

***IFAST***

International Forum on ANSI-41  
Standards Technology

# **International Roaming Guide**

## International Roaming Guide

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### Disclaimer

This International Roaming Guide is informational in nature. It provides guidance to service providers regarding issues related to, and aspects of, International Roaming implementation. The information contained here should not be construed as implementation mandates. Service Providers should adapt the information to suit their unique telecommunications environment.

The International Forum on ANSI-41 Standards Technology (IFAST), as the authoring entity, disclaims any legal responsibility for the implementation of the information contained in the Guide.

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# 1 Introduction

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## 1.1 International Roaming

The definition of International Roaming in an ANSI-41 (TIA/EIA-41) network is complicated because roaming between countries that adopt the North American Numbering Plan<sup>1</sup> (NANP) is generally not a problem. However, unlike the Global System for Mobile Communications (GSM) standard, the ANSI-41 standard was not originally intended to support International Roaming and did not take into account conflicts with numbering plans and/or routing schemes in other countries that utilize ANSI-41 protocols (particularly those in South America and the Asia/Pacific Rim region.)

In the past, most of the problems associated with International Roaming were due to numbering assignments and different dialing plans. Recently, other issues affecting International Roaming have surfaced.

The International Forum on ANSI-41 Standards Technology (IFAST) actively tries to resolve such International Roaming conflicts. IFAST members work to facilitate ways of supporting International Roaming and resolve many related issues on a consensus basis. An example of this effort is the assignment of International Roaming MINs (IRMs) and System Identifiers (SIDs) that enables carriers to realize the benefits of International Roaming and motivates others to find efficient and reliable ways to enhance International Roaming.

At the IFAST-9 meeting, IFAST members recognized the need for a set of recommendations and guidelines to help carriers—who were interested in providing International Roaming to their subscribers—become more knowledgeable about the issues/problems and the resolutions. The primary purpose of this document, the International Roaming Guide (IRG), is therefore to provide, to all carriers using the ANSI-41 standard worldwide, a description of some of the issues relating to International Roaming. The lessons learned, along with input from carriers who have dealt with these issues, may help other carriers benefit from the experiences, and find common approaches or solutions to the challenges facing International Roaming implementation.

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<sup>1</sup> For example, roaming between Canada and the United States of America.

## 1.2 Scope

This document describes some of the issues, challenges and concerns related to International Roaming and, where possible, suggest how carriers can deal with them effectively. However, it is not intended to serve as a standard or to provide a process for implementing International Roaming. Ideally, the need for this document will diminish as standards for supporting International Roaming evolve and carriers implement them.

## 1.3 Issue Categories

The issues covered in this IRG are classified into the following categories—new issues may be included in these categories, or new categories may be created if deemed necessary:

- Numbering Issues.
- Dialing Issues.
- Fraud Issues.
- Billing Issues.
- Signaling Issues.
- Services Issues.
- Miscellaneous Issues.

## 1.4 Issue Subsections

Each issue associated with International Roaming has subsections:

- **Description** – This subsection identifies the issue associated with International Roaming.
- **Resolution** – This subsection details the specific concerns and alternatives that have been tried by service operators to resolve the issue.
- **Recommendation** – This subsection provides the recommended solution—if it exists—for the issue, as recommended by IFAST members.

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## 2 Numbering Issues

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### 2.1 International Roaming MIN (IRM) Assignment

#### 2.1.1 Description

The Mobile Identification Number (MIN) is a number to identify a wireless subscriber or mobile terminal. These numbers are assigned to every mobile in a network or to newly programmed mobiles. However, there are International Roaming networks that may have a MIN range conflict with the MIN assigned to the roaming subscribers.

For example, a MIN 2022441234, assigned to a subscriber in Washington, DC in the US, may look like a MIN assigned to a Brazilian subscriber. When the US subscriber roams into Brazil, he/she will not be able to register with this MIN on the Brazil network due to the MIN conflict. To overcome this problem, a unique MIN, which is not in conflict with another MIN range, must be assigned to the international roamer. This MIN may be stored in a separate NAM in the mobile terminal and used only for roaming, or may be assigned as the primary MIN for the mobile terminal.

#### 2.1.2 Resolution

An International Roaming MIN (IRM) is a unique MIN using the format of 0XX-X+6D or 1XX-X+6D, where X is a digit between 0 and 9, inclusive. IFAST is responsible for assigning the 4-digit IRM Network Identifier prefixes (0XX-X or 1XX-X) to a carrier and the assigned carrier allocates the last six digits based on their requirements.

Thus, an IRM Network Identifier contains one million unique numbers. Each IRM Network Identifier is uniquely assigned to identify each carrier interested in providing International Roaming and these unique identifiers can be each assigned to a carrier anywhere in the world.

When assigning IRM Network Identifiers, IFAST tries to ensure that these numbers are not used by any other entity or applications that may conflict with International Roaming and posts the latest assignments on its Web site ([www.ifast.org](http://www.ifast.org)) for public access. However, IFAST does not have the intent to enforce compliance; rather, it encourages carriers and other interested entities to follow its guidelines with full cooperation, and



to solicit their governments to ensure that MINs assigned locally or internationally do not conflict with the IRMs assigned by IFAST.

### 2.1.3 Recommendation

More than half of the IRM Network Identifiers have been assigned—at a rate much faster than expected—and some numbering conflicts are already beginning to appear (although many have been resolved.) Carriers must recognize that IRMs are a short-term solution to a long-term problem, and should try to define and implement other global standards—such as International Mobile Subscriber Identity (IMSI) and Global Title Translation (GTT)—for International Roaming

## 2.2 MIN/MDN Separation

### 2.2.1 Description

The Mobile Identification Number (MIN) and Mobile Directory Number (MDN) are often programmed with the same value, or two closely related values. This simplifies the management of MIN codes. However, because of an FCC mandate, all the wireless carriers in the USA must implement Wireless Number Portability (WNP) by November 24, 2003. The greatest impact of WNP is the separation of the MDN from the MIN.

The separation of the MDN and MIN has been chosen as the method to retain the ability to identify the home service provider of a wireless subscriber while still enabling the MDN to be portable. All the wireless carriers who roam must do MIN/MDN separation for WNP. Even non-porting wireless service providers, whether they are outside the top 100 MSAs within the US or international, may have to separate the MIN and the MDN to support roaming for porting wireless service providers inside the top 100 MSAs.

The potential roaming impacts are:

- Delivery of calling number/calling name, automatic callback, and callback number on E911 calls; and
- Generation of correct calling party number for toll billing by the inter-exchange carriers, billing records and various operator services.

MIN/MDN Separation has a number of benefits for the MIN resource:

- More efficient use of numbering resources.
- Allocation of larger sized blocks of numbers.

- Removal of constraints imposed by numbering plan.
- Avoidance of MIN reprogramming when numbering changes occur.
- Smaller roamer agreement tables.

### 2.2.2 Resolution

MIN/MDN separation requires wireless carrier to:

- Update the billing systems to ensure that they consistently and correctly use either the MIN or MDN.
- Identify mobiles via the MDN and not the MIN to emergency services or long distance companies.
- Allow roamer ports to use the MDN and not the MIN.
- Upgrade the databases and switches to support both the MDN and the MIN.

The US wireless industry is currently implementing MIN/MDN separation through the creation of an MBI assignment authority.

### 2.2.3 Recommendation

An Operations Team should be formed to implement the necessary upgrades and/or modifications to the network elements, message-processing system, billing records and customer care facilities as recommended by the industry, and perform the internal testing upon completion of the implementation. This Team should also coordinate with roaming partners to conduct the inter-carrier testing in accordance with a mutually agreeable test plan.

It should be noted that the use of the IRM does not force MIN/MDN separation, as it may still be possible to derive one number from the other by deleting and prefixing digits. However, the use of the IRM may allow an opportunity to introduce this separation while network changes are being made. The advantages of implementing MIN/MDN separation are important enough that IFAST recommends it highly.

## 2.3 SID Assignment

### 2.3.1 Description

A System ID (SID) is a 15 bit (0 through 32,767) number that is transmitted by a base station to identify a wireless license. The upper 16-bit range (32,768 through 65,535) is reserved to be used on the network for different purposes—such as a Billing ID (BID)—and is therefore not available for use on the radio interface.

SID numbers are allocated to countries in accordance with the guidelines provided in the TIA Standard TSB-29. However, there are SIDs in use that are not within the assigned block—thus creating SID conflicts—some of which have been reported to the IFAST community.

### 2.3.2 Resolution

IFAST is responsible for the management of the SID resource and posts the assignments of SIDs, and all known SID conflicts, on its web site ([www.ifast.org](http://www.ifast.org)). It is imperative that carriers and regulatory agencies cooperate and comply with IFAST assignments, and report conflicts.

### 2.3.3 Recommendation

IFAST is attempting to accumulate information on the actual usage of SID blocks around the world. If there is information on the usage of SID codes in any country, or by any other entity, the IFAST Secretariat (ATIS) should be contacted immediately by using the contact information given at the end of this document.

## 2.4 International TLDN

### 2.4.1 Description

A Temporary Local Directory Number (TLDN) is a number used to route calls to a roamer on a visited ANSI-41 system. As the name implies, this directory number is local (up to ten digits in the North American Dialing Plan) in nature and is assigned only for the duration of call setup.

ANSI-41 standards were originally developed to support the North American Dialing Plan and only 10-digit TLDNs were allowed in the early implementation of protocols. As currently implemented in the wireless network, the TLDNs do not include a country code, thereby making a

TLDN unable to access international numbers. However, systems that support the International TLDN cannot successfully transmit this format to a system that does not support it, and must use the National TLDN format instead. Some systems have supported International Roaming by using the National TLDN format through regional agreements and special conversion. These techniques have proved useful when used on a small scale. As the number of roaming partners increases, they become less practical.

### 2.4.2 Resolution

As ANSI-41 continues to grow and support calls that cross national boundaries, the need for a TLDN that supports fifteen digits to accommodate the Country Code (CC) is becoming important. Revision D of ANSI-41 calls for the implementation of an International TLDN that contains a Nature of Number parameter that distinguishes between national and international formats.

The International TLDN will provide the following benefits:

- To distinguish between a TLDN of national and international format.
- To provide an international unique TLDN between two countries with different numbering plan administration.
- To ensure call delivery in an International Roaming environment.

The implementation of an international TLDN requires that the visited network populate the TLDN parameter with the Nature of Number field set to Value 1 corresponding "international." The TLDN must be in E.164 format, while the home network must recognize also the E.164 format and have the capability to check the Nature of Number field in order to route the call. Hence, prior to implementing TLDN, ANSI-41D features and capabilities must be in place.

### 2.4.3 Recommendation

The resolution to implement an International TLDN up to fifteen digits by activation of the ANSI-41D parameter in the wireless networks was agreed at the IFAST14 meeting in Lima, Peru.

It is important to note that IS-41 Revision C was published with the Nature of Number parameter *incorrectly* specified as Value 0 for International and 1 for National. Carriers must ensure that only the ANSI-41D encoding of this parameter field is used.

## 2.5 IMSI Implementation

### 2.5.1 Description

The MIN to identify a mobile subscriber/station was developed with only the North American Dialing Plan in mind and was originally intended to be used in the United States and Canada. It does not have any provisions for distinguishing between countries, nor does it conform to any international numbering plans. Due to MIN conflicts, and the fact that a 10-digit MIN cannot provide the necessary information needed to facilitate International Roaming on a global scale, a better Mobile Identifier is becoming increasingly important. The International Mobile Subscriber Identity (IMSI) has been considered such a Mobile Identifier.

### 2.5.2 Resolution

An IMSI is a 15-digit number defined by ITU recommendation E.212. It has a 3-digit Mobile Country Code (MCC) that is assigned to a single country, and a 1-3 digit Mobile Network Code (MNC) that is unique to a carrier in that country. The IMSI functionality has been used and proven effective in the GSM world—it has always been supported by GSM standards. It is currently supported by CDMA standards from IS-95 Revision A, TDMA standards from IS-136 Revision A and for intersystem operations, if the recommendations of IS-751 are incorporated in a TIA/EIA-41-D system. However, IMSI is not supported in any analog standards.

In the US, a special IMSI format (310+00+MIN, where 310 is the MCC, so-called “MIN-based IMSI”) has been defined considering backward compatibility. Although the concept of the MIN-based IMSI is useful in other countries, it is not universally possible to designate “00” as the IMSI\_11\_12 (first two digits of MNC) for the MIN-based IMSI for all the MCCs since the MNC numbering plan is a national matter. If this technique is not universally supported, when a mobile terminal with the MIN-based IMSI sends a registration request to the HLR, the HLR may not be able to recognize the ANSI-41 IMSI parameter and the registration may fail. A list of MIN-based IMSIs should be shared among roaming partners and programmed in their Mobile Switching Centers (MSC) to solve this problem.

### 2.5.3 Recommendation

Currently, although IMSI is considered an ideal long-term solution, because of lack of support in the analog systems and incorrect implementation in some early digital mobiles, it is unlikely that IMSI will be imple-

mented in the immediate future. However, as the demand for International Roaming increases and availability of IRMs decreases, carriers may be forced to implement IMSI as the only viable alternative to the MIN problem. Further, since the MNC numbering plan is a national matter, the value of the IMSI\_11\_12 of the MIN-based IMSI is determined country by country. It is recommended that the values be reported to the IFAST if the MIN-based IMSI is used, and that the digits "00" are used for the MNC if allowed by the national IMSI numbering plan.

## 2.6 MSC Identity

### 2.6.1 Description

The identity of the MSC/VLR is registered at the HLR during the location registration procedure and used to send a message asking for the TLDN. Three parameters, PC\_SSN, MSCID, and MSCIN (MSCIdentification-Number) are defined for this purpose in the ANSI-41. There were uncertainty and confusion as to how these three parameters should be used within an International Roaming environment.

### 2.6.2 Resolution

The PC/SSN should not be used for International Roaming because the numbering plan of the PC/SSN is a national matter, while the MSCID includes the market ID field, whose value is usually the SID, and the MSCIN is an E.212 number (IMSI). The MSCID is a mandatory parameter in the REGNOT and the MSCIN is optional. However, either the MSCID or the MSCIN can be used to identify MSC for International Roaming.

Should MSCID be used, a lower layer signaling conversion function may be required in cases where the lower layer protocol—e.g., Mobile Transfer Point (MTP)—is different, by for example, maintaining a conversion table between ANSI point code and ITU-T point code. This table must be designed efficiently such as in the way of the cluster entry. If the MSCIN were used, Signaling Connection Control Part (SCCP) GTT should also be supported. The introduction of the SCCP GTT has a big impact on the system, requiring extensive international coordination and therefore the use of MSCIN should only be considered as a long-term solution.

### 2.6.3 Recommendation

The MSCID be used as the identity of MSC in short-term, and the MSCIN for a long-term solution.

## 2.7 DPC Assignment

### 2.7.1 Description

To address SS7 messages, the ANSI-41 protocol uses an ANSI formatted Destination Point Code (DPC) for routing of the call to the final destination. These DPCs addresses are assigned in accordance with the ANSI SS7 Point Code Assignment Guidelines, which are developed and maintained by Committee T1. The addressing to establish mobility interconnection between NANPA (North America Numbering Plan Area) based operators and other countries' operators also utilizes ANSI DPCs.

### 2.7.2 Resolution

The proposed IFAST solution is to allow DPCs to be assigned to the non-NANPA operators in other countries, and request that Committee T1 modify the SS7 Point Code Assignment Guidelines by allocating a block of Point Codes for such purpose.

Another alternative is the implementation of the GTT capability in gateway switches. GTT is an indirect addressing method, a function provided by the SCCP specified in ANSI and ITU, where the addressing identity is placed in a field named Global Title. A Global Title is a virtual/logical indirect address identifying a telecom resource and translated into a SS7 Point Code, which is a numeric direct address to the destination or other intermediate node. GTT eliminates the need for the originating nodes to determine where a message should be routed. Instead, the Signal Transfer Points (STPs) determine the routing based on the type of query and some identifying numbers like a subscriber's MIN, a MDN, or other type of number. The routing, based on Point Code, which is provided to the Destination Point Code (DPC) field, is based on analysis of the identity provided from the user part. There may need to be several Global Titles based on the same type of number for different purposes.

The TIA TR-45.2 subcommittee has developed a list of standards relevant to Global Titles for ANSI SS7 systems with related information on ITU SS7 Global Titles (Ref: IS-807 and TSB-29), and has expressed willingness to expand this list to include information on the Global Titles provided in other countries.

Global Title Translation provides the following tangible benefits:

- To decrease the costs of administering national/international Point Codes.

- Reduce the number of digits analyzed in SPs and STPs in the visited network, thereby increasing routing analysis performance in each involved node.
- To remove the administration of MIN/IMSI ranges and related information from visiting MSCs (Mobile Switching Centers) and VLRs (Visitor Location Registers).
- To use national unique Point Codes instead of coordinating Point Codes on international level, with each country maintaining its own Point Code administration.
- To simplify the interoperability between ANSI and ITU SS7 networks, as the identity used in the Global Title field is common to both signaling standards.
- Increase the robustness in the network, since any changes to cooperating networks will not affect the home network.

### 2.7.3 Recommendation

IFAST submitted a contribution to the appropriate Subcommittee within Committee T1 (T1S1.3) and proposed a modification of the current Point Code assignment rules so that operators in other countries are entitled to have unique DPCs assigned to themselves in order to provide International Roaming services with the NANPA based operators in a fair and competitive environment. The Committee T1 agreed to this proposal and modified the Point Code assignment rules for this purpose. A new large network code has been designated to permit non-US operators to request small blocks of point codes—for equipment and gateways.

In view of the long-term implication, there is a need for another feasible alternative, particularly in view of the long-term implication and rapid expansion of International Roaming on a global basis. Implementation of the GTT capability in the gateway switch is the only long-term alternate solution that should be considered.

The implementation of GTT requires that the following conditions be met:

- Compliance according to standards as listed below:
  - ANSI-41D Cellular Radio-telecommunications Intersystem.
  - IS-807 TIA/EIA-41D International.
  - ANSI T1.112 Signaling System No.7, SCCP Functional Description.



- The signaling network nodes such as MSC/VLR, HLR (Home Location Register), MC (Message Center) and STP/International Gateways must have GTT capability.

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## 3 Dialing Issues

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### 3.1 Uniform Dialing Plan

#### 3.1.1 Description

A uniform dialing plan is needed to support services needed by subscribers while roaming. These services include:

- Local Customer Service.
- Home Customer Service.
- Directory Assistance.
- Emergency Calling.
- Long Distance Operator.

Routing should be, if possible, to a service that can speak the preferred language of the subscriber (as transmitted by ANSI-41).

#### 3.1.2 Resolution

Being Revised.

#### 3.1.3 Recommendation

Being Revised.

### 3.2 Emergency Number Dialing

#### 3.2.1 Description

ANSI-41 is used in various countries where different languages are spoken, with a variety of dialing plans. International roaming subscribers are usually not aware of the required digits to dial, or procedure to follow, to reach an emergency operator in a foreign country. Being able to easily, and consistently, dial the correct emergency number while roaming is probably the most important safety feature needed in the ANSI-41 protocol.

### 3.2.2 Resolution

There are two possible solutions:

- Create a Global Emergency Number (probably not likely, although a technically simple solution).
- Use the “Emergency bit” on the radio interface (e.g. TIA/EIA-136) when either a special emergency function is selected or a sequence of digits recognized by the phone as an emergency call is dialed. This method works except in places where neither the home digits nor the emergency bits are supported.

### 3.2.3 Recommendation

Being Revised.

## 3.3 Optimal Routing

### 3.3.1 Description

Terminating calls to roamers in foreign markets are more complicated and expensive than necessary, which involves routing the call to the home MSC and then to the serving MSC, since callers do not usually know where the mobile subscribers are. For example, if a caller from Brazil dials the number of a Mexican subscriber roaming in Brazil, the call must get to the Home MSC (Mexico) and then routed to the serving market (Brazil) even if the caller and the called roamer are standing next to each other.

### 3.3.2 Resolution

Possible solutions include:

- Use of the roamer port (works only with mobile-to-mobile calls, and requires knowledge of the local roamer port number by callers).
- Redirection via ISUP or ANSI-41 solution by means of the Release-To-Pivot capability, in accordance with the national and international SS7 standards
- In-band signaling, as proposed for tandem-free operation

**3.3.3 Recommendation**

Being Revised.

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## 4 Signaling Issues

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### 4.1 ANSI-41/IS-41 Backward Compatibility

#### 4.1.1 Description

In order to ensure that operations between various levels of IS-41 are workable, any mixture of IS-41 Rev. A (including mandatory TSB-55), IS-41 Rev. B (including mandatory TSB-41), IS-41 Rev. C, TIA/EIA-41 Rev. D (ANSI-41-D) and, in future, TIA/EIA-41 Rev. E and so on, backward compatibility will be very essential to maintain service quality and cost control. Compatibility must support partial implementations, particularly of IS-41 Rev. C and later, since full implementations may not be possible.

#### 4.1.2 Resolution

Being Revised.

#### 4.1.3 Recommendation

Being Revised.

### 4.2 SS7 Related Roaming Issue

Being Revised.

#### 4.2.1 Description

Being Revised.

#### 4.2.2 Resolution

Being Revised.

#### 4.2.3 Recommendation

Being Revised.

## **4.3 ANI Compatibility**

Being Revised.

### **4.3.1 Description**

Being Revised.

### **4.3.2 Resolution**

Being Revised.

### **4.3.3 Recommendation**

Being Revised.

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## 5 Fraud Issues

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### 5.1 Fraud In International Roaming

#### 5.1.1 Description

Fraud has been one of the major obstacles to International Roaming and is an expanding problem in the wireless industry. It would be difficult to grasp the full impact of fraud since operators do not consistently or uniformly track fraud losses. The Cellular Telecommunications Internet Association (CTIA) estimates fraud losses in North America in 1996 were \$900M, or about 3.6% of industry revenues. Although fraud losses have been steadily declining, fraud still represents a serious threat globally.

Fraud has taken different forms and is continuously changing its nature. There are generally three types of Fraud:

- Cloning Fraud – Changing the ESN after every call (tumbling) has been largely replaced with cloning of the phones. Cloning fraud occurs when the identity of the mobile phone is stolen. When the mobile unit presents its identity to the network, a criminal scanning the airwaves can steal the phone's identification numbers, the ESN and mobile number, and then program them into another phone. When this cloned phone is used, the charges appear on the legitimate subscriber's bill.
- Subscription Fraud – Subscription Fraud is another type of wireless fraud, which occurs when a criminal uses fraudulently obtained customer information or a false identity to subscribe to wireless service without any intention of paying for service. True name subscription fraud occurs when a criminal steals a person's identity. GSM operators in Europe have suffered significant subscription fraud losses for years while enjoying protection against cloning fraud through the authentication capabilities inherent in their digital technology. In addition to subscription fraud, operators are experiencing hacking into their networks to obtain access to confidential information, such as MIN/ESN combinations. Many operators are unaware of where their weaknesses are and should perform external testing to determine their vulnerabilities.
- Employee or Reseller Agent fraud – Employee or Reseller Agent Fraud is another area affecting operators and the one that does not lend itself to a technical solution. Selling MIN/ESN combinations to

criminals is a tempting opportunity for some employees to capitalize on their access to valuable information. Operators can screen employees before hiring, implement access controls and increase internal security. This type of fraud is anticipated to increase, as technical fraud becomes a more difficult and costly type of fraud to perpetrate.

### 5.1.2 Resolution

Three Fraud control technologies are deployed today in combating cloning fraud, as described below:

- Roamer Verification – Roamer Verification and Reinstatement (RVR) systems intercept roamers and forward them to a customer service representative to verify their identity before allowing them to make calls. Subscribers may be required to set up a code to enter the network. The subscribers are then required to enter a Personal Identification Number (PIN) or voice print password to use the network in selected high fraud markets. The home operator generally pays for this service, although the cooperation of the serving operator is required. Many operators have implemented PINs in high fraud markets as a stopgap solution until authentication is deployed. However, cloners who capture both the MIN and the PIN from the airwaves using scanners and other devices have compromised PINs. Additionally, the set up and ongoing use of PIN is rather intrusive on the customer. Because of these issues, operators have demanded improved fraud prevention technology, which can be deployed with limited customer involvement.
- RF fingerprinting – RF fingerprinting is a technique in which each phones unique signals fingerprint is matched with its MIN/ESN combination. This match is confirmed before each call is connected. This technology is extremely effective and transparent to the user, but expensive to implement, as special hardware must be installed at each cell site. The US government originally developed RF fingerprinting, and it has been primarily implemented in major U.S. markets by larger operators.
- Authentication – Authentication requires a specially equipped authentication-capable phone with an activated Authentication-Key (A-Key) and an Authentication Center (AC). When a call is made, the network challenges both the handset and the AC to perform independent calculations using an encrypted algorithm and shared secret data. The results must match in order for the user to be authenticated and service to be provided. This process is instantaneous and transparent to the user. Since only the answer is broadcast over the network, fraud criminals cannot steal the important authentication in-



formation. Most operators in the U.S. have successfully deployed this technology in more than half the major American markets. Although the number of authentication-capable phones is growing rapidly, the majority of subscribers still have phones that cannot be protected by authentication and it may take years to replace the embedded base.

### **5.1.3 Recommendation**

Profiling systems address all types of fraud by providing visibility into what is happening on a carrier's network. These systems detect fraud and act as an early warning system. They monitor information from switch and billing systems, and compare actual usage against the parameters of a customer's usage profile. When usage falls outside these defined parameters, a case is flagged and assigned a severity level. A fraud analyst then investigates the case. The skill and experience of the analysts is a factor in the success of this method.

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## 6 Billing Issues

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### 6.1 International Roaming Billing Issues

#### 6.1.1 Description

In order to reap the financial rewards that International Roaming can deliver, an operator must have an efficient process in place for the exchange of roamer billing records, validation or editing of those records, and systems for calculating and reporting financial positions with its roaming partners. Other elements that are essential to inter-operator relationships include record conversion to the appropriate billing record format, wholesale and retail rating of records and ultimately financial settlement with the exchange of funds with roaming partners. Managing hundreds of roaming agreements with roaming partners in different countries and time zones that are potentially utilizing different billing record formats and operating on different settlement cycles poses a significant administrative problem for any operator interested in International Roaming.

#### 6.1.2 Resolution

Being Revised.

#### 6.1.3 Recommendation

Being Revised.

### 6.2 Billing Standards

The Transferred Account Procedure (TAP) is the roamer billing standard used in GSM. The equivalent in the ANSI-41 is CIBER. The Transferred Account Data Interchange Group (TADIG) is responsible for the development and documentation of the TAP standard, which business strategy and direction is provided by the Billing and Accounting Rapporteur Group (BARG).

CIBER was developed to support:

- Separate air, toll and tax fields.

- Multiple market identifiers for one carrier via the use of Billing Identifiers (BIDs).
- The Data Clearinghouses as the Authorized Receipt Points (ARPs) for file and record level editing and validation, and provides certification thus eliminating the one-to-one billing testing done between GSM operators.
- A process that enabled the “batching” and return of invalid, unbillable records and the forwarding of “good” data.

TAP was originally designed for the European community, and later its use was expanded to other continents, when GSM was adopted in the United States. At that time, operators received a license for regional markets—therefore intra-country roaming was established. For a number of years, there were, at most, two to four providers in a country, therefore operators built or purchased their own billing systems and did not outsource to a billing vendor. Since operators had their own billing systems, data clearinghouses were initially used only for file validation and routing.

TAP was primarily developed to support:

- Inter-country level “international” roaming only—no market identifiers were created.
- Use of a currency equivalent called the SDR (Special Drawing Rights). Rules exist for how to apply the exchange rate of currency type to the SDR.
- International identifiers known as Public Land Mobile Network (PLMN) codes – comprised of a 3-character ITU customer ID. This number is distinct and separate from the customer phone number.
- One charge field with VAT taxes calculated as a percentage.
- Voice and data utilization.

There are multiple TAP standards in use. TAP 2+ is the de facto standard for most of the world, but some operators still use TAP 1 and TAP 2. North American GSM operators use NA-TAP2 (North American TAP2) which has BIDs and separate fields for air, toll and tax. Most operators rely on the data clearinghouses for the conversion of one version of the standard to another. Conversion ‘between’ TAP and CIBER is also done by data clearinghouses as well as by some billing vendors and operators. Over the last few years, the TADIG group, with approval of the BARG, has developed and adopted a robust editing process, and just recently completed work on a Record level reject and returns process. Lastly, they have frozen the specification for TAP 3, which utilizes the ASN.1 stan-

standard and included the use of BIDs and the separation of air, toll and tax. TAP 3 is expected to be in use industry-wide by March 31, 2000, and the Rejects and Returns process by September 30, 2000. Although the standard for TAP 3 is frozen, not all operators will adopt it, as GSM allows for bilateral agreement on use of a standard. Operators in countries that do not utilize the new fields may agree to continue exchanging TAP 2 or TAP 2+.

**6.2.1 Record Conversion**

One of the important challenges that carriers face is conversion of incompatible call data records. The TAP formats (TAP 1, TAP 2, TAP2+ and NA TAP 2) have differences with CIBER records. The following is a brief list of the major differences between CIBER and TAP record formats that could cause carriers/operators problems when attempting inter-standard roaming and record conversion. This matrix is very high level and not intended to be record translation type information. It only outlines some major differences between CIBER and TAP business functionality and data usage. For the purpose of this document, NA TAP 2 is a hybrid of CIBER and TAP 2. As a result, it contains enough information to be translatable to both CIBER and TAP 2, and is not referenced in the matrix.

<i>CIBER</i>	<i>TAP</i>
Rejects and Returns process in place.	No Rejects and Returns process today.
On rejects, individual records or whole files can be rejected if failing edits.	If a file contains an error, the whole file is rejected. Individual records in the file are not rejected, although this is changing. Some operators are now doing record-level rejecting, but there is no process in place to return rejected records to the submitting operator.
The industry settlement period is mid-month at the 15 <sup>th</sup> of the month.	The industry settlement period is at the end of the calendar month.
Uses 10-digit MIN to identify subscriber.	Uses 15-digit IMSI to identify subscriber. Used similar to an account number. MSISDN is the actual dialable number of the subscriber.
Able to separate air and toll charges and to specify multiple types of taxes.	Only 1 charge filed so separation of charges is not possible. In addition, there are not multiple tax fields. (A new record has been defined to provide a breakout of toll charges, but it is not currently being used and probably will not be used in the future.)

All charges on records indicate an actual dollar amount.	All charges are in Special Drawing Rights (SDR) and require conversion to the country's currency. In addition, negative charges (credits) cannot be handled.
Time duration fields on the records are reported in minutes and seconds.	Time duration fields are reported in seconds only.
US carriers rely heavily on SID/BID information in reporting and segmenting of their markets.	SID/BID does not exist. The PLMN or Operator code is the lowest level of distinction. Although MSCID is on records and could be used as a distinction for reporting, the MSCIDs do not necessarily denote geographic areas. Some operators set up their MSCs by criteria other than geographical location.
Time zones are indicated by a Time Zone Indicator.	Time zones are indicated by a UTC Time Offset (difference between local time and Greenwich Mean Time).

**6.2.2 Recommendation**

The integration of an operator's own in-house expertise with services offered by wireless billing vendors and data clearinghouses as described below will provide a solution to the above issues.

**6.3 Authorized Receipt Point, Rating and Conversion**

Automated services offered by billing vendors and some data clearinghouses can often receive and convert switch data to standard billing formats including CIBER and TAP 1, TAP 2, TAP 2+ and NA TAP 2. The clearinghouse acts as the ARP for the home operator in processing the billing records in the appropriate formats and if needed for inter-standard roaming, converts them to a different version used by the roaming partner. In the multiple clearinghouse scenarios, clearinghouses work closely together to exchange and reconcile data between themselves for their member operators. Today, five or so major clearinghouses serve wireless operators worldwide. The major clearinghouses should operate within mutually agreed-to processes enabling them to inter-operate smoothly on behalf of their member operators who roam together; operators do not need to have the same clearinghouse in order to have roaming arrangements with each other.

### 6.3.1 Validating or Editing

An important element of the clearinghouse function is editing or validation of records, providing additional revenue assurance for the member operator. The clearinghouse reviews data to ensure that it meets all CI-BER or TAP standards and provides a “clean data stream” for further processing and for use in reports that assist in the management and operation of roamer business. Most clearinghouses perform industry standard edits; some also perform other more specific edits—an example being roaming agreement edits. Additionally, most clearinghouses edit or validate at both the record level and the file level. File level edits cause the entire file or batch of call records to be rejected. Conversely, record level editing allows for individual records to be edited and rejected from the file and for the rest of the records to be processed. Records that fail the validation process are sent back to the operator who submitted the data for correction and re-submission. The clearinghouse will also generate reports that provide information related to any files or records that have failed the validation and editing process for the operator to use for trouble-shooting and problem resolution.

### 6.3.2 Reporting

The clearinghouse is in the position to provide valuable reporting on roaming trends and revenues for management to manage their roaming business more effectively. In its processing cycle, the clearinghouse provides operators with important reports used for financial analysis by consolidating all accounts receivable, accounts payable, reject returns and analytical report data electronically. This process allows operators to monitor their roaming activity on a daily basis. The clearinghouse also provides data processing reports that typically go to the billing vendor of the operator. If properly monitored and acted upon, these daily reports provide information that can mean the difference between an efficiently run, profitable roamer business, and one that is at risk, victimized by operational problems and fraudulent roaming. During the processing cycle, the clearinghouse forwards records to the billing vendor for re-rating for subscriber billing. At the end of the settlement period, the clearinghouse performs its monthly processing and along with the monthly financial and analytical standard reports that are provided to the operators, it provides financial settlement information used by its own financial net settlement program. The clearinghouse also provides the reports that can be used by the operator for accounts receivable billing or that can be forwarded onto another financial settlement program.

Today, most operators use a clearinghouse and/or billing vendor instead of setting up the exchange, rating, conversion and reporting of billing information themselves. Roaming partners using the same billing format

don't experience the same strain on resources that inter-standard roaming can pose, but with the advent of satellite roaming and other newer technologies, the number of potential formats is increasing. Roaming agreements and settling roaming revenues between operators will become more complicated as international and inter-standard roaming grows. In terms of technologies, for example, CDMA operators will not necessarily restrict their roaming agreements to other CDMA operators and GSM operators are growing their scope to include roaming in TDMA markets today.

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## 7 Services Issues

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### 7.1 Support of Supplementary Services

#### 7.1.1 Description

##### 7.1.1.1 *Activation and Deactivation of Supplementary Services*

In general, Activation and Deactivation of Supplementary Services occurs when a mobile subscriber originates a call and enters digits that consist of a feature code string. The serving network receives the digits, analyzes the digits and triggers an ANSI-41 Feature Request or Origination Request operation to the HLR in the roaming subscriber's home network. Since the HLR in the home network receives the feature code string regardless of whether the subscriber is at home or roaming, the corresponding feature activation/deactivation is not affected by the subscriber's location. ANSI-41 allows the home network to specify that the serving network should play announcement(s) or tone(s) to the mobile subscriber upon completion of the feature activation/deactivation call. The announcement(s) or tone(s) indicate whether the feature activation/deactivation attempt was successful. They can be either standard or custom announcements or tones. Clearly, custom announcements should be avoided since there is little chance that the custom announcement specified is available in the visited network. Standard announcements or tones are preferred over custom announcements, although in the former case, the standard announcement played to the mobile subscriber may be in a foreign language, leading to the possibility that the subscriber may not know whether the activation/deactivation attempt was successful.

##### 7.1.1.2 *Invocation of Supplementary Services*

Invocation is generally Supplementary Service specific. The invocation can occur in the home network or occur in the visited foreign network. A home network example is invocation of the Call Forwarding Unconditional (CFU) feature. When a subscriber is roaming in a foreign network and has CFU activated, mobile termination attempts to that subscriber first arrive in the home network and are then forwarded to a previously registered forward number. The process of forwarding the call occurs in the home network. The visited foreign network is generally not involved in the mobile termination attempt.<sup>2</sup> A visited foreign network example is

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<sup>2</sup> An exception could occur if both the home and visited networks support notification (e.g., pip tone alert) when a call has been forwarded.



invocation of the Call Forwarding-No Answer (CFNA) feature. Here, the serving network needs to be aware that it should notify the home network when the subscriber fails to answer an incoming call. Specifically, the visited foreign network needs to know when to trigger an ANSI-41 Redirection Request message to the originating MSC in the home network.

## 7.1.2 Resolution

### 7.1.2.1 *Activation and Deactivation of Supplementary Services*

A general recommendation is to use tones to signal success or failure of feature activation/deactivation attempts, particularly while roaming internationally. A possible alternative is to use standard announcements when the ANSI-41 PreferredLanguageIndicator capability is supported in both the home and visited networks.

### 7.1.2.2 *Invocation of Supplementary Services*

Foreign network support of ANSI-41 triggers, both originating triggers and terminating triggers, requires consideration when assessing which Supplementary Services to offer subscribers wishing to roam internationally. Determination of whether origination and termination triggers are supported and if supported, which triggers are supported are important questions to ask during such an assessment. Some of this will depend on which version of IS-41/ANSI-41 is supported. For example, IS-41 Revision B does not support the TerminationTrigger parameter and instead, the serving network may need to trigger on the Calling Features Indicator, which is less flexible than the termination trigger parameter.

## 7.1.3 Recommendation

Determining which Supplementary Services to offer to international roamers requires careful assessment of the international serving network's services when compared to the home network's services.

The following provides general guidelines to follow during this assessment:

- Determine whether the foreign serving network supports the candidate Supplementary Services being offered to home subscribers that will roam internationally.
- Determine how the foreign serving network will notify the home HLR when a feature code string has been dialed by an international roamer.

- Agree on the method of notifying the international roamer of the outcome of an Activation/Deactivation attempt. If an announcement will be played, determine if the announcement will be understood by the subscriber.
- When Supplementary Services are invoked, determine whether the invocation takes place in the home or visited foreign network. The Supplementary Services invoked in the visited foreign network will require additional assessment. Differences in operation between the home and visited foreign network need to be understood and communicated to the international roamers.

Activation, Deactivation and Invocation of Supplementary Services should ideally function in the same way for subscribers served in their home network and subscribers roaming internationally. When this is not possible, either the Supplementary Service operational differences should be clearly identified and communicated to the international roamers or the Supplementary Service(s) should not be offered while subscribers are roaming internationally.

## 7.2 Deployment of Wireless Intelligent Network (WIN) Services

### 7.2.1 Description

Wireless Intelligent Network (WIN) is based on an open industry standard that enables equipment from different suppliers to interoperate successfully, and allows automatic roaming between various networks. WIN standard is part of the ANSI-41 family of standards, that allows additions of capabilities to any existing ANSI-41-based network within an open vendor environment, to ensure full interoperability with third-party products and services.

During the past several years, the wireless industry has been actively developing WIN capabilities that can be overlaid onto an existing wireless network. Network operators will be able to add WIN capabilities to any ANSI-41 based wireless networks by upgrading switching systems, typically with software upgrades, and installing new network elements such as Service Control Points (SCPs), Service Nodes (SNs), or Intelligent Peripherals (IPs). Further deployment of WIN additional capabilities will allow operators to create and deploy value-added services and enhanced features rapidly and at low costs.

The SCP platform in the WIN architecture reuses the hardware and software components deployed in a building block approach to reduce WIN

investment requirements while measurably reducing service time to market. The platform is scalable to allow capacity additions and flexible enough to provide multiple applications to meet changing subscriber and market demands. Innovative WIN solutions can now be deployed for networks based on AMPS, Code Division Multiple Access (CDMA), or Time Division Multiple Access (TDMA) technology to satisfy 800 or 1900 MHz requirements.

Most of the current Wireless services are switch-based (e.g. Call Waiting), Home Location Register (HLR) based (e.g. Call Delivery, Call Forwarding), or built on specialized platforms (e.g. Short Message Service, Prepaid Charging). Any or all of these existing services, plus many new services, can be built on WIN platforms, when they are migrated to SCP-based service logic. All of the specialized resources required to support advanced/value-added services can also be built on a stand-alone Intelligent Peripheral platform that allows the resources to be shared by all WIN services. This reduces the cost to the network operator as the costs of the resource are spread over more applications. Some of the resources that may be IP-based include announcement machines, speech recognition devices, store-and-forward equipment, or voice mail systems.

Essentially, the potential benefits of deploying a service based on WIN platforms are:

- New services can be created, implemented, tested, modified quickly;
- Seamless roaming can be provided at low costs;
- “Virtual Home Environment” can be offered in such that the customer experiences the same user interface in any market;
- Services can be tailored to small groups if desired.

It should be emphasized, however, that although the WIN will offer many benefits in terms of service offering, each of the service offerings must be assessed individually to determine whether WIN platforms or current technologies would be most suitable.

The WIN capabilities that have been developed so far are “service independent.” The following provides a list of potential services using WIN capabilities:

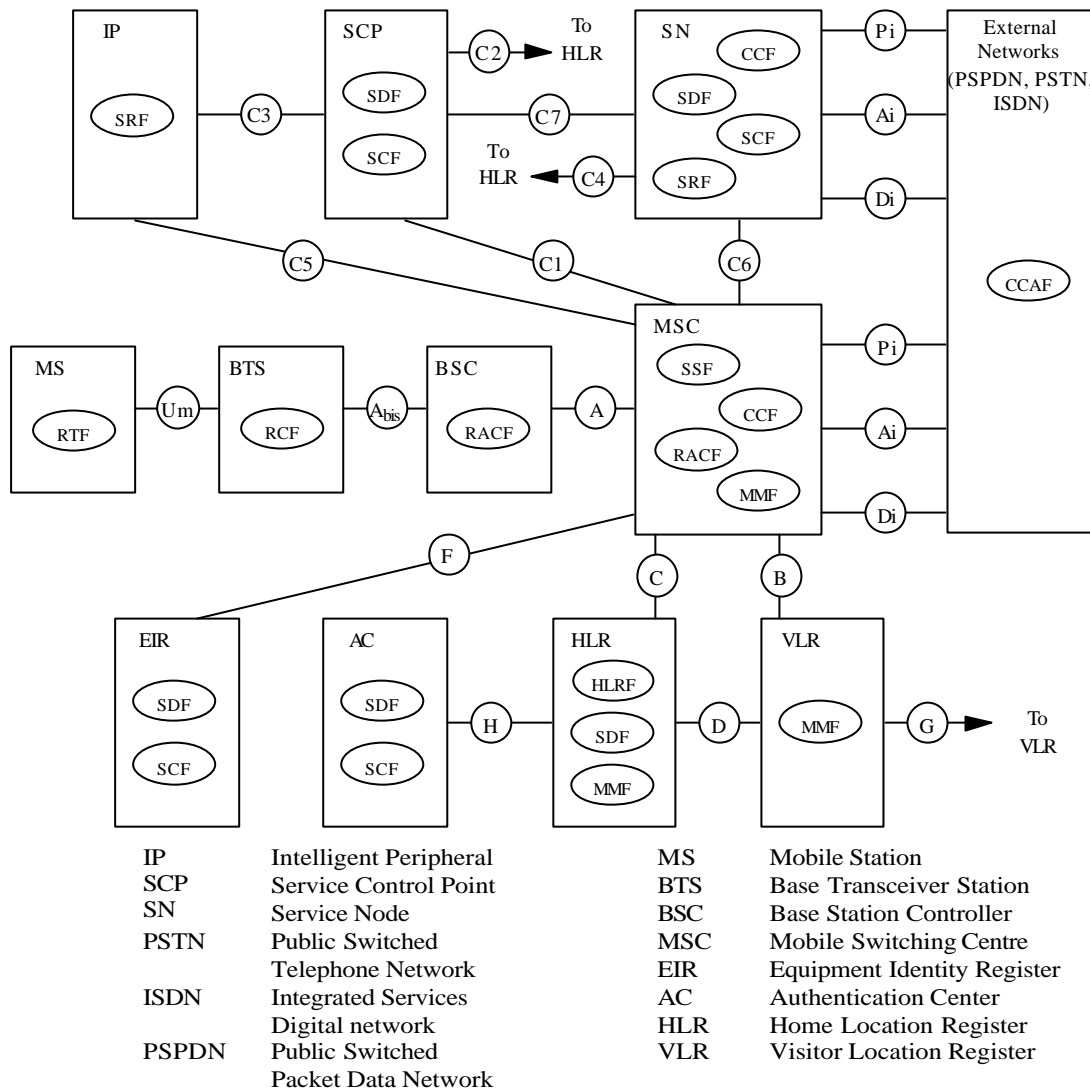
- Communication Management Services (CMS).
- Personal Numbering Services (a.k.a. Universal Access Numbers).
- Short Message Services (SMS).
- Traditional Intelligent Network Services.

- Prepaid Services.
- Wireless Group Conferencing Services.
- Mobile Virtual Private Network (VPN) Services.
- Information Messaging Services (IMS).
- Voice Recognition Services (VRS).
- Location Based Solutions Services.

## 7.2.2 Resolution

### 7.2.2.1 *Network Architecture*

One of the most important aspects of the WIN architecture is to “map” the functional entities to the physical entities. Once the industry has reached consensus on this mapping, equipment designers will have more flexibility in developing the appropriate platforms. It will be much easier to make platforms from different suppliers to inter-operate, and to allow service developer to specify the location of the functional entities more precisely. The following Network Reference Model illustrates an industry’s proposal of such a mapping.



7.2.2.2 Call Process

In a WIN-capable network, the switching platform uses WIN call processing triggers and ANSI-41 messaging to access a range of SCPs, IPs or SNs based intelligent network services. This switch trigger approach allows optimum use of network resources while giving wireless subscribers access to the services that could previously only be provided with wireline intelligent networks.

The WIN triggers initiate an array of services based on call-related activities including billing, feature requests, origination, termination, mobile and registration, etc. Origination and termination triggers eliminate the need for subscribers to enter complicated feature codes and can provide simple access to abbreviated dialing, voice dialing and other enhanced features or advanced/value-added services. Termination triggers route

callers to subscriber features such as incoming call screening, group ringing and distinctive ringing. Mobility-related triggers manage roaming, and mid-call triggers detect and confirm prepaid and other enhanced features or advanced/value-added services.

All calls are processed based on the standardized call models, called Basic Call State Model (BCSM). Inside the BCSM, Detection Points are defined to allow WIN service logic to control how a call is handled. Triggers are defined in the Detection Point in certain “point in call” for control transfer from the MSC to WIN service logic outside the MSC. Triggers can be defined for a single subscriber as well as a group of subscribers. Based on these capabilities, the WIN DFP provides distributed service control during call processing. Each subscriber can have a different set of triggers activated, or service logic active for each subscriber, so WIN features can be incredibly flexible.

During call processing, when a trigger is armed and the condition is met, the MSC will stop processing the call and launch a query to the WIN service logic as defined in the WIN standards. The WIN service logic will process the request and instruct the MSC to continue call processing according to the instruction. The standards define a set of network capabilities based on service drivers. Capabilities developed for these service drivers can be used to develop other WIN services.

### 7.2.2.3

#### *Technical Standards*

The engineering of WIN is a complex process, so the standards development work is divided into large packages. Each package contains a set of service independent “triggers” and/or “capabilities,” supporting a variety of services. Each network operator can then negotiate with its suppliers to develop the services as demanded by its local market.

The following three standards packages have been or are being developed by the TIA (Telecommunications Industry Association) TR-45 Engineering Committee:

- **Package 1 (WIN Phase I):** Defines the architecture, provides the first batch of triggers and capabilities for basic call origination and call termination, and supports services such as Calling Name Presentation, Incoming Call Screening and Voice Controlled services. The standards documentation has been published as TIA/EIA/IS-771.
- **Package 2 (WIN Phase II):** Adds the second batch of triggers and capabilities, and supports Charging Services such as Prepaid, Freephone, Premium Rate, and Advice of Charging. The standards documentation has been recommended for publication as TIA/EIA/IS-826 for Prepaid and 848 for other Charging Services.

- **Package 3 (WIN Phase III):** Adds the third batch of triggers and capabilities, and supports Location Based Services such as Location Based Charging, Fleet and Asset Management, Location Based Information Service, and Enhanced Calling Routing. The standard documentation is currently being under development and is to be published as TIA/EIA/IS-843.

To support the above packages for inter-systems operations, the TIA TR-45 Engineering Committee has also completed and published the related standards documentation as per ANSI-41 Revision D. WIN has impact to many of the messages in IS-41D. The fields required vary depending on a specific WIN feature.

### 7.2.3 Recommendation

#### 7.2.3.1 *Implementation Strategy*

Implementing WIN services in a wireless network requires:

- Upgrade MSCs to support WIN triggers
- Upgrade HLRs to support WIN triggers and service profiles
- Deploy WIN service logic programs

The service logic programs can be deployed on the Compaq SCPs, or on Ericsson Jambalas, or both. Another path would be to deploy an SCP and service logic programs from another vendor entirely such as Lucent or Nortel.

There are some unique challenges to deploying WIN-based services. The key difference between WIN services and conventional switch-based or HLR-based services is the use of WIN triggers. Conventional services do not employ triggers. WIN services require that the MSCs be upgraded to support WIN triggers.

Once the WIN upgrades have been installed in the network, it will be necessary to test the network to ensure that the new services work properly, that existing services have not been negatively impacted, and that the existing infrastructure can handle the increased SS7 traffic. Additionally, operators will have to work with their roaming partners to make sure that roamers can access their WIN services as they roam between networks.

The following specific issues must be carefully addressed:

- **Interaction with existing services:** The new WIN capabilities will be built on the existing SS7/ANSI-41 signaling protocol; hence, many of the existing ANSI-41 operations may have to be modified to support

these new WIN capabilities. As a result, the behavior of existing services based on SS7/ANSI-41 signaling protocol may be affected when WIN is introduced into a network. Detailed information is provided in the appropriate TIA WIN standards.

- **Signaling traffic volume:** WIN will result in a higher signaling volume — more signaling to control the complex services and network elements — that will increase as subscriber usage increases. Operators will need to test them under extreme conditions to ensure that adding new services does not compromise reliability. It may be appropriate to invest in a test platform for WIN in order to simulate the operation of the WIN call models. A good testing platform will allow Engineering to explore scenarios using different call scenarios or unusually high call volumes, signaling link failures and other network variables.
- **Interoperability while roaming with partners:** The industry has developed technical standards for WIN so that the equipment designed will be in compliance to these standards, in order to ensure interoperability between equipment from different vendors, and roaming between networks. Interoperability between the different types of equipment must be tested by network operators to ensure that they are compatible. This should be done on test platforms prior to deploying any WIN capabilities in the network.

For “partner” subscribers, automatic roaming and service consistency will be more difficult to achieve because the partners networks may employ the types of MSCs different from those of the home system.

There are three possible service creation options based on WIN platforms:

- **“Turn-key” solutions** provided by infrastructure suppliers using applications built for a particular platform. This approach will limit deploying only those services that this infrastructure supplier has developed.
- **“Off-the-shelf” solutions** offered by a variety of application developers, using applications developed for open platforms. This approach will provide as many services as are commercially available, but need more engineering and testing, as the burden will shift to interoperability testing between the switch and the application.
- **“Do It Yourself” solutions** based on the applications developed by operators using Service Creation Environment developed by software suppliers. This approach will allow creation of almost any services as demanded, however, there is a substantial learning curve involved for the designers, plus potential interoperability issues that may have to be resolved.



### 7.2.3.2 *Installation Requirements*

WIN installation affects the following network nodes:

- Mobile Switching Centers (MSC).
- Home Location Registers (HLR).
- Service Interaction Managers (SIM).
- Service Control Point (SCP) in support of the HLR and/or the SIM.

WIN, in general, does not affect the mobile units. Some features (such as Calling Name Presentation) may require display capabilities on the mobile, but most features will not affect the handset.

MSCs and HLRs must be upgraded to allow the triggers to be downloaded to the switch during the registration process. The HLR may also act in the role of a SIM, so the SIM itself is optional. Flexible Service Logic Programs (FSLP's) will also be needed, but the interface between the SIM and the FSLP is not standardized, and varies from vendor to vendor. It is also possible to have several SIMs in the same network offering different services. Each company will need to determine its needs and its engineering plans prior to installation. SIMs, or HLRs acting as SIMs, are complicated systems in their own right, and should be studied well before installation. Contacting vendors early for training is highly suggested.

The main communications path for WIN and roaming partners is SS7. WIN will work as long as SS7 connectivity exists, however, Global Title Translation and use of the IMSI is highly suggested to simplify the long-term support issues with roaming partners.

In general, WIN allows for a very quick reversal of the installation process by simply changing the user profile in the HLR. Additionally, WIN tends to reduce the need for new MSC and/or HLR loads since their action is always the same. New services require only a new FSLP (and perhaps a new SIM) to add this feature to the network.

The prerequisites required for WIN installation include GTT, ANSI-41D, IS-771. IMSI is also suggested to assist with GTT and to simplify services.

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## 8 Miscellaneous Issues

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### 8.1 Tandem Free Operation

#### 8.1.1 Description

Operation of mobile-to-mobile calls without intermediate voice coders is desirable. This requires compatible voice coders in each mobile, in-band signaling to control the voice coder modes, the ability to switch intermediate voice coders in and out of the call path dynamically, and the absence of intermediate network components, such as echo cancellers.

#### 8.1.2 Resolution

Being Revised.

#### 8.1.3 Recommendation

Being Revised.

### 8.2 Inter-standard Roaming Commercial Issues

#### 8.2.1 European and Asian GSM Carriers Roaming Into ANSI-41 markets

##### 8.2.1.1 *Roaming Agreements*

In the GSM Association, there is a standard roaming agreement between all carriers; Swiss law governs this roaming agreement. In the ANSI-41 world of North and South America, local law dictates the interpretation of roaming agreements.

Noticeable differences between standard GSM roaming agreements and standard ANSI roaming agreements are:

- The ANSI serving market may require that the GSM carrier become a member of the CIBERNET net settlement program.
- While roaming in ANSI markets, roaming subscribers will be charged for airtime on incoming calls.

- In standard ANSI roaming agreements, the home carrier is responsible for fraud on their MINs.

Each of these points may be negotiable on a carrier-by-carrier basis.

The GSMA GGRF is in the process of creating a universal inter-standard roaming agreement with ANSI carriers. However, many competing interests are holding back completion of this standard agreement.

Details that should be specifically included in the inter-standard roaming agreement:

- **Choice of Law:** Spell out specifically which state and national legal system will be used to judge and interpret the roaming agreements.
- **Liability:** Do not make assumptions about fraud liabilities. Spell out fraud notification procedures, response procedures, and ultimate financial responsibilities in the case of fraud.
- **Charges:** Spell out in detail exactly what charges and taxes will be imposed on roamers.
- **Technical Data distribution:** There are distinct differences between technical data requirements between the two standards. Define how both sides will communicate technical data.
- **Testing procedures and commercial acceptance** should be defined during roaming agreement negotiations.
- **Customer Care Operations:** What will be expected and required from each party in the way of roaming customer care.

#### 8.2.1.2 *Clearing and Settlement*

The ANSI-41 carriers will probably only have the capabilities to produce CIBER billing records (discussed earlier in this document) and send them to their designated ARP. The se carriers will know nothing about SDRs, and the records will be denominated in US Dollars.

The GSM carrier will either have to make arrangements enter into the CIBERNET clearing system and choose an ARP, or they will have to make arrangements with a third party to settle with the CIBER partner and convert the records to TAP records denominated in SDRs.

## 8.2.2 Engineering issues

### 8.2.2.1 *Numbering issues*

The ANSI-41 based carriers operate using a MIN identification system. For GSM subscribers to operate in the ANSI world, an IRM must be obtained and assigned to the subscriber.

Currently, IFAST is responsible for assigning the 4-digit IRM prefixes (0XX-X or 1XX-X) to carriers.

GSM carriers have the option to assume the responsibility of maintaining the IRM to IMSI relation, or delegate it to a third party to handle mobile application protocol translation.

### 8.2.2.2 *Protocol Translation issues*

Multiple protocol translation issues must be addressed by GSM carriers to roam with ANSI-41 carriers. The most obvious is the mobile application protocol or MAP. Although the function (and indeed even the messages) of ANSI-41 and GSM MAP are very similar, the actual structure of the protocol is very different.

To operate in the ANSI world, the GSM operator will be required to obtain a protocol translation device (or service). The operator of this device will be responsible for not only the translation of the mobile application protocol; they will also be responsible for maintenance of the IRM to IMSI relationship.

Bearer protocol translation is yet another signaling issue for engineering to resolve. The ANSI-41 carrier will use ANSI-SS7 based signaling. This is incompatible with most GSM carriers. GSM carriers in North America will need to arrange for ITU-TCAP/ANSI-SS7 signaling between the protocol converter and their gateway switches or HLRs. European and Asian GSM carriers must arrange to receive ITU-C7 (or local variant) messaging from the protocol translator to their gateway switches or HLRs.

The engineering department will also need to deal with point code based addressing on the ANSI-SS7 network. Global title is still rare in the ANSI-41 / ANSI-SS7 signaling network.

### 8.2.2.3 *International TLDN/MSRN Translation issues*

The IRG published by IFAST recommends that ANSI-41 operators upgrade their switch software to revision D of the standard. This revision allows for the inclusion of full E.164 temporary numbers for call delivery. Unfortunately, very few carriers have actually done this. Temporary numbers for call delivery are usually local in nature and in some places

look very little like the E.164 number that would be required to reach it internationally.

Successful call delivery will depend on the ability somewhere in the protocol conversion chain to recognize exactly where the roamer is, and manipulate the temporary number that is returned in response to a PRO-VIDE\_RN (GSM MAP) or ROUTEREQ (ANSI-41) message. In certain areas of the Americas, this will be a daunting task.

### 8.2.3 Fraud management

There are several fraud management tools available when roaming with ANSI-41 carriers. Unfortunately, for the GSM carrier, they are significantly different from those currently employed in their own environments.

#### 8.2.3.1 *Authentication*

Authentication is available in many, but certainly not all ANSI markets. Further complicating the issue of authentication is that the ANSI handset being carried by the subscriber cannot be authenticated against his or her home Authentication Center (AC). The authentication algorithms in use in ANSI markets are not compatible.

There are methods available for the GSM carrier to authenticate handsets roaming in ANSI markets through external ANSI authentication centers or protocol converters that have ANSI authentication center capabilities incorporated in to them.

#### 8.2.3.2 *High Usage Reports*

Although the use of *High Usage Reports* for fraud control is de rigueur in GSM operations, they are rare in North American ANSI carriers. However, some South American carriers generate *High Usage Reports* as a normal part of their security operations for roaming partners. These reporting arrangements and any liability agreements must be spelled out in roaming agreements.

#### 8.2.3.3 *Call Data Record (CDR) Reporting*

For GSM operators, standard TADIG procedures require fully rated records be returned to the home carrier within 36 hours. ANSI operators working under the CIBERNET rules have 30 days to provide rated records back to their clearing receipt point. This makes the use of rated CDR exchanges virtually useless in fraud prevention.

There are, however, alternatives available to rated CDR exchanges. There are third-party agencies operating in the ANSI roaming world that can

provide unrated CDRs to the home carrier within 30 minutes of a call transaction.

#### 8.2.3.4 *PIN based fraud protection*

In areas where there is a fraud risk and no other mitigation means are available, Personal Identification Number (PIN) based roaming can provide some measure of protection. PIN-based roaming requires the subscriber enter a feature code and number known only to the subscriber into the handset. The verification of this number gives the subscriber an open period of operation time.

#### 8.2.3.5 *Default Positive vs. Default Negative markets*

Another issue to confront the security department of the GSM carrier is how the serving system reacts in the event of a loss of signaling service. There is a difference of opinion among ANSI-41 operators over how to operate in the event that the HLR does not reply to the VLR.

Some carriers bar roaming services unless the VLR receives a positive acknowledgement from the HLR (known as default negative markets). Some carriers allow roaming without a positive acknowledgement, but limit the roamer to local airtime only. Finally, there are carriers that give full rights including international long distance to roamers unless specifically forbidden by a message back from the HLR (known as default positive markets). All of these conditions have implications for security and for the service level provided to roamers.

The conditions of operation in the event of communication failure between HLR and VLR must be spelled out in the roaming agreement.

### 8.2.4 **Other Issues**

#### 8.2.4.1 *Services*

GSM Subscribers are used to receiving many special services and features while roaming in a GSM network. In an ANSI-41 network, these features may not be available. Most basic call controls features such as call barring, caller identification, and call forwarding should be available in most markets, but there are no guarantees.

One expected service that may not be available is SMS. Roaming SMS termination is only beginning to be adopted by ANSI-41 carriers and mobile origination while roaming is even rarer. GSM operators should contact each of their roaming partners and determine features provided to roamers.

**8.2.4.2**      *Airtime Charges*

GSM Carriers do not charge each other for airtime when delivering calls to roamers. That practice is definitely not carried over into the ANSI-41 world. At a wholesale level, ANSI carriers will charge for airtime for call delivery. GSM carriers must be prepared to include these costs in their business operations.

# 9 Glossary

<i>Cate-gory</i>	<i>Term</i>	<i>Abb'n</i>	<i>Definition</i>
<b>Billing Term</b>			
	Billing Identifier	BID	A SID allocated for accounting purposes, and administered by CIBERNET Corp.
	Cellular Inter-carrier Billing Exchange Record	CIBER	Tape format for wireless billing records. Maintained by CIBERNET Corp.
<b>Industry Association</b>			
	Alliance for Telecommunications Industry Solutions	ATIS	
	Cellular Telecommunications Internet Association	CTIA	
	CIBERNET Corp		A subsidiary of the CTIA responsible for facilitating billing aspects of roaming.
<b>Network Element</b>			
	Authentication Center	AC	Stores information for authenticating mobiles and encrypting their voice and data transmissions.
	Base Station	BS	Includes BTS and BSC.
	Base Station Controller	BSC	The 'brains' of a base station, controlling the radio equipment in the BTS.
	Base Transceiver System	BTS	Radio portion of BS.
	Equipment Identity Register	EIR	
	Global Title	GT	A non-native SS7 address based on E.164 DNs, E.212 IMSI, etc.
	Global Title Translation	GTT	A method of routing in SS7 networks based on global titles and not Point Codes.
	Home Location Register	HLR	
	Message Center	MC	See "Short Message Center."
	Mobile Station	MS	Wireless Phone.
	Mobile Switching Center	MSC	



<i>Category</i>	<i>Term</i>	<i>Abb'n</i>	<i>Definition</i>
	Service Node	SN	A combination of SCP and IP functionality.
	Service Switching Point	SSP	An MSC or other type of switch.
	Short Message Center	SMC	
	Short Message Service	SMS	
	Signaling Control Point	SCP	
	Signaling Transfer Point	STP	An SS7 packet router.
	Subscriber Identification Module	SIM	"Smart Card" for a GSM phone (See UIM).
	User Identification Module	UIM	"Smart Card." See SIM.
	Visitor Location Register	VLR	
<b>Numbering Term</b>			
	Directory Number	DN	The number dialed to terminate a call to a phone.
	Electronic Serial Number	ESN	32 bit identifier of an AMPS mobile.
	International Mobile Equipment Identity	IMEI	
	International Mobile Subscriber Identity	IMSI	Formerly called International Mobile Station Identity. Based on the ITU-T E.212 numbering plan.
	International Roaming MIN	IRM	A MIN beginning with the digit 0/1 that uniquely identifies a mobile that does not have a DN, to avoid conflict with NANP MINs.
	MIN Block Identifier	MBI	A 6-digit code used to identify a block of MIN codes within the NANP.
	Mobile Country Code	MCC	A 3-digit number that is assigned to a single country. The first three digits of an E.212 IMSI.
	Mobile Directory Number	MDN	A phone number (DN) assigned to a mobile.
	Mobile Identification Number	MIN	A 10-digit identifier of a mobile subscription. See IRM, MNC, E.212.
	Mobile Network Code	MNC	Identifies an individual carrier, or a portion of a carrier network.
	Mobile Station Identifier	MSID	Either a MIN or an IMSI.
	North American Numbering Plan	NANP	

<i>Category</i>	<i>Term</i>	<i>Abb'n</i>	<i>Definition</i>
	Number Assignment Module	NAM	Storage for a single MIN/IMSI/both with related information to identify the subscription. A mobile may have multiple NAMs for multiple subscriptions.
	Originating Point Code	OPC	Where an SS7 message came from.
	Point Code	PC	A numeric SS7 address. 24 bits in the NANP, 16 bits in Japan, and 14 bits in most other countries.
	Sub-system Number	SSN	Along with PC, identifies and SS7 network application or a virtual SS7 network entity.
	System Identifier	SID	A 15-bit identifier of an AMPS wireless license or system.
	Temporary Local Directory Number	TLDN	A number used for routing calls from the Home MSC to MSC-V.
	Temporary Mobile Station Identity	TMSI	Used as a shorter, more private, mobile identifier. Identifies the system that assigned it and not the mobile directly.
<b>Standards Document</b>			
	E.164		ITU-T dialing plan standard.
	E.212		ITU-T Mobile Identification number standard.
	IS-		TIA Interim Standard.
	IS-124		Wireless call detail and billing record format for online transfer.
	IS-136		Second-generation TDMA air interface standard.
	IS-2000		CDMA 2000 air interface standard.
	IS-41		Wireless inter-systems operation standard. Now called TIA/EIA-41 or ANSI-41.
	IS-634		A-interface standard between BS and MSC.
	IS-91		Most advanced analog air interface standard (including NAMPS).
	IS-95		CDMA One CDMA air interface standard.
	J-STD		Joint ATIS -T1/TIA standard.
	Project Number	PN	TIA Project Number.

<i>Category</i>	<i>Term</i>	<i>Abb'n</i>	<i>Definition</i>
	Standards Proposal Number	SP-	ANSI Standards Proposal Number.
	Telecommunications System Bulletin	TSB	TIA often uses it as an addendum or erratum to a published interim standard.
	TIA/EIA-124		Wireless call detail and billing record format for online transfer. Replaces IS-124.
	TIA/EIA-136		Second-generation TDMA air interface standard. Replaces IS-136.
	TIA/EIA-41		Wireless intersystem operations standard. Previously called IS-41. Also known as ANSI41.
	TIA/EIA-95-B		Third generation CDMA air interface standard. Replaces IS-95.
<b>Standards Organization</b>			
	American National Standards Institute	ANSI	
	Committee T1		ATIS standards committee.
	Electronic Industry Alliance	EIA	
	International Telecommunications Union	ITU	
	International Telecommunications Union-Radio Communications Division	ITU-R	
	International Telecommunications Union-Telecommunications Division	ITU-T	
	Standard Development Organization	SDO	The TIA and ATIS are examples of SDOs.
	Telecommunications Industry Association	TIA	
	TR-45		TIA Standards Committee responsible for AMPS-based cellular and PCS standards.
	TR-45.1		TIA analog cellular standards subcommittee.
	TR-45.2		TIA Standards Subcommittee responsible for inter-system protocols.

<i>Category</i>	<i>Term</i>	<i>Abb'n</i>	<i>Definition</i>
	TR-45.3		TIA DMA digital cellular/PCS standards subcommittee.
	TR-45.4		TIA BS/MSC "A" interface standards subcommittee.
	TR-45.5		TIA CDMA digital cellular/PCS standards subcommittee.
	TR-45.6		TIA CDPD standards subcommittee.
<b>Signaling Term</b>			
	Common Channel Signaling System #7	CCS7	ITU-T version of SS7
	ISDN User Part	ISUP	SS7 call processing signaling between switches
	Message Application Part	MAP	Protocol that interconnects wireless telephone systems (e.g., MSCs and HLRs)
	Message Transfer Part	MTP	SS7 transport layer
	Signaling Connection Control Part	SCCP	SS7 enhanced routing and identification layer
	Signaling Point	SP	
	Signaling System Number 7	SS7	Common channel telecommunications packet switching
	Transaction Capabilities Application Part	TCAP	Message packaging standard used by ANSI-41/IS-41 and defined in ANSI T1.114
<b>Technical Term</b>			
	Advanced Mobile Phone Service	AMPS	
	Calling Party Pays	CPP	The calling party pays for calls to mobile, not the mobile receiving the call
	Digital AMPS	D-AMPS	IS-54 and IS-136 TDMA
	Dual Tone Multi-frequency	DTMF	Tone signaling used by phones
	Global System for Mobile Communications	GSM	
	Invoke		Message sent to initiate an ANSI-41/IS-41 transaction
	Narrowband AMPS	NAMPS	

<i>Category</i>	<i>Term</i>	<i>Abb'n</i>	<i>Definition</i>
	Over-the-Air Programming	OTA	Uploads internal mobile tables.
	Personal Communications System	PCS	
	Public Land Mobile Network	PLMN	A cellular or PCS network.
	Public Switched Telephone Network	PSTN	Utilizing R1 MF tone interfaces.
	Time Division Multiple Access	TDMA	Modulation technique used by D-AMPS and GSM.
	Wireless Intelligent Network	WIN	Protocol with similar goals as IN and AIN.

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## 10 Contact Information

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# 11 Appendix: Roaming Agreement Model

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## 11.1 Introduction

This section is a guideline for Inter-carrier Roaming Service Agreements. IFAST provides it primarily as an information tool and recommends that each business entity modify this document for specific business purposes and. The Inter-carrier Roaming Service Agreement is also available in Spanish on the IFAST Web Site at [www.ifast.org](http://www.ifast.org).

## 11.2 Roaming Agreement Model

### **INTERCARRIER ROAMER SERVICE AGREEMENT**

THIS INTERCARRIER ROAMER SERVICE AGREEMENT (the "Agreement") is dated as of the \_\_\_\_ day of \_\_\_\_\_, 20\_\_ by and between Carrier [A], on behalf of itself and its Affiliates listed in Schedule 1 hereto (individually and collectively, "[A]") and Carrier [B], on behalf of itself and its Affiliates listed in Schedule 2 hereto (individually and collectively, "[B]"). [A] and [B] are sometimes referred to, individually, as a "Party" and together as "Parties".

### **RECITAL**

WHEREAS, each of [A] and [B] desire to make arrangements to facilitate the provision of voice and voice-related mobile wireless radiotelephone service to the customers of the other Party, while such customers are using the wireless radiotelephone facilities of such Party, in accordance with the terms of this Agreement;

NOW, THEREFORE, in consideration of the mutual promises herein set forth and intending to be legally bound hereby, the Parties do hereby agree as follows:

### **ARTICLE I** **DEFINITIONS**

1.1 As used in this Agreement, the terms below shall have the following meanings:

*Affiliate* means, with respect to a Party, any facilities-based CMRS operating company that (a) is controlled by or under common control with the Party, (b) is an entity in which the Party has at least fifty percent (50%) voting interest, (c) shares switching facilities with the Party, (d) is managed by the Party, or (e) is providing Service utilizing CMRS spectrum it has acquired from a Party

*Agreement* means the Inter-Carrier Roamer Service Agreement, including all schedules and exhibits attached thereto.

*Approved CIBERNET Negative File Guidelines* means the negative file guidelines appearing in the CIBER Record in effect from time to time.

*Authorized Receipt Point or "ARP"* means the location or address of the party designated by the Home Carrier as the delivery point for its CIBER records and authorized agent for performing CIBER edits.

*Authorized Roamer* means a Roamer using equipment and an assigned telephone number with the NPA/NXX combinations listed in accordance with Article IV below for whom the Serving Carrier has not received a negative notification in accordance with the provisions of this Agreement.

*CIBER* means Cellular Inter-carrier Billing Exchange Record.

*CIBER Record* means the publication prepared by CIBERNET Corporation, a wholly owned subsidiary of the Cellular Telecommunications Industry Association, as a service to the wireless communications industry. Unless specifically provided otherwise in this Agreement, all words and phrases defined in the CIBER Record shall have the meaning herein that they have therein.

*Clearinghouse* means that entity that provides for the exchange of CIBER records and performs industry accepted CIBER edits, including edits to verify Industry Negative File information.

*CMRS* means Commercial Mobile Radio Service.

*ESN* means the Electronic Serial Number that is encoded in a wireless telephone set by the manufacturer and which is broadcast by such telephone.

*Home Carrier* means a Party who is providing Service to its registered customers in a geographic area where it holds a license or permit to construct and operate a mobile wireless radiotelephone system and station.

*Industry Negative File* means the negative file maintained by the authorized Clearinghouses in accordance with approved CIBERNET Negative File Guidelines.



*MIN* means the "Mobile Identification Number" which is assigned by a Home Carrier to each of its registered customers.

*NPA/NXX combinations* means the six-digit numerical combinations assigned by regulatory authorities to identify the area code and telephone number prefix for Service.

*Roamer* means a customer of one Party who seeks Service within a geographic area served by the other Party.

*Service* means telecommunications service for the transmission and reception of voice and voice-related features provided by means of radio frequencies that are or may be licensed, permitted or authorized now or in the future by the Federal Communications Commission (or any successor agency or other equivalent governmental agency in other countries), and in respect of which service the user equipment is capable of and intended for usage during routine movement, including halts at unspecified points, at more than one location throughout a wide area public or private wireless network. Unless otherwise specifically agreed by the Parties, Service shall include personal base station services but, by way of example and without limitation, does not include fixed wireless services, two-way messaging wireless services (NBPCS), video broadcasting wireless services, television services (whether cable, broadcast or direct broadcast satellite), broadcast radio services, interactive informational or transactional content services such as on-line content network services, Internet based services, and air to ground communications services.

*Serving Carrier* means a Party who provides Service for registered customers of another Party while such customers are in the geographic area where the Serving Carrier, directly or through subsidiaries, provides Service.

## **ARTICLE II** **PROVISION OF SERVICE**

2.1 Each Party shall provide, to any Authorized Roamer who so requests, voice communication service and any and all other types of Service that such Party provides to its own customers. Notwithstanding the foregoing, the Serving Carrier shall not be required to modify or supplement its system in any way to address any incompatibility in the technologies used by the Serving Carrier and the Home Carrier that may preclude the provision of Service to an Authorized Roamer. Service shall be provided in accordance with the Serving Carrier's own ordinary requirements, restrictions, practices, and tariffs, if applicable, and with the terms and conditions of this Agreement.

2.2 Notwithstanding anything in this Agreement to the contrary, a Serving Carrier may suspend or terminate Service to an Authorized

Roamer in accordance with the terms of its own ordinary requirements, restrictions, practices, and tariffs, but such suspension or termination shall not affect the rights and obligations of the Parties for Service furnished hereunder prior to such termination or suspension.

2.3 In connection with its Service to Roamers, no Serving Carrier shall use recorded announcements or other inducements for an Authorized Roamer to discontinue the Service of its Home Carrier or, unless otherwise authorized herein, Roamer's use of a Serving Carrier's system.

2.4 In the event that an operating entity becomes an Affiliate of a Party after the date of this Agreement, such Party may, upon thirty (30) days prior written notice to the other Party, add such operating entity to Schedule 1 or Schedule 2, as the case may be, at the expiration of which thirty-day period (a) the customers of such entity shall be entitled to Service as Roamers from the other Party on the terms and conditions of this Agreement and (b) such operating entity shall provide Service to customers of the other Party who are Authorized Roamers, although the other Party is not obligated to request such Service or to require its customers to request such Service. Notwithstanding the foregoing, the other Party, in its reasonable discretion, may reject the addition of any such Affiliate by delivering written notice thereof prior to the expiration of the thirty-day period.

### **ARTICLE III** **CHARGES**

3.1 Each Home Carrier whose customers (including the customers of its resellers) receive Service from a Serving Carrier as Authorized Roamers under this Agreement shall pay to the Serving Carrier who provided such Service one hundred percent (100%) of the Serving Carrier's charges for CMRS and one hundred percent (100%) of the toll charges set forth in Exhibit A. The amount of the charges for the use of each Serving Carrier's Service are set forth in Exhibit A attached to this Agreement.

### **ARTICLE IV** **EXCHANGE OF INFORMATION**

4.1 Exhibit B to this Agreement is a list furnished by the respective Parties of the valid NPA/NXX combinations used by their respective customers. These combinations shall be accepted by the other Party. Each NPA/NXX combination is and shall be within the entire line range (0000-9999) or a specified portion thereof. The minimum line range to be exchanged by the Parties shall be 1,000 line numbers. Each Party shall be responsible for all billings otherwise properly made under this Agreement to any number listed by such Party within the range or ranges specified by it in Exhibit B. Additions, deletions, or changes to NPA/NXX combinations and line number range(s) for the Home Carrier's customers

may be made upon at least fifteen (15) days prior written notice to the Serving Carrier. Such notice shall be in the form attached as Exhibit B to this Agreement and shall include the requested effective date for the addition, deletion or change.

4.2 Each Party shall provide to each other Party a list of MINs (from among those within the NPA/NXX combination(s) identified pursuant to Section 4.1 hereof) and ESNs (of the telephones to which the other Party is not authorized to provide Service pursuant to this Agreement), which shall be entered into the Industry Negative File. The approved CIBERNET Negative File Guidelines, as amended from time to time, shall be the governing criteria for the Parties. Thereafter, from time to time, as agreed by the Parties, each Party shall notify each other Party of all additions to, and deletions from, these lists for the customers of that particular Party. Such notifications shall be made during normal business hours of the Party being notified by facsimile or by telephone with a written confirmation and shall be effective one (1) hour after receipt.

4.3 Each Party hereby agrees to indemnify each and all of the other Parties, together with their partners and any and all of their officers, directors, employees, agents and/or affiliates, against, and hold them harmless from, any and all claims, suits, demands, losses and expenses, including reasonable attorneys' fees and disbursements, which may result in any way whatsoever from the indemnified Party's denial of Roamer or local Service to any NPA/NXX and MIN combination which has been listed by the indemnifying Party as not being authorized to receive Service; provided that (i) the person seeking indemnification (the "Indemnified Person") provides notice of such claim promptly after its discovery to the Party from which indemnification is sought (the "Indemnifying Person") and in any event the Indemnifying Person will be released from any obligation hereunder to the extent it is prejudiced by any delay in the delivery of such notice, (ii) the Indemnifying Person shall have the right to assume the defense of such claim, (iii) the Indemnified Person shall provide such reasonable assistance and cooperation in the defense of such claim as is requested by the Indemnifying Person, and (iv) the Indemnified Person shall not settle or compromise any such claim without the prior written consent of the Indemnifying Person.

4.4 Each Party, due to system limitations, may purge or delete numbers of its customers from the lists as referred to in Section 4.2 hereof, but in all such cases, such purging or deletion must be done in accordance with the approved CIBERNET Negative File Guidelines. If purging or deletion of numbers is done prior to the time periods established by such Guidelines, or through procedures not otherwise set forth, in the approved CIBERNET Negative File Guidelines, the Party implementing the purge or deletion will assume financial liability for any charges incurred by those numbers. All purges or deletions made pursuant to this Section

4.4 shall be given through the Parties and shall be in the form mutually agreed upon by the Parties and effective as of the time established by the approved CIBERNET Negative File Guidelines (unless otherwise modified by mutual agreement of the Parties.)

4.5 Upon the implementation of wireless number portability in any portion of either Party's system, the Parties shall cooperate in establishing an alternative method for exchanging ESN, MIN, and NPA/NXX information required to permit roaming by the other Party's customers in their respective systems.

#### **ARTICLE V** **FRAUD**

5.1 The Parties will cooperate and, as necessary, supplement this Agreement in order to minimize fraudulent or other unauthorized use of their systems. If any Party reasonably decides that, in its sole judgment, despite due diligence and cooperation pursuant to the preceding sentence, fraudulent or other unauthorized use has reached an unacceptable level of financial loss and is not readily remediable, such Party may suspend the use of applicable NPA/NXX combinations, in whole or in part, pursuant to the terms of this Agreement.

5.2 Each Party shall take reasonable actions to control fraudulent Roamer usage, including without limitation using either (i) a positive validation/verification ("PV") system provided by a mutually agreed upon validation/verification service under which the ESN, MIN and/or NPA/NXX used in a call in the Serving Carrier's system is compared against a list of Authorized Roamers or (ii) SS-7 connections through a network of carriers. The Parties shall work together in good faith to designate and implement a mutually agreeable PV system and enhancements thereto or alternative systems. The Home Carrier shall have no responsibility or liability for calls completed by a Serving Carrier without obtaining positive validation/verification as required herein.

5.3 In addition to other procedures set forth in this Agreement, a Home Carrier may notify a Serving Carrier by facsimile, with written confirmation, that certain NPA/NXX combinations are not to receive Service. Any calls completed using such NPA/NXX combinations made one full business day or more after such notice has been given shall be the sole responsibility of the Serving Carrier and the Home Carrier shall not be charged any amount for such calls.

5.4 For purposes of notification under this Article V, the following addresses and facsimile numbers shall be used:

If to [A]: Carrier [A]

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If to [B]: Carrier [B]

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Each Party may change the names, addresses and numbers set forth above by providing notice to the other Party as provided in Article XIII below.

**ARTICLE VI**  
**BILLING**

6.1 Each Home Carrier shall be responsible for billing to, and collecting from, its own customers all charges that are incurred by such customers as a result of service provided to them as Authorized Roamers by the Serving Carrier. The Home Carrier shall also be responsible for billing its customers for, and remitting to, the Federal Government or other applicable governmental authorities all federal excise tax or other applicable taxes that may be due in connection with the service being billed by it to its customers. While the Serving Carrier will be responsible for the computation and remittance of all state and local taxes, each Home Carrier shall be liable to the Serving Carrier for all such state and local taxes remitted by the Serving Carrier, for Authorized Roamers regardless of whether these amounts are paid to the Home Carrier by its customers.

6.2 Each Serving Carrier who provides Service to an Authorized Roamer pursuant to this Agreement shall forward Roamer billing information on at least a weekly basis, within thirty days of the call date in accordance with the procedures and standards set forth in the CIBER Record, to the Home Carrier's Authorized Receipt Point. CIBER Type 70 records shall not be accepted without mutual signed agreement and if such mutual agreement is reached it will be attached to this Agreement. Any future revisions of the CIBER Record or additional record types must be mutually agreed upon before implementation. In the event the parties use the CIBERNET Net Settlement Program, or alternative settlement program such information must be in a format in compliance with the CIBER Record requirements or agreed upon format.

6.3 Where the Authorized Roamer billing information required to be provided by the Serving Carrier in accordance with Section 6.2 above is not in accordance with the CIBER Record, the Home Carrier may return a record to the Serving Carrier as provided in the CIBER Record. Returning the defective record will be in accordance with CIBER Record established procedures. The Serving Carrier may correct the defective record and return it to the Home Carrier for billing, provided that the time period from the date of the Service call at issue to the receipt of the corrected record does not exceed sixty (60) days.

6.4 No credit for insufficient data or defective records shall be permitted except as provided in Section 6.3 above, unless mutually agreed upon by both Parties.

6.5 Each Home Carrier may at its discretion perform any necessary edits at its Clearinghouse on incollect or outcollect call records to ensure compliance with the terms of this Agreement.

#### **ARTICLE VII** **SETTLEMENT**

7.1 Each Party will settle its accounts with the other Parties on the basis of billing information received as described in this Article VII. In the event both Parties use a net financial settlement procedure, the Parties shall not submit a paper invoice but will make payments in accordance with such net financial settlement procedures provided that the Parties may submit call records for payment that relate to calls made more than sixty (60) days from the date of the call if such call was the subject of a dispute or investigation regarding fraudulent or unauthorized use.

7.2 If an incorrect roaming rate is charged by the Serving Carrier to the Home Carrier, the Serving Carrier shall refund all amounts in excess of the contract rate back to the Home Carrier within forty-five (45) days of notification by the Home Carrier. Each carrier shall have ninety (90) days from the end of the settlement period to invoice for amounts in excess of the contract rate. The Home Carrier will send a collection letter within sixty (60) days of the invoice date, within ninety (90) days of the invoice date, and within one hundred (120) days of the invoice date. If the invoice remains unpaid after one hundred twenty (120) days from the original invoice date, the Home Carrier may withhold the amounts from the CIBERNET Net Settlement Program or alternative settlement program.

7.3 In the event that either Party does not use a net financial settlement procedure, the billing and payment for charges incurred under this Agreement shall be as set forth below.

7.3.1 The parties shall determine amounts owed to each other for Service provided to Roamers in one-month periods with such period beginning on the sixteenth day of each calendar month and

ending on the fifteenth day of the following month in which Service is provided. The end of this Period shall be referred to as "Close of Billing."

7.3.2 The Parties shall send each other an invoice for Services used under this Agreement within fifteen (15) days after the Close of Billing.

7.3.3 Each invoice shall contain the following information:

1. Billing period used by Serving Carrier
2. Batch sequence number
3. Serving and Home Carrier System Identification Number
4. Air Service charges
5. Total toll charges
6. All other charges and credits
7. Total taxes
8. Total charges

7.3.4 Payment on such invoices shall be made in the form of a check or a wire transfer which must be received by the invoicing party within thirty (30) days from the date of the invoice. Late payments shall be charged with a late payment fee of one and one half percent (1.5%) of the outstanding balance for each thirty-day period (or portion thereof) that such payments are late.

7.3.5 Each Party may offset the amount owed to the other Party under this Agreement and a single payment of the balance to the Party entitled to receive such balance shall be made.

7.4 If the Serving Carrier provides pre-call validation of the Home Carrier's customers, the Home Carrier agrees to implement Negative File Suppression at the Clearinghouse and the CIBERNET Negative File Guidelines and procedures do not apply.

#### **ARTICLE VIII** **AUTOMATIC CALL DELIVERY AND OTHER FEATURES**

8.1 Each Party shall, as Serving Carrier, provide for automatic call delivery for customers of the other Party who are Roamers in the Serving Carrier's system. To this end, each Party shall continuously provide the hardware, software and transmission facilities required for such call delivery either directly between the systems of the Parties or indirectly through a separate network of communications carriers. The hardware,

software and transmission facilities provided by each Party hereunder shall at all times be operated and maintained to provide the most efficient level of service that is technically feasible and commercially reasonable to minimize transmission errors and Service interruptions.

**ARTICLE IX**  
**TERM, TERMINATION AND SUSPENSION OF AGREEMENT**

9.1 This Agreement shall commence on the date of signature by both Parties and continuing for a period of one (1) year. Thereafter, this Agreement shall renew automatically on a year-to-year basis. Either Party may terminate this Agreement unilaterally and without cause at any time upon 60 days prior written notice to the other Party. The Parties acknowledge that the targeted starting date for commercial roaming in respect of this Agreement may not be immediate. [A] shall notify [B] in writing when it is able to commence the relevant test procedures. The Parties agree that prior to the commencement of the test procedures, neither Party shall incur any liability to the other under this Agreement except for a breach of the confidentiality obligations detailed in Article XIV.

9.2 This Agreement may be terminated or suspended by either Party immediately upon written notice to the other of a Default (as defined in Section 10.1) by the other Party. In addition, either Party may suspend this Agreement immediately upon written notice to the other Party of the existence of a breach of this Agreement, whether or not such breach constitutes a Default, which materially affects the Service being provided to Customers of the non-breaching Party. While any suspension of this Agreement, whether in part or in whole, is in effect, the Parties shall work together to resolve as expeditiously as possible the difficulty that caused the suspension. At such time as the Party originally giving notice of suspension concludes that the problem causing the suspension has been resolved, that Party shall give to the other written notice to this effect. This Agreement shall resume in full effect within five (5) business days after the Parties have mutually agreed that the problem has been resolved.

9.3 The Parties shall cooperate to limit the extent and effect of any suspension of this Agreement to what is reasonably required to address the cause of the suspension.

9.4 In the event that a Party transfers control of an Affiliate listed in Schedule 1 or Schedule 2, as the case may be, the Party shall provide at least one (1) months' prior written notice to the other Party and upon such transfer such Affiliate shall be deleted from the appropriate Schedule.

9.5 The termination or suspension of this Agreement shall not affect the rights and liabilities of the Parties under this Agreement with respect



to all Authorized Roamer charges incurred prior to the effective date of such termination or suspension.

**ARTICLE X**  
**DEFAULT**

10.1 A Party will be in "Default" under this Agreement upon the occurrence of any of the following events:

10.1.1 Material breach of any material term of this Agreement, if such breach shall continue for thirty (30) days after receipt of written notice thereof from the nonbreaching Party;

10.1.2 Voluntary liquidation or dissolution or the approval by the management or owners of a Party of any plan or arrangement for the voluntary liquidation or dissolution of the Party;

10.1.3 A final order by the governmental agencies or authorities which have jurisdiction over wireless communications services revoking or denying renewal of CMRS licenses or permits granted to such Party which, individually or in the aggregate, are material to the business of such Party; or

10.1.4 Such Party (i) filing pursuant to a statute of the country, state, or province, a petition for bankruptcy or insolvency or for reorganization or for the appointment of a receiver or trustee for all or a portion of such Party's property, (ii) has filed against it, pursuant to a statute of the country, state, or province, a petition for bankruptcy or insolvency or for reorganization or for the appointment of a receiver or trustee for all or a portion of such Party's property, provided that within sixty (60) days after the filing of any such petition such Party fails to obtain a discharge thereof, or (iii) making an assignment for the benefit of creditors or petitioning for, or voluntarily entering into, an arrangement of similar nature, and provided that such filing, petition, or appointment is still continuing.

10.2 All claims and disputes relating in any way to the performance, interpretation, validity, or breach of this Agreement, including but not limited to a claim based on or arising from an alleged tort, shall be resolved as provided in this Section 10.2. It is the intent of the Parties that any disagreements be resolved amicably to the greatest extent possible.

10.2.1 If a disagreement cannot be resolved by the representatives of the Parties with day-to-day responsibility for this Agreement, such matter shall be referred to an executive officer of each of the Parties. The executive officers shall conduct face-to-face negotiations at a neutral location or such other location as shall be mutually agreed upon. If these representatives are unable to resolve the dis-

pute within fifteen (15) business days after either Party requests the involvement of the executive officers, then either Party may, but is not required to, refer the matter to arbitration, as applicable in accordance with Sections 10.2.2.

10.2.2 If any claim, controversy or dispute of any kind or nature whatsoever arises between the Parties and cannot be resolved in accordance with 10.2.1 then the dispute shall be resolved by arbitration. A single neutral arbitrator engaged in the practice of law, who is knowledgeable about the matter in Dispute, shall conduct the arbitration under the then current rules of the American Arbitration Association.

10.3 Each party shall bear its own costs and attorneys' fees, and the parties shall share equally the fees and expenses of the arbitrator. The arbitrator shall not have authority to award punitive damages. The arbitrator's decision and award shall be final and binding, and the parties hereby waive all means of recourse to the courts of any other country. The judgment upon the award rendered by the arbitrator may be entered in any court having jurisdiction thereof.

10.4 The place and language of arbitration shall be mutually agreed upon but if no agreement as to place and/or language can be reached, the place of arbitration will be New York City, New York and the proceedings shall be conducted in the English language.

#### **ARTICLE XI** **SUCCESSORS AND ASSIGNS**

11.1 Neither Party may, directly or indirectly, sell, assign, transfer, or convey its interest in this Agreement or any of its rights or obligations hereunder, including any assignment or transfer occurring by operation of law, without the written consent of both Parties, except that (i) either Party may assign or delegate this Agreement or any of its rights or obligations hereunder to an Affiliate of such Party without the consent of the other Party, but such assignment or delegation will not relieve the Party of any of its obligations hereunder and (ii) a Party may assign its rights and obligations hereunder to an assignee of its Service license or permit issued by the governmental agencies or authorities which have jurisdiction over wireless communications services, or to an assignee which holds licenses and other rights for the provision of [A] Services, to whom a partial assignment may be made, provided that such assignee expressly assumes, by written instrument, all of the assigned obligations of such Party hereunder and thereby becomes a Party hereunder. In no event will an assignment permitted under this Section 11.1 without the consent of the other Party obligate a Serving Carrier to provide Service to any customers of the assignee or any of its Affiliates other than customers resid-

ing in the area in which the assignor previously was licensed to provide Service.

11.2 No person other than a Party to this Agreement shall acquire any rights hereunder as a third party beneficiary or otherwise by virtue of this Agreement.

**ARTICLE XII**

**NO PARTNERSHIP OR AGENCY RELATIONSHIP IS CREATED**

12.1 Nothing contained in this Agreement shall constitute the Parties as partners with one another or render any Party liable for any debts or obligations of any other Party, nor shall any Party hereby be constituted the agent of any other Party.

**ARTICLE XIII**

**NOTICES AND AUTHORIZED REPRESENTATIVES**

13.1 Unless otherwise provided herein, any notice, request, instruction or other document to be given hereunder by any Party to the other shall be in writing and delivered by hand delivery, certified mail (postage pre-paid, return receipt requested), facsimile, or overnight air delivery service, as follows:

If to [A], to: Carrier[A]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

with a copy to: Carrier [A]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

If to [B], to: Carrier [B]

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

with a copy to: Carrier [B]

\_\_\_\_\_

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or such other address as any Party may from time to time furnish to the other Party by a notice given in accordance with the terms of this Section. All such notices and communications shall be deemed to have been duly given at the time delivered by hand, if personally delivered; ten business days after being deposited in the mail, if mailed; subject to confirmation of receipt, on the date of receipt if received by 3:00 p.m., local time, on any business day and otherwise on the next business day, if by facsimile; and the next business day, if sent by overnight air delivery service.

**ARTICLE XIV**  
**CONFIDENTIALITY**

14.1 Each Party shall, and shall cause each of its Affiliates and each of its and their employees, agents, and contractors, to keep confidential and not use for any purpose, except as contemplated by this Agreement, any and all information and know-how provided to it by the other Party which is identified in writing as confidential ("Confidential Information"). Identification of information as confidential shall, in the case of information delivered in tangible form, appear on at least the face or first page of such information and, in the case of information communicated verbally, be given verbally contemporaneously with the delivery of the information and confirmed in writing within five business days thereafter. Notwithstanding the foregoing, the following information shall be treated as Confidential Information without any further identification as such: (i) The terms, but not including the mere existence, of this Agreement; and (ii) all information exchanged pursuant to Article IV.

14.2 Notwithstanding Section 14.1, a Party shall have no obligation to keep confidential any information that (a) was rightfully in the receiving Party's possession before receipt from the disclosing Party, (b) is or becomes a matter of public knowledge without violation of this Agreement by the receiving Party, (c) is received by the receiving Party from a third party in possession of and, to the best of the receiving Party's knowledge, with a right to make an unrestricted disclosure of such information, (d) is disclosed by the disclosing Party to a third party without imposing a duty of confidentiality on the third party, or (e) is independently developed by the receiving Party without the use of any Confidential Information. In addition, a Party may disclose any Confidential Information to the extent required by applicable law or regulation or by order of a court or governmental agency; provided, that prior to disclosure the Party shall use all reasonable efforts to notify the other Party of such pending disclosure

and shall provide any reasonable assistance requested by the other Party to maintain the confidentiality of the information.

14.3 The Parties agree that a Party will not have an adequate remedy at law in the event of a disclosure or threatened disclosure of Confidential Information in violation of this Article XIV. Accordingly, in such event, in addition to any other remedies available at law or in equity, a Party shall be entitled to specific enforcement of this Article XIV and to other injunctive and equitable remedies against such breach without the posting of any bond.

14.4 The obligations under this Article XIV shall survive the termination of this Agreement for a period of three years.

#### **ARTICLE XV** **MISCELLANEOUS**

15.1 The Parties agree to comply with, conform to, and abide by all applicable and valid laws, regulations, rules and orders of all governmental agencies and authorities, and agree that this Agreement is subject to such laws, regulations, rules and orders. All references in this Agreement to such laws, regulations, rules and orders include any successor provision. If any amendment to or replacement of the same materially alters the benefits, rights, and duties of the Parties hereunder, the Parties agree to negotiate in good faith an amendment to this Agreement to restore the respective positions of the Parties to substantially the same point as existed prior to such amendment or replacement.

15.2 The Parties agree to use their respective best, diligent, and good faith efforts to fulfill all of their obligations under this Agreement. The Parties recognize, however, that to effectuate all the purposes of this Agreement, it may be necessary either to enter into future agreements or to amend this Agreement, or both. In that event, the Parties agree to negotiate with each other in good faith.

15.3 This Agreement constitutes the full and complete agreement of the Parties. Any prior agreements among the Parties with respect to this subject matter are hereby superseded. This Agreement may not be amended, except by the written consent of the Parties. Waiver of any breach of any provision of the Agreement must be in writing signed by the Party waiving such breach or provision and such waiver shall not be deemed to be a waiver of any preceding or succeeding breach of the same or any other provision. The failure of a Party to insist upon strict performance of any provision of this Agreement or any obligation under this Agreement shall not be a waiver of such Party's right to demand strict compliance therewith in the future.

15.4 The headings in this Agreement are inserted for convenience and identification only and are not intended to describe, interpret, define or limit the scope, extent or intent of this Agreement or any provision thereof.

15.5 This Agreement may be executed in counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same Agreement.

15.6 This Agreement shall be construed in accordance with the laws of the state of New York, United States of America.

15.7 Neither Party shall be liable to the other Party for any special, indirect, consequential or punitive damages.

15.8 The Parties agree that they will not use the name, service marks or trademarks of the other party or any of its Affiliates in any advertising, publicity releases or sales presentations, without such Party's written consent. Neither Party is licensed hereunder to conduct business under any logo, trademark, service or trade name (or any derivative thereof) of the other Party.

15.9 Neither of the Parties will be liable for nonperformance or defective performance of its obligations under this Agreement to the extent and for such periods of time as such nonperformance or defective performance is due to reasons outside such Party's control, including, without limitation, acts of God, war, acts of any governmental authority, riots, revolutions, fire, floods, explosions, sabotage, nuclear incidents, lightning, weather, earthquakes, storms, sinkholes, epidemics, strikes, or delays of suppliers or subcontractors for the same causes. Neither Party shall be required to settle any labor dispute or other third party dispute in any manner which is deemed by that Party to be less than totally advantageous, in that Party's sole discretion.

15.10 This Agreement is a non-exclusive arrangement between the Parties. Nothing contained in this Agreement is intended or should be construed to preclude or limit a Party from obtaining from or providing to a third party Service of a type available or required to be provided under this Agreement.

**ARTICLE XVI**  
**LIMITATION OF LIABILITY**

16.1 Liability between the Parties shall be circumscribed according to the following conditions:

16.2 Neither Party shall be liable to the other Party under or in connection with the Agreement except:

16.2.1 In respect of charges to be paid to the Serving Carrier in accordance with Article III.

16.2.2 To the extent of its negligence where such negligence results in proven damage or loss to the other Party, in which event the liability of the negligent Party shall be limited to and shall in no event exceed one hundred thousand U.S dollars (US\$100,000) with respect to any one incident or series of incidents arising from the same cause.

EXECUTED by both Parties:

Carrier [A]

Carrier [B]

By \_\_\_\_\_ By \_\_\_\_\_

Date: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Name: \_\_\_\_\_

Title: \_\_\_\_\_ Title: \_\_\_\_\_

**SCHEDULE 1**

**Affiliates of Carrier [A]**



**SCHEDULE 2**

**Affiliates of Carrier [B]**

**EXHIBIT A**

**SERVICE CHARGES**

CHARGES for [A] Satellite airtime and toll to be determined and communicated sixty (60) days before launch of [A] Satellite Services which is currently scheduled for Q4 2000.

**Terrestrial Roaming Charges:**

[A]'s rates to [B]:

Airtime Rates:

Toll Rates:

[B]'s rates to [A]:

Airtime Rates: \$.40/minute

Toll Rates: 100% pass through

**EXHIBIT B**

**Technical Data**

**METHODS AND PROCEDURES**

The following information is furnished by [A] to [B] pursuant to Section 4.1 of the Inter-carrier Roamer Service Agreement between Carrier [A] and Carrier [B], by \_\_\_\_\_:

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NPA/NXX LINE RANGE SID /BID CITY START DATE END DATE

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Information from [A] to be supplied at a later date.

By: \_\_\_\_\_

Title: \_\_\_\_\_

Issue Date: \_\_\_\_\_

The effective date shall be:

\_\_\_\_\_

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**12**      **Notes**

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