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**Digital cellular telecommunications system (phase 2);  
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(GSM 03.16)**

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## Foreword

This European Telecommunication Standard (ETS) has been produced by the Special Mobile Group (SMG) Technical Committee (TC) of the European Telecommunications Standards Institute (ETSI).

This ETS specifies the stage 2 description of the subscriber data management. This ETS corresponds to GSM Technical Specification (GSM-TS) GSM 03.16 version 4.1.2.

The specification from which this ETS has been derived was originally based on CEPT documentation, hence the presentation of this ETS is not in accordance with the ETSI/PNE rules.

Reference is made within this ETS to GSM Technical Specifications (GSM-TS) (note).

Reference is also made within this ETS to GSM 03.8x series. The specifications in the series can be identified, with their full title, within the normative reference clause of this ETS by the last two digits of their GSM reference number e.g. GSM 03.8x series, refers to GSM 03.81, GSM 03.82, etc.

NOTE: TC-SMG has produced documents which give the technical specifications for the implementation of the European digital cellular telecommunications system. Historically, these documents have been identified as GSM Technical Specifications (GSM-TS). These TSs may have subsequently become I-ETSs (Phase 1), or ETSs (Phase 2), whilst others may become ETSI Technical Reports (ETRs). GSM-TSs are, for editorial reasons, still referred to in current GSM ETSs.

<b>Transposition dates</b>	
Date of adoption of this ETS:	31 January 1996
Date of latest announcement of this ETS (doa):	30 April 1996
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	31 October 1996
Date of withdrawal of any conflicting National Standard (dow):	31 October 1996

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## 1 Scope

This European Telecommunication Standard (ETS) gives the stage 2 description of the subscriber data management handling between the Home Location Register (HLR) and the Visitor Location Register (VLR).

A number of procedures require updating of subscriber information from HLR to VLR:

- location updating;
- restoration;
- modification of data by the operator;
- modification of data by the subscriber via the Mobile Station (MS).

Only the rules for the updating of subscriber data from the HLR to the VLR are described in this ETS. Public Land Mobile Network (PLMN) specific and Unstructured Supplementary Service Data (USSD) subscriber data are out of scope of this ETS.

## 2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

- |      |   |
|------|---|
| [1]  | GSM 01.04 (ETR 100): "Digital cellular telecommunications system (Phase 2); Abbreviations and acronyms".  |
| [2]  | GSM 02.01 (ETS 300 500): "Digital cellular telecommunications system (Phase 2); Principles of telecommunication services supported by a GSM Public Land Mobile Network (PLMN)". |
| [3]  | GSM 02.02 (ETS 300 501): "Digital cellular telecommunications system (Phase 2); Bearer Services (BS) Supported by a GSM Public Land Mobile Network (PLMN)".                     |
| [4]  | GSM 02.03 (ETS 300 502): "Digital cellular telecommunications system (Phase 2); Teleservices Supported by a GSM Public Land Mobile Network (PLMN)".                             |
| [5]  | GSM 02.04 (ETS 300 503): "Digital cellular telecommunications system (Phase 2); General on supplementary services".   |
| [6]  | GSM 03.07 (ETS 300 525): "Digital cellular telecommunications system (Phase 2); Restoration procedures".  |
| [7]  | GSM 03.08 (ETS 300 526): "Digital cellular telecommunications system (Phase 2); Organisation of subscriber data".   |
| [8]  | GSM 03.11 (ETS 300 529): "Digital cellular telecommunications system (Phase 2); Technical realization of supplementary services".   |
| [9]  | GSM 03.15 (ETS 300 533): "Digital cellular telecommunications system (Phase 2); Technical Realization of Operator Determined Barring (ODB)".                                    |
| [10] | GSM 03.81 (ETS 300 542): "Digital cellular telecommunications system (Phase 2); Line identification supplementary services - Stage 2".  |

- [11] GSM 03.82 (ETS 300 543): "Digital cellular telecommunications system (Phase 2); Call Forwarding (CF) supplementary services - Stage 2".
- [12] GSM 03.83 (ETS 300 544): "Digital cellular telecommunications system (Phase 2); Call Waiting (CW) and Call Hold (HOLD) supplementary services - Stage 2".
- [13] GSM 03.84 (ETS 300 545): "Digital cellular telecommunications system (Phase 2); Multi Party (MPTY) supplementary services - Stage 2".
- [14] GSM 03.85 (ETS 300 546): "Digital cellular telecommunications system (Phase 2); Closed User Group (CUG) supplementary services - Stage 2".
- [15] GSM 03.86 (ETS 300 547): "Digital cellular telecommunications system (Phase 2); Advice of Charge (AoC) supplementary services - Stage 2".
- [16] GSM 03.88 (ETS 300 548): "Digital cellular telecommunications system (Phase 2); Call Barring (CB) supplementary services - Stage 2".
- [17] GSM 03.90 (ETS 300 549): "Digital cellular telecommunications system (Phase 2); Unstructured supplementary services operation - Stage 2".
- [18] GSM 09.02 (ETS 300 599): "Digital cellular telecommunications system (Phase 2); Mobile Application Part (MAP) specification".

### **3 Definitions and abbreviations**

#### **3.1 Abbreviations**

Abbreviations used in this ETS are listed in GSM 01.04.

#### **3.2 Definitions**

Subscriber data to be stored in the HLR and VLR are defined in GSM 03.08 and GSM 03.8x and GSM 03.9x-series of technical specifications.

##### **Shared subscriber data:**

Common subset of subscriber data defined to be stored in both the HLR and VLR. Subscriber data only stored in the HLR is not part of shared subscriber data. Shared subscriber data includes:

- BS: Bearer Service (see GSM 02.02);
- TS: Teleservice (see GSM 02.03);
- BSG: Basic Service Group (see GSM 02.01, GSM 02.04 and GSM 03.11);
- EBSG: Elementary Basic Service Group (see GSM 03.11);
- CBSG: Collective Basic Service Group (see GSM 03.11).



**Mandatory data:**

Data required to form a self-consistent set of subscriber data. The context governs whether a specific parameter is mandatory, e.g. the data set for a specific service may be optional, however if data for this service is present, then parameters within this data set may be mandatory.

Mandatory data is defined by the service description (see e.g. GSM 03.6x, GSM 03.8x and GSM 03.9x-series of technical specifications and GSM 03.15) and by PLMN defined requirements.

NOTE 1: The above definition is seen from a semantic point of view. Semantically, mandatory parameters may be defined as syntactically optional or mandatory by the protocol.

**Optional data:**

Data which is defined as subscriber data, but which is not required to form a self-consistent set of subscriber data; the context governs whether a specific parameter is optional.

Optional data is data which is defined by the service description (see e.g. GSM 03.6x, GSM 03.8x and GSM 03.9x-series of technical specifications and GSM 03.15) or by PLMN defined requirements but is not defined as mandatory data.

NOTE 2: The above definition is seen from a semantic point of view. Semantically optional parameters are always defined as syntactically optional by the protocol.

**Missing data:**

Data which is mandatory in a given context but is not received nor is valid data available locally.

Unexpected data:

Data which is received and cannot be further processed. This may be either:

- optional data not required in a given context; or
- optional or mandatory data, required in this context but received with an unexpected value.

**Overlapping data:**

Two different cases of overlapping within subscriber data are possible:

- two or more parameters are to be stored at the same address in the data structure (see subclause 4.4);
- two or more BSGs within a BSG list include or are identical with one and the same EBSG.

The following **groups of subscriber information** are defined:

- subscriber information (Group A):
  - International Mobile Subscriber Identity (IMSI);
  - basic Mobile Station International ISDN Number (MSISDN);
  - category;
  - subscriber status;
- basic service information (Group B):
  - Bearer Service list;
  - Teleservice list.

- Supplementary Service (SS) information (Group C):
  - forwarding information;
  - call barring information;
  - Closed User Group (CUG) information;
  - SS Data;
- Operator Determined Barring (ODB) information (Group D):
  - ODB Data;
- roaming restriction information (Group E):
  - roaming restriction due to unsupported feature;
- regional subscription information (Group F):
  - regional subscription data.

#### **4 General on handling of subscriber information**

In general, the VLR stores only a subset of the subscriber data available in the HLR. Updating of subscriber information shall be done in a way to make available and to keep consistency of data shared between HLR and VLR.

Two different cases for the updating of subscriber data can be identified:

- framed operation: during location update or restoration a complete set of the shared subscriber data needs to be inserted in the VLR;
- stand-alone operation: whenever subscriber data are added, deleted or changed in the HLR, this may need partial insertion, deletion or change of shared subscriber data in the VLR.

Subclauses 4.1 to 4.4 explain the actions of the HLR and the VLR within a framed or stand-alone dialogue on subscriber data handling.

##### **4.1 Updating of the VLR in framed operation**

If requested by the framing operation, the HLR shall send all stored shared subscriber data to the VLR. This may be done with one or more messages within a single dialogue.

The VLR shall check the received messages, and:

- a) if mandatory data is missing in a message:
  - the VLR may immediately reject the message towards the HLR; or
  - the VLR may acknowledge the message towards the HLR and wait for further data from the HLR.

Which of the two options apply is either defined by the protocol specification or is an implementation option;

- b) if unexpected data are received in a message:
  - the VLR may reject the message towards the HLR; or
  - in case of unexpected data not required in a given context, the VLR may acknowledge the message towards the HLR and ignore this unexpected data. All other data shall be stored by the VLR.

Which of the two possibilities apply is an implementation option;

- c) if data for unsupported services or features is received:
  - the VLR shall respond towards the HLR to the message indicating these features and shall ignore all received data related to them. All other subscriber data shall be stored;

- d) if cases a), b) and c) do not apply for a message, the VLR shall store all subscriber data received.

If during the entire dialogue none of the messages was rejected by the VLR and at termination of the dialogue no subscriber data are missing, the VLR shall mark the subscriber data as "confirmed by HLR". Otherwise the subscriber data shall remain marked as "not confirmed by HLR" (see GSM 03.07).

The HLR shall check all responses from the VLR, and:

- a) if a message is rejected, no further updating of the VLR shall occur. The further action on the framing operation is out of scope of this ETS;
- b) if one or more unsupported features are indicated by the VLR, the HLR may:
- store subscriber data including replacement feature(s) locally;
  - store and send subscriber data including replacement feature(s);
  - ignore this indication.

Which of the three options apply for which feature is out of scope of this ETS;

- c) if a message is acknowledged by the VLR, this shall be recognised by the HLR.

The further action on the framing operation after all shared subscriber and replacement data have been sent (e.g. closing of the dialogue) is out of scope of this ETS.

## 4.2 Updating of VLR in stand alone operation

If shared subscriber data are added, deleted or changed in the HLR, the HLR shall insert or delete this subscriber data in the VLR to keep consistency of data stored.

### 4.2.1 Insertion of data in the VLR

For the insertion of data, the HLR may send one or more messages in a single dialogue.

The VLR shall check the received data, and:

- a) if mandatory data is missing in a message:
- the VLR may reject the message towards the HLR; or
  - the VLR may acknowledge the message towards the HLR and wait for further data from HLR.

Which of the two possibilities apply is either defined by the protocol specification or an implementation option;

- b) if unexpected data are received:
- the VLR may reject the message towards the HLR; or
  - in case of unexpected data not required in a given context, the VLR may acknowledge the message towards the HLR and ignore this unexpected data. All other data shall be stored by the VLR.

Which of the two possibilities apply is an implementation option;

- c) if data for unsupported services or features is received:
- the VLR shall respond towards the HLR to the message indicating these features and shall ignore all data assigned to them. All other subscriber data shall be stored;
- d) if cases a), b) and c) do not apply for a message, the VLR shall store all subscriber data received.

If during the entire dialogue none of the messages was rejected by the VLR and at termination of the dialogue no subscriber data are missing, the VLR shall mark the subscriber data as "confirmed by HLR". Otherwise the subscriber data shall be marked as "not confirmed by HLR" (see GSM 03.07).

The HLR shall check all responses from the VLR, and:

- a) if a message is rejected no further updating of the VLR is allowed and the HLR shall terminate the dialogue;
- b) if one or more unsupported features are indicated by the VLR, the HLR may:
  - store subscriber data including replacement feature(s) locally;
  - store and send subscriber data including replacement feature(s);
  - ignore this indication.

Which of the three possibilities apply for which feature is out of scope of this ETS;

- c) if a message is acknowledged by the VLR, this shall be recognised by the HLR.

After all required shared subscriber and replacement data have been sent, the HLR shall terminate the dialogue with the VLR.

#### **4.2.2 Deletion of data in the VLR**

Deletion needs a separate dialogue.

HLR and VLR actions are the same as above except for the following case:

- if, in response to deletion, one or more unsupported features are indicated by the VLR, the HLR may:
  - delete subscriber data including replacement feature(s) locally;
  - delete subscriber data including replacement feature(s) locally and in the VLR;
  - take no further action.

Which of the three options apply for which feature is out of scope of this ETS.

NOTE: This deletion in the VLR needs a separate dialogue.

The HLR shall terminate the dialogue after the response was received from the VLR.

#### **4.2.3 Change of data in the VLR**

If existing data in the VLR is to be modified, the HLR may insert the replacing data, which overwrites the existing data according to the rules described in subclause 4.4. Alternatively, the HLR may delete the existing data as described in subclause 4.2.2 and then insert the replacing data as described in subclause 4.2.1.

### **4.3 Order of information and distribution over message boundaries**

#### **4.3.1 Order of information sent by the HLR**

The order of information is defined by the order in which the transfer syntax is generated by the HLR. This includes a sequence of messages as well as the syntax within a message (first to last message, component, operation, parameter, etc.).

With the above definitions, the following rules shall apply for the order of information within a dialogue:

- Group A information (subscriber status) shall be sent first;
- Group B information shall be sent after Group A information and before any Group C, E or F information;
- Group D information shall be sent after Group A information and in any order with respect to Group B, C, E and F information.
- a specific order of Group C, E and F information is not required.

There is no requirement for the sending of subscriber information groups in the same message.

#### **4.3.2 Order of information received by the VLR**

Normally, the order of information sent and received shall be identical. However, if subscriber data are sent distributed over several messages within a dialogue in exceptional cases the order of these messages may change during transmission.

If the order of information received violates the rules given above, the VLR has the following options:

- the VLR rejects all messages which cannot be processed due to violation of these rules. In this case, checking of missing mandatory parameters is done for each message;
- the VLR processes and accepts all received messages although rules are violated. In this case, checking of missing mandatory parameters is done after the last message i.e. after termination of the dialogue.

Both options may be used in a single implementation. Missing parameters may be detected during the dialogue. For other parameters, the checking is done after termination of the dialogue between the HLR and the VLR.

The VLR is not required to handle received data in a specific order. As a consequence, any overlapping of data within a dialogue should be avoided to keep consistency of data between HLR and VLR.

#### **4.4 Abstract data structure of shared subscriber data**

The figures 1 to 9 show the organisation of the shared subscriber data stored in the HLR and VLR. This structure is only valid for data stored in the registers and is not identical with the structure in the protocol, defining how data are transferred.

NOTE: This description is only a model for the logical structure and does not define the specific implementation of the data storage.

With this structure, the following general rules for the handling of subscriber data are defined:

- the root of this data tree is always the IMSI which identifies the subscriber;
- to address a specific parameter within this hierarchical tree, it is necessary to start from the IMSI and to go through the branches until the parameter is reached. The list of parameters met on the way defines the address of the parameter within the data structure;
- to delete or insert a specific parameter, the complete address information is required;
- if a parameter is inserted, all parameters in the address and the parameter itself shall be marked as present. A parameter value is stored irrespective of whether a value was already stored;
- if a parameter is deleted, all parameters connected to it in the subbranches are also deleted i.e. they are marked as not present;
- if a parameter is overwritten with a new value, parameters connected to it in the sub-branches shall be set according to the rules of the individual service specification.

In addition to the general rules given above, special rules apply to certain specific subscriber data. This is out of scope of this ETS (see references in the notes in figures 1 to 9).

#### **4.5 Handling of supplementary service data with respect to basic service data**

Some supplementary service data is qualified by elementary basic service group (EBSG) data. This part of the service data is below the parameter "BSG" in the abstract data hierarchy, and is referred to as the "EBSG-related SS data". This clause provides special rules for handling of EBSG-related SS data.

The internal representation of EBSGs and EBSG-related SS data in the HLR and VLR is outside the scope of this ETS. For simplicity this description uses a model where all EBSG-related SS data is stored against individual EBSGs. Implementations may use alternative internal data structures.

##### **4.5.1 General**

EBSG-related SS data shall be stored in the HLR and VLR for all EBSGs that meet all the following criteria:

- at least one basic service in the EBSG is supported; and
- the supplementary service is applicable to at least one (possibly different) basic service in the EBSG; and
- the subscriber has a subscription to at least one (possibly different) basic service in the EBSG.

EBSG-related SS data shall not be stored for any other EBSGs.

For each service for which the HLR sends EBSG-related SS data to the VLR, the HLR shall send the data for all EBSGs that meet all the following criteria:

- at least one basic service in the EBSG is supported at the HLR; and
- the supplementary service is applicable to at least one (possibly different) basic service in the EBSG; and
- the subscriber has a subscription to at least one (possibly different) basic service in the EBSG.

At any time, if the HLR has to send identical EBSG-Related SS data for several EBSGs, then it may be able to represent a set of EBSGs by a collective basic service group (CBSG), or by omitting the EBSG information altogether. This is specified in detail in GSM 09.02.

#### **4.5.2 Changes to basic service subscription**

Changes to the basic service subscription can impact EBSG-related SS data.

If a new basic service is provisioned, and this is the first basic service to be provisioned for this subscriber in a particular EBSG, then the HLR shall update supplementary service data in the VLR if necessary. The HLR shall insert in the VLR EBSG-related SS data for the new EBSG for all supplementary services that:

- have EBSG-related SS data; and
- are applicable to at least one basic service in the new EBSG; and
- are in a state where the VLR should receive data (normally this means the service must be provisioned).

If a new basic service is provisioned, and this is not the first basic service provisioned for this subscriber in a particular EBSG, then the HLR is not required to send any new supplementary service data as a result.

If a basic service is withdrawn, and this was the last remaining basic service provisioned for this subscriber in a particular EBSG, then when they are informed about the withdrawal of the basic service the HLR and VLR shall locally delete any supplementary service data relating to that EBSG.

If a basic service is withdrawn, and this was not the last remaining basic service provisioned for this subscriber in a particular EBSG, then the HLR and VLR shall not make any changes to supplementary service data as a result.

#### 4.5.3 Special rules for BS61 and BS81 "alternate and followed-by services"

There is no EBSG-related SS data for the groups BS61 and BS81 ("alternate" and "followed-by"). Instead, supplementary services related to these basic services are handled according to the bearer service group BS2x or BS3x corresponding to the data part of the "alternate" and "followed by" bearer service (see GSM 02.04). This means that special rules are required for subscribers with subscriptions to BS61 or BS81.

For the handling of EBSG-related SS data, a subscription to BS61 or BS81 shall be treated in the same way as a subscription to a basic service in each of the groups "all data circuit asynchronous" and "all data circuit synchronous" (BS2x and BS3x). If a user subscribes to BS61 or BS81 then the HLR shall send any relevant EBSG-related SS data to the VLR for the groups BS2x and BS3x even if the subscriber does not subscribe to any basic services in the groups BS2x and BS3x.

Examples:

- If a user who does not subscribe to any basic services in BS2x or BS3x is given a subscription to BS81 then the HLR updates the VLR with any relevant EBSG-related SS data for the groups BS2x and BS3x. If the subscription to BS81 is then withdrawn, the VLR locally deletes all EBSG-related SS data for BS2x and BS3x.
- If a user who has a subscription to BS21, but not to any basic services in BS3x is given a subscription to BS81 then the HLR updates the VLR with any relevant EBSG-related SS data for the group BS3x. If the subscription to BS81 is then withdrawn, the VLR locally deletes all EBSG-related SS data for BS3x (though not for BS2x).

EBSG-related SS data shall not be qualified by the groups BS61 or BS81.

#### 4.5.4 Consistency of supplementary service data

In some cases, the protocol used between the HLR and VLR encodes some data that is not EBSG-related SS data with an EBSG qualifier. In this case, the HLR shall ensure that when this data is sent it is always the same for all EBSGs. If this data is modified, the HLR must send the supplementary service data to the VLR for all EBSGs which meet all the following criteria:

- at least one basic service in the EBSG is supported; and
- the supplementary service is applicable to at least one (possibly different) basic service in the EBSG; and
- the subscriber has a subscription to at least one (possibly different) basic service in the EBSG.



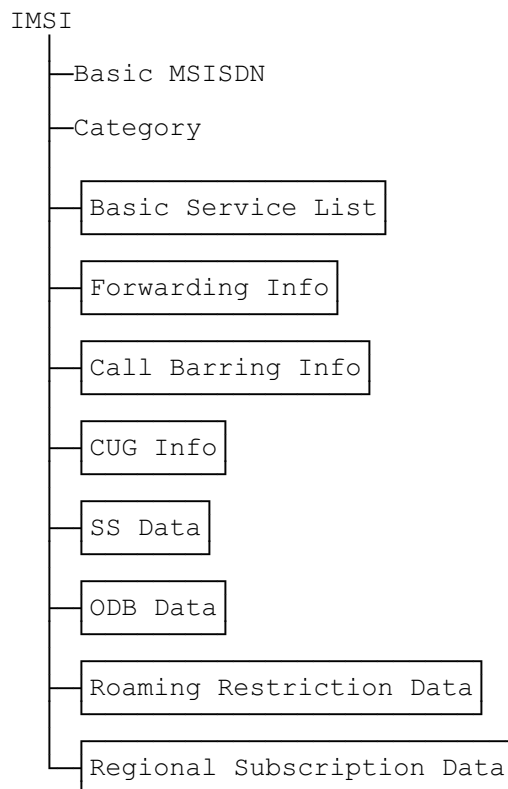
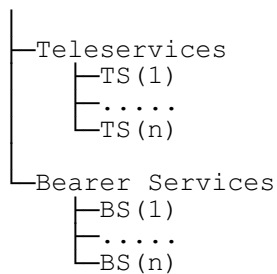
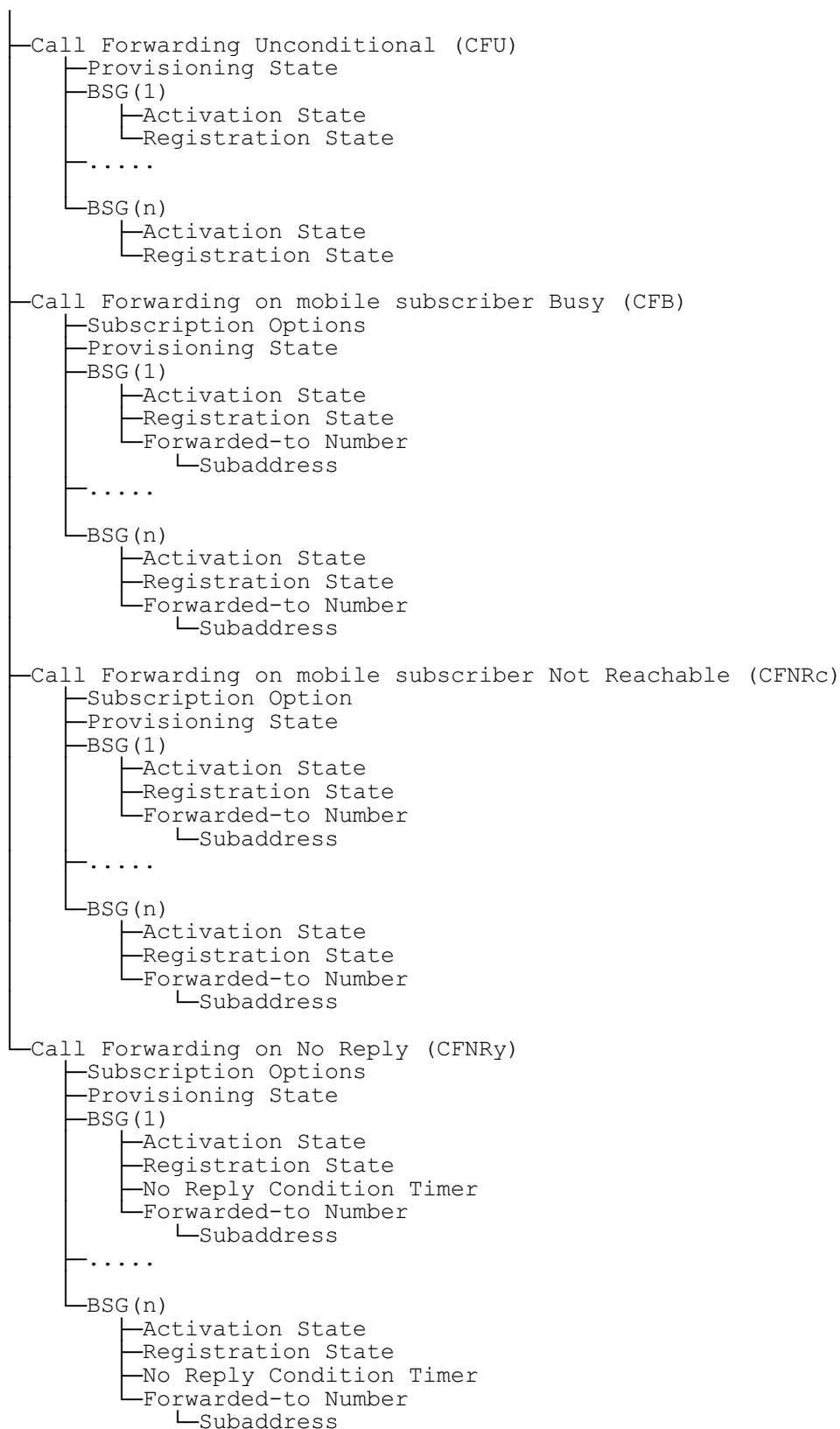


Figure 1: Abstract data structure of Subscriber Data



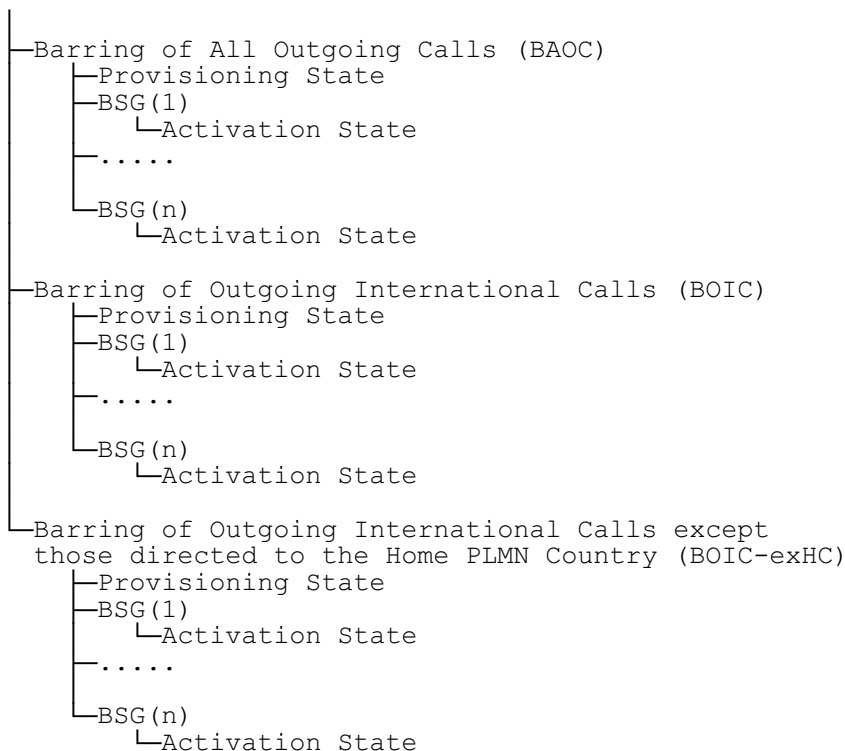
NOTE: For detailed information see GSM 02.01, GSM 02.02, GSM 02.03 and GSM 09.02.

Figure 2: Basic Service List



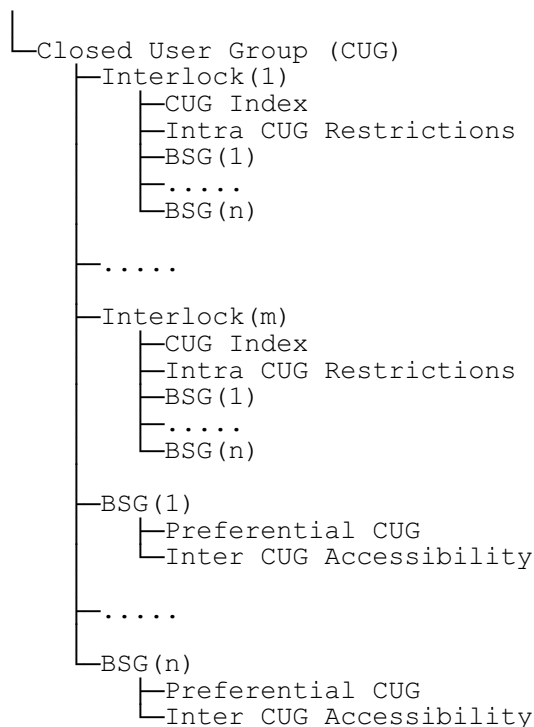
NOTE: For detailed information see GSM 03.82 and GSM 09.02.

**Figure 3: Forwarding Info**



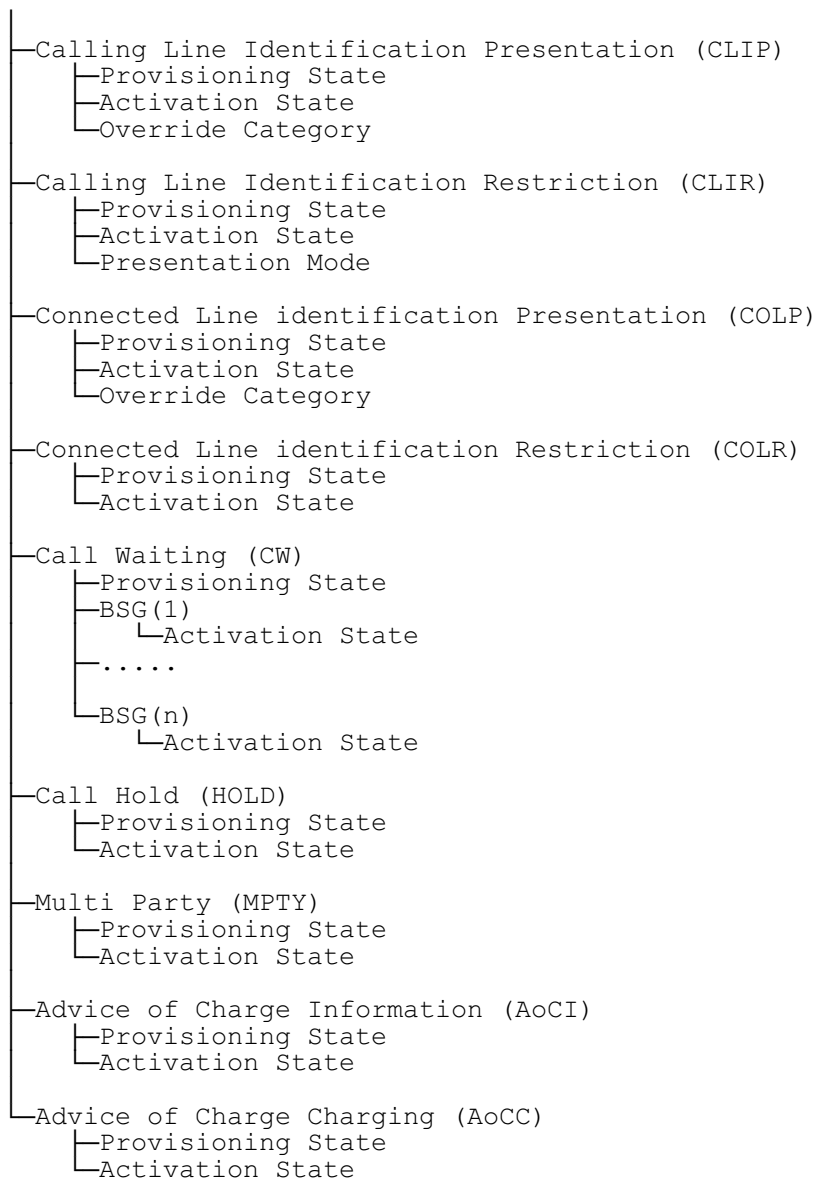
NOTE: For detailed information see GSM 03.88 and GSM 09.02.

**Figure 4: Call Barring Info**



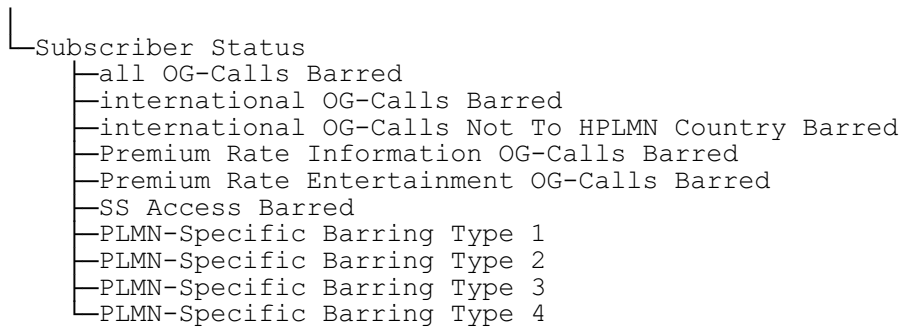
NOTE: For detailed information see GSM 03.85 and GSM 09.02.

**Figure 5: CUG Info**



NOTE: For detailed information see GSM 03.81, GSM 03.83, GSM 03.84, GSM 03.86 and GSM 09.02.

Figure 6: SS Data



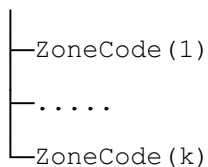
NOTE: For detailed information see GSM 03.15 and GSM 09.02.

**Figure 7: ODB Data**



NOTE: For detailed information see GSM 09.02.

**Figure 8: Roaming Restriction Data**



NOTE: For detailed information see GSM 09.02.

**Figure 9: Regional Subscription Data**

**History**

<b>Document history</b>			
May 1995	Public Enquiry	PE 84:	1995-05-22 to 1995-09-15
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