



Next Generation Addressing & Routing Infrastructure

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NetNumber Solutions

- Provider of next generation addressing and routing solutions to the global communications industry.
 - Founded November 1999
 - First revenue 2004
 - Cash-flow positive 2006
 - Recurring revenue profitable 2007
- TITAN: “Transactional IP Telephony Addressing & Numbering”
 - Common addressing/routing platform for SS7/C7 and IP services.
 - ENUM services
 - VoIP, IMS, MMS, SIP-Redirect, SIP Routing Proxy
 - Number-portability LNP/MNP
 - AIN 0.2, PCS-1900, IS-41, MAP/SRF, INAP, CAP, etc.
 - End-user addressing/routing services
 - GTT, SLF, CNAM, etc.
- SPIDER: “Service Provider Interconnect Data Exchange Resource”
 - Interconnect data distribution platform for use by multiple VoIP registry providers.
 - NeuStar SIP-IX, Arbinet PeeringSolutions, VOEX SuperRegistry, etc.
- LSMS: “Local Service Management System”
 - Number-portability database distribution service.

NetNumber

NetNumber Clients

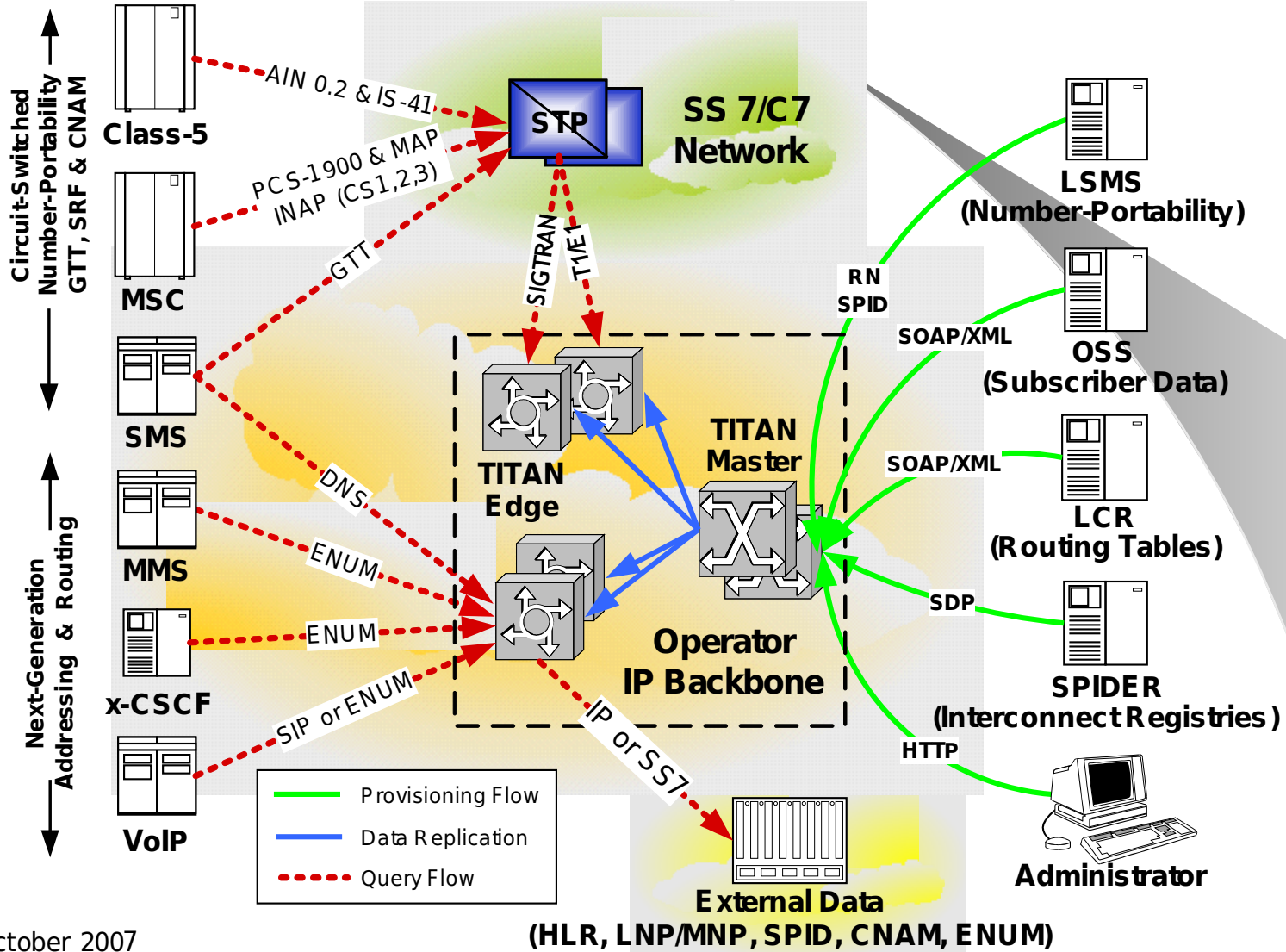


ENUM Experience - Key customers

- Fixed-line carriers
 - BT 21CN
- Cable MSOs
 - Comcast
 - Cablevision
- ENUM service providers
 - Arbinet PeeringSolutions
 - NeuStar SIP-IX
 - VOEX SuperRegistry
 - Telcordia SIR
 - Syniverse Carrier-ENUM
- Mobile Operators
 - AT&T Mobility
 - Sprint/Nextel
- Messaging Intermediaries
 - MBlox
 - MQube
- Mobile content providers
 - Yahoo!
 - New York Times
- Telecom vendors
 - Cisco
 - Motorola

#NetNumber TITAN Solution Architecture

Common Infrastructure For Many Applications



Early Learning *Market driver*

- ENUM market is being driven by communications service-providers.
 - Internal routing:
 - Routing to a destination switch within a carrier's network.
 - Interconnect routing:
 - Routing to an interconnect partner or intermediary.
- NetNumber has not yet seen a market develop for User-ENUM routing to intelligent endpoints.

User-ENUM market might develop in the future but real-world routing problems are being solved with Carrier-ENUM today.



Early Learning

End-user routing creates scaling problems in large networks

- BT21CN example
 - 33 million subscribers
 - Up to 50 origin-specific next-hop routes for each end-office switch.
 - 33M subs x 50 next-hop routes = 1.65B end-user specific NAPTRs
 - *Impossibly slow to load, update and audit.*
 - Conclusion: Simple DNS database is insufficient for large-scale ENUM.
- Solution: BT21CN uses a two-step normal-form resolution process to route to a destination-switch not to an end-user.
 - 33 million subscribers associated with 2,000 end-office switches.
 - Routing Number (RN) View: E.164 → RN (switch-ID)
 - Origin-specific Route View: RN → NAPTR (route)
 - 2k switches x 50 next-hop routes = 100,000 switch-specific NAPTRs.

Carrier-ENUM is about routing to a destination switch or to a destination service-provider, not to an end-user.

Early Learning

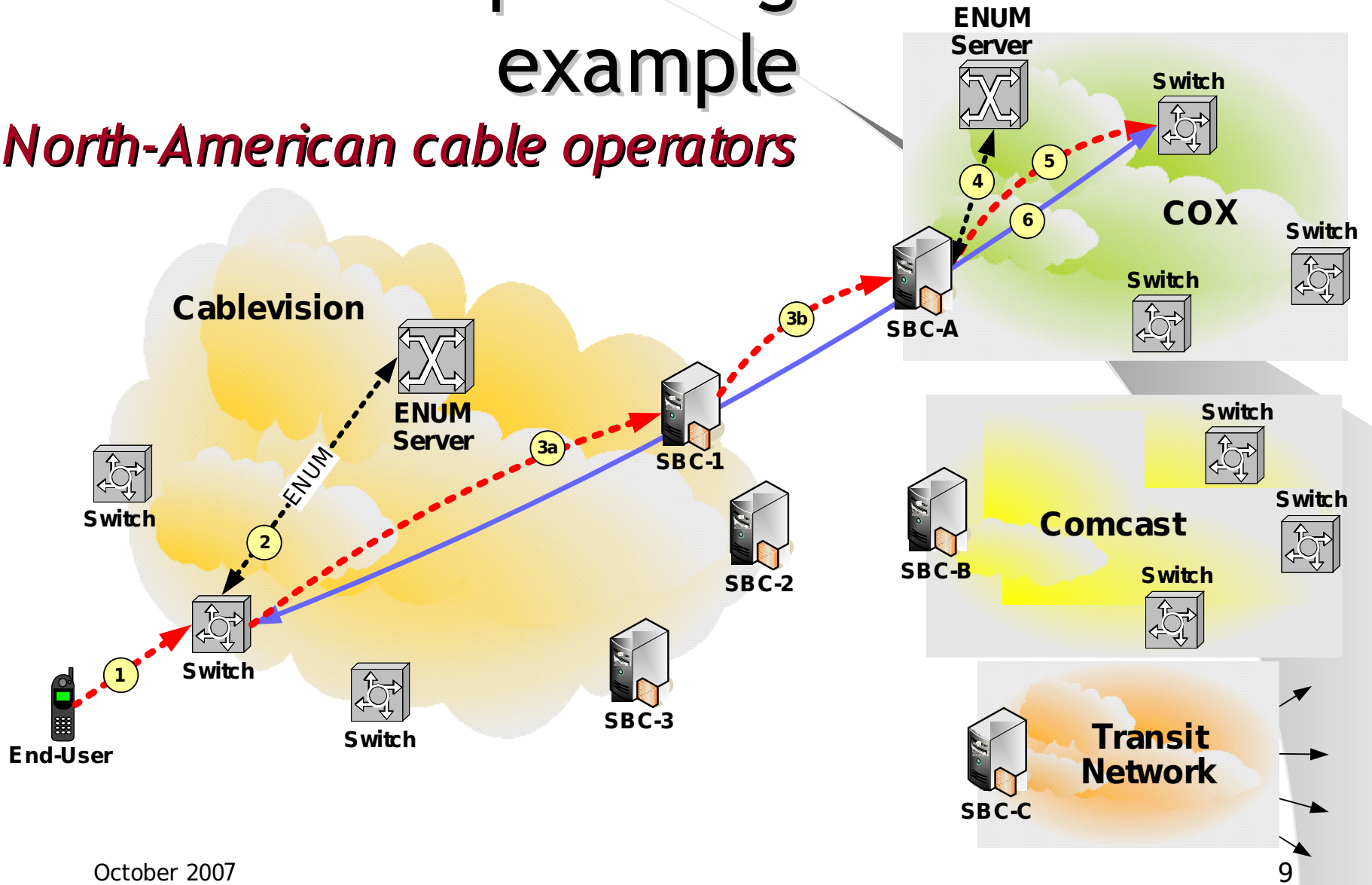
Destination routing alone is insufficient

- North-American cable operator example
 - Large networks like Comcast, Cablevision, COX maintain multiple SIP-service entry/exit-points.
 - SIP routing often includes a next-hop border-controller that varies based on the origin and destination of the call/session.
 - SIP:+12125551212@sbca.cox.com (insufficient for routing)
 - SIP:+12125551212@sbca.cox.com?route=sip:sbc1.cablevision.net
 - *Complete route includes destination and next-hop.*
 - *See the diagram on the next page.*
 - Simple translation of E.164 → destination URI only provides part of the routing answer.
 - What is the appropriate next-hop for reaching the destination given where a call/session is originating?

If the ENUM query fails to include next-hop routing information then some other network element needs to solve this problem.

#NetNumber Next-hop routing example

North-American cable operators



Early Learning

Multiple options exist for routing to a given dialed-number

- ITSP example (DN = 1-212-555-1234)
 - DN → Level3
 - PSTN carrier of record
 - DN → ITSP
 - VoIP service provider using PSTN services from Level3
 - DN → Enterprise
 - Enterprise customer getting VoIP services from ITSP
 - DN → VoIP Community
 - VoIP peering community that includes the ITSP or Enterprise.

Correct routing selection varies depending on the business model of the carrier originating the call. Least-cost-routing is required when more than one valid termination option exists.

Early Learning

Multiple ENUM registries will exist

- Current examples:
 - xConnect Registry
 - Arbinet PeeringSolutions
 - NeuStar SIP-IX
 - IntelPeer SuperRegistry
 - BT IPX
 - Verisign NRD
 - Telcordia SIR
 - Stealth Registry
 - GSMA Carrier-ENUM NRS

Multiple registries exist to meet the needs of multiple user-groups defined by geography, network-type, interconnect-model, etc.

Early Learning

DNS query for NAPTR isn't the only way to access ENUM

- Most of NetNumber's customers license both DNS and SIP interfaces for ENUM on TITAN.
 - TITAN supports three ways of accessing ENUM.
 - DNS query for NAPTR
 - SIP-Redirect
 - Stateless SIP-Routing-Proxy
 - Many operators view ENUM as a "routing concept" not as a DNS protocol.

*End-to-end SIP routing is the problem that operators are trying to solve.
ENUM is the term that is often used to mean IP service routing.*

Conclusions

- Carrier-ENUM is a real business.
 - Multiple Carrier-ENUM registries will exist.
 - Multiple ENUM server/software providers will exist.
- Many carriers/operators view ENUM as a term that describes end-to-end IP service routing.
 - Internal routing = routing to a switch.
 - Interconnect routing = routing to a destination carrier or intermediary.
- ENUM routing is a three-step logical process.
 - E.164 → RN (List of options)
 - Internal routing number for a destination switch.
 - Portability-corrected carrier-of-record routing number.
 - OCN, HNI (MCC+MNC), DG...
 - Multiple ENUM registry assigned routing-numbers.
 - SPID-1, SPID-2, SPID-3...
 - RN → Order
 - Least-cost-routing “ordering” of the options
 - RN → Route
 - Origin-specific, next-hop route is often required.



Thank You