

Interfacing with interWAVE



White Paper

Steps to Becoming a GSM Operator

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Introduction

This interWAVE white paper reviews several necessary steps a company must take to become a GSM operator.

Subscription to the GSM MoU Association

The GSM MoU Association is the principle body responsible for promoting and evolving the GSM wireless platform worldwide. Full Membership is open to licensed mobile network operators committed to building and implementing GSM based systems and government regulators/administrations who issue commercial mobile telecommunication licenses.

Before becoming a member of the GSM Association, an operator must go through an application procedure. After the operator's application has been reviewed by the GSM Association and membership has been granted, the applicant is accepted as a provisional member. Full membership only becomes definitive upon the ratification of membership at the next Plenary Meeting.

To be a member of the GSM Association an operator must contribute to the running of the Association and fund on-going projects being carried out by the Association. Each member's share of the annual contribution is calculated by using statistics such as population of their Licensed Service Area (LSA), GNP per capita and number of Public Land Mobile Networks (PLMN) in the LSA.

Membership of the GSM Association provides some values to the operator's business, which are discussed in the following sections.

Availability of the GSM Algorithms

There are four main algorithms used in GSM voice telephony. These algorithms are used either for authenticating subscribers with the network authentication center (AuC) or used as part of the speech and data encryption process between the handset and the network's base station. The algorithms used in the authentication process are known as A3 and A8 (or more commonly combined as A3/A8 or COMP 128). The algorithms used in the encryption process are known as A5/1 and A5/2.

The A3 and A8 algorithms are used to check the identity of the subscriber and protect not only the operator against fraud but also the subscriber, by restricting the access of his mobile account to a third person. These algorithms must be programmed into the smart cards (SIMs) by the SIM supplier and also into the network's authentication center (AuC). An example version of the A3/A8 algorithm is supplied to members by the GSM Association. The design choices of GSM allow the operator to substitute his own version of A3/A8 instead of using the exact provided example version. The new example version of COMP 128, called COMP 128-2, is also supplied by the GSM Association's headquarters in Dublin, Ireland.

The series of A5 algorithms are used within each handset to scramble the call between the handset and the base station and are available to the GSM Association members only. There are two main A5 algorithms, namely A5/1 and A5/2, which are

mandatory algorithms required by handset manufacturers and HLR vendors. Nevertheless some countries don't allow the use of any encryption algorithm for security/defense reasons; China is one example.

While the ETSI GSM specifications refer to the algorithms in general terms, the Association defines and distributes the A5 algorithms to allow interworking between operators. Distribution of A5/1 is now limited to CEPT countries or countries who had this algorithm prior to January 1995. Consequently, A5/2 is now a more widely distributed encryption algorithm.

The A3/8 and A5 algorithms are only available to the Association members. The operator may distribute them to manufacturers if the required Confidentiality / Non-disclosure agreements are signed by the manufacturers.

Other Benefits

Other benefits of being a member of the GSM Association include, but are not limited to:

- Access to a library of documentation referred to as "Permanent Reference Documents" (PRD), which contain commercial and operational procedures for operating a GSM network.
- Know-how transfer on starting and operating GSM based networks. Additionally, an internet-based system, the GSM InfoCentre, is accessible 24 hours a day and allows members to share a wide range of information on issues such as roaming, standards, forthcoming events, meetings and technical discussions.
- Participation in the GSM Global Roaming Forum, which includes: participating in critical standardization work to enable Inter-Standard Roaming, building consensus for new roaming features and services, and gaining access to proprietary reference material.

Codes Allocation

Mobile Country Code (MCC) and Mobile Network Code (MNC)

The operator needs to be assigned a Mobile Country Code (MCC) and a Mobile Network Code (MNC) since these codes are part of the IMSI number, which is used as the main subscriber key in the GSM location databases.

The MCC is the first field of the IMSI and is three digits in length; it identifies the country. The MNC is the second field of the IMSI and is two to three digits in length; it identifies the network within the country. The MNC, in combination with the MCC, uniquely identifies the home network of the mobile terminal or mobile user.

The allocation of MCCs is administered by the ITU-T, International Telecommunication Union. The ITU-T publishes the list of Mobile Country Codes in its form, Complement to Recommendation E.212, "List of Mobile Country or Geographical Area Codes." This form is available from the ITU web site at http://www.itu.int/itudoc/itu-t/ob-lists/icc/e212_685.html.

MNCs are administered by the designated administrator within each country (usually the national telecommunication authority of regulation). The operator can recommend the MNC but in all cases the country regulator will have to approve it.

Network Color Codes

In a GSM network, there can be configurations where the mobile station is able to capture more than one beacon channel (BCCH: Broadcast Control Channel) using a given frequency. This may happen when frequency planning must be done with very few frequencies, or at national

boundaries. For instance, when the radio spectrum available to a given operator is limited to, say, 2 MHz, frequency planning must cope with at most 10 frequencies. The best beacon frequency allocation scheme may not be able to avoid overlapping coverage, and a mobile station will in some cases receive two beacon channels with the same frequency. A similar situation is also frequent along national boundaries. Whereas inside a country, the frequency allocation of different operators are separate and distinct, two Public Land Mobile Network operators on each side of the border may have some frequencies in common. In turn, a mobile station will be in a position to receive the same beacon frequency transmitted by two base stations of different PLMNs.

The purpose of the color codes is to provide a method for the mobile station to distinguish between two different cells, in the same or different networks, using the same beacon frequency.

Two cell-identity parameters are provided in GSM: the Base Station Color code (BCC) and the Network Color Code (NCC). The two combined make up the Base Station Identity Code (BSIC), which is broadcast on the Synchronization Channel (SCH).

Within the same network, the identification can be done on the basis of the Base Station Color Code. The allocation of this code is purely a network operator choice.

Where networks overlap, the unique network identification is achieved using the Network Color Code. NCCs are not allocated by a central body; PLMN operators must agree on which NCCs are to be used.

SIM Header

The SIM Header is part of the SIM Serial Number that is printed on the smart cards.

The serial number is standardized in accordance with the ITU-T Recommendation E.118. This recommendation specifies a maximum of 19 digits, starting with the header as follows:

- 89;
- followed by the country code specified in ITU-T Recommendation E.164 "List of assigned country codes", available from the ITU web site at http://www.itu.int/itudoc/itu-t/ob-lists/icc/e164_717.html;
- followed by the Issuer Identifier Number.

The remaining digits are the individual serial number and a check digit.

Generally, the Issuer Identifier Number is allocated by the national administration of the operator's country. The header selected should then be registered to the ITU using the procedure indicated in Recommendation E.118.

Roaming - Collaboration with a Clearinghouse

When two GSM networks wish to interwork they setup a roaming agreement, which is based on the standard GSM MoU agreement. Roaming is not a mandatory step in becoming a wireless operator, but most operators go through the process of setting up roaming agreements. Today, roaming is predominantly implemented for postpaid users.

This process involves opening a signaling connection for signaling messages (SS7 MAP) to be exchanged between the networks and a commercial settlement procedure to exchange billing records and net charges within agreed upon timeframes.

The primary aim of a clearinghouse is to speed-up market entry of new network operators and to support their global roaming operations; from the negotiation of Roaming Agreements to on-site testing. It is targeted at operators wishing to outsource the complex process of starting a roaming capability. Operators do have the choice to perform this activity without reliance on a clearinghouse, but this consumes lots of time and resources.

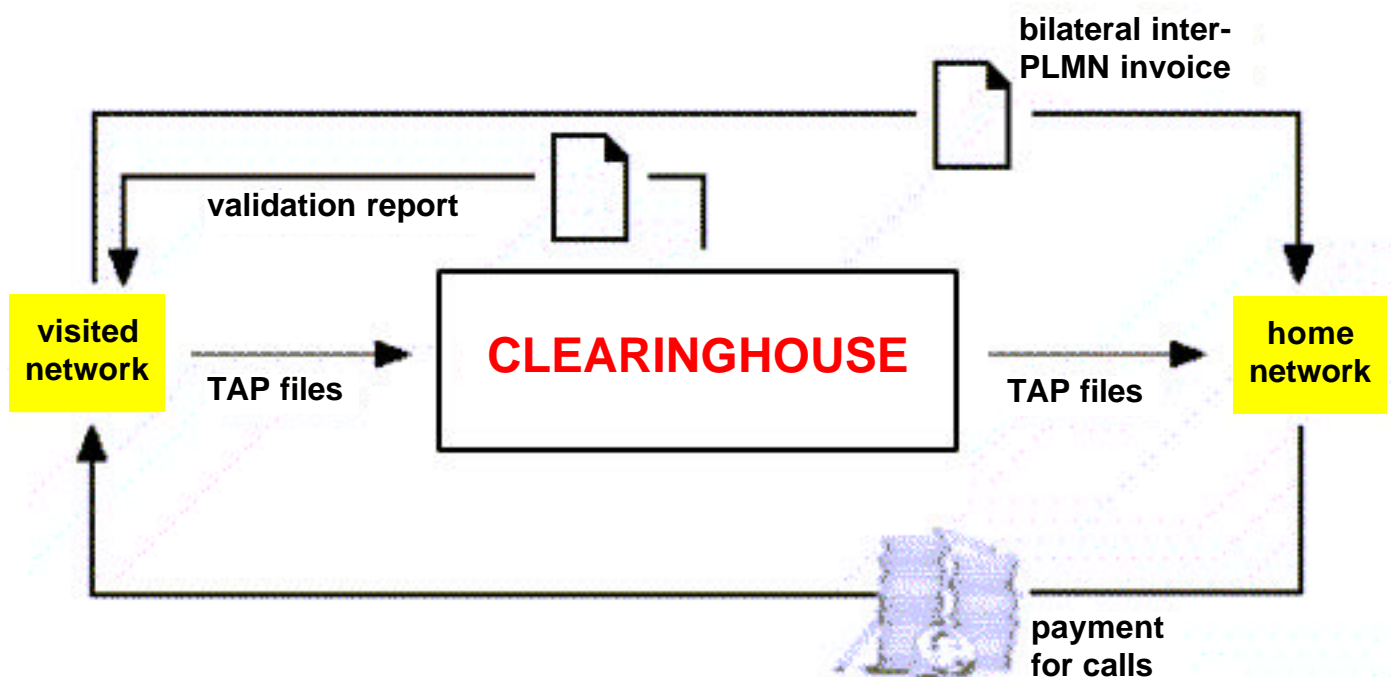
The clearinghouse assists operators in the following areas:

- Preparation of the roaming agreements and management of all aspects of negotiation, documentation and correspondence.
- Validation and transmission of billing data. The visited network sends the call data in TAP (Transferred Account Procedure) format to the clearinghouse. In case of errors, a validation report is sent out. Accepted files are sent to the respective home networks (see diagram below).

- Operators can deliver the billing records to the clearinghouse in TAP format as an output of their Billing System. If they do not have a Billing System in service within their network

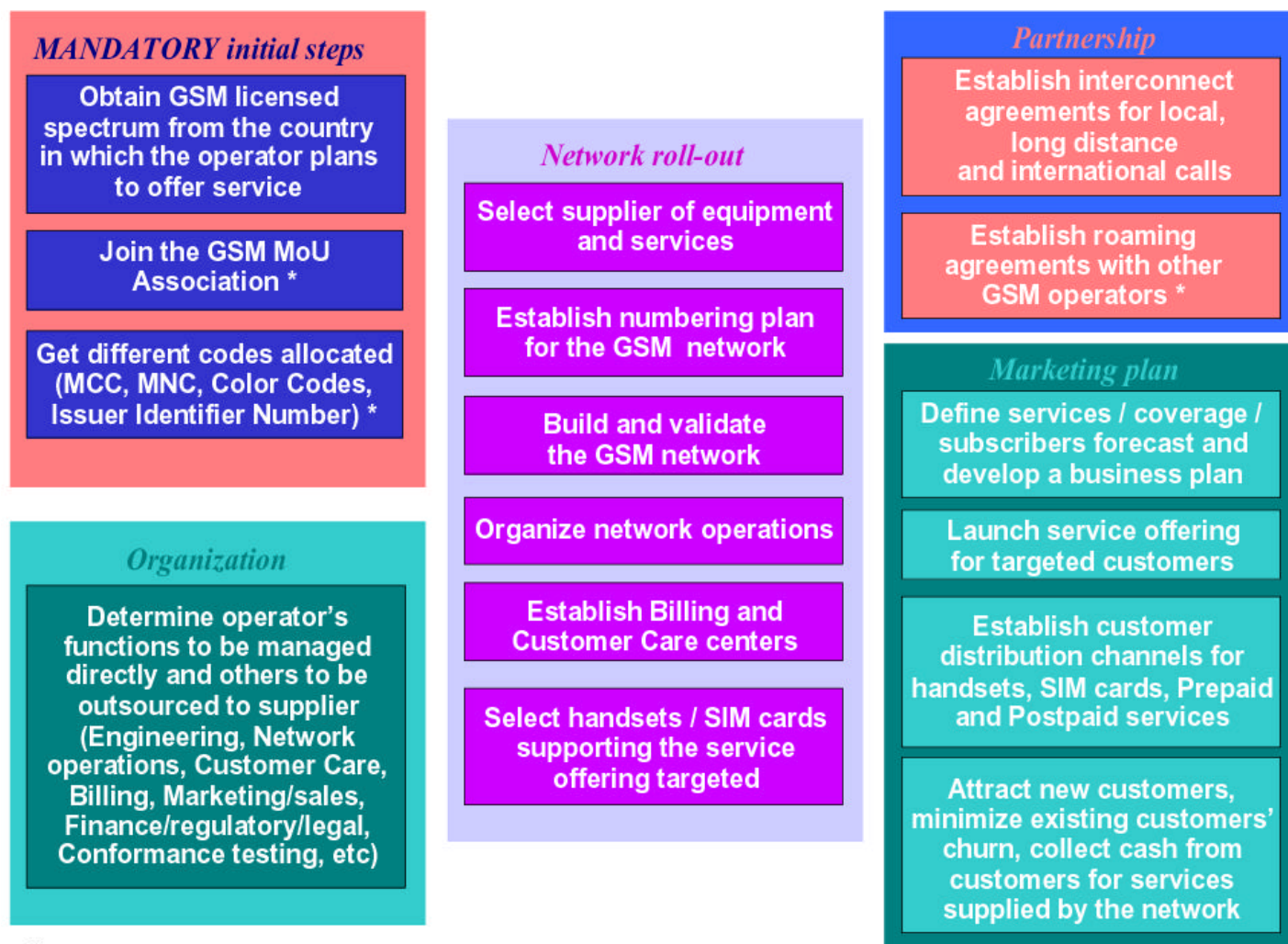
Production of invoices or credit notes based on validated billing formats.

Providing connection paths to the SS7 Network. In the case of international roaming, operators have to get access to an International Gateway that has been attributed an International Signaling Point Code (ISPC). The ISPC uniquely identifies a signaling point within the International SS7 Network. This code is issued whenever it is necessary to address that particular signaling point. Because ISPCs are a relatively scarce resource, only a few are assigned by country by the ITU-T to networks that are expected to meet certain size requirements. Please note that international signaling point codes are not only required for roaming but also necessary should an operator want to have an international gateway license to terminate international calls to the cell phones of his subscriber base. This can represent a significant additional revenue source.



Summary

In addition to the necessary tasks that have been detailed above, there are some further, yet self-explanatory, actions to be taken by a GSM operator. They are highlighted in the diagram below.



* These steps have been explained in detail in the body of the white paper

List of Acronyms

A3	Authentication algorithm
A5	Signaling data and user data encryption algorithm
A8	Ciphering key generating algorithm
AuC	Authentication Center
BCC	Base Station Color Code
BCCH	Broadcast Control Channel
BSIC	Base Station Identity Code
CEPT	Conférence Européenne des Postes et Télécommunications
ETSI	European Telecommunications Standards Institute
GNP	Gross National Product
GSM	Global System for Mobile communication
HLR	Home Location Register
IMSI	International Mobile Subscriber Identity
ISPC	International Signaling Point Code
ITU-T	International Telecommunication Union
LSA	Licensed Service Area
MAP	Mobile Application Part (NSS signaling messages)
MCC	Mobile Country Code
MNC	Mobile Network Code
MoU	Memorandum of Understanding
NCC	Network Color Code
PLMN	Public Land Mobile Network
PRD	Permanent Reference Documents
SCH	Synchronization Channel
SIM	Subscriber Identity Module
SS7	CCITT Signaling System Number 7
TAP	Transferred Account Procedure