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Part 3: Speech services, network aspects**

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Foreword

This draft second edition European Telecommunication Standard (ETS) has been produced by the Electromagnetic compatibility and Radio spectrum Matters (ERM) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the One-step Approval Procedure (OAP) phase of the ETSI standards approval procedure.

This ETS has been split into three parts as follows:

Part 1: "Speech services, facilities and requirements";

Part 2: "Speech services, radio interface";

Part 3: "Speech services, network aspects".

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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1 Scope

This European Telecommunication Standard (ETS) covers the specification of equipment for provision of a terrestrial Aeronautical Public Correspondence (APC) service working in the frequency spectrum bands allocated at World Administrative Radio Conference (WARC) 92 (1 670 to 1 675 MHz and 1 800 to 1 805 MHz). The ETS fully specifies aspects of the radio interface and Terrestrial Flight Telecommunication System (TFTS) Ground Network (GN) required to maintain interoperability of equipment. Within Europe European Radiocommunications Committee (ERC) Decision ERC/DEC (92)01 [13] is applicable to TFTS frequency spectrum.

The general architecture of the TFTS is considered in ETS 300 326-1 [1]. This part expands on that explanation to consider aspects of fixed network interworking. This part does not specify any specific signalling system for that purpose. It only specifies the functionality required for correct operation of the system.

Call handling and decision processes are specified. These should be used in conjunction with ETS 300 326-2 [2]. These explanations include the decision processes for the handover function.

Signalling requirement between Ground Switching Centres (GSCs) are specified for supporting inter-GSC handovers.

The TFTS Aircraft Station (AS) was specified by the European Airlines Electronics Committee (EAEC) and has subsequently been adopted as (ARINC) Characteristic 752 [14] by the Airlines Electrical Engineering Committee (AEEC). ARINC Characteristic 752 [14] makes reference to this ETS for specification of certain radio and telecommunication matters to avoid ambiguity. The TFTS AS is one of a set of facilities within an overall architecture being defined for aircraft on board telecommunications by the AEEC.

An Interim European Telecommunications Standard (I-ETS) is being produced which covers aspects of conformance testing for TFTS aircraft mobile stations. The specification of data application and facsimile will be the subject of a further (I-)ETS.

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications 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 applies.

- [1] ETS 300 326-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Terrestrial Flight Telecommunication System (TFTS); Part 1: Speech services, facilities and requirements".
- [2] ETS 300 326-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Terrestrial Flight Telecommunication System (TFTS); Part 2: Speech services, radio interface".
- [3] CCITT I-Series of Recommendations (I.500 - I.605).
- [4] CCITT Recommendation E.164 (1997): "The international public telecommunication numbering plan".
- [5] CCITT Recommendation E.163: "Numbering plan for the international telephone service".
- [6] CCITT Recommendation I.112: "Vocabulary of terms for ISDNs".
- [7] CCITT Recommendation I.310: "ISDN-Network functional principles".

- [8] CCITT Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".
- [9] CCITT Recommendation X.1: "International user classes of service in, and categories of access to, public data networks and Integrated Services Digital Networks (ISDNs)".
- [10] CCITT Recommendation X.121: "International numbering plan for public data networks".
- [11] CCITT Recommendation X.200 (1988): "Reference model of open system interconnection for CCITT applications".
- [12] CCITT Recommendation X.210 (11/93): "Open systems interconnection layer service definition".
- [13] ERC Decision ERC/DEC (92)01: "Decision on the frequency bands to be designated for the coordinated introduction of the Terrestrial Flight Telecommunications System (TFTS)".
- [14] ARINC Characteristic 752: "Terrestrial Flight Telephone System (TFTS) Airborne Radio Subsystem".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

(digital) connection: A concatenation of (digital) transmission channels or (digital) telecommunication circuits, switching and other functional units set up to provide for the transfer of (digital) signals between two or more points in a telecommunication network to support a single communication.

TFTS connection: A connection that is established through TFTS between specified TFTS reference points.

TFTS connection type: A description of a set of TFTS connections which have the same characteristics.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

AC	Administrative Centre
AEEC	Airlines Electrical Engineering Committee
AEN	Aircraft Equipment Number
APC	Aeronautical Public Correspondence
ARINC	Aeronautical Radio INCorporated
AS	Aircraft Station
ASI	Aircraft Station Identity
AT	Avionics Termination
ATE	Airborne Telecommunications Equipment
ATEI	Aircraft Termination Equipment Identifier
BCCH	Broadcast Control Channel
CC	Call Control
CCd	Country Code
CCM	Call Control Management
CCITT	Consultative Committee on International Telegraphy and Telephony
CEI	Content of Information Element
DCCH	Dedicated Control Channel

DDI	Direct Dial In
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency
EAEC	European Airlines Electronics Committee
FACCH	Fast Associated Control Channel
GCC	Ground switching Centre Code
GCT	Ground station Cell Type
GN	Ground Network
GS	Ground Station
GSC	Ground Switching Centre
GSIC	Ground Station Identity Code
GSN	Ground station Serial Number
GSS	Ground Station System
HRM	Handover Resource Management
HO	Handover
IEI	Information Element Identifier
INTGS	Intermediate Ground Station
ISDN	Integrated Services Digital Network
IWF	InterWorking Function
LI	Length Indicator
MF	Mandatory Fixed (information elements)
MR	Maintenance Resource
MRM	Maintenance Resource Management
MV	Mandatory Variable (information elements)
NMC	Network Management Centre
OF	Optional Fixed (information elements)
OM	Operations and Maintenance
OMC	Operations and Maintenance Centre
OSI	Open Systems Interconnection
OV	Optional Variable
PAD	Packet Assembler Disassembler
PDU	Protocol Data Unit
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
RF	Relay Function
RR	Radio Resource
RRM	Radio Resource Management
SABM	Set Asynchronous Balanced Mode
SACCH	Slow Associated Control Channel
SAP	Service Access Point
SDL	System Description Language
TCH	Traffic Channel
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TFTS	Terrestrial Flight Telephone System
TI	Transaction Identifier
TRM	Terrestrial Resource Management
UA	Unnumbered Acknowledgement
WARC 92	World Administrative Radio Conference 1992
WOW	Weight On Wheels

4 TFTS network architecture

4.1 General

The basic network architecture of the TFTS is described in ETS 300 326-1 [1]. The following subclauses elaborate some of the functions performed by the entities of the TFTS.

4.2 The functional entities of the TFTS

To provide the TFTS service it is necessary to define some specific functions. These functions may be implemented in, or gathered into, different equipments. In any case, exchanges of data occur between these functions.

4.2.1 The Ground Station System (GSS)

The radio equipment of a GSS (transceivers, controllers, etc.) may sustain one or more cells. A GSS may consist of one or more Ground Stations (GS). Where a GS-GSC interface is implemented, it shall consist of one GSC and several GSs.

There are three different types of GSs as described in ETS 300 326-1 [1]:

- airport stations;
- intermediate stations; and
- en-route stations.

4.2.2 The GSC

The GSC constitutes the interface between the radio system and the fixed networks. It performs all the switching functions for ASs located in a geographical area designated as the GSC area. The main difference between a GSC and an exchange in a fixed network is that the GSC takes into account the impact of the allocation of radio resources and the mobile nature of the subscribers and performs in addition, at least the following procedures:

- procedures for call-set up;
- procedures required for the aircraft access validity check;
- procedures required for handover;
- procedures for Operations and Maintenance (OM).

4.2.3 The GS

A GS is a network component which comprises the transceiver equipment needed to establish the radio link between the GN and ASs. The GS services one cell and is controlled by a GSC.

4.2.4 The Interworking Function (IWF)

The IWF is an entity associated with the GSC. The IWF provides the functionality necessary to allow interworking between the TFTS network and the fixed networks (i.e. Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN) and Packet Switched Public Data Network (PSPDN)). The IWF converts the protocols used in the TFTS network to those used in the appropriate fixed network. The IWF may have no functionality where the service implementation in the TFTS network is directly compatible with that at the fixed network. The interworking requirements are described in clause 5.

4.2.5 The AS

A description of an AS is given in ETS 300 326-1 [1], subclause 4.3.1.

4.3 Configuration of the TFTS network

4.3.1 General

The basic configuration of the TFTS network and the interconnection to the PSTN, ISDN and PSPDN is presented in figure 1. This configuration presents all possible signalling interfaces which can be found in the TFTS network. The specific implementation in each country may differ; particular functions may be gathered in the same equipment and then these interfaces may become internal interfaces.

In any case the implementation of particular TFTS network components has no impact on the TFTS network.

In the basic configuration presented in figure 1, all the functions are considered implemented in different equipments. Therefore, all the interfaces within the TFTS network are external. From this configuration, all the possible TFTS network organizations may be deduced. In the case when some functions are contained in the same equipment, the relevant interfaces become internal to that equipment.

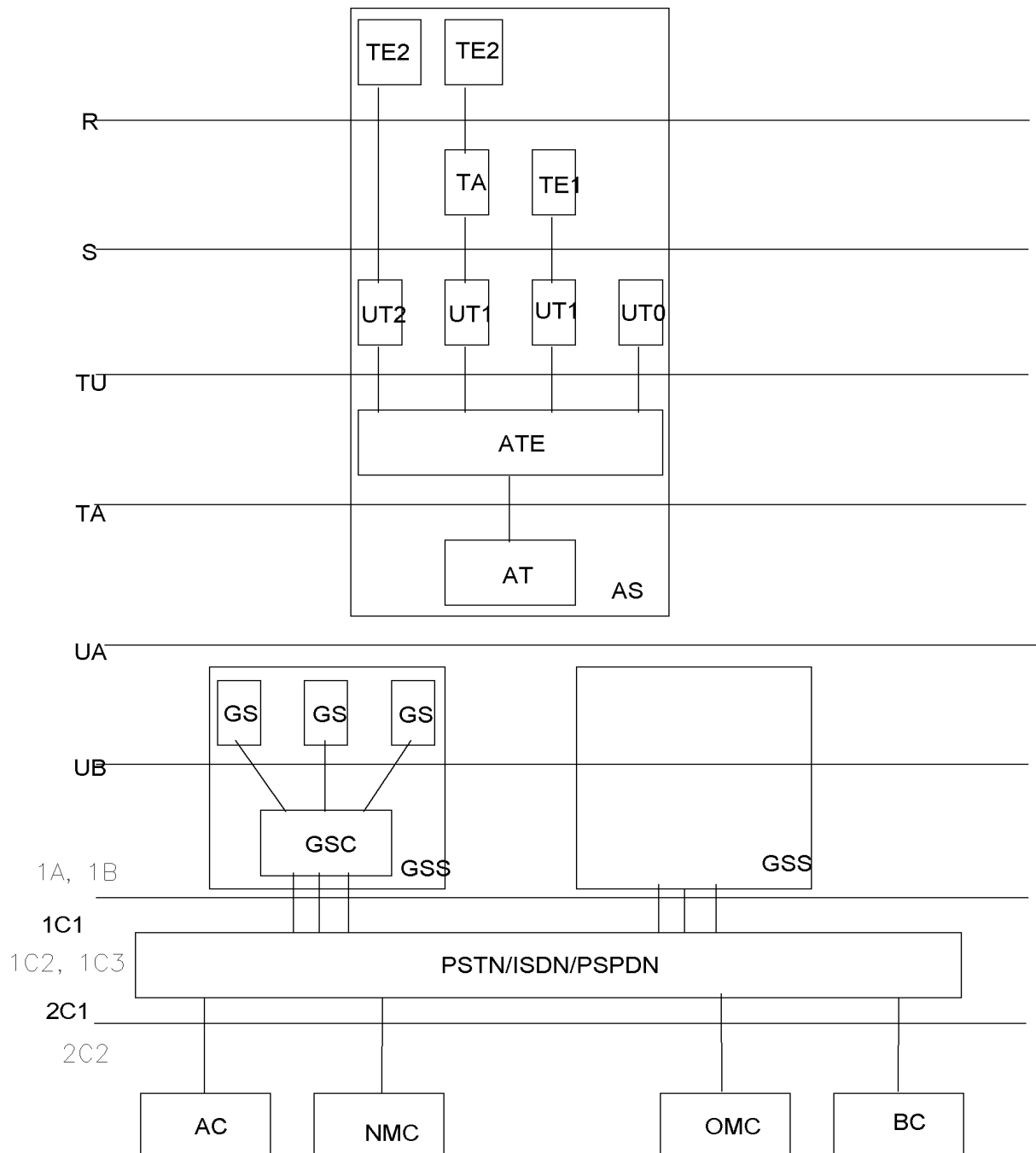


Figure 1: TFTS Interfaces

4.3.2 Description of the TFTS configuration

There may be none, one or more GSC interfaces from the TFTS network to the PSTN, ISDN and PSPDN in any country. Among switching functions, the GSC performs the control of the user access to the TFTS network. Handover functions may be performed between GSCs via the fixed networks or a dedicated handover network. Handover functions between GSs of the same GSS or between radio channels of a GS are performed within a GSS without the PSTN, ISDN or PSPDN being involved.

There is an Administrative Centre (AC) which may perform the following functions:

- data collection to support billing; and
- other service oriented central tasks.

There is a Network Management Centre (NMC) which supports management tasks that need to be globally co-ordinated for the system.

The system and equipment Operations and Maintenance (OM) within one or several GSS are performed by an Operation and Maintenance Centre (OMC).

The AC, NMC and OMC communicate to the GSSs via the fixed networks.

4.4 TFTS network interfaces

4.4.1 General

The implementation of the TFTS service implies the exchange of data between the equipments involved in the service.

4.4.2 Interface between the GSC and GSs (Ub)

The interface between the GSC and its GSs is not specified in this ETS.

4.4.3 Interface between AS and GS system (Ua)

The interface between the AS and the GS is described in ETS 300 326-2 [2].

4.5 Interfaces with the fixed networks

4.5.1 Interface between the GSC and the fixed networks

In order to perform the required functions of the TFTS network there are five different types of interfaces between the GSC and the fixed network:

- the user traffic interface (1a);
- the handover interface (1b);
- the AC interface (1c1);
- the NMC interface (1c2);
- the Operations and Maintenance (OM) interface (1c3).

The interfaces with fixed networks, including dedicated networks, are described in this part.

The GSC 1a and 1b interfaces interface to the fixed network(s) without causing any changes to the fixed networks(s).

The GSC 1b interfaces (i.e. handover) is used to support handover between different GSSs within the TFTS. This interface is described in clause 6.

The GSC 1c1 interface is used for communication with the Administration Centre.

The GSC 1c2 interface may be used to communicate directly with the NMC.

The GSC 1c3 interface is used to communicate with the OMC.

4.5.2 Scope of TFTS specification

With the exception of the data aspects and interface requirements defined in ETS 300 326-1 [1] and clause 5, the specification of interfaces 1c1, 1c2 and 1c3 is outside the scope of this ETS.

4.6 Interfaces between AC, OMC and NMC, and the fixed networks

The specification of interfaces 2c1 and 2c2 is outside the scope of this ETS.

4.7 Network connection types

4.7.1 Introduction

The TFTS may be described by a limited set of access interfaces and a limited set of TFTS connection types to support the telecommunication services described in ETS 300 326-1 [1]. This subclause identifies and defines these connection types in so far as they relate to the particular network capabilities.

The basic lower layer capabilities shall be represented by a set of connection types. The definition of a set of connection types shall provide the necessary information to identify network capabilities of TFTS. In addition to describing network capabilities the identification of connection types shall facilitate the specification of network-to-network interfaces. It may also assist in the allocation of network performance parameters.

4.7.2 General considerations

Low layer capabilities are defined in ETS 300 326-1 [1], clause 5. All Bearer Services shall be provided using low layer capabilities in the connection mode.

4.7.2.1 Relationship between lower layer capabilities and radio traffic channels

The realization of lower layer capabilities for the provision of telecommunication services shall make use of a physical medium consisting of Traffic Channel(s) (TCH). For each connection at least one TCH shall be used, and no multiplexing of low data rate connections on one TCH is allowed.

4.7.2.2 Lower layer capabilities

One class of lower layer capabilities is identified and is a transparent class which is characterized by constant throughput, constant transit delay and variable error rate, which is applicable to speech services.

The definition described above provides the basis for the definition of a limited set of connection types to be implemented by a TFTS.

4.7.3 Framework for the description of connection types

4.7.3.1 Introduction

TFTS shall provide a set of network capabilities which enable telecommunication services to be offered to a user.

A TFTS connection shall be a connection established between TFTS reference points.

NOTE: A TFTS connection type is a way of referring to, and describing, a TFTS connection. Therefore, each TFTS connection may be characterized as belonging to a particular connection type.

Figure 2 illustrates the concepts.

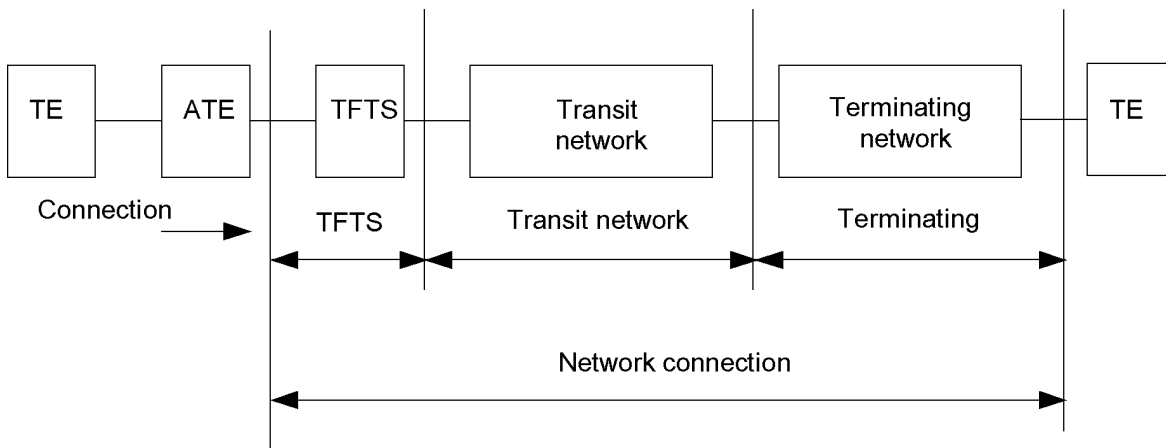


Figure 2: Framework for the description of TFTS connections

4.7.3.2 Purpose of TFTS connection types

The definition of a set of TFTS connection types shall provide the necessary input to identify the network capabilities of a TFTS. Other key requirements of TFTS are contained in ETS 300 3261 [1]. In addition to describing network capabilities of TFTS, the identification of connection types shall facilitate the specification of network-to-network interfaces. It may also assist in the allocation of network performance parameters.

NOTE: The user specifies only the telecommunication service required, whilst the TFTS allocates the resources to set up a connection of the specific type as necessary to support the requested service. It is further noted that, for certain service offerings, additional network functions, e.g. additional lower layer functions and/or higher layer functions, may be required (see figure 3).

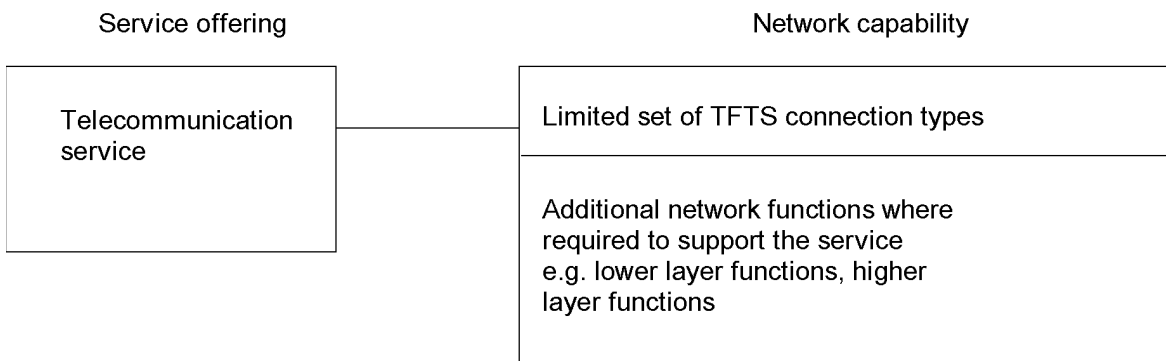


Figure 3: The role of network capabilities in supporting service offering

4.7.3.3 Functions associated with TFTS connection

Any TFTS connection shall involve an association of functions to support telecommunication services as shown in figure 4. Three sets of functions are required:

- connection means, including transmission and switching;
- control functions and protocols, including signalling, flow/congestion control and routing functions;
- OM functions, including network management and maintenance functions.

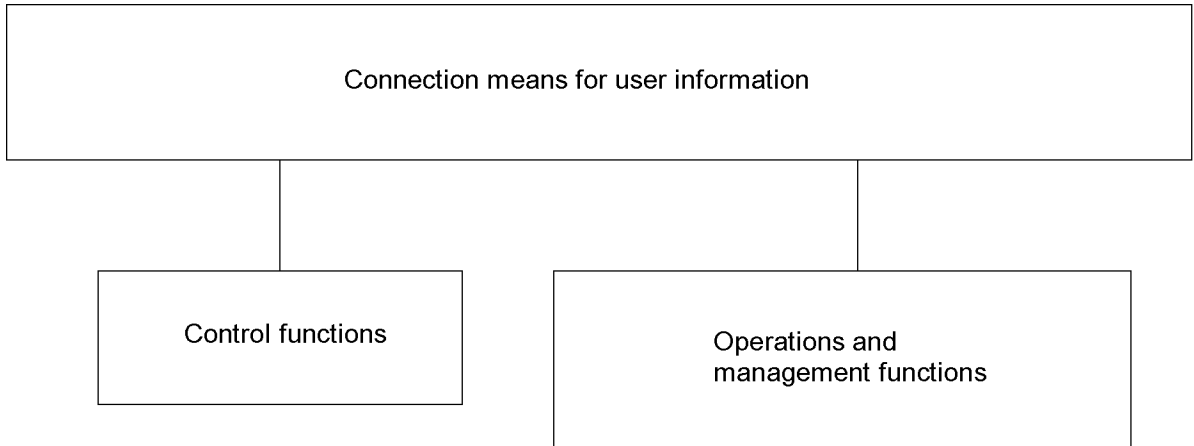
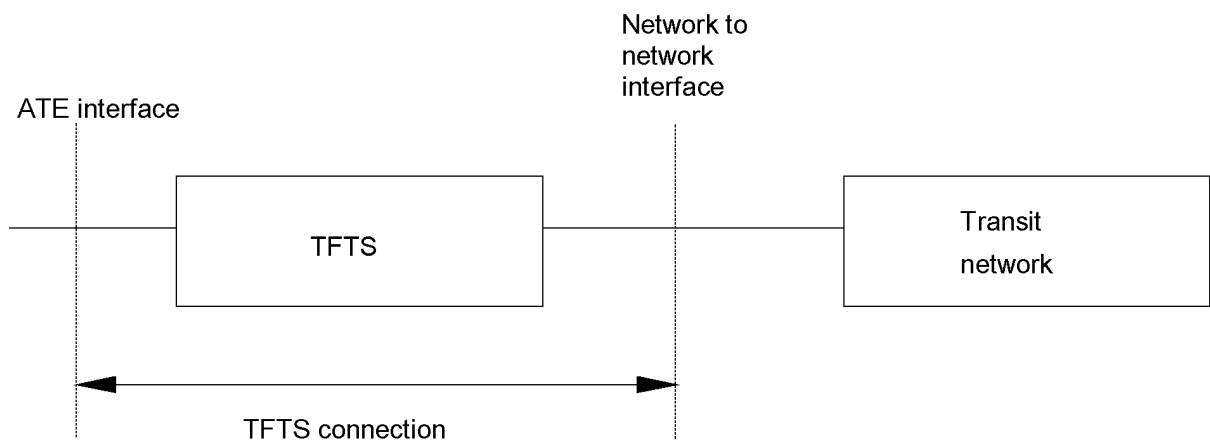


Figure 4: Functional description

4.7.3.4 Applications of TFTS connection types

The situation to which TFTS connection types shall apply is given in figure 5.



NOTE: The term "Network" implies any fixed transit network as described in clause 6.

Figure 5: TFTS network connection

4.7.4 TFTS connection types

4.7.4.1 Description of TFTS connection types

The characterization of TFTS connection types shall be implemented using a set of attributes. A TFTS connection type attribute shall be specific characteristic of a TFTS connection type whose values shall distinguish it from another TFTS connection type. Particular values shall be assigned to each attribute.

The definitions of the attributes and the attribute values are contained in subclause 4.7.6.

A TFTS connection type shall be partitioned into connection elements. This partitioning shall be based on the two most critical transitions of a connection as follows:

- the change of signalling system; and
- the type of transmission system.

Subclause 4.7.4.3 describes the relationship between the attribute values of connection elements and connection types.

The definitions in the following subclauses are used in subclause 4.7.4.4 to describe the limited set of TFTS connection types.

4.7.4.2 TFTS connection elements

The radio interface connection element is the portion of the connection spanning from the Airborne Station to an appropriate internal reference point within the GS System.

By using connection elements and attributes which have a layered nature the construction of a connection type is more easily viewed. The use of different values for the same attribute allows a greater degree of description and flexibility.

4.7.4.3 Rules of association for the attribute values of connection elements and connection types

This subclause describes the relationship between the attribute values of connection elements and connection types. For each attribute the various possible values recommended are listed.

The definition of the attributes and attribute values are contained in subclause 4.7.6. In addition to the (possible) attribute values applicable to the connection elements, an association law is given (where appropriate) for each attribute to show how the value of the attribute for the overall connection type is obtained from the values of the attribute applicable to the connection elements.

4.7.4.3.1 Information transfer mode

Attribute values for connection elements: circuit.

Attribute values for overall connection type: circuit.

Association law: not applicable.

4.7.4.3.2 Information transfer rate (kbits/s)

Attribute values for connection elements: 9,6 kbit/s.

Attribute values for overall connection type: 9,6 kbit/s.

Association law: not applicable.

4.7.4.3.3 Information transfer susceptance

Attribute values for connection elements: speech processing functions (e.g. TETS speech coding/A-Law conversion, and/or echo control functions and/or Dual Tone Multi-Frequency (DTMF) insertion).

Attribute values for overall connection types: speech.

Association law: not applicable.

For an overall connection type value speech it has to contain a TETS Speech Coding/A-Law conversion equipment, echo suppression functions and DTMF functionalities when appropriate.

4.7.4.3.4 Establishment of connection

Attribute values for connection elements: switched.

Attribute values for overall connection type: switched.

Associate Law: as some of the connection elements are switched, then the overall connection type has to be "switched".

4.7.4.3.5 Symmetry

Attribute values for connection elements: bi-directional symmetric.

Attribute values for overall connection type: bi-directional symmetric.

Association law: the overall symmetry can only be generated from the connection elements by analysis of the connection element values in the context of the architecture of the connection.

4.7.4.3.6 Connection configuration

Topology:

Attribute values for connection elements: point-to-point.

Attribute values for overall connection type: point-to-point.

Association law: as some of the connection elements are "point-to-point", then overall connection type has to be "point-to-point".

4.7.4.3.7 Structure

Attribute values for connection elements: unstructured.

Attribute values for overall connection type: as per values for connection elements.

Association law: not applicable.

4.7.4.3.8 Channels

4.7.4.3.8.1 Information channel (rate)

Attribute values for connection elements: Ma, La or Ba (may be associated with Slow Associated Control Channel (SACCH)).

Attribute values for overall connection type: not applicable.

4.7.4.3.8.2 Signalling channel (rate)

Attribute values for connection elements: Fast Associated Control Channel (FACCH).

Attribute values for overall connection type: not applicable.

4.7.4.3.9 Connection control protocol

Attribute value for connection elements are given in the following clauses of ETS 300 326-2 [2]:

Layer 1: clause 8;

Layer 2: clause 9;

Layer 3: clause 10.

Attribute values for overall connection type: not applicable.

4.7.4.3.10 Information transfer coding/protocol

Attribute values for connection elements are as follows:

Layer 1: ETS 300 326-2 [2], clause 8;

Layer 2: not applicable;

Layer 3: transparent.

Attribute values for overall connection type: not applicable.

4.7.4.3.11 Further attributes and attribute values

This subclause outlines the relationships between those attribute values presently existing, the possibility for new values being added remains. Table 1 summarizes the attribute values for TFTS connection elements.

Table 1: Attribute Values for TFTS connection elements

Attributes	Attribute values
	Radio interface connection
1 Information transfer mode	Circuit
2 Information transfer Layer 1 Layer 2 Layer 3	9,6 kbits/s
3 Information transfer susceptance	Speech processing equipment Echo control equipment DTMF functions PAD functions Null
4 Establishment of connection	Switched
5 Symmetry	Bi-directional symmetric
6 Connection configuration topology	Point-to-point
7 Structure Layer 1 Layer 2 Layer 3	20 ms integrity SDU integrity SDU integrity
8 Channel rate Information channel Signalling channel	La, Ma or Ba channel DCCH
9 Connection protocol Layer 1 Layer 2 Layer 3	ETS 300 326-2 [2], clause 8 ETS 300 326-2 [2], clause 9 ETS 300 326-2 [2], clause 10
10 Information control protocol Layer 1 Layer 2 Layer 3	ETS 300 326-2 [2], clause 8 ETS 300 326-2 [2], clause 9 Transparent
NOTE:	Null is equivalent to no susceptance.

4.7.4.4 Limited set of TFTS connection types

From the connection element defined in subclause 4.7.4.2, the list of attributes and their possible values given in subclause 4.7.4.3, and from the service requirement defined in ETS 300 326-1 [1], clause 5, a limited set of TFTS connection types have been identified.

Figure 6 gives the information transfer protocol models for the identified set of TFTS connections types.

Protocol model 1 is the model for speech and DTMF tone transmission.

For all the models, only the minimum functionality of the interworking model is shown. Additional functions will be required for various interworking situations. These additional functions are described in subclause 4.3.

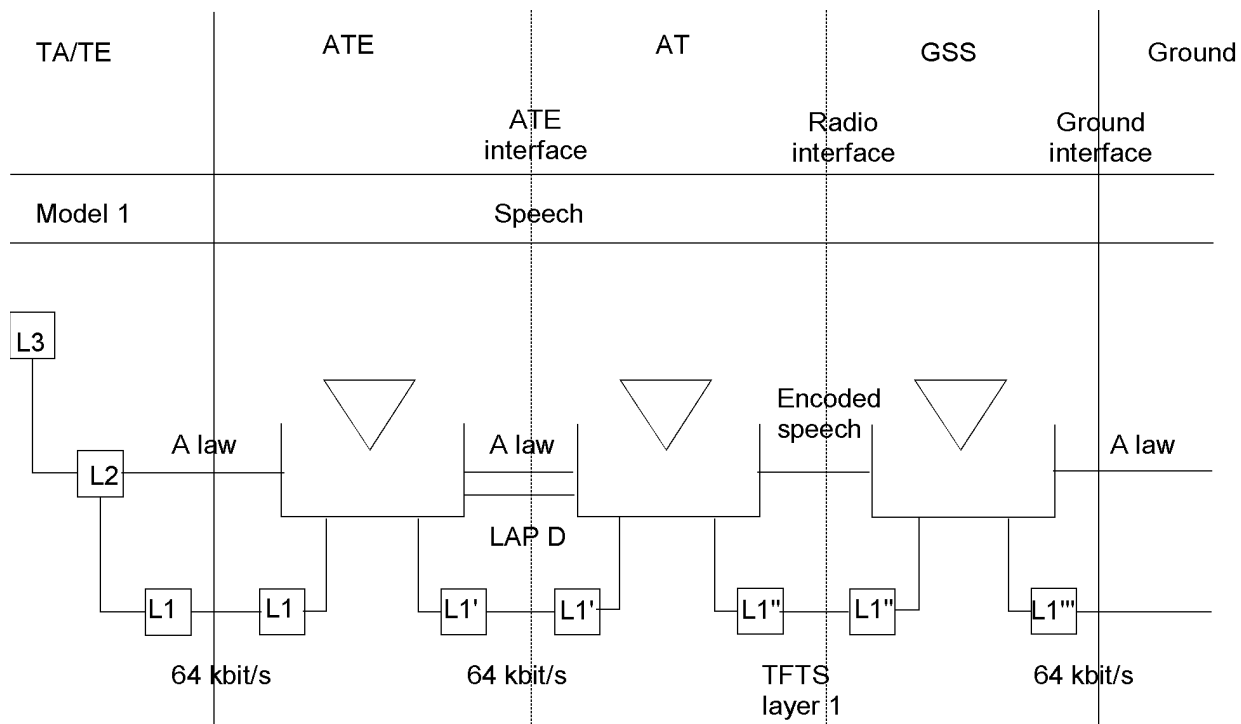


Figure 6: Protocol model 1

4.7.5 Relationship between bearer and connection types

Given a request for a telecommunication service at the initiation of a call, the TFTS shall establish a connection of connection type that supports the attributes of the service requested.

NOTE: TFTS connection types represent the technical capabilities of TFTS and provide a basis for the definition of performance and interworking with other networks.

Table 1 shows the relationship between bearer services and TFTS connection types. In table 2, the connection elements for each connection type related to a bearer service are shown.

Dominant attributes of the connection elements, such as information transfer mode, information transfer rate, information transfer capability and structure are indicated. The type of radio TCH used is also shown.

Table 2: Connection elements

Bearer service	Air interface connection element	GS / GSC connection elements	Protocol model (figure 6)	note
Speech	Speech circuit Ba, Ma or La DTMF circuit	64 kbits/s coding		note 1
Circuit mode unrestricted with unrestricted digital capability	Non speech services			note 2
PAD access to PSPDN transmission				
Packet access to PSPDN				
NOTE 1:	This model does not identify any internal interface in the GS to support multiplexing. However multiplexing is not precluded.			
NOTE 2:	Services other than speech are outside the scope of this ETS.			

4.7.6 List of definitions of TFTS connection type attributes and their values

4.7.6.1 Attribute definition and their values

information transfer mode: This attribute describes the operational mode for transferring (transportation and switching) user information through a TFTS connection in the network.

- **values:** Circuit.

information transfer capability: This attribute describes the capability associated with the transfer of different types of information through a TFTS connection.

- **values:** Speech.

information transfer rate: This attribute describes the bit rate (circuit mode). It refers to the transfer of digital information on a TFTS connection.

- **values:** Appropriate bit rate.

establishment of connection: This attribute describes the mode of establishment used to establish and release a TFTS connection.

- **values:** Bi-directional symmetric.

connection configuration: This attribute describes the special arrangement for transferring information on a given TFTS connection.

- **values:** Point-to-point.

structure: This attribute refers to the capability of a TFTS connection to deliver information to the destination access point or reference point in a structure (e.g. time interval for circuit mode, service data unit for packet mode) that was presented in a corresponding signal structured at the origin (access point or reference point).

- **values:** Unstructured.

channel rate: This attribute value describes the channels and their bit rate used to transfer the user information and/or signalling information.

- **values:** Name and number of channel(s) (designation) and/or the corresponding bit rate.
- **connection control protocol, information transfer coding/protocol (layers 1 to 3):** These attributes characterize the protocols on the connection control and/or user information transfer channel.
- **value:** Appropriate protocol for each layer.

NOTE: This attribute can be used several times for connection characterization.

4.7.6.2 Definition of values

speech: Digital representation of speech coded according to a specified encoding rule (e.g. A-Law, see ETS 300 326-1 [1], clause 5).

switched connection: TFTS circuit switched connection is set up at any time on demand via a digital channel in response to signalling information received from the AS or other GSCs or other networks, i.e. on a per call basis.

bi-directional symmetric: This value applies when the information flow characteristics provided by the TFTS connection are the same between two (or more) access points or reference points in the forward and backward directions.

point-to-point connection: This value applies when more than two end points are provided by the connection and thus many different information flows are possible.

unstructured: This value applies when at each user network interface, protocols do not provide a mechanism for identifying the boundaries of a service data unit.

5 Fixed network interworking

5.1 Interworking requirements

5.1.1 Interworking definition

Within the scope of Consultative Committee on International Telegraphy and Telephony (CCITT) I-Series of Recommendations [3], "Interworking" is used to express interactions between networks, between end systems or between part of thereof. The aim is to provide an end-to-end communication. Those interactions rely on functions and on the means to select them. Those functions are required to convert the protocols used by the TFTS network to those used in the appropriate fixed network. They are referred to as the IWF.

5.1.2 Interworking between networks

5.1.2.1 Network interworking

Two connection scenarios may occur in the TFTS network for signalling between the GSC and the fixed networks as shown in figure 7.

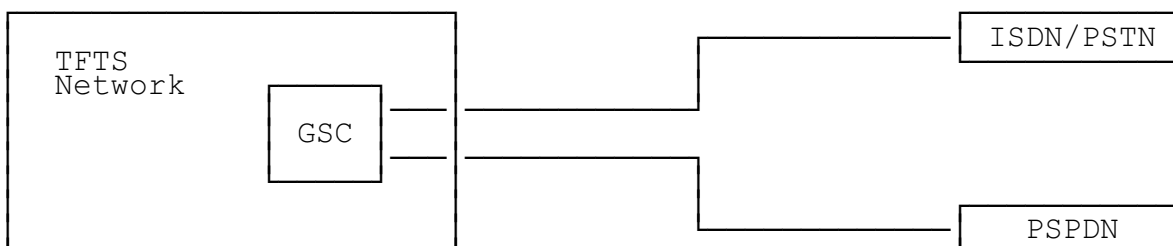


Figure 7: Network interworking

5.1.2.2 Service interworking

Service interworking shall be required when the teleservices of the end terminal are different (see figure 8).

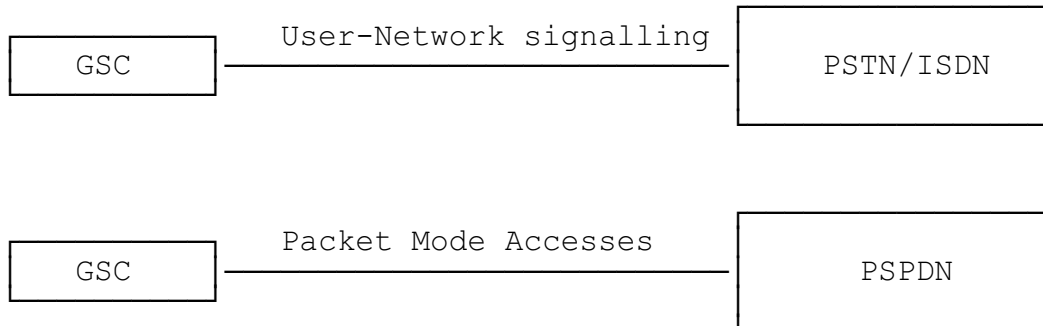


Figure 8: Service interworking

5.2 Network interworking traffic part

5.2.1 General

The purpose of this subclause is to identify IWF requirements to support interworking between:

- TFTS and ISDN;
- TFTS and PSTN.

These IWF are examined from a terminal user perspective.

NOTE: It is not possible to deal with ISDN and PSTN as one type of network, even when both ISDN and PSTN users are served by the same exchange (because of the limitations of the PSTN subscriber access).

When ISDN and PSTN connections are available for the GSC, the ISDN shall be chosen.

5.2.2 Definitions

Use of the following terms is made within this subclause. They refer to information requirements which are mandatory to support interworking functions.

bearer capability information: Specific information defining the lower layer characteristics required within the network.

lower layer capability information: Information defining the lower layer characteristics of the terminal.

higher layer capability information: Information defining the higher layer characteristics of a teleservice which is active on the terminal.

protocol identifier: Information defining the specific protocols used for the support of data transfer by a terminal.

progress indicator: Information supplied by the network to indicate to the terminal that network interworking has taken place.

out of band parameter exchange: Information exchanged via an associated or non-associated signalling link.

5.2.3 Traffic part introduction

Most calls initiated by TFTS users will terminate in either a PSTN or an ISDN. Since the numbering plan for ISDN (see CCITT Recommendation E.164 [4]) includes the numbering plan for the telephone network (see CCITT Recommendation E.163 [5]), it is not possible to distinguish by the number whether a given subscriber is a PSTN or an ISDN subscriber. Further in some countries, both ISDN and PSTN subscribers will be connected to the same exchange, so the only difference for this type of combined network will be in the nature of the customer access.

5.2.4 Network characteristics

5.2.4.1 Key characteristics of networks concerned

Table 3 indicates the key characteristics required of networks.

Table 3: Key characteristics of networks

	TFTS	ISDN	PSTN
Subscriber interface	Digital	Digital	
User - Network Signalling	ETS 300 326-2 [2], clause 10	CCITT Recommendations Q.920, Q.930	Analog
User terminal equipment supported	ETS 300 326-2 [2], clause 6	Digital Terminal equipment (TE)	Loop disconnect DTMF
Transmission facilities	Digital	Digital	Analog TE (I 411)
Exchange type	Digital	Digital	Analog digital
Info transfer mode	Circuit	Circuit / Packet	Circuit
Info transfer capability	Speech		3,1 KHz Audio (Voice/Voiceband data)

5.2.4.2 Characteristics of PSTNs

Differences between PSTNs need to be highlighted. Each PSTN has its own characteristics. and therefore, for this subclause, it is necessary to make some assumptions about a generalized PSTN.

PSTN key characteristics are given in table 3 above. Specific IWFs shall be needed to allow interworking between a TFTS and a PSTN depending on the concerned PSTN. Table 4 gives categories that may be used to classify PSTNs, and shows the possibilities within each category.

Table 4: PSTNs characteristics

Category	Possibility within category
Type of User Signalling	PSTN Loop Disconnect (10 pps)
	PSTN with DTMF user signalling
Type of inter-exchange signalling	PSTN channel associated
	PSTN common channel
Type of inter-exchange transmission	Analog
	Digital
Type of exchange switching	PSTN electromechanical
	PSTN electronic non digital
	PSTN electronic digital
Type of exchange control	non SPC
	SPC

NOTE: Under each category, a particular PSTN may have a combination of different possibilities, rather than only one.

5.2.4.3 Interworking classification

5.2.4.3.1 Network interworking

Network interworking shall be required whenever a TFTS and a non TFTS network are both involved in providing an end-to-end connection.

The concept of bearer services was developed for the ISDN and has been extended to the TFTS network. A bearer service is defined in the CCITT Recommendation I.112 [6]; "A type of telecommunication service that provides the capability for the transmission of signals between user-network interfaces".

Bearer services are described by many attributes, where an attribute is defined as a specified characteristic of an object or element whose values distinguish that object or element from others (see CCITT Recommendation I.310 [7]).

For the purpose of this ETS, a PSTN is assumed to provide a bearer service equivalent to an ISDN 3,1 kHz audio bearer service (see table 5).

Table 5: Bearer service interworking

Bearer service category in TFTS	Access in AS	Bearer service in ISDN	Bearer service in PSTN
Speech	Speech capability	Speech or circuit mode 3,1 KHz audio	Circuit mode 3,1 KHz audio

5.2.4.3.2 Signalling interworking

The IWF shall ensure the conversion of TFTS signalling into one of the user-network signalling protocols defined for TFTS connections to ISDN or PSTN.

5.2.4.3.3 Numbering

Numbering shall have one of the following forms:

- if the Avionics Termination (AT) receives the international prefix "00" the TFTS shall receive a standard CCITT international number containing the Country Code (CCd) and a national element;
- if the AT does not receive the prefix "00" the TFTS shall assume that the dialled number is TFTS specific.

In both cases the GSC shall translate the received number into an appropriate form for transmission to the network.

5.2.5 Interworking to the PSTN/ISDN

5.2.5.1 Interworking indications to TFTS terminals

Indications provided by the PSTN shall be the minimum signalling expected and the Airborne Telecommunications Equipment (ATE) capabilities.

5.2.5.2 Transmission aspects

For details of transmission aspects see ETS 300 326-1 [1], subclause 6.7.

Due to the transmission delay in the TFTS network or fixed network echo cancellation may be required. This function shall be part of the associated with the GSC and shall be implemented in accordance with the local public network capabilities.

It is recommended that the signalling system used between the TFTS and the public networks has the capability to enable or disable the echo cancellation devices in the TFTS and the fixed network in a co-ordinated way. Where this capability is not available the GSC may enable or disable echo control devices by analysis of the call parameters (e.g. destination number).

5.3 Interworking to the ISDN

The ISDN teleservice "Telephony" shall be used for speech call transmission in the ISDN. Any further requirements in addition to those above are network operator dependent.

6 Call handling and handover procedures

6.1 General

This subclause specifies procedures for call handling and handover. The procedures in this subclause are linked to the signalling processes of ETS 300 326-2 [2] to enable correct operation of the system.

6.2 Handover criteria and resource allocation management

6.2.1 General

This subclause details the arrangements applying to the decision point to be adopted by the AS in determining when a handover request is to be initiated to a GS in a TFTS for public use. It also identifies the action to be taken by an AS when the initial and any subsequent handover requests fail to establish the necessary resource requirements. It establishes a general overview of the resource allocation principles to be applied at the GS, in particular identifying priority of allocations where conflicts may arise.

6.2.2 General handover decisions

Handover may be initiated by both the AS and the GS for primarily totally different reasons. There are also a number of different types of handover.

Four types of handover are identified:

- Type 1) inter-slot handover on same carrier;
- Type 2) handover between carriers on same GS;
- Type 3) handover between GSs on the same GSC;
- Type 4) handover between GSs on different GSCs.

6.2.2.1 AS need for handover

Type 1 shall not be initiated by the AS. Type 2 shall only be initiated by the AS if it is experiencing link quality problems on the GS to AS link. A further type 2 handover shall not be initiated within three minutes of the completion of a successful handover of this type.

For types 3 and 4 the AS shall initiate handover either on the basis of a physical indication, i.e. weight on wheels, where the intermediate GS hands over to the airport GS, or radio quality measurements e.g. range, received quality Bit Error Ratio (BER).

6.2.2.2 GS need for handover

The GS shall only initiate type 1 and 2 handovers.

NOTE: These handovers are required to enable the GS to balance its traffic on the carrier channels it has associated with it. In this case it has to balance with regard to a number of factors:

- the need for a new AS to request a first call on the system;
- the need for an existing aircraft with traffic already established to initiate a further call on the system;
- the need to manage a handover from another GS and allocate new capacity to an aircraft, this may necessitate allocating anything from 1 to 4 traffic channels if Ba channels are used.

The GS shall never initiate a handover to pass the AS to another GS.

6.2.2.3 Handover decision point priority

There are a number of cases where a conflict may arise between the AS and GS handover requirements. Where such a conflict arises the following rules shall apply:

- in the case of any GS initiated handover requirement conflicting with any AS initiated inter-GS handover requirement, the AS requirement shall take precedence;
- in the case of a conflict between AS and GS initiated inter-carrier handover requirements the GS requirement shall take precedence;
- in the case of an AS inter-carrier handover requirement conflicting with a GS inter-slot handover requirement, the AS requirement shall take precedence.

6.2.3 Handover strategy to be applied at AS

Where the handover is to be invoked on the basis of link quality on the GS to AS link, then there is a need to fully define how the AS determines the link quality and what the tolerance limits of the link quality should be. ETS 300 326-2 [2], subclause 8.10 identifies a quality parameter (Q), which defines the BER performance on the physical link between the AS and the GS. When the value of Q falls below that specified in ETS 300 326-2 [2], subclause 8.10, then the AS should attempt to seek a handover to another suitable carrier on the same, or another, GS. Where this is not possible see the following subclauses on handover failure conditions.

6.2.4 Handover strategy to be applied at AS for cell boundary selection

The AS shall attempt to perform handover to another GS on the basis of its measurement of the AS-GS range at the Range Limit minus LIMK, both of which are transmitted on Broadcast Control Channel (BCCH)(D).

To discriminate between the handover strategy identified in subclauses 6.2.3 and 6.2.5 the AS must also be aware of the range limit information.

It is important where handover failure actions are to be applied, that the AS can discriminate between the handover origination mechanism.

For further information on the reception and usage of the range limit and tolerance parameters, see ETS 300 326-2 [2], subclause 8.10.

6.2.5 Alternative handover strategy to be applied at AS for cell boundary selection

The major alternatives to the selection process identified above come in the selection process to be applied between airport and intermediate/en-route GSs and intermediate and en-route GSs where the en-route and intermediate stations are implemented separately. In this case there could well be some physical related information provided by the airborne equipment to initiate the handover. This physical information could comprise the following:

- Weight On Wheels (WOW): this parameter would invoke handover from an INT/ER GS to an AP GS or vice versa;
- altitude information: this parameter would invoke handover from an INT to an ER GS or vice versa in the case where these GSs are separately implemented.

6.2.6 Conflict in signalling requirements

An AS shall only be allowed to initiate and have outstanding a single handover request towards its currently connected GS. There shall be no mechanism provided whereby an AS can cancel a handover request and initiate a subsequent one to a different target GS. Where an initial handover requirement has been registered in the AS, any subsequent handover decisions shall be managed in the AS such that they will not be initiated until the first requested handover is completed or has failed.

NOTE: This could be particularly important where a link quality induced handover is closely followed by a physically induced handover requirement.

6.2.7 Resource management strategy to be applied at the GS

The resource management strategy to be defined for the GS determines the best means of balancing traffic and how this is to be managed. Should the AS be balanced to allow a spare traffic slot on each carrier, this would ensure that an additional call request from an existing aircraft would be handled. However, there could be problems in finding capacity for aircraft being handed over with more than one traffic channel. Therefore, there is a need to define some order of priority for the GS in allocating resources when there is a conflict in demand for its resources. The following subclause defines the requirements for resource management.

6.2.7.1 General requirements on GS resource management

- 1) The GS shall not initiate a handover towards an AS or ASs to accommodate an incoming handover request from another AS, i.e. there shall be no linking of handovers at the GS.
- 2) The GS shall attempt to maintain at least one TCH per carrier free, by managing handover of other ASs on that carrier.

NOTE: As an example, in the case of a 5 channel GS with 12 Ba TCHs allocated, the ideal allocation pattern will be as given in figure 9. The allocation of resources to achieve this distribution of TCHs is not specified here and is an implementation issue.

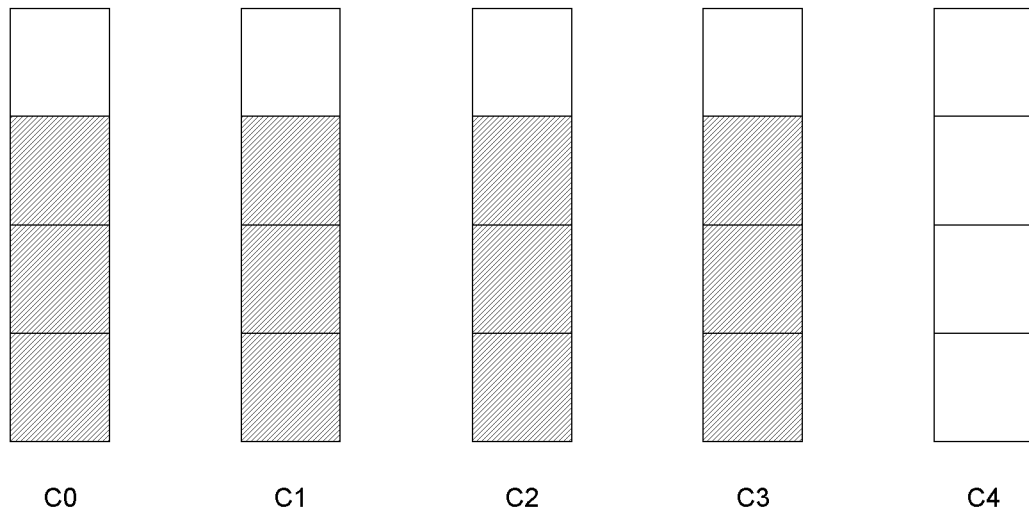


Figure 9: Allocation pattern

- 3) The GS shall attempt to maintain one carrier with no TCHs allocated, to manage incoming handover requirements. To accomplish this and avoid unnecessary handover from this free carrier to other carriers when ASs access this circuit directly, this channel shall not be offered as the access carrier on the BCCH(S). ASs in accessing the system shall not access a carrier for new calls where this condition is indicated on the BCCH. Where a free carrier is unable to be maintained due to the requirements of 2 above, then this channel will be offered in the BCCH(D).
- 4) Where resource management at the GS identifies a conflict between 2 and 3 above, then 2 is given priority over 3, i.e. the resource management at the GS should, as the primary principle provide for a single TCH vacancy per carrier.
- 5) The resource management at the GS shall minimise the handover disruption caused to ASs in catering for the above conditions. The GS shall maintain ASs such that the maximum handovers of a single AS within that GS shall not be more than once per minute.
- 6) The GS shall only initiate a handover request to an AS when the resources are available at the GS to meet the AS resource requirements and when conditions 1 to 5 above are fulfilled.

6.2.8 Handover failure actions due to lack of resources

The following subclauses detail, the actions to be taken due to a lack of resources at the GS to manage handover. Other failure conditions on handover due to signalling or other error conditions are defined in subclause 6.3. There are a number of instances where an AS in requesting a handover will fail due to a change of resources at the GS in the time period between sending the handover request and the GS receiving it. This is particularly likely in the case whereby a handover is requested to a different GS. The following subclauses also detail the actions to be taken at the GS and the AS when this incident does occur.

6.2.8.1 Handover failure action at the GS side due to lack of resources

When a handover request is received at the GS from an AS, this shall be in the form of a request for a number of TCHs. If the GS, in reviewing its current resource allocation, is unable to fulfil the requirements requested, then it shall return an unsuccessful indication in the HANDOVER REJECT message.

In a successful case the handover information shall be passed to the AS and handover shall take place. In an unsuccessful case indication shall be passed to the AS.

The GS shall never return a HANDOVER COMMAND message allocating anything less than the total resource requested by the AS. If the total requested resources are not available then an unsuccessful result shall be returned.

6.2.8.2 AS action on handover failure due to resource shortage

When the AS receives a handover message indicating an unsuccessful request due to lack of resources, a number of actions are possible dependent upon the initial handover condition and the present situation of the AS.

6.2.8.2.1 Handover initiated due to poor link quality

If the AS receives an unsuccessful handover information, it shall start a timer with a duration of 3 minutes. The AS shall then identify, where possible, other GSs which are within its coverage at the time, and shall initiate a handover, if possible.

If a handover is successfully completed the timers shall be stopped. If a handover initiation is not in progress and the poor link quality condition is still applicable when the timer expires, then another handover request may be made to the current serving GS.

6.2.8.2.2 Handover initiated due to cell boundary

If a unsuccessful handover is received by the AS then a number of actions are available:

- if the AS is within the range tolerance limit of the existing GS, then the action shall be as defined in subclause 6.2.8.2.1;
- if the AS is outside of the range tolerance limit the connection to the current serving GS shall be terminated immediately. An indication shall be provided to the ATE to enable the "recall" facility to be invoked.

6.2.8.2.3 Handover initiated due to physical condition

If an unsuccessful handover is received at the AS then the connection to the current serving GS shall be terminated immediately. An indication shall be provided to the ATE to enable the "recall" facility to be invoked.

6.2.9 General handover and cell selection issues

The process for selecting the target GS both in the case of a handover initiation, and an initial access request, is defined in ETS 300 326-2 [2], subclause 8.8.

NOTE: The subclause identifies the handover initiating circumstance and the process to be applied when resources are not available at the target GS to meet the initiation requirement.

Subclause 6.3 identifies the signalling processes involved in the handover process and also identifies the actions to be taken when these signalling processes fail.

6.3 Call handling and handover management procedures

6.3.1 General

This subclause describes the general procedures to be used for communication establishment and release. It describes also, the general handover procedures that lead to resource modification while maintaining communications.

Detailed procedures for Call Control (CC) and handover are specified in ETS 300 326-2 [2], clause 10.

6.3.2 Call handling procedures

CC deals with calls from aircraft passengers to PSTN/ISDN subscribers. The CC function relies on a resource function to convey CC signalling. Call Handling procedures describe the interaction between call control and resource functions. The way these functions work together is the main objective of this subclause.

For a detailed description of:

- CC function (see ETS 300 326-2 [2], clause 10);
- Radio Resource (RR) function (see ETS 300 326-2 [2], clause 10);
- terrestrial resource function (see clause 4);
- network interworking (see clause 5).

6.3.2.1 General aspects

CC is based upon a peer to peer signalling. It is carried over a TFTS resource from the AS to the Ground Switching Centre (GSC). Only the AS and the GSC at a peer to peer level cope with CC signalling. The AS also manages RR and the GSC manages terrestrial resource. Inside the GS there is no processing of CC signalling, but the GS manages RR and terrestrial resource. The GSC is involved with CC signalling while interfacing the PSTN/ISDN.

As soon as a call occurs on the AS side, the AT requires a resource. This resource shall be granted according to availability. On the radio path where the AS operates, the resource consists of two parts. A first part shall be dedicated to the support of the signalling. The second part shall carry traffic when call set-up is achieved.

Due to the low signalling rate on the radio path, the resource part which will carry traffic shall be used for signalling when the call is not in the conversation phase. This capacity shall be added to other dedicated signalling capacity. Whenever the AT deals with several calls, the associated signalling capacities shall be gathered to offer a common signalling support.

The use of a call dedicated resource for both signalling and traffic implies a switch mechanism. This mechanism shall be triggered when a call enters the conversation phase, and switch from signalling to traffic mode. It shall be triggered again when the call enters the call release phase, and switch from traffic to signalling. This mechanism implies that CC notifies the "resource provider" function to allow the resource mode switching.

NOTE: Despite the fact that the CC signalling is carried over the TFTS network from the AS to the GSC, the physical path over which this signalling is carried might be changed due to a handover need. This fact should have no implication on the CC signalling or protocol.

6.3.2.2 Functional aspects for call handling

Subclause 6.3.2.1 indicates that call handling functions rely on resource functions. The following paragraphs give further explanations and features of these entities in the TFTS stations.

In the AS, the CC function shall exchange information with the peer function in the GSC. The means to support the exchange on the AS side shall be provided by the resource function. On the Ua interface, it shall consist of the RR. Details about the Ua interface are found in ETS 300 326-2 [2].

In the GSC, the CC function shall exchange information with the AS. The support shall be provided by the terrestrial resource function.

In the GS, there shall be no CC function. But, the GS shall manage the RR on the Ua interface and with the terrestrial resource on the Ub interface. Therefore, the GS shall act as a "relay" for CC signalling and shall manage interactions between RR and Terrestrial Resource Management (TRM).

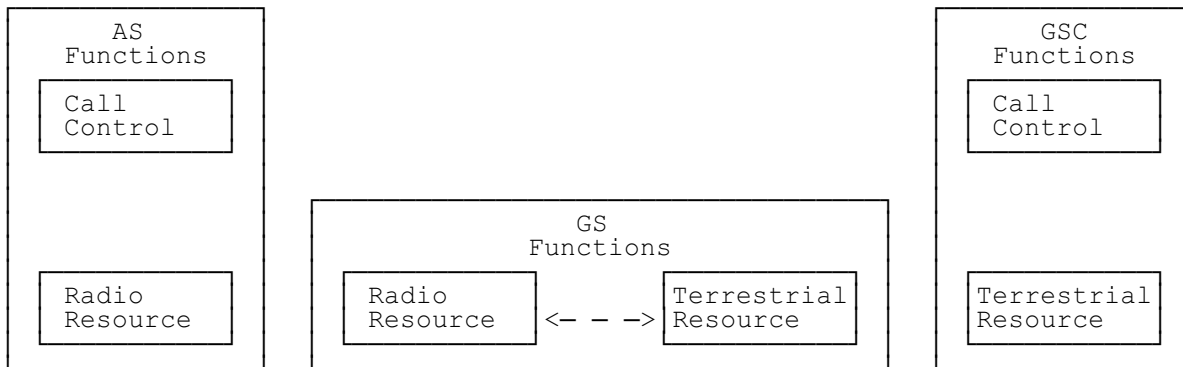


Figure 10: Call handling architecture

6.3.2.2.1 AS functional entities

The AS RR function shall be responsible for:

- AS radio entry procedure;
- AS signalling link set-up, maintaining and release;
- AS channel negotiation, set-up and release;
- AS channel mode switching from traffic to control and vice versa;
- AS handover procedure;
- carrying CC and OM signalling to and from GS resource function.

The AS CC function shall be responsible for:

- signalling interface on the CTU side;
- requesting resource for each call;
- requesting resource mode switch from traffic to control and vice versa;
- dialogue with CC function in the GSC;
- requesting release of resource at the end of call release.

6.3.2.2.2 GS functional entities

GS RR function shall be responsible for:

- entry procedure acceptance;
- multiple access management;
- signalling links to the ASs;
- AS identification on signalling link opening;
- RR allocation;

- channel mode switching from traffic to control and vice versa;
- handover procedures;
- carrying CC and OM signalling to and from AS resource function.

NOTE: GS relay functionality should assume that CC signalling received from one of the resource functions will be transmitted to the other. It also applies to some handover signalling and might apply to OM signalling. This GS functionality may be split into two parts and included in RR and terrestrial resource functions.

GS terrestrial resource function shall be responsible for:

- signalling link to the GSC;
- circuit management on the GS/GSC interface;
- carrying CC and OM signalling to and from the GSC.

6.3.2.2.3 GSC functional entities

GSC terrestrial resource function shall be responsible for:

- signalling links to the GSs;
- terrestrial circuits monitoring;
- terrestrial circuits switching in handover procedures;
- carrying CC and OM signalling to and from the GSs.

GSC CC function is responsible for:

- dialogue with CC function in the AS;
- requesting the GS for resource mode switch from traffic to signalling and vice versa;
- signalling interface with the PSTN/ISDN;
- requesting resource release at the end of a call release.

6.3.2.3 Call handling phases

Call handling is usually organized around the following phases:

- **call set-up:** The call set-up phase consists in the progression of the call on the network up to the called subscriber off-hook;
- **conversation:** The conversation phase consists of the period of time where the two subscribers are speaking together. In this period the main call handling activity is hang-up supervision; and
- **call release:** As soon as one of the subscribers hangs up, the call enters the call release phase.

NOTE 1: In some public telephone networks, calls may only be cleared when the calling party returns to the on hook state. In spite of this it is recommended that calls from an AS should be released when either party goes on hook.

This general scheme has been enhanced to comply with TFTS requirements. Between AS and GSC, call set-up phase shall only take place after a resource set-up phase has been completed. The resource release phase may be delayed to offer a larger capacity to exchange OM information.

NOTE 2: For handover interaction with call handling, it is important to indicate which phase the system is dealing with. Handover is active in modifying the physical path between an AS and a GSC. This means that the set of resource associated to the AS is modified. Therefore calls for which resource set-up phase has been completed, can be handed over.

In the following diagrams, three kinds of arrows are used:

- > : indicates messages out of the scope of Ua or Ub interface;
- ===> : indicates messages for CC function;
- > : indicates messages for RR function;

NOTE 3: N in these diagrams indicates Network.

6.3.2.3.1 Resource set-up phase

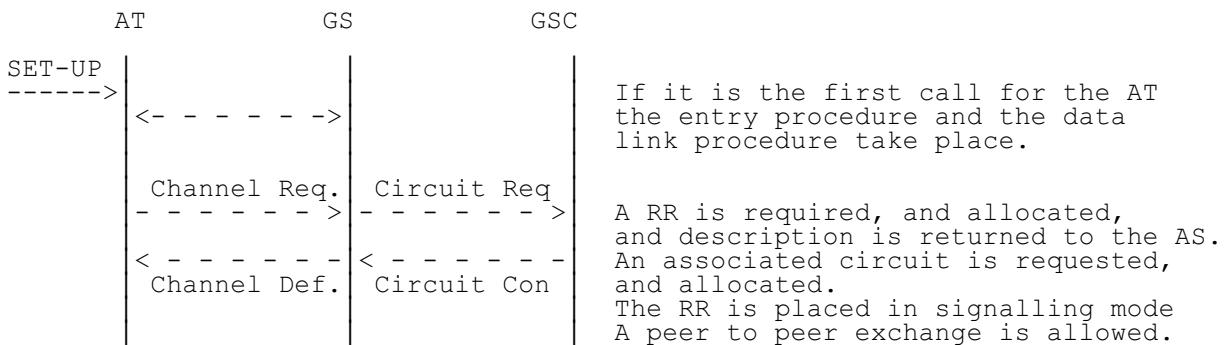


Figure 11: Resource set up phase

If this phase cannot be completed, the ATE shall be informed of the rejection of the call.

NOTE: This may happen when the AS is out of coverage of a GS or when no RR is available for a call.

6.3.2.3.2 Call set-up phase

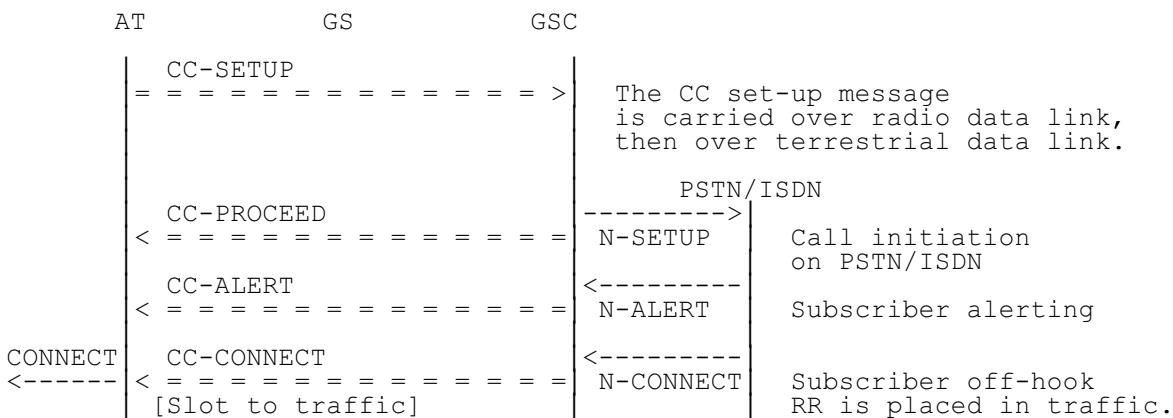


Figure 12: Call set up phase

Detailed information about "TCH connection" is given in ETS 300 326-2 [2], clause 7.

In this phase handover may occur.

6.3.2.3.3 Conversation phase

In most cases, only speech traffic occurs during conversation phase. A DTMF facility shall be offered in conversation phase.

In this phase handover may occur.

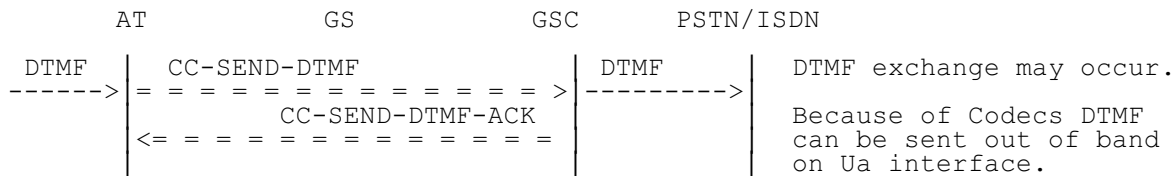


Figure 13: Conversation phase

6.3.2.3.4 Call release phase

In this phase handover may occur.

GSC side initiation:

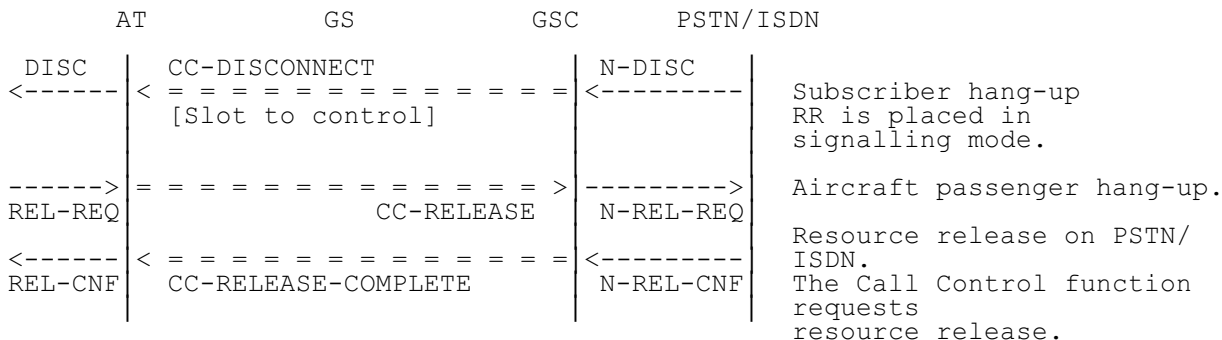


Figure 14: Call release phase - GS initiated

AS side initiation:

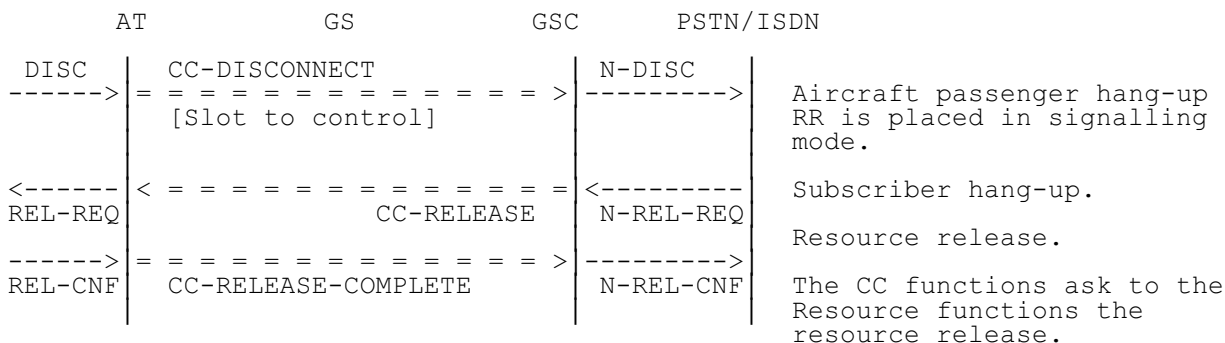
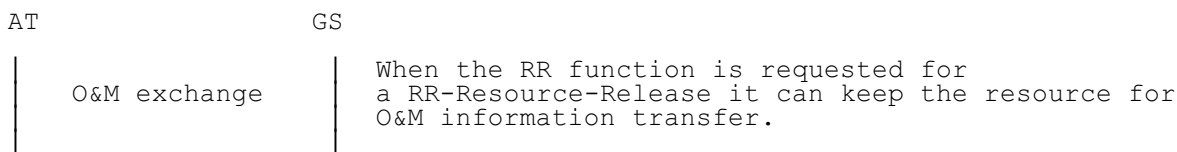


Figure 15: Call release phase - AS initiated

Detailed information about TCH disconnection is given in ETS 300 326-2 [2], clause 10.

6.3.2.3.5 Resource Release phase



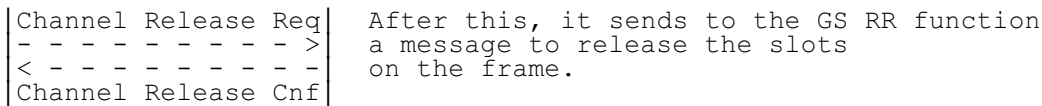


Figure 16: Resource release

Detailed information about the use of RR at the end of a call release is given in ETS 300 326-2 [2], clause 10.

When the release resource was the last resource for the AS, the phase shall end with AS "radio exit procedure". The AS shall cease to transmit towards the GS.

The GS which is in charge of the RR may send the release slot message if needed.

6.3.3 Handover procedures

6.3.3.1 Handover decision

6.3.3.1.1 Reasons for handover

6.3.3.1.1.1 Reason for handover initiation on the AS side

Whilst moving, the AS shall search for the next GS which satisfies the criteria defined in ETS 300 326-2 [2], subclause 8.10.2, so that, when needed, it may initiate a handover to another GS.

On the AS side, movement outside the range limit shall be a basis for handover decision.

6.3.3.1.1.2 Reason for handover initiation on the GS side

The down-link between the AS and GS, operating in Time Division Multiple Access (TDMA) mode, shall handle multiple ASs on each frequency it is managing. Thus each AS may offer as many communications links as it is able to establish on any one frequency. Resource availability and therefore service quality may take advantage of frequency load balancing which requires GS initiated handover.

On the GS side, RR load balancing shall be the basis for handover decision.

6.3.3.1.2 Strategy for handover

See ETS 300 326-2, subclause 8.10.2

6.3.3.2 Handover management

6.3.3.2.1 Resource management

Resource management principles shall be:

- the AS is responsible for determining the GS toward which it needs to transmit;
- the GS is responsible for RR allocation to the AS (i.e. frequency and slots in the frame).

6.3.3.2.2 Handover phase organization

The handover process may be described in terms of:

- **negotiation phase:** The negotiation phase is used to exchange information about resource needs between each TFTS component;
- **execution phase:** Execution phase leads to effective change of paths;
- **completion phase:** Completion phase leads to release of unused resources.

6.3.3.2.2.1 Negotiation phase

In the negotiation phase, if all the necessary resources are available, they shall be reserved and placed in stand-by state.

All information about RR shall be sent to the AS. This information shall consist of the frequency identification and the allocated slot description for each traffic link.

When the AS receives the information in the command message, the network shall be ready to enter the next phase and the AS shall be able to change frequency (within the same GS or not).

If resources are not available, a handover reject message shall be returned to the AS.

6.3.3.2.2.2 Execution phase

The AS shall suspend its signalling link when it enters the execution phase. The old GS shall reserve its current resources allocated to that AS.

The AS shall change RR according to parameters given by the terrestrial network. In order to achieve this, the AS shall:

- change its radio configuration;
- synchronize; and
- change its allocated slot configuration.

The AS shall establish a physical link with the new GS and connect the TCHs.

NOTE: The "entry slot" is sent by stealing one of the traffic slots associated with the AS in the frame. The "power and timing information slot" is sent by stealing one of the traffic slots in the next frame. The other traffic slots are carrying traffic. See ETS 300 326-2 [2], subclause 8.10.2.

The AS shall open a signalling data link with the GS in charge of the new path.

When the signalling data link is established, the execution phase shall end.

The execution phase may be replayed with the previous GS, in case of access failure on the target GS.

6.3.3.2.2.3 Completion phase

When the AS has successfully dealt with the execution phase with the target GS, it shall notify the network (the original GS) that the handover is complete. All the TETS network components implied in the operation shall be informed. When they are informed they shall release the resources that are no longer required.

When a handover failure has occurred in the execution phase, the completion phase shall be performed with the previous GS and the AS shall send failure information to the network to release resources at the target GS.

6.3.3.2.3 Failure procedures

When the execution phase cannot be completed with the target GS, the AS shall return to the previous GS. Whatever the cause, e.g. synchronization failure, physical link establishment failure, datalink establishment failure, the AS shall replay the execution phase with the previous GS. This shall cause the AS to transmit a handover failure message to the network. This message shall be transmitted to the stations implied in handover to free radio and terrestrial resources on the new paths.

In the case of success a completion phase with the previous GS shall take place.

If the AS cannot go back to the previous GS, it shall stop radio transmission and notify the ATE that each call has been released.

6.3.3.3 Functional composition of TFTS stations

Signalling functions for handover shall be the same throughout the network. They shall involve all communications established by the aircraft which processes a handover.

For the GS there shall be two kinds of function:

- on the AS/GS interface:
 - procedure relative to the old frequency;
 - procedure relative to the new frequency;
- on the GS/GSC interface:
 - procedure relative to GS originating handover request to GSC;
 - procedure relative to GS receiving handover request from GSC.

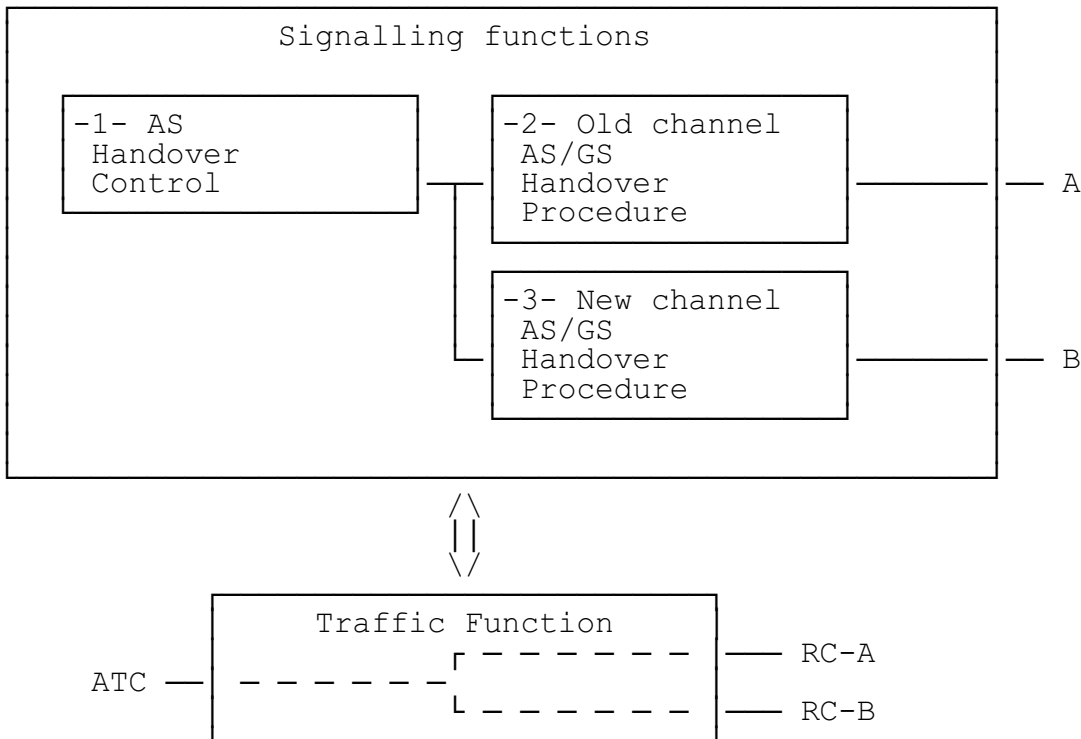
For the GS there shall be three kinds of control function:

- control relative to handover between channels of the GS;
- control relative to previous GS;
- control relative to new GS.

For the GSC there shall be:

- two kinds of function on the GS/GSC interface:
 - procedure relative to GSC originating handover request to GS;
 - procedure relative to GSC receiving handover request from GS.
- two kinds of function on the GSC/GSC interface:
 - procedure relative to GSC originating handover request to another GSC;
 - procedure relative to GSC receiving handover request from another GSC.
- three kinds of control function:
 - control relative to handover between channels of single GSC;
 - control relative to previous GSC;
 - control relative to new GSC.

6.3.3.3.1 AS functional composition for handover



A = Signalling connection to the GS on the old frequency.

B = Signalling connection to the GS on the new frequency.

ATC = Aircraft traffic circuit.

RC-A = Radio channel supporting traffic on previous frequency.

RC-B = Radio channel supporting traffic on new frequency.

Signalling functions:

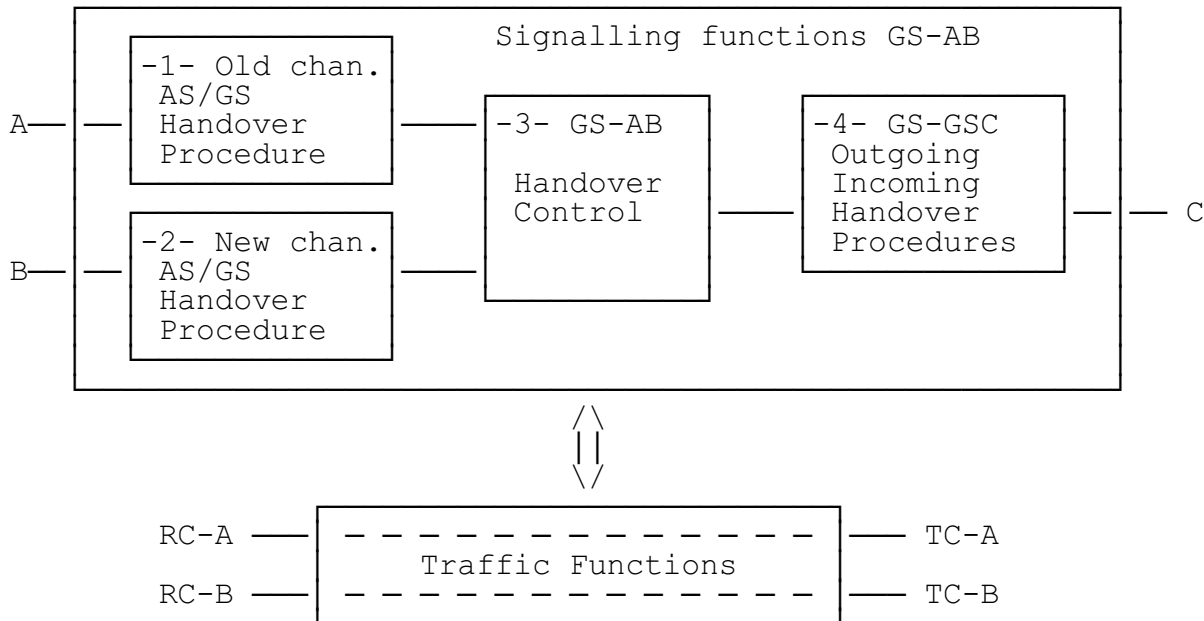
- 1) **AS handover control:** AS handover decision, negotiation, execution, completion;
- 2) **old frequency AS/GS handover procedure:** Handover message management on AS/GS interface;
- 3) **new frequency AS/GS handover procedure:** Handover message management on AS/GS interface.

Figure 17: AS functional architecture for handover

6.3.3.3.2 GS functional composition for handover

- **GS-AB:** GS involved in handover between channels of the same GS.
- **GS-A:** Previous GS in a handover between GSs.
- **GS-B:** New GS in a handover between GSs.

6.3.3.3.2.1 Functional composition for handover between carriers of a GS



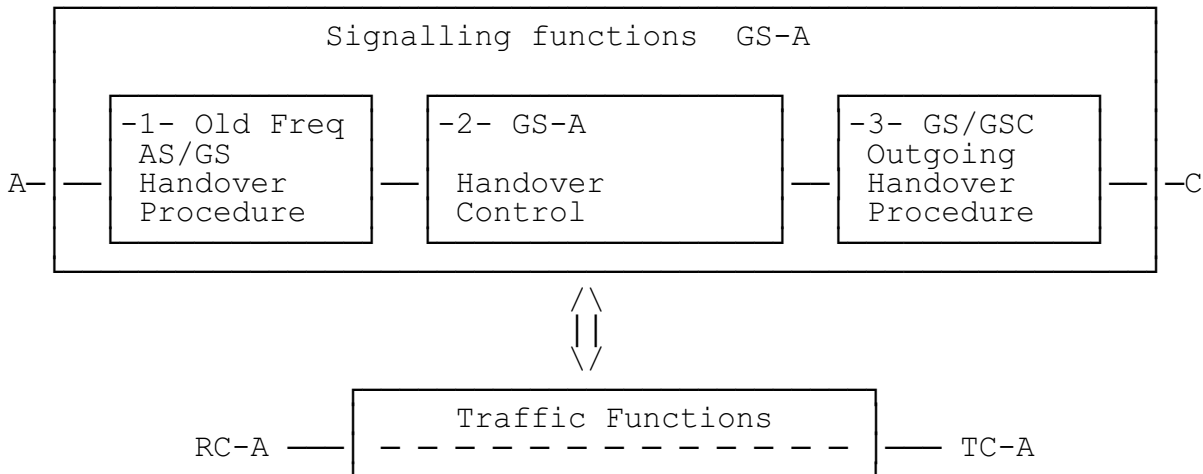
- A = Signalling connection to the AS on the previous frequency.
- B = Signalling connection to the AS on the new frequency.
- C = Signalling connection to the GSC.
- RC-A = Radio channel supporting traffic on the previous frequency.
- TC-A = Traffic circuit to the GSC before handover.
- RC-B = Radio channel supporting traffic on the new frequency.
- TC-B = Traffic circuit to GSC after handover.

Signalling functions:

- 1) **old frequency AS/GS handover procedure:** Handover message management on AS/GS interface;
- 2) **new frequency AS/GS handover procedure:** Handover messages management on AS/GS interface;
- 3) **GS-AB handover control:** GS handover decision, negotiation, execution, completion;
- 4) **GS/GSC outgoing/incoming handover procedures:** Handover message management on GS/GSC interface.

Figure 18: Handover between GS channels

6.3.3.3.2 Functional composition for a previous GS in handover between different GSs



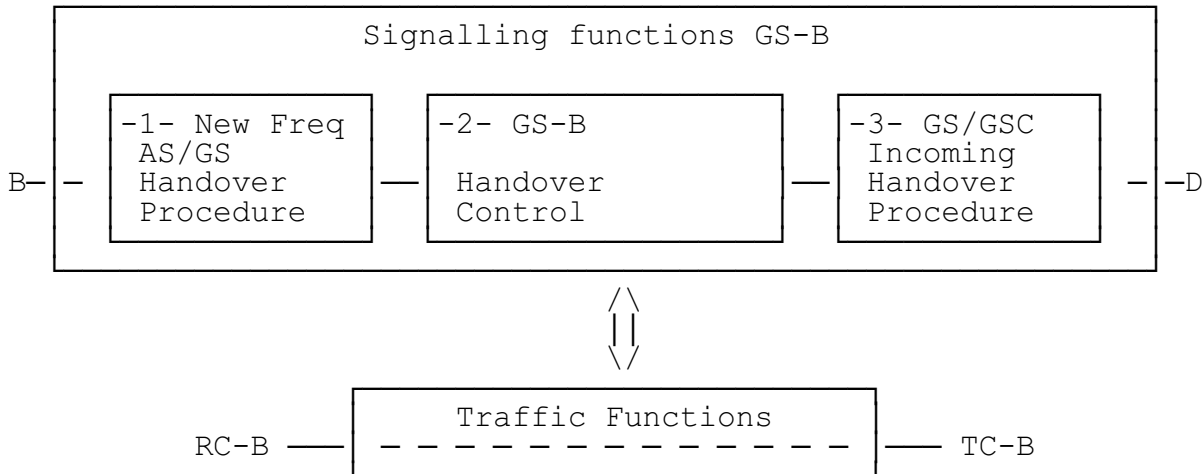
- A = Signalling connection to the AS.
- C = Signalling connection to the GSC.
- RC-A = Radio channel supporting traffic.
- TC-A = Traffic circuit to GSC.

Signalling functions:

- 1) **old frequency AS/GS handover procedure:** Handover message management on AS/GS interface;
- 2) **GS-A handover control:** GS handover, negotiation, execution, completion.
- 3) **GS/GSC outgoing handover procedure:** Handover message management on GS/GSC interface.

Figure 19: Previous GS handover

6.3.3.3.3 Functional composition for a new GS in handover between different GSs.



- B = Signalling connection to the AS.
- D = Signalling connection to the GSC.
- RC-B = Radio channel supporting traffic.
- TC-B = Traffic circuit to GSC.

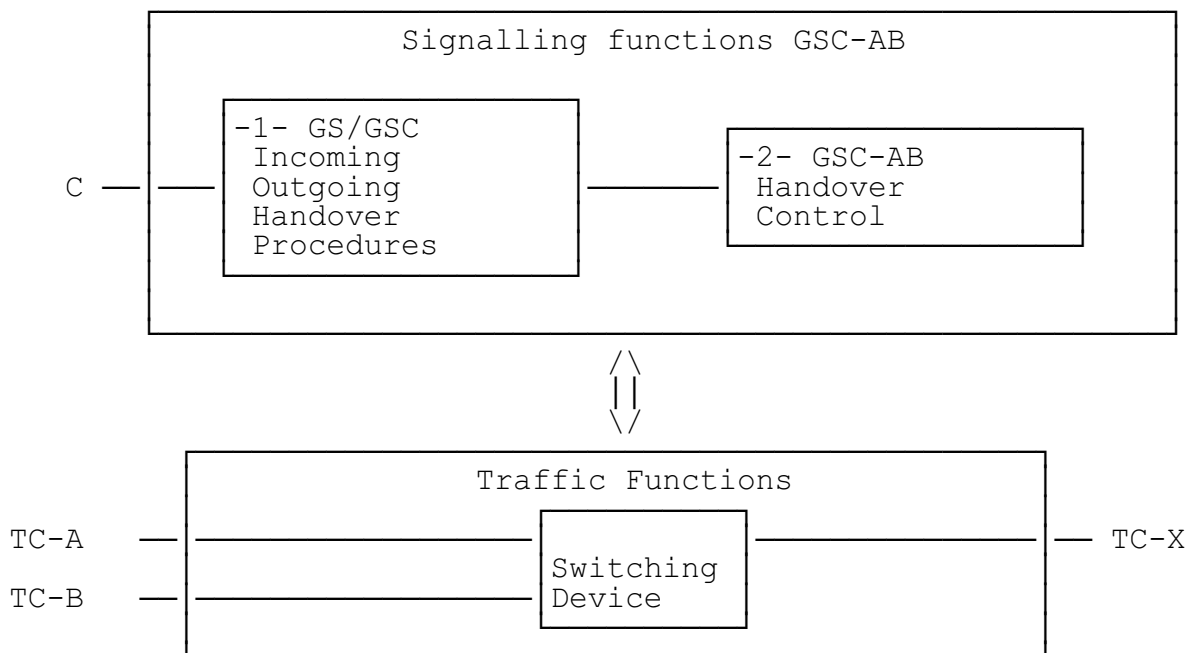
Signalling functions:

- 1) **new frequency AS/GS handover procedure:** Handover message management on AS/GS interface;
- 2) **GS-B handover control:** GS handover, negotiation, execution, completion;
- 3) **GS/GSC incoming handover procedure:** Handover message management on GS/GSC interface.

Figure 20: New GS in handover

6.3.3.3.3 GSC functional composition for handover

- GSC-AB: GSC involved in handover between channels of the same GS or between GS of the same GSs.
- GSC-A: GSC requesting handover in a handover between GSs of different GSCs.
- GSC-B: GSC requested for handover in handover between GSs of different GSCs.



- C = Connection to the GS.
- TC-A = Traffic circuit to the GS.
- TC-B = New traffic circuit to the GS.
- TC-X = Traffic circuit to PSTN called subscriber (via other GSCs or not).

Signalling functions:

- 1) **GS/GSC incoming/outgoing handover procedures:** Handover message management on GS/GSC interface;
- 2) **GSC-AB handover control:** GSC handover negotiation, execution, completion.

Figure 21: GSC Handover architecture

Switching function:

Interfaces:

- TC-A to the traffic circuit of the GS;
- TC-B to another traffic circuit of the GS;
- TC-X to the traffic circuit to PSTN subscriber (via other GSCs or not).

For handover between channels of the same GS and for handover between GSs of the same GSC; states of switching device are:

- **initial connection:** TC-A to TC-X;
- **intermediate connection:** TC-A and TC-B to TC-X;
- **final connection:** TC-B to TC-X.

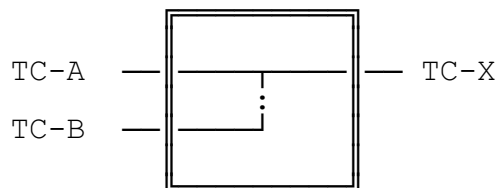
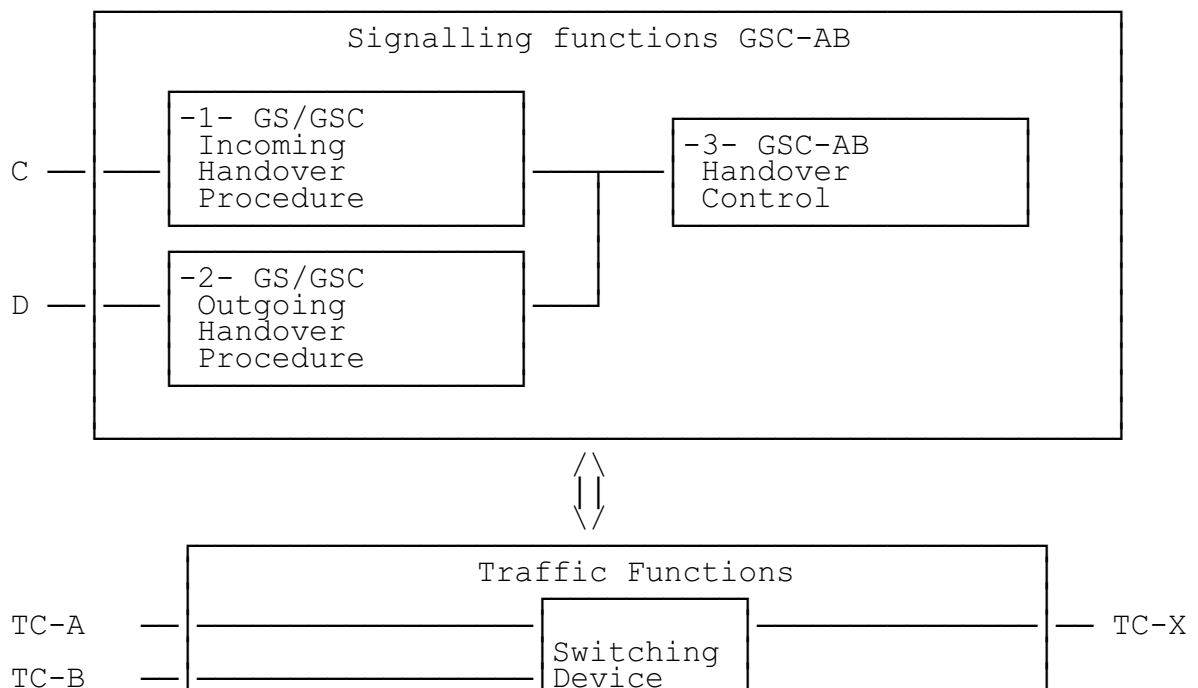
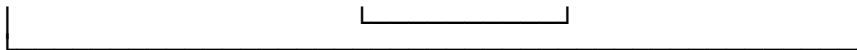


Figure 22: Switching states

6.3.3.3.1 GSC signalling functions for handover between GSs of the same GSC





- C = Signalling connection to the previous GS.
- D = Signalling connection to the new GS.
- TC-A = Traffic circuit to the previous GS.
- TC-B = Traffic circuit to the new GS.
- TC-X = Traffic circuit to PSTN called subscriber (via other GSCs or not).

Signalling functions:

- 1) **GS/GSC incoming handover procedures:** Handover message management on GS/GSC interface;
- 2) **GS/GSC outgoing handover procedures:** Handover message management on GS/GSC interface;
- 3) **GSC-AB handover control:** GSC handover negotiation, execution, completion.

Figure 23: Handover between GSs on same GSC

Switching function:

Interfaces:

- TC-A to the traffic circuit of the previous GS;
- TC-B to another traffic circuit of the new GS;
- TC-X to the traffic circuit to PSTN subscriber (via other GSCs or not).

For handover between channels of the same GS and for handover between GSs of the same GSC; states of switching device are;

- **initial connection:** TC-A to TC-X;
- **intermediate connection:** TC-A and TC-B to TC-X;
- **final connection:** TC-B to TC-X.

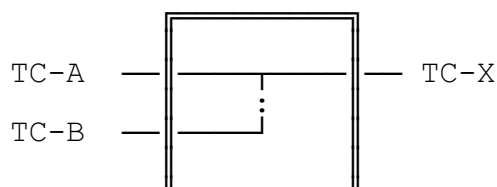
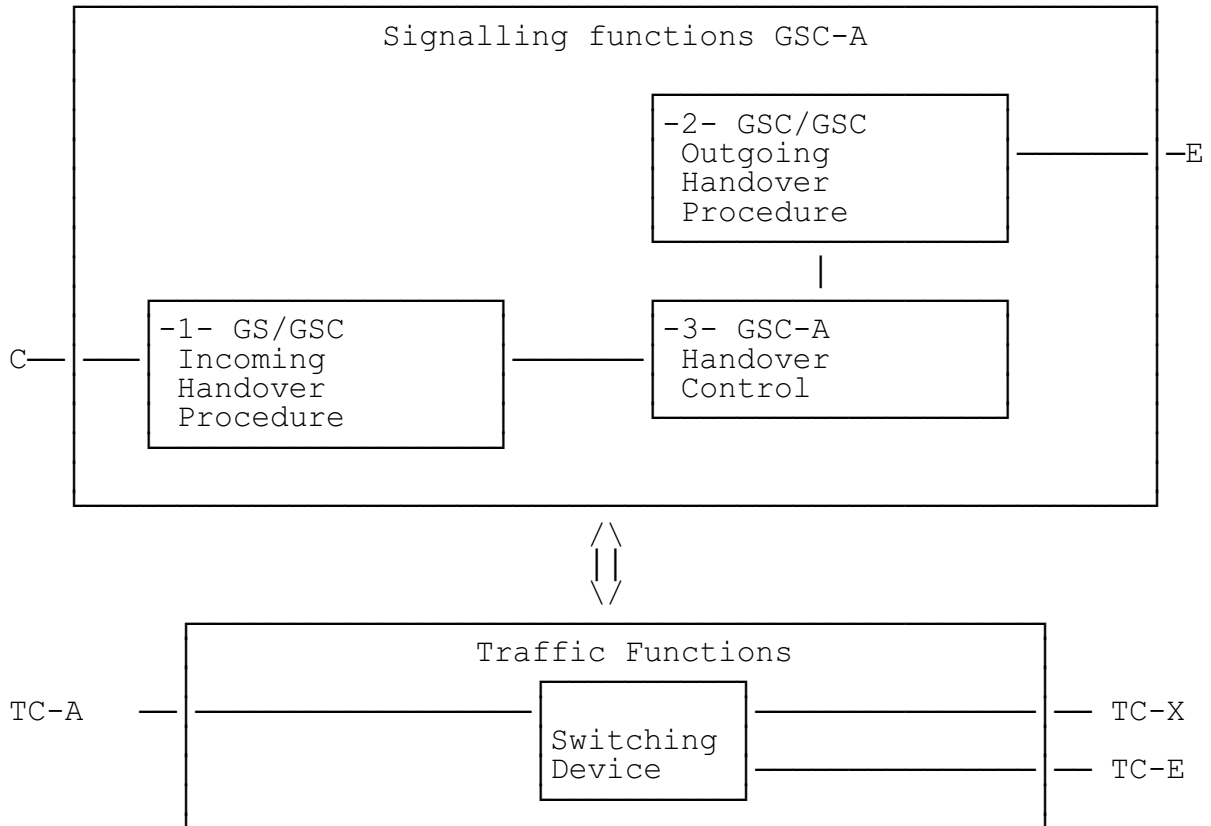


Figure 24: Switching states

6.3.3.3.2 Signalling functions for a GSC requesting handover



- C = Connection to the previous GS.
- E = Connection to requested GSC.
- TC-A = Traffic circuit to the previous GS.
- TC-X = Traffic circuit to PSTN called subscriber (via other GSCs or not).
- TC-E = Traffic circuit to requested GSC.

Signalling functions:

- 1) **GS/GSC incoming handover procedure:** Handover message management on GS/GSC interface;
- 2) **GSC/GSC outgoing handover procedure:** Handover message management on GSC/GSC interface;
- 3) **GSC-A handover control:** GSC handover negotiation, execution, completion.

Figure 25: GSC requesting handover

Switching function:

Interfaces:

- TC-A to the traffic circuit of the previous GS;
- TC-X to the traffic circuit to PSTN subscriber (via other GSCs or not);
- TC-E to the traffic circuit to requested GSC.

For handover between GSs of different GSCs; states of switching device are;

- **initial connection:** TC-A to TC-X;
- **intermediate connection:** TC-A and TC-E to TC-X;
- **final connection:** TC-X to TC E.

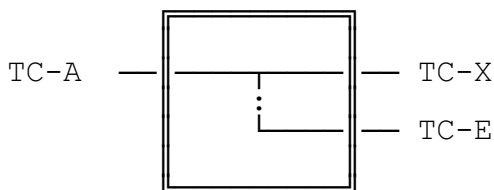
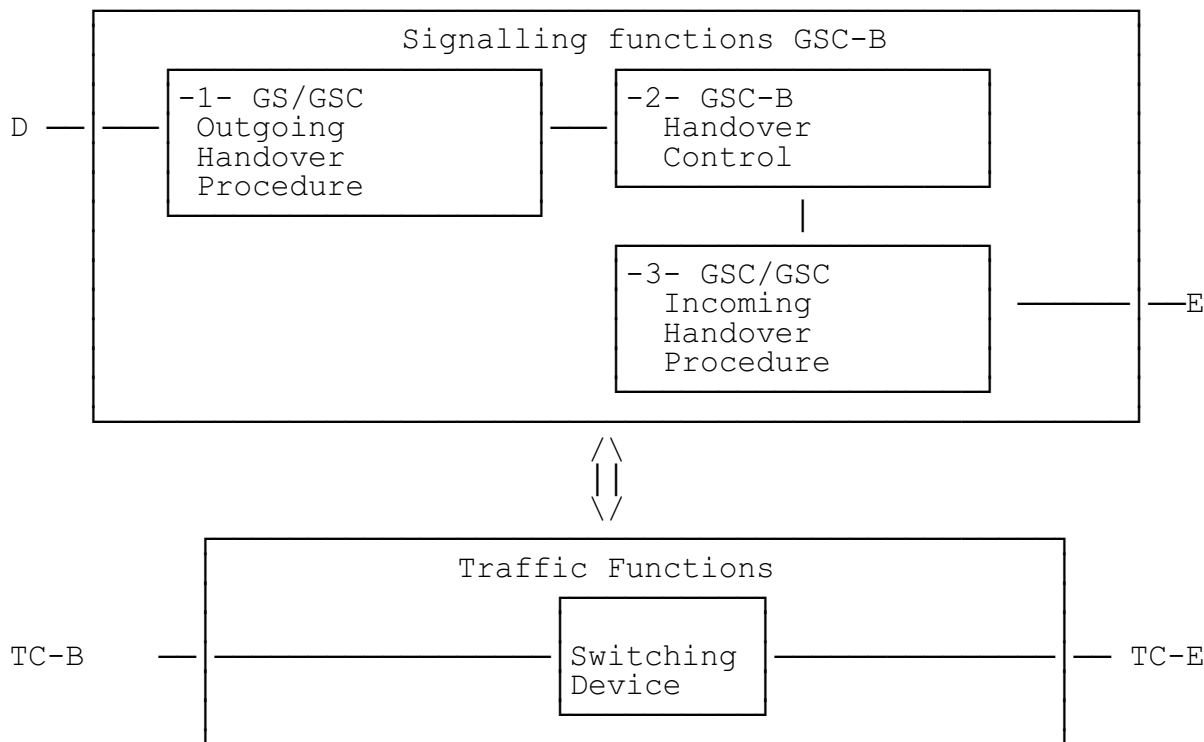


Figure 26: Switching states

6.3.3.3.3 Signalling functions for a handover requested GSC



D = Connection to the new GS.

E = Connection to the previous GSC.

TC-B = Traffic circuit to the new GS.
TC-E = Traffic circuit to the previous GSC.

Signalling functions:

- 1) **GS/GSC outgoing handover procedure:** Handover message management on GS/GSC interface;
- 2) **GSC-B handover control:** GSC handover negotiation, execution, completion;
- 3) **GSC/GSC Incoming handover procedure:** Handover message management on GSC/GSC interface.

Figure 27: GSC requested handover

Switching function:

Interfaces:

- TC-B to the traffic circuit of the new GS;
- TC-E to traffic circuit of the previous GSC.

States of switching device are:

- **initial state:** no connection;
- **final connection:** TC-B to TC-E.

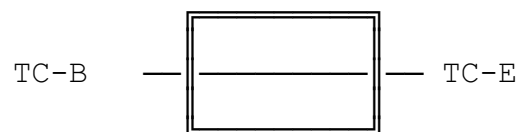


Figure 28: Switching states

6.3.3.4 Handover general description

Each kind of handover is described with a diagram and a description part.

On the diagrams the following arrows are used:

- - ->: indicates specific exchanges at physical layer as "entry slot" or "power and timing information slot";
- >: indicates resource function exchange i.e. handover messages;
- =====>: indicates messages for "inter-GSC" traffic resource management.

6.3.3.4.1 Handover between channels of the GS

Handover between channels of the GS shall be initiated by the GS for frequency load balancing.

6.3.3.4.1.1 General description of handover between channels of the GS

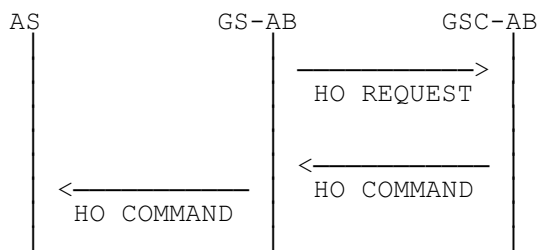


Figure 29

The AS shall switch frequency and slots.

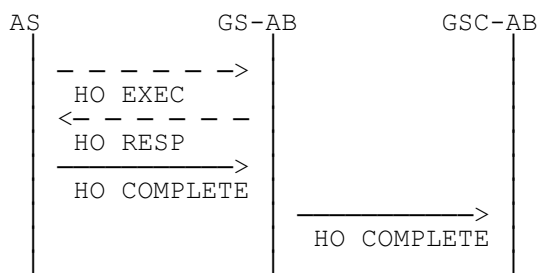


Figure 30

Abnormal case procedure.

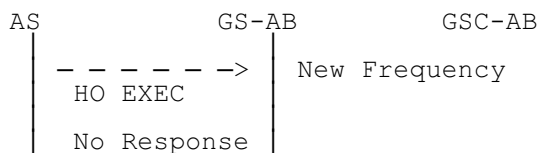


Figure 31

The AS shall switch back.

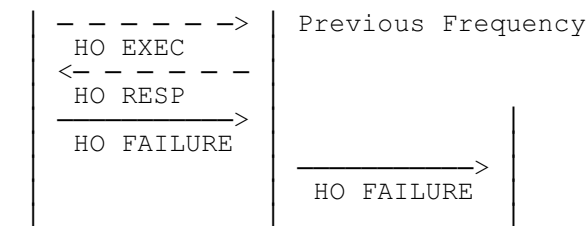


Figure 32

6.3.3.4.1.2 Description of handover between channels of the GS

The GS shall identify an AS and a new frequency.

GS-AB to GSC-AB HO REQUEST:

This message shall ask the GSC for handover procedure to GS.

At this time, the resource manager in the GS shall not accept any request for establishment or release from the AS involved in handover process.

GSC-AB to GS-AB HO COMMAND:

The GSC shall acknowledge request for handover.

The GSC shall initiate circuits to the GS.

GS-AB to AS HO COMMAND:

The GS shall give the AS the RR allocation.

The AS shall now be ready for handover.

The AS shall execute handover operation; it shall suspend its signalling data link and re-tune to the new frequency.

AS to GS-AB HO EXEC:

The AS shall send an entry slot (S2) in TCH.

GS-AB to AS HO RESP:

The GS shall send a power and timing information slot (G3) in TCH.

The AS shall set-up its signalling link (Set Asynchronous Balanced Mode (SABM)/Ua exchange at layer 2).

SUCCESSFUL CASE: The layer-1 and the layer-2 exchange on the new frequency is completed.

AS to GS-AB HO COMPLETE:

The AS shall indicate it has successfully dealt with handover.

The resource manager may accept further establishment or release requests from the AS involved in handover process.

GS-AB to GSC-AB HO COMPLETE:

The GS shall release its old RRs.

The GSC shall be informed that handover is completed.

The GSC shall release its old traffic circuits.

FAILURE CASE: The layer-1 or the layer-2 exchange on the new frequency is not completed.

The AS shall tune back to the previous frequency and shall exchange entry slot (S2) and power and timing information slot (G3).

If successful the AS shall sets up a signalling link.

If not SUCCESSFUL:

- AS Radio Resource Management (RRM) shall indicate a loss of radio connection to the Call Control Management (CCM);
- GS times out and releases its RR.

Communication release shall then occur.

AS to GS-AB HO FAILURE:

This message shall indicate to the GS to keep its RR for the AS.

GS-AB to GSC-AB HO FAILURE:

The GSC shall release its new traffic circuits to GS and maintains the old traffic circuits to GS.

6.3.3.4.1.3 Handover between GSs of the same GSC

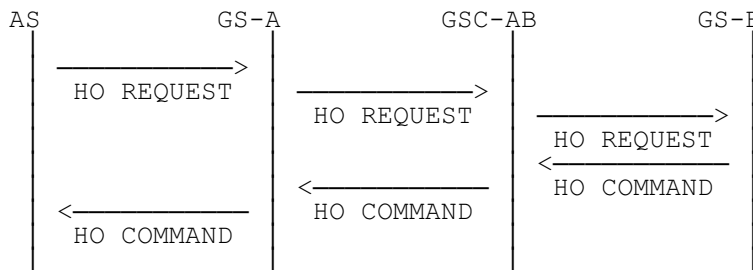


Figure 33

The AS shall switch frequency and slots.

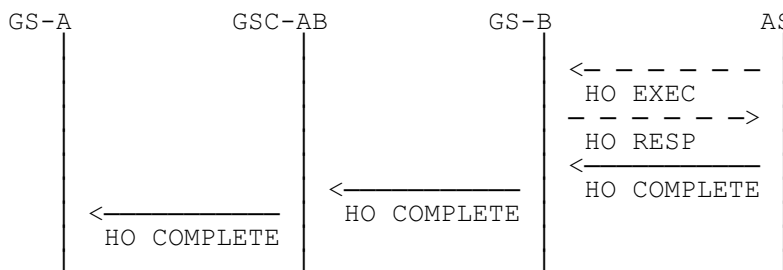


Figure 34

Abnormal case procedure.

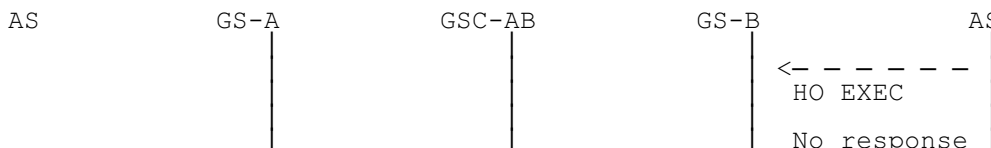


Figure 35

The AS shall switch back.

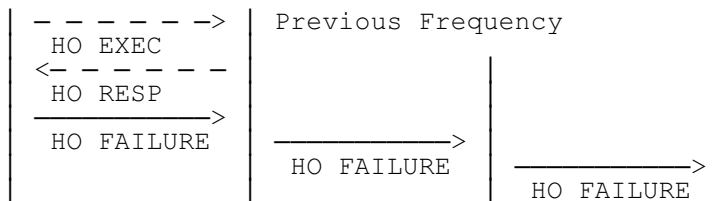


Figure 36

6.3.3.4.1.4 Description of handover between GSs of the same GSC

The AS shall identify a new GS.

AS to GS-A HO REQUEST:

This message shall request the GS-A for a handover procedure to another GS, GS-B.

The RRM in the AS shall not accept any RR establishment or release request from the connection manager.

GS-A to GSC-AB HO REQUEST:

This message shall be transmitted to the GSC to request handover of specified TCHs to another GS-B.

GSC-AB to GS-B HO REQUEST:

GSC shall send the message to the GS-B to request handover resources.

The GS-B shall look for resources to execute handover.

GS-B to GSC-AB HO COMMAND:

The GS-B shall specify to the GSC the resources to be allocated.

The GSC shall initiate the circuits to the new GS; GS-B.

GSC-AB to GS-A HO COMMAND:

The GSC shall transmit to the GS-A the RR specification for handover.

GS-A to AS HO COMMAND:

The AS shall be ready for handover operation.

The AS shall execute the handover operation; and suspends its signalling data link, and re-tune to the new frequency.

AS to GS-B HO EXEC:

The AS shall send an entry slot (S2) in TCH.

GS-B to AS HO RESP:

The GS shall send a power and timing information slot (G3) in TCH.

The AS shall set-up a signalling link (SABM/Unnumbered Acknowledgement (UA) exchange at layer 2).

SUCCESSFUL CASE: The layer-1 and the layer-2 exchange with the new GS is completed.

AS to GS-B HO COMPLETE:

The AS shall indicate it has successfully dealt with handover; it shall not return to previous GS; GS-A.

At this time, the RRM in the AS may accept further RR establishment or release request from the connection manager layer.

GS-B to GSC-AB HO COMPLETE:

The GS-B shall transmit to the GSC

The GSC shall release its traffic circuits to the GS-A.

GSC-AB to GS-A HO COMPLETE:

The GSC shall transmit to the GS-A.

The GS-A shall release its RRs.

FAILURE CASE: The layer-1 or layer 2 exchange with the new GS is not completed.

The AS shall tune back to the previous GS and exchange entry slot S2 and power and timing slot G3.

If SUCCESSFUL the AS shall set-up a signalling link.

If not SUCCESSFUL:

- AS RRM shall indicate a loss of radio connection to the connection manager;
- GSs shall time out and release their RRs.

This shall be followed by communication release.

AS to GS-A HO FAILURE:

This message shall indicate to the GS-A to reserve its RRs for the AS.

GS-A to GSC-AB HO FAILURE:

The GSC shall release its traffic circuits to GS-B and shall maintain the traffic circuits to GS-A.

GSC-AB to GS-B HO FAILURE:

The GS-B shall release its reserved RRs.

6.3.3.4.2 Handover between GSs of different GSC

A single procedure shall be used to hand over a communication from one GSC to another GSC whatever the case, first handover or subsequent handover. When handover has occurred the communication crosses both the old GSC and the new GSC. When subsequent handover occurs the new GSC shall be inserted in the link between the AS and the old GSC, so that a communication follows a chain of GSCs as shown in figure 37.

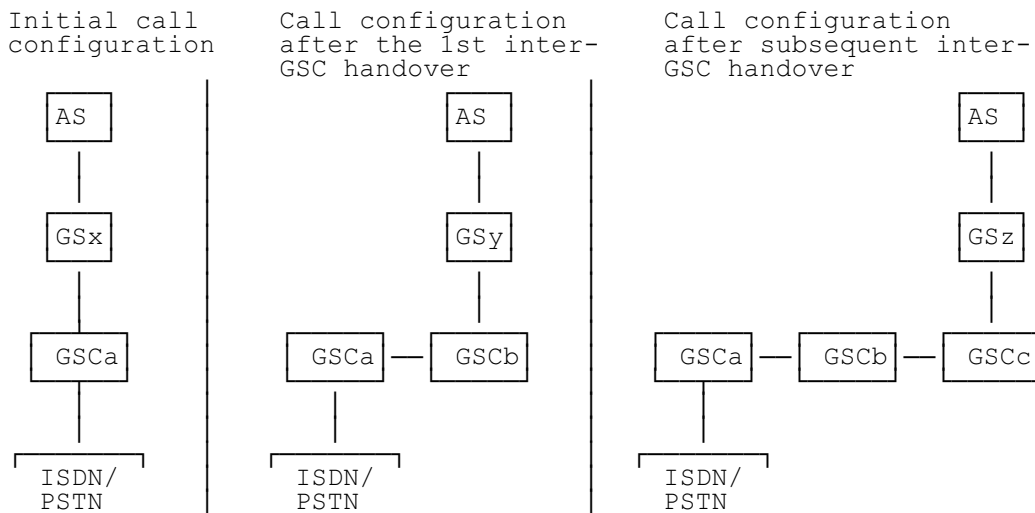


Figure 37: Handover between GSs of different GSCs

The system should avoid the loop possibility between GSCs.

6.3.3.4.2.1 General description of handover between GSs of different GSC

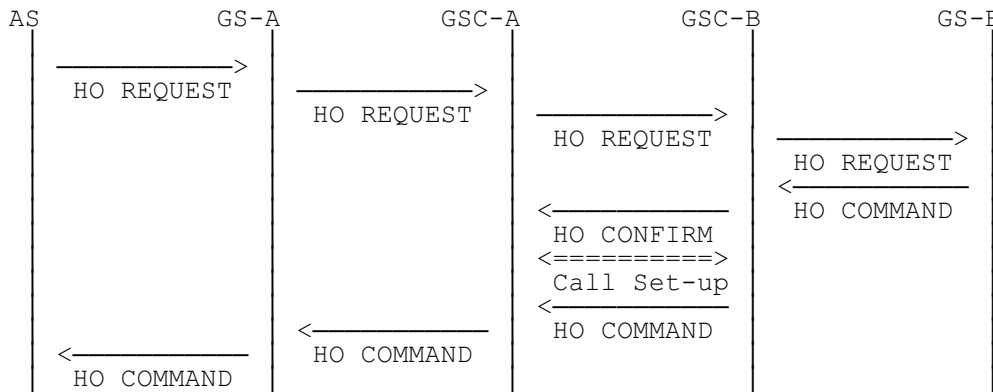


Figure 38: Handover between GSs of different GSCs

The AS shall switch frequency and slots.

The AS shall open the new radio link.

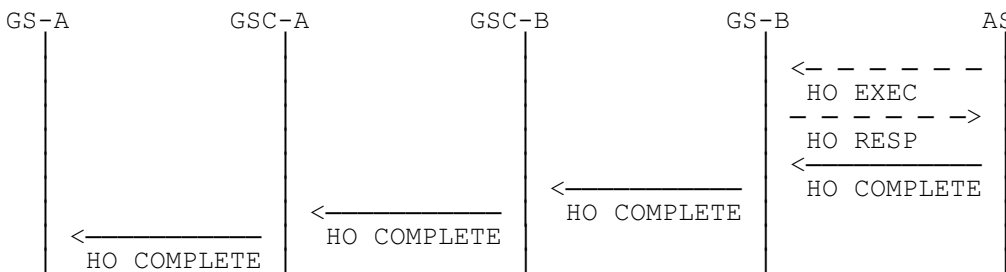


Figure 39

Abnormal case procedure



Figure 40

The AS shall switch back, exchange entry slot and power and timing slot and open a signalling link.

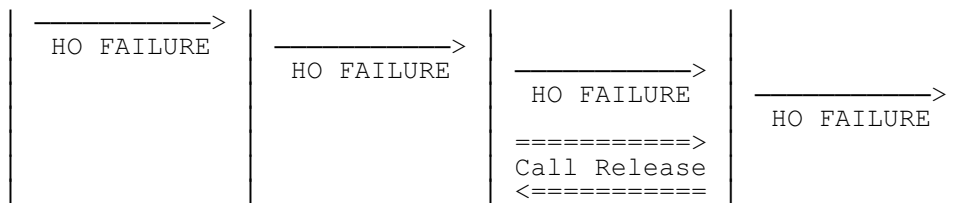


Figure 41

6.3.3.4.2.2 Description for handover between GSs of different GSC

The AS shall identify a new GS.

AS to GS-A HO REQUEST:

This message shall request the GS for a handover procedure to another GS.

During this procedure the RRM in the AS cannot accept any RR establishment or release request from the connection manager.

GS-A to GSC-A HO REQUEST:

This message shall transmit to the GSC the request for handover of specified TCHs to another GS.

GSC-A to GSC-B HO REQUEST:

The GSC-A shall transmit to the GSC-B the handover request information.

The GSC-B shall transmit to the new GS.

GSC-B to GS-B HO REQUEST:

The GSC shall send the message to the GS to ask for handover resource.

The GS shall look for resources to execute handover.

GS-B to GSC-B HO COMMAND:

The GS shall specify to the GSC, the resources to be used.

The GSC shall initiate the circuits to the new GS.

GSC-B to GSC-A HO CONFIRM:

The GSC-B shall specify to the GSC-A the telephone numbers on which it wishes to be called.

NOTE: The purpose of this is to establish the traffic-links between the two GSCs across the switched network for each TFTS user communication supported by the AS in handover.

The GSC-A shall establish the calls to GSC-B for each TFTS communication (refer to double line exchange).

GSC-B to GSC-A HO COMMAND:

When all traffic links are established between the two GSCs, the GSC-B shall transmit to the GSC-A the description of the resources to be used by the AS.

The GSC-A shall transmit the RR description to the GS-A.

GSC-A to GS-A HO COMMAND:

The GSC shall transmit to the GS the RR specification for handover.

GS-A to AS HO COMMAND:

The AS shall be ready for handover operation.

The AS shall execute handover operation, suspend its signalling data link, and re-tune to new frequency.

AS to GS-B HO EXEC:

The AS shall send an entry slot (S2) in TCH.

GS-B to AS HO RESP:

The GS shall send a power and timing information slot (G3) in TCH.

The AS shall set-up a signalling link (SABM/UA exchange at layer 2).

SUCCESSFUL CASE: The layer-1 and layer-2 exchange with the new GS is completed.

AS to GS-B HO COMPLETE:

The AS shall indicate it has successfully dealt with handover; it shall not return to previous GS.

GS-B to GSC-B HO COMPLETE:

The GS shall notify the new GSC that handover is complete.

GSC-B to GSC-A HO COMPLETE:

The GSC-B shall transmit the GSC-A.

GSC-A to GS-A HO COMPLETE:

The GSC-A shall transmit the GS-A.

The GS-A shall release its RRs.

FAILURE CASE: The layer-1 or the layer-2 exchange with the new GS is not completed.

The AS shall tune back to the previous GS, exchange entry slot (S2) and power and timing information slot (G3).

If SUCCESSFUL the AS shall set-up a signalling link.

If not SUCCESSFUL:

- AS RRM shall indicate a loss of radio connection to connection manager;
- GSs shall time out and release their RRs.

This is followed by communication release.

AS to GS-A HO FAILURE:

This message shall indicate to the GS-A to keep its RRs for the AS.

GS-A to GSC-A HO FAILURE:

The GSC-A shall release its traffic circuits to GSC-B (refer to double line messages) and maintain the traffic circuits to GS-A.

GSC-A to GSC-B HO FAILURE:

The GSC-B shall release its reserved traffic circuits to GS-B.

GSC-B to GS-B HO FAILURE:

The GS-B shall release its reserved RRs.

6.4 Network interworking handover part

6.4.1 General

The purpose of this subclause is to identify interworking requirements for inter-GSC handover. To cope with inter-GSC handover there are two different needs:

- specific TFTS signalling link using either dedicated lines or Packet Switched Data Networks (PSPDN);
- traffic link using dedicated lines or public network ISDN or PSTN. Traffic link must use digital connectivity.

The requirements for dedicated lines are outside the scope of this ETS.

6.4.2 TFTS/PSPDN interworking requirements

Main characteristics for the GSC:

The GSC should assume the Data Terminal Equipment (DTE) function to be connected to the PSPDN according to CCITT Recommendation X.25 [8].

The DTE class shall be compliant with CCITT Recommendation X.1 [9], which identifies the different data rate for X.25 interface.

The GSC address shall be compliant with CCITT Recommendation X.121 [10].

The GSC should be able to deal with a minimum of 6 virtual circuits.

The user-network interface of the PSPDN should present the following general characteristics:

- CCITT Recommendation X.25 [8], interface for DTE connection;
- user classes of services compliant with CCITT Recommendation X.1 [9];
- numbering system compliant with CCITT Recommendation X.121 [10]; and
- access to international facilities.

The different GSCs may be connected to different PSPDNs.

Interconnection between two PSPDNs may not be available. In this case it shall not be possible to make a handover between two GSCs connected to two different PSPDNs.

6.4.3 TFTS/ISDN interworking requirements

Traffic resource shall be established between GSCs for inter GSC handover purpose. The targeted GSC shall be able to identify each incoming call and associate it with the corresponding TFTS communication. Therefore resources between GSCs shall be established using the Direct Dial In (DDI) facility of the targeted GSC.

When the GSC can be connected to ISDN, see clause 5 for other aspects.

6.4.4 TFTS/PSTN interworking requirements

When no ISDN connection is available, the alternative is a PSTN connection. There is a requirement for DDI to support inter-GSC handover.

For other interworking aspects see clause 5.

6.5 Handover part specification

6.5.1 Introduction

This subclause presents the description of the interface between two GSCs which may be used to perform handover between two GSs connected to two different GSCs.

This interface is supported by a signalling link for protocol exchange and traffic links for traffic flow.

The subclause specifies the upper layer protocol to be used between two GSCs for handover purposes.

6.5.2 Interface presentation

6.5.2.1 General

The GSC to GSC interface is provided to allow handover processing between GSs connected to two different GSCs.

The main functions of this interface are:

- to establish, maintain and release a signalling link between two GSCs;
- to manage Handover Resources between the GSCs to allow the traffic flow between those two elements;
- to process handover procedures between two GSCs.

The GSC-GSC interface shall cover all resources and procedures used to achieve the functions of this interface.

The GSC-GSC interface procedures are supported by a signalling protocol.

The signalling protocol on the GSC-GSC interface is specified in this ETS. This protocol uses the concepts of the reference model of Open System Interconnection (OSI) given in CCITT Recommendations X.200 [11] and X.210 [12].

For signalling, on the GSC-GSC interface, four layers are required. The layers, the main entities and the service access points for communication between layers and peer entities are shown in figure 42.

Because the GSC-GSC interface shall not use the same layering that the other TETS interfaces use, the CCM function and the Maintenance Resource Management (MRM) function are considered as sub-layers of layer 4 (instead of layer 3).

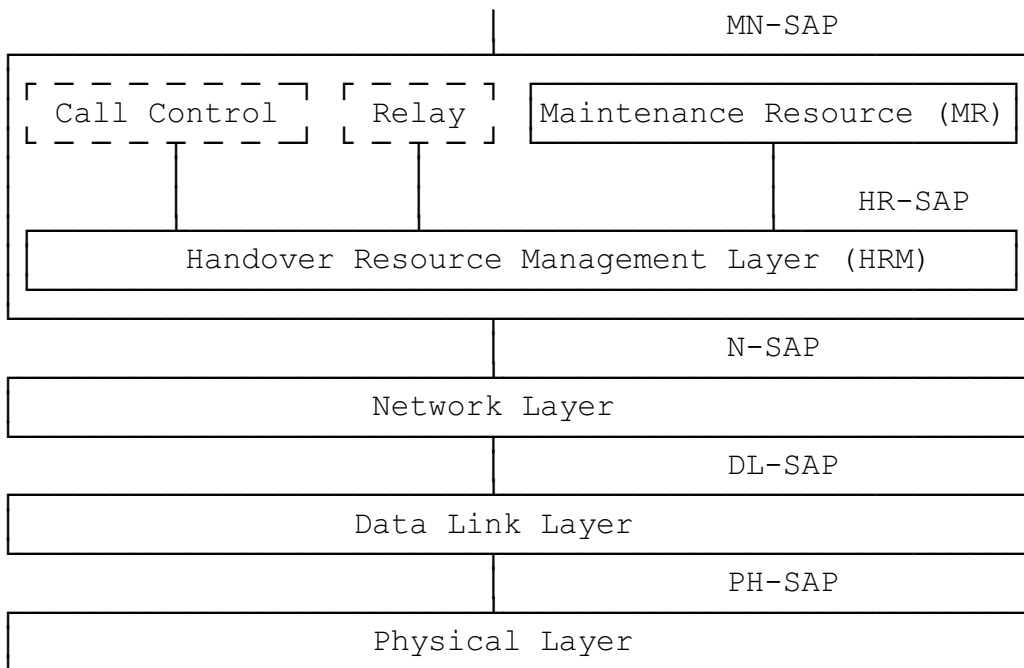


Figure 42: Layering on the GSC-GSC interface

The term "handover signalling layer" is the general term used to refer to the procedures described in this ETS.

Handover signalling layer shall provide the functions to establish, maintain and release connections between GSCs in order to transmit TCHs from one GSC to an other GSC in case of handover. Those connections may use either dedicated lines between the two GSCs or public switched circuits established for the duration of the associated TCH. The handover signalling layer shall include the functions needed by the Handover Resource Management (HRM).

The handover signalling layer shall be composed of two sub-layers:

- CC, relay and MRM sub-layer;
- HRM sub-layer.

This subclause specifies the HRM sub-layer protocol which shall be used between two GSCs.

6.5.2.2 Objectives

The objectives of the HRM sub-layer are to provide the means for:

- the establishment, operation and release of TCHs (HRM) either with dedicated resources or across public switched network;
- the relaying of CC messages from one GSC to an other;
- the transmission and reception of signalling messages for MRM sub-layer.

6.5.2.3 General characteristics

6.5.2.3.1 Technique of description

The HRM sub-layer is described in terms of:

- services provided by the HRM sub-layer;

- services assumed from the lower layers;
- functions of the HRM sub-layer.

The functions of the HRM sub-layer shall be performed by means of the HRM sub-layer protocols between two systems which represent the two GSCs implied in an handover operation. This subclause considers the distribution of signalling functions among the different entities of the GSC. The functions of HRM sub-layer and its supporting lower layers shall provide the TFTS network service to the upper layers.

6.5.2.3.2 Primitives

The services provided by the various sub-layers are described in this ETS. The elementary interactions among adjacent sub-layers are described by primitives and shall consist of the following four types:

- **REQUEST:** the REQUEST primitive type is used when a higher layer is requesting a service from the next lower layer;
- **INDICATION:** the INDICATION primitive type is used by a layer providing a service to notify the next higher layer of any specific activity which is service related. The INDICATION primitive may be the result of an activity of lower layer related to the primitive REQUEST at the peer entity;
- **RESPONSE:** the RESPONSE primitive type is used by a layer, if the receipt of the primitive type INDICATION, from a lower layer, is to be acknowledged;
- **CONFIRM:** the CONFIRM primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

6.5.2.3.3 Peer-to-peer communication

Exchange of information between two peers of Handover signalling layer shall be performed by means of the lower layer protocols. The information consisting of control information and user data shall be contained in Protocol Data Units (PDU). The protocol is a set of rules and formats by which PDUs are exchanged between the two peers.

6.5.3 Structure of signalling functions

6.5.3.1 Basic groups of functions

Handover signalling layer shall comprise the following groups of signalling functions:

- HRM;
- CCM;
- Relay Function (RF);
- Maintenance Resource Management (MRM).

These functional groups shall be realized by separate protocol control entities.

6.5.3.2 Protocol architecture

The protocol architecture of handover signalling layer is divided into two sub-layers (figure 43):

- the HRM sub-layer shall provide services to the CCM sub-layer, Relay and MRM sub-layer and utilize the services of network signalling layer;
- the CCM sub-layer, Relay and MRM sub-layer shall use the services of HRM sub-layer.

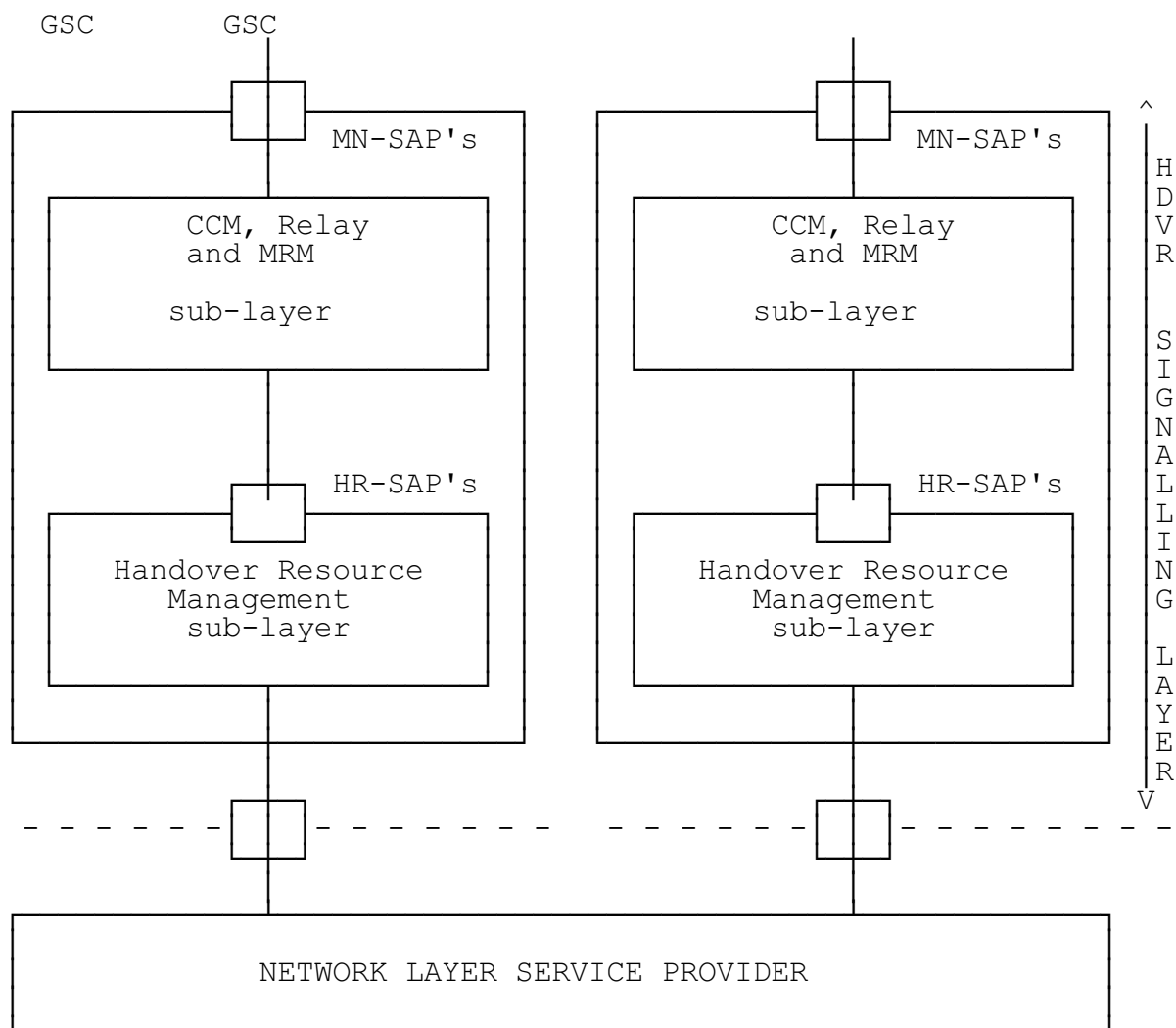


Figure 43: Protocol architecture of handover signalling layer

Depending on the position of the GSC in the TCH, the HRM sub-layer may offer either services to CCM and MRM (the GSC is terminal on the network connection side), or services to (RF) and MRM (the GSC is intermediate or terminal on the GS side).

Because the CCM shall be handled only within the GSC which is terminal on network connection side, the other GSCs shall be considered as a relay carrying CCM messages.

The CCM messages shall be transmitted to and received from the HRM sub-layer as defined in this ETS.

The Relay Function (RF) shall be the link either between HRM sub-layer and TRM sub-layer for the GSC which is terminal on GS side, or between HRM sub-layer and an other HRM sub-layer oriented to an other GSC, for intermediate GSC.

The interactions between the TRM sub-layer (or other HRM sub-layer) and the HRM sub-layer, for handover purposes shall be exchanged through the RF sub-layer.

The link between TRM sub-layer (or other HRM sub-layer) and HRM sub-layer across RF and MRM entity may be represented as follows (figure 44).

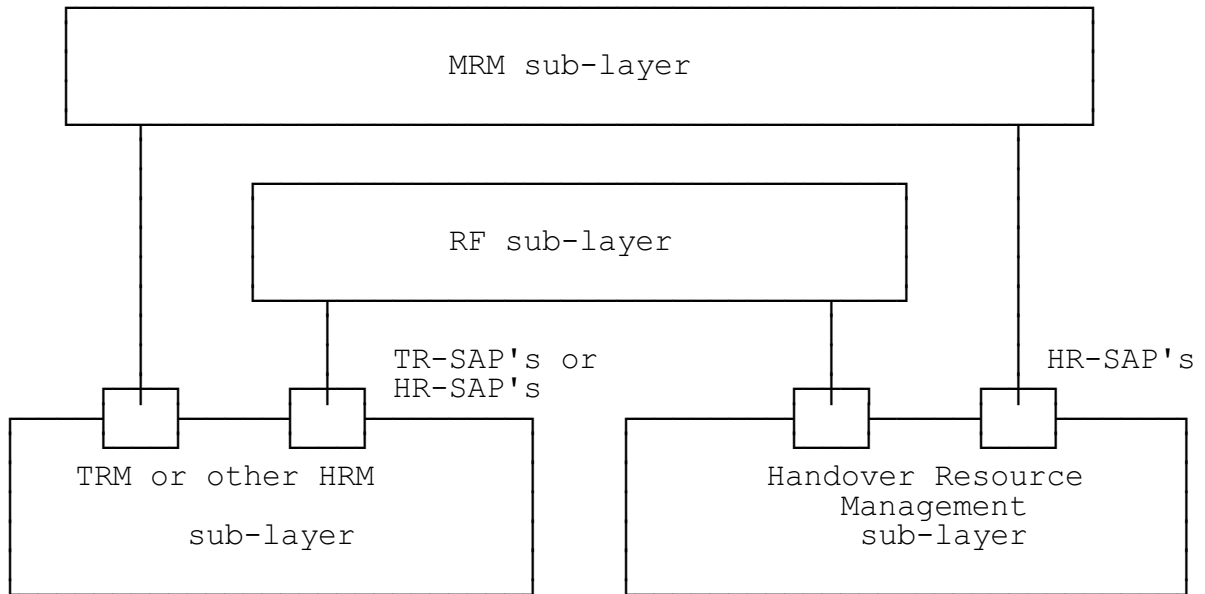


Figure 44: Link between TRM sub-layer and HRM sub-layer representation

6.5.4 Services provided by handover signalling layer

6.5.4.1 CC services

General service state diagram and service primitives are described in detail in the ETS 300 326-2 [2], clause 10.

6.5.4.2 MRM services

General, service state diagram and service primitives are described in detail in ETS 300 326-2 [2], subclause 9.6.

6.5.4.3 HRM services

The HRM sub-layer shall provide the following services to the CCM, MRM and RF:

- **process handover procedure:** This service offers the capability to process a handover operation from a GS connected to a GSC to an other GS connected to an other GSC. The service consists in handover message transfer, establishment of handover TCHs;
- **release handover TCH:** When the call using a handover TCH is released, all the resources used by the call are released and the corresponding handover TCH has to be released;
- **CCM message transfer:** CCM may request for message transfer, then the messages are transmitted by the HRM sub-layer if handover between two GSCs has been processed for this call;

NOTE: Connect and disconnect messages are transmitted by HRM on request of CCM or RF.

- **MRM message transfer:** MRM may request for message transfer to the MRM on the other peer.

6.5.5 Services assumed from network layer

6.5.5.1 General

The services provided by layer 3 are described in detail in CCITT Recommendation X.25 [8].

The services used for TFTS handover purpose are:

- transmission security;
- TSDU splitting and recombination;
- flow control.

6.5.5.2 Service primitives

T-CONNECT-REQ/IND/RES/CNF:

These primitives shall be used to request, indicate, confirm and reply the outcome of the procedures for establishing a network connection.

NOTE: The GSC having the highest value of the Ground Station Identity Code (GSIC) is tasked for initiating the network connection.

T-DATA-REQ/IND:

These primitives shall be used to request and indicate data message transfer from one peer to the other.

T-DISCONNECT-REQ/IND:

These primitives shall be used to request and indicate the outcome of the procedures either for terminating a previously established network connection, or for reporting an unsuccessful establishment attempt.

6.5.6 Inter-layer service interfaces

6.5.6.1 Services provided by HRM entity

6.5.6.1.1 General

The HRM sub-layer provides services to the CCM, MRM and RF.

The HRM services shall be used to:

- process handover procedure to establish and to maintain handover TCHs;
- release handover TCH;
- CCM message transfer;
- MRM message transfer.

The HRM services are represented by the HR-service primitives.

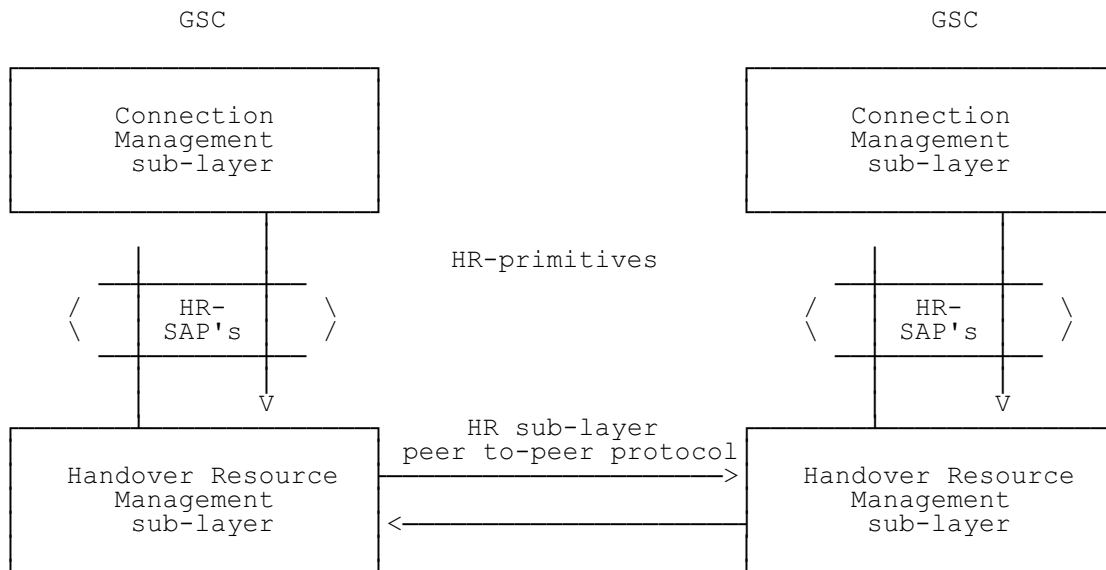


Figure 45: Services provided at HR-SAP

6.5.6.1.2 Service primitives

The primitives exchanged between HRM and CCM, RF and MRM shall be as follows.

HR-Channel-Release-REQ:

This request shall be used by the CCM or RF to request for the release of a handover TCH.

HR-Channel-Release-IND:

This indication shall be used to indicate to CCM or RF that the handover TCH has been released.

HR-Connect-REQ:

This request shall be used by CCM in the network side terminal GSC or by RF in an intermediate GSC or the GS side terminal GSC, to send a CONNECT message to the other GSC related to the TCH.

HR-Connect-IND:

This indication shall be used at the reception of a CONNECT message to inform CCM in the network side terminal GSC or RF in an intermediate GSC or a GS side terminal GSC.

HR-Disconnect-REQ:

This request shall be used by CCM in the Network side terminal GSC or by RF in an intermediate GSC or the GS side terminal GSC, to send a DISCONNECT message to the other GSC related to the TCH.

HR-Disconnect-IND:

This indication shall be used at the reception of a DISCONNECT message to inform CCM in the network side GSC or RF in an intermediate GSC or a GS side terminal GSC.

HR-Data-REQ:

This request shall be used by the CCM, RF and MRM to send data message to the corresponding entity in the other GSC, via the HR-connection.

HR-Data-IND:

This indication shall be used by HR to indicate to CCM, RF or MRM that a data message has been received from the corresponding entity of the other GSC, via the HR-connection.

HR-Abort-IND:

This shall indicate that the HR-connection has been aborted by a lower layer failure.

HR-HO-REQ:

This request shall be used by RF to initiate an Handover procedure and to send a HO-REQUEST message to the targeted GSC.

HR-HO-IND;

This shall indicate to RF a reception of HO-REQUEST message from the originating GSC.

HR-HO-RSP:

This response shall be used by RF to initiate the transmission of either a HO-COMMAND message to the originating GSC if the handover is accepted or a HO-REJECT message if the handover is rejected.

HR-HO-CNF:

This confirmation shall be used by HR to indicate to RF either the acceptance or the reject of the HR-HO-REQ primitive.

HR-HO-Reject-REQ:

This request shall be used by RF to initiate the transmission of a HO-REJECT message to the GSC originating HO-REQUEST. A parameter shall give the cause of the reject.

HR-HO-Reject-IND:

This shall indicate to RF a reception of HO-REJECT message from the targeted GSC. A parameter shall give the cause of the reject.

HR-HO-Complete-REQ:

This request shall be used by RF to send a HO-COMplete message to the GS originated of HO-REQUEST.

HR-HO-Complete-IND:

This shall indicate to RF a reception of HO-COMplete message from the targeted GS.

HO-Failure-REQ:

This request shall be used by RF in the originating GSC to indicate that the handover processing failed.

HO-Failure-IND:

This shall indicate to RF in the targeted GSC that the handover processing failed.

6.5.7 Functions to be provided by the handover layer entities

6.5.7.1 Functions provided by the HRM entity

The HRM entity contains elementary procedures for handover management e.g. establish, maintain, and release handover TCHs.

The elementary procedures in the HRM sub-layer are described in subclause 6.5.8.

6.5.7.2 Functions provided by the CCM entity

The CCM entity contains elementary procedures to support establishing, maintaining and clearing of aircraft originating circuit-switched calls.

The elementary procedures in the CCM entity are described in ETS 300 326-2 [2], clause 10.

6.5.7.3 Function provided by the RF

The functions of the RF shall be:

- to receive primitives from TRM sub-layer or parallel HRM sub-layer and to deliver them to HRM sub-layer;
- to receive primitives from HRM sub-layer and to deliver them to TRM sub-layer or parallel HRM sub-layer.

6.5.7.4 Functions provided by the Distribution Function (DF)

The functions of the DF shall be:

- to receive messages from HRM and distribute them to the addressed CC entity. A CC entity is addressed by its Transaction Identifier (TI) associated with the Aircraft Termination Equipment Identifier (ATEI);
- to multiplex messages from different CC entities on the HRM signalling channel.

6.5.7.5 Functions provided by the MRM entity

See subclause 6.6.

6.5.8 Elementary procedures for HRM

6.5.8.1 General

HRM procedures shall provide the functions related to the transport connection for signalling channel and the management of TCHs used for handover between two GSCs.

The HRM procedures shall provide capabilities to:

- establish, maintain and release a transport connection which allow a point-to-point dialogue between two GSCs;
- manage the handover resources between the two GSCs;
- process the handover procedures which allocate handover resources, establish and maintain traffic links between two GSCs;
- release the TCH individually;
- transmit and receive data messages for CCM function, RF or MRM function using the transport connection.

6.5.8.2 Inter GSC Connection

The inter GSC connection between two GSCs is initiated according to two different cases:

Case 1: Permanent Connection:

Between two GSCs, the GSC which has the highest value of GSIC, shall initiate the X.25 connection by a T-CONNECT-REQ primitive.

The connection request shall occur at the beginning of the GSC process and each time the X.25 connection has been disconnected.

Case 2: X.25 On Demand:

In the case of X.25 On Demand, the connection (if not already established) is requested by the old GSC to the new GSC. When the link is no longer required, the link is disconnected after a timeout.

6.5.8.3 HRM

After the transport connection initiation, each GSC shall initiate a RESTART procedure to put the handover resources in an equivalent state at the two ends.

See subclause 6.6 for RM detailed procedure.

6.5.8.4 Handover processing

This procedure shall be used when a handover operation is requested by a GS (Old-GS) connected to a GSC (Old-GSC) and concerning an other GS (New-GS) connected to an other GSC (New-GSC).

According to the previous activity of the aircraft, the different calls implied by the handover may have been initiated in the Old-GSC (network access point) or in a preceding GSC.

6.5.8.4.1 Outgoing handover procedure

The RF shall request a handover to HRM function using a HR-HO-REQ primitive when the GSC (Old-GSC) has to process a handover to a GS which is connected to an other GSC (New-GSC).

If a transport connection is open between the two GSCs and if the Old-GSC is able to allocate handover resources for the operation, the handover may be initiated. If not, a HR-HO-RSP (Error) shall be transmitted to the RF, and the procedure ends.

The Old-GSC shall allocate the handover resources and send a HO-REQUEST to the New-GSC. The HO-REQUEST message shall describe the handover resources to be used and shall contain all information needed by the New-GS.

NOTE: The rule to allocate handover resources is: the Ground Switching Centre (GSC) with the highest Ground switching Centre Code (GCC) value begins the handover resources allocation with the highest value of "Handover Resource Number". The GSC with the lowest GCC value begins the handover resources allocation with the lowest value of "Handover Resource Number".

The Old-GSC may receive either a HO-REJECT message, or a HO-CONFIRM message.

If the Old-GSC receives a HO-REJECT message, the handover resources shall be released and a HR-HO-RSP (Reject) shall be transmitted to the RF, and the procedure ends.

If the Old-GSC receives a HO-CONFIRM message, the handover resources shall be initiated at the Old-GSC side.

The Old-GSC shall receive a HO-COMMAND when all handover resources are initiated on the New-GSC side, then the Old-GSC shall inform the RF using the HR-HO-RSP primitive.

At this time the Old-GSC either may receive a HO-COMplete message from the New-GSC, or may be informed by the RF using a HR-HO-Failure-REQ that the handover failed.

If the Old-GSC receives the HO-COMplete message, the Old-GSC shall inform the RF using HR-HO-Complete-IND.

If the Old-GSC is informed by HR-HO-Failure that the handover processing failed, the Old-GSC shall send a HO-FAILURE message to the New-GSC which shall perform the task of handover resource release.

Abnormal cases:

- it may happen that some handover resource is allocated at the same time by both GSCs. Both GSCs may receive a HO-REQUEST with handover resource already allocated. The following rule shall apply:
 - the GSC with the highest value of the GSIC shall keep the resources and shall send to the other a HO-REJECT message with the cause "resource already allocated";
 - when the other GSC receives such a HO-REJECT message, it shall allocate new resources, if possible, and send a new HO-REQUEST message. If not, the handover request shall be rejected for lack of resource;
- if an abort procedure is initiated during the handover procedure, the handover resource release shall be initiated.

6.5.8.4.2 Incoming handover procedure

The New-GSC shall receive a HO-REQUEST from the Old-GSC.

If the handover resources are available, HRM shall inform the RF using a HR-HO-IND primitive. If the handover resources are not available, a HO-REJECT with the corresponding cause shall be transmitted to the Old-GSC.

When the New-GS part of the handover processing is completed, the RF shall inform HRM using the HR-HO-RSP primitive.

If the GS response is negative, the handover resources shall be released and a HO-REJECT message transmitted to the Old-GSC.

If the GS response is positive, the HO-CONFIRM shall be transmitted to the Old-GSC with the information needed by the Old-GSC.

The New-GSC shall start a timer and wait for the completion of the traffic link establishment. Either the traffic link establishment event happens before the timeout and the New-GSC shall send the HO-COMMAND message to the Old-GSC, or the timeout happens, and the handover resources are released. A HO-REJECT message with the cause indication shall be sent to the Old-GSC and a HR-HO-Failure-IND primitive transmitted to the RF to stop the handover procedure in the New-GS.

If the handover operation is achieved the HRM shall be informed by a HR-HO-Complete-IND and send a HO-COMplete message to the Old-GSC. If the handover operation is not achieved the HRM shall receive a HO-FAILURE message from the Old-GSC, release handover resources and inform the RF using the HR-HO-Failure-IND primitive.

6.5.8.5 Handover information transmission

After handover procedure completion, if the Old-GSC is not the network access point (CCM) for one or more traffic link, the Old-GSC shall transmit to the preceding GSC of the corresponding traffic links, an HO-INFORMATION message for administration purpose. The HO-INFORMATION message shall contain the handover resource identity list of the traffic links and the handover characteristics.

When the preceding GSC receives an HO-INFORMATION message, it shall consider the traffic links identified by the handover resource identity in the message. For each traffic link, if the GSC is the network access point, the appropriate administrative action shall be undertaken (handover record generation) and the traffic link shall be removed from the list. At the end of this operation, if the list is not empty, the list shall be updated with the corresponding handover resource identifiers and an HO-INFORMATION message shall be transmitted to the preceding GSC.

6.5.8.6 TCH release

There shall be two methods of TCH release: either

- the HRM function is informed of the TCH release by the upper layer (Relay or CCM), using HR-Channel-Release-REQ. The HRM function initiates the release of the corresponding handover resource and sends a TRAFFIC-CHANNEL-RELEASE message to the other peer. When HRM receives the RELEASE-CONFIRM message, the handover resource is released and may be re-used; or
- the HRM function receives a TRAFFIC-CHANNEL-RELEASE message from the other peer. The corresponding handover resource is released, the upper layer (Relay or CCM) is informed using the HR-Channel-Release-IND. A RELEASE CONFIRM message is sent to the other peer.

6.5.8.7 Data message transmission

In the GSC, the MRM entity, the CCM entity (if any) and the RF entity (if any) may request to send data message using the HR-DATA-REQ primitive. The GSC shall send a DATA message to the other GSC. When the data message is related to CCM, a the corresponding TCH identifier shall be given.

When HRM receives a DATA message, it shall inform MRM entity, or CCM entity, or the RF entity, of the reception of data message using the HR-DATA-IND primitive. When the data message is related to CCM, a the corresponding TCH identifier shall be given.

6.5.9 Message functional definition and contents

This subclause provides an overview of the message structure, which highlights the functional definition and information content of each message. Each definition includes:

- a brief description of the message direction and use;
- a table listing the information elements in the order of their appearance in the message (mandatory before optional).

For each information element the table indicates:

- the subclause of this specification describing the information element;
- the direction to which the message may be sent; i.e., Old GSC to New GSC (OGSN->NGSC) or, NGSC to OGSC (NGSC->OGSC), or both;
- the type of information element i.e. whether it is mandatory with fixed length (MF), mandatory with variable length (MV), optional with fixed length (OF) or, optional with variable length (OV);
- the length of the information element (or permissible range of lengths), in octets, where "?" denotes an undefined maximum length.

6.5.9.1 Messages for HRM

Table 6 summarizes the messages for HRM.

Table 6: Messages for HRM

Handover resources messages	Reference
TRAFFIC CHANNEL RELEASE	6.5.9.2.1
RELEASE CONFIRM	6.5.9.2.2
Handover messages between GSCs	Reference
HO REQUEST	6.5.9.3.1
HO CONFIRM	6.5.9.3.2
HO COMMAND	6.5.9.3.3
HO COMPLETE	6.5.9.3.4
HO REJECT	6.5.9.3.5
HO FAILURE	6.5.9.3.6
HO INFORMATION	6.5.9.3.7
Miscellaneous messages	Reference
CONNECT	6.5.9.4.1
DISCONNECT	6.5.9.4.2
CCM MESSAGE TRANSFER	6.5.9.4.3
MRM MESSAGE TRANSFER	6.5.9.4.4

6.5.9.2 Handover resource messages

The handover resource messages shall be exchanged between GSCs using a common reference to specify which handover resource is implied by the current message.

The reference shall be allocated on one GSC side using the handover resource identifier corresponding to the physical handover resource.

6.5.9.2.1 TCH release

This message shall be used to release the handover resource defined by the handover resource identifier given in reference.

Message Type: TRAFFIC CHANNEL RELEASE
Direction: both

Table 7: TRAFFIC CHANNEL RELEASE message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	both	MF	1
Hdvr Resource Ident	6.5.10.3.5	both	MF	2
HRM Cause	6.5.10.3.12	both	MF	1

6.5.9.2.2 Release Confirm

This message shall be used to confirm to the GSC a handover resource release.

Message Type: RELEASE CONFIRM
Direction: both

Table 8: RELEASE CONFIRM message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	both	MF	1
Hdvr Resource Ident	6.5.10.3.5	both	MF	2

6.5.9.3 Handover messages between GSCs

The handover messages shall be exchanged between the Old-GSC and the New-GSC using a common identifier which is the "handover procedure reference".

The handover procedure reference is a local reference, and shall be allocated by the Old-GSC. When associated with the Old-GSC identifier, it shall identify the handover procedure which is implied by the current handover message.

For a handover procedure, each message type shall have only one direction: Old-GSC to New-GSC or New-GSC to Old-GSC.

6.5.9.3.1 HO-Request

This message shall be used to initiate the handover procedure in the New-GSC. The handover procedure shall be identified by the handover procedure reference. The Old-GSC shall transmit to the New-GSC, the description of the handover resource allocated to each TCH, the addressee GS identifier and a set of information to be transmitted to the new GS.

Message Type: HO REQUEST

Direction: Old-GSC to New-GSC

Table 9: HO REQUEST message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	OGSC->NGSC	MF	1
Hdvr Proc Reference	6.5.10.3.2	OGSC->NGSC	MF	1
GS Ident	6.5.10.3.3	OGSC->NGSC	MF	3
ATEI	6.5.10.3.4	OGSC->NGSC	MF	4
Hdvr Resource Descript	6.5.10.3.6	OGSC->NGSC	MV	5-65
Service provider ident	6.5.10.3.16	OGSC->NGSC	MF	3
Previous GSIC ident	6.5.10.3.3	OGSC->NGSC	MF	3
Call Data Description	6.5.10.3.15	OGSC->NGSC	MV	10-145

6.5.9.3.2 HO-Confirm

This message shall be sent by the New-GSC to the Old-GSC to indicate that all TCHs required for the handover operation has to be established.

If the TCHs, between the two GSCs, use the public switched network, the handover call number shall be produced.

If handover call number has too many items and is therefore too long, more than one HO-CONFIRM message shall be sent.

It concerns the procedure identified by the handover procedure reference.

The handover call number shall be included once for each additional call implied by the handover up to a maximum of 16 calls.

Message Type: HO CONFIRM

Direction: New-GSC to Old-GSC

Table 10: HO CONFIRM message content

Information element	Reference	Direction	Reference	Type	Length
Message Type	6.5.10.2	NGSC->OGSC	6.5.10.2	MF	1
Hdvr Proc Reference	6.5.10.3.2	NGSC->OGSC	6.5.10.3.2	MF	3
Hdvr Call Number 1	6.5.10.3.7	NGSC->OGSC	6.5.10.3.7	OV	4 - 12
Hdvr Call Number 2	6.5.10.3.7	NGSC->OGSC	6.5.10.3.7	OV	4 - 12
:					
Hdvr Call Number 16	6.5.10.3.7	NGSC->OGSC	6.5.10.3.7	OV	4 - 12

6.5.9.3.3 HO-COMMAND

This message shall be sent by the New-GSC to initiate the handover processing. In the Old-GSC, the handover procedure shall be identified by the handover procedure reference.

The New-GSC shall transmit to the Old-GSC the data information to be transmitted to the Old-GS and the AS.

Message type: HO COMMAND

Direction: New-GSC to Old-GSC

Table 11: HO COMMAND message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	NGSC->OGSC	MF	1
Hdvr Proc Reference	6.5.10.3.2	NGSC->OGSC	MF	1
Allocated Frequency	6.5.10.3.10	NGSC->OGSC	MF	1
Allocated Slots	6.5.10.3.11	NGSC->OGSC	MF	2

6.5.9.3.4 HO-Complete

This message shall be sent by the New-GSC to indicate the successful processing of handover to the Old-GSC. It concerns the handover procedure identified by the handover procedure reference.

Message type: HO COMPLETE

Direction: New-GSC to Old-GSC

Table 12: HO COMPLETE message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	NGSC->OGSC	MF	1
Hdvr Proc Reference	6.5.10.3.2	NGSC->OGSC	MF	1
HRM Cause	6.5.10.3.12	NGSC->OGSC	MF	1

6.5.9.3.5 HO-Reject

This message shall be sent by the New-GSC to terminate a handover process requested by the Old-GSC. It concerns the handover identified by the handover procedure reference. The reason for the reject shall be given in the message.

Message type: HO REJECT

Direction: New-GSC to Old-GSC

Table 13: HO REJECT message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	NGSC->OGSC	MF	1
Hdvr Proc Reference	6.5.10.3.2	NGSC->OGSC	MF	1
HRM Cause	6.5.10.3.12	NGSC->OGSC	MF	1

6.5.9.3.6 HO-Failure

This message shall be sent by the Old-GSC. It shall be used after a successful re-connection of the AS to the Old-GS, to indicate that the handover processing will not be achieved. The handover resources shall be released. It concerns the handover identified by the handover procedure reference.

Message type: HO FAILURE

Direction: Old-GSC to New-GSC

Table 14: HO FAILURE message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	OGSC->NGSC	MF	1
Hdvr Proc Reference	6.5.10.3.2	OGSC->NGSC	MF	1
HRM Cause	6.5.10.3.12	OGSC->NGSC	MF	1

6.5.9.3.7 HO-Information

This message shall be used to transfer the handover characteristics from the one GSC to a preceding GSC. The GSC (Old-GSC or preceding GSC) shall transmit to the preceding GSC the identification of the New-GS implied in the handover operation, the handover characteristics (administrative information) and the list of the handover resource identifications used as TCH between the two GSCs.

Message Type: HO INFORMATION

Direction: both

Table 15: HO INFORMATION message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	both	MF	1
GS Ident	6.5.10.3.3	both	MF	3
Handover charact	6.5.10.3.9	both	MV	2-30
Hdvr Res Ident List	6.5.10.3.8	both	MV	3-33

6.5.9.4 Miscellaneous messages

6.5.9.4.1 Connect

This message shall be sent by a GSC to the other to indicate that the TCH becomes active end to end.

The handover resource identifier shall identify the TCH which is implied by this message.

Message type: CONNECT

Direction: both

Table 16: CONNECT message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	both	MF	1
Hdvr Resource Ident	6.5.10.3.5	both	MF	2

6.5.9.4.2 Disconnect

This message shall be sent by a GSC to the other to indicate that the TCH is no longer active end to end.

The handover resource identifier shall identify the TCH which is implied by this message.

Message type: DISCONNECT

Direction: both

Table 17: DISCONNECT message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	both	MF	1
Hdvr Resource Ident	6.5.10.3.5	both	MF	2

6.5.9.4.3 CCM message transfer

This message shall be used to transfer CCM signalling messages between GSCs.

Message type: CCM MESSAGE TRANSFER

Direction: both

Table 18: CCM MESSAGE TRANSFER message content

Information element	Reference	Direction	Type	Length
Message type	6.5.10.2	both	MF	1
Hdvr Resource Ident	6.5.10.3.5	both	MF	1
CCM Message	6.5.10.3.13	both	OV	112

6.5.9.4.4 MRM message transfer

This message shall be used to transfer MRM signalling messages between GSCs.

Message type: MRM MESSAGE TRANSFER

Direction: both

Table 19: MRM MESSAGE TRANSFER message content

Information element	Reference	Direction	Type	Length
Message Type	6.5.10.2	both	MF	1
MRM Message	6.5.10.3.14	both	OV	241

6.5.9.5 Messages for MRM

See subclause 6.6.

6.5.10 Message format and information element coding

The figures and text in this subclause describe message contents. Within each octet, the bit designated "bit 1" shall be transmitted first, followed by bits 2, 3, 4, etc. Similarly, the octet shown at the top of each figure shall be sent first.

6.5.10.1 Overview

Within this protocol, every message shall consist of the following part:

- message type;
- other information elements, as required.

This organization is illustrated in the example shown in figure 46.

All equipment should be able to ignore any extra information, present in a message, which is not required for the proper operation of that equipment.

Unless specified otherwise, a particular information element may be present only once in a given message.

When a field extends over more than one octet, the order of bits values progressively decreases as the octet number increases. The least significant bit of the field is represented by the lowest numbered bit of the highest numbered octet of the field.

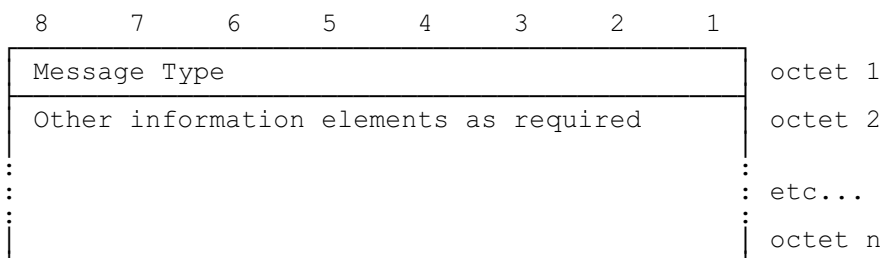


Figure 46: General message organization example

6.5.10.2 Message type

The purpose of the message type is to identify the function of the message being sent.

The message type shall be the first part of every message and occupies the eight bits of the first octet in a message and it shall be coded as shown in figure 47 and table 20.

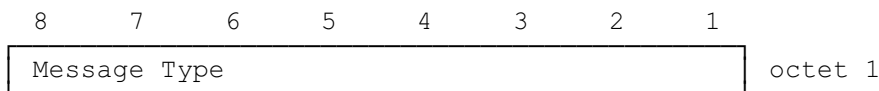


Figure 47: Message type

Table 20: Message type

Message Type								
Bits								
8	7	6	5	4	3	2	1	
0	0	0	1	-	-	-	-	Handover Resource connection
				0	0	0	0	TRAFFIC CHANNEL RELEASE
				0	0	0	1	RELEASE CONFIRM
0	0	1	0	-	-	-	-	Handover between GSCs
				0	0	0	0	HO REQUEST
				0	0	0	1	HO CONFIRM
				0	0	1	0	HO COMMAND
				0	0	1	1	HO COMPLETE
				0	1	0	0	HO REJECT
				0	1	0	1	HO FAILURE
				0	1	1	0	HO INFORMATION
0	1	0	0	-	-	-	-	Miscellaneous
				1	0	0	0	CONNECT
				1	0	0	1	DISCONNECT
				1	1	0	0	CCM SIGNALLING MESSAGE TRANSFER
				1	1	0	1	MRM SIGNALLING MESSAGE TRANSFER

6.5.10.3 Other information elements

When a message contains other information elements these may be split into two different types for that message:

- information elements which are mandatory for the message;
- information elements which are optional for the message.

Possible mandatory information elements shall be sent before possible optional information elements. This organization is shown in figure 48.

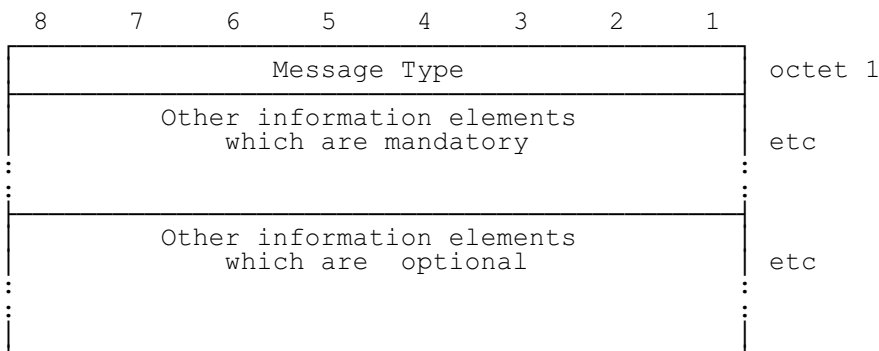


Figure 48: Organization of other information elements

When an information element, which is optional for a given message, is contained in the message, it shall be identified by means of an information element identifier.

An information element which is mandatory for a given message does not have to be identified by means of an information element identifier as the presence and the order of the mandatory information element are unambiguously determined by the message type.

An information element may be mandatory for some messages and optional for other messages i.e. information elements shall contain the information element identifier in their definition. When an information element is mandatory for a message the information element identifier shall be stripped off the information element in that message.

Two main categories of information elements are defined:

- information elements with fixed length;
- information elements with variable length.

An information element with variable length shall be provided with a length indicator of one octet which determines the length of content of that information element. The length indicator shall be the binary coding of the number of octets of content with bit 1 as the least significant bit.

The length of content of a mandatory information element with fixed length shall be determined by the message type of the message.

The length of content of a mandatory information element with variable length shall be determined by the length indicator, which is the first octet of the information element. The length of content of an optional information element with fixed length shall be determined by the information element identifier.

The length of content of an optional information element with variable length shall be determined by the length indicator and shall be the second octet of the information element.

Four types of information elements are defined:

- information elements with 1/2 octet of content (Type 1);
- information elements with 0 octet of content (Type 2);
- information elements with fixed length and at least one octet of content (Type 3);
- information elements with variable length (Type 4).

A Type 2 information element shall not be mandatory in a message.

Type 1 information elements shall provide the information identifier in bit positions 7, 6, 5. The value "0 1 0" in these bit positions is reserved for Type 2 information elements which together with bit positions 4, 3, 2, 1 shall provide the information element identifier. Type 3 and 4 information elements provide the information element identifier in bit positions 7, 6, 5, 4, 3, 2, 1 in the first octet.

These information elements are shown in figures 49 to 56 for both the case where the information element is optional in a message and mandatory in a message. In the mentioned figures IEI is used as an abbreviation for Information Element Identifier, CEI as an abbreviation for Content of Information Element and LI as an abbreviation for Length Indicator.

Type 1 Information elements with 1/2 octet of content.

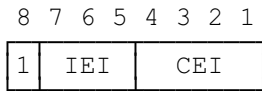


Figure 49
 The information element is optional

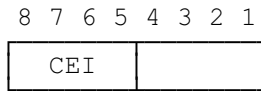


Figure 50
 The information element is mandatory

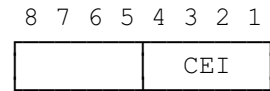


Figure 51
 The information element is mandatory

Type 2 Information elements with 0 octet of content.

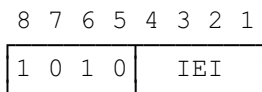


Figure 52
 The information element is optional

Type 3 Information elements with fixed length and at least one octet of content.

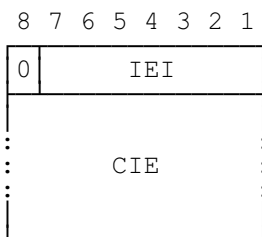


Figure 53
 The information element is optional

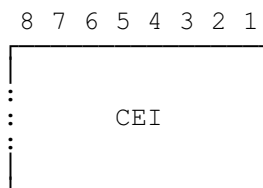


Figure 54
 The information element is mandatory

Type 4 Information elements with variable length

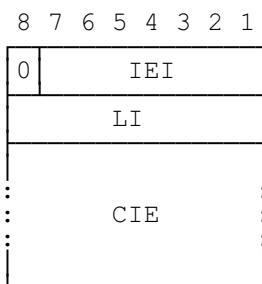


Figure 55

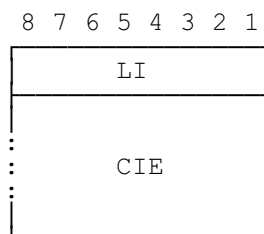


Figure 56

The information element

is optional

The information element

is mandatory

The information elements for HRM are listed in subclause 6.5.7.3.1. The coding of the information element identifier bits is summarized in table 21.

The descriptions of the information elements are organized in alphabetical order. However, there is a particular order of appearance for each information element in a message.

The order of appearance for each information element which is mandatory in a message is laid down in the definition of the message (see subclause 6.5.6).

The order of the mandatory information elements shall be chosen so that information elements with 1/2 octet of content (type 1) go together in succession. The first type 1 information element occupies bits 1 to 4 of octet N, the second bits 5 to 8 of octet N, the third bits 1 to 4 of octet N+1 etc. If the number of type 1 information elements is odd then bits 5 to 8 of the last occupied by these information elements shall be treated as spare bits i.e. coded with a "0" in each.

The order of appearance in a message for each optional information element with fixed length (type 3) or with variable length (type 4) shall be determined by the information element identifier. The code of the information element identifier for these formats shall be assigned in ascending numerical order, according to the actual order of appearance of each information element in the message. This allows the receiving equipment to detect the presence or absence of a particular optional information element of one of these two formats (type 3 and 4) without scanning through an entire message. Unrecognized information element identifiers shall be assumed to belong to an information element of type 4. Optional information elements with 1/2 octet or 0 octet of content (types 1 and 2) may appear at any point among the optional information elements in a message.

Where the description of information elements in this subclause contains spare bits, these bits are indicated as being set to "0". In order to allow compatibility with future implementation, messages shall not be rejected simply because a spare bit is set to "1".

An optional variable length information element may be present, but empty. This shall be interpreted by the receiver as equivalent to that information element being absent. Similarly, an absent information element shall be interpreted by the receiver as equivalent to that information element being empty.

The following rules shall apply for the coding of variable length information elements:

- a) the first digit in the octet number identifies one octet or a group of octets;
- b) each octet group is a self contained entity. The internal structure of an octet group may be defined in alternative ways;
- c) an octet group is formed by using some extension mechanism. The preferred extension mechanism is to extend an octet (N) through the next octet(s) (Na, Nb, etc..) by using bit 8 in each octet as an extension bit. The bit value "0" indicates that the octet continues through the next octet. The bit value "1" indicates that this octet is the last octet. If one octet (Nb) is present, also the preceding octets (N and Na) shall be present;

in the format descriptions appearing in subclause 11.3.1, bit 8 is marked "0/1 ext" if another octet follows. Bit 8 is marked "1 ext" if this is the last octet in the extension domain;

additional octets may be defined later ("1 ext" changed to "0/1 ext") and equipments shall be prepared to receive such additional octets although the equipment need not be able to interpret or act upon the content of these octets;

- d) in addition to the extension mechanism defined above, an octet (N) may be extended through the next octet(s) (N.1,N.2 etc.) by indications in bits 7-1 (of octet N);
- e) the mechanisms in c) and d) may be combined;
- f) optional octets are marked with asterisks (*).

6.5.10.3.1 HRM information elements

For the HRM information elements listed below, the coding of the information element identifier bits is summarized in table 21.

Table 21: Information elements identifier for handover resource management information elements

	Reference subclause	Length in octet
Bits 8 7 6 5 4 3 2 1		
0 - - - - - - - type 3 and 4 info element		
0 0 1		
- - - 0 0 0 0 Hdvr Proc Reference	6.5.10.3.2	F2
- - - 0 0 0 1 GS Ident	6.5.10.3.3	F4
- - - 0 0 1 0 ATEI	6.5.10.3.4	F5
- - - 0 0 1 1 Hdvr Resource Identifier	6.5.10.3.5	F3
- - - 0 1 0 0 Hdvr Resource Description	6.5.10.3.6	Max 66
- - - 0 1 0 1 Hdvr Call Number	6.5.10.3.7	Max 12
- - - 0 1 1 0 Hdvr Res Ident List	6.5.10.3.8	Max 34
- - - 0 1 1 1 Handover Characteristics	6.5.10.3.9	Max 30
- - - 1 0 0 0 Allocated Frequency	6.5.10.3.10	F2
- - - 1 0 0 1 Allocated Slots	6.5.10.3.11	F3
- - - 1 0 1 0 HRM Cause	6.5.10.3.12	F2
- - - 1 0 1 1 CCM Message	6.5.10.3.13	Max 112
- - - 1 1 0 0 MRM Message	6.5.10.3.14	Max 241
- - - 1 1 0 1 Call data description	6.5.10.3.15	max 145
- - - 1 1 1 0 Service provider ident	6.5.10.3.16	max 4
NOTE: For fixed length information elements the length is indicated as F length value e.g. F4. For variable length information elements the length is indicated as Max length value e.g. Max 10. The indicated length is the length included information identifier and a possible length indicator. When an information element is mandatory in a message the length is reduced with 1 octet as the information element identifier is stripped off.		

6.5.10.3.2 Handover procedure reference

The handover procedure reference, associated with the Old-GSC identity, shall identify the handover procedure between two GSCs during all the duration of the procedure.

The handover procedure reference information element shall be coded as shown in figure 57 and table 22.

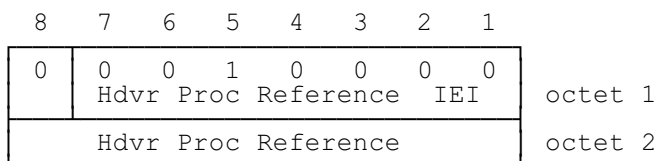


Figure 57: Handover procedure reference information element

Table 22: Handover procedure reference information element

Handover Procedure Reference values: (octet 2)
 Range determined by the GCC and NIC value.

6.5.10.3.3 GS Identifier

The purpose of the GS Identifier information element shall be to identify the GS in the TFTS network.

The GS Identifier information element shall be coded as shown in figure 58 and table 23

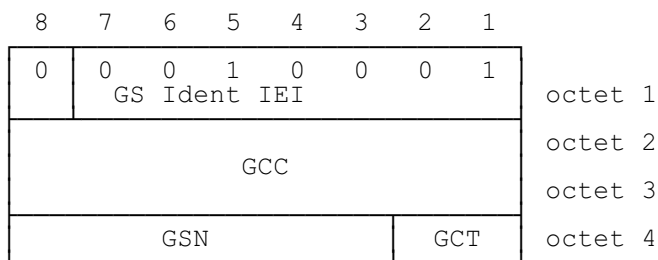


Figure 58: GS Identifier information element

Table 23: GS Identifier information element

The GCC, GSN and GCT fields shall be coded following the rules defined in ETS 300 326-1 [1], clause 8.

6.5.10.3.4 ATEI

The purpose of the (ATEI) information element shall be to identify the aircraft.

The ATEI information element shall be coded as shown in figure 59 and table 24.

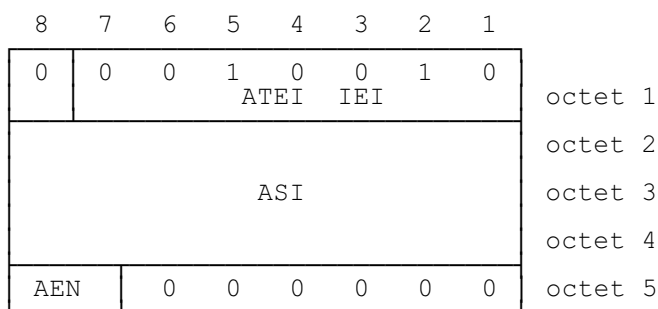


Figure 59: ATEI information element

Table 24: ATEI information element

The ASI and AEN fields shall be coded following the rules defined in ETS 300 326-1 [1], clause 8.

6.5.10.3.5 Handover resource identifier

The purpose of the handover resource identifier information element shall be to identify each handover resource between the two GSCs.

The handover resource identifier information element shall be coded as shown in figure 60 and table 25.

8	7	6	5	4	3	2	1	
0	0	0	1	0	0	1	1	octet 1
Hdvr resource ident IEI								
Handover resource identifier								octet 2
								octet 3

Figure 60: Handover resource identifier information element

Table 25: Handover resource identifier information element

Handover resource identifier Range 0 to 32767 octet 2 Bit 8 : high octet 3 Bit 1 : low

According to a special convention between GSC operators, some range of values may be allocated for dedicated lines and some other range for switched circuits.

In the same way, if it is needed, some range may be allocated for incoming circuits, some for outgoing circuits and some for mixed circuits.

6.5.10.3.6 Handover resource description

The purpose of the handover resource description information element shall indicate, for each channel identifier, the handover resource identifier.

The channel identifier shall be composed of the protocol discriminator and the TI fields.

The channel identifier, associated with the ATEI, shall identify the channel unambiguously.

The maximum number of handover resource description shall be 16.

The handover resource description information element shall be coded as shown in figure 61 and table 26.

8	7	6	5	4	3	2	1	
0	0	0	1	0	0	1	1	octet 1
Hdvr Resource Descrip IEI								
Length Hdvr Resource Descrip								octet 2
Transaction Ident					Prot discri			octet 3
Handover Resource Identifier								octet 3a
								octet 3b
Radio Resource Allocated								octet 3c
								etc.

Figure 61: Handover resource description information element

Table 26: Handover resource description information element

Protocol Discriminator values : (octet3)	
Bits	
3 2 1	
0 0 0	Radio Resource Management (RRM) messages
0 0 1	Call Control messages
0 1 0	Operation & Maintenance messages
1 1 1	Test procedures messages
other values are reserved	
TI values: (octet 3)	
Range 0 to 31	
Bit 4	low
Bit 8	high
Handover Resource Identifier (octet 3a and 3b)	
Range 0 to 32767	
octet 3a	Bit 8: high
octet 3b	Bit 1: low
Radio resource allocated (octet 3c)	
Bit 8	0 = traffic mode 1 = signalling mode
Bits 1 to 7 reserved	

NOTE: Resource type is defined in ETS 300 326-2 [2] subclause 10.11.8.5.2.9.

6.5.10.3.7 Handover call numbers information element

The handover call numbers information element shall be used for GSC to GSC handover using TCHs across the public switched network.

The Handover Call Number shall have a maximum length of 18 digits. The Handover Call Numbers Information Element shall support a maximum of 16 Handover Call Numbers (transactions).

The handover call number shall provide the number to be dialled by the Old-GSC in order to allow the New-GSC to associate incoming call and the specific TCH.

The channel identifier shall be composed of the protocol discriminator and the TI fields and shall be associated with the ATEI to identify the channel.

The handover resource description information element shall be coded as shown in figure 62 and table 27.

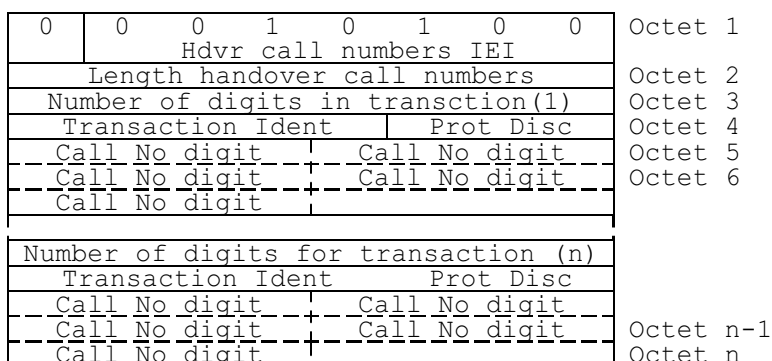


Figure 62: Handover call number information element

Table 27: Handover call number information element

Protocol Discriminator values : (octet 3)	
Bits	
3 2 1	
0 0 0	RRM messages
0 0 1	Call Control messages
0 1 0	Operation & Maintenance messages
1 1 1	Test procedures messages
other values are reserved	
TI values: (octet 3)	
Range 0 to 31	
Bit 4	low
Bit 8	high
Call Number Digit (octet 4-4n)	
Bits	
8 7 6 5	Range 0 to 9, coded "1111" when not used
4 3 2 1	Range 0 to 9
The order of the digits is :	
octet 4a Bits 4-1,	octet 4a Bits 8-5,
octet 4b Bits 4-1,	octet 4b Bits 8-5, ...

6.5.10.3.8 Handover resource identifier list

The purpose of the handover resource identifier list information element shall be to indicate handover resource identifier of each TCH used between two GSCs.

The maximum number of handover resource identifier is 16.

The handover resource identifier list information element shall be coded as shown in figure 63 and table 28.

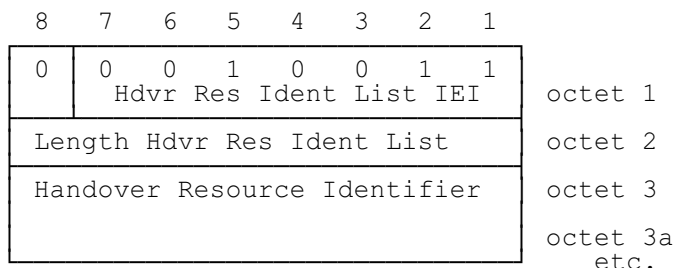


Figure 63: Handover resource identifier list information element

Table 28: Handover resource identifier information element

Handover Resource Identifier (octet 3-3a)
Range 0 to 32767
octet 3a Bit 8: high
octet 3b Bit 1: low

6.5.10.3.9 Handover characteristics

The purpose of the handover characteristics information element shall be to provide the appropriate information about the handover operation for administrative purpose.

The handover characteristics information element shall be coded as shown in figure 64 and table 29.

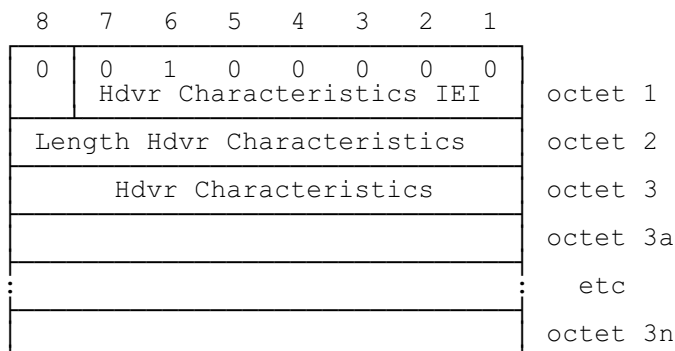


Figure 64: Handover characteristics information element

Table 29: Handover characteristics information element

Handover Characteristics: (octet 3-3n)
The Handover Characteristics is a set of characters giving the information needed for Handover Record as described in ETS 300 326-1 [1], clause 8
the information values are:
Handover connection request time (HH-MM-SS)
Handover completion time (HH-MM-SS)
Coded in BCD octet 3a hours
octet 3b minutes
octet 3c seconds
octet 3d hours
octet 3e minutes
octet 3f seconds
Completion type
Bits 2 1
0 0 successful
0 1 unsuccessful reverted to old GS
1 1 unsuccessful call aborted

6.5.10.3.10 Allocated frequency

The purpose of the allocated frequency information element shall be to provide a description of a specific allocated frequency.

The allocated frequency information element shall be coded as shown in figure 65 and table 30.

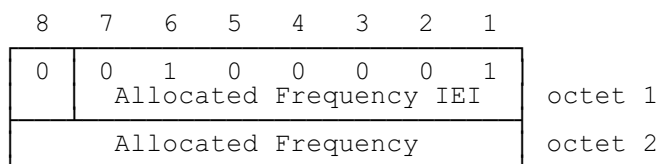


Figure 65: Allocated frequency information element

Table 30: Allocated Frequency information element

Allocated Frequency values: (octet 2) Coded following the Radio Frequency Channel Number (RFCN) given in ETS 300 326-2 [2], subclause 8.8 Range 1 to 164 Bit 1 low Bit 8 high All other values are reserved

6.5.10.3.11 Allocated slots

The purpose of the slot allocated information element shall be to indicate to the AS the slots which are allocated to the requests resources.

The slot allocated information element shall be coded as shown in figure 66 and table 31.

8	7	6	5	4	3	2	1	
0	0	0	1	0	0	1	0	octet 1
Slot Allocated IEI								
Slot Allocated								octet 2
								octet 3

Figure 66: Slot allocated information element

Table 31: Slot allocated information element

Slot Allocated values: Bits (octet 2) 8 identifies slot number 15 7 identifies slot number 14 : : 1 identifies slot number 8 Bits (octet 3) 8 identifies slot number 7 7 identifies slot number 6 : : 1 identifies slot number 0
--

6.5.10.3.12 HRM Cause

The purpose of the HRM Cause information element shall be to transmit the cause of reject or the condition of an operation achievement.

The HRM Cause information element shall be coded as shown in figure 67 and table 32.

8	7	6	5	4	3	2	1	
0	0	1	1	0	0	1	0	octet 1
HRM Cause IEI								
HRM Cause								octet 2

Figure 67: HRM reject cause information element

Table 32: HO cause information element

HRM Reject Cause values: (octet 2)								
Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	-	-	-	-	Reserved for RRM see ETS 300 326-2 [2] clause 10
0	0	0	1	-	-	-	-	Reserved for TRM
0	0	1	0	-	-	-	-	HRM Cause
-	-	-	-	0	0	0	0	Correct operation achievement
-	-	-	-	0	0	0	1	No Handover Resource available
-	-	-	-	0	0	1	0	Timeout on Traffic Channel establish
-	-	-	-	0	0	1	1	Unknown Handover Resource
-	-	-	-	0	1	0	0	Unavailable Handover Resource
-	-	-	-	0	1	0	1	Hdvr Resource already allocated
-	-	-	-	0	1	1	0	Handover release in the new GS
-	-	-	-	0	1	1	1	Handover resource abort
-	-	-	-	1	0	0	0	Aircraft not allowed
-	-	-	-	1	0	0	1	Unknown Aircraft
other values are reserved								

6.5.10.3.13 CCM data message

The purpose of the CCM data message information element shall be to identify a CC data message to be transferred by HRM signalling facility.

The CCM data message information element shall be coded as shown in figure 68 and table 33.

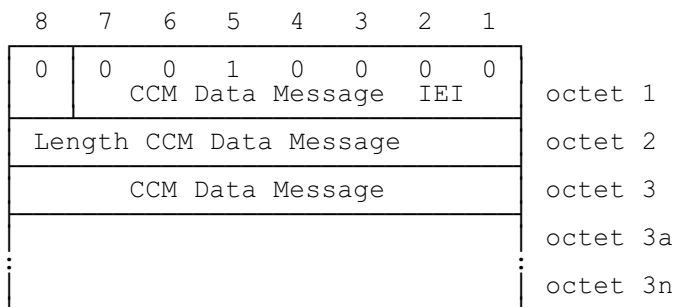


Figure 68: CCM Data Message information element

Table 33: CCM Data Message information element

CCM Data Message (octet 3)
The CCM Data Message is a set of octets transferred transparently peer-to-peer by HRM
The maximum length of the message is defined in the ETS 300 326-2 [2], clause 10

6.5.10.3.14 MRM data message

The purpose of the MRM data message information element shall be to identify a Maintenance Resource (MR) data message to be transferred by HRM signalling facility.

The MRM data message information element shall be coded as shown in figure 69 and table 34.

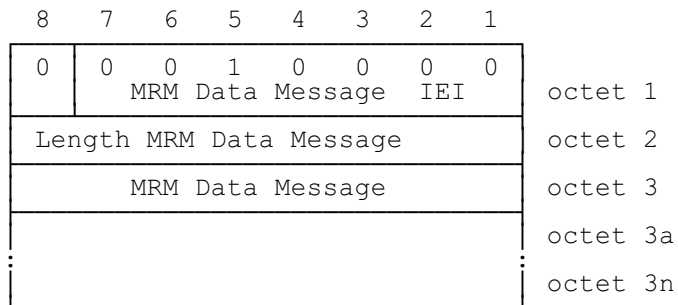


Figure 69: MRM Data Message information element

Table 34: MRM Data Message information element

MRM Data Message (octet 3) The MRM Data Message is a set of octets transferred transparently peer to peer by HRM The maximum length of the message is defined in subclause 6.6
--

6.5.10.3.15 Call Data Description

The Call Data Description information element shall indicate for each channel identifier the related Call Data.

The initial GSIC shall identify the GS at which the call was initially requested.

The VCR Reference Number shall indicate the Voice Call Record reference number in the initial GSC.

The Data/Time VCR Request shall represent the date and time when the call was requested in the initial GSC.

The maximum Call Data Description is 16. This is the same number as for handover resource description.

The Call Data Description element shall be coded as shown in figure 70 and table 35.

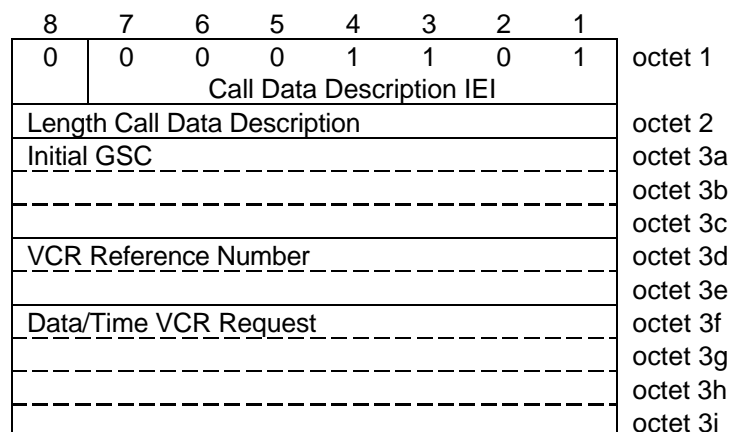


Figure 70: Call Data Description information element

Table 35: Call Data Description information element

Initial GSIC: octet 3a,3b,and 3c see section 6.5.10.3.3							
VCR Reference number: octet 3d and 3e range 0 to 65535							
Date/time: octet 3f, 3g, 3h, and 3i							
octet 3f							
bits	8	7	6	5	4	3	year, starting with base 1992
	0	0	0	0	0	0	1992
	0	0	0	0	0	1	1993
			:				
			:				
	1	1	1	1	1	1	2055
octets	3f		3g				
bits	2	1	8	7			month
	0	0	0	1			January
	0	0	1	0			February
			:				
	1	0	1	0			December
octet 3g							
bits	6	5	4	3	2		day
	0	0	0	0	1		1
	0	0	0	1	0		2
			:				
	1	1	1	1	1		31
octet	3g		3h				
bits	1	8	7	6	5		hours
	0	0	0	0	0		1
	0	0	0	0	1		2
			:				
	1	0	1	1	1		23
octet	3h				3i		
bits	4	3	2	1	8	7	minutes
	0	0	0	0	0	0	0
	0	0	0	0	0	1	1
			:				
	1	1	1	0	1	1	59
octet	3i						
bits	6	5	4	3	2	1	seconds
	0	0	0	0	0	0	0
	0	0	0	0	0	1	1
			:				
	1	1	1	0	1	1	59

6.5.10.3.16 Service Provider Ident

The service provider ident shall indicate the identity of the service provider to which the aircraft is contracted.

The Call Data Description element shall be coded as shown in figure 71 and table 36.

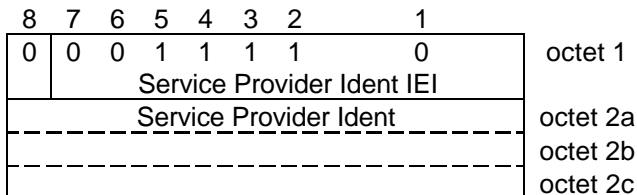


Figure 71: Service Provider Ident

Table 36: Service Provider Ident information element

Service Provider Ident:								
Octet 2a								
bits	8	7	6	5	4	3	2	1
	0	0	0	0	0	0	0	0
Octet 2b								
bits	8	7	6	5	4	3	2	1
	0	0	0	0	0	0	0	0
Octet 2c								
bits	8	7	6	5	4	3	2	1
	0	0	0	0	0	0	0	0

6.5.11 Handling of error conditions

6.5.11.1 Transport disconnect

In case of transport disconnection, all handover resources shall be released.

The GSC shall be in "isolated state" until the transport connection has been re-established.

6.5.11.2 Release resource already released

If a TCH request is received for a handover resource already released, the request shall be ignored.

6.5.11.3 Unknown handover resource identifier

If a traffic release request is received for an unknown handover resource identifier, the request shall be ignored.

If a handover request is received with unknown handover resource identifier, the handover request shall be rejected with the cause "unknown handover resource".

If a connect, disconnect or transfer request is received with an unknown handover resource identifier, the message shall be ignored.

6.5.11.4 Unknown handover reference

If a handover message is received with an unknown handover reference, the message shall be ignored.

6.5.12 Handover diagrams

6.5.12.1 Handover scenario diagrams

This subclause is provided for information purposes only. In arrow diagrams examples of handover message exchanges between different entities are shown. See subclause 6.3 for more details about handover scenarios.

6.5.12.1.1 Normal case

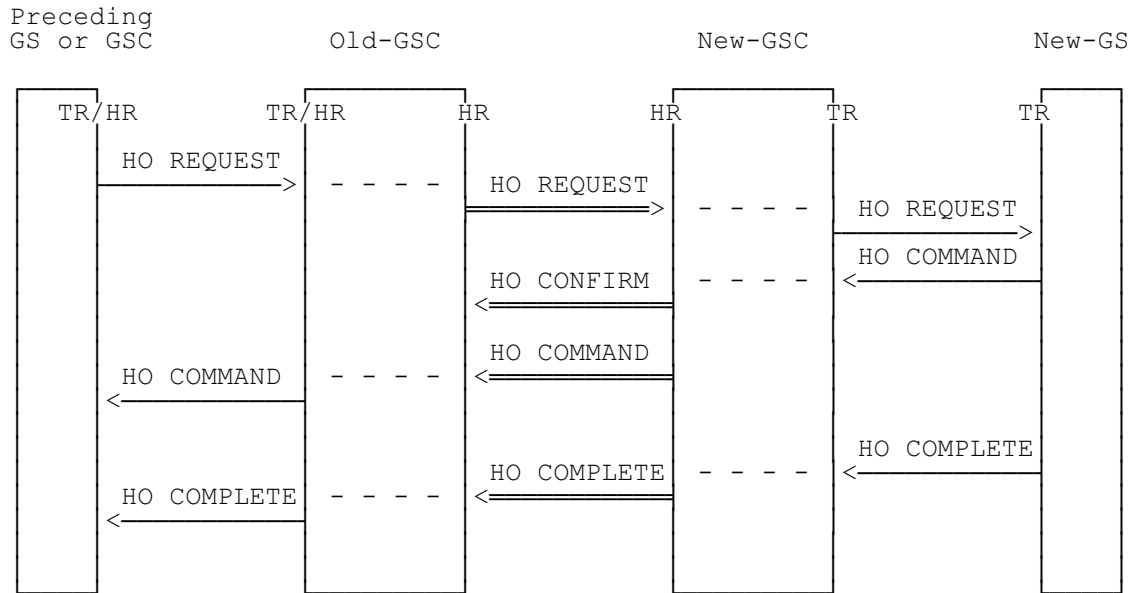


Figure 72

6.5.12.1.2 Reject by Old-GSC

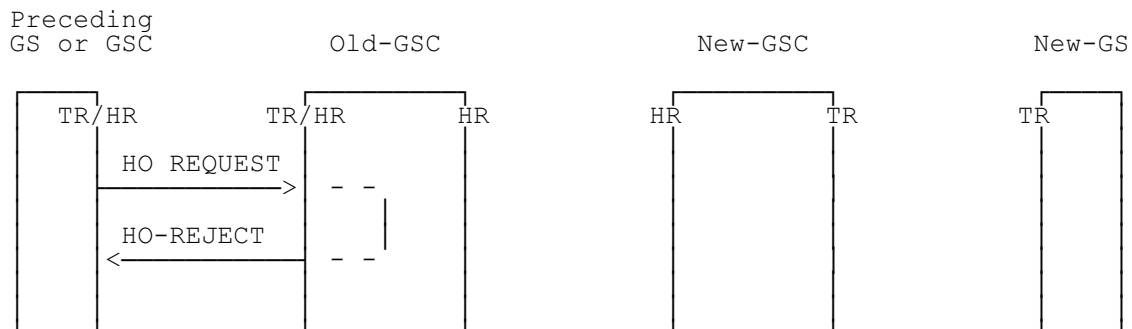


Figure 73

6.5.12.1.3 Reject by New-GSC

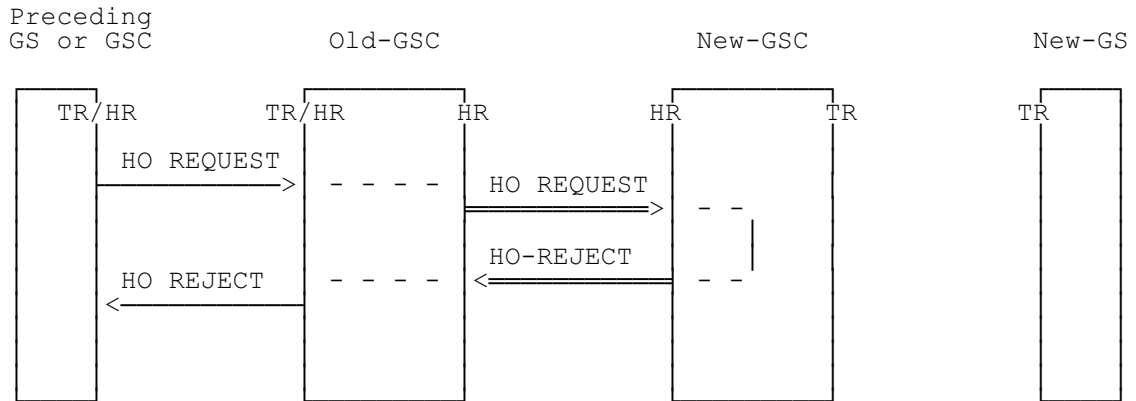


Figure 74

6.5.12.1.4 Reject by the New-GS

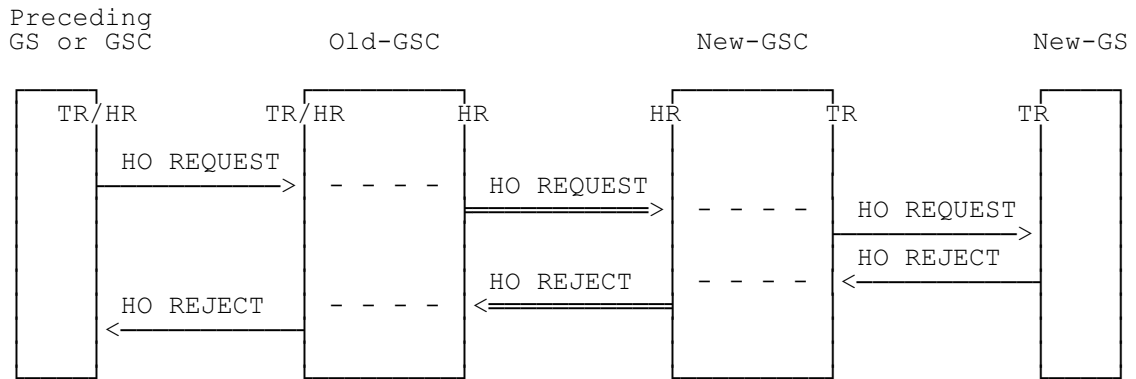


Figure 75

6.5.12.1.5 Reject by the New-GSC after HO-CONFIRM

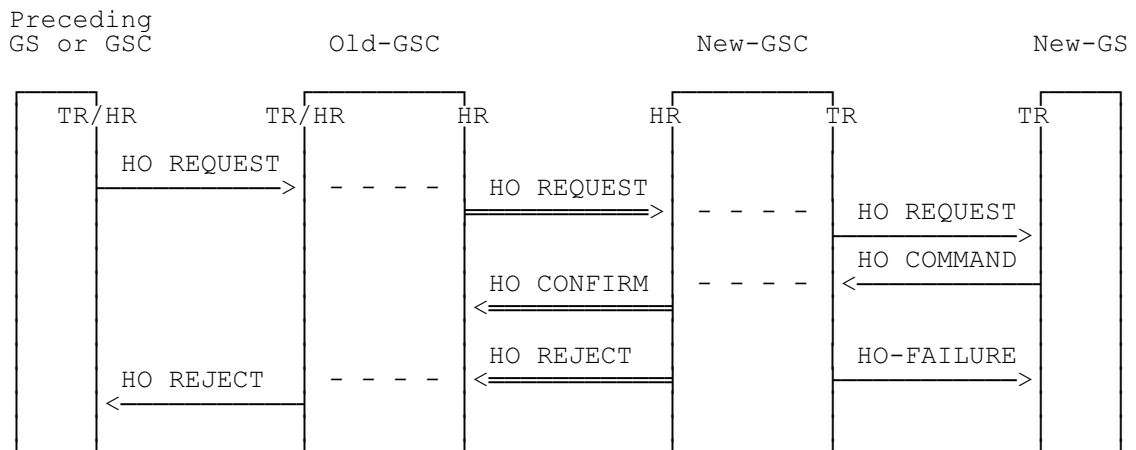


Figure 76

6.5.12.1.6 Failure by the AS

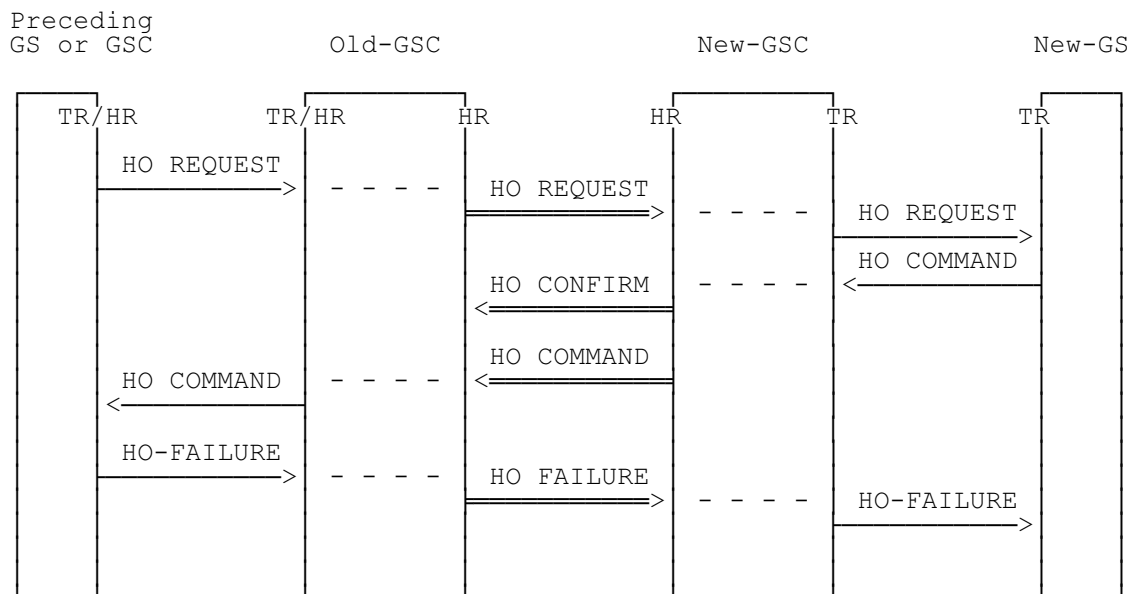


Figure 77

6.5.12.2 State diagram and System Description Language (SDL) of HRM

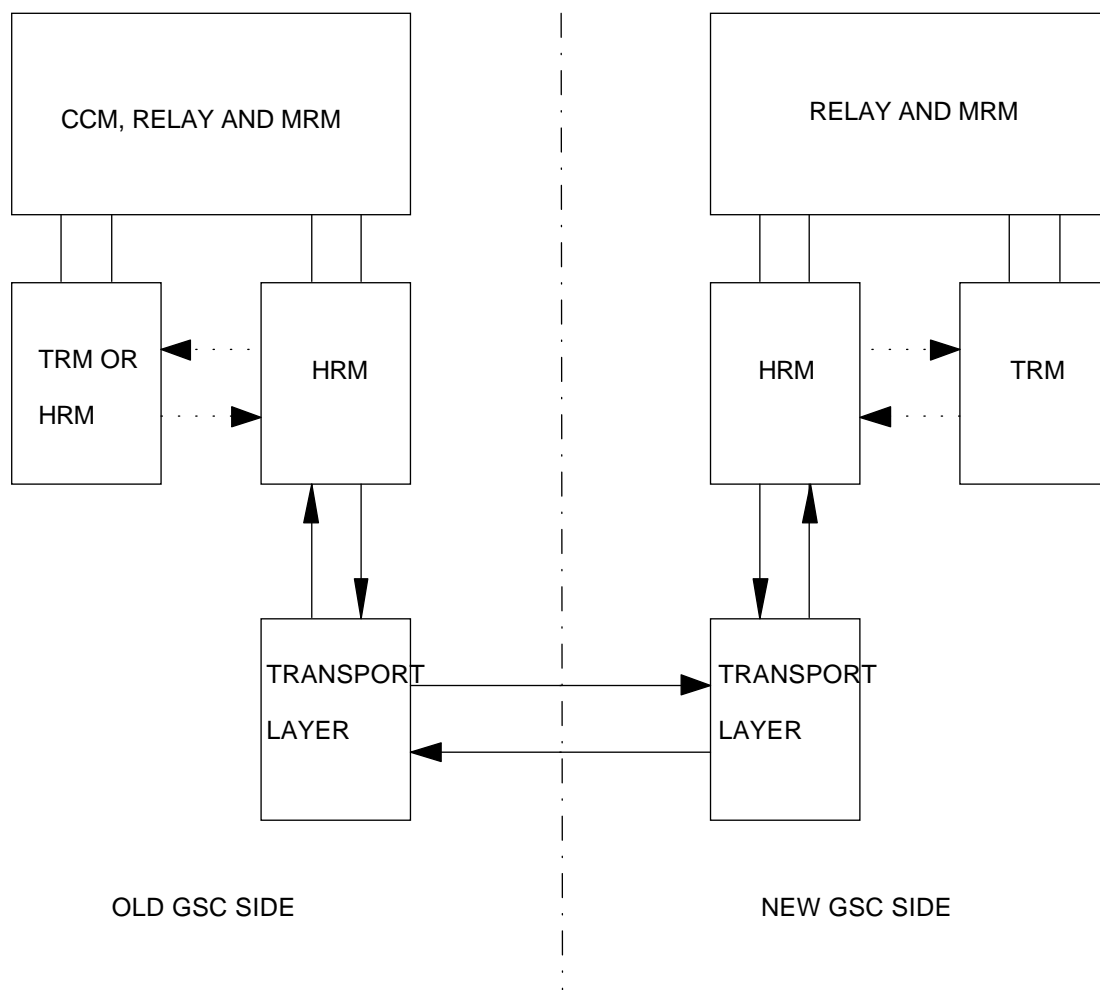


Figure 78: Signalling structure

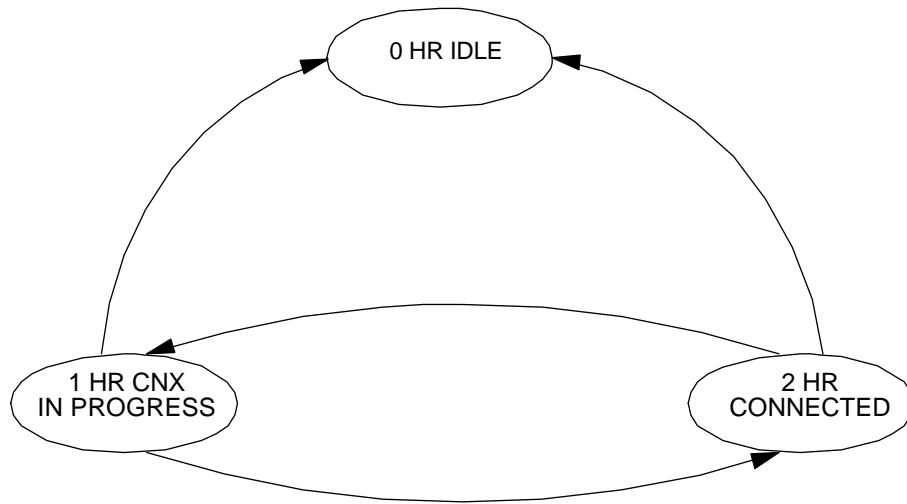


Figure 79: State diagram HRM

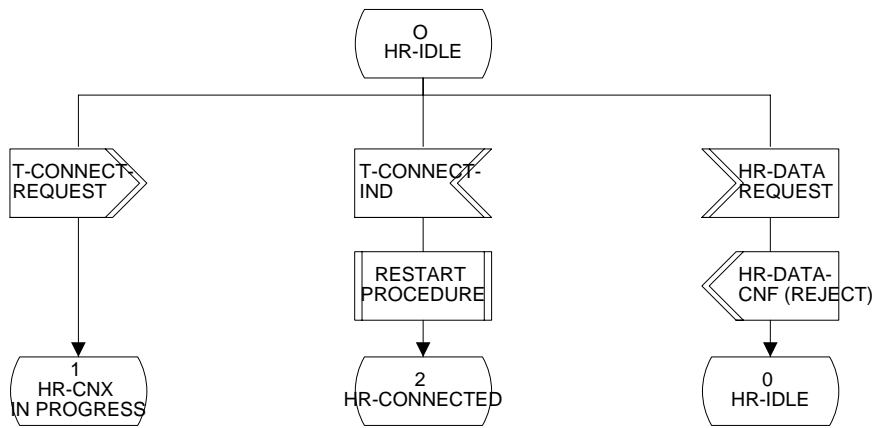


Figure 80: SDL of HRM

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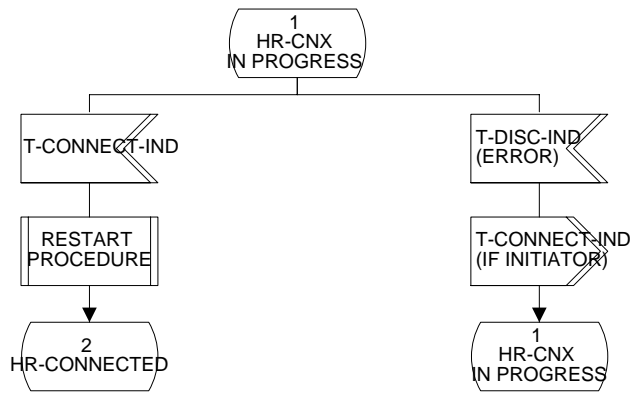


Figure 81: SDL of HR

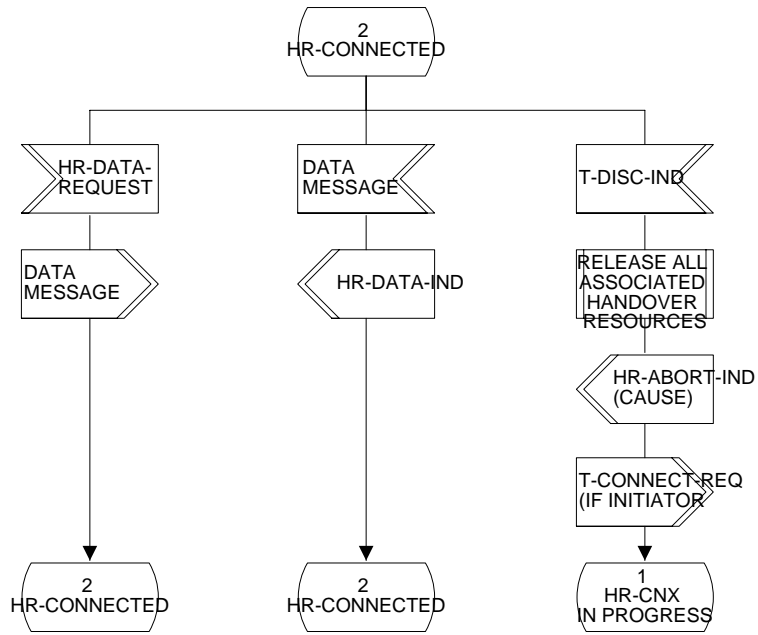


Figure 82: SDL of HRM

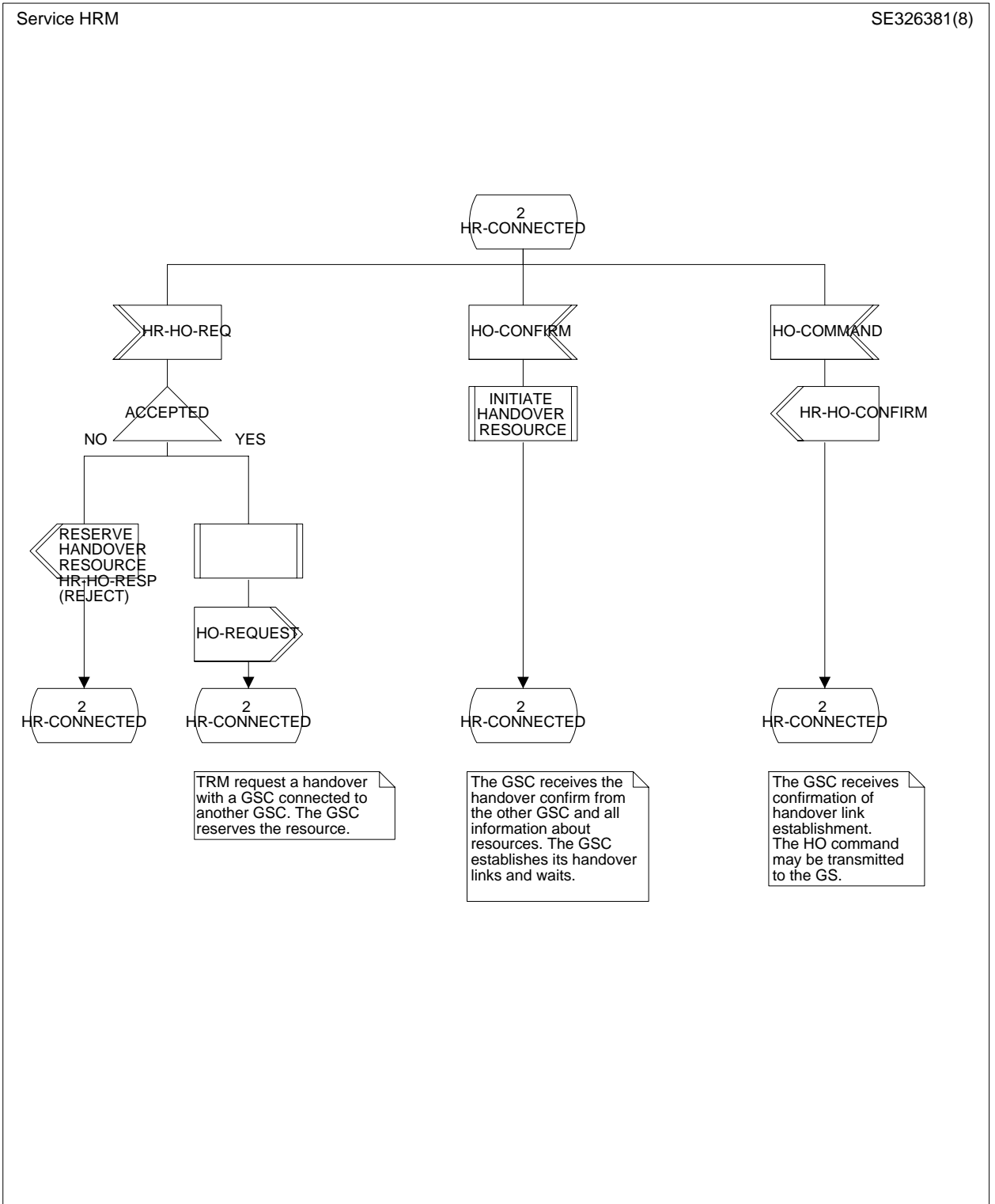


Figure 83: SDL of HRM

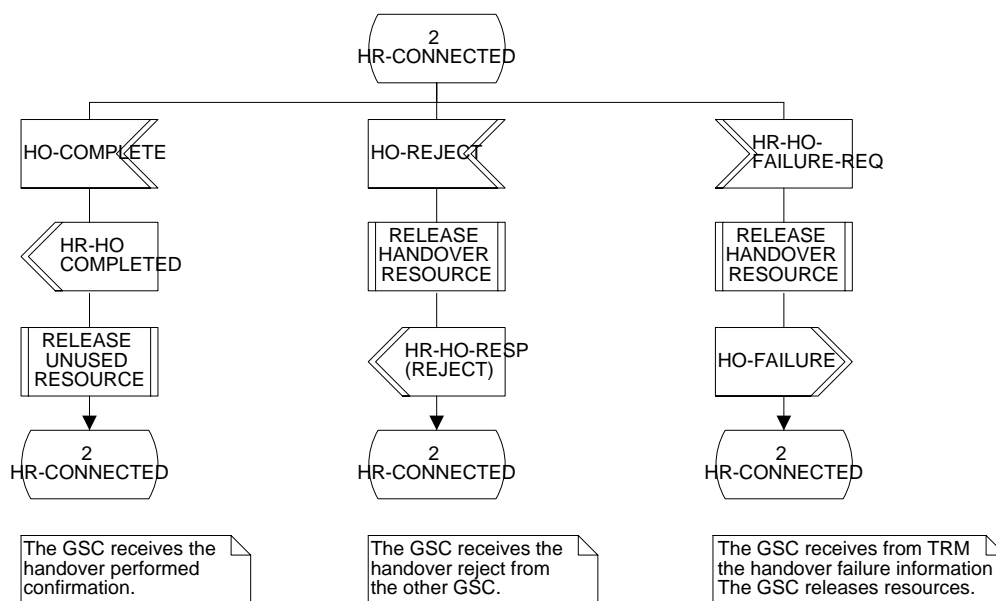


Figure 84: SDL of HRM

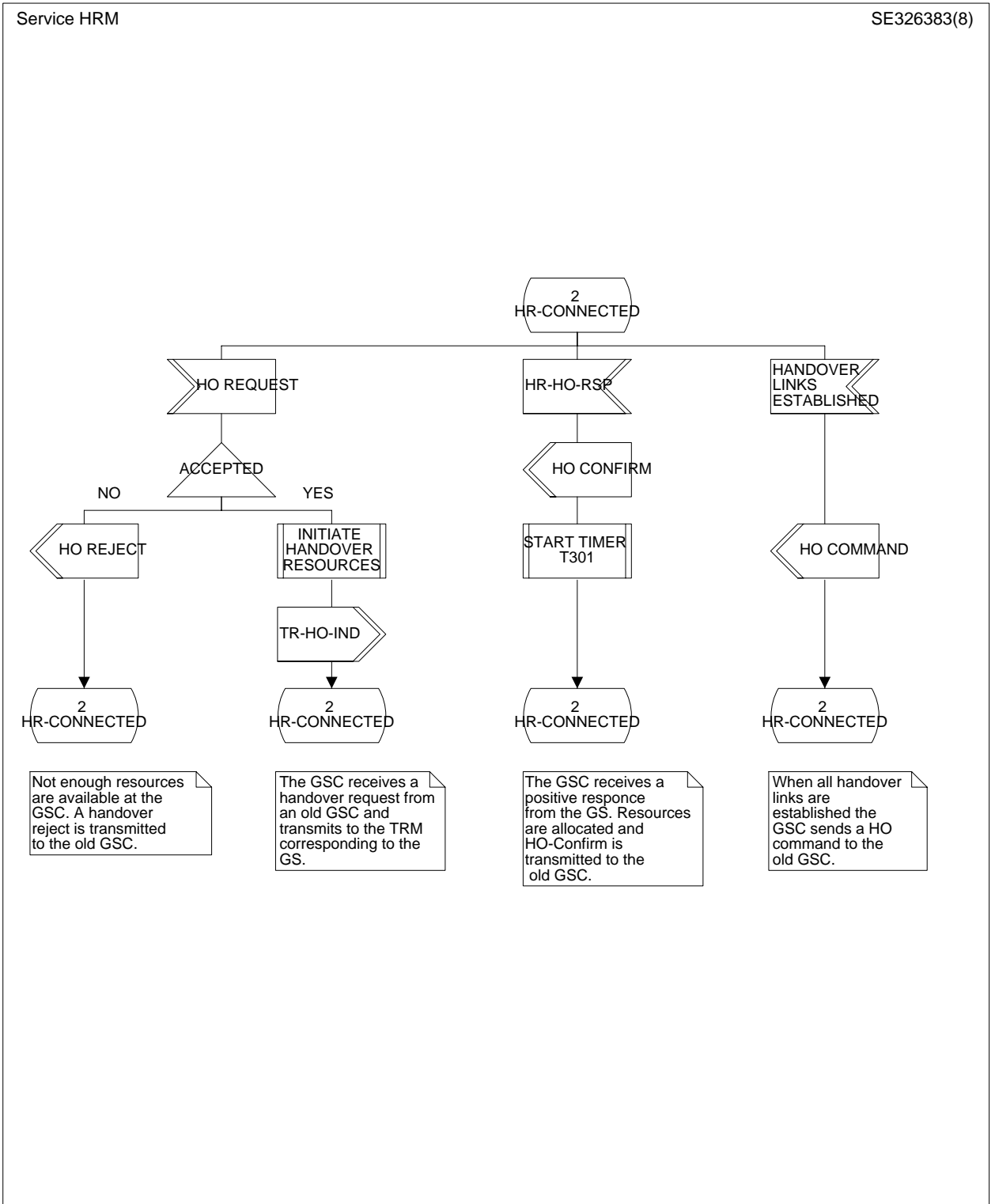


Figure 85: SDL of HRM

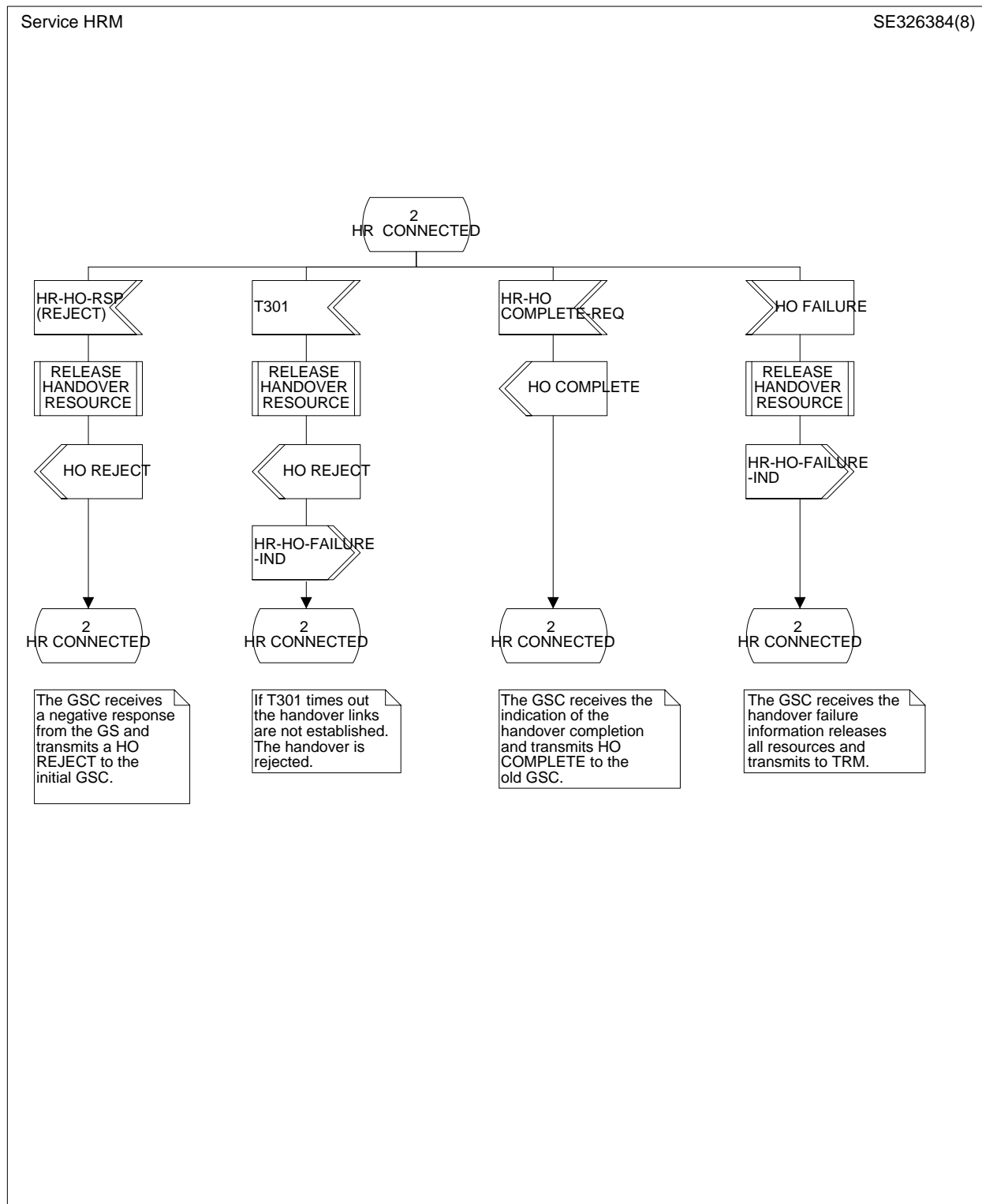


Figure 86: SDL of HRM

Service HRM

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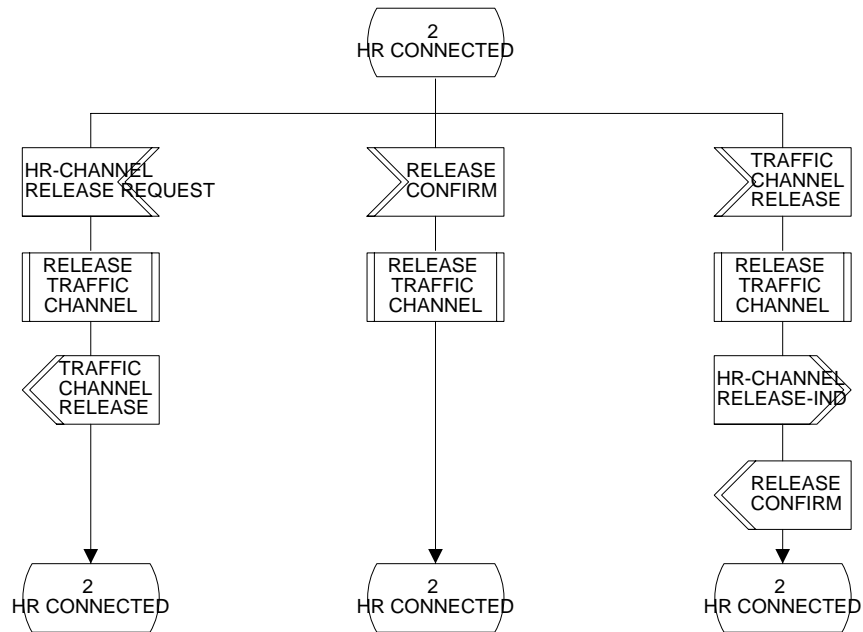


Figure 87: SDL of HRM

6.6 GSC - GSC isolation and restoration

6.6.1 General

This subclause specifies the conditions to meet when GSCs are isolated and the actions to be undertaken when the conditions of isolation end.

When any of the GSC element is isolated, actions to release common resources shall be undertaken but the acknowledgement of the other party cannot be obtained. When these elements are connected again, a special procedure shall be processed to ensure that all common resources are released by both parties.

When any disturbance happens on common resources, each extremity shall be informed in order to avoid the use of such resources.

For the purpose of maintenance, common resources will become unavailable and in this case each extremity shall be informed.

At the end of maintenance or out of service state of common resource, each side shall be informed to be able to use the resource if needed.

6.6.2 Isolation

The GSC shall be considered as isolated either when it is started or when the network layer has been disconnected.

A major alarm shall be sent to the OMC using an adequate procedure for maintenance purposes. The definition of this action is outside the scope of this ETS.

When this condition is reached, the GSC shall enter the procedure of handover resource release.

All the calls which are using the GSC-GSC interface shall be cleared by the abnormal procedure (no answer of the other peer), and the handover resources shall be released with no acknowledgement from the other peer.

6.6.3 Handover resource states

6.6.3.1 Handover resource dynamic states

For the handover MRM point of view, the dynamic states of a handover resource shall be:

- **ANY STATE:** Is the state of a handover resource before any usage of the resource;
- **HALF-FAULTY:** Is the state of a handover resource either after an un-acknowledged release operation or when a RESTART procedure between the two GSCs is necessary;
- **TO BE INITIALISED:** Is the temporary state of a handover resource when a RESTART request has been transmitted and the response is awaited;
- **FREE:** Is the state of a handover resource which may be allocated for traffic;
- **ENGAGED:** Is the state of a handover resource which is allocated for traffic.

6.6.3.2 Handover resource usage states

The handover resources between two GSCs may be in three usage states:

- **IN SERVICE:** In this state, the resource is normally used for traffic service. From this state, the resource state may be moved to "MAINTENANCE" state or to "OUT OF SERVICE" state by either side of the interface;
- **MAINTENANCE:** In this state, the resource cannot be used for normal traffic service, but for special diagnostic service. Both sides may initiate such service, both sides has to process such service. From this state, the resource state may be moved to "OUT OF SERVICE" state by either side, or to "IN SERVICE" state if both sides agree to do so;
- **OUT OF SERVICE:** In this state, the resource cannot be used for any service. From this state, the resource state may be moved to the "IN SERVICE" or "MAINTENANCE" state if both sides agree to do so.

6.6.4 Restart procedure

When the connection between the two GSCs is established or re-established by the network layer, a special restoration procedure shall be required.

The GSCs shall exchange a special release request for all common handover resources. This request shall be sent until a release response is given by the other side.

This procedure takes place in the MRM function of the system (handover resource part).

6.6.4.1 General restart procedure

When the release operation of a handover resource is not acknowledged by the other peer, the handover resource dynamic state shall become "HALF-FAULTY".

At the initiation of the connection, all resource states shall be set to "HALF-FAULTY".

At starting time and periodically afterwards, the handover MRM function shall examine the state of each handover resource. If the handover resource dynamic state is "HALF-FAULTY", the handover MRM function shall try to send a "RESTART" message to the handover MRM function of the other peer, with the resource identity and the usage state of the resource (or resources) which has to be restarted. The corresponding resource (or resources) dynamic state shall become "TO BE INITIALISED".

When the Handover MRM function receives a "RESTART" message, the resource (or resources) specified in the message shall be examined.

If the dynamic state is "FREE" it shall remain "FREE". If the dynamic state is "ENGAGED", the resource release operation shall be initiated. If the dynamic state is "HALF-FAULTY" or "TO BE INITIALISED", it shall become "FREE".

The usage state shall be aligned to the usage state specified in the message according to the rule for usage state alignment.

The "RESTART" message shall be acknowledged by sending a "RESTART ACKNOWLEDGE" message containing the usage state of the resource (or resources).

When the Handover MRM function receives the "RESTART ACKNOWLEDGE" message, the corresponding resource dynamic state shall be set to "FREE".

The usage state shall be aligned to the usage state specified in the message according to the rule for usage state alignment.

The rule for usage state alignment shall be as follows:

- if the message usage state is "IN SERVICE", the local usage state shall not be modified;
- if the message usage state is "MAINTENANCE" and if the local usage state is "IN SERVICE" it shall be changed to "MAINTENANCE" otherwise it shall not be modified;
- if the message usage state is "OUT OF SERVICE", and if the local usage state is not "OUT OF SERVICE" it shall be changed to "OUT OF SERVICE", otherwise it shall not be modified.

6.6.4.2 Handover resource dynamic state diagram

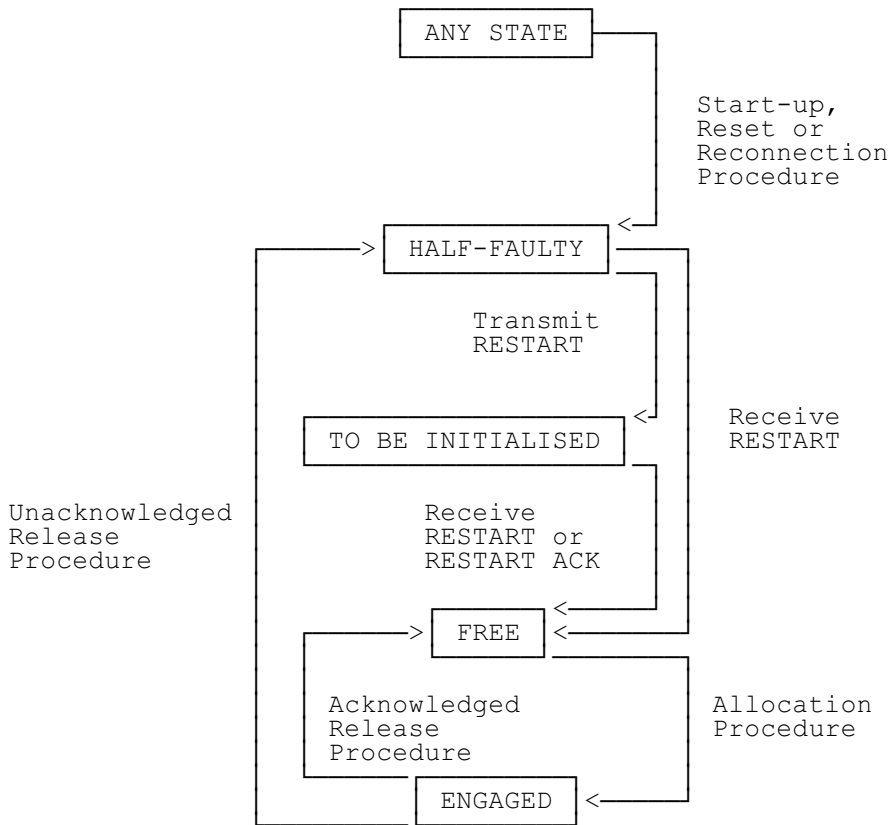


Figure 88: Handover resource diagram

6.6.5 Handover Resource Maintenance

6.6.5.1 Handover resource usage state modification procedure

The change of usage state shall be accomplished using "SERVICE" message with the resource identity and the state requested, and "SERVICE ACKNOWLEDGE" with the resource identity and the state response.

The procedure of usage state change may be used when a peer receives any message concerning an unknown terrestrial resource. In this case the side may request to set this terrestrial resource in "OUT OF SERVICE" state.

6.6.5.2 Handover resource usage state diagram

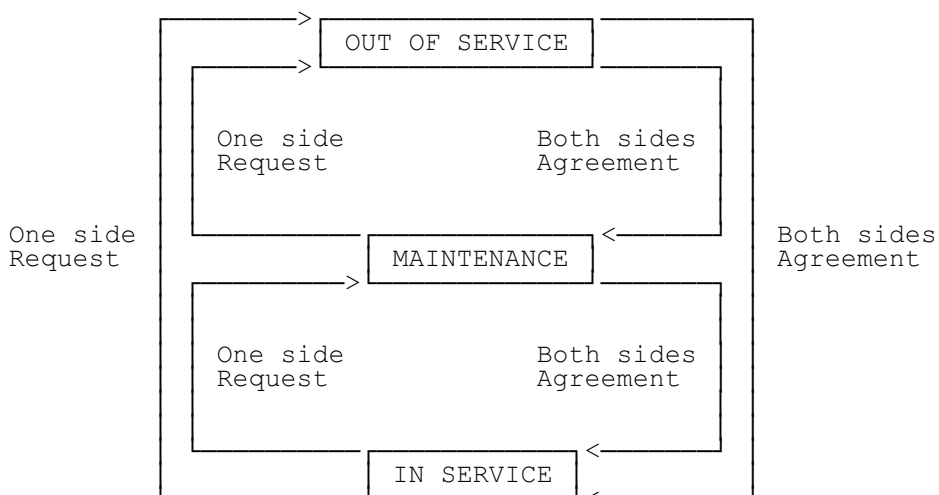


Figure 89: Handover resource diagram

6.6.6 Messages functional definition and contents

Table 37: Message list

Message list :

	Reference
RESTART	6.6.6.1
RESTART ACKNOWLEDGE	6.6.6.2
SERVICE	6.6.6.3
SERVICE ACKNOWLEDGE	6.6.6.4

In the message description, the length of each element is given in OCTET.

6.6.6.1 Restart message

This message shall be used to initiate handover resource (or resources) between GS and GSC. Up to 16 Handover Resource Identity may be described in the message.

Table 38: Restart message

Information element	Reference	Direction	Type	Length
Message Type	6.6.7.2	both	MF	1
MRM Transaction Reference	6.6.7.4	both	MF	2
Hdvr Resource Ident + State	6.6.7.5	both	MV	4-65

6.6.6.2 Restart acknowledge message

This message shall be used to acknowledge the RESTART message. It shall reply with the resources defined in the "RESTART" message.

Table 39: Restart acknowledge message

Information element	Reference	Direction	Type	Length
Message Type	6.6.7.2	both	MF	1
MRM Transaction Reference	6.6.7.4	both	MF	2
Hdvr Resource Ident + State	6.6.7.5	both	MV	4-65

6.6.6.3 Service message

This message shall be used to initiate the usage state of one or more handover resource between GS and GSC. The resource state given in the message shall be the requested resource state. Up to 16 handover resource identity and state may be given in the same message.

Table 40: Service message

Information element	Reference	Direction	Type	Length
Message Type	6.6.7.2	both	MF	1
MRM Transaction Reference	6.6.7.4	both	MF	2
Hdvr Resource Ident + State	6.6.7.5	both	MV	4-65

6.6.6.4 Service acknowledge message

This message shall be used to acknowledge the SERVICE message. The resource state given in the message shall be the actual resource state.

Table 41: Service acknowledge message

Information element	Reference	Direction	Type	Length
Message Type	6.6.7.2	both	MF	1
MRM Transaction Reference	6.6.7.4	both	MF	2
Hdvr Resource Ident + State	6.6.7.5	both	MV	4-65

6.6.7 Message format and information element coding

The figures and text in this subclause describe message contents. Within each octet, the bit designed "bit 1" shall be transmitted first, followed by bits 2, 3, 4, etc. Similarly, the octet shown at the top of each figure shall be sent first.

6.6.7.1 General message format

Within the MRM protocol, every message shall consist of:

- message type;
- other information elements as required.

All equipment should be able to ignore any extra information, present in a message, which is not required for the proper action of that equipment.

Unless specified otherwise, a particular information element shall be present only once in a given message.

General message organization example:

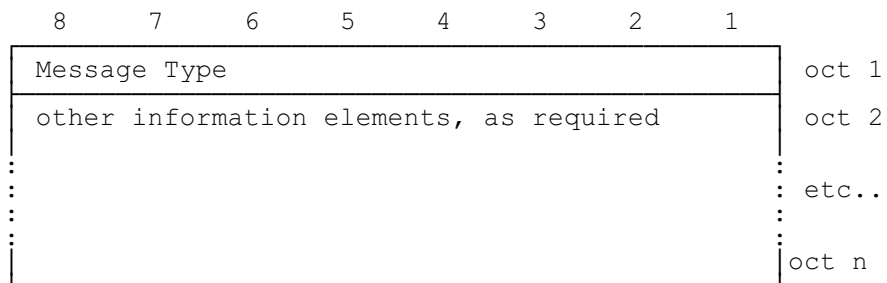


Figure 90: General message example

6.6.7.2 Message type

"Message type" defines the type of action which shall be involved by the message and also defines the message format.

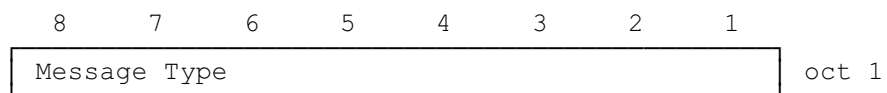


Figure 91: Message type

Table 42: Message type

Message Type												
Bits												
8	7	6	5	4	3	2	1					
0	0	0	0	-	-	-	-	Handover MRM messages				
								0	0	0	0	RESTART
								0	0	0	1	RESTART ACKNOWLEDGE
								0	0	1	0	SERVICE
								0	0	1	1	SERVICE ACKNOWLEDGE

6.6.7.3 Other information elements

Table 43: Other information elements

	Reference subclause	Length in octet
Bits 8 7 6 5 4 3 2 1		
0 - - - - - - - type 3 and 4 info element		
0 0 0 0 0 0 0 MRM Transaction Reference	6.6.7.4	2
0 0 0 0 0 0 1 Hdvr Resource Ident and State	6.6.7.5	Max 64
0 0 0 0 0 1 0) to) These values are reserved		
0 0 0 0 1 1 1)		

6.6.7.4 MRM transaction reference

The MRM transaction reference information element shall identify the transaction in the request response exchange. This reference shall only be used for one exchange. It shall be defined by the requesting element and shall be used for the response.

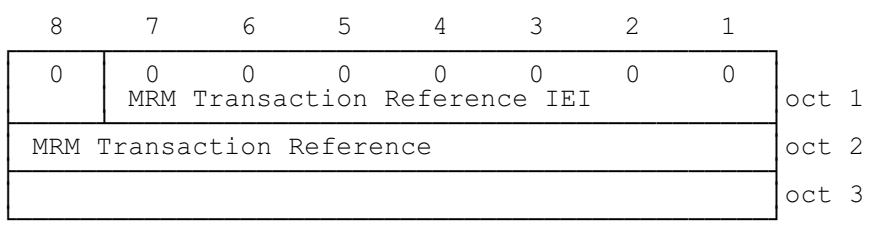


Figure 92: MRM transaction reference

Table 44: MRM transaction reference

MRM Transaction Reference values : (octet 2 and 3)

Range 0 to 32767

octet 2 Bit 8: high
 octet 3 Bit 1: low

6.6.7.5 Handover resource identity and state

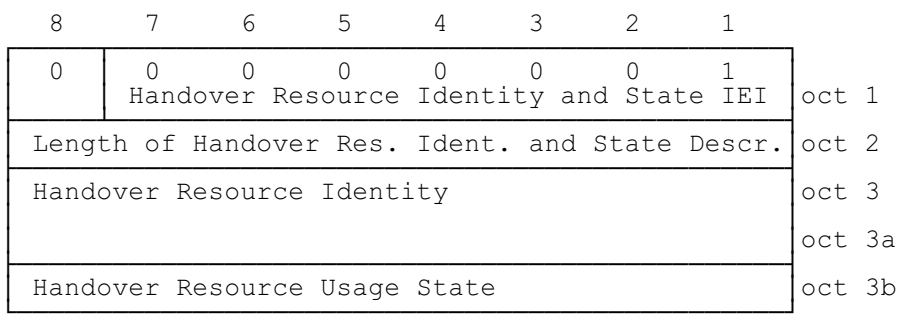


Figure 93: Handover resource identity and state

Table 45: Handover resource identity values

Handover Resource Identity values : (octet 2 and 3)	
Range 0 to 4095	
octet 2 Bit 8 : high	
octet 3 Bit 1 : low	
Handover Resource Usage State	
0 0 0 0 0 0 0 0	Out of Service
0 0 0 0 0 0 0 1	Maintenance
0 0 0 0 0 0 1 0	In Service

History

Document history	
February 1996	First Edition
March 1998	One-Step Approval Procedure OAP 9829: 1998-03-20 to 1998-07-17