Number Portability Forum Report
October 9-11, 1996
Las Vegas, NV

Cellular Telecommunications Industry Association

Number Portability Forum
Agenda
October 9-11, 1996

Wednesday-October 9 (Skyview 1, North 26th Floor)

1.	**Call to Order**	***1:00 pm***
2.	**Opening Comments and Introductions**	***Ed Hall-CTIA***
	NANC Update	***Dr. Brian Fontes-CTIA***
	Anti-Trust	***Mike Altshul-CTIA***
3.	**Number Portability Background**	***Dr. Chuck Bailey, SBMS***
4.	**Forum Mechanics**	***Char Meins, AT&T WS***
5.	**Presentations by RFI Respondents**	
	AT&T Wireless	
	Ericsson	

Thursday, October 10 (Bronze 3&4)

6.	**Presentations Continued**	***8:30 am***
	Bellcore	
	DSC Communications	
	GTE	
	Lunch	
	Lucent Technologies	
	Motorola	
	Nortel	

Friday, October 11 (Bronze 3&4)

7. **Related Contributions** *8:30 am*

   Bellcore
   Teleport Communications

8. **Open Discussions, Develop Themes**

9. **Adjourn** *11:30*

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Background:

During August 1996, the Cellular Telecommunications Industry Association (CTIA) released a Notice of Request for Information (RFI) to the wireless industry. The goal of the RFI was to identify options available to the wireless industry in order to implement Number Portability (NP) in the time frame specified by the Federal Communications Commission (FCC). The intent was to present and discuss the various positions in an open forum. CTIA received more than one hundred (100+) inquiries to the RFI, which led to several substantive responses. A Number Portability Forum was held October 9-11 in Las Vegas. The overall purpose of the 2 1/2 day forum was to listen to and discuss presentations on responses and attempt to develop consensus on an approach to NP for the wireless industry.

Forum Format:

CTIA, in accordance with recommendations from its Numbering Advisory Group (NAG), established a format for the Number Portability Forum. All formal responses to the RFI were eligible for inclusion. Eight (8) presentations were delivered during the regular two (2) day session. Each presenter, in alphabetical order, was allotted a period of time to adequately provide for their presentation and question and answers. Following is a list of companies and their presenters:

1. **AT&T Wireless**	**Hans Andersson**
2. **Ericsson** [1]	**David Spies** ***(a)*** **Jim Mills** ***(b)***
3. **Bellcore**	**Peter Campanella**
4. **DSC Communications**	**Jeff Copley**
5. **GTE/TSI**	**Joe Juliano**
6. **Lucent Technologies**	**V. Sudarsan**
7. **Motorola**	**Ken Gustafsson**
8. **Nortel**	**Wil Pickens**

[1] Ericsson was a contributor to AT&T Wireless' response and presented supplemental coverage and detailed information.

a. David Spies focused on Wireless Number Portability within IS-41 context.

b. Jim Mills focused on Wireless Number Portability within GSM context.

On the final day of the forum, two additional presentations were made, highlighting work completed for wireline number portability implementation.

1. **Bellcore Professional Services** **Arkady Grinberg**
2. **Teleport Communications, Inc.** **Phil Presworsky**

Copies of the presentations are available upon request.

Agreements Reached:

The objective of the Forum was to discuss and come to agreement on issues central to Wireless Number Portability implementation. The following initial agreements will serve as the basis for further proposals.

1. **Decouple the MIN (MSID) from MDN**
    - MDN Portable
    - MIN (MSID) not portable
    - Standards support for MSID as MIN and IMSI

Discussion: *The following comments were made during open discussion, they do not necessarily reflect a consensus view. They reflect comments made by individuals and/or companies.*

- Although IMSI is the industry's long range solution, this agreement does not require IMSI implementation.
- This agreement has two elements:
    - 1. Separation of the MIN from the MDN
    - 2. Define the MSID
- An MDN may be associated with either a MIN or an IMSI.
- Consensus reached that the MIN is not portable.
- A carrier can support one or the other or both.
  Comment for Stage 1 Document "The MIN will be the common denominator and will have backward compatibility for analog

2. **LRN for Routing:**

    - Consensus reached, no comments.

3. **As a minimum, an LNP query to LNP-SCP will be launched for a call to a number in a portable NPA-NXX in your serving area.**

Discussion: *The following comments were made during open discussion, they do not necessarily reflect a consensus view. They reflect comments made by individuals and/or companies.*

- This will require a lot of vendor involvement to develop implementation techniques for launching queries.
- Implies "a" query will be done without specifying a query type.

4. **For Internetwork signaling for call set-up, ISUP will be used (FCI, GAP, etc.)**

- Consensus reached, no discussion

5. **Standard, Open Interface(s) from CXR -SMS functionality to NPAC/SMS**

Discussion: *The following comments were made during open discussion, they do not necessarily reflect a consensus view. They reflect comments made by individuals and/or companies.*

- Should not be limited to only one interface
- Consideration for fraud prevention through pro-active security measures
- This interface should be in place by the time a WSP is ready to "port"
- Lockheed Martin is developing an open interface for Illinois. The documents will be available to the industry.

6. **Original: Standard for Interface from MSC to LNP-SCP**
   Modified: Open Standards for Interface from MSC to LNP-SCP

Discussion: *The following comments were made during open discussion, they do not necessarily reflect a consensus view. They reflect comments made by individuals and/or companies.*

No agreement was reached on the final wording for Agreement #6. It was agreed to allow CTIA NAG to develop final wording.

- The purpose is to support carriers using AIN, WIN, IS-41, GSM
- There can be more than one interface
- Statement must be worded to support all technologies
- SS7 as lower layers should be identified
- There can be more than one interface/standard

Acronym List

AIN	Advanced Intelligent Network
CTIA	Cellular Telecommunications Industry Association
CXR	Carrier
FCI	Forward Call Indicator
GAP	Generic Address Parameter
GSM	Global System for Mobile Communications
IMSI	International Mobile Station Identifier
IS-41	Interim Standard -41
ISUP	Integrated Services Digital Network User Part
LNP	Local Number Portability
LRN	Location Routing Number
MDN	Mobile Directory Number
MIN	Mobile Identification Number
MSC	Mobile Switching Center
MSID	Mobile Station Identifier
NAG	Numbering Advisory Group
NPA	Numbering Plan Area
NPAC	Number Portability Administration Center
NXX	Where N=Number 2-9, X=Any Number
RFI	Request for Information
SCP	Service Control Point
SMS	Service Management System
SS7	Signaling System 7
WIN	Wireless Intelligent Network
WSP	Wireless Service Provider

Post Forum/Follow-On Actions

Two Fold Work Effort: CTIA and NAG

- Industry Standards Development
- Operations and Administration

The Operations and Administrative portion has not yet been developed. The following addresses the urgent issue of developing industry standards.

Wireless Number Portability Task Group

Goal: To expeditiously develop an industry standard, approved and accepted by recognized industry setting bodies that defines the implementation and functionality of LNP for the wireless industry.

A task group was formed to define:

Standards Requirement Document (SRD)/Stage 1 Document: Definition of Number Portability and description from customer perspective

Stage 2 Document: Network Element Functionality/Architecture, Functions needed to be accomplished and Procedures

CTIA developed a Number Portability Task Group comprised of NAG members. The goal of the task group was to identify deliverables and time tables. Key elements are:

1. Develop a composite report of responses to the RFI based on their commonalties.
2. Develop Standards Documentation (SRD, Stage 1 and Stage 2) in support of wireless number portability from the RFI responses and consistent with agreements reached.
3. Prepare those documents for follow-on submission to appropriate industry standard organizations (TR45, TR46, T1)
4. Identify other issues which need to be addressed outside of standards.

The Task group will meet on November 19 & 20 in Atlanta to develop a standards document for standards bodies. This document will serve as network reference model for wireless Number Portability. All NAG members are welcome to attend this meeting. It is task group's intent to make contributions to standards bodies by January 1997. NAG members interested in attending should contact: Lori Messing at CTIA (202) 736-3654.

Stage 3

Stage 3 defined: Messages (between elements), Information in Messages, Encoding of messages, Error Procedures

All work done at this stage will be completed by industry standards bodies.

CTIA Number Portability Forum
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Talk	Issue	Type
AWS	Decoupling MIN/MDN -administration of MIN	PA
AWS	Default Routing	
AWS	MDN Display	
AWS	HLR Support for Separation	
AWS	IMSI in Analog Standards?	
AWS	Origination Request Msg Enhancements (IS 41)?	
AWS	N-1 Network determination? N-1 requirements?	
AWS	Identification of TLDN vs. Forwarded number (FCI impacts????)	
AWS	IMSI preference in digital standards	
AWS	ACG requirements	
AWS	MSC call origination - check HLR first or LNP-SCP first	
AWS	Include both MDN and MSID in call data record	
AWS	ISUP vs. MF Issues	
AWS	Class requirements?	
AWS	IS-41 Enhancements -pg.25 AWS presentation	
AWS	LNP-SCP reliability needs	
AWS	MSC impacts - pg 26 AWS presentation - pg 27 AWS presentation	
AWS	Triggers and detection points How do you determine when to do a query?	
AWS	Translation types Support	
AWS	SMS interfaces? • Local (cxr), regional (3rd party) /NANC?	
AWS	Roaming Table Support	
AWS	Single database - HLR/LRN *(carrier specific?, merged query-stds impact?)*	
DSC	Define standard SMS interface to network elements.	
DSC	NPA-NXX = Portable ? Triggering?	
DSC	SCCP 10 digit requirements (Insufficient digits) • internetworking • looping issues	
DSC	Move to Extended Unitdata (XUDT) Msgs	
GTE	LRN indicator: wireline or wireless	
GTE	Rate center (service features and service restrictions) interpretation in wireless environment	
GTE	Is there a limit to NXX's in switch?	
Lucent	Availability of ORIGREQ capability	
Lucent	Single Solution	
Motorola	Multiple triggering from the same detection point in the WIN call model	FS
Motorola	PCS1900 (GSM) Query Messages	
Motorola	Covered SMR Query Messages when not IS-41	
Motorola	Should LRN point to HLR?	FS
-	Distinction between mobility (IS-41) and call setup.	

Meeting Roster

Group Name: Number Portability Meeting **Date:** Oct. 9 - 11, 1996

Hotel: Bally's Hotel **City/State:** Las Vegas Nevada

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EXHIBIT 1

The Wireless Number Portability Solution

CTIA Number Portability Forum
October 9, 1996
Las Vegas, Nevada

Presented by

AT&T Wireless Services

In cooperation with & appreciation to

AG Communications
Ericsson Inc.
Lucent Technologies
Tandem Computers Inc.

Presentation Agenda

- Goals of any Number Portability Solution
- Key Elements of the WNP Solution
- Network Architecture
- Call Flows
- System Impacts
- Conclusion & Discussion

Goals of a Number Portability Solution

The solution must

- ✓ be an industry-wide solution supported by all service providers
- ✓ continue to support roaming as it exists today
- ✓ not inhibit future growth of wireless services & technology
- ✓ not unduly deplete the *N*orth *A*merican *N*umbering *P*lan resources
- ✓ minimize impact on existing network architectures

Goals of a Number Portability Solution

(continued)

The solution must also

- ✓ be competitively neutral
- ✓ be in line with the stated FCC performance criteria
- ✓ be the right solution for the long-term

Key Elements of the WNP Solution

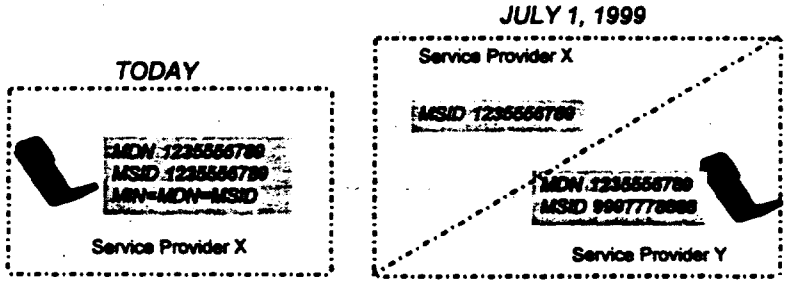
- Based on the wireline *L*ocation *R*outing *N*umber solution on call routing
- Promotes decoupling the *M*obile *D*irectory *N*umber from the *M*obile *S*tation *ID*entifier
- Aligns the MSID with the IMSI format & concurrently promotes backward compatibility w/ the existing MIN format
- Uses IS-41 as a point of reference but expects to encompass all technologies

The Wireline LRN Solution Overview

- A 10-digit number is associated with each switch.
- This is the Location Routing Number (LRN).
- The 1st 6 digits of the # are significant to the PSTN for routing the call.
- A database (i.e., a Service Control Point) maps every ported number to the LRN of the switch serving the called party.
- The *N-1* network in the call path launches the query to the Number Portability SCP (NP-SCP).
- The trunk choice to the next switch is based on the obtained LRN returned in the query response.

Decoupling the MSID from the MDN

- The MDN is the portable number.
- The MSID is a non-portable number.
- MSIDs assigned from current pool of numbers allocated to each provider



Decoupling the MSID from the MDN

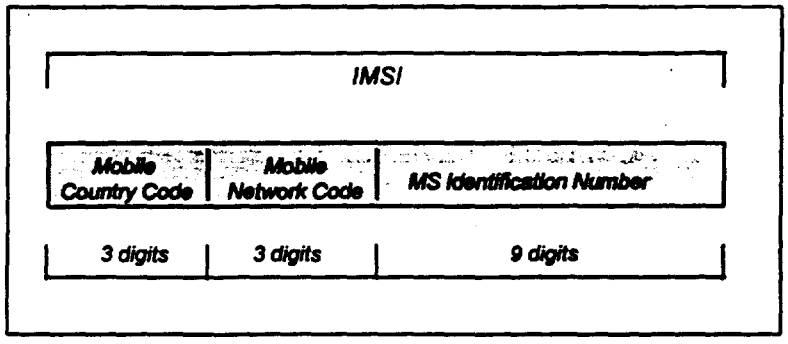
- Why is decoupling essential to the solution?
  - To avoid 10-digit Global Title Translation for wireless MAP transactions
  - To avoid 10-digit number mgmt in the MSC roaming tables
  - To avoid 10-digit number mgmt in the operations, billing, provisioning & care systems
- Why avoid 10-digit analysis?
  - Extensive admin overhead to manage data tables with each & every subscriber number (in the STP, the MSC, billing & provisioning)
  - Processing overhead of billing reconciliation w/o the benefit of number block carrier identification.
  - Carriers can introduce GTT when & how appropriate to own business needs

Format of the MSID

The Vision of IMSI

- TIA embraced the ITU E.212 IMSI standard for mobile station identification.
- Advantages of IMSI include
  - Only int'l standardized identifier for mobile stations
  - Unique format:
    - non-dialable number
    - 1st 6-digits identify service provider network
  - International roaming
  - Only MSID format with existing guidelines & assignment body

Format of an IMSI



Format of the MSID

IMSI within the NP Solution

- Why bring IMSI into the NP solution?
  - Changing paradigm for MSID with NP
  - Efficiently incorporate wireless vision of IMSI in this paradigm shift
- IMSI Introduction Plan with NP
  - Complete wireless standards support for an IMSI MSID
  - Each wireless service provider updates network as sees fit
  - Provide backward compatibly for an agreed upon period of time

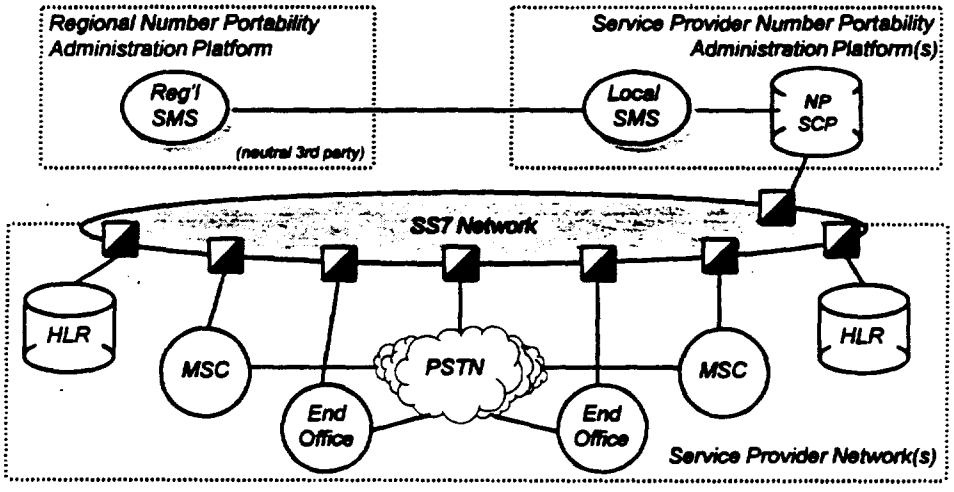
Format of the MSID

Backward Compatibility

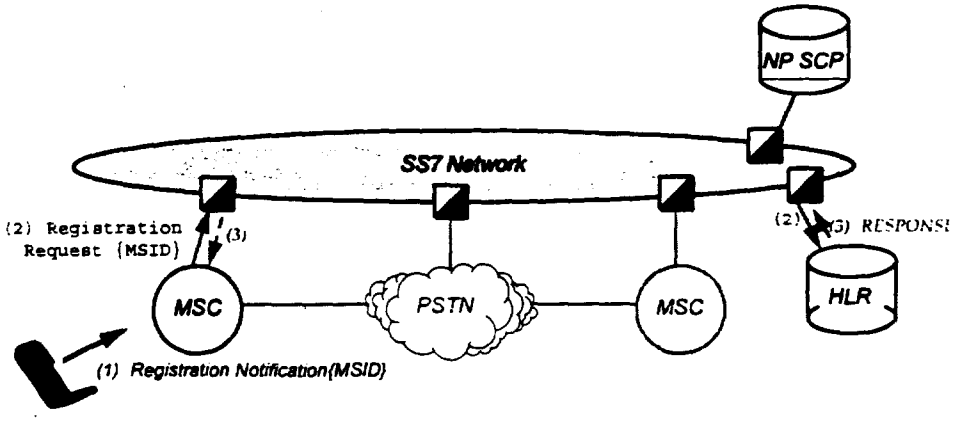
- Any evolution to IMSI must support dual identifiers: a MIN & an IMSI.
  - If register in an IMSI-capable network, register with IMSI.
  - If register in a non-IMSI capable network, register with MIN.

- Must agree upon a means to administer MINS
  - Use MINs as assigned today.
  - Continue to administer MINs as MSIDs in blocks
  - Outstanding Issue: assigning new MIN blocks if needed

Number Portability Network Architecture



Mobile Registration



Routing to the Home HLR on LocationRequest

Three Alternatives

(a) GTT on MDN to HLR Point Code
- arrange MDN in blocks of numbers for <10-digit GTT
- requires new intra-network Translation Type

(b) Route with similar table in the MSC
- arrange MDN in blocks of numbers
- map to PC-SSN (of the HLR)

(c) Map MDN to MSID number block & then GTT on MSID
- arrange in blocks of numbers for <10-digit GTT

Each Service Provider can implement the alternative best suited.

NP SCP Triggers & Queries

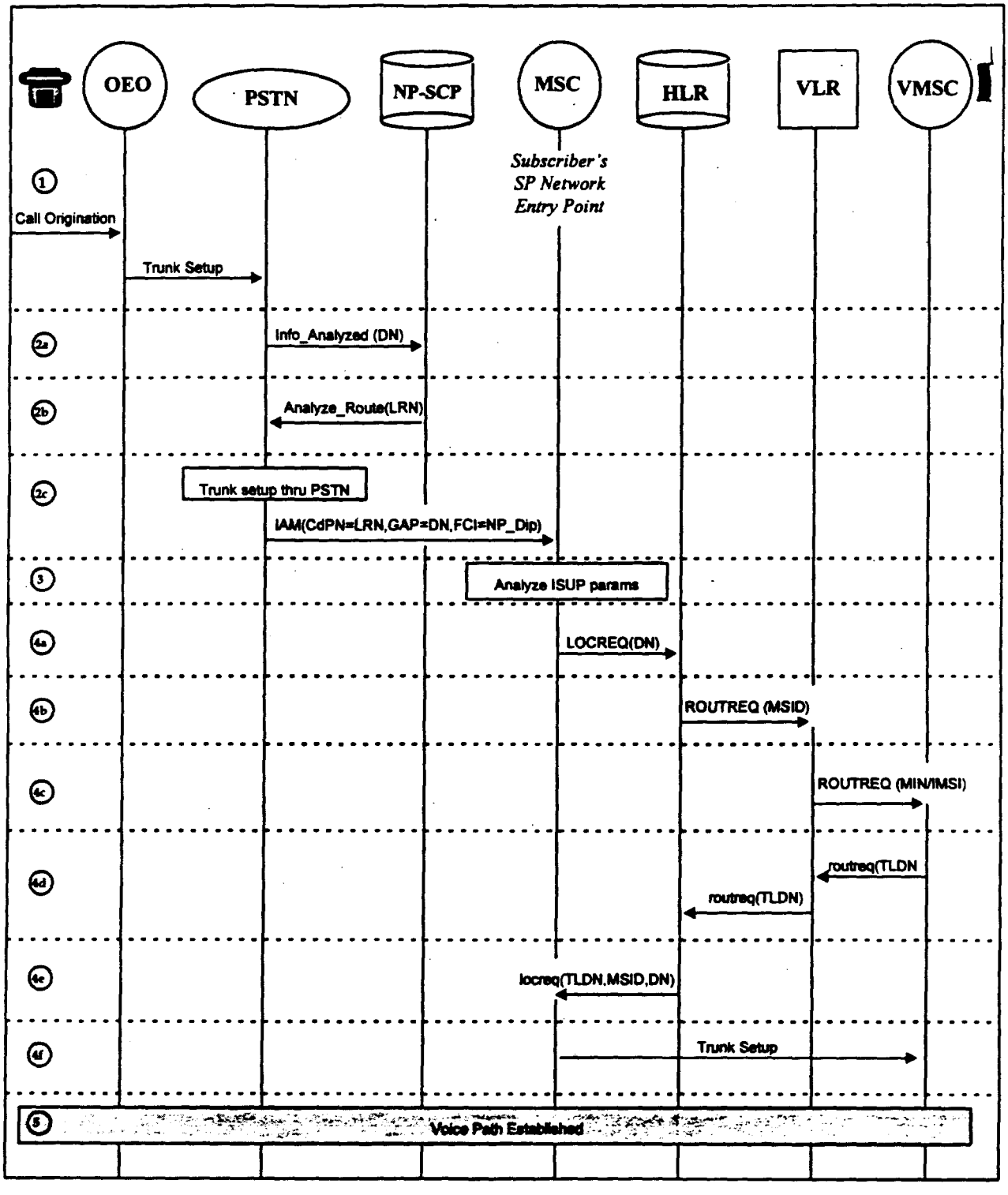
- NP-SCP Trigger
  - 3-to-10 digit conditional dialed number trigger to launch query
  - administered on MSC basis
- NP-SCP Queries
  - Route via GTT w/ a new TT or via MTP
  - If N-1 network switch is an MSC, send an IS-41 OriginationRequest or wireless equivalent message.
  - Landline switches will query via an AIN or IN message.

ISUP Message Contents per LRN

IAM(CdPN=____,GAP=____,FCI=____)

- *Called Party Number* denotes the LRN from NP-SCP
- *Generic Address Parameters* holds the dialed Directory Number
- *Forward Call Indicator* indicates whether the NP-SCP dip has been made using the M bit (aka *Translated Called Party Number* indicator)

Land-to-Mobile Call



Land-to-Mobile Call

The following steps correspond to the above flow:

(1) A landline phone originates a call. The dialed DN is analyzed in the Originating End Office (OEO). The OEO will send the call to the preferred IXC for the mobile subscriber, and the IXC will be the N-1 network.

(2) The N-1 network switch processes the call to the ported number via the following steps:

- *a) Send query to the NP-SCP to obtain the LRN of the DN.*
- *b) The NP-SCP responds with the LRN of one of the service provider's MSC (per the provider's designation).*
- *c) The querying N-1 network switch translates the LRN to find the next switch in the call path, It then sends this switch an ISDN User Part (ISUP) Initial Address Message (IAM) with the following parameters:*

  CdPN = LRN or DN depending if DN is ported

  GAP = DN (included only if DN is ported)

  FCI = TCPN indicator(to indicate NP-SCP dip has been made)

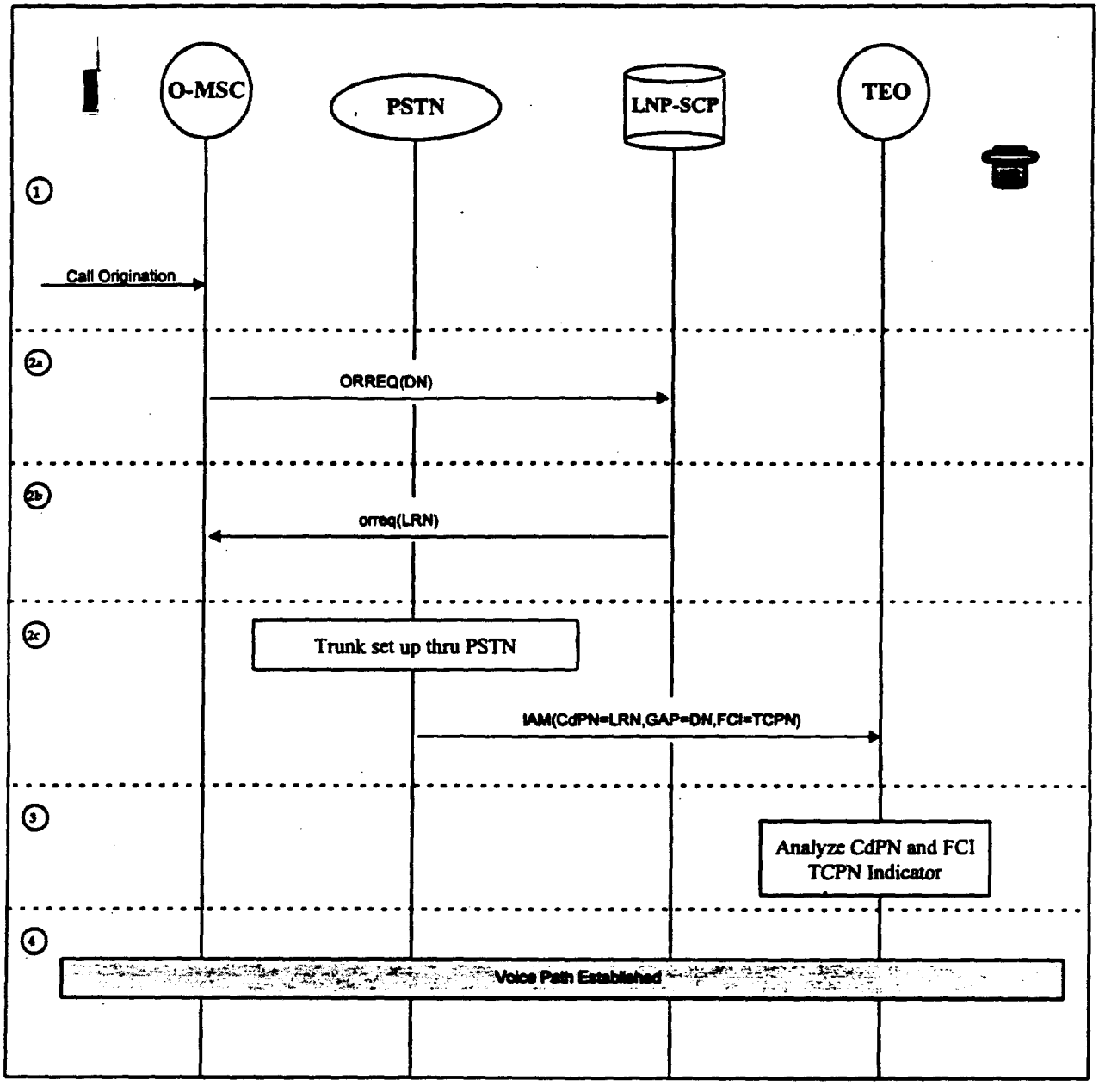
(3) Upon receipt of the message, the MSC performs analyzes the IAM parameters.

(4) The MSC attempts to deliver the call to the mobile with the following steps:

- *a) The MSC sends a LocationRequest query to an HLR within its network based on the DN received in the GAP parameter of the IAM message.*
- *b) The HLR sends a RouteRequest to the V-MSC's VLR with the MSID.*
- *c) The VLR routes the message to the V-MSC.*
- *d) The V-MSC responds to the RouteRequest message with a Temporary Local Directory Number (TLDN) identifying the V-MSC serving the roaming subscriber.*
- *e) The HLR returns the TLDN in the LocationRequest return result message.*
- *f) The MSC receives the TLDN and routes the call through the cellular/PSTN network based on the TLDN.*

(5) The serving V-MSC receives the call and directs it to the MS located in the serving area. The MS answers, and the call is completed.

Mobile-to-Land Call



Mobile-to-Land Call

The following steps correspond to the above flow.

(Note: This flow assumes that the Originating MSC will be the N-1 network.)

(1) A mobile phone registers and places a call. The dialed DN is analyzed in the Originating Mobile Switching Center (O-MSC).

(2) The N-1 network switch will process the call to the dialed number.

a) The O-MSC sends a query to the NP-SCP through the STPs to identify the LRN of the DN. The MSC will use the IS-41 OriginationRequest message to query the NP-SCP.

b) The NP-SCP will respond to the query with an OriginationRequest response message to the O-MSC.

If the response carries the same dialed DN in the CdPN as in the query message, it indicates that the specific number is not ported. For ported numbers, the response will include the LRN of the Terminating End Office (TEO) along with the DN.

c) The querying switch sends an ISUP IAM message to the next switch with the following parameters:

CdPN = LRN, if DN is ported, or DN

GAP = DN (included only if DN is ported)

FCI = TCPN indicator(to indicate NP-SCP dip has been made)

Before the call is received by the TEO, the intermediate switches will not change the CdPN and the optional GAP parameter and the TCPN indicator in the FCI of the IAM. These parameters are to be passed to the next switch.

(3) The TEO analyzes the CdPN to find it belongs to the TEO and checks the FCI TCPN indicator in the IAM for any NP-SCP dip indication. The TEO will replace the CdPN with the DN value in the GAP parameter and find a match in the switch database.

(4) The TEO will complete the call to the loop to the assigned to the DN. The call is then connected.

Key Impacts to the Mobile Station

- Must contain the MDN and the MSID
- Support of IMSI
- Backward compatibility support for MIN as well
- Display of DN and not MSID is desirable

Key Impacts to Air Interface

- IMSI precedence over MIN when registering in an IMSI-capable network

Key Impacts to Signaling (IS-41)

- Messages with MIN must support MSID
  (e.g., RegistationNotification message)
- Include MDN in RegistrationNotification response message
- Enhance OriginationRequest for query to NP-SCP?
- Enhance to support Automatic Code/Call Gapping with the NP-SCP
- Add new Translation Type for IMSI

Key Impacts to MSC

Registration/Validation

- Support of both MIN & IMSI in MSID
- Must be capable of querying the appropriate HLR with the MSID
- Support of DN in VLR/V-MSC
- Must be capable of distinguishing the MSID from the DN
- Roaming validation table must support new MSID
  - both MIN & IMSI

Key Impacts to MSC

Call Origination & Call Delivery

- Support of the new ISUP parameters
- Populate the dialed digits field of the LocationRequest message with the contents of the GAP parameters
- Map LRN to HLR per chosen alternative
- Include both MDN & MSID in billing records
- Support of OriginationRequest or equivalent for NP-SCP query

Key Impacts to the STP

- Support of new Translation Type for IMSI to PC-SSN (HLR) *(Registration)*
- Support of directory number to PC-SSN (HLR) for call delivery *(LocationRequest)*
- Support for new TT to routing to NP-SCP *(OriginationRequest)*

Key Impacts to the NP-SCP

- Support of wireless network signaling protocols, IS-41 or equivalent

Key Impacts to Customer Care & Provisioning

- Develop interfaces with regional SMS & NP-SCP databases, as appropriate
- Support separation of MDN from MSID
- Support multiple MSIDs (e.g., MIN & IMSI)

Key impacts to Billing

- Roaming tables must support both MIN and IMSI.
- Support separation of MSID from MDN.

Discussion

EXHIBIT 2

Wireless Number Portability

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Bell Labs Innovations

Wireless Number Portability

The Motivation

- The Telecommunication Act of 1996 is expected to dramatically increase competition in local market.
- Federal Communications Commission (FCC) order has imposed two deadlines on Commercial Mobile Radio Service (CMRS) carriers:
  - 12/31/98 to deliver calls to ported numbers nationally
  - 6/30/99 full number portability for CMRS carriers

Wireless Number Portability

Definitions

- Number Portability: Allows the subscriber to retain the directory number while:
  - Changing local service providers (**Service Provider Portability**)
  - Changing physical locations (**Geographic Portability**)
  - Changing services (**Service Portability**)

Wireless Number Portability

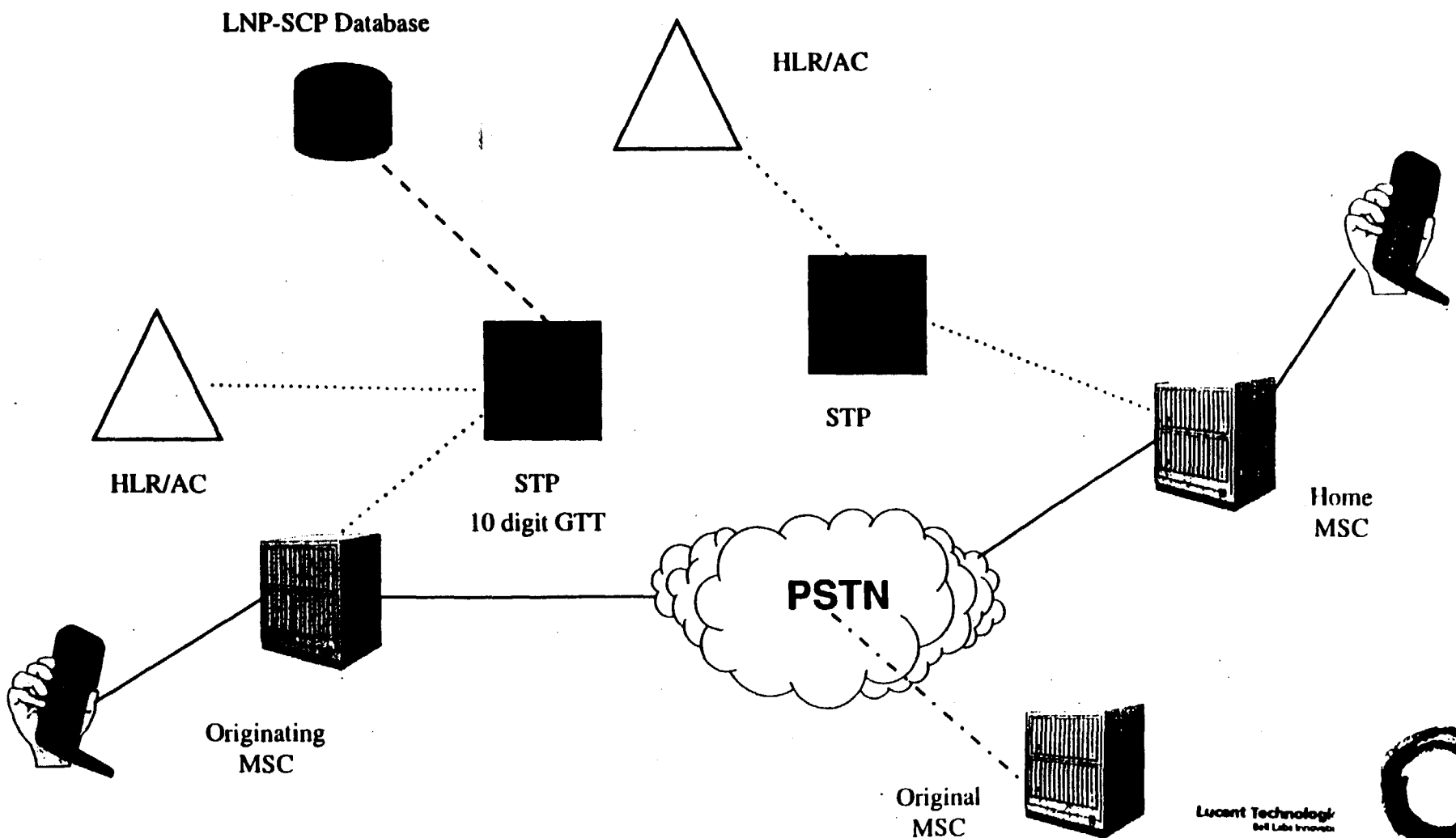
Assumptions

- Location Routing Number (LRN) solution will be used in wireless number portability
- Local Number Portability- Service Control Point (LNP-SCP) database query is done at the first possible exchange

Wireless Number Portability Options

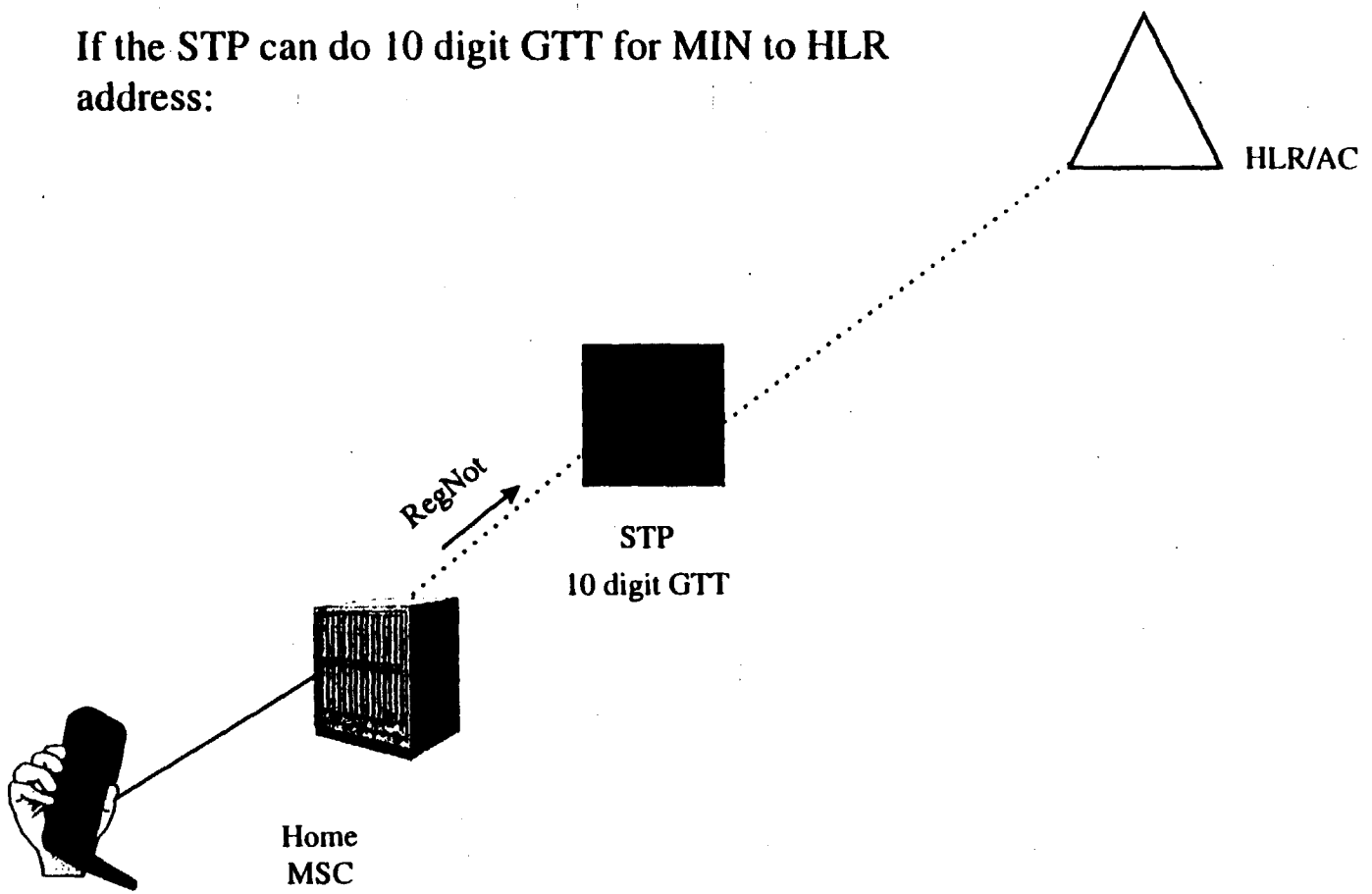
- Option 1:
  - Port both Mobile Station Identification (MSID-Mobile Identification Number (MIN)) and Mobile Directory Number (MDN).
  - International Mobile Station Identification (IMSI) is not applicable for this option as by definition of IMSI, it is not portable.
- Option 2:
  - Port MDN only.

Wireless Number Portability - Option 1
Basic Network Elements



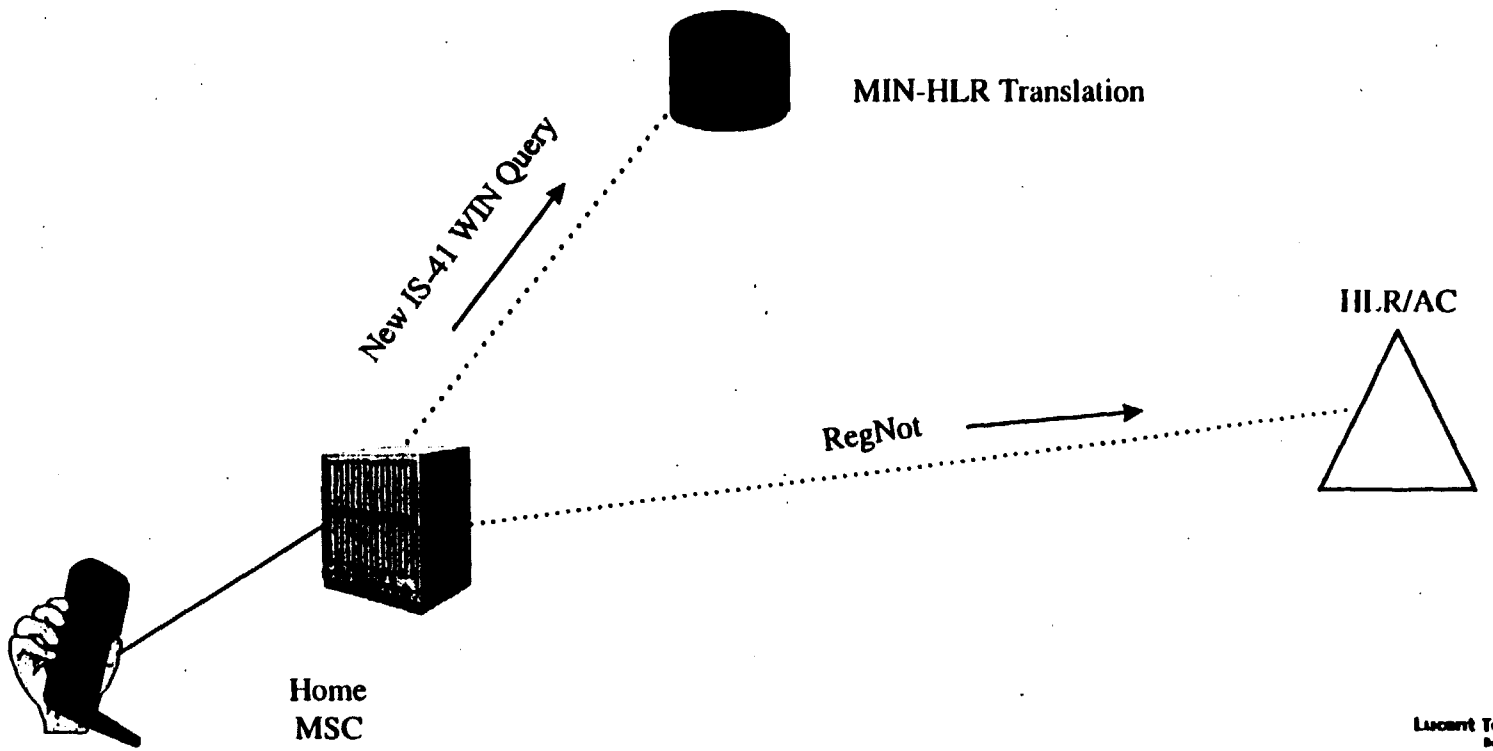
Wireless Number Portability - Option 1 Registration

If the STP can do 10 digit GTT for MIN to HLR address:

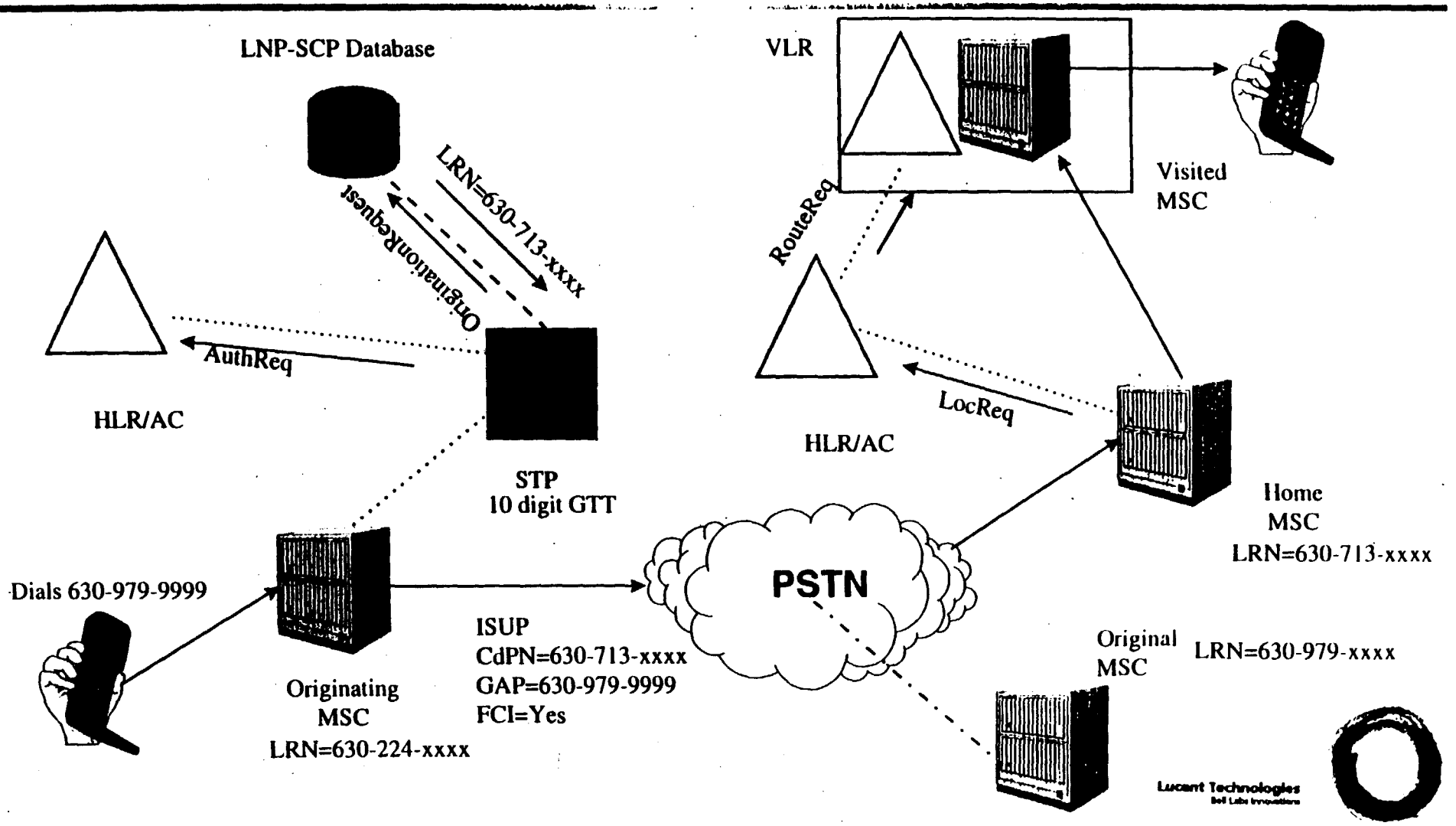


Wireless Number Portability - Option 1 Registration

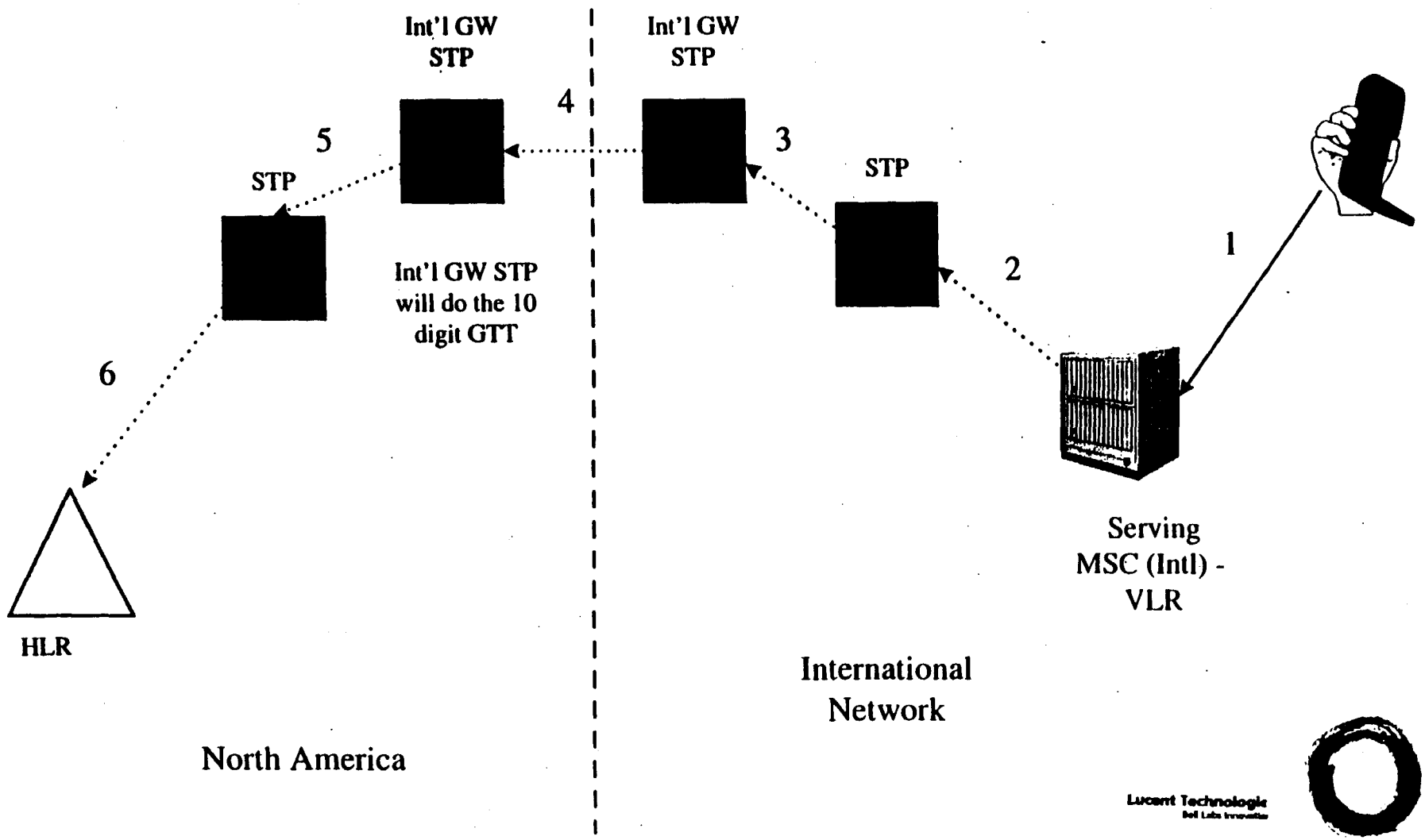
If the STP can not do 10 digit GTT for MIN to HLR address:



Wireless Number Portability - Option 1
Call Delivery to Roaming Subscriber



Wireless Number Portability - Option 1
International Roaming - Registration



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Wireless Number Portability
International Roaming - Registration

MIN based query:

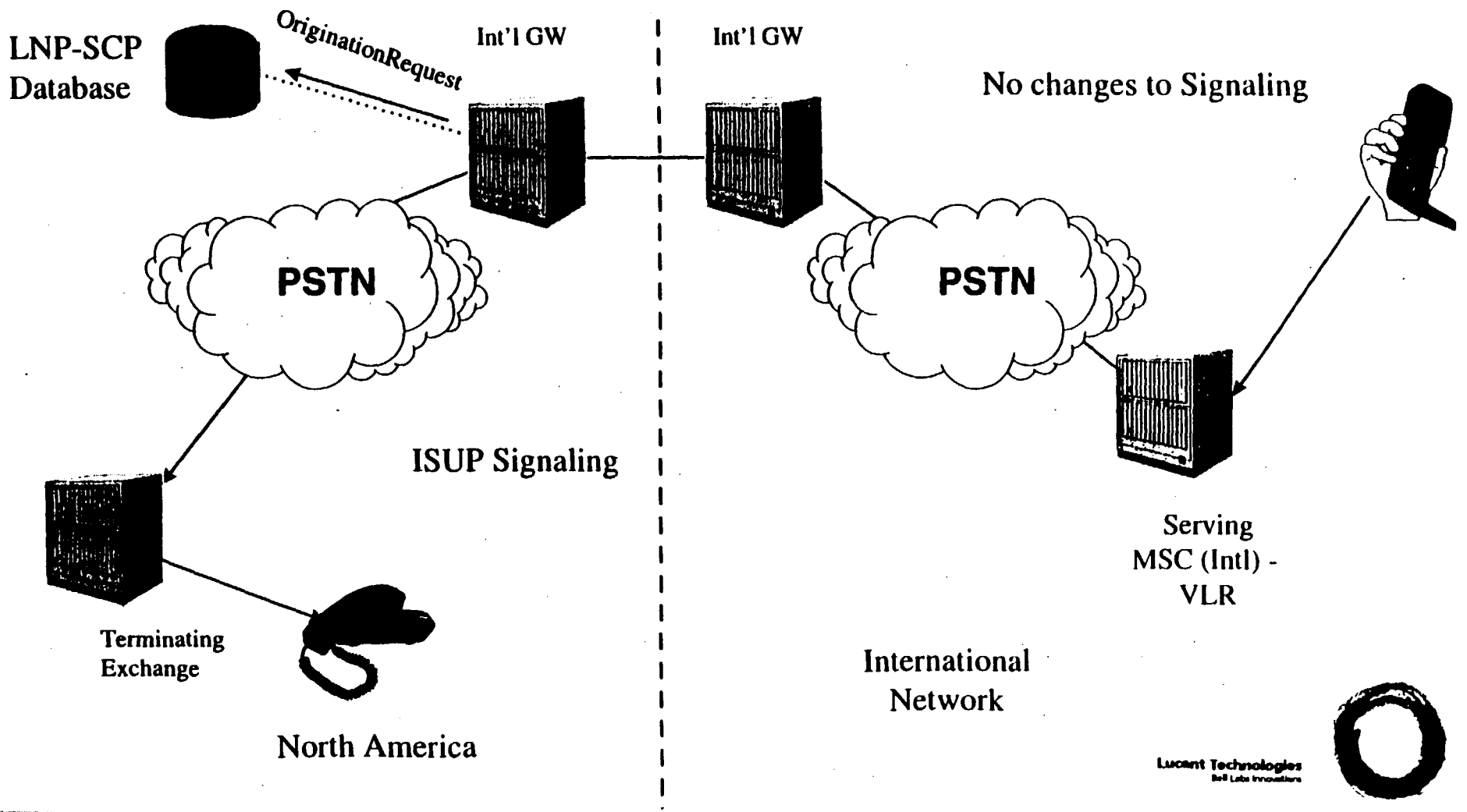
- The foreign system should recognize the MIN and determine the Mobile Country Code and place it in the first 3 digits of the IMSI.
- The next two digits will be filled with either "00" or could be used to select the proper home country gateway STP.
- The low 10 digits of the IMSI will hold the MIN.

Wireless Number Portability - Option -1
International Roaming - Registration

Implications:

- Visited country system should recognize the MIN and determine the Mobile Country Code. MIN to MCC/MNC mapping need to be set out. This mapping may require updates as MINs get ported from one service provider to another.
- Home country international gateway STP should be capable of doing 10 digits Global Title Translation (GTT) on MIN to get HLR address.
- International Gateway STPs should be able to handle E.212 translation.

Wireless Number Portability
International Roaming - Call Delivery



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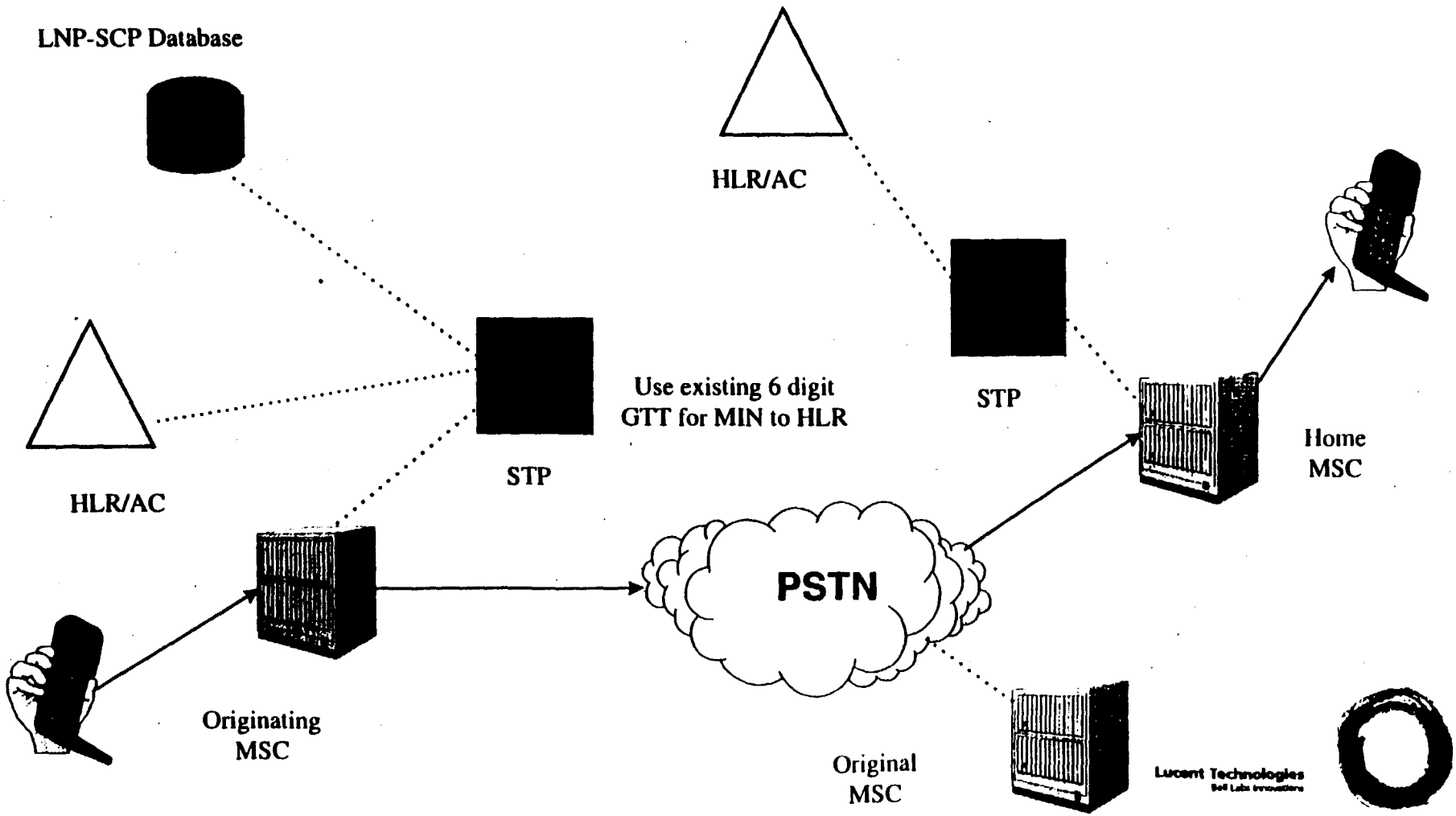
Wireless Number Portability - Option 1 Implications

- Need 10 digit GTT at the STP for mapping MIN to HLR.
  - If the STP cannot handle 10 digit GTT, there will be a need for MIN to HLR translation database.
- No need to program the mobile with a new MIN.
- This option does not support IMSI.
- MIN does not have enough address space for country code.
- For international roaming, need to update the MIN to MCC/MNC mapping.
- Needs administration of MIN to HLR translation.

Wireless Number Portability - Option 2
Basic Network Elements



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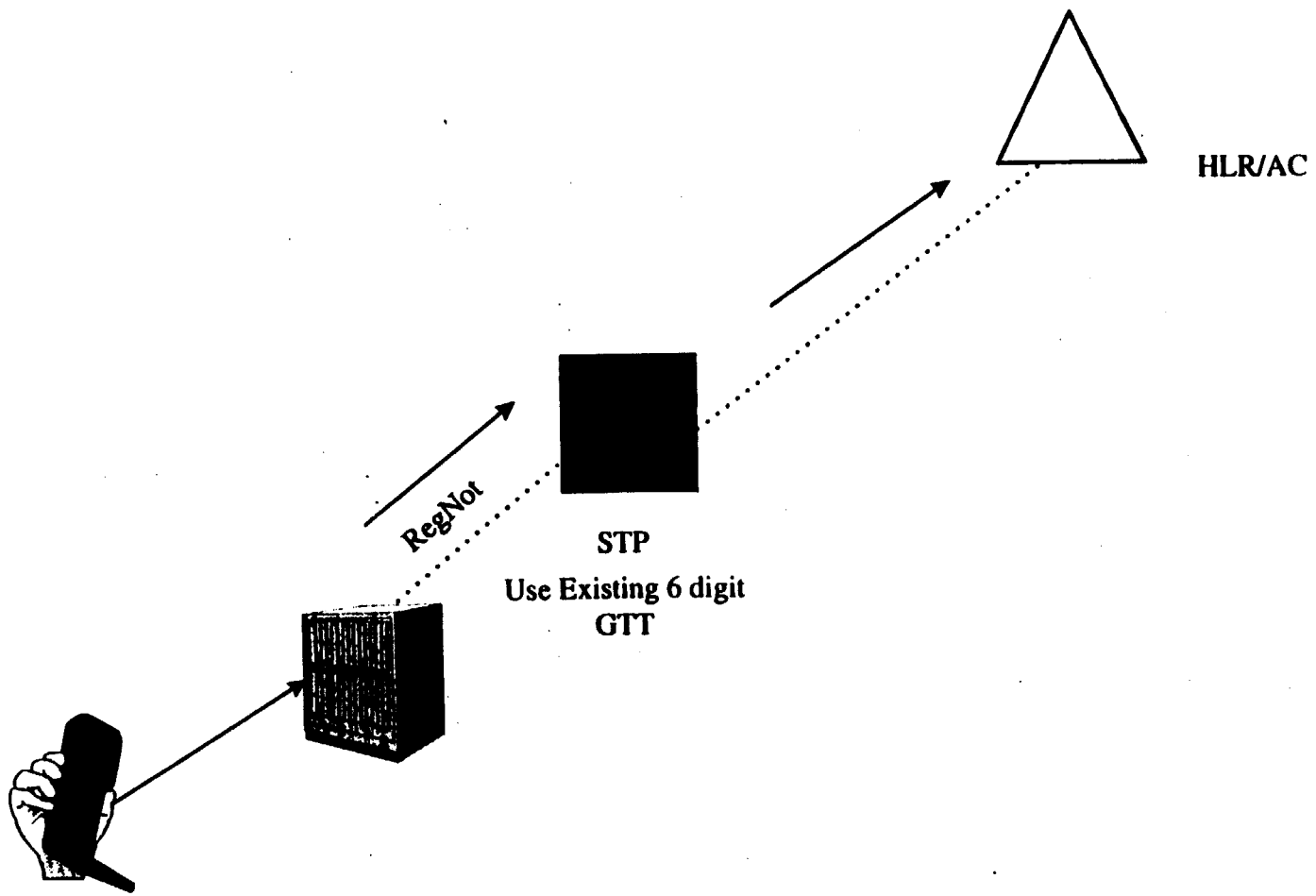
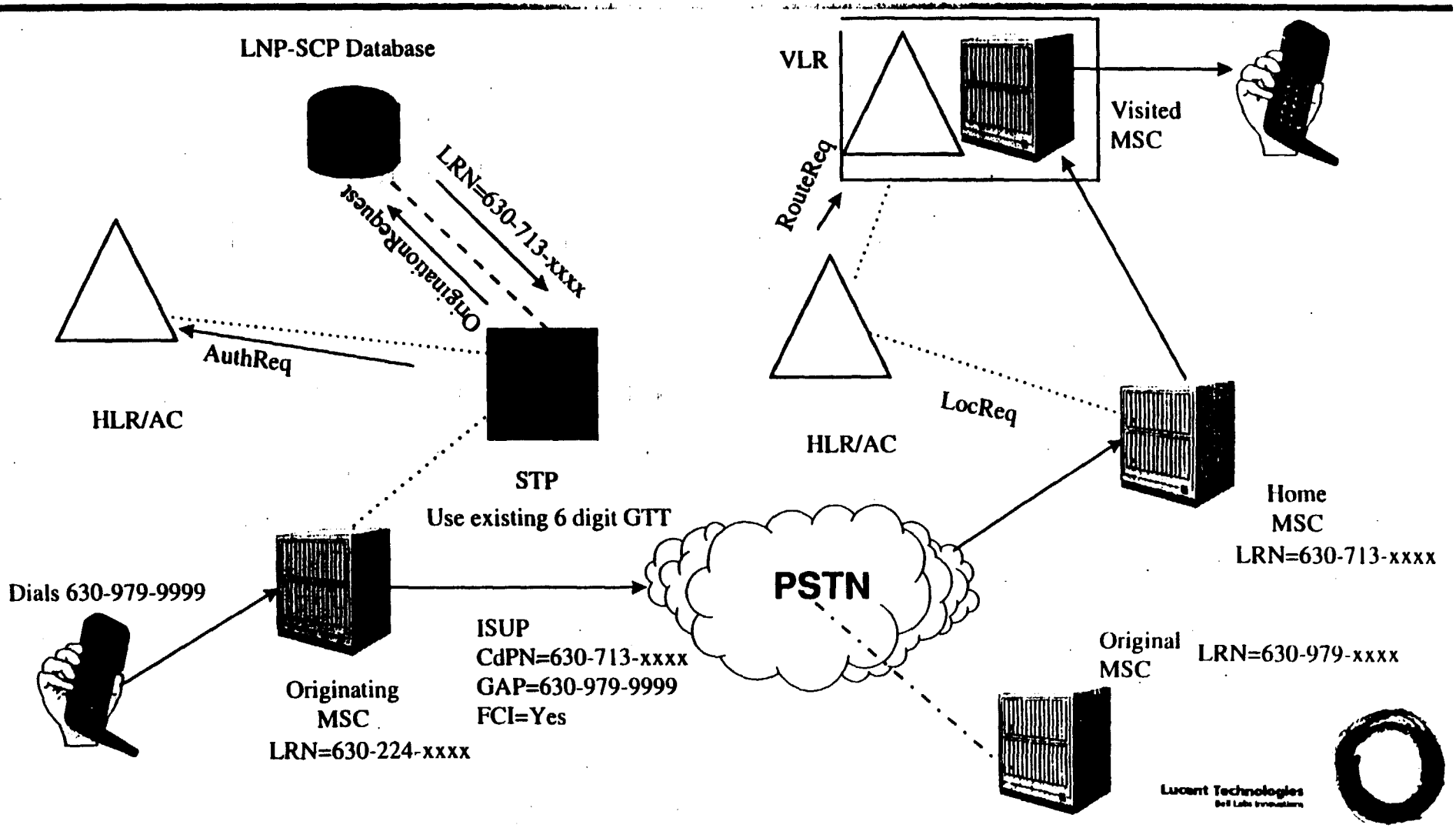
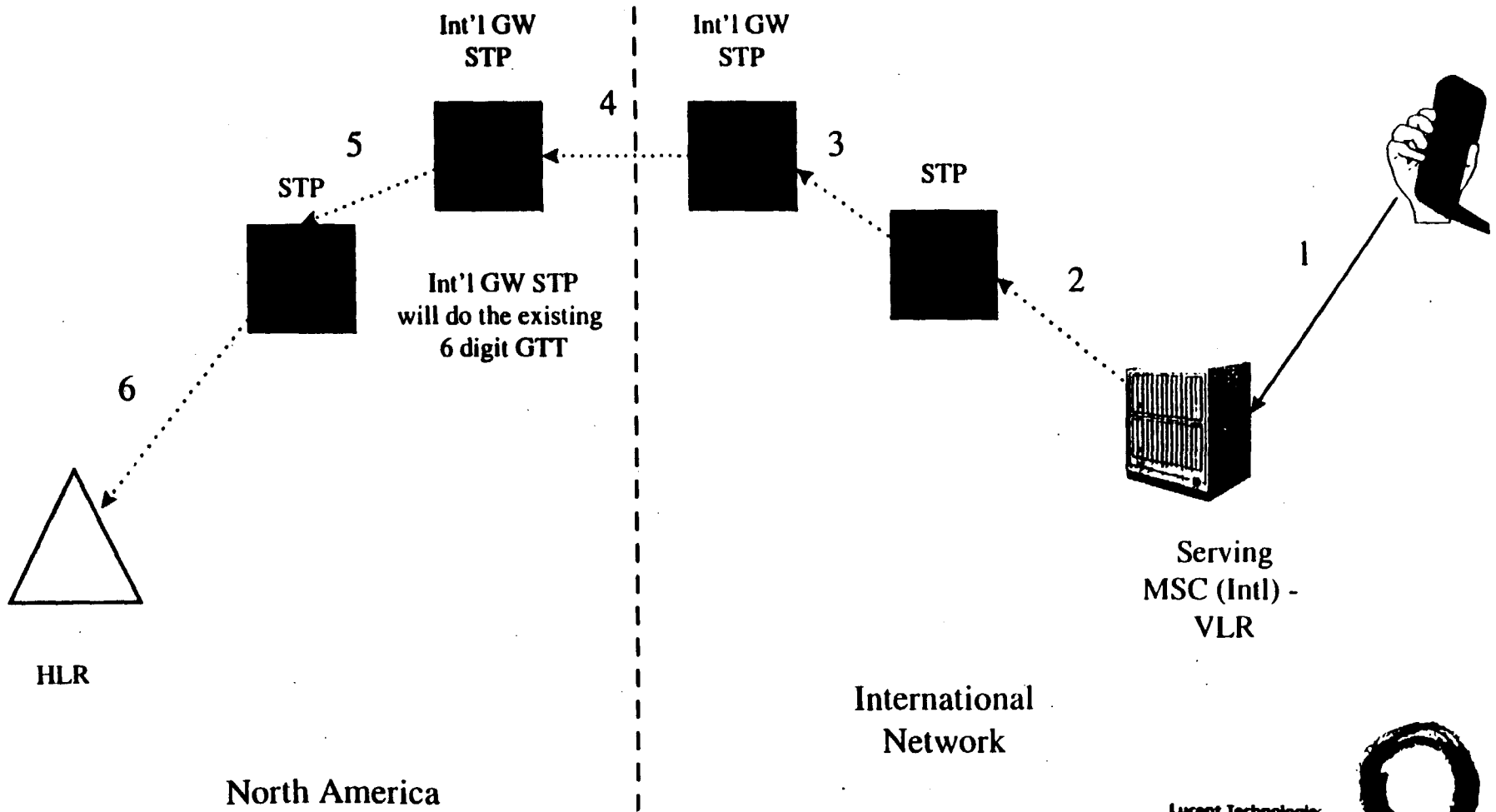
Wireless Number Portability - Option 2
Registration



Wireless Number Portability - Option 2
Call Delivery



Wireless Number Portability - Option 2
International Roaming - Registration



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Wireless Number Portability - Option 2 Implications

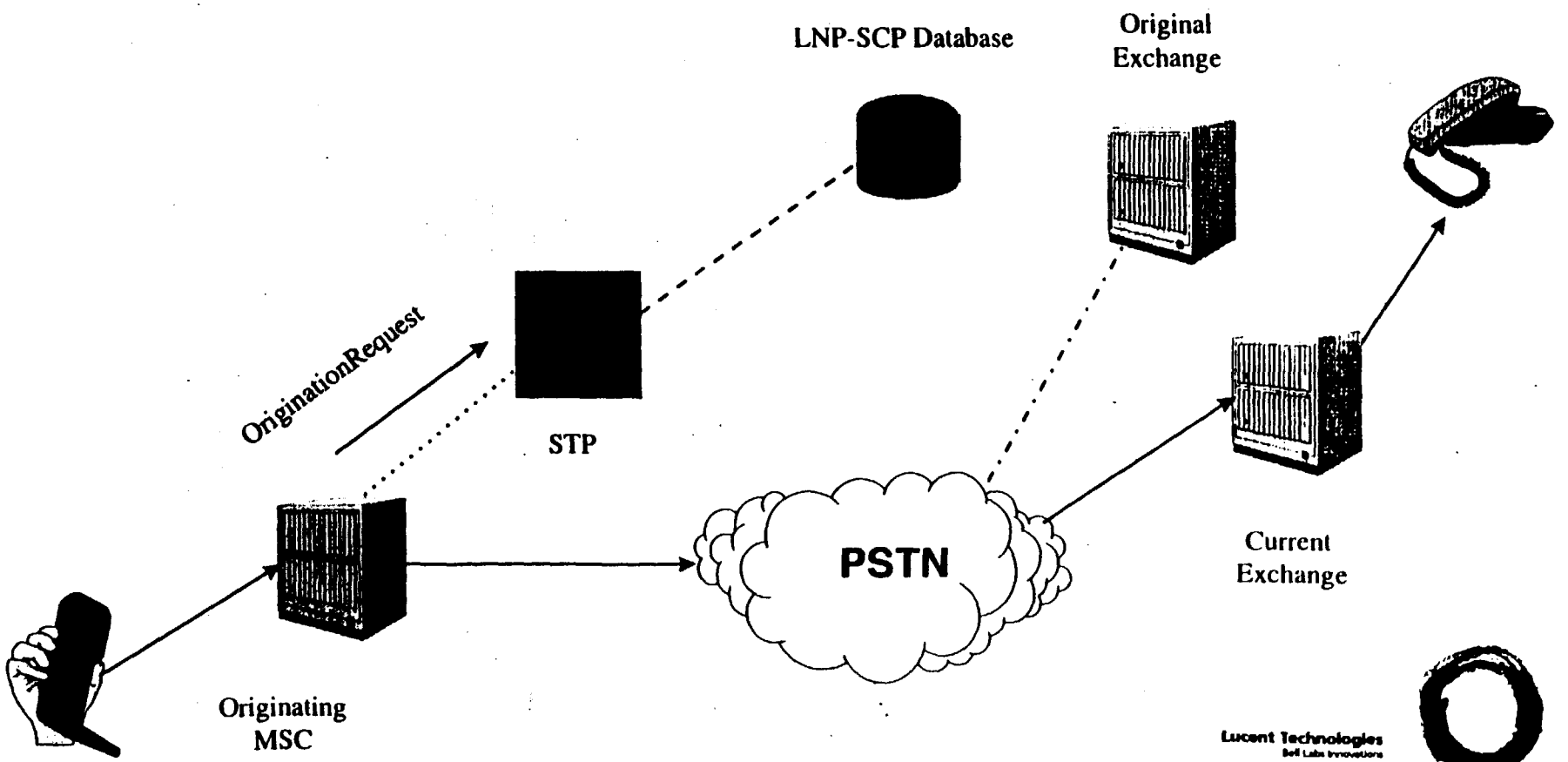
- Need to program the mobiles with new MSID whenever a subscriber changes service provider.
- No need to do 10 digit GTT for MSID to HLR translations.
- Needs administration of MIN.
- Supports both MIN and IMSI.

Wireless Number Portability - Timing

- 12/31/98:
  - Wireless Service Providers should be able to deliver calls to ported landline subscribers.

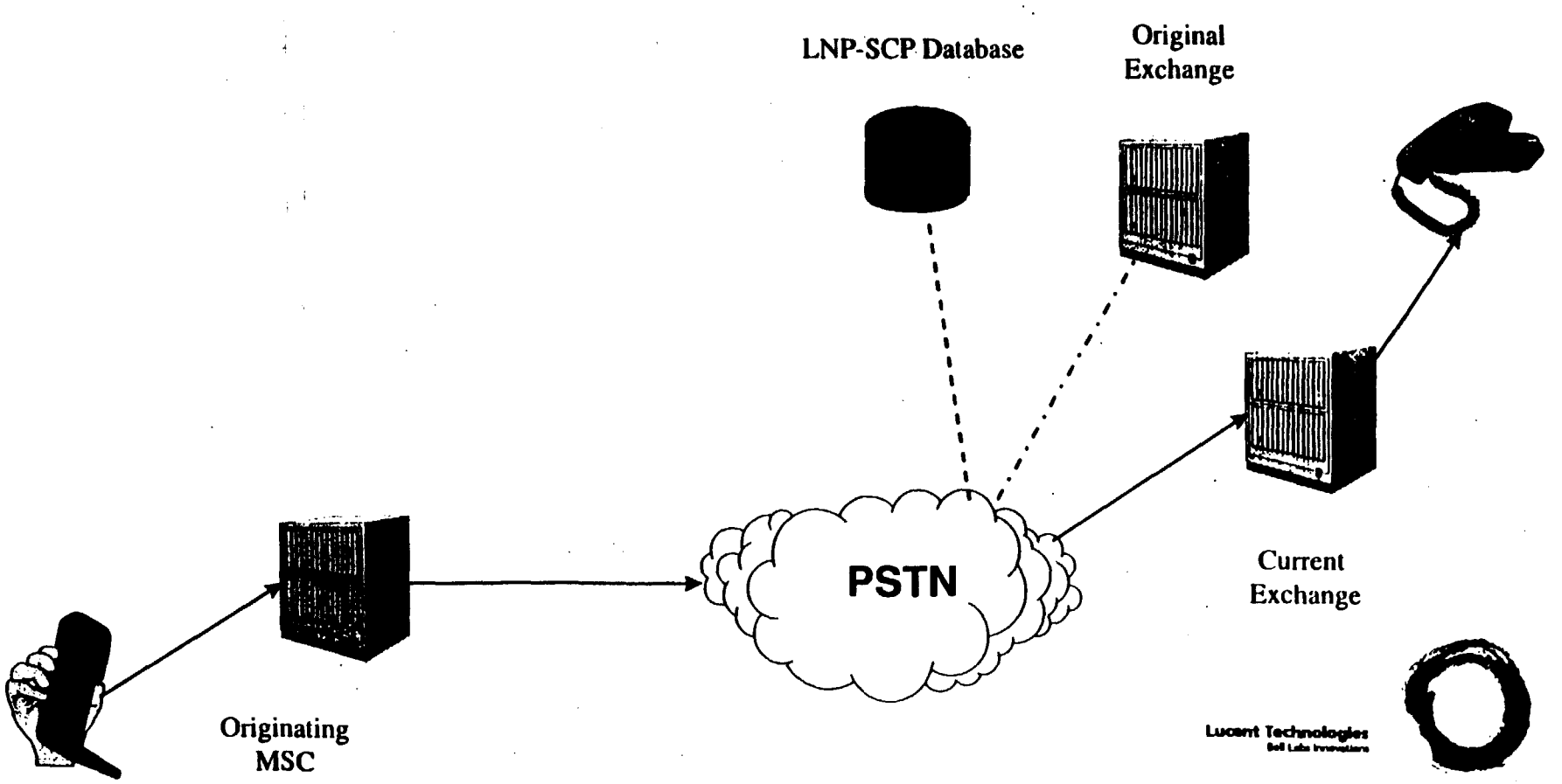
Wireless Number Portability - Timing Mobile-Landline Call

LNP-SCP Query by the wireless service provider:



Wireless Number Portability - Timing Mobile-Landline Call

LNP-SCP Query by the landline service provider:



Wireless Number Portability - Timing 12/31/98 Implications

- LNP-SCP query by the wireless service provider:
  - LNP-SCP needs an IS-41 interface for query.
  - Implementation of ISUP-IAM message modifications.
  - Implementation of call processing (routing) software at the originating MSC based on LRN.
  - Implementation of the list of ported number blocks for LNP-SCP query trigger at the MSC.

Wireless Number Portability - Timing
12/31/98 Implications

- LNP-SCP query by landline service provider:
  - Implementation of ISUP-IAM message modifications in the MSC software
  - Need LNP-SCP query access agreement with the landline service provider

Wireless Number Portability
Open Issues

- If both OPTION-1 & OPTION-2 are implemented, then
  - Subscribers of OPTION-2 will become "Universal Roamers"
  - Carriers of OPTION-1 will become "Universal Roamer Recipients"
  - Subscribers of OPTION-1 will not be able to roam into OPTION-2 network
- Therefore, unless we have a single solution we need to implement both options to meet FCC requirement on full number portability (needed by 6/30/99).

EXHIBIT 3

Bellcore

Wireless Local Number Portability

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October, 1996

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Overview

- Introduction
- Intelligent Network Approach
- Bellcore's ISCP ™ Solution
- Wireline LNP with Bellcore's ISCP
- Wireless LNP Approach
- Conclusion

TM - ISCP is a trademark of Bellcore.

Introduction
WLNP Drivers

- Market Forces
- FCC Regulations
- Local Commission Rulings
- Competition, Competition, Competition

800 Number Portability
A Success of the Past with Application for the Future

- FCC mandate
- SCP & SMS designed and implemented rapidly to meet FCC schedule
- Changeover to new architecture for dozens of SCPs "over night"
- Zero interruptions - 140 million + calls per day

Intelligent Network
"Any" IN Approach

- Intelligent Networks
  - Wireless IN (WIN)
  - Wireline IN
    - Advanced IN (AIN)
    - ETSI IN

"Any" Intelligent Network Approach
The Basic Enablers

- Wireless switch triggers
  - routing
  - messaging
  - registration (!)
- Switch WLNP query/response
- WLNP service creation environment

Bellcore's ISCP
An Intelligent Network Solution Today!

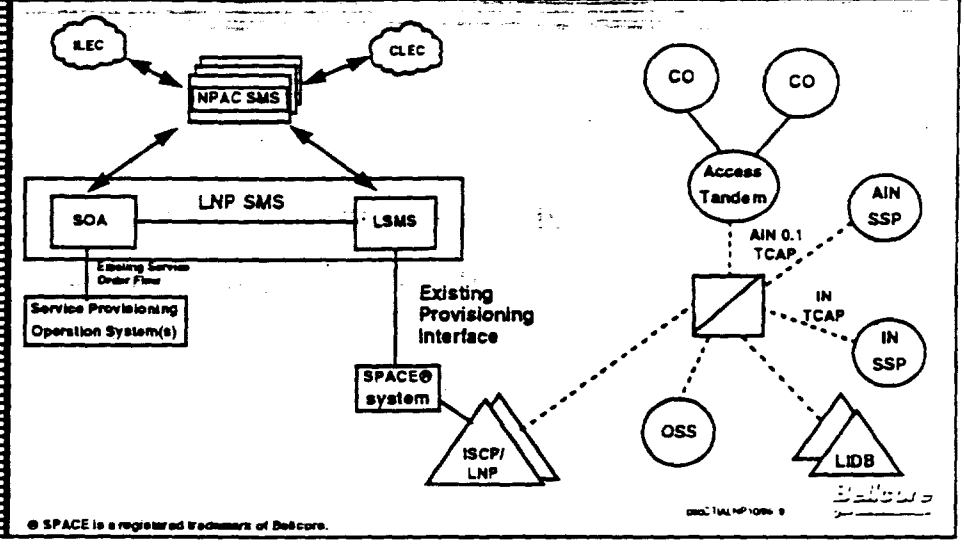
- ISCP Centralized Intelligence
  - LRN Query & Response
  - LRN Database
  - GUI Service Creation
  - Wireless/Wireline Integration
    - IS-41, AIN & ETSI IN interfaces

Bellcore's LNP Solution
An Intelligent Network Solution Today!

- NPAC SMS
- LSMS
- SOA
- LNP SCP

Bellcore LNP Solution - ISCP

An Intelligent Network Solution Today!



® SPACE is a registered trademark of Bellcore.

Bellcore's ISCP

An Intelligent Network Solution Today!

- Reliability, availability, disaster recovery
- Capacity & processing requirements
- SS7 interface evolution
- SPACE® service creation environment
- Billing & measurements
- Operations, administration & maintenance

® SPACE is a registered trademark of Bellcore.

Bellcore LNP Solution
ISCP/LNP Functionality

- ISCP/LNP V5.0 LNP Features
  - Support Location Routing Number (LRN) model
  - Support Local Service Provider Portability (LSPP)
  - Support the AIN query (PODP-like trigger)
  - Support the IN query
  - Support Message Relay Service (MRS) capability
  - Based on the Illinois Commerce Commission LNP requirements Issue 0.95, dated September, 1996 and the Bellcore LNP switch requirements (GR-2936-CORE)

Bellcore LNP Solution
ISCP/LNP Functionality - Query Processing

- LNP Query Processing
  - Support for LRN via IN and AIN Messages
  - IN - IN Start query, Connection Control response
  - AIN - Info_Analyzed query, Analyze_Route response

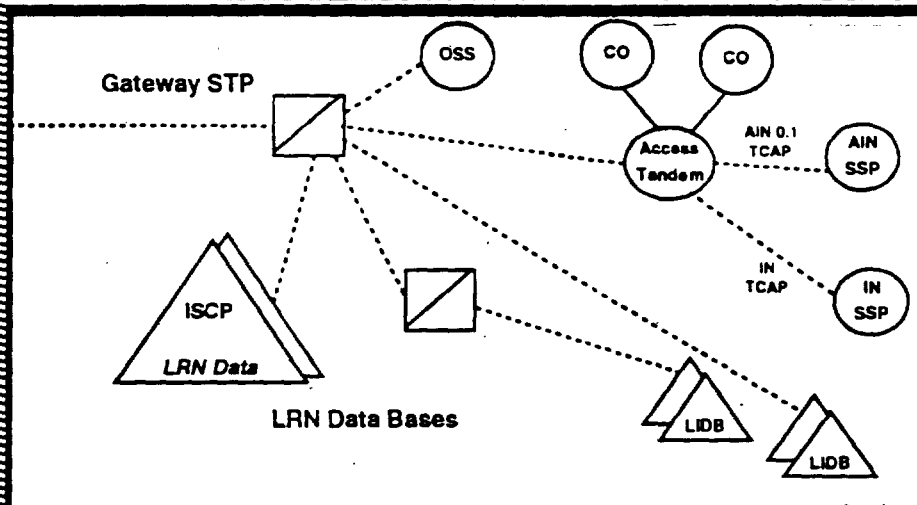
Bellcore LNP Solution

ISCP/LNP Functionality - Message Relay Service

- Message Relay Service will be supported (10 digit Global Title Translation) for LIDB and CLASS queries
- Existing Regional "Gateway" STPs will redirect queries via an ISCP lookup

Wireline LNP

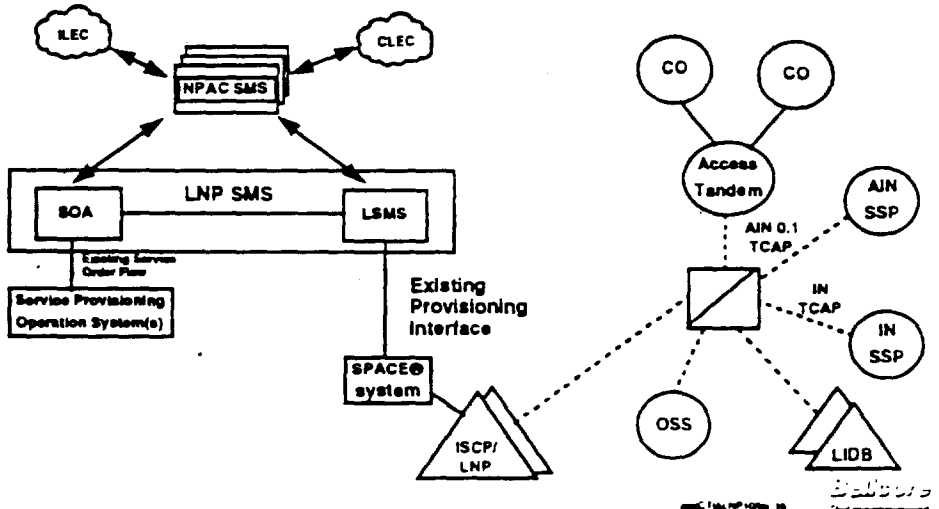
Message Relay Service



Bellcore LNP Solution - ISCP/LNP Functionality - DUARS Measurements

- **Measurements for LNP Queries by**
  - Originating SSP
  - LRN for Ported Numbers
  - NPA-NXX for Non-Ported Numbers
  - Failures
- **Measurements for MRS by**
  - Originating SSP
  - LRN for Ported Numbers
  - NPA-NXX for Non-Ported Numbers
  - Failures

Bellcore LNP Solution - LNP SMS - An Intelligent Network Solution Today!



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Bellcore's LNP SMS
LSMS Functionality

- Provides secure "buffering" between multiple carriers and your network
- Supports CMISE-based connection to NPAC
  - Receives downloads of TN data (ported #'s)
  - Receives network data (e.g., NPA-NXX)
  - Processes audit requests (NPAC vs. LSMS)

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Bellcore's LNP SMS
LSMS Functionality

- Stores data and forwards it to multiple ISCPs
  - Utilizes SPACE Provisioning interface
- Supports local administration of data
  - Changes to service provider's network data
  - Mass updates: e.g., NPA splits
  - GUI-based terminals for data administration

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LNP SMS
SOA Functionality

- Supports CMISE-based connection to NPAC
  - Request subscription administration and receive responses
  - Submit audit requests and receive responses
  - Send notifications - e.g., authorization denial, conflict resolution

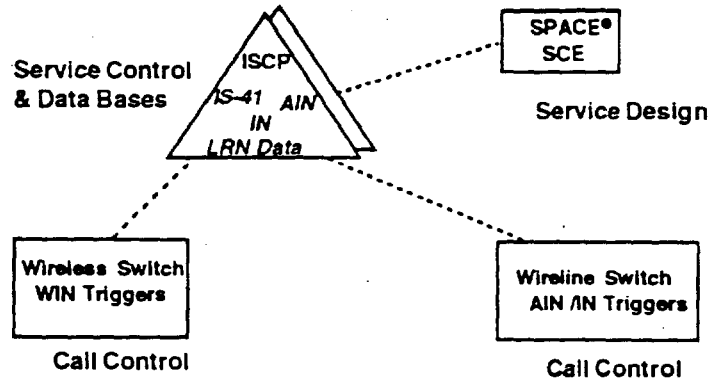
LNP SMS
SOA Functionality

- Stores records in an administrative data base
  - Provide workcenter capabilities for data administration
- Provides an FCIF interface to an upstream OS system for subscription administration functions
  - Create, cancel, activate, disconnect, etc.

Bellcore's LNP Solution
An Intelligent Network Solution Today!

- NPAC SMS
- LSMS
- SOA
- LNP SCP

Wireless and Wireline LNP
Flexibility & Integration



Conclusion

- **An intelligent network approach is necessary**

  Bellcore believes that the flexibility and capabilities of an IN establishes a synergistic relationship with future services

- **Bellcore has LNP experience**

  Bellcore has provided specifications and software solutions addressing number portability requirements

- **Bellcore has the capabilities to help CTIA and its members**

  Bellcore can provide consultation on specifications, interfaces and testing as well as offer software product solutions for Wireless LNP

EXHIBIT 4

Number Portability

David Spies
Ericsson Inc., Radio Systems

CTIA NP RFI Response

- Joint WNP response
- AG Communications
- AT&T Wireless
- Ericsson Inc.
- Lucent Technologies
- Tandem Computer

Do's and Don'ts of a Good Number Portability Solution

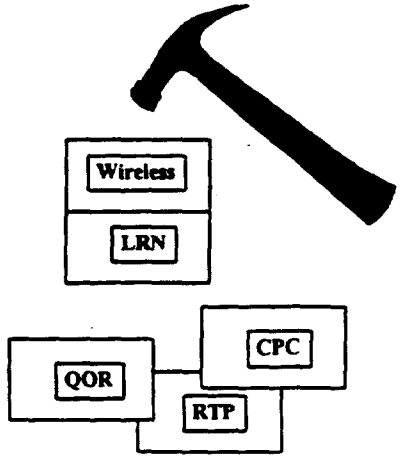
- Do let subscribers keep their existing telephone number
- Do preserve the NANP
- Do provide a fair solution that supports equal competition
- Do meet FCC Performance Criteria
- Don't impact the existing network
- Don't break what already works
  - roaming
  - existing Service quality / reliability
- Don't prevent the evolution of wireless technology

Wireless Number Portability (WNP) Solution

WNP Toolbox

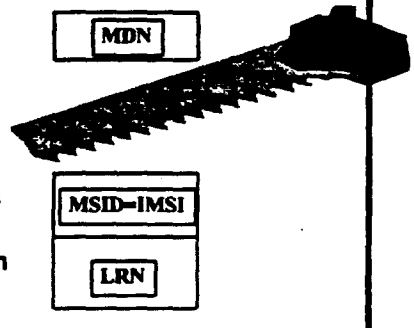
WNP Solution: LRN Compatible

- Incorporates Location Routing Number (LRN) solution
  - Accepted as wireline solution
  - Does not require a unique address per ported number
  - Call routing follows existing switch process with minor ISUP modifications



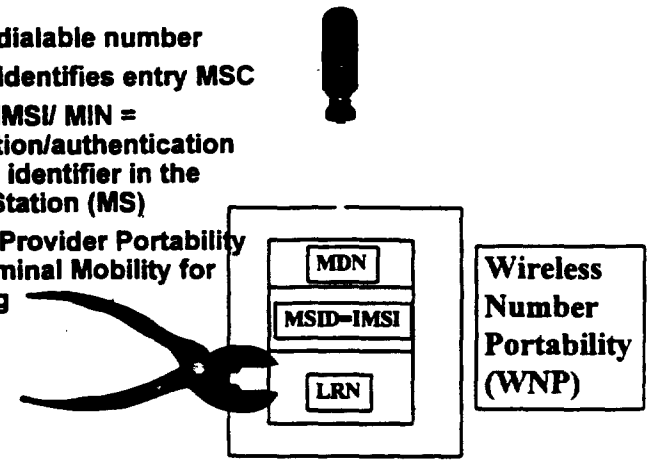
WNP Solution: Separate MSID / DN

- Functional Separation of Mobile Directory Number (MDN) from Mobile Station IDentifier (MSID)
- MDN is the portable number; subscriber takes or brings
- MSID is non-portable, controlled by the wireless provider. MSID not diallable; not subject to NP
- Use ITU E.212 International Mobile Station Identifier (IMSI) as the principal MSID for future
- MIN MSID usage supported for an interim period for compatible evolution



WNP Solution: NP and Wireless

- MDN = dialable number
- LRN = identifies entry MSC
- MSID = IMSI/ MIN = registration/authentication terminal identifier in the Mobile Station (MS)
- Service Provider Portability and Terminal Mobility for Roaming

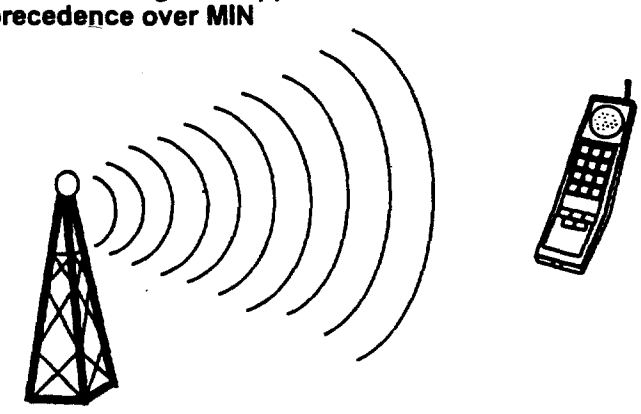


Impacts to Mobile Stations (MS)

- MS must contain both MDN and MSID (MIN and/or IMSI)
- MS display/ memory of MDN distinctively from MIN/IMSI

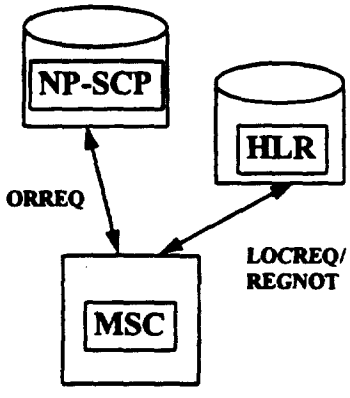
Impacts to Air Interface

- IS-136A change to support IMSI precedence over MIN



Impacts to Signaling (IS-41)

- Explicitly separate MSID and MDN
- IS-41 Automatic Code Gapping (ACG) might be needed
- LocationRequest: distinguish forwarding numbers from routing numbers for NP query



Impacts to the Home Location Register (HLR)

- HLR must map MSID to MDN and vice versa (MSID includes MIN/ IMSI)
- HLR must support changes to IS-41 due to NP and IMSI

Impacts to the Mobile Switching Center (MSC)

- IS-41 NP enhancements
- ISUP NP enhancements; FCI, CgPN, GAP parameter handling
- Coordinate dialled digits in LocReq (Not LRN, Not 'MIN')
- MDN/ MIN/ IMSI differentiation and translation types
- Trigger and query mechanism for NP
- Locate NP-SCP with no more than 6-digit analysis
- Billing: MDN, MSID ...

EXHIBIT 5

Wireless Number Portability:

DSC

COMMUNICATIONS

Wireless Number Portability:

INTRODUCTION

★ Providing information to help solve a piece of the puzzle

★ Key mostly on Global Title Translation (GTT)

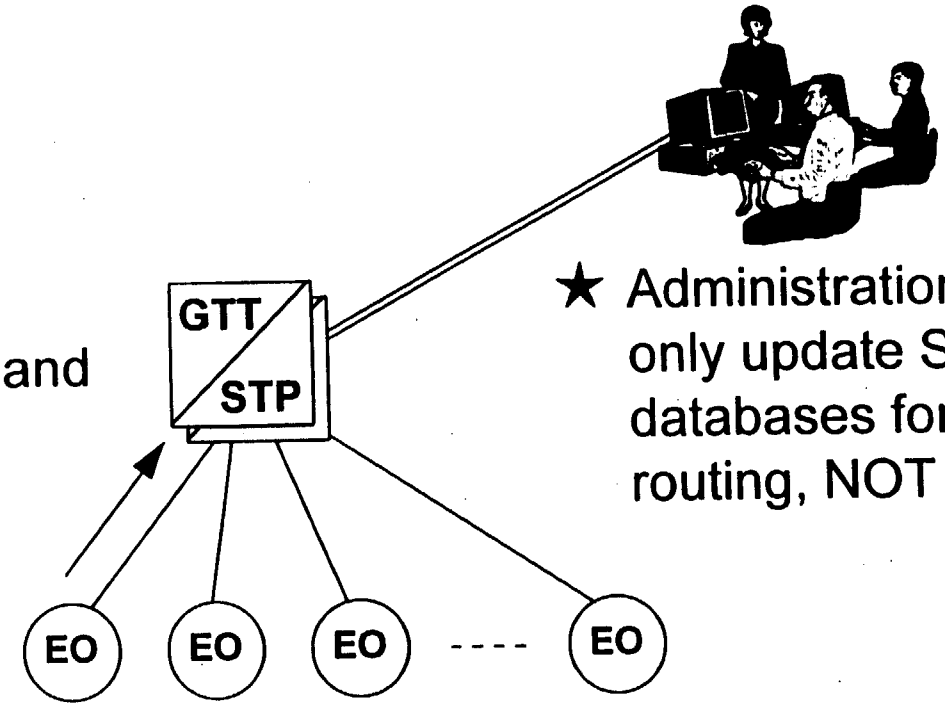
» Definition and Impacts

★ Suggestions for Wireless Networks

GLOBAL TITLE TRANSLATION

Wireless Number Portability:
GTT Administration Benefits

★ Switch sends message to STP and lets STP handle message routing



★ Administration systems only update STP GTT databases for SCCP routing, NOT each switch.

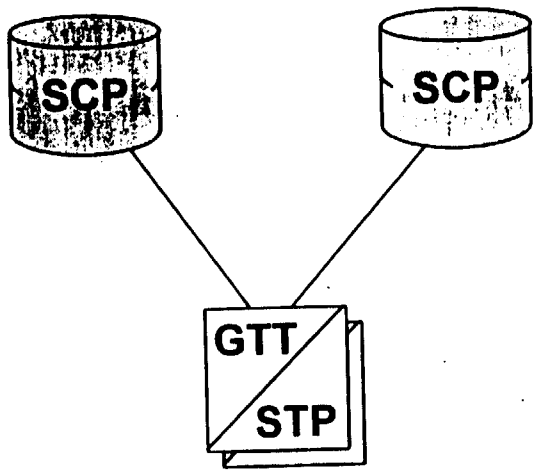
★ Multiple occurrences of SS7 routing database eliminated

★ Prevents duplication of significant databases at each switch

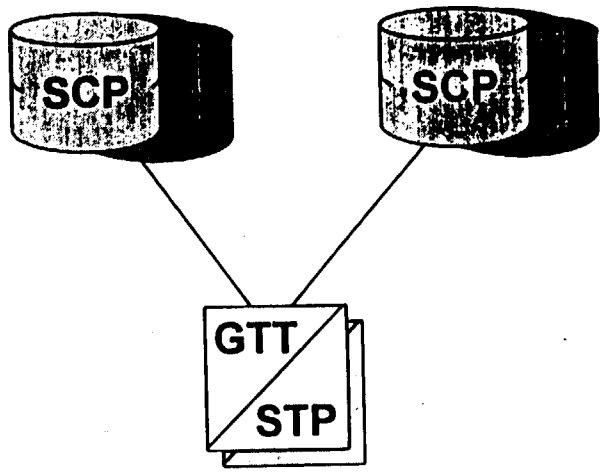
Wireless Number Portability:

GTT Loadsharing and Backup Capabilities

★ GTT at STP provides message load sharing between SCPs



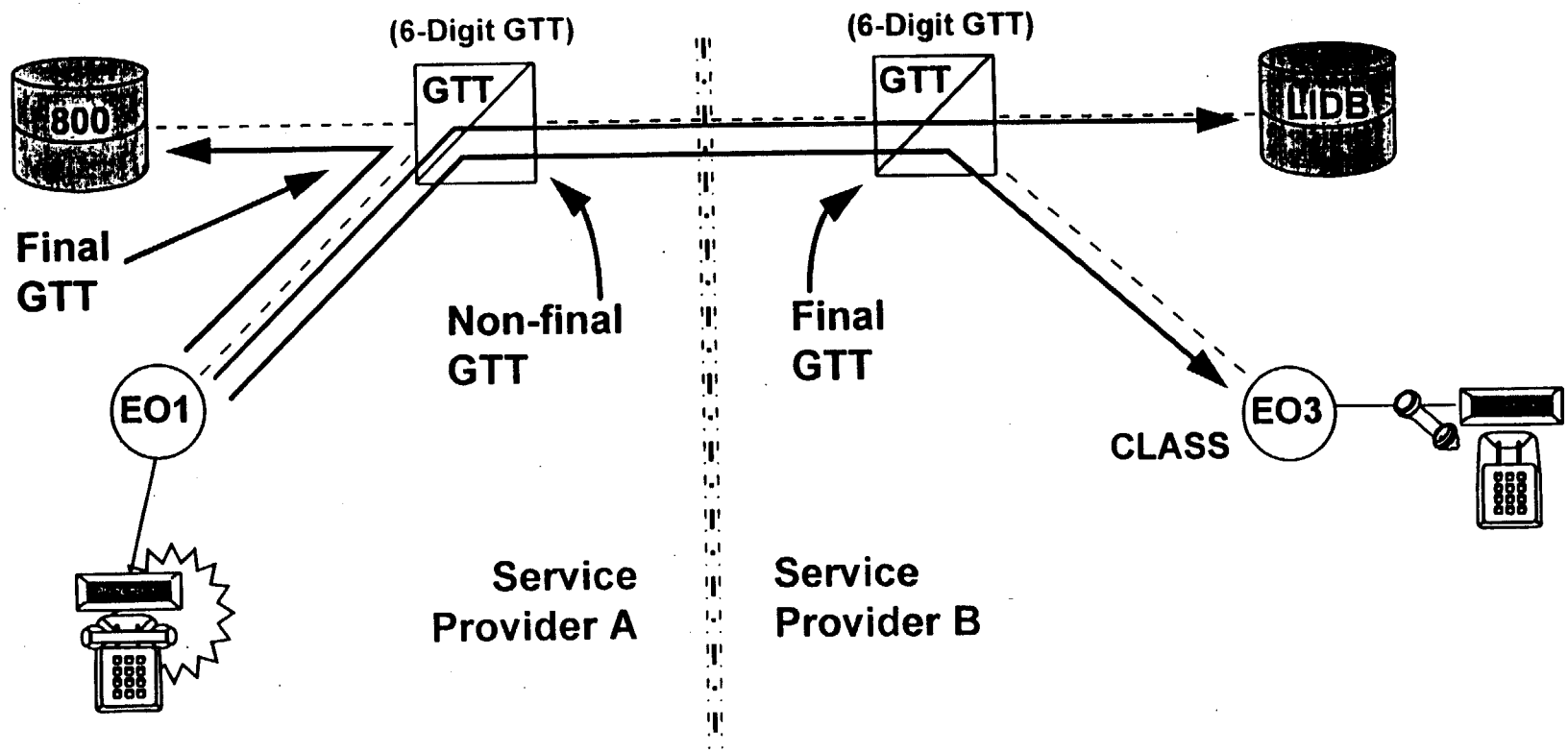
★ GTT at STP provides multiple SCP backup capabilities



Wireless Number Portability:

Today's Structures

★ Three examples of today's structures:
- ☆ one GTT per Intranetwork service query
- ☆ two GTTs per Internetwork service query



Wireless Number Portability:

Message before GTT

SCCP UNITDATA MESSAGE

		H	G	F	E	D	C	B	A	
A	1	Destination Point Code								Routing Label
	2	Originating Point Code								
	3	Spare			Signalling Link Selection					
B		0	0	0	0	1	0	0	1	Message Type
C		0	0	0	0	0	0	0	0	Class/Options
D	1	0	0	0	0	0	0	1	1	Pointers
	2	0	0	0	0	1	0	1	1	
	3	0	0	0	1	0	0	0	0	
E	1	0	0	0	0	1	0	0	0	SCCP Called Party Address
	2	1	0/1	0	0	1	0	0	1	
	3	Subsystem Number								
	4	Translation Type								
	5	2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
F	1	0	0	0	0	0	1	0	1	SCCP Calling Party Address
	2	1	1	0	0	0	0	1	1	
	3	Subsystem Number								
	4	Point Code of Originating SSP/MSC								
G	1	Length Indicator								TCAP
	2	TCAP Data								
		⋮								
		2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
		2nd XXXX Digit				1st XXXX Digit				
		4th XXXX Digit				3rd XXXX Digit				
		⋮								

- ★ **DPC of STP where GTT processing is to be performed**
- ★ **OPC of message originator**
- ★ **Translation type which points at desired STP GTT database**
- ★ **Digits to be translated by GTT function**
- ★ **Point code of application that originated the query. Point code of which response will be sent.**

Wireless Number Portability:

What GTT Does...

SCCP UNITDATA MESSAGE

		H	G	F	E	D	C	B	A	
A	1	Destination Point Code								Routing Label
	2	Originating Point Code								
	3	Spare			Signalling Link Selection					
B		0	0	0	0	1	0	0	1	Message Type
C		0	0	0	0	0	0	0	0	Class/Options
D	1	0	0	0	0	0	0	1	1	Pointers
	2	0	0	0	0	1	0	1	1	
	3	0	0	0	1	0	0	0	0	
E	1	0	0	0	0	1	0	0	0	SCCP Called Party Address
	2	1	0/1	0	0	1	0	0	1	
	3	Subsystem Number								
	4	Translation Type								
	5	2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
F	1	0	0	0	0	0	1	0	1	SCCP Calling Party Address
	2	1	1	0	0	0	0	1	1	
	3	Subsystem Number								
	4	Point Code of Originating SSP/MSC								
G	1	Length Indicator								TCAP
	2	TCAP Data								
		⋮								
		2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
		2nd XXXX Digit				1st XXXX Digit				
		4th XXXX Digit				3rd XXXX Digit				
		⋮								

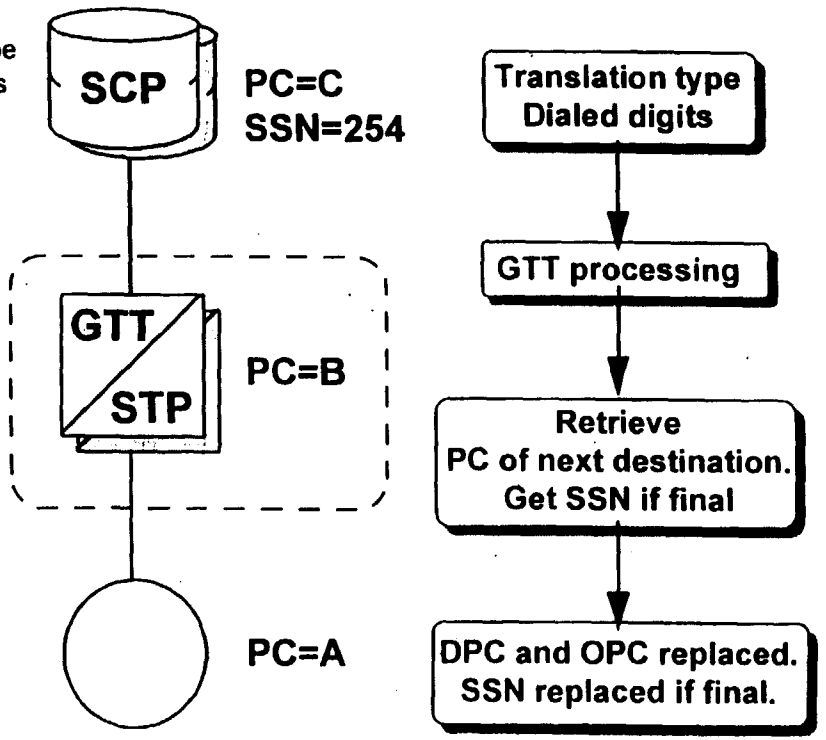
- ★ Translates according to SCCP CdPA encoding
- ★ STP uses the Translation Type to identify GTT procedures and which GTT database to use
- ★ STP performs either final or non-final GTT
- ★ Translation results in
  - ★ DPC of next destination for SCCP processing
- ★ OPC is replaced with that of the translating STP
- ★ CdPA SSN field populated if a final GTT is performed

Wireless Number Portability:

Message After GTT

SCCP UNITDATA MESSAGE

		H	G	F	E	D	C	B	A	
A	1	was PC=B, now PC=C					Destination Point Code			Routing Label
	2	was PC=A, now PC=B					Originating Point Code			
	3	Spare				Signalling Link Selection				
B		0	0	0	0	1	0	0	1	Message Type
C		0	0	0	0	0	0	0	0	Class/Options
D	1	0	0	0	0	0	0	1	1	Pointers
	2	0	0	0	0	1	0	1	1	
	3	0	0	0	1	0	0	0	0	
E	1	0	0	0	0	1	0	0	0	SCCP Called Party Address
	2	1	1	0	0	1	0	0	1	
	3	was SSN=0, now SSN=254								
	4	Translation Type								
	5	2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
F	1	0	0	0	0	0	1	0	1	SCCP Calling Party Address
	2	1	1	0	0	0	0	1	1	
	3	Subsystem Number								
	4	Point Code of Originating SSP/MSC								
G	1	Length Indicator								TCAP
	2	TCAP Data								
		⋮								
		2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
		2nd XXXX Digit				1st XXXX Digit				
		4th XXXX Digit				3rd XXXX Digit				
		⋮								

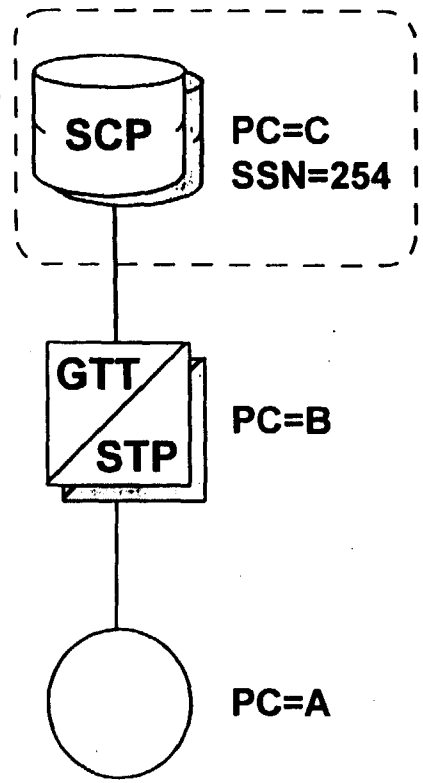


Wireless Number Portability:

Application database processing

SCCP UNITDATA MESSAGE

		H	G	F	E	D	C	B	A	
A	1	PC=C					Destination Point Code			Routing Label
	2	PC=B					Originating Point Code			
	3	Spare				Signalling Link Selection				
B		0	0	0	0	1	0	0	1	Message Type
C		0	0	0	0	0	0	0	0	Class/Options
D	1	0	0	0	0	0	0	1	1	Pointers
	2	0	0	0	0	1	0	1	1	
	3	0	0	0	1	0	0	0	0	
E	1	0	0	0	0	1	0	0	0	SCCP Called Party Address
	2	1	1	0	0	1	0	0	1	
	3	SSN=254								
	4	Translation Type								
	5	2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
F	1	0	0	0	0	0	1	0	1	SCCP Calling Party Address
	2	1	1	0	0	0	0	1	1	
	3	Subsystem Number								
	4	Point Code of Originating SSP/MSC								
G	1	Length Indicator								TCAP
	2	TCAP Data								
		⋮								
		2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
		2nd XXXX Digit				1st XXXX Digit				
		4th XXXX Digit				3rd XXXX Digit				
		⋮								



Identifies Message for itself, PC=C

SCCP hands TCAP Portion to SSN 254

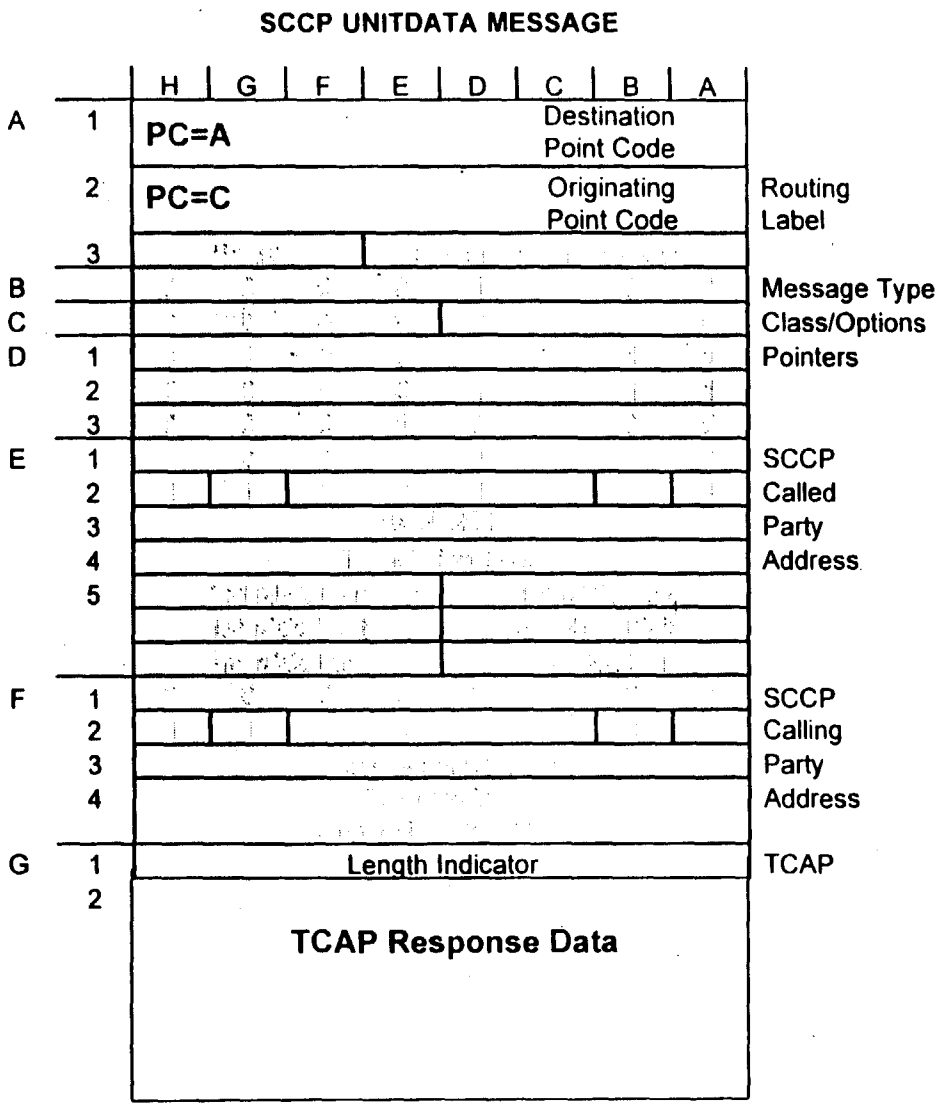
SCP creates response message

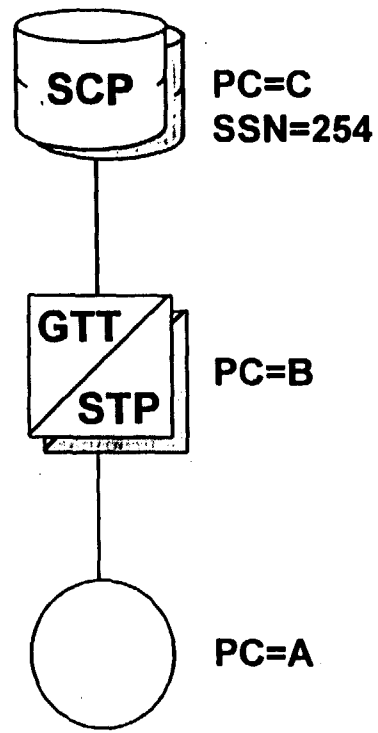
Response data put in TCAP part

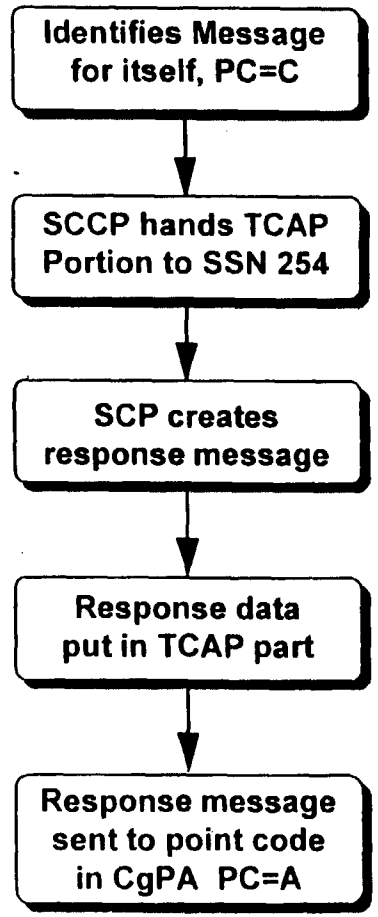
Response message sent to point code in CgPA PC=A

Wireless Number Portability:

Response message





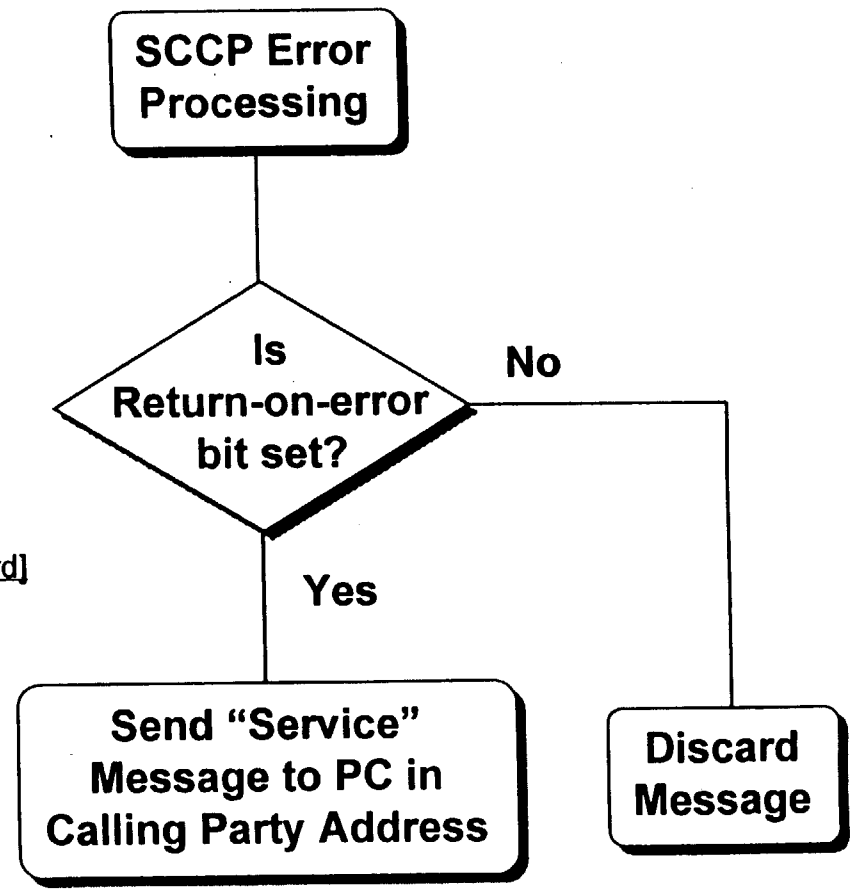


Wireless Number Portability:

GTT error processing

bits 87654321	
00000000	no translation for an address of such nature
00000001	no translation for this specific address
00000010	subsystem congestion[8)]
00000011	subsystem failure
00000100	unequipped user
00000101	network failure
00000110	network congestion
00000111	unqualified
00001000	SCCP hop counter violation (1)
00001001	error in message transport (1)
00001010	error in local processing (1)
00001011	destination cannot perform reassembly (1)
00001100	SCCP Failure [used by CCITT but not by this standard]
00001101 to 11111000	spare
11111001	invalid ISNI routing request (1)
11111010	unauthorized message
11111011	message incompatibility
11111100	cannot perform ISNI constrained routing (1)
11111101	redundant ISNI constrained routing information (1)
11111110	unable to perform ISNI identification (1)
11111111	spare

(1) Note: only applicable to XUDTS messages

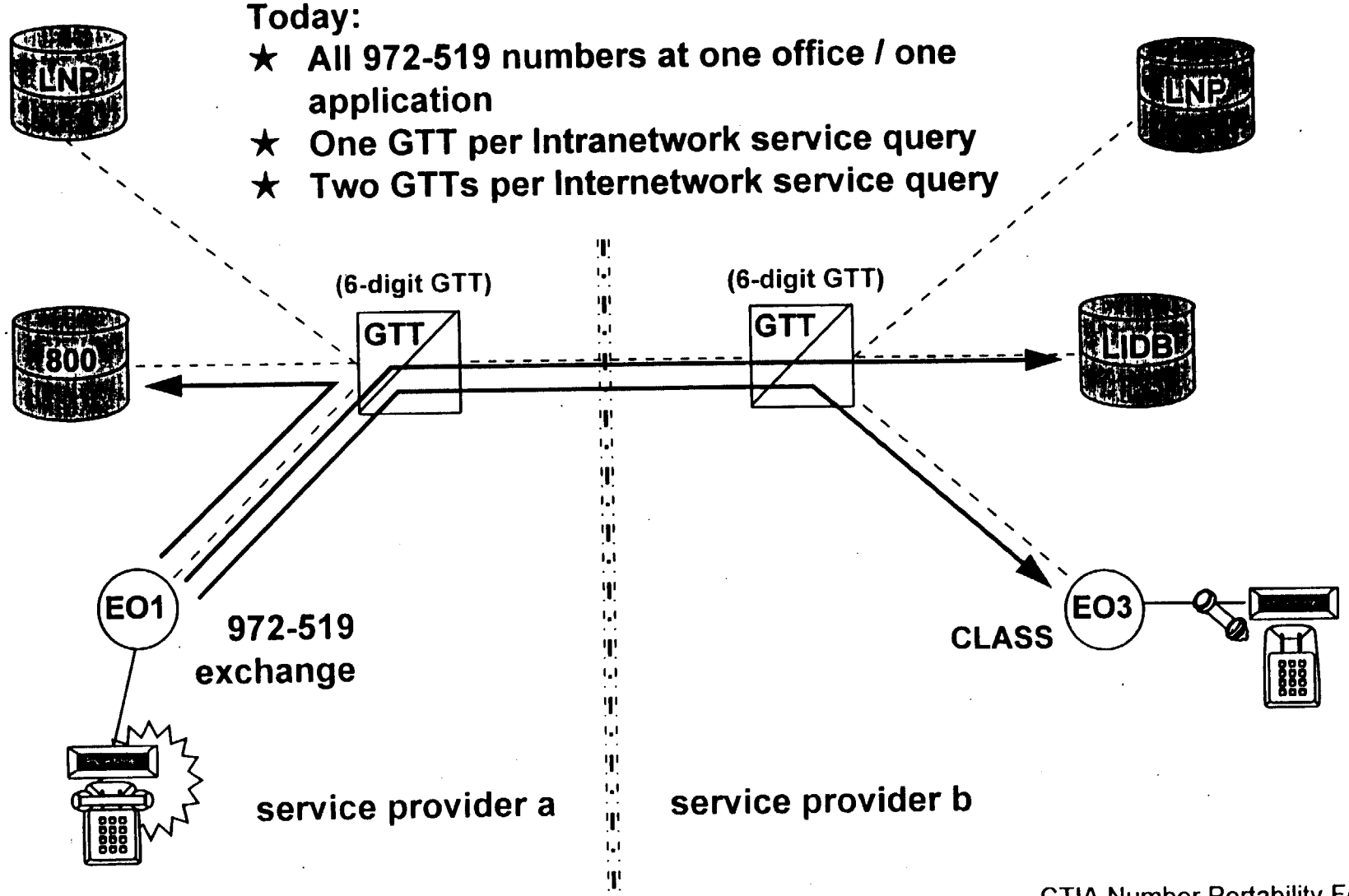


Wireless Number Portability:

Today's GTT Processing

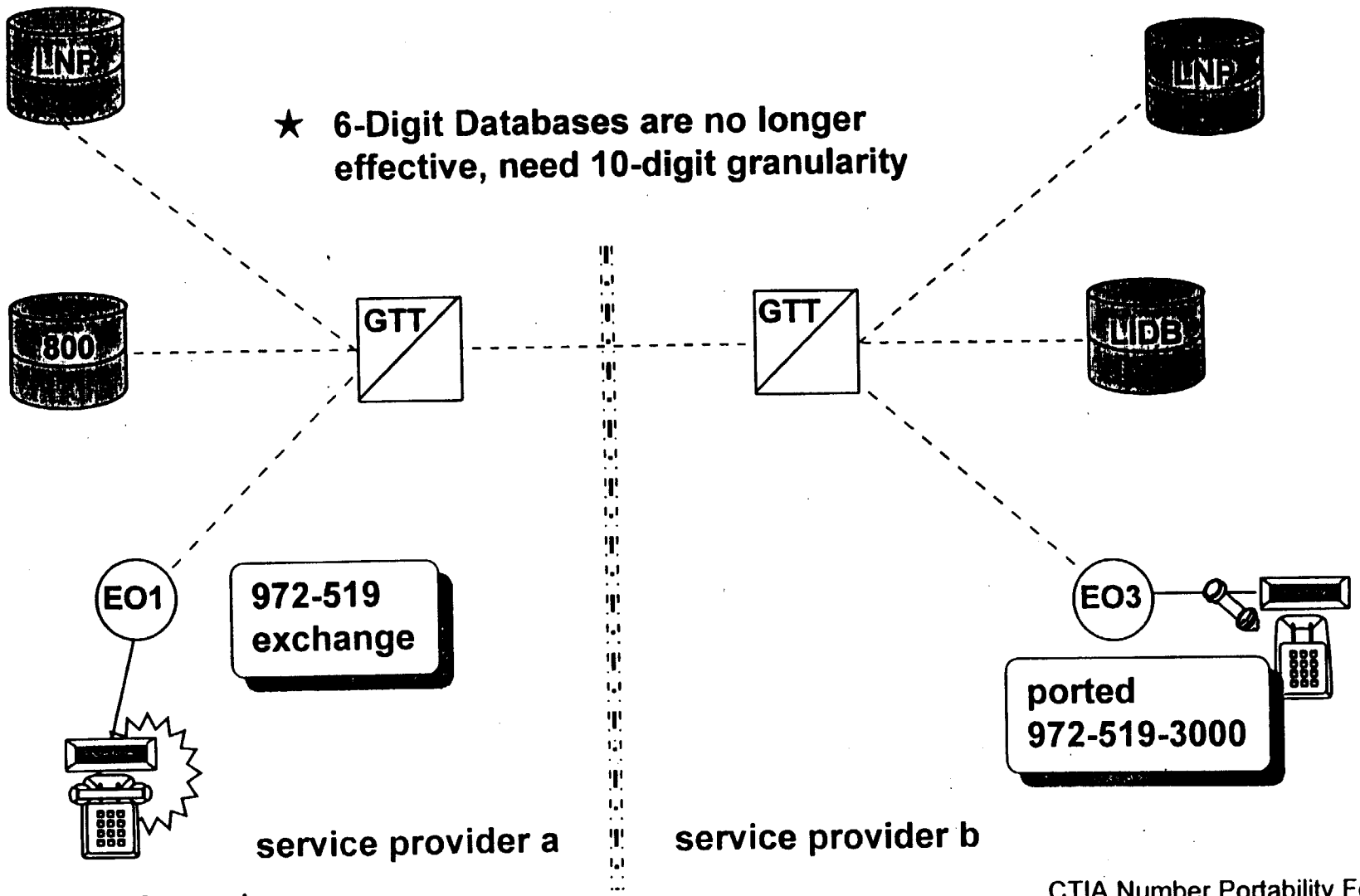
Today:

- ★ All 972-519 numbers at one office / one application
- ★ One GTT per Intranetwork service query
- ★ Two GTTs per Internetwork service query



Wireless Number Portability:

Service GTT Impacts



Wireless Number Portability:

GTT for Services in NP environment

SCCP UNITDATA MESSAGE

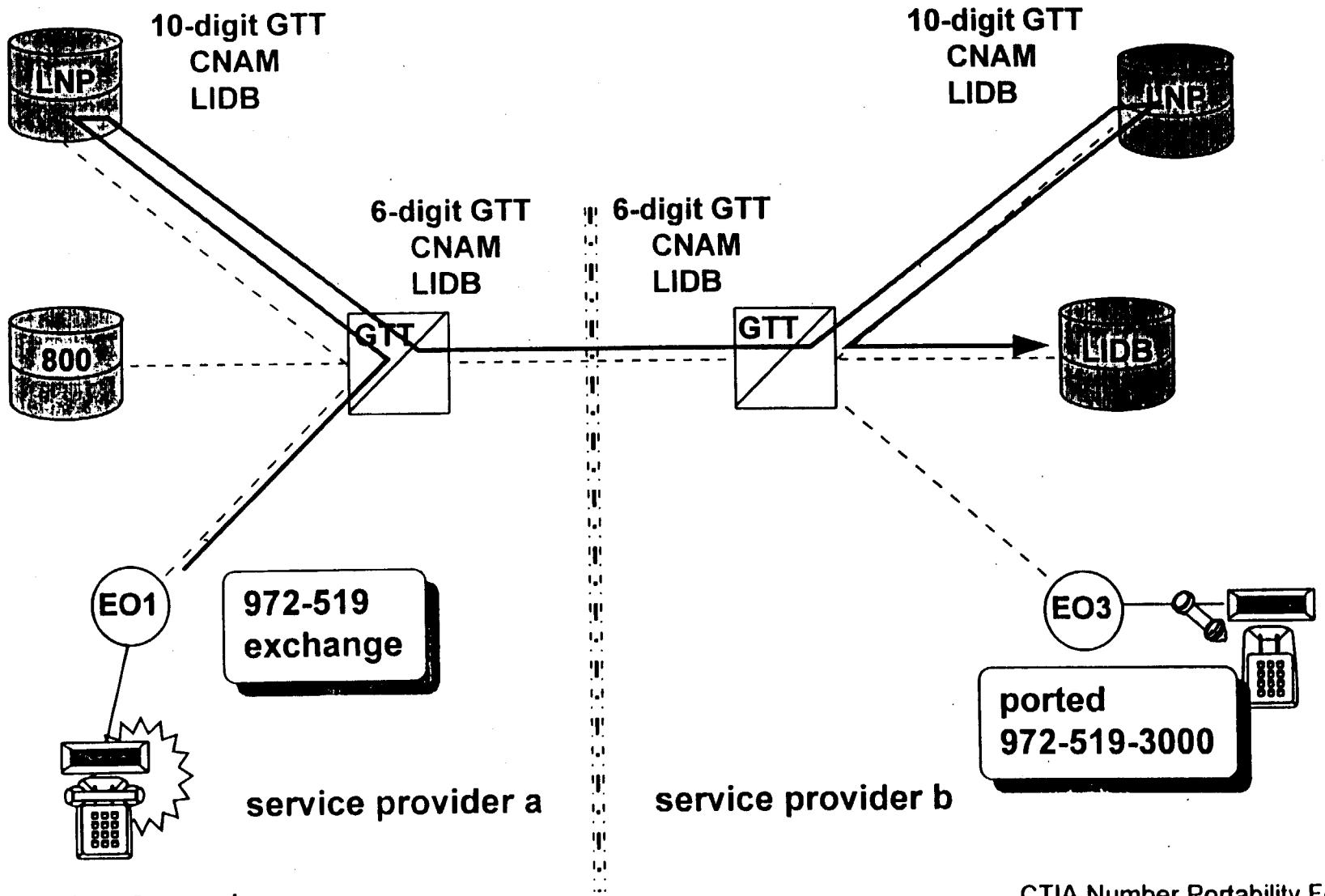
		H	G	F	E	D	C	B	A	
A	1	Destination Point Code								Routing Label
	2	Originating Point Code								
	3	Spare			Signalling Link Selection					
B		0	0	0	0	1	0	0	1	Message Type
C		0	0	0	0	0	0	0	0	Class/Options
D	1	0	0	0	0	0	0	1	1	Pointers
	2	0	0	0	0	1	0	1	1	
	3	0	0	0	1	0	0	0	0	
E	1	0	0	0	0	1	0	0	0	Called Party Address
	2	1	0/1	0	0	1	0	0	1	
	3	Subsystem Number								
	4	Translation Type								
	5	2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
F	1	0	0	0	0	0	1	0	1	Calling Party Address
	2	1	1	0	0	0	0	1	1	
	3	Subsystem Number								
	4	Point Code of Originating SSP/MSC								
G	1	Length Indicator								TCAP
	2	TCAP Data								
		⋮								
		2nd NPA Digit				1st NPA Digit				
		1st NXX Digit				3rd NPA Digit				
		3rd NXX Digit				2nd NXX Digit				
		2nd XXXX Digit				1st XXXX Digit				
		4th XXXX Digit				3rd XXXX Digit				
		⋮								

- ★ GTTs to get to LNP Database
  - » A simple 6-Digit GTT satisfies the need
- ★ Impact to GTTs for Services such as CNAM
  - » Services that previously required 6-Digit GTT now require 10-Digit GTT
  - » Not all services populate SCCP Called Party Address with sufficient digits
  - » Preferred interim resolution by industry in these cases is to extract needed digits from TCAP portion of the message (less $$)

Wireless Number Portability:

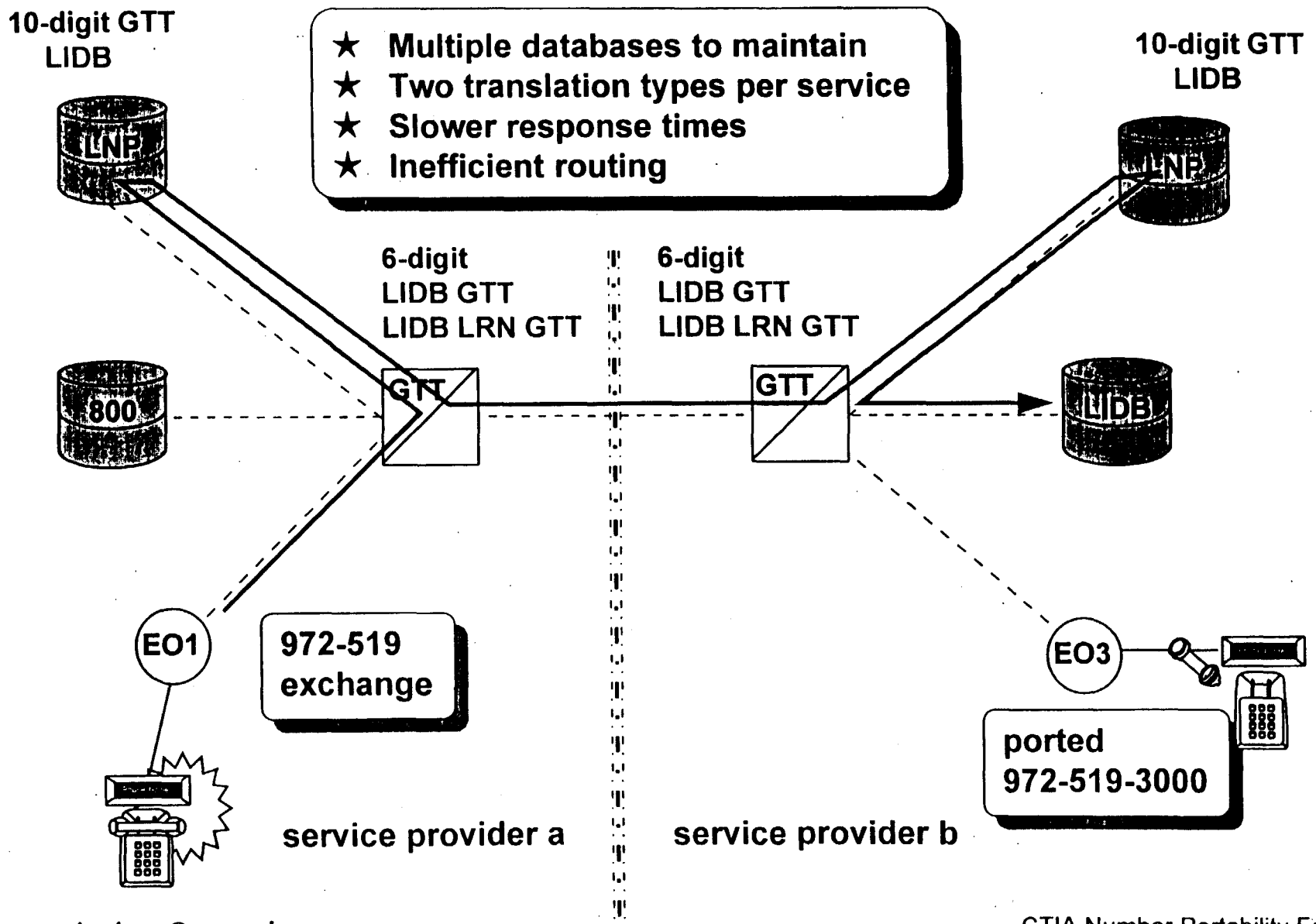
GTT at SCP Scenario

- ★ Multiple databases to maintain
- ★ Slower response times
- ★ Inefficient routing and link set utilization



Wireless Number Portability:

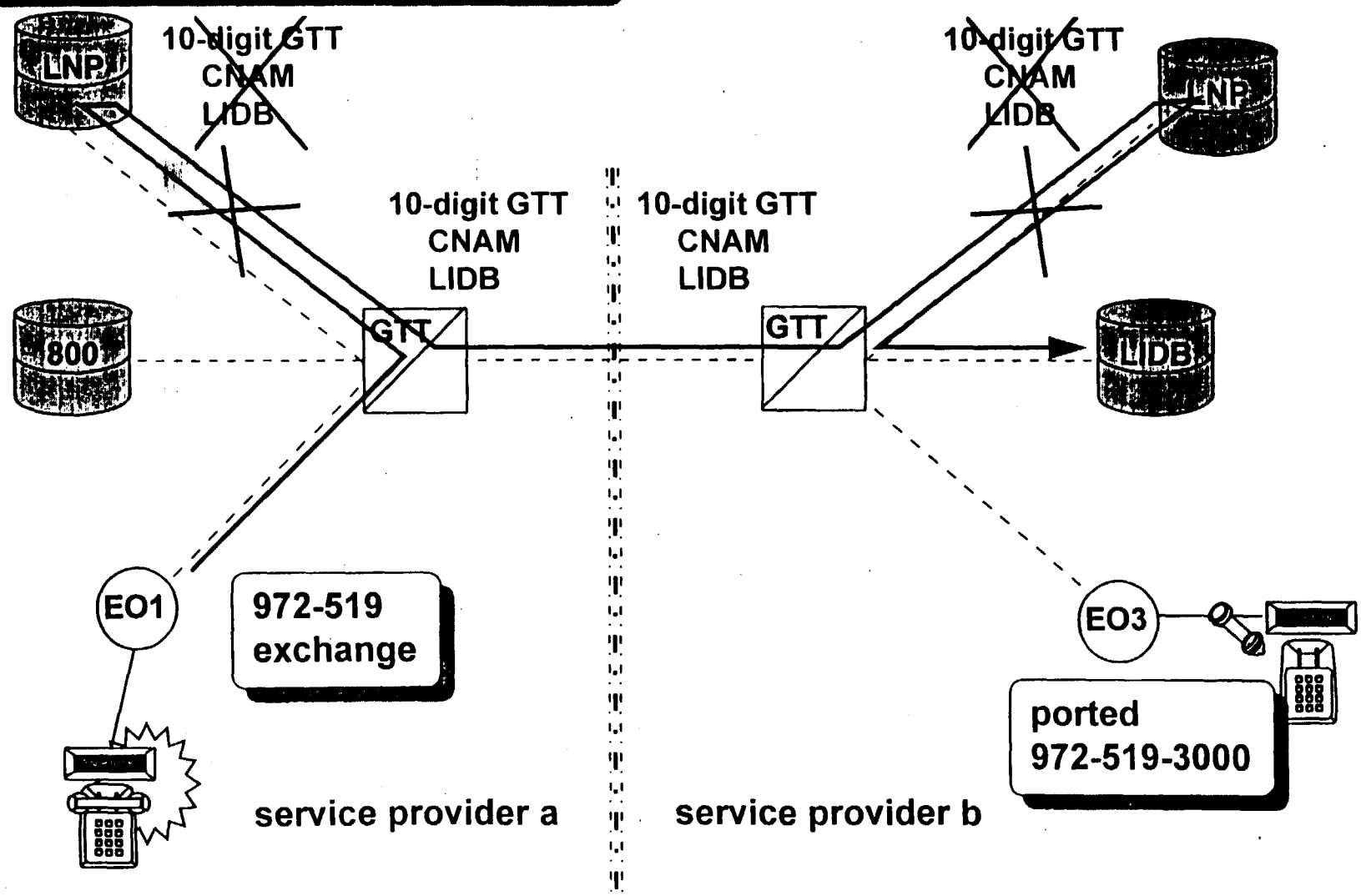
Message Relay Function



Wireless Number Portability:

Keeping GTT at the STP

- ★ Just one database to maintain
- ★ Minimal impact to response times
- ★ Most efficient routing
- ★ Cost effective high transaction rates



Wireless Number Portability:

SCCP Hop Counter

Unitdata Message

Parameter	Reference	Type F V O	Length (octets)
Message Type	2.1	F	1
Protocol Class	3.6	F	1
Called Party Address	3.4	V	3 min.
Calling Party Address	3.5	V	2 min.
Data	3.16	V	2-252[1]

Extended Unitdata Message

Parameter	Reference	Type F V O	Length (octets)
Message Type	2.1	F	1
Protocol Class	3.6	F	1
SCCP hop counter	3.17	F	1
Called Party Address	3.4	V	3 min.
Calling Party Address	3.5	V	2 min.
Data	3.16	V	2-251[1]
Segmentation	3.18	O	6
ISNI	3.19	O	3-18
End of optional parameters	3.1	O	1

- ★ Miscoordination between networks can cause SCCP message looping
- ★ Industry currently only uses SCCP Unitdata (UDT) messages for queries
- ★ Does not provide loop protection
- ★ Standards developed Extended Unitdata (XUDT) message specifically for SCCP loop prevention
- ★ Minor technical changes to implement

NUMBER PORTABILITY IMPACTS TO WIRELESS NETWORKS

Wireless Number Portability:

Registration - IS41-C

- ★ Use subset of IS41-C which separates MIN from MDN
- ★ Uses technical advantages similar to earlier LNP proposals like an overlay network or a one time number change

- ★ Only MIN changes when customer ports
  - » Used as global title value to find HLR
- ★ MDN stays the same
- ★ Uses STPs existing HLR GTT database
- ★ No impact to Authentication

- ★ Disadvantage is the economical impacts of upgrading to IS41-C

Wireless Number Portability:

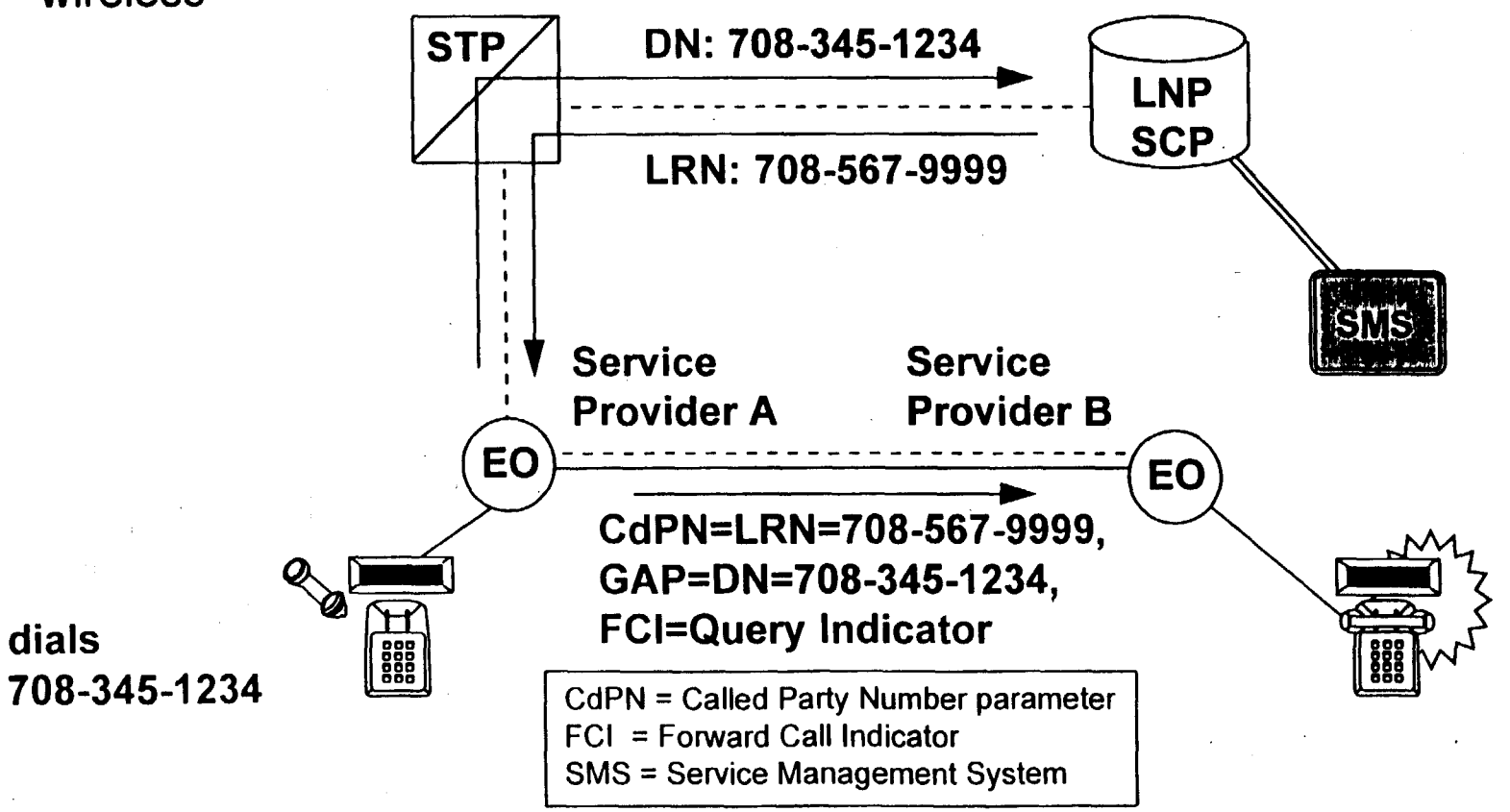
Registration IS41-B

- ★ In IS41-B, MIN and MDN are typically not separated
- ★ HLR found based on value of MIN/MDN
- ★ LNP breaks the MIN/MDN addressing scheme like it did to the land-line NPA-NXX addressing scheme

- ★ Could expand GTT database to ten-digits
  - » database updated with ported numbers and address of associated HLR from regional SMS
- ★ No impact to Authentication

Wireless Number Portability:
Routing to Portable Numbers

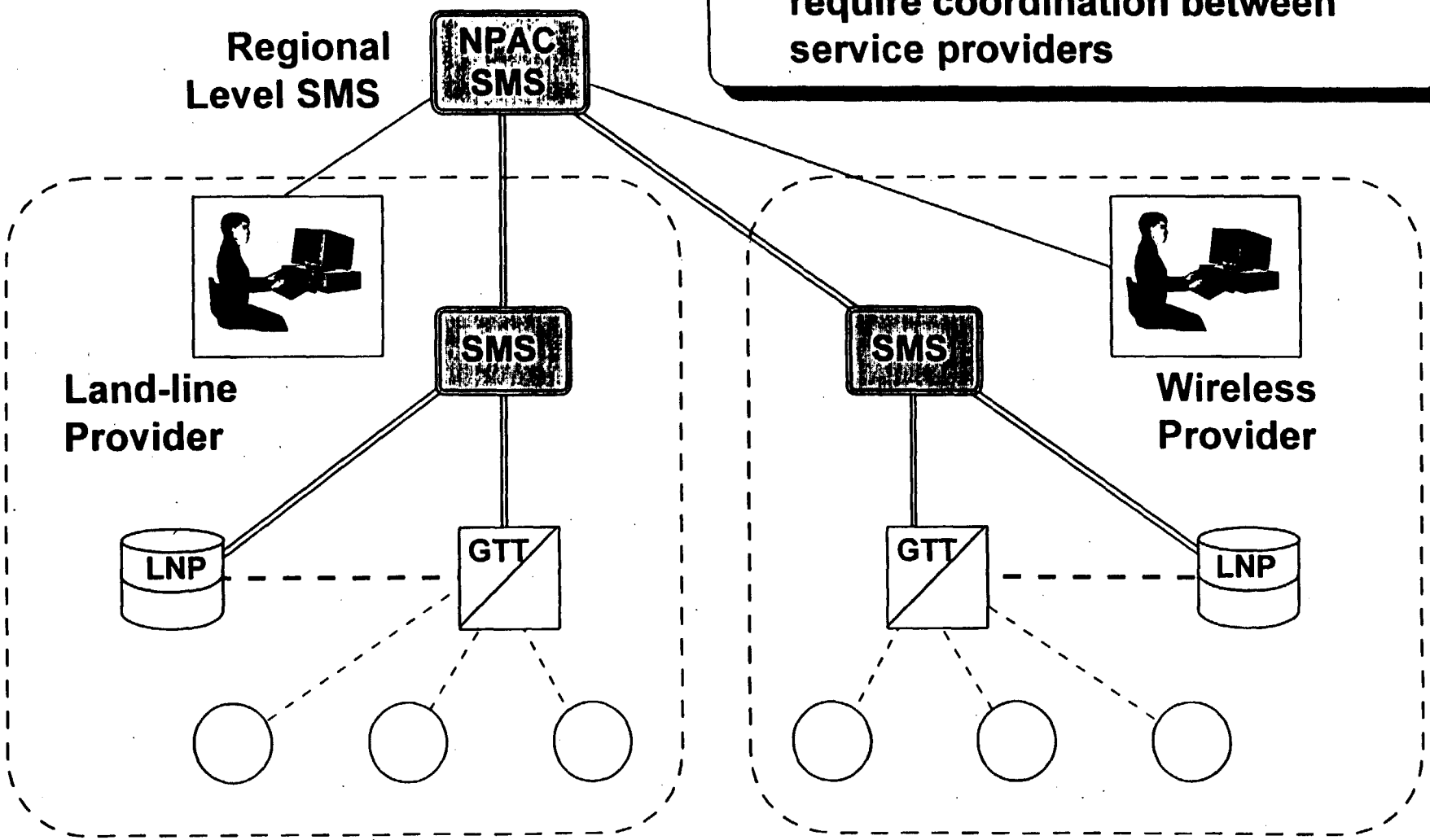
- ★ LRN (CCPN) is the preferred method in many fora
- ★ Preferred method for interconnection to wire-line or wireless
- ★ Requires LRN database managed at network level



Wireless Number Portability:

Regional Level SMS

★ **Both IS41-C and IS41-B solutions require coordination between service providers**



Wireless Number Portability:

Summary

- ★ Global Title Impacts
  - » Internetwork Services
  - » Registration
  - » Routing
  - » Looping Prevention
  - » GTT databases
  - » GTT administration
- ★ LNP Database
  - » Engineering
  - » Administration
  - » Internetwork agreements
- ★ Routing Impacts
  - » Must do query for internetwork routing either in home network or pay for doing in interconnection network
- ★ Administration
  - » NPAC SMS interface
  - » Local SMSes
  - » Internetwork agreements

★ Bottom line, Wireless implementations are a matter of the correct technical solution applied against econimics