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# ***Subscriber Services***

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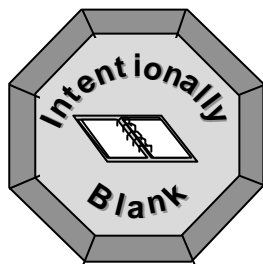
## ***Chapter 12***

This chapter is designed to provide the student with an overview of subscriber services. It introduces the main types of services and describes their functions, features, and specifications.

### **OBJECTIVES:**

Upon completion of this chapter the student will be able to:

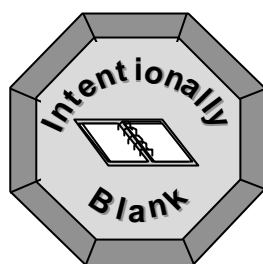
- List the different types of services available in the network
- Identify one of each of the following service types in the network: teleservices, bearer services and supplementary services
- Identify one of the Ericsson innovative services in the network
- Briefly describe the Mobile Intelligent Network (MIN) services available with Ericsson's GSM systems
- Briefly describe the mobile intelligent network nodes
- Understand the need and advantages of the CAMEL system



# 12 Subscriber Services

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## INTRODUCTION

The primary objective of a mobile telephony system is to allow mobile subscribers to communicate effectively. Ericsson's GSM systems provide this by offering a number of different basic telecommunication services.

The service functionality of Ericsson's GSM system improves with each system release. Technical specifications are continuously being developed in order to incorporate new and improved functions into the system.

## SERVICE CATEGORIES

There are three main types of telecommunications services:

- **Basic services:** These are available to all subscribers to a mobile network. For example, the ability to make voice telephone calls is a basic service.
- **Supplementary services:** These are additional services that are available by subscription only. Call forwarding is an example of a supplementary service.
- **Intelligent Network Services:** These services are distinguished by being implemented in a special way. (In theory one could implement the same service as a Supplementary Service or as an Intelligent Network Service). Prepaid services are an example of an Intelligent Network Service.

In addition, basic telecommunication services can be divided into two main categories:

- **Bearer services:** A bearer service transports speech and data as digital information within the network between user interfaces. A bearer service is the capability to transfer information and does not include the end-user equipment. Every teleservice is associated with a bearer service. For example, a bearer service associated with the speech telephony teleservice is the timeslot assigned to a call on a TDMA frame over the air interface.
- **Teleservices:** A teleservice allows the subscriber to communicate (usually via voice, fax, data or SMS) with another subscriber. It is a complete system including necessary terminal equipment.

## BASIC TELECOMMUNICATIONS SERVICES

### BEARER SERVICES

Ericsson's GSM systems offer a wide range of bearer services. The DTI supports data services offered by the system. Rates up to 48 kbits/s are possible.

**Traffic to PSTN:** for data traffic external to PLMN such as internetworking with ISDN or directly to PSTN, the system selects a suitable modem in the DTI.

**Traffic to ISDN:** an entire set of data communication services with ISDN terminals is available. Unrestricted digital information is transferred and no modem is necessary.

**Traffic to Packet Switched Public Data Networks (PSPDN):** Packet service supports synchronous data transfers with the PSPDN with rates from 1.2 to 48 kbits/s. With synchronous data transfers a packet mode terminal can be directly connected to the MS. Synchronous data communication between an MS and a packet switched network is possible via the Packet Assembler-Disassembler (PAD) facility. Rates between 300 and 9600 bits/s are supported.

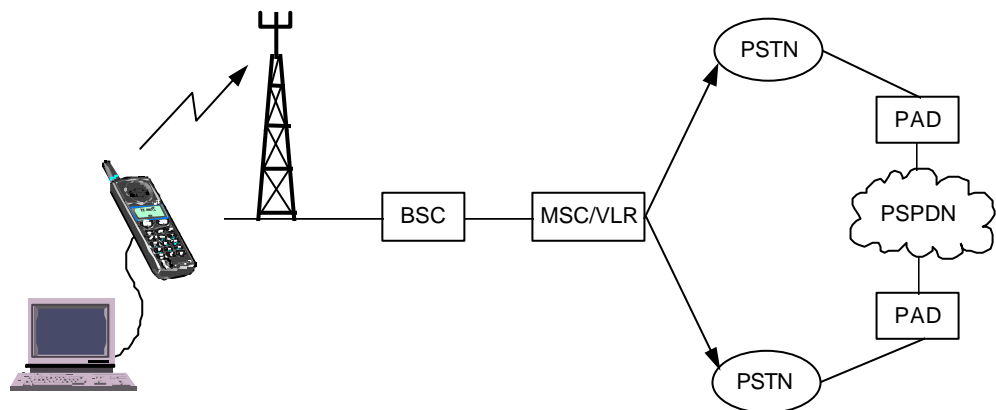


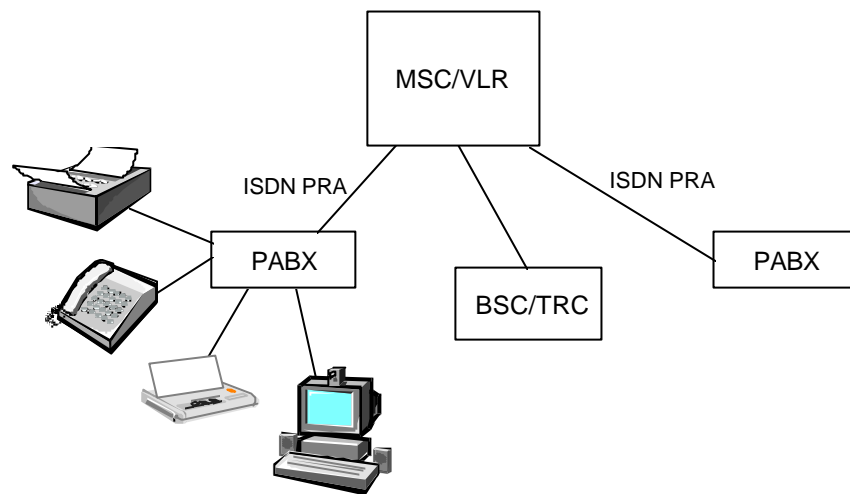
Figure 12-1 Data call in GSM to PSPDN

**Traffic to Circuit Switched Public Data Networks (CSPDN):** Data communications with a CSPDN is possible via the PSTN or ISDN, depending on the CSPDN-transit network interface.

**Traffic to Internet:** traditionally, an MSC accessed Internet nodes via existing networks such as the PSTN. However, the direct access

function enables an MSC to communicate directly with Internet nodes, thus reducing call set-up time.

**ISDN Primary Rate Access (PRA):** this function enables an MSC to provide PRA services to subscribers. For example, a network operator can offer PABX connection services through the PLMN. In this way the operator can compete directly with PSTN operators for ISDN business subscribers. PRA provides a data rate of up to 2 Mbits/s.



*Figure 12-2 ISDN Primary rate access provided by an MSC*

## TELESERVICES

This section describes the major teleservices supported by Ericsson's GSM systems.

**Speech:** This is normal telephony (two-way voice communication) with the ability to make and receive calls to/from fixed and mobile subscribers worldwide. This is the most fundamental service offered.

**Emergency calls/Flexible Positioning Support:** The emergency call function enables a subscriber to make an emergency call by pressing a predefined button or by using the emergency number. With an emergency area origin identifier, the call is automatically routed to the emergency center nearest to the subscriber. Emergency calls can be made with the phone itself, without a valid SIM-card, overriding locked phone and pin codes. The emergency number in GSM 900 & 1800 is 112 and in GSM 1900 it is 911.

The provision of 'Flexible Positioning Support' fulfills the regulatory requirement that the network must be able to locate subscribers who make emergency calls. The accuracy varies depending on the positioning method used but ranges between 550 to below 10 meters. (It is envisaged many new subscriber services, based on positioning, will emerge. An example would be the provision of tourist information (e.g. hotels, restaurants) based on subscriber location. See chapter 7 on BSS)

**Facsimile group 3:** GSM supports International Telecommunications Union (ITU) group 3 facsimile. Standard fax machines are designed to be connected to a telephone using analog signals, a special fax converter is connected to the exchange. This enables a connected fax to communicate with any analog fax in the fixed network.

**Dual Tone Multi Frequency (DTMF):** This is a tone signaling facility which is often used for various control purposes, such as remote control of answering machines and interacting with automated telephone services.

**Alternative Speech/Fax:** This service allows the subscriber to alternate between speech and fax within one call setup. The subscriber can start the call either with speech or fax and then alternate between the two call types. The subscriber can switch several times within the same call.



**Short Message Services (SMS):** This service allows simple text messages consisting of a maximum of 160 alphanumeric characters to be sent to or from an MS.

If the MS is switched off, or has left the coverage area, the message is stored in a Short Message Service Center (SMS-C). When the mobile is switched on again or has re-entered the network coverage area, the subscriber is informed that there is a message. This function guarantees that messages are delivered.

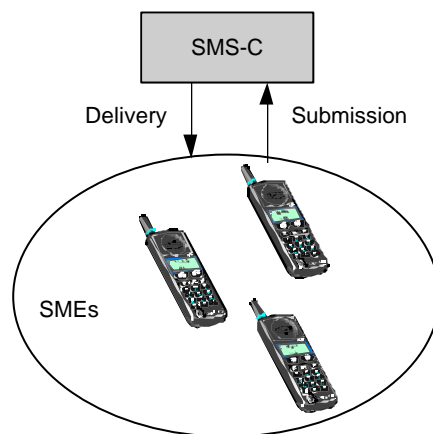


Figure 12-3 SMS-C

**SMS Cell Broadcast (SMSCB):** The cell broadcast facility is a variation of the short message service. A text message with a maximum length of 93 characters can be broadcast to all mobiles within a certain geographic area. Typical applications are traffic congestion warnings and accident reports, and in the future, possibly advertisements.

**Voice mail:** This service is an answering machine within the network that is controlled by the subscriber. Calls can be forwarded (see supplementary services, call forwarding) to the subscriber's voice mailbox. The subscriber accesses the mailbox using a personal security code.

**Fax mail:** This service allows the subscriber to receive fax messages at any fax machine via the MS. Fax messages are stored in a network service center. The subscriber accesses the fax mail via a personal security code and the fax is then sent to the desired fax number.

## SUPPLEMENTARY SERVICES

This section describes the main supplementary services supported by Ericsson's GSM systems.

**Call forwarding:** This service provides the subscriber with the ability to forward incoming calls to another telephone number in the following situations:

- Call forwarding on MS not reachable
- Call forwarding on MS busy
- Call forwarding on no reply
- Call forwarding, unconditional

**Barring of outgoing calls:** The subscriber can activate or deactivate this service from the MS with a variety of options for barring outgoing calls. For example, the subscriber can:

- Bar all outgoing calls
- Bar all outgoing international calls
- Bar all outgoing international calls except those directed to the home PLMN

**Barring of incoming calls:** With this function, the subscriber can prevent incoming calls. This is desirable because in some cases the called mobile subscriber is charged for parts of an incoming call (e.g. during international roaming).

There are two incoming call barring options:

- Barring of all incoming calls
- Barring of incoming calls when outside home PLMN

**Advice of Charge:** The Advice of Charge (AoC) service provides the MS with information needed to calculate the charge of a call. This information is provided at call set-up.

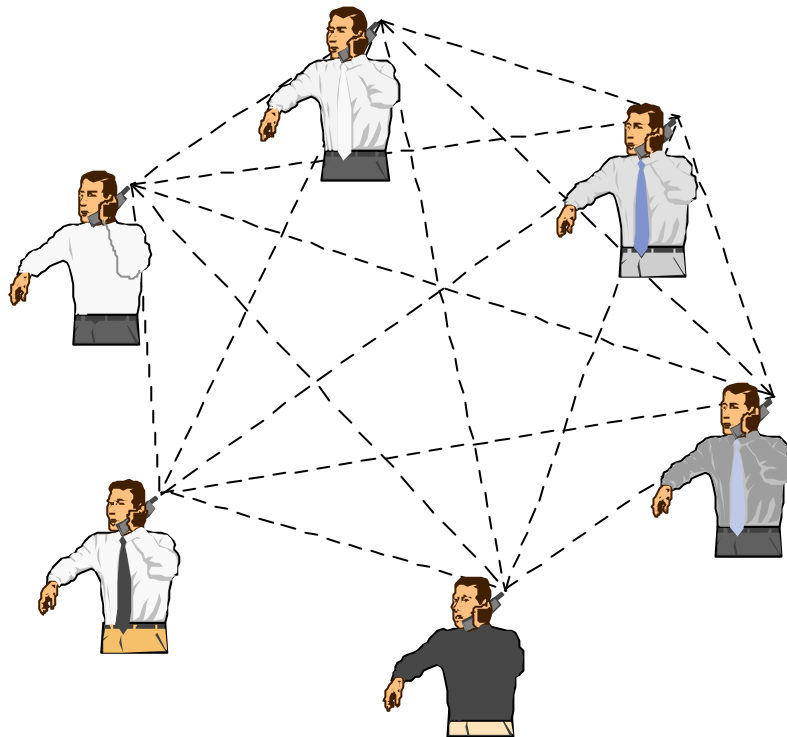
Charges are indicated for the call in progress when mobile originated. For a mobile terminated call, AoC only offers information on the roaming leg.

**Account Codes:** This service enables a subscriber, e.g. a business, to identify an account number, which is to be charged for particular call components. Account codes can be identified on a per call basis.

**Call waiting:** This service notifies the mobile subscriber, usually by an audible tone, for incoming call. The call can then be answered, rejected or ignored. The incoming call can be any type of basic service including speech, data or fax. There is no notification in the case of an emergency call or SMS.

**Call hold:** This supplementary service enables the subscriber to put the basic normal telephony service on hold in order to set up a new call or accept a waiting call. Communication with the original call can then be re-established.

**Multiparty service:** The multiparty service enables a mobile subscriber to establish a multiparty conversation, that is, a simultaneous conversation between up to six subscribers. This service can only be used with basic speech telephony.



*Figure 12-4 Multiparty service*

**Calling line identification services:** These supplementary services cover both the presentation and restriction of the calling line identity. The presentation part of the service supplies the called party with the ISDN or MSISDN number of the calling party. The restriction service enables calling parties to restrict the presentation of their numbers on the MSs of called parties. Restriction overrides presentation.

**Connected line identification presentation/restriction:** These supplementary services supply the calling party with the ISDN number of the connected (called) party. The restriction enables the connected party to restrict the presentation. Restriction overrides presentation.

This service is useful when the call is forwarded or when it is connected via a switchboard.

**Closed User Group (CUG):** The CUG service enables subscribers connected to the PLMN/ISDN and possibly other networks, to form groups in which access is restricted. For example, members of a specific CUG can communicate with each other, but generally not with users outside the group.

## ERICSSON'S INNOVATIVE FEATURES

Ericsson's innovative features offer a level of service beyond the basic network standards. New features are developed on an ongoing basis as customer demands and competition increase. Some features are described in this section.

**Single personal number:** The single personal number service allows a subscriber to arrange call forwarding to other networks when the mobile is not reached in the subscriber's primary network. With this feature, one directory number can reach the subscriber even though the subscriber may have subscriptions in several different networks.

**Dual numbering:** This feature allows the subscriber to have two different directory numbers connected to the same subscription and the same mobile equipment. In this way different accounts can be connected to the different directory numbers. For example, the subscriber may want one business account and one private account connected to the same subscription. Support for this feature is required in the MS.

**Immediate call itemization:** This feature is also called 'Hot billing'. It is used when it is necessary to have immediate call charging data output (e.g. to bill a third party for use of a telephone, which is rented).

**Regional and local subscription:** These features allow subscribers to subscribe to a service in a specified geographical area. Requests for service outside the area are rejected with the exception of emergency calls and SMS. For local subscriptions, the geographical area consists of a number of cells, and for regional subscriptions, the area consists of LAs. The cells or LAs do not need to be adjacent but can be spread out over the PLMN. For regional subscriptions, LAs in other PLMNs in other countries may be included. Handovers are not influenced.

**Geographically differentiated charging:** This feature enables the GSM PLMN area to be divided into different tariff regions. A tariff region is defined as a set of cells. A subscriber may be offered cheaper calls within certain areas. This feature can be combined with the service regional subscription.

## MOBILE INTELLIGENT NETWORK (MIN) SERVICES

### INTRODUCTION

A Mobile Intelligent Network (MIN) is a telecommunications concept that meets the market demand for advanced services within the existing telephony network.

Intelligent Networks (IN) are an established concept in the PSTN. IN functionality has been adapted to meet the requirements of mobile networks, hence Mobile Intelligent Networks (MIN). A mobile intelligent network is an overlaid network, that is the MIN nodes are overlaid onto an existing mobile network.

The 'intelligence' in the MIN is realized in centralized computer software and data. The ultimate objective of MIN is to increase revenue for the network operator and the service provider.

MIN offers a number of advantages to a GSM network operator:

- Increased subscriber numbers due to more attractive services
- Increased revenue due to use of services
- Increased subscriber loyalty
- Increased flexibility in deploying services in a network
- Decreased development time for services
- Reusability of service modules

The following MIN services are available for Ericsson's GSM systems:

- Personal Number
- Pre-Paid SIM Card
- Cellular Virtual Private Network (CVPN)
- Information and business (I&B)

## **PERSONAL NUMBER**

This MIN service assigns a single number to a subscriber. This personal number is used to contact that subscriber at defined connections, using a time-based routing profile for that subscriber. For example, if the personal number is dialed between 9am and 5pm the call may be routed to the subscriber's work number. However, if the personal number is dialed between 5pm and 9am the next morning, the call may be routed to the subscriber's mobile phone.

The target market for this service are subscribers with high existing mobile communication expenditures. The service can be used to keep, attract, and possibly migrate customers from different networks. Increased profitability will come from long term effects such as customer loyalty and, in the short term, increased airtime, increased call completion rates and new service charges.

## **PRE-PAID SIM CARD**

This service enables a subscriber to pay in advance for an agreed amount of call charges. The amount is stored on the subscriber's SIM card or in SCF in the network. When the limit of call charges is exceeded, the subscriber will no longer be able to make calls, but may purchase more call charges as desired.

In addition, there is no fixed term of subscription, meaning that a subscriber is not bound to a contract of subscription and the associated fees. Advantages for an operator include:

- Increased number of subscribers
- Increased number of calls
- Payment in advance for calls

## CELLULAR VIRTUAL PRIVATE NETWORK (CVPN)

The Cellular Virtual Private Network (CVPN) service allows groups of users to define a common short numbering plan to simplify communication within the group. In the CVPN service, both mobile and fixed- subscribers can be integrated as well as PABX users. Subscribers in the cellular private network are able to make calls outside the network by dialing an escape code.

Within this service it is possible to design a personal profile for each subscriber by combining call barring and terminating screening functions. Subscribers can also have a personal routing of their calls based on conditions (e.g. 'No reply').

## Information and business (I&B)

Ericsson's I&B suite of services includes the following:

**Freephone:** this service allows subscribers to call for free. (In Sweden 020-numbers, in USA 800-numbers)

**Universal Access Number:** A company can have one single number on which it can be reached. The MIN routes the call based on the location of the caller.

**Premium Rate Service:** gives the subscriber access to specialized information services, e.g. financial, sporting or weather information.

## MIN INTERESTED PARTIES

There are four interested parties in a MIN service:

- **Service User:** the party which makes a call to a MIN service
- **Service Subscriber:** the party which offers the MIN service to the marketplace
- **Service Provider:** the party which operates the network and designs the MIN services
- **Service Supplier:** the party which supplies the hardware and software platforms for MIN services



## SERVICE ARCHITECTURE

MIN service intelligence consists of modular software blocks called service scripts. Each script is designed to perform a particular function. For example, there may be a script that requests the user to enter a security code and checks that it is the correct code for their account. This could be one of many scripts used as part of a credit card calling service.

Service scripts are collections of smaller blocks of logic, each designed to perform a particular task.

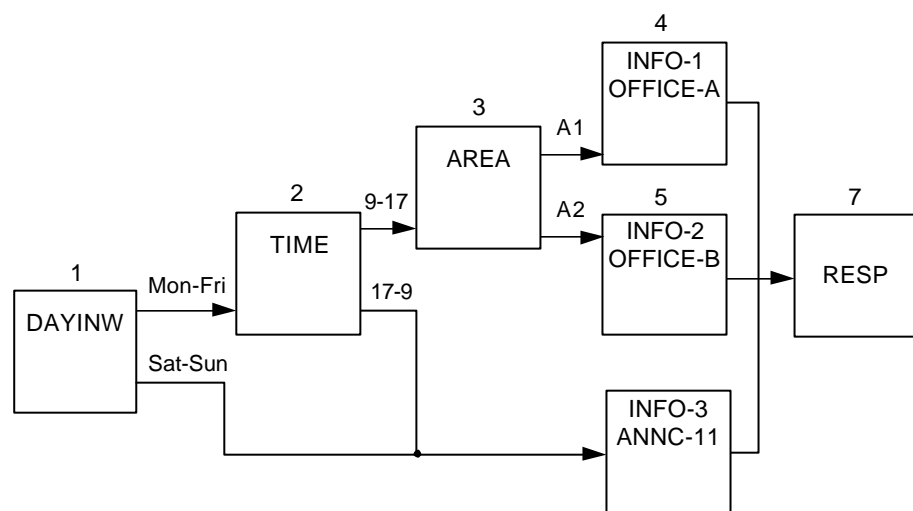


Figure 12-5 Example of logic in a script for a time-based routing service

## MIN NETWORK ARCHITECTURE

The Mobile Intelligent Network (MIN) provides architecture for the introduction of new services throughout the network, with a minimum impact on the switching elements and the signaling systems.

To introduce MIN into an Ericsson-based GSM network requires the introduction of the following functions and environments:

- Service Switching Function (SSF)
- Service Control Function (SCF)
- Service Data Function (SDF)
- Special Resource Function (SRF)
- Service Management Environment (SME)
- Service Creation Environment (SCE)

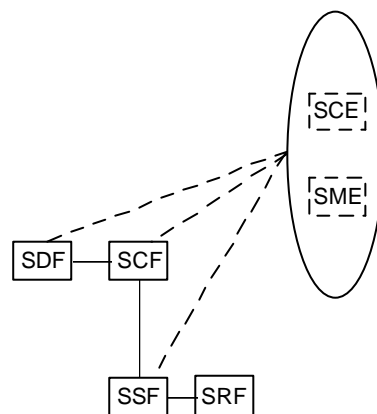


Figure 12-6 MIN network functions

## ***THE SERVICE SWITCHING FUNCTION (SSF)***

The Service Switching Function (SSF) acts as an interface between the normal mobile call control functions of an MSC/VLR and the functions that control a MIN service. The node in which an SSF is located is termed the Service Switching Point (SSP). The SSP performs the necessary switching, signaling and charging to implement a MIN service, in response to the instructions it receives from the Service Control Function (SCF).

An SSF includes functions for:

- Initiating a MIN service (triggering)
- Call handling and switching
- Activation of resources such as announcement machines
- Charging
- Communication with the MSC/VLR and with the SCF

In Ericsson's GSM systems, SSF functions are implemented using the Service Switching Function Application Module (SSFAM), which uses function blocks from the Service provisioning Subsystem (SES). The SSFAM is integrated within an MSC/VLR.

## **THE SERVICE CONTROL FUNCTION (SCF)**

A node in which the SCF is implemented is termed a Service Control Point (SCP). The logic and data required to execute a MIN service is located in a SCP. The SCP is the platform for the execution of MIN services.

An SCF contains functions for:

- Service script interpretation
- Service script storage
- Error handling
- Communication with the SSF and SDF

In Ericsson's GSM systems, SCF functions are implemented using the Service Control Function Application Module (SCFAM), which uses function blocks from SES. The SCFAM is located stand-alone on a dedicated AXE node. Alternatively, the SCF and SSF functions can be located together on one node termed the Service Switching and Control Point (SSCP).

## THE SERVICE DATA FUNCTION (SDF)

In a MIN with more complex services or a larger number of services, it is often more efficient to store the data used by a service in a dedicated database. This node is called the Service Data Point (SDP). The function that administers the data is called the Service Data Function (SDF). Depending on the amount of data to be handled, this database may be a stand-alone or it may be integrated within the SCP node.

Each item of data is stored in a data module (DM), which may include 100s of parameters about, e.g. a particular subscriber to a service.

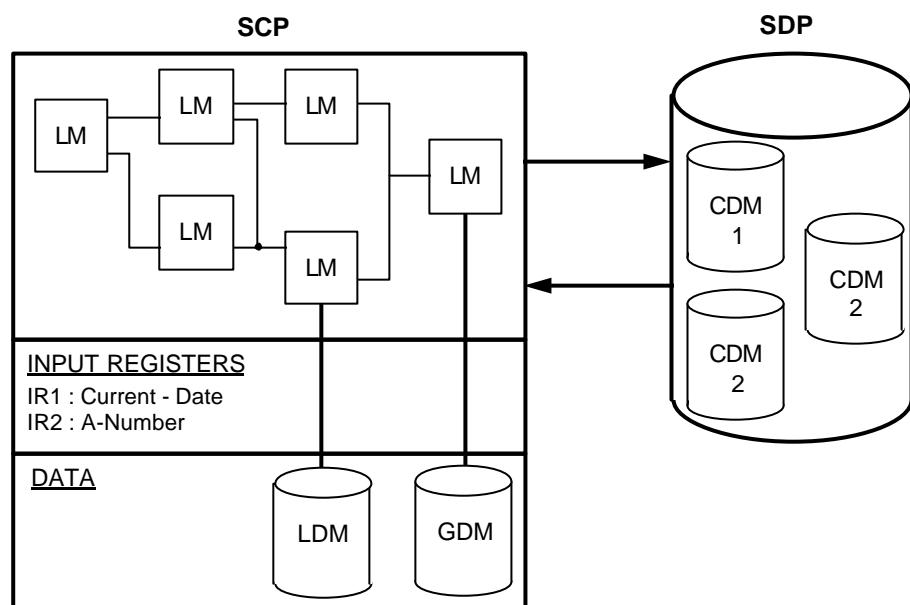


Figure 12-7 Data modules are stored in the SDP

In addition, for some services there may be large amounts of data, which already exists on a database which is not part of a MIN. One example may be a bank that has data about credit card accounts. It is neither secure nor economical to copy all these details into a node in a telecommunications network (i.e. an SDP) on a regular basis. Instead, using the SDP's External Gateway Function (EGF), it is possible to contact such an external database for data during a MIN call.

In Ericsson's GSM systems, the SDP is implemented in a Hewlett Packard UNIX-based computer. Communication between operator staff and the SDP takes place by the use of the Service Management Application System (SMAS).

## ***THE SPECIAL RESOURCE FUNCTION (SRF)***

In order to complete some MIN services, interaction is required between call party and network devices. For example, for authorization purposes a MIN service may request a call party to enter a sequence of digits, which is the call party's Personal Identity Number. Such an announcement is handled by a Special Resource Function (SRF). A machine, which implements the SRF, is termed an Intelligent Peripheral (IP). In Ericsson's GSM systems there are several platforms that can act as IPs, including, e.g. the AST-DR as supplied by the Extended Switching System (ESS) in AXE.

## ***SERVICE MANAGEMENT ENVIRONMENT (SME)***

In order to ensure that the MIN services operate correctly, it is necessary to use a Service Management Environment (SME). The SME supports installation and management of the MIN services and their data. In Ericsson's GSM systems, the SME is implemented using the application Service Management Application System (SMAS) on the TMOS platform.

## ***SERVICE CREATION ENVIRONMENT (SCE)***

The Service Creation Environment (SCE) is used to define the logic and data which MIN services consist of. In Ericsson's GSM systems, the SCE is implemented using the application Service Management Application System (SMAS) on the TMOS platform.

## MIN CALLS (GENERAL DESCRIPTION)

For every MIN call the following procedures are followed:

1. MSC/VLR functions identify that the call requires a MIN service and contacts the SSF.
2. The SSF determines which SCF must be contacted for the service and identifies the call data, which must be sent to that SCF. The SSF requests instructions from the SCF about how to implement the MIN service.
3. The SCF executes the logic for the requested service and retrieves the necessary data from the SDF.
4. The SCF sends instructions to the SSF about the processing of the service.
5. The SSF performs actions to process the service, interacting with the MSC/VLR's call control functions where necessary.

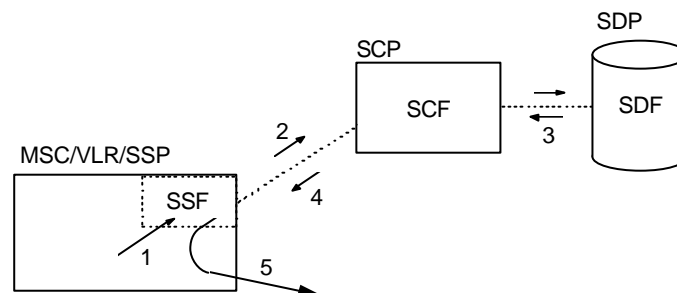


Figure 12-8 Inter-working of MIN nodes in a call

## CAMEL

Customized Application for Mobile Enhanced Logic (CAMEL) is a network feature, not a supplementary service. It is a protocol that may be used by operators to provide the subscriber with operator specific services even when roaming outside the home PLMN.

CAMEL is based on ETSI (European Telecommunications Standards Institute) CSx standards and is the first true multi-vendor IN standard. Camel allows competition between operators for the same service types.

Probably one of the most important features of CAMEL is to support prepaid international roaming. There is high consumer demand for this feature and it results in considerable revenue increases for operators.

There are different phases and releases of CAMEL. They have been implemented in GSM R7, R8 and R9

CAMEL Phase 1    Did not support Prepaid

CAMEL Phase 2    Supports:

- 2.0 VPN
- Home and Office
- Remote Operation for Supplementary Services
- Malicious Call Barring
- Call Limit
- Operator and Location dependant routing

CAMEL Phase 3    Charging Control Node supports prepaid SMS and prepaid GPRS

When different networks which support CAMEL want to signal to each other they use CAMEL Application Part (CAP) signalling. CAP is the control protocol used between the home SCP and the SSF to which the roaming MS is attached. CAP is an SS7 compliant protocol.