I N T E R N A T I O N A L

R O A M I N G

G U I D E

International Roaming Guide

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Disclaimer:

This Guide is informational in nature. It is intended to provide guidance to international roaming service providers regarding issues related to and aspects of international roaming implementation. The information contained herein should not be construed as implementation recommendations or mandates. Service Providers should use and 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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INTERNATIONAL ROAMING GUIDE

1. International Roaming

The definition of International Roaming within the ANSI-41 (TIA/EIA-41) environment is fairly complicated because international roaming within countries that adopt the North American Numbering plan is not an issue. For example, roaming between Canada and the United States does not fall within the scope of International Roaming issues. Most of the problems concerning international roaming are related to the fact that two ANSI-41 compliant carriers (for example, one in South America and one in North America) may have the same Mobile Identification Numbers (MINs), System Identifiers (SIDs) and a different dialing plan.

IFAST has been trying to resolve these conflicts by assigning unique MINs called IRMs (International Roaming MINs) to carriers who wish to provide international roaming. In addition, IFAST recently took the responsibility of assigning SIDs and recommending ways to resolve conflicting dialing and routing plans between carriers. Other issues influencing carriers' ability to support international roaming include the use of the international Temporary Local Directory Number (TLDN) for call termination, emergency service dialing, supplementary services, and authentication.

2. Introduction

During the IFAST-9 meeting, members recognized the need for a set of recommendations and guidelines that will help carriers interested in providing international roaming to their subscribers become more efficient. Unlike the GSM (Global System for Mobile Communications) standard, the ANSI-41 standard was not originally intended to support international roaming. It was designed around the North American dialing plan and did not take into account conflict with numbering plans or routing schemes in other countries utilizing ANSI-41 as in South America, Japan, Korea, etc.

IFAST members have been working hard to facilitate ways to support international roaming. The assignment of IRMs and SIDs enabled many carriers to realize the benefits of international roaming and motivated others to find more efficient and reliable ways to provide international roaming.

2.1 Purpose

The primary purpose of this document is to provide IFAST members with a description of some of the issues and challenges relating to international roaming. In addition, we hope that the lessons learned and input from various carriers who deal with these issues may help carriers benefit from each other's experiences, and find common approaches or solutions to most of the challenges facing international roaming implementation.

2.2 Scope

This document is intended to highlight some of the issues, challenges and concerns related to International Roaming, and provide recommendations for dealing with them where possible. In addition, this document can serve as a recommended guideline for carriers who wish to implement International Roaming.

This document is not intended to serve as a standard or to provide a process for implementing International Roaming. It merely describes some of the challenges facing international roaming providers, and where possible, describes how carriers deal with these issues. Ideally, the need for this document will diminish as standards for supporting international roaming evolve and carriers implement them.

3. International Roaming MIN (IRM)

The International Forum on ANSI-41 Standards Technology (IFAST) assigns 4-digit IRM prefixes. These uniquely identify blocks of 1 million numbers, each assigned to a carrier anywhere in the world. IRMs are unique non-NANP MINs assigned to uniquely identify a range for each carrier interested in providing international roaming capability.

An IRM is a MIN of the format 0-XXX+6D or 1-XXX+6D that is allocated by IFAST. The 0-XXX or 1-XXX portion will be assigned by IFAST to a carrier. The assigned carrier allocates the last 6 digits of an IRM.

3.1 Description of the Issue

IRMs may be used to register international roamers on networks that may have a MIN range conflict with the original MIN assigned to the subscriber. They may also be assigned to every mobile in a network, or to all newly programmed mobiles. For example, a MIN assigned to a subscriber from Washington, DC 2022441234 may look like a MIN assigned to a Brazilian subscriber. When the Washington, DC subscriber travels to Brazil, he cannot register with this MIN due to this conflict. To overcome this problem, a unique MIN is assigned to the roamer out of a range assigned by IFAST to the roamers home carrier, which is not in conflict with any other MIN range. This MIN may be stored in a separate NAM, and used only for roaming, or may be assigned as the primary MIN for the mobile.

When assigning these blocks of numbers, IFAST tries to make sure that these numbers are not used by any other entity or application that may conflict with international roaming. IFAST does not have the intent or the means to enforce compliance with this assignment. Rather, it encourages members to cooperate and solicit their governments to ensure that MINs assigned locally or internationally do not conflict with the IRMs assigned by IFAST.

To date more than half of the IRMs have been assigned, IRMs are being assigned much faster than expected, and some numbering conflicts are already beginning to appear, although many have been resolved.

4. Separation of MIN and MDN

The 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, but has significant limitations, particularly regarding international roaming and local number portability (LNP). Increasingly, it is expected that these two values will be separated.

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

MIN/MDN Separation has a number of benefits:

- More efficient use of numbering resources
- Allocation of larger sized blocks of numbers (e.g., IRM blocks are 1 million numbers larger while phone numbers in the U.S. are generally allocated in blocks of 10,000).
- Removal of constraints imposed by numbering plan
- Avoidance of MIN reprogramming when numbering changes occur.
- Smaller roamer agreement tables

MIN/MDN separation does introduce some new constraints:

- Billing systems may need to be updated to ensure that they consistently and correctly use either the MIN or MDN.
- Identification of mobiles to emergency services or to long distance companies must be via the MDN and not the MIN
- Roamer ports should use the MDN and not the MIN.
- Databases and switches must support both identifiers (many already do).

4.1 Recommendations

- IFAST posts the latest assignments of IRMs and SIDs on its Web site (http://www.ifast.org/irm.html) and encourages carriers and other interested entities to follow its guidelines when requesting MINs or assigning numbering plans.
- Carriers must recognize that IRMs are a short-term solution to a long-term problem. They should cooperate to define and implement global standards for international roaming (e.g. IMSI and GTT).

5. SID Number

A SID is the 15 bit (0-32,767) System Identity Number that is transmitted by a base station to uniquely identify a wireless license. The range 32,768 through 65,535 is available for use on the network (e.g. as a Billing ID (BID)), but cannot be used on the radio interface.

5.1 Description of the Issue

SID numbers are allocated to most countries in TIA TSB-29. However, there are SIDs that have been used, that are not from the assigned block. This creates SID conflicts, some of which have been reported to the IFAST community.

5.2 Recommendations

IFAST posts the latest assignments of SIDs and all know SID conflicts on its web site (http://www.ifast.org/SID/SIDtable.htm). It is imperative that carriers and regulatory agencies cooperate and comply with IFAST assignments and report conflicts.

5.3 Call for Information

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

6. International TLDN

A Temporary Local Directory Number (TLDN) is used to route calls to a roamer on a visited ANSI-41 system. As the name implies, this directory number is local (up to 10 digits in the North American Dialing Plan) in nature. It lacks the country code (CC) and 10 digits may not be sufficient to dial an international number.

6.1 Description of the Issue

Since ANSI-41 was originally developed to support the North American Dialing Plan, only 10 digit TLDNs were allowed in the protocol's early implementation. National and International TLDNs are distinguished by the Nature of Number field (see next section for more details). Consequently, they can co-exist. However, systems that support the International TLDN cannot successfully transmit this format to a system that does not support it, but must use the National TLDN format instead. Some systems have supported international roaming by using the National TLDN format through regional agreements.

As ANSI-41 continues to grow and cross boundaries, the need for up to 15 digits TLDN to accommodate the country code (CC) is becoming apparent. ANSI-41 Rev. D calls for the implementation of this. However, many carriers have not yet implemented this feature. The international TLDN problem is still a real and widespread one.

IFAST is investigating whether an industry-wide implementation of this capability is feasible. By turning the feature on in all switches at the same time the compatibility issue will be eliminated.

6.2 Recommendations

The best way to deal with this issue is to upgrade switches to handle the international TLDN. Carriers should ensure that they are capable of sending and receiving up to 15 digits TLDN. Carriers should also use the standardized format for International TLDN, which is the E.164 ITU recommendation.

Many carriers have been utilizing creative ways to temporarily deal with the problem by converting an international TLDN to 10 digits one by using a three-digit code that translates to 5 digit code at the other end. These techniques proved useful when used on a small scale. As the number of roaming partners increases, this option becomes less practical.

7. Nature of Number

The Nature of Number field within ANSI-41 Digits parameter distinguishes between national and international numbering formats. IS-41 Revision C was published with the Nature of Number bit incorrectly specified as 0=International, 1=National.

7.1 Description of the Issue

Rev C of the IS-41 standard used this value to enable the distinction between national and international in order to append a country code or an access code. Unfortunately, these values are defined incorrectly. The two values were reversed, 0 should indicate national and 1 should indicate international. This problem was corrected in Rev D where the values are set correctly. In Rev C, 0 indicated international and 1 indicates national.

This issue has been causing some confusion among carriers who utilize this parameter to facilitate international roaming.

7.2 Recommendations

Carriers should ensure that only the ANSI-41-D encoding of this parameter field is used.

8. International Mobile Subscriber Identifier (IMSI)

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 proved effective in the GSM world.

8.1 Description of the Issue

Since it was originally intended to be used in the United States and Canada, the MIN identifier was developed with only the North American Dialing Plan in mind. It does not have any provisions for distinguishing between countries, nor does it conform to any international numbering plans. Due to the MIN conflict discussed earlier in international roaming scenarios, and due to 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.

Unfortunately, analog systems are not capable of supporting IMSI, therefore it may be years before analog systems are phased out and IMSI is implemented in all new digital systems. As the demand for international roaming increases and availability of IRMs decreases, carriers will be forced to implement IMSI to meet this demand, hopefully they will not be caught by surprise, and will plan this implementation sooner rather than later.

It has also been found that some digital terminals did not implement IMSI correctly. These factors are delaying the implementation of IMSI.

A special IMSI format so-called MIN-based IMSI has been defined in the U.S. considering the backward compatibility. In the U.S., the MCC 310 has been designated for the use with MIN-based IMSIs with the format 310+00+MIN. Although the concept of the MIN-based IMSI is useful in other countries, it is not possible to universally designate “00” as the IMSI_11_12 for the MIN-based IMSI for all the MCC because the MNC numbering plan is a national matter. If this technique is not universally supported a mobile terminal with the MIN-based IMSI may send a registration request to the Home Location Register (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 MSCs to solve this problem.

8.2 Support for IMSI in Standards

IMSI 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. IMSI is not supported in any analog standards.

8.3 Recommendations

It is becoming apparent that the only long-term solution to the international roaming issues revolves around the implementation of the IMSI. Because E.212 is an internationally adopted numbering scheme, carriers do not have to worry about numbering conflicts with other carriers around the world.

However, although IMSI is the ideal long-term solution, lack of support in analog and incorrect support in some early digital mobiles makes it unlikely that it will be implemented in the near future.

Because 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. The values should be reported to the IFAST if the MIN-based IMSI is used. It is recommended that the digits “00” be used for the MNC if allowed by the national IMSI numbering plan.

9. Identity of MSC

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 (MSC Identification Number) are defined for the purpose in the ANSI-41.

9.1 Description of the Issue

The PC/SSN should not be used for international roaming because the numbering plan of the PC/SSN is a national matter.

The MSCID includes the market ID field whose value is usually the SID.

The MSCIN is an E.212 number (IMSI).

Either the MSCID or the MSCIN is recommended for use in international roaming. The MSCID is a mandatory parameter in the REGNOT and the MSCIN is optional.

If MSCID is used, a lower layer signaling conversion function may be required if the lower layer protocol (e.g., Mobile Transfer Point (MTP)) is different. For example, the lower layer signaling conversion function will maintain a conversion table between ANSI PC and ITU-T PC. (The conversion table must be designed efficiently such as in the way of the cluster entry.)

In case that the MSCIN is used, SCCP GTT should also be supported. The introduction of the SCPP GTT has a big impact on the system, requires extensive international coordination and probably will not be implemented for some time for international roaming. That is why it is the long-term solution.

9.2 Recommendations

The MSCID is used as the identity of MSC in the short-term solution and the MSCIN is used in the long-term solution.

10. Uniform Dialing Plan

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

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

11. Support of Supplementary Services

Activation, Deactivation and Invocation of Supplementary Services should ideally function the same 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.

11.1 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 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 either be 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.

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 Preferred Language Indicator capability is supported in both the home and visited networks.

11.2 Invocation of Supplementary Services

Invocation is generally Supplementary Service specific. The invocation can occur in the home network or can 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.[1]

A visited foreign network example is 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

[1] An exception could occur if both the home and visited networks support notification (e.g., pip tone alert) when a call has been forwarded.

know when to trigger an ANSI-41 Redirection Request message to the originating MSC in the home network.

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 Termination Trigger parameter and instead, the serving network may need to trigger on the Calling Features Indicator, which is less flexible than the termination trigger parameter.

11.3 Summary

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 all of 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.

12. Emergency Number Dialing

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.

12.1 Description of the Issue

ANSI-41 is used in various countries where various languages are spoken and various dialing plans are implemented. International Roamers are usually not aware of the required digits to dial or procedure to follow in order to reach an emergency operator in a foreign country.

1.1 Recommendations

Two solutions are possible.

- 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 are dialed. This method works except in places that support neither the home digits nor the emergency bit.

12.2 Call Termination at a Lesser Cost (Optimal Routing)

Terminating calls to roamers in foreign markets are more complicated and expensive than necessary. Since callers do not usually know where the subscriber is, calls to mobile subscribers are always routed to the Home MSC, which in turn reroutes them to the serving MSC.

12.3 Description of the Issue

Terminating a call to a subscriber roaming into a foreign country involves routing the call to the home MSC and then to the serving MSC. 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 get routed to the serving market (Brazil) even if the caller and the called roamer are standing next to each other.

12.4 Recommendations

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 requires standardization being performed by national and international SS7 standards organizations using the Release-To-Pivot capability.
- In-band signaling, as proposed by some for tandem-free operation (see following section)

13. Fraud Issues

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.

13.1 Fraud Types

Fraud has taken different forms and is continuously changing its nature. 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 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 is another area affecting operators and one, which 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.

13.2 Fraud Control Technologies

Three technologies are deployed today in combating cloning fraud: roamer verification, RF fingerprinting and authentication.

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 is a technique in which each phone's unique signal fingerprint is matched with its ESN/MIN 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 United States government originally developed RF fingerprinting, and it has been primarily implemented in major U.S. markets by larger operators.

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 information. Cellular 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.

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.

15. Billing Issues

15.1 Billing Standards

The TAP or Transferred Account Procedure is the roamer billing standard used in GSM. The equivalent in the ANSI-41 world is CIBER. The Transferred Account Data Interchange Group (TADIG) is responsible for the development and documentation of the TAP standard. The Billing and Accounting Rapporteur Group, known as BARG, provides business strategy and direction to the TADIG. The development of TAP proceeded somewhat differently than CIBER.

CIBER was developed to support:

- Separate air, toll and tax fields.
- Multiple market identifiers for one carrier via the use of Billing Identifiers known as BIDs.
- The concept of Data Clearinghouses acting as the Authorized Receipt Points (known as ARPs) for file and record level editing and validation (these ARPs are certified by CIBERNET and eliminate 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 to support the European community, then it's use spread to other continents. In the GSM community, until only a few years ago, operators were licensed to provide coverage for an entire country. Because of this, roaming only occurred when traveling to another country until 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 out-source to a billing vendor. Since operators had their own billing systems, data clearinghouses were initially used only for file validation and routing.

TAP was originally 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 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. (THESE DATES HAVE PASSED. IS THERE NEW INFORMATION TO GO HERE?)

Although the standard for TAP 3 has been 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+.

15.2 Roaming Data Clearing, Settlement and Billing

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.

15.3 Call Data 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 therefore not referenced in the below matrix.

CIBER	**TAP**
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 15th 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. Also, 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 SDR's (Special Drawing Rights) and require conversion to the country's currency. Also, 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 don't 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).

15.4 Resolution

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

15.5 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 authorized receipt point (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 scenario, 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.

15.6 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 it meets all CIBER 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.

15.7 Reporting

The clearinghouse is in the position to provide valuable reporting on roaming trends and revenues for management to effectively manage their roaming business. 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 closely 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. These daily reports provide information which, if properly monitored and acted upon, can mean the difference between an efficiently run, profitable roamer business or 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.

15.8 Inter-operator Data Transfer and Typical Clearinghouse Process

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 won't necessarily restrict their roaming agreements to other CDMA operators and GSM operators are growing their scope to include roaming in TDMA markets today.

16. ANSI-41/IS-41 Backward Compatibility

Backward compatibility requires recommendations for ensuring that operations between various levels of IS-41 are possible, 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.

Compatibility must support partial implementations, particularly of IS-41 Rev. C and later (as full implementations may never exist.)

17. Tandem Free Operation

Operation of mobile-to-mobile calls without intermediate voice coders is desirable. This requires the use of compatible voice coders by both mobiles, 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.

18. SS7-Related Roaming Issues

MIKE DOYLE IS THE CURRENT MENTOR FOR THIS ISSUE.

19. Roaming Agreement Modeling

The following document is intended to be a guideline for Intercarrier Roaming Service Agreements. IFAST understands that each business entity may need to modify this document for specific business purposes and provides it as an information tool. The Intercarrier Roaming Service Agreement is also available in Spanish on the IFAST Web Site at http://www.ifast.org.

INTERCARRIER ROAMER SERVICE AGREEMENT

THIS INTERCARRIER ROAMER SERVICE AGREEMENT (the "Agreement") is dated as of the ____ day of _____, 1999 by and between ICO Global Communications Services B.V., on behalf of itself and its Affiliates listed in Schedule 1 hereto (individually and collectively, "ICO") and Carrier [B], on behalf of itself and its Affiliates listed in Schedule 2 hereto (individually and collectively, "[B]"). ICO and [B] are sometimes referred to, individually, as a "Party" and together as "Parties".

R E C I T A L

WHEREAS, each of ICO 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

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 Intercarrier 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 which 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

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 ICO: ICO Global Communications
Attn: Oscar R. Peña
1001 Brickell Bay Drive, Suite 2600
Miami Florida, 33131
Tel. No. +1 305 523 4500
Fax No. +1 305 523 4501
Email: oscar.pena@ico.com

If to [B]: Carrier [B]
_____
_____
_____
_____

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.

a. Billing period used by Serving Carrier
b. Batch sequence number

c. Serving and Home Carrier System Identification Number
d. Air Service charges
e. Total toll charges
f. All other charges and credits
g. Total taxes
h. 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. ICO 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 dispute 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.

> 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.

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 ICO 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 residing 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

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

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 prepaid, return receipt requested), facsimile, or overnight air delivery service, as follows:

If to ICO, to: ICO Global Communications
Attn: Oscar R. Peña
1001 Brickell Bay Drive, Suite 2600
Miami Florida, 33131
Tel. No. +1 305 523 4500
Fax No. +1 305 523 4501
Email: oscar.pena@ico.com

with a copy to: ICO Global Communications B.V.
Attn: Mr. Gardner Grant
General Counsel
Drenstestraat 20, 1083 HK Amsterdam
The Netherlands

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

_____

_____
_____
_____

with a copy to: Carrier [B]

_____
_____
_____
_____

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:

ICO Global Communications Services B.V.	Carrier [B]
By_____	By_____
Date: _____	Date: _____
Name: Armando Vargas-Araya	Name:_____
Title: Regional General Manager	Title _____

SCHEDULE 1

Affiliates of ICO Global Communications Services, B.V.

SCHEDULE 2

Affiliates of Carrier [B]

EXHIBIT A

SERVICE CHARGES

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

Terrestrial Roaming Charges:

ICO's rates to [B]:

Airtime Rates:
Toll Rates:

[B]'s rates to ICO:

Airtime Rates:	**$.40/min**
Toll Rates:	100% pass through

EXHIBIT B

Technical Data

METHODS AND PROCEDURES

The following information is furnished by ICO Global Communications to [B] pursuant to Section 4.1 of the Intercarrier Roamer Service Agreement between ICO Global Communications and Carrier [B] , by _____:

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

Information from ICO to be supplied at a later date.

By:_____

Title:_____

Issue Date:_____

The effective date shall be

_____

20. ANI Compatibility

RICARDO GOMEZ AND/OR BERNARDO MARTINEZ SHOULD PROVIDE TEXT FOR THIS SECTION.

GLOSSARY

Term	Abbreviation	Definition
Advanced Mobile Phone Service	AMPS	TIA analog cellular, and all standards that retain compatibility with it (NAMPS, D-AMPS, CDMA).
Alliance for Telecommunications Industry Solutions	ATIS	
American National Standards Institute	ANSI	
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.
Billing Identifier	BID	A SID allocated for accounting purposes. Allocated by Cibernet
Calling Party Pays	CPP	The calling party pays for calls to mobile, not the mobile receiving the call.
Cellular Intercarrier Billing Exchange Record	CIBER	Tape format for wireless billing records. Maintained by Cibernet Corp.
Cellular Telecommunications Internet Association	CTIA	
Cibernet		A subsidiary of the CTIA responsible for facilitating billing aspects of roaming.
Committee T1		ATIS Standards Committee.
Common Channel Signaling System #7	CCS7	ITU-T version of SS7.
Digital AMPS	D-AMPS	IS-54 and IS-136 TDMA
Directory Number	DN	The number dialed to terminate a call to a phone.
Dual Tone Multifrequency	DTMF	Tone signaling used by phones.
E.164		ITU-T dialing plan standard.
E.212		ITU-T mobile identification number standard.
Electronic Serial Number	ESN	32 bit identifier of an AMPS mobile.
Electronics Industry Alliance	EIA	
Equipment Identity Register	EIR	
Global System for Mobile Communications	GSM	
Global Title	GT	A non-native SS7 address based on E.164 DN's, 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	
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 or 1 to uniquely identify a mobile that does not have a DN within the NANP assigned to it.
International Roaming MIN	IRM	A mobile subscription identifier beginning with the digit 0 or 1 to avoid conflict with NANP MINs
International Telecommunications Union	ITU	
International Telecommunications Union--Telecommunications Division	ITU-T	
International Telecommunications Union-Radio Communications Division	ITU-R	
Invoke		Message sent to initiate an ANSI-41/IS-41 transaction
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 intersystem 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.
ISDN User Part	ISUP	SS7 call processing signaling between switches
ITU-R		International Telecommunications Union - Radio Communications Division
ITU-T		International Telecommunications Union - Telecommunications Division
J-STD		Joint ATIS-T1/TIA standard.
Message Center	MC	See “Short Message Center”
Message Transfer Part	MTP	SS7 transport layer
MIN Block Identifier	MBI	A 6-digit code used to identify a block of MIN codes within the NANP.

Mobile Application Part	MAP	Protocol that interconnects wireless telephone systems (e.g., MSCs and HLRs).
Mobile Country Code	MCC	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	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	MS	Wireless phone.
Mobile Station Identifier	MSID	Either a MIN or an IMSI.
Mobile Switching Center	MSC	
Narrowband AMPS	NAMPS	
North American Numbering Plan	NANP	
Number Assignment Module	NAM	Storage for a single MIN or IMSI (or both) along with related information to identify the subscription for a mobile. A mobile may have multiple NAM's to allow multiple subscriptions.
Originating Point Code	OPC	Where an SS7 message came from.
Over-the-Air Programming	OTA	Uploads internal mobile tables.
Personal Communications System	PCS	
Point Code	PC	A numeric SS7 address. 24 bits in the NANP, 16 bits in Japan, and 14 bits in most other countries.
Project Number	PN	TIA Project Number
Public Land Mobile Network	PLMN	A cellular or PCS network.
Public Switched Telephone Network	PSTN	Utilizing R1 MF tone interfaces.
Service Node	SN	A combination of SCP and IP functionality.
Service Switching Point	SSP	An MSC or other type of switch.
Short Message Center	MC	
Short Message Service	SMS	
Signaling Connection Control Part	SCCP	SS7 enhanced routing and identification layer.
Signaling Control Point	SCP	
Signaling Point	SP	
Signaling System Number 7	SS7	Common channel telecommunications packet switching.
Signaling Transfer Point	STP SS7	An SS7 packet router.
Standards Development Organization	SDO	The TIA and ATIS are SDOs
Standards Proposal Number	SP-	ANSI Standards Proposal Number

Sub-system Number	SSN	Along with PC, identifies and SS7 network application or a virtual SS7 network entity.
Subscriber Identification Module	SIM	"Smart Card" for a GSM phone. See UIM.
System Identifier	SID	A 15-bit identifier of an AMPS wireless license or system.
Telecommunications Industry Association	TIA	
Telecommunications System Bulletin	TSB	TIA often uses it as an addendum or erratum to a published interim standard.
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.
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 ANSI-41.
TIA/EIA-95-B		Third generation CDMA air interface standard. Replaces IS-95.
Time Division Multiple Access	TDMA	Modulation technique used by D-AMPS and GSM.
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 intersystem protocols.
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.
Transaction Capabilities Application Part	TCAP	Message packaging standard used by ANSI-41/IS-41 and defined in ANSI T1.114.
User Identification Module	UIM	"Smart Card." See SIM.
Visitor Location Register	VLR	
Wireless Intelligent Network	WIN	Protocol with similar goals as IN and AIN.

Related Contact Information:

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Notes: