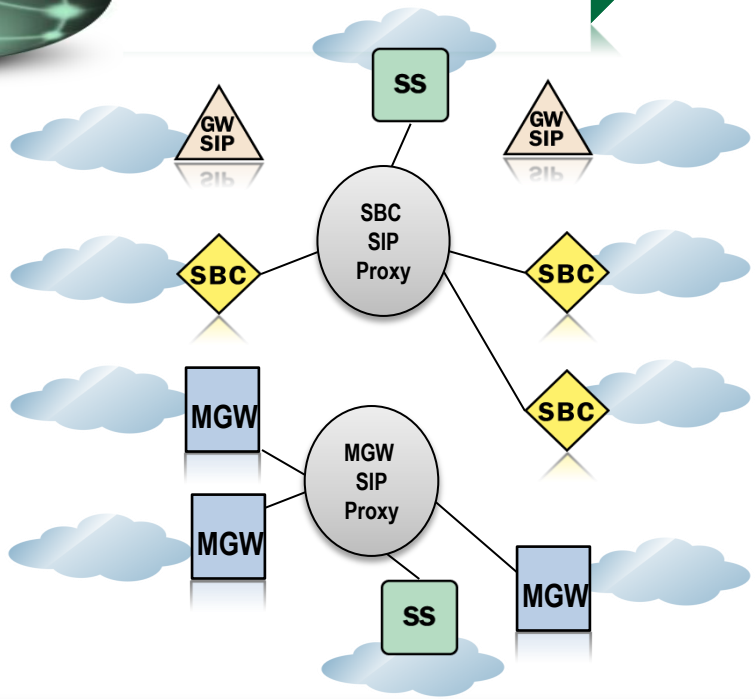
Minuses

- Expensive (CapEx/OpEx)
- Limited call control points and functionality
- Difficult to extend to IP

Routing Evolution – IP Edge

1990s – 2000s

- IP Elements Evolve to:
  - **M**edia **G**ateway
  - **S**ession **B**order **C**ontroller
  - **S**oft **S**witch
- SIP-based with several standards
- Evolving to centralized SIP Proxy control



Pluses

- IP Cloud connectivity
- SIP is powerful/flexible
- Modern provisioning

Minuses

- SIP is too powerful/flexible
- SIP Proxy highly optimized per vendor
- Difficult to extend to other vendors & network types

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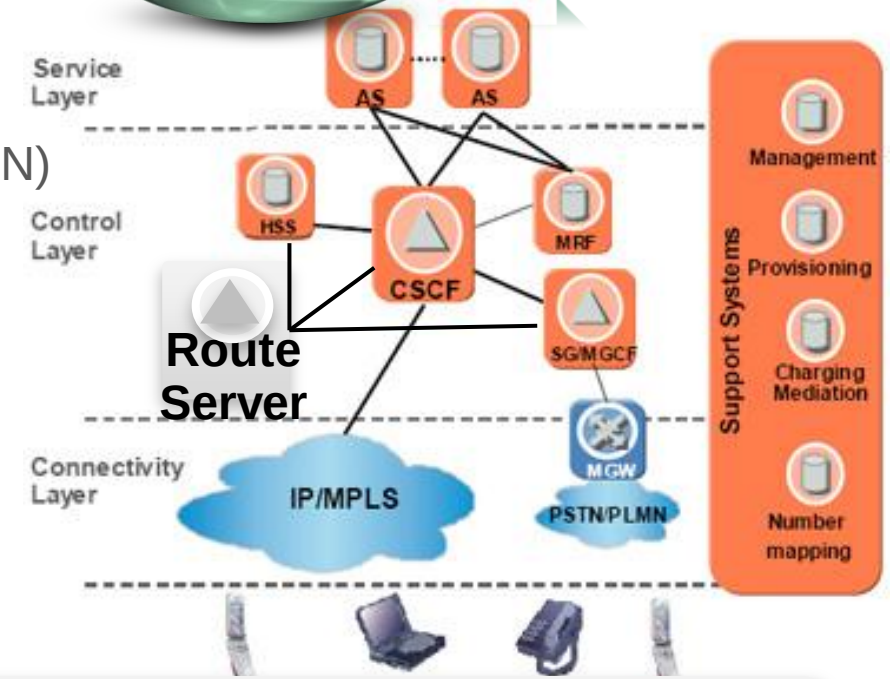
Routing Evolution – IMS Futures

2010s +

- IMS Routing is Distributed:
  - **B**reakout **G**ateway **C**ontrol **F**unction (PSTN)
  - **C**all **S**ession **C**ontrol **F**unction (IP)
  - **H**ome **S**ubscriber **S**erver (SLAs)
- Single Network Evolution (Fixed, Cable, Wireless, ASP)
- Although not defined, Route Server can centralize addressing and routing



Pluses

- SIP standardization across fixed/mobile
- Shares services approach
- Common billing/provisioning

Minuses

- Major network evolution
- Routing & Addressing not specifically defined
- Alignment to data evolutions such as LTE needs work

The Promise of IP and the Reality

The Promise

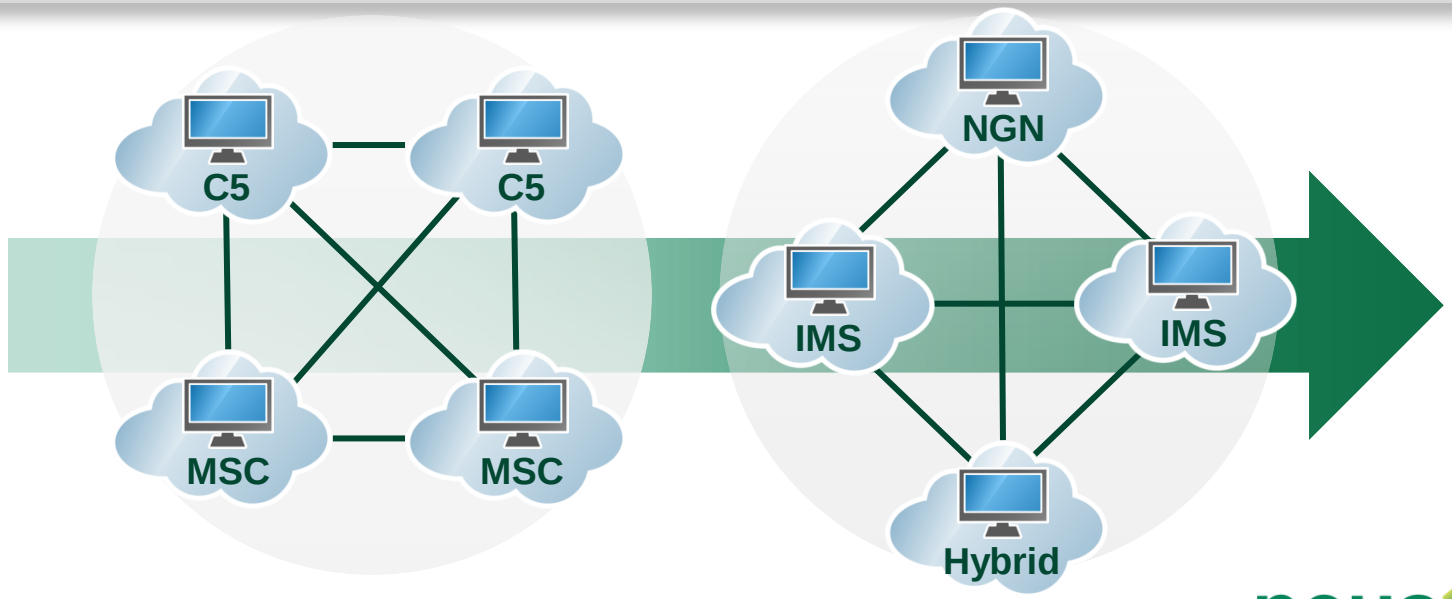
IP was supposed to simplify and unify networks, services and management

The nature of large networks is to be in transition and continually evolve

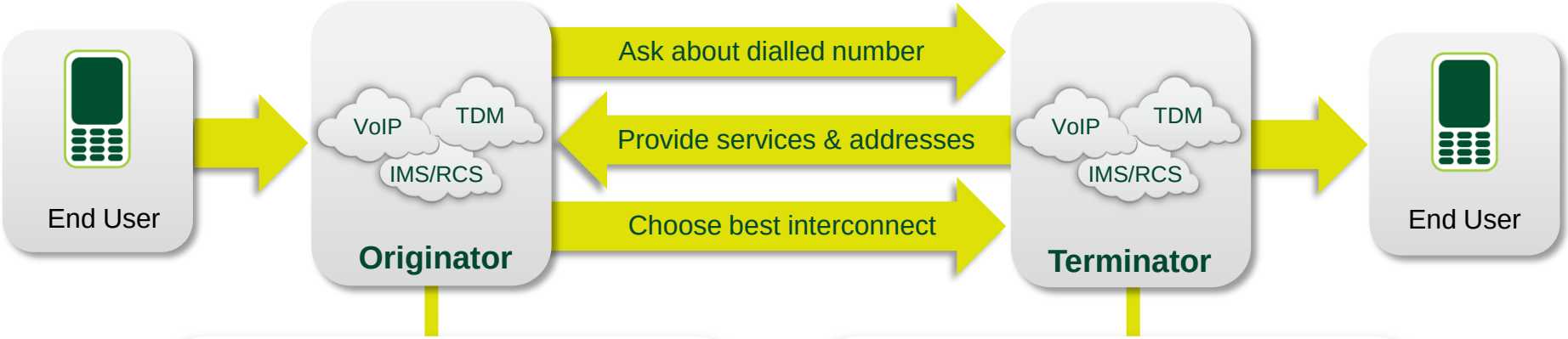
The Reality

Investment in IP has led to 'Islands' of technology

- Each island tends to have its own services
- Each Island tends to use separate policy architectures
- Each Island tends to have separate routing and addressing rules



What problems can ENUM solve?



Originator Challenges:

- Send traffic via SS7/C7 or IP?
- Is the end destination compatible?
- Which carrier or route can deliver?
- What is the IP based address?

Destination Challenges:

- How will others find my services?
- How will others find my gateways?
- How will others find my service provider?
- How do I indicate a SS7/C7 or IP preference?

"Inform" others dynamically about how to reach your services

Network Addressing

- Naming and addressing are critical for networking
- People *and service providers know how to use* telephone numbers
  - » Billions of telephony devices only use numeric key pads
- Telephone Numbers and IP URI's can and will be used interchangeably
  - » tel:+15714345400
  - » sip:5400@lab2pbx2.neustarlab.biz
- VoIP and PSTN domains MUST be transparently interoperable to ensure universal reach
- Number Portability is a great competitive enabler
  - » But adds complexity to network addressing

Why Interconnect Networks?

- Metcalfe's Law
  - The "value" or "power" of a network increases in proportion to the square of the number of nodes on the network.
  - Adoption of Next Generation services will increase substantially as peering expands the addressable network/community
- BUT…
  - How will users address each other?
  - How will this address actually find the other user if in another network?
  - How do users specify which service they are looking for?

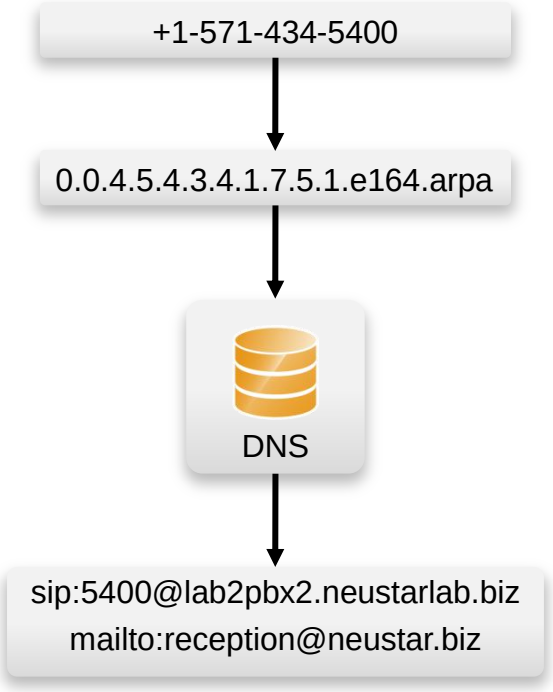
Ideal Technology for Addressing?

- ENUM, of course!
  - » Based on Telephone Numbers
  - » Found in any Registry/ Location worldwide
  - » For all available services
- Private ENUM, not Public ENUM
  - » Secure, accurate, and commercializable

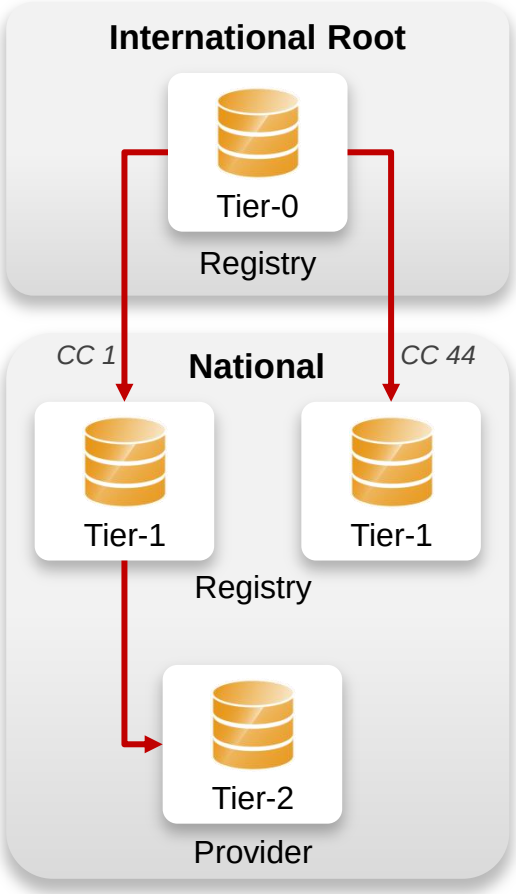
What is ENUM?

1. Take a phone number
2. Turn it into a full domain name
3. Ask the DNS
4. Returns a list of URIs

URI: Uniform Resource Identifier



In any location worldwide?



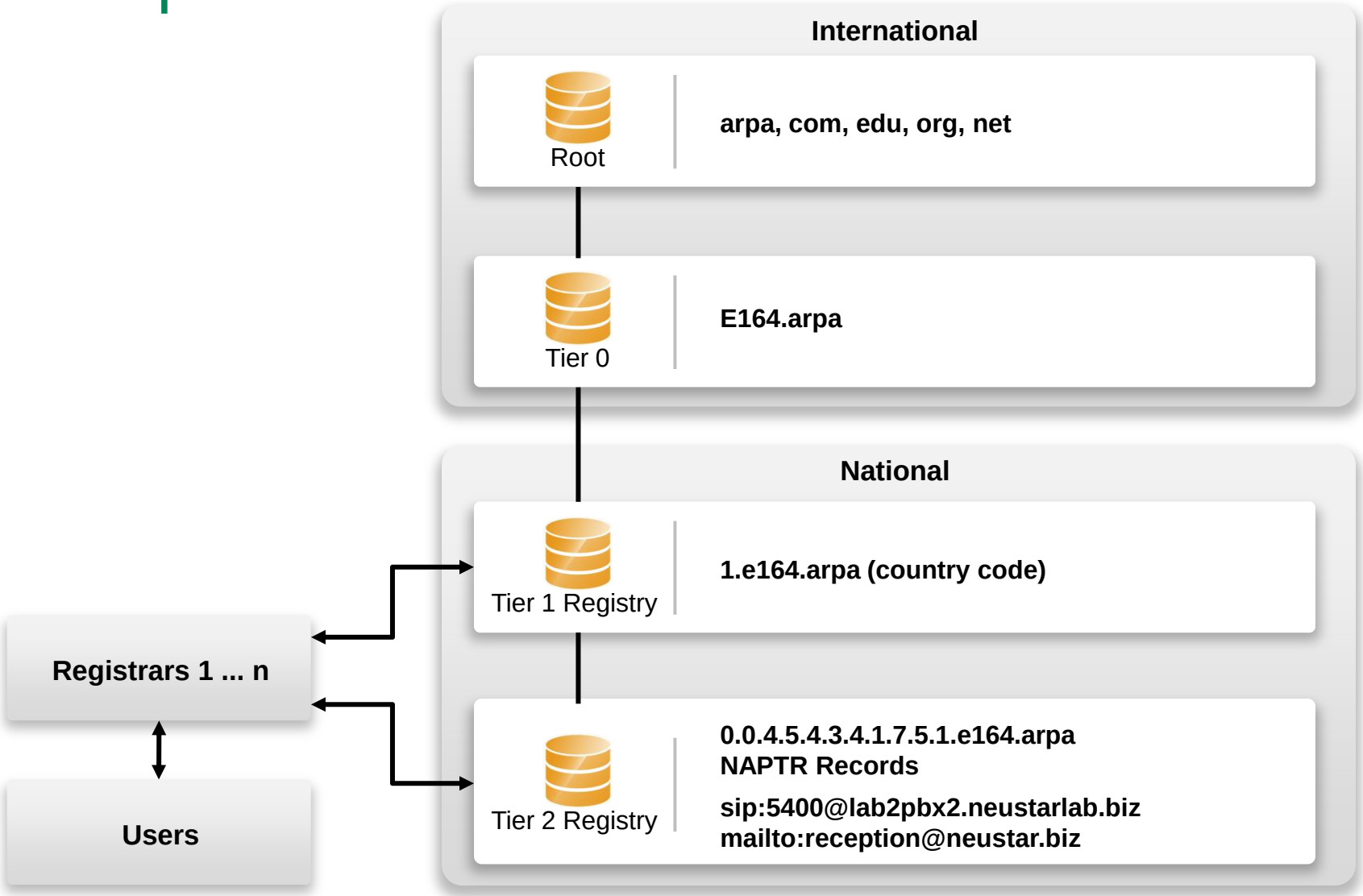
Directs DNS query to country's Tier-1 registry(ies). NS record* provided for each Tier-1 registry

Directs DNS query to customer's Tier-2 providers. NS record provided for each subscriber's telephone number

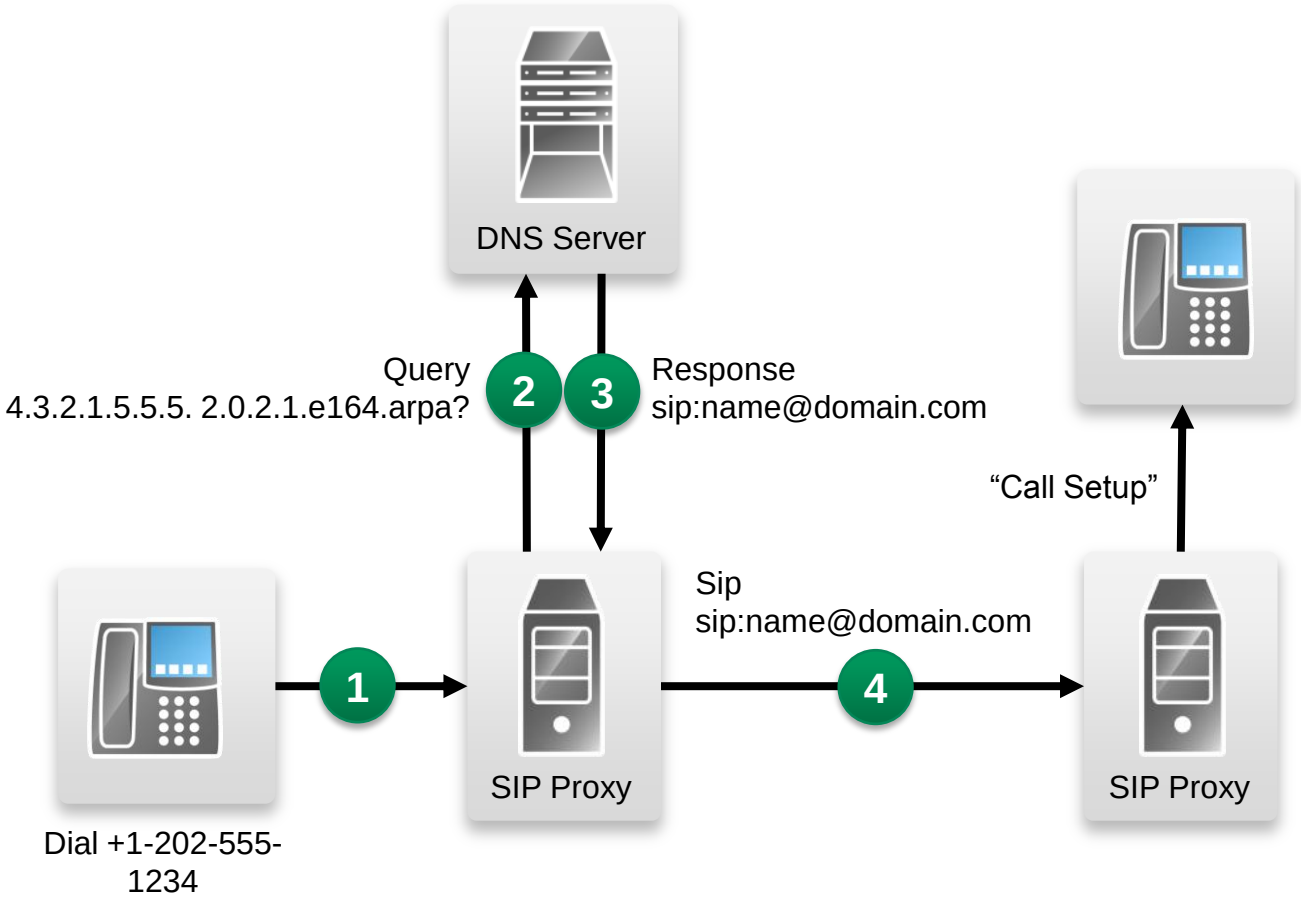
Stores list of service-specific internet addresses in of URI's in a DNS resource record called NAPTR for each subscriber. Returns the **full** list of IP addresses associated with the E.164 number being queried.

* *An NS record is an authoritative name server DNS record used to delegate to subordinates*

Example



ENUM In Action



1. The caller simply dials the person's normal telephone number 202-555-1234
2. Calling party proxy queries DNS for location of end point
3. DNS returns NAPTR record containing SIP URL
4. Calling party proxy connects the call

ENUM Implementation Approaches and Worldwide Deployment Status

Three ENUM Implementation Approaches:

- Public ENUM (End User ENUM)
- Carrier ENUM (Infrastructure ENUM)
- Private ENUM

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Public ENUM

- Also known as End User ENUM
- Records entered by end users to associate Telephone Numbers with the URIs of their devices
- Implementation architecture widely discussed in standards bodies and industry forums
- Key concerns on data availability, validity and privacy

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Public ENUM Status

Countries that have trialed Public ENUM

- Austria
- Finland
- France
- Germany
- Ireland
- Japan
- Netherlands
- Poland
- Sweden
- South Korea
- Switzerland
- UK
- US

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Public ENUM Observations

- Based on the trials the following observations can be made
  - ENUM is viewed as a potential enabler for future services and therefore has general regulatory support
  - Privacy and data security issues are viewed as critical
  - The approach towards validation/authentication varies widely, from very secure to almost non-existent
  - The implementation approach and interface requirements also vary widely
  - There is currently no killer application for the initial launch, but there is a strong focus on VoIP
  - There are differing views on the importance and potential role of incumbent telco
- Regulatory issues are important but are not THE key factor in the rollout of ENUM services

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Making Public ENUM Actually Work

- How will carriers and enterprises provision ENUM?
  - In order for ENUM to work, Carriers and Enterprises will have to exchange data on their TN-to-URI translations
  - Carrier Customer Management Systems will have to learn how to provision ENUM
- What is the business model?
  - What will be the model for how much the Registrar, Tier 1, and Tier 2 ENUM providers get paid?
  - What is the end user willingness to pay?
- Will there be Regulatory policies relating to security and privacy?

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ENUM Implementation Approaches

	Party to control data	Data Accessibility	TN-URI Mapping	Deployment Status
Public ENUM	End user (opt-in)	Public (ENUM DNS entries may exist only if the number assignee opts in)	Full end-user TN to end-user URI	Country-wide trials e.g., CC1 ENUM LLC, with limited commercial offerings
Carrier/ Infra ENUM				
Private ENUM				

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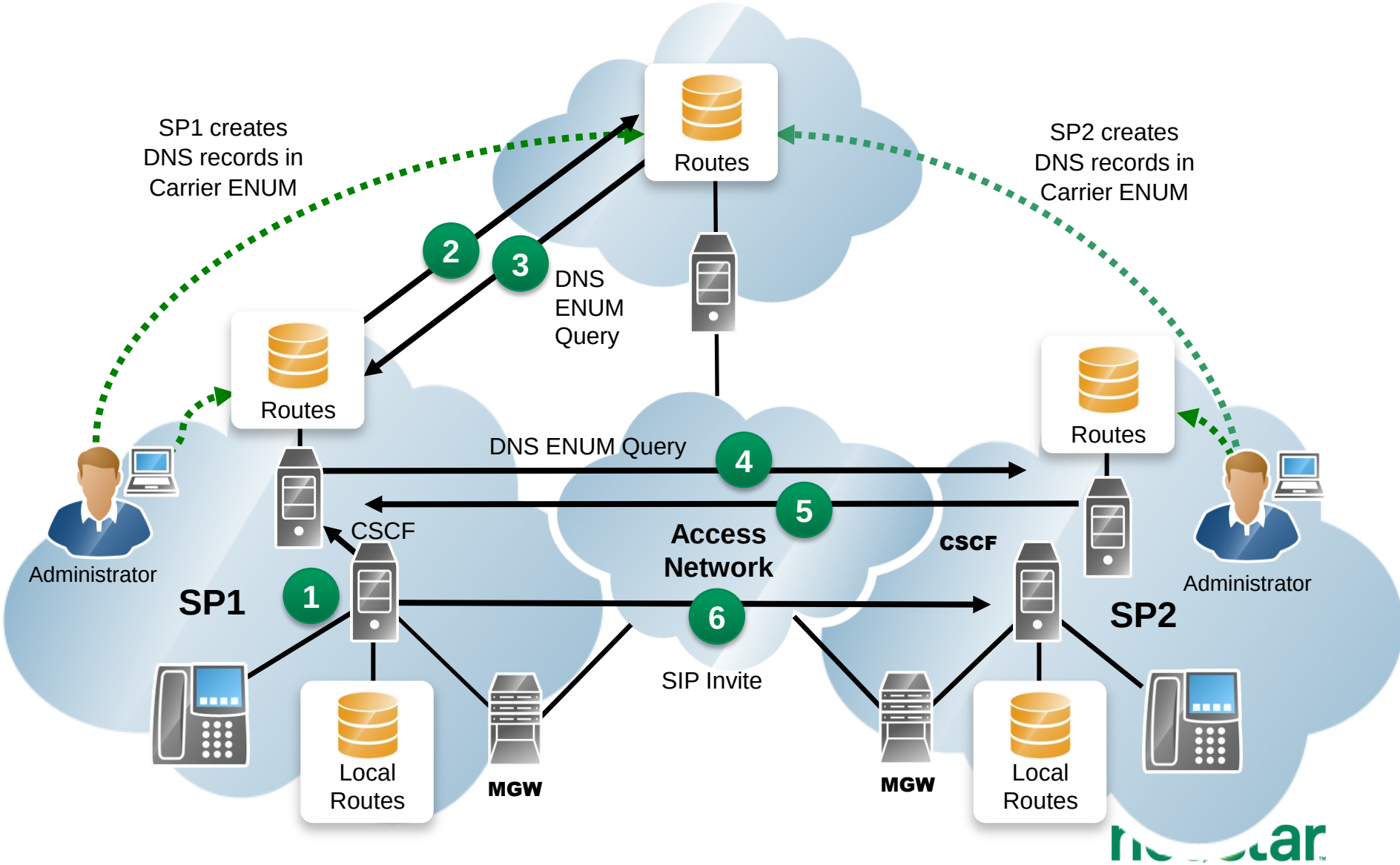
Carrier ENUM – High Level Overview



Status of Carrier ENUM

- Requirements work on draft RFCs & other related standards have not been completed
- No commercial trial using a Carrier/Infrastructure ENUM approach utilizing public data accessibility
- Not clear carriers or operators would place their numbers & entry points to their network in publicly accessible DNS tree

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Carrier/ Infra ENUM	Operator	Public	Full End User TN - Operator Gateway URI (End user info not disclosed)	Deployed
Private ENUM				

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Private ENUM

- Private ENUM is one or more technologies (including DNS) permitting service providers to exchange TN to URI data *privately & securely*
- Use any mutually agreed upon domain
- Private ENUM is assumed authoritative for all endpoints for which service providers choose to exchange data (no need to opt out)
- Private ENUM actually means private; data not accessible via general Internet. Current uses include:
  - Wireless carriers for MMS SMS routing
  - Federations, e.g., X-Connect and Stealth
  - MSO interconnection (Cable Labs RFI)
  - CC1 ENUM LLC
  - GSMA - Pathfinder

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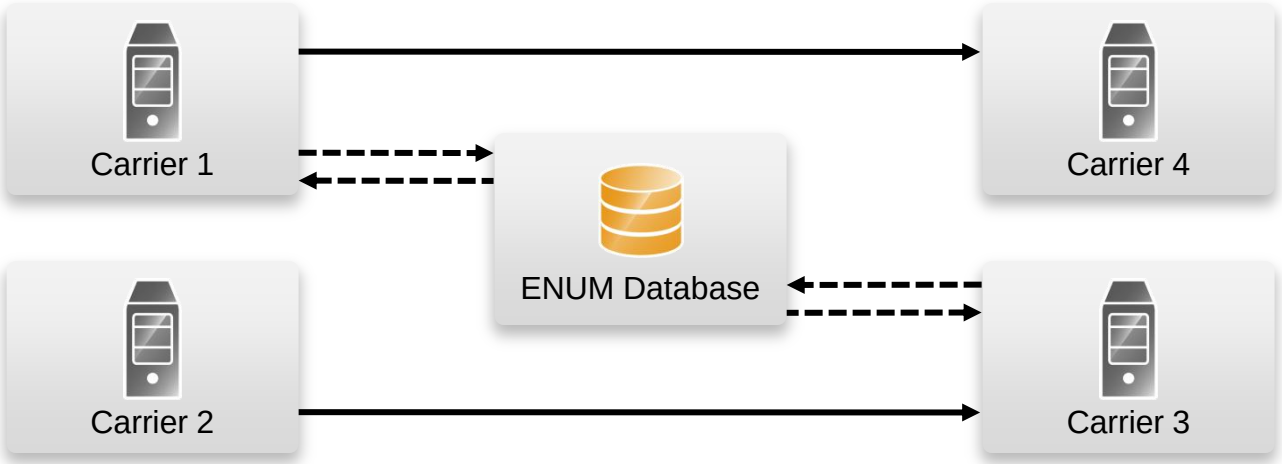
Private ENUM: Federation



Carriers optimize VoIP sessions by routing directly between carriers

Private, secure shared database within “Federation”

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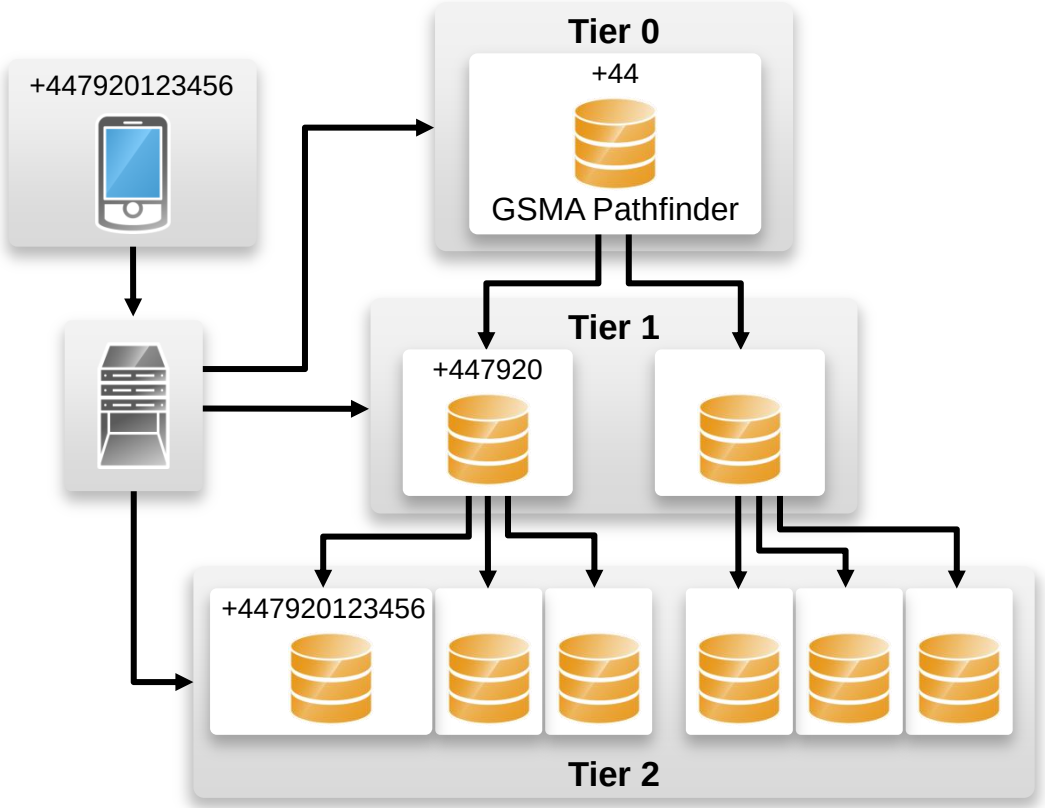
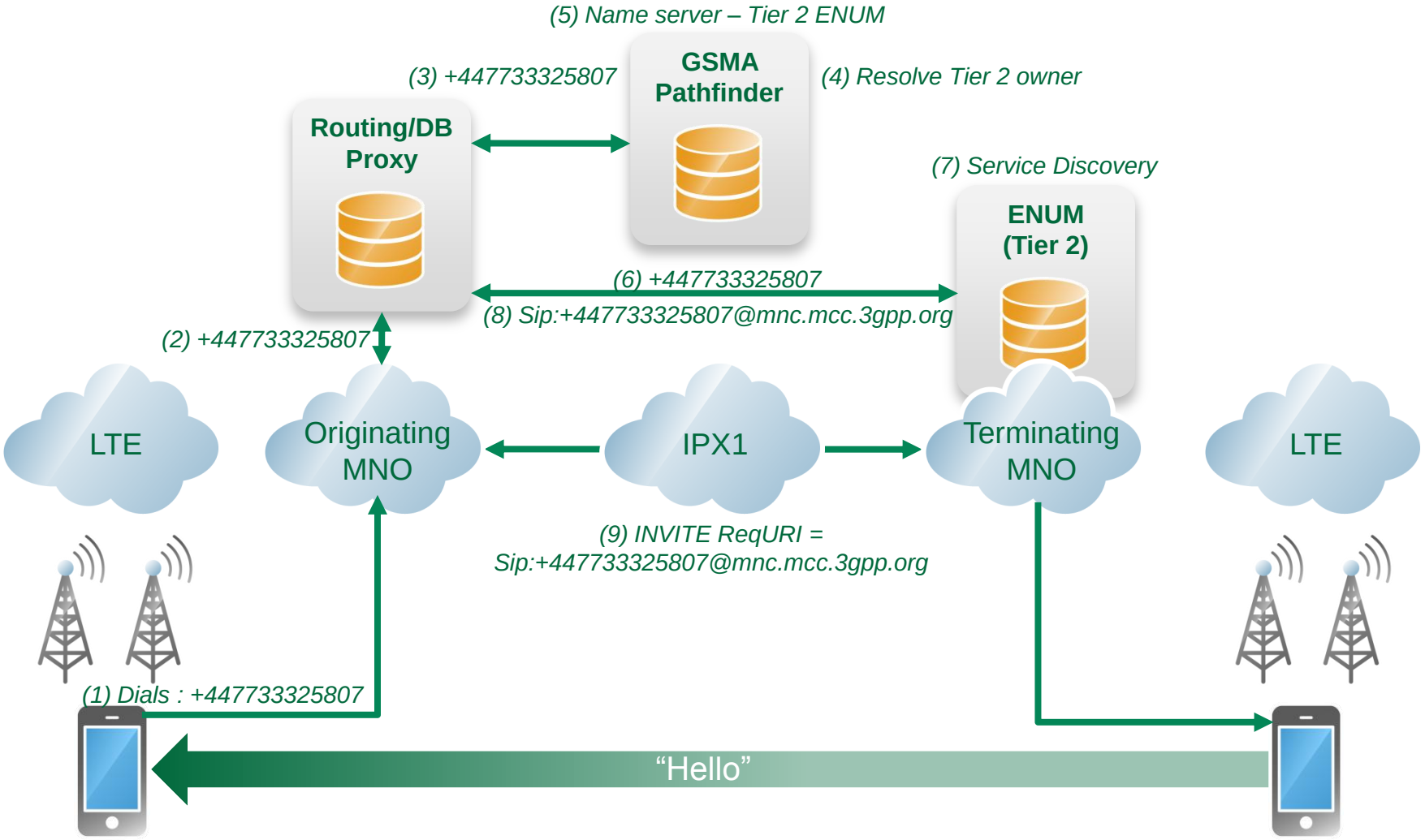
What is GSMA ENUM?

- Framework
  - Hosted Private ENUM
  - Global interoperability
  - Operators do not charge each other for queries (IN.12)
- Distributed database lookup
  - DNS based hierarchy
  - Tier 0 delegates to Tier 1 based on country code
  - Tier 1 delegates to Tier 2 based on network code
  - Tier 2 contains address mapping results
- Service providers control the data
  - SPs own and maintain the data
  - SPs control access
- GSMA Carrier Policy ensures
  - Data is authoritative
  - Used for service delivery
  - Secure
  - Not accessible from the internet
  - No re-sale, storage or profiling



Enables phone numbers to be looked up globally and network addressing info to be found without issues relating to number portability

Use case : Inter-network interconnect



Ensuring a Network Effect

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Carrier/ Infra ENUM	Operator	Public	Full End User TN - Operator Gateway URI (End user info not disclosed)	Still being defined by Industry
Private ENUM	Operator	Authorized Parties	Full End User TN - Operator Gateway URI	Deployed

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ENUM Adoption in Industry

- 50+ countries approved for a Public ENUM Tier 1 national registry
  - No successful commercial services launched and none in sight
- No official Carrier ENUM Tier 1 (country level) registries
  - Requires Regulatory/Ministry approval and consensus amongst operators
- Commercial Deployments
  - ITRS H.323/IM/Video URIs and MMS NP address lookup deployed using ENUM across the USA
  - Mobile Operators, message aggregators and message content providers using GSMA PathFinder ENUM for Global NP assisted message delivery
  - XConnect Global Alliance using ENUM Directory Server to route onnet traffic within the community with link to PathFinder for offnet traffic
  - Various operators using ENUM for intra-networking of IMS or exception handling for messaging, mobile email and other traffic
- Work in progress
  - CableLabs and MSOs working with TNS on Cable ENUM registry with ESPP
  - CC1ENUM LLC working with Telcordia on ENUM Tier 1 registry
  - i3forum (30+ International Wholesale Carriers) evaluating ENUM for Global NP assisted voice delivery evolving to full ENUM service discovery

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Obstacles to ENUM Adoption

- Initial activity was centered around Public/End-User ENUM
  - » Lack of security, accuracy and commercialization uncertainty
- Lack of clear drivers to justify ENUM and IP Interconnect business case
  - » Intra-networking use cases seem more pressing today
- Network equipment vendors have been slow to support ENUM standards
- Lack of network-based products to handle outbound ENUM routing as well as ENUM publication to interconnect partners (ENUM Tier 2 servers)
- Lack of official Tier 1 (country level) ENUM Registries
  - » Must have a means to traverse the ENUM E.164 DNS hierarchy
- Need for carrier interconnection offerings that can leverage the increased service awareness enabled by ENUM
- Need to maintain commercial interconnect commitments in parallel with leveraging increased service awareness

Number Portability Challenges in an IP Environment

- PSTN/TDM & IP networks will co-exist
- Synchronization of ported information is required
- Push vs. pull
  - Push – number portability database drives deletion of old registration & creation of new registration
  - Pull - ported to carrier responsible for change in number portability environment
- In some countries no central number portability database exists

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Impacts of Converged Services on Number Portability

- Since Converged Services will likely leverage ENUM to use Telephone Numbers as the key user identifier, what is the impact on Number Portability?
  - » Will ENUM replace portability?
  - » Is ENUM the ultimate technical solution to portability?
  - » Does ENUM signify the end of portability?

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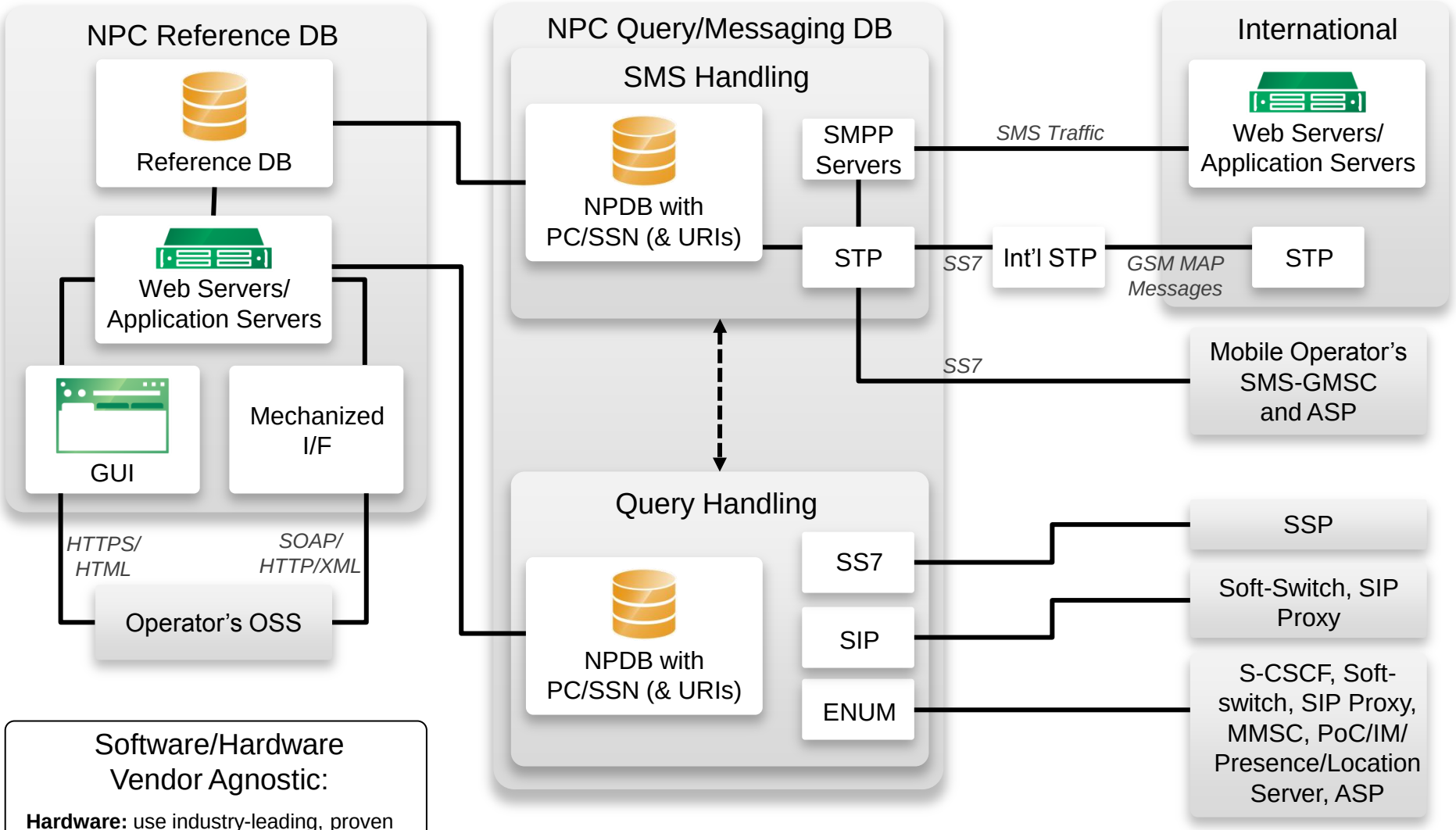
Architecture Evolution for NGN



Software/Hardware Vendor Agnostic:

Hardware: use industry-leading, proven and trusted manufacturers

Software: leverage COTS and well-supported tools

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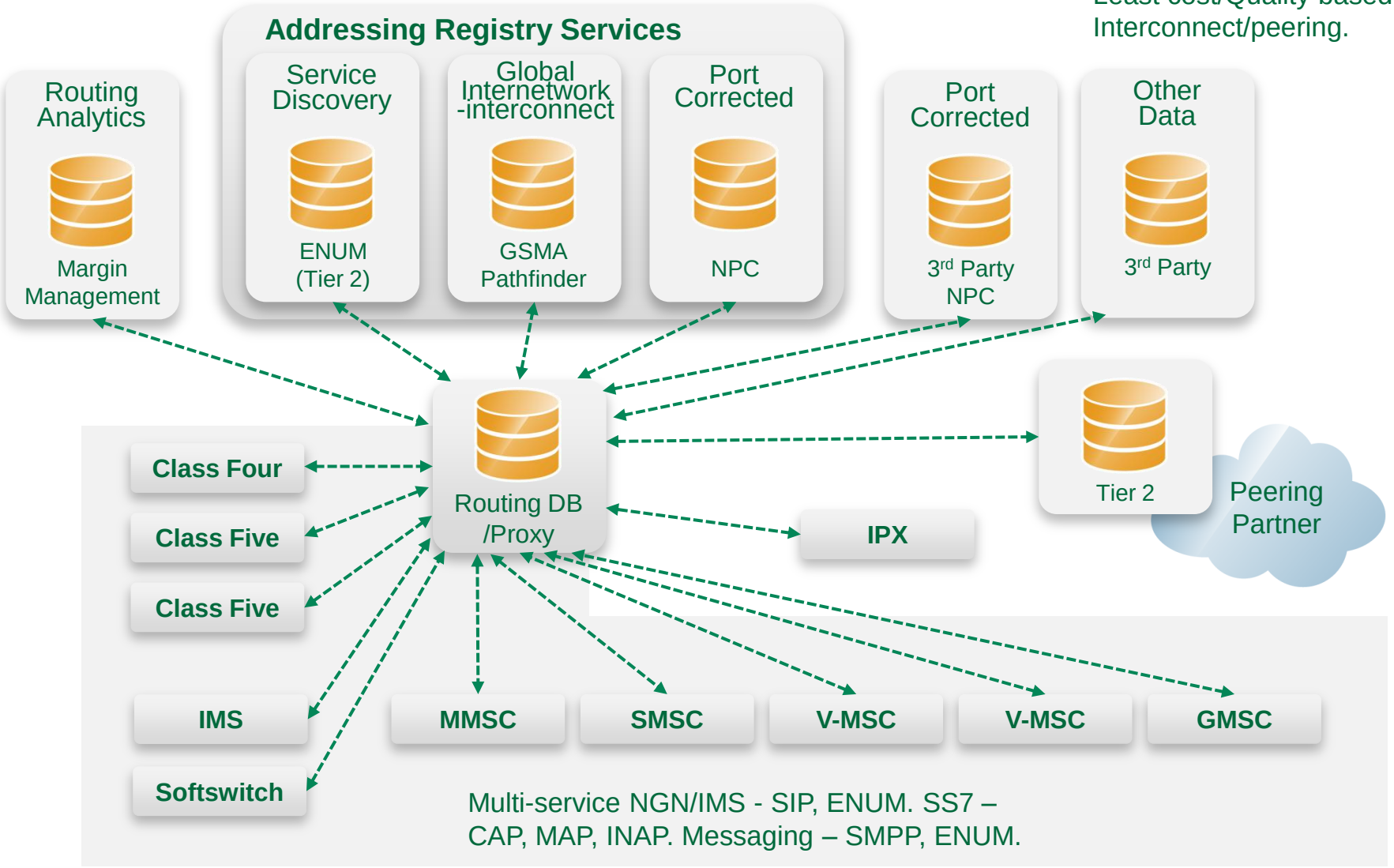
Multi-Registry Framework

Common/centralized,
Real-time routing,
Least cost/Quality based,
Interconnect/peering.



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Summary

- Converged services are here now
- Converged Services require IP interconnection among Operators – calling for a new approach to consider architecture implementation and settlement model
- Number portability is here to stay – implementation will need to adapt to converged services needs

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Questions and Answers.

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