ETSI/TC SMG
Released by : ETSI/PT 12
Release date: February 1992

RELEASE NOTE

Recommendation GSM 03.10

GSM PLMN Connection Types

Previously distributed version : 3.3.0 (Release 1/90)
New Released version February 92 : 3.3.0 (Release 92, Phase 1)

1. Reason for changes

No changes since the previously distributed version.

ETSI-GSM
Technical
Specification

GSM 03.10

Version 3.3.0

UDC: 621.396.21

Key words: European Digital Cellular Telecommunications System, Global System for Mobile Communications (GSM)

European digital cellular telecommunication system (phase 1);

GSM PLMN Connection Types

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ETSI/GSM

Released by: ETSI PT12

Release date: February 1992

Recommendation: GSM 03.10

Title: GSM PLMN CONNECTION TYPES

List of contents:

Original language: English

Number of pages: 39

0. SCOPE

A GSM PLMN may be described by a limited set of access interfaces (refer to Rec. GSM 04.02 and 02.01) and a limited set of GSM PLMN connection types to support the telecommunication services described in the GSM 02-series of Recommendations. This Recommendation identifies and defines these connection types in so far as they relate to the particular network capabilities for a GSM PLMN.

The basic lower layer capabilities of a GSM PLMN are represented by a set of GSM PLMN connection types. The definition of a set of GSM PLMN connection types provides the necessary input to identify network capabilities of a GSM PLMN. In addition to describing network capabilities of a GSM PLMN, the identification of connection types facilitates the specification of network-to-network interfaces. It may also assist in the allocation of network performance parameters.

This recommendation should be considered in conjunction with other GSM Recommendations with particular reference to Recommendations GSM 01.02, 02.01, 02.02, 02.03, 03.01, 03.02, 04.02 and 04.03.

This recommendation provides a bridge between the service specification in the GSM 02-series of recommendation and the more detailed recommendations. As such, it establishes a framework for the specification and understanding of the more detailed recommendations. It is therefore not a recommendation against which detailed conformance testing can be performed. However, it shall be considered mandatory for the understanding of the more detailed recommendations and used to resolve issues of conflict in these recommendations.

1. DEFINITIONS

(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.

GSM PLMN connection:

A connection that is established through a GSM PLMN between specified GSM PLMN reference points.

GSM PLMN connection type:

A description of a set of GSM PLMN connections which have the same characteristics.

2. GENERAL CONSIDERATIONS

Low layer capabilities are defined in Recommendation GSM 02.01 "Principles of Telecommunication services supported by a GSM PLMN" and characterized in Recommendations GSM 02.02 "Bearer Services" and GSM 02.03 "Teleservices". Apart from the short message service, all Bearer Services and Teleservices are provided using low layer capabilities in the connection mode. Network capabilities to support the short message services are defined in Rec. GSM 03.40 and 03.41.

2.1. Relationship between lower layer capabilities and radio traffic channels

The realization of low layer capabilities for the provision of telecommunication services will make use of a physical medium consisting of a traffic channel TCh (refer to Rec. GSM 04.03). Per connection one TCh will be used and no multiplexing of low data rate connections on one TCh is allowed.

Either a full rate or a half rate channel may be used depending on the requirements of the individual service. User data rates below or equal to 4800 bit/s may be supported either on a full rate channel or on a half rate channel. User data rate of 9600 bit/s is always supported on a full rate channel.

Technically every MS, regardless of whether it uses a half or a full rate TCh for speech transmission, should be able to use both half and full rate TChs for data transmission and telematic services. However, particular designs of MS may only provide access to a limited set of services and therefore only use limited options.

For the alternate speech and data bearer service and the alternate speech and group 3 facsimile teleservice, when a full rate traffic channel is required for one service and a half rate traffic channel is required for the alternate service, a full rate traffic channel will be reserved for the duration of the call (leaving one of the half rate channels composing the full rate channel unused when the service provided requires only a half rate channel).

For the Speech followed by data Bearer services, when a full rate traffic channel is required for speech and a half-rate traffic channel is required for the data service, a full-rate traffic channel will be used for the speech phase of the call. When the data phase is entered, the unused half-rate channel will be released. In the case of half-rate traffic channel speech and full rate traffic channel data, a full rate traffic channel is reserved for the whole call.

Within a GSM PLMN, the transport of user data and access interface status information (if present) will use a rate adaptation method based on CCITT Recommendation V.110. For the access interface, the rate adaptation schemes used are referenced in the GSM 07-series of Recommendations. On the

radio path, the rate adaptation leads to rates of 12.0, 6.0 and 3.6 k bit/s (see Rec. GSM 04.21). At the BS to MSC interface, the rate adaptation scheme used is described in Recommendation GSM 08.20.

Protection of information from errors on the radio path (i.e. between MS and BSS) will be implemented by use of FEC techniques (see Rec. GSM 05.03).

2.2. Transparent and non-transparent lower layer capabilities

Two classes of low layer capabilities have been identified (see Rec. GSM 02.02 and GSM 02.03):

- a transparent class which is characterized by constant throughput, constant transit delay and variable error rate.
- a non-transparent class for which an ARQ technique is used (see Rec. GSM 04.22) on the radio path and extended to an appropriate interworking function. This class is characterized by improved error rate with variable transit delay and throughput.

The considerations described above provide the basis for the definition of a limited set of connection types to be implemented by a GSM PLMN.

3. FRAMEWORK FOR THE DESCRIPTION OF CONNECTION TYPES

3.1. Introduction

A GSM PLMN provides a set of network capabilities which enable telecommunication services to be offered to a user.

A GSM PLMN connection is a connection established between GSM PLMN reference points. A GSM PLMN connection type is a way of referring to and describing a GSM PLMN connection. Thus a GSM PLMN connection is a physical or a logical realization of a GSM PLMN connection type. Each GSM PLMN connection can be characterized as belonging to a connection type.

Figure 1 illustrates the concepts (see also Figure 1 of GSM 02.01).

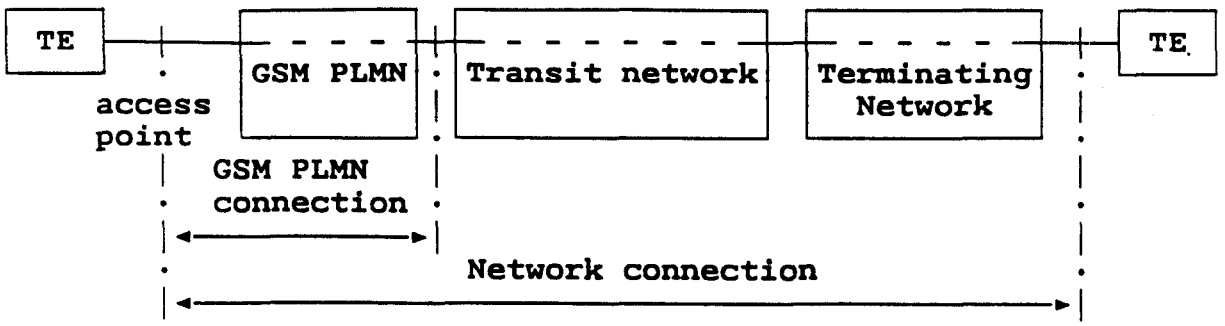


Figure 1: Framework for the description of GSM PLMN connections

3.2. Purpose of GSM PLMN connection types

The definition of a set of GSM PLMN connection types provides the necessary input to identify the network capabilities of a GSM PLMN. Other key requirements of a GSM PLMN are contained in other GSM Recommendations, in particular 03.01, 04.01 and 04.02. In addition to describing network capabilities of a GSM PLMN, the identification of connection types facilitates 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 while the GSM PLMN 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 2).

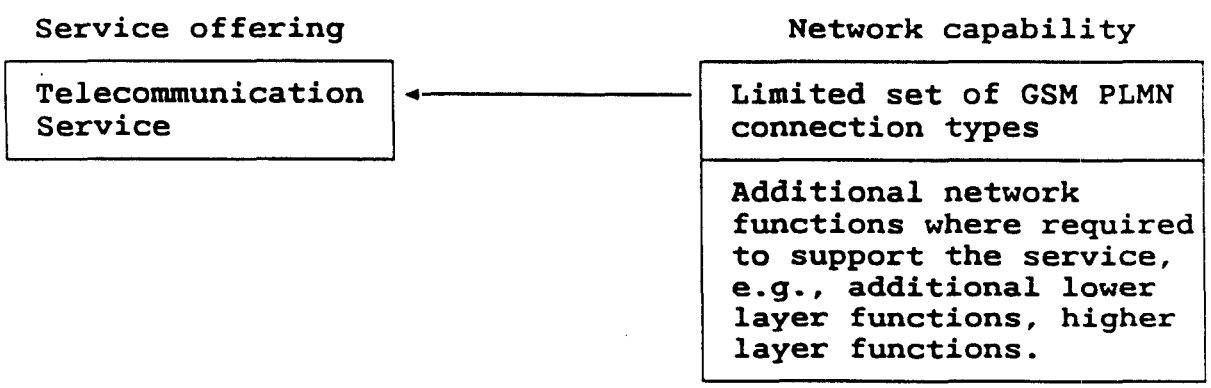


Figure 2: The role of network capabilities in supporting service offerings

3.3. Functions associated with a GSM PLMN connection

Any GSM PLMN connection involves an association of functions to support telecommunication services as shown in Figure 3. Three sets of functions are required.

i) Connection means - including transmission and switching.

ii) Control functions and protocols - including signalling, flow/congestion control and routing functions.

iii) Operations and management functions - including network management and maintenance functions.

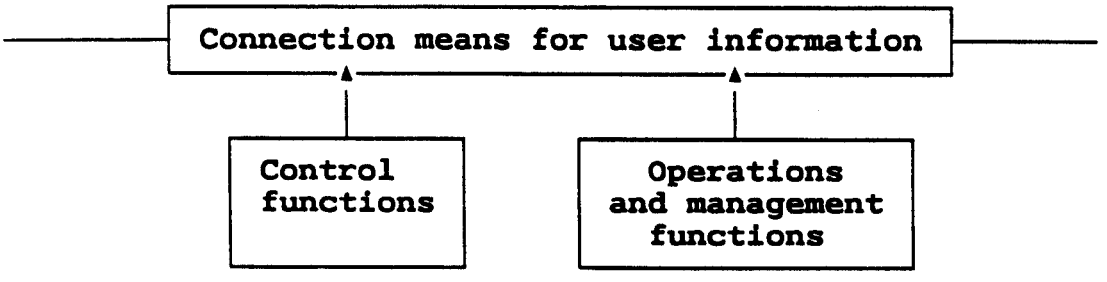


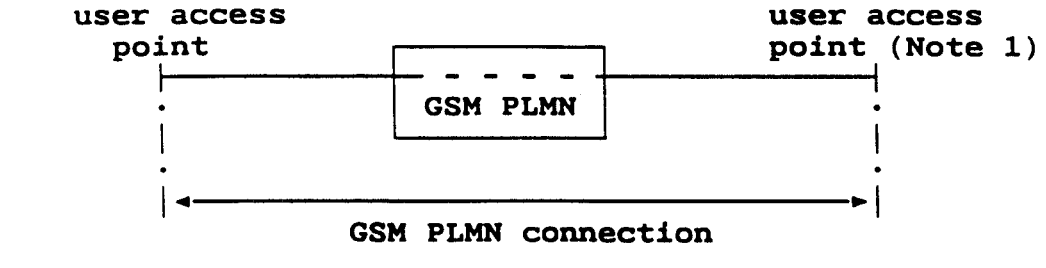
Figure 3: Functional description

3.4. Applications of GSM PLMN connection types

The following situations to which GSM PLMN connection types apply (see Figure 4) may arise:

- Between two GSM PLMN user access points (refer to Rec. GSM 02.01 and 04.02): see figure 4a.
- Between a GSM PLMN user access point and a network-to-network interface: see figure 4b.
- Between a GSM PLMN user access point and an interface to a specialized resource within the GSM PLMN: see figure 4c.
- Between a GSM PLMN user access point and an interface to a specialized resource outside the GSM PLMN: see figure 4d.

a)



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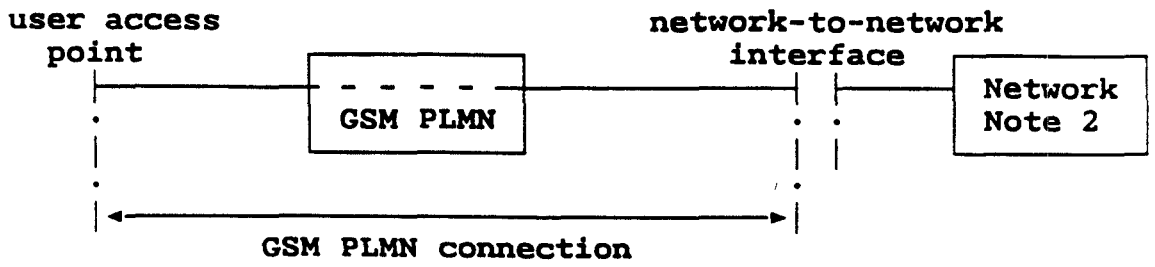

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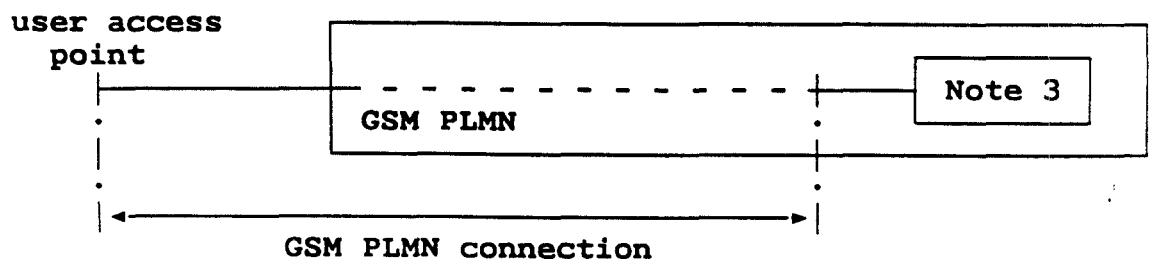

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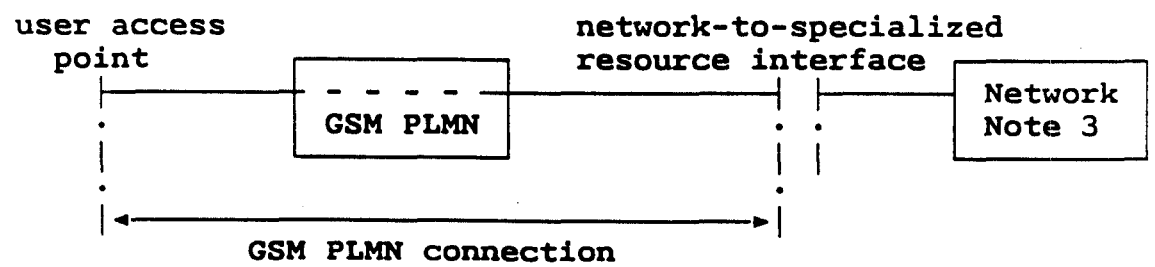


Note 1: See Rec. GSM 02.01.
Note 2: Network means here any fixed network as described in Rec. GSM 02.01.
Note 3: The box represents a specialized resource. Its use originates from a service request. Further study is required to give some examples.

Figure 4: Applications of GSM PLMN connection types

3.5. GSM PLMN connection involving several networks

A GSM PLMN connection may comprise a number of tandem network connections. Figure 5 shows an example in which each end network is a GSM PLMN. The intermediate network(s) must offer the appropriate network capabilities for the service provided by the (overall) GSM PLMN connection. In (overall) GSM PLMN connections involving several networks, each network provides a part of the connection and may be categorized by different attribute values.

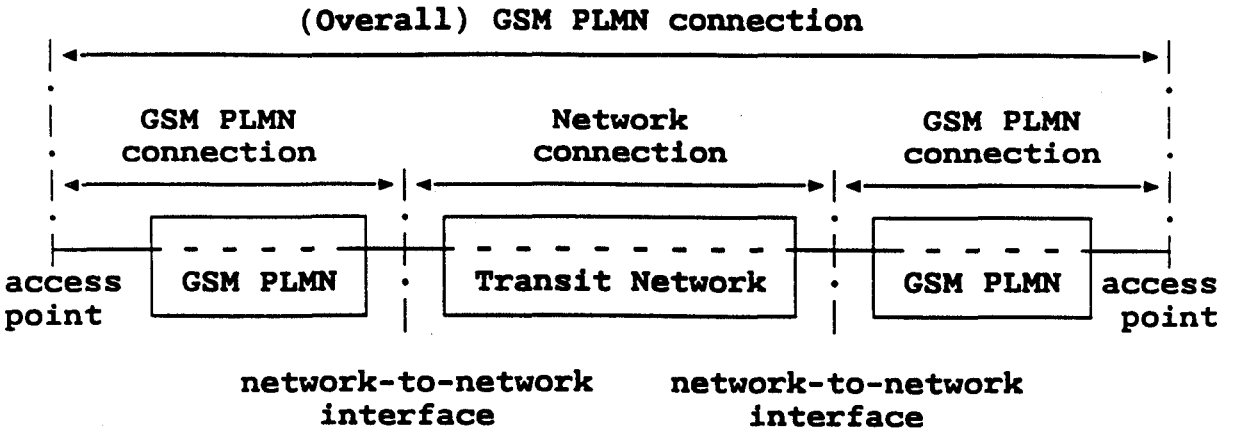


Figure 5: Example of a GSM PLMN connection involving several networks

4. GSM PLMN CONNECTION TYPES

4.1. Description of GSM PLMN connection types

The characterization of GSM PLMN connection types is done by using a set of attributes. A GSM PLMN connection type attribute is a specific characteristic of a GSM PLMN connection type whose values distinguish it from another GSM PLMN connection type. Particular values are assigned to each attribute when a given GSM PLMN connection type is described and specified.

A list of definitions of attributes and values is contained in the Annex to this recommendation.

A GSM PLMN connection type is partitioned into connection elements. This partitioning is based on the two most critical transitions of a connection, firstly, the change of signalling system, secondly, the type of transmission system. In a GSM PLMN, the change in signalling and transmission between the radio interface and the BSS-MSC interface leads to two connection elements, the radio interface connection element and the BSS-MSC connection element. Section 4.3 describes the relationship between the attributes values of connection elements and connection types.

To complete the description of GSM PLMN connection types, the definition of functions within the different entities of a GSM PLMN which are involved in the realization of a GSM PLMN Connection is needed. These functions will be used in section 4.4 to describe the limited set of GSM PLMN connection types.

The following functions have been identified:

- Rate adaptation functions
- The radio link protocol function
- The forward error correction function
- The Layer 2 relay function.

4.1.1. Rate adaptation

The RA0 rate adaptation is only used with asynchronous interfaces. Incoming asynchronous data is padded by the addition of stop elements to fit the nearest channel defined by (2 to the power n) times 600 bit/s. Thus both 75 and 300 bit/s user data signalling rate shall be adapted to a synchronous 600 bit/s stream. This function is described in Rec. GSM 04.21.

The adaptation to intermediate rate function (RA1) is a rate adaptation function which takes either the output of an RA0 function or synchronous user data, and produces an output stream at 8 or 16 kbit/s by bit repetition and frame addition. This function is described in Rec. GSM 04.21.

The adaptation of intermediate rates to 64 kbit/s (RA2) performs the final conversion from the intermediate rates generated by an RA1 function to 64 kbit/s.

The radio interface intermediate rate adaptation function (RA1') is in the case of transparent data transmission a variant of the RA1 function which adapts the user data rate or the output of the RA0 function to one of the following data rates: 3.6, 6.0 or 12.0 kbit/s over the radio path. For the non-transparent case, the RA1' function provides direct access to the 12.0 or 6.0 kbit/s data rates by allowing the V.110 frame status bits to be used as additional data bits. This function is described in Recommendation GSM 04.21 and 08.20.

The rate adaptation functions for the various user data rates are summarized in Tables 1 to 3.

R I/F	RA0		RA1'	Radio I/F
async	◄——►	sync		
≤ 2.4	◄——►	≤ 2.4	◄——►	3.6
4.8	◄——►	4.8	◄——►	6.0
9.6	◄——►	9.6	◄——►	12.0

Note: In the case of synchronous data transmission, the RA0 is not present.

Table 1: Rate adaptation functions for the support of TE2 in the transparent case.

RA0		RA1		RA2	S I/F	RA2		RA1/RA1'	Radio I/F
async	◄——►	sync							
≤2.4	◄——►	≤2.4	◄——► 8	◄——►	64	◄——►	8	◄——►	3.6
4.8	◄——►	4.8	◄——► 8	◄——►	64	◄——►	8	◄——►	6.0
9.6	◄——►	9.6	◄——► 16	◄——►	64	◄——►	16	◄——►	12.0

Note: In the case of synchronous data transmission, the RA0 is not present.

Table 2: Rate adaptation functions for the support of TE1/TA in the transparent case.

RA1'		RA1'
6.0	◄——————►	6.0
12.0	◄——————►	12.0

Table 3: RA1' function in the non-transparent case.

4.1.2. Radio Link Protocol

The Radio Link Protocol function (RLP) performs grouping of user data for the purpose of implementing error control and retransmission mechanisms in the case of non-transparent low layer capabilities. This function is described in Recommendations GSM 04.22.

4.1.3. Layer 2 Relay function

The Layer 2 Relay function (L2R) performs protocol conversion between the user data structure (e.g. characters or X.25 Layer 2 frames) and a structure more adapted to the radio link protocol. This function is described in the relevant GSM 07-series recommendations.

4.2. GSM PLMN connection elements

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

The BSS-MSC connection element is the portion of the connection from the above internal reference point within the base station to an appropriate internal reference point within the interworking function (IWF) of the MSC.

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.

4.3. Rules of association for the attribute values of connection elements and connection types

This section describes the relationship between the attribute values of connection elements and connection types. For each attribute the various possible values recommended are listed. The definitions of the attributes and attribute values are contained in the annex. 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.

4.3.1. Information transfer mode

Attribute values for connection elements:

Circuit or Packet

Attribute values for overall connection type:

Circuit or Packet

Association Law:

Due to the nature of current packet systems the use of packet mode in any connection element would make the overall connection type packet.

4.3.2. Information transfer rate (kbit/s)

Attribute values for connection elements:

3.6 or 6.0 or 12.0 or 13.0 or 64

Attribute values for overall connection type:

3.6 or 6.0 or 12.0 or 13.0 or 64

Association Law:

The value for the overall connection type will be equal to the lowest value of any of its connection elements.

4.3.3. Information transfer susceptance

Attribute values for connection elements:

Speech processing functions (e.g. GSM Speech Coding/A Law conversion, Discontinuous Transmission) and/or Echo suppression functions and/or Multiple satellite hops or null.

Attribute values for overall connection types:

Unrestricted Digital Information or Speech

Association Law:

For an overall connection type to have the value Unrestricted digital no connection element may contain speech processing functions or echo suppression functions. Connection elements containing speech processing devices having the flexibility to change operation between speech and unrestricted digital would on the other hand be allowed to be part of a number of different connection types.

For an overall connection type to have the value speech it must contain GSM Speech Coding/A Law conversion equipment and echo suppression functions when appropriate.

4.3.4. Establishment of connection

Attribute values for connection elements:

Switched

Attribute values for overall connection type:

Switched

Association Law:

If any of the connection elements are Switched, then the overall connection type is Switched.

4.3.5. Symmetry

Attribute values for connection elements:

Bidirectional Symmetric

Attribute values for overall connection type:

Bidirectional 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.

4.3.6. Connection configuration

Topology

Attribute values for connection elements:

Point to point

Attribute values for the overall connection type:

Not applicable

Association Law:

Not applicable

4.3.7. Structure

Attribute values for connection elements:

Layer 1: 8 kHz Integrity or Unstructured
Layer 2: Service Data Integrity or Unstructured
Layer 3: Service Data Integrity or Unstructured

Attribute values for the overall connection type:

As per values for connection elements.

Association Law:

For further study.

4.3.8. Channels

4.3.8.1. Information channel (rate)

Attribute values for connection elements:

Radio interface connection element:	Full-rate TCh or Half-rate TCh
BSS-MSC connection element:	64 kbit/s

Attribute values for the overall connection type:

Not applicable

4.3.8.2. Signalling channel (rate)

Attribute values for connection elements:

Radio interface connection element: Dm
BSS-MSC connection element: Common channel signalling system (64 kbit/s)

Attribute values for the overall connection type:

Not applicable

4.3.9. Connection control protocol

Attribute values for connection elements:

Radio interface connection element:
Layer 1: GSM 04.03 and GSM 05-series
Layer 2: GSM 04.05 and 04.06
Layer 3: GSM 04.07 and 04.08

BSS-MSC connection element:
Layer 1: GSM 08.04
Layer 2: GSM 08.06
Layer 3: GSM 04.07, 04.08 and 08.08

Attribute values for the overall connection type:

Not applicable

4.3.10. Information transfer coding/protocol

Attribute values for connection elements:

Radio interface connection elements:
Layer 1: GSM 04.21, GSM 05-series and 06-series
Layer 2: GSM 04.22 and GSM 07.02 or
GSM 04.22 and GSM 07.03 or transparent
Layer 3: Transparent

BSS-MSC connection element:
Layer 1: GSM 08.04 and GSM 08.20
Layer 2: GSM 04.22 and GSM 07.02 or
GSM 04.22 and GSM 07.03 or transparent
Layer 3: Transparent

Attribute values for the overall connection type:

Not applicable

4.3.12. Further attributes and attribute values

This section has outlined the relationships between those attributes values presently existing, the possibility for new values being added remains.

Table 4 summarizes the attributes values for GSM PLMN connection elements.

Attributes	Values for attributes	
	Radio interface connection element	BSS-MSC connection element
1 Information Transfer Mode	Circuit	Circuit
2 Information Transfer Rate Layer 1 Layer 2 Layer 3	 3.6 or 6.0 or 12.0 or 13. Throughput options for further study. Throughput options for further study.	 64 Throughput options for further study. Throughput options for further study.
3 Information Transfer Susceptance	Speech processing equipment, Echo supression equipment, Null	Speech processing equipment, Echo suppression equipment, Null
4 Establishment of Connection	Switched	Switched
5 Symmetry	Bidirectional symmetric	Bidirectional symmetric
6 Connection Configuration Topology	Point to point	Point to point
7 Structure Layer 1 Layer 2 Layer 3	 Unstructured SDU integrity, Unstructured SDU integrity, Unstructured	 8 kHz integrity, Unstructured SDU integrity, Unstructured SDU integrity, Unstructured

Table 4: So far identified values for attributes for GSM PLMN connection elements

8 Channel Rate		
Information Channel	TCh fullrate or halfrate	64
Signalling Channel	Dm	Common channel signalling system
9 Connection Control Protocol		
Layer 1	GSM 04.03 and 05-series	GSM 08.04
Layer 2	GSM 04.05 and 04.06	GSM 08.06
Layer 3	GSM 04.07 and 04.08	GSM 04.07, 04.08 and 08.08
10 Information Transfer Coding/Protocol		
Layer 1	GSM 04.21, 05- and 06-series	GSM 08.04 and 08.20
Layer 2	GSM 04.22 and 07.02 or 04.22 and 07.03 or transparent	GSM 04.22 and 07.02 or 04.22 and 07.03 or transparent
Layer 3	Transparent	Transparent

Table 4 cont'd: So far identified values for attributes for GSM PLMN connection elements

4.4. Limited set of GSM PLMN connection types

From the two connection elements defined in section 4.2, the list of attributes and their possible values given in section 4.3, and from the service requirements defined in recommendations GSM 02.02 and 02.03, a limited set of GSM PLMN connection types have been identified (see also Table 5 and Table 6 for the relationship between connection elements and telecommunication services).

Figure 6 gives the information transfer protocol models for the identified set of GSM PLMN connection types.

Protocol Model 1 is the model for asynchronous data transmission in the transparent mode.

Protocol Model 2 is the model for synchronous data transmission in the transparent mode.

Protocol Model 3 is the model for asynchronous IA5 character mode data transmission in the non-transparent mode. In this case, L2RCOP represents the protocol used between the Layer 2 Relay functions (L2R) to convey IA5 characters between the MS and the IWF (see GSM 07.02).

Protocol Model 4 is the model for synchronous data transmission using the CCITT Recommendation X.25 PSPDN access protocol in the non-transparent mode. In this case, L2RBOP represents the protocol used between the Layer 2 Relay functions (L2R) to convey the LAP B information between the MS and the IWF (see GSM 07.03).

In all the above models, the a and b variants indicate alternative access arrangements at the MS, i.e. access at the S interface or at the R interface. The c variant indicates a further alternative access arrangement where rate adaptation at the S interface is performed by flag stuffing as defined in CCITT Recommendation X.31.

Protocol Model 5 is the model for the transparent support of group 3 facsimile transmission.

Protocol Model 6 is the model for speech transmission. As in models 1-4, the a and b variants indicate alternative access arrangements at the MS, i.e. access at the S interface or direct access of the telephony teleservice.

Protocol model 7 is the model for the non-transparent support of group 3 facsimile transmission.

For all the models, only the minimum functionality of the IWF is shown. Additional functions will be required for various interworking situations. These additional functions are described in Recommendation GSM 09.04, GSM 09.05, GSM 09.06 and GSM 09.07.

It should be noted that, in Figure 6, the representation of the transcoding and rate adaptation from the intermediate rate on the radio interface to the 64 kbit/s rate required by the MSC is not intended to indicate a particular implementation. The Appendix to Rec. GSM 03.10 identifies alternative arrangements.

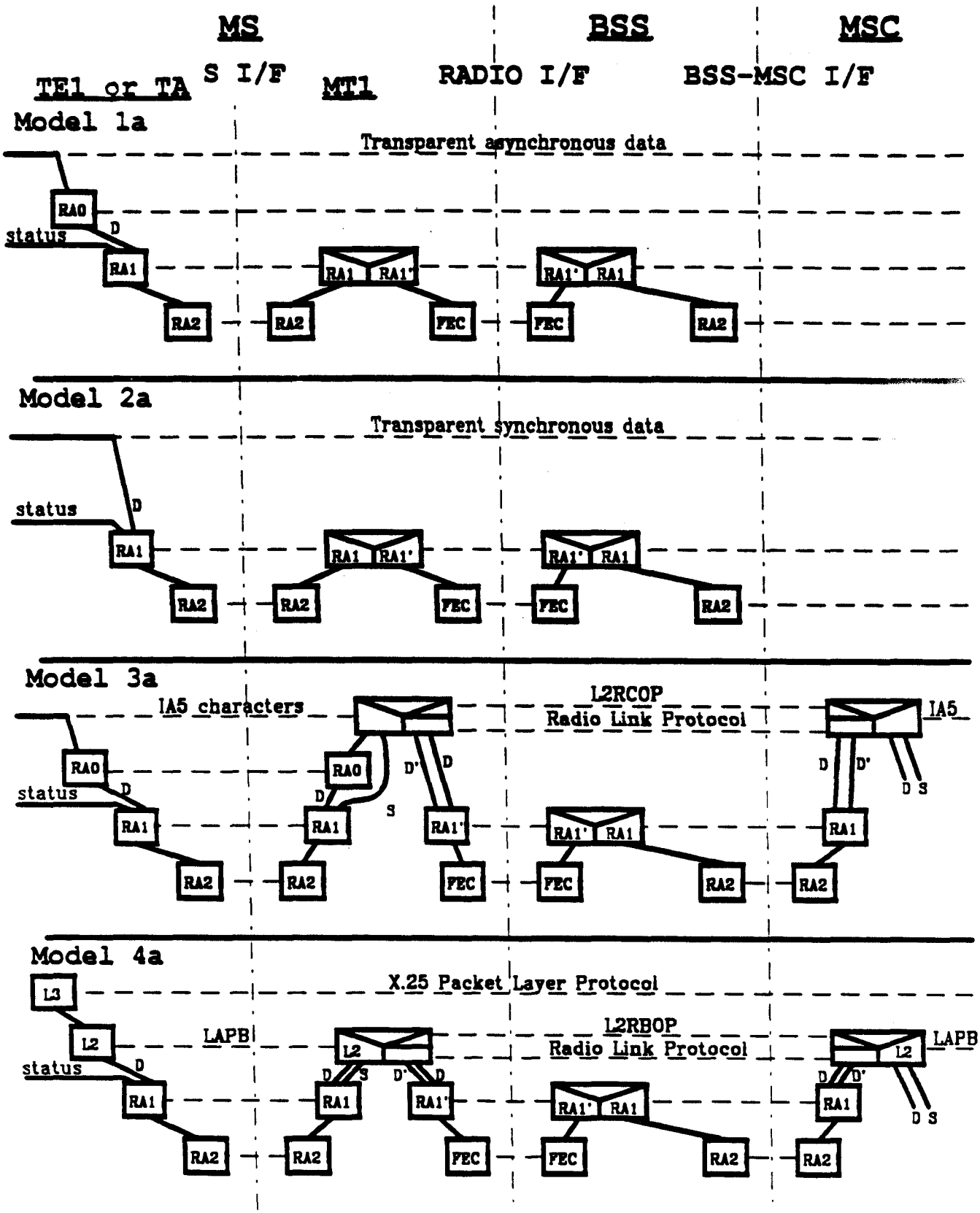


Figure 6: Information transfer protocol models for GSM PLMN connections

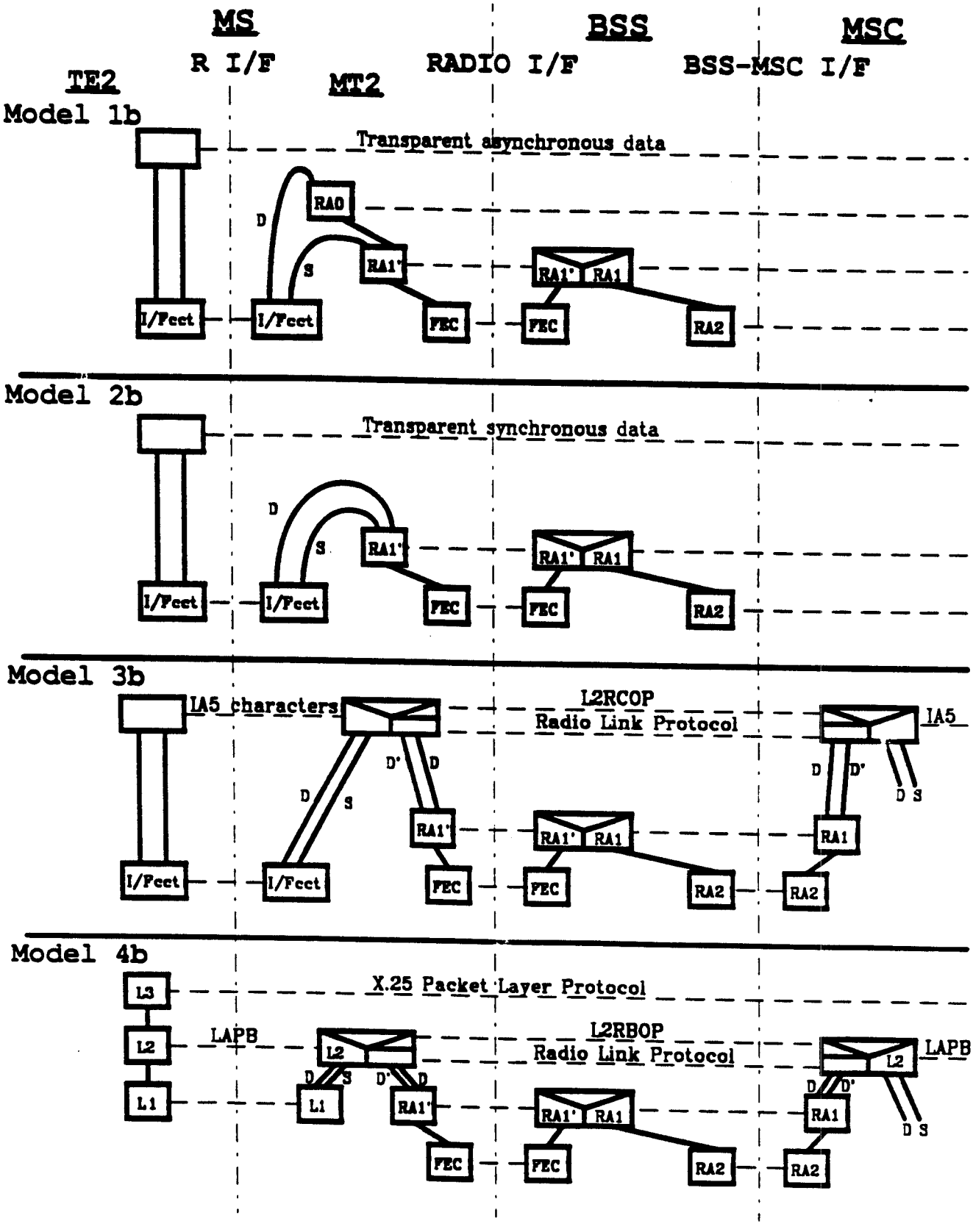
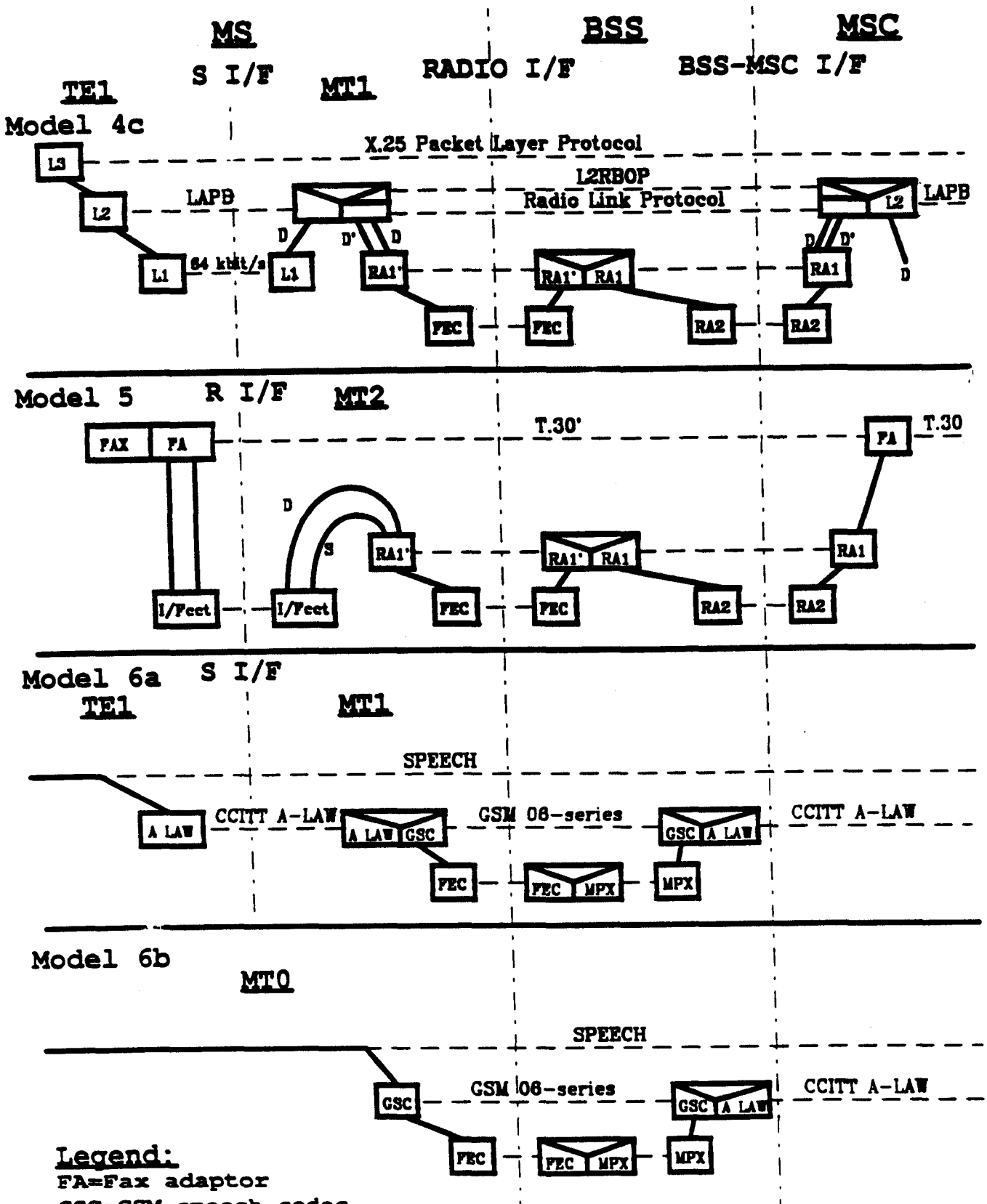


Figure 6 cont'd



Legend:
FA=Fax adaptor
GSC=GSM speech codec
FEC=Forward error correction
MPX=Multiplex/demultiplex

Figure 6 cont'd

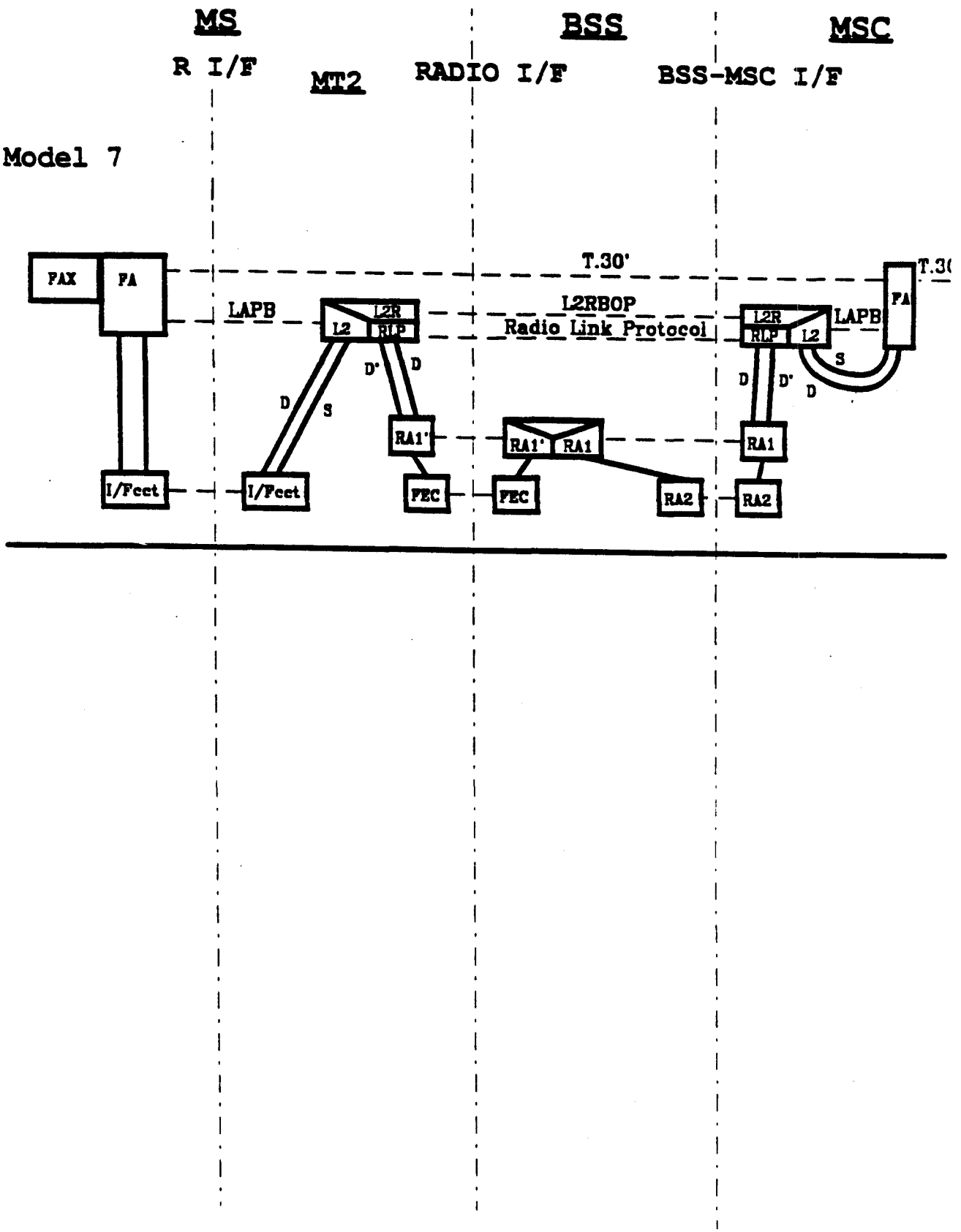


Figure 6 cont'd

5. RELATIONSHIP BETWEEN TELECOMMUNICATION SERVICES AND CONNECTION TYPES

5.1. General

Given a request for a telecommunication service at the initiation of a call, the GSM PLMN must establish a connection of a connection type that supports the attributes of the service requested. This establishment of a connection is effected at the time of call set up.

It should be noted that GSM PLMN connection types represent the technical capabilities of a GSM PLMN and provide a basis for the definition of performance and interworking with other networks. Telecommunication services supported by a GSM PLMN are The packages offered to customers and the definition of their attributes is the means to standardize the service offerings in all GSM PLMNs.

Quality of service and commercial attributes are relevant to telecommunication services whereas connection types are characterized by network performance, network operations and maintenance attributes.

5.2. Relationship between Bearer services and connection types

Table 5 shows the relationship between Bearer services and GSM PLMN connection types. In table 5, 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 traffic channel used is also shown (half rate and full rate).

5.3. Relationship between Teleservices and connection types

Table 6 shows the relationship between teleservices and connection typeselements. As in Table 5 / GSM 03.10, dominant attributes of the connection elements and the type of radio traffic channel are shown.

5.4. Network capability to support in-call modification

Recommendations GSM 02.02 and 02.03 identify a particular need for a GSM PLMN to support the Alternate speech/unrestricted digital, Alternate speech and group 3 facsimile, and Speech followed by unrestricted digital services.

These services allow the of in-call modification of the mode of service when required. The network capability to support in-call modification is described in GSM 04.08. An in-call modification of the service mode is not possible for other services.

5.5. Network capability to support channel mode modification

Recommendation GSM 03.45 (Technical Realization of the Group 3 Facsimile Teleservice) identifies a need for a GSM PLMN to support channel mode modification within the facsimile phase of the alternate speech and facsimile group 3 service. The network capability to support channel modification is described in GSM 04.08. Channel mode modification is not possible for other services. A channel mode modification results in a change of connection element over the radio interface with resultant change in access at the mobile station.

TABLE 5: Relationship between Bearer services and GSM PLMN connection elements

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Circuit mode unstructured with unrestricted digital capability transparent	Data circuit duplex async 9600 bit/s Data circuit duplex sync 9600 bit/s	cct mode unstructured unrestricted 12 kbit/s on full rate channel	16 kbit/s	cct mode unstructured unrestricted 64 kbit/s	1 2
	12 kbit/s digital unrestricted	FS	FS	FS	FS
Circuit mode unstructured with unrestricted digital capability non transparent	Data circuit duplex async 9600 bit/s	cct mode unstructured unrestricted 12 kbit/s on full rate channel	16 kbit/s	cct mode unstructured unrestricted 64 kbit/s	3
Circuit mode unstructured with unrestricted digital capability transparent	Data circuit duplex async 4800 bit/s Data circuit duplex sync 4800 bit/s	cct mode unstructured unrestricted 6 kbit/s on full rate channel and half rate channel	8 kbit/s	cct mode unstructured unrestricted 64 kbit/s	1 2
Circuit mode unstructured with unrestricted digital capability non transparent	Data circuit duplex async 4800 bit/s	cct mode unstructured unrestricted full rate channel, 12 kbit/s or half rate channel, 6 kbit/s	16 kbit/s FR 8 kbit/s HR	cct mode unstructured unrestricted 64 kbit/s	3
Circuit mode unstructured with unrestricted digital capability transparent	Data circuit duplex async 300 Data circuit duplex async 1200 Data circuit duplex async 1200/75 Data circuit duplex async 2400 Data circuit duplex sync 1200 Data circuit duplex sync 2400	cct mode unstructured unrestricted 3.6 kbit/s on full rate channel and half rate channel	8 kbit/s	cct mode unstructured unrestricted 64 kbit/s	1 1 1 1 2 2

NA: Not Applicable FR: Full Rate channel HR: Half Rate channel

Table 5 (cont'd)

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Circuit mode unstructured with unrestricted digital capability non transparent	Data circuit duplex async 300 Data circuit duplex async 1200 Data circuit duplex async 1200/75 Data circuit duplex async 2400	cct mode unstructured unrestricted full rate channel,12 kbit/s or half rate channel, 6 kbit/s	16 kbit/s FR 8 kbit/s HR	cct mode unstructured unrestricted 64 kbit/s	3 3 3 3
3.1 kHz Ex PLMN transparent	9.6 kbit/s	cct mode unstructured unrestricted 12 kbit/s full rate channel	16 kbit/s	cct mode unstructured unrestricted 64 kbit/s	1 or 2
	4.8 kbit/s	cct mode unstructured unrestricted 6 kbit/s full and half rate channel	8 kbit/s		
	≤2.4 kbit/s	cct mode unstructured unrestricted 3.6 kbit/s full and half rate channel			
3.1 kHz Ex PLMN non transparent	9.6 kbit/s	cct mode unstructured unrestricted 12 kbit/s full rate channel	16 kbit/s	cct mode unstructured unrestricted 64 kbit/s	3 or 4
	4.8 kbit/s	cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel,12 kbit/s	16 kbit/s FR 8 kbit/s HR		
	≤2.4 kbit/s	cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel,12 kbit/s			

Table 5 (cont'd)

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
PAD services transparent	PAD access circuit async 300 PAD access circuit async 1200 PAD access circuit async 1200/75 PAD access circuit async 2400	cct mode unstructured unrestricted 3.6 kbit/s on full rate channel and half rate channel	8 kbit/s	cct mode unstructured unrestricted 64 kbit/s	1 1 1 1
	PAD access circuit async 4800	cct mode unstructured unrestricted 6 kbit/s on half rate channel and full rate channel			1
	PAD access circuit async 9600	cct mode unstructured unrestricted 12 kbit/s on full rate channel	16 kbit/s		1
PAD services non transparent	PAD access circuit async 300 PAD access circuit async 1200 PAD access circuit async 1200/75 PAD access circuit async 2400	cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel,12 kbit/s	16 kbit/s FR 8 kbit/s HR	cct mode unstructured unrestricted 64 kbit/s	3 3 3 3
	PAD access circuit async 4800	cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel,12 kbit/s			3
	PAD access circuit async 9600	cct mode unstructured unrestricted 12 kbit/s on full rate channel	16 kbit/s		3

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Packet services transparent	Data packet duplex sync 2400	cct mode unstructured unrestricted 3.6 kbit/s on half rate channel and full rate channel	8 kbit/s	cct mode unstructured unrestricted 64 kbit/s	2
	Data packet duplex sync 4800	cct mode unstructured unrestricted 6 kbit/s on half rate channel and full rate channel			2
	Data packet duplex sync 9600	cct mode unstructured unrestricted 12 kbit/s on full rate channel	16 kbit/s		2
Packet services non transparent	Data packet duplex sync 2400	cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel,12 kbit/s	16 kbit/s FR 8 kbit/s HR	cct mode unstructured unrestricted 64 kbit/s	4
	Data packet duplex sync 4800	cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel,12 kbit/s			4
	Data packet duplex sync 9600	cct mode unstructured unrestricted 12 kbit/s on full rate channel	16 kbit/s		4

Table 5 (cont'd)

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Circuit mode unstructured with alternate speech and unrestricted digital transparent 9.6 kbit/s user data rate	Alternate speech and data duplex async 9600	cct mode speech alternating with cct mode unstructured unrestricted 12 kbit/s on full rate channel	Speech NA 16 kbit/s	cct mode alternate speech and unstructured unrestricted 64 kbit/s	6 and 1
	Alternate speech and data duplex sync 9600				6 and 2
Circuit mode unstructured with alternate speech and unrestricted digital non transparent 9.6 kbit/s user data rate	Alternate speech and data duplex async 9600	cct mode speech alternating with cct mode unstructured unrestricted 12 kbit/s on full rate channel	Speech NA 16 kbit/s	cct mode alternate speech and unstructured unrestricted 64 kbit/s	6 and 3
Circuit mode unstructured with alternate speech and unrestricted digital transparent 4.8 kbit/s user data rate	Alternate speech and data duplex async 4800	cct mode speech alternating with cct mode unstructured unrestricted 6 kbit/s on full rate channel or half rate channel	Speech NA 8 kbit/s	cct mode alternate speech and unstructured unrestricted 64 kbit/s	6 and 1
	Alternate speech and data duplex sync 4800				6 and 2
Circuit mode unstructured with alternate speech and unrestricted digital non transparent 4.8 kbit/s user data rate	Alternate speech and data duplex async 4800	cct mode speech alternating with cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel,12 kbit/s	Speech NA 16 kbit/s FR 8 kbit/s HR	cct mode alternate speech and unstructured unrestricted 64 kbit/s	6 and 3

Table 5 (cont'd)

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Circuit mode unstructured with alternate speech and unrestricted digital non transparent ≤2.4 kbit/s user data rate	Alternate speech and data duplex async ≤2400	cct mode speech alternating with cct mode unstructured unrestricted full rate channel,12 kbit/s or half rate channel, 6 kbit/s	Speech NA 16 kbit/s FR 8 kbit/s HR	cct mode alternate speech and unstructured unrestricted 64 kbit/s	6 and 3
Circuit mode unstructured with alternate speech and unrestricted digital transparent ≤2.4 kbit/s user data rate	Alternate speech and data duplex async ≤2400	cct mode speech alternating with cct mode unstructured unrestricted 3.6 kbit/s on full rate channel or half rate channel	Speech NA 8 kbit/s	cct mode alternate speech and unstructured unrestricted 64 kbit/s	6 and 3
	Alternate speech and data duplex sync ≤2400				6 and 4

Table 5 (cont'd)

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Circuit mode unstructured with speech followed by unrestricted digital transparent	Speech followed by 9.6 kbit/s data duplex async	cct mode speech followed by cct mode unstructured unrestricted 12 kbit/s on full rate channel	Speech NA 16 kbit/s	cct mode speech followed by cct mode unstructured unrestricted 64 kbit/s	6b then 1b
	Speech followed by 9.6 kbit/s data duplex sync				6b then 2b
Circuit mode unstructured with speech followed by unrestricted digital non transparent	Speech followed by 9.6 kbit/s data duplex async	cct mode speech followed by cct mode unstructured unrestricted 6 kbit/s on full and half rate channel	Speech NA 16 kbit/s	cct mode speech followed by cct mode unstructured unrestricted 64 kbit/s	6b then 3b
Circuit mode unstructured with speech followed by unrestricted digital transparent	Speech followed by 4.8 kbit/s data duplex async	cct mode speech followed by cct mode unstructured unrestricted 6 kbit/s on full and half rate channel	Speech NA 8 kbit/s	cct mode speech followed by cct mode unstructured unrestricted 64 kbit/s	6b then 1b
	Speech followed by 4.8 kbit/s data duplex sync				6b then 2b
Circuit mode unstructured with speech followed by unrestricted digital non transparent	Speech followed by 4.8 kbit/s data duplex async	cct mode speech followed by cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel, 12 kbit/s	Speech NA 8 kbit/s HR 16 kbit/s FR	cct mode speech followed by cct mode unstructured unrestricted 64 kbit/s	6b then 3b

Table 5 (cont'd)

Table 5 (cont'd)

Bearer service category	Bearer service user data rate	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Circuit mode unstructured with speech followed by unrestricted digital transparent	Speech followed by ≤2.4 kbit/s data duplex async	cct mode speech followed by cct mode unstructured unrestricted 3.6 kbit/s on full and half rate channel	Speech NA 8 kbit/s	cct mode speech followed by cct mode unstructured unrestricted 64 kbit/s	6b then 1b
	Speech followed by ≤2.4 kbit/s data duplex sync				6b then 2b
Circuit mode unstructured with speech followed by unrestricted digital non transparent	Speech followed by ≤2.4 kbit/s data duplex async	cct mode speech followed by cct mode unstructured unrestricted half rate channel, 6 kbit/s or full rate channel, 12 kbit/s	Speech NA 8 kbit/s HR 16 kbit/s FR	cct mode speech followed by cct mode unstructured unrestricted 64 kbit/s	6b then 3b

Teleservice in GSM PLMN	Access at Mobile station	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Telephony		cct mode speech	NA	cct mode structured 64 kbit/s speech	6
Emergency calls		cct mode speech	NA	cct mode structured 64 kbit/s speech	6
Advanced MHS Access 2.4 kbit/s	Data packet duplex synchronous 2.4 kbit/s	cct mode service data unit integrity unrestricted 3.6 kbit/s HR, FR transparent	8 kbit/s	cct mode service data unit integrity 64 kbit/s unrestricted	2
Advanced MHS Access 4.8 kbit/s	Data packet duplex synchronous 4.8 kbit/s	cct mode service data unit integrity unrestricted 6 kbit/s HR, FR transparent	8 kbit/s	cct mode service data unit integrity 64 kbit/s unrestricted	2
Advanced MHS Access 9.6 kbit/s	Data packet duplex synchronous 9.6 kbit/s	cct mode service data unit integrity unrestricted 12 kbit/s FR transparent	16 kbit/s	cct mode service data unit integrity 64 kbit/s unrestricted	2
Videotex access profile 1	Data cct duplex asynchronous access 1200/75 bit/s	cct mode unstructured unrestricted 3.6 kbit/s HR, FR transparent	8 kbit/s	cct mode structured 64 kbit/s unrestricted	1
Videotex access profile 2	Data cct duplex asynchronous access 1200/75 bit/s	cct mode unstructured unrestricted 3.6 kbit/s HR, FR transparent	8 kbit/s	cct mode structured 64 kbit/s unrestricted	1

TABLE 6: Relationship between Teleservices and GSM PLMN connection types

NA: Not Applicable FR: Full Rate channel HR: Half Rate channel

Teleservice in GSM PLMN	Access at Mobile station	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Videotex access profile 3	Data cct duplex asynchronous access 1200/75 bit/s	cct mode unstructured unrestricted 3.6 kbit/s HR, FR transparent	8 kbit/s	cct mode structured 64 kbit/s unrestricted	1
Teletex	Data packet duplex synchronous access 2.4 kbit/s	cct mode service data unit integrity unrestricted 3.6 kbit/s HR, FR transparent	8 kbit/s	cct mode service data unit integrity 64 kbit/s unrestricted	2
Alternate Speech/ Facsimile Group 3	Data cct duplex synchronous access alternate speech/ group 3 fax	cct mode speech alter-nating with unstuctured unrestricted 3.6 or 6 or 12 kbit/s on FR transparent	8 kbit/s HR 16 kbit/s FR	cct mode structured 64 kbit/s alternate speech/ unrestricted	5 and 6
Advanced MHS Access 2.4 kbit/s	Data packet duplex synchronous 2.4 kbit/s	cct mode service data unit integrity unrestricted 6 kbit/s HR, 12 kbit/s FR non transparent	8 kbit/s HR 16 kbit/s FR	cct mode service data unit integrity 64 kbit/s unrestricted	4
Advanced MHS Access 4.8 kbit/s	Data packet duplex synchronous 4.8 kbit/s	cct mode service data unit integrity unrestricted 6 kbit/s HR, 12 kbit/s FR non transparent	8 kbit/s HR 16 kbit/s FR	cct mode service data unit integrity 64 kbit/s unrestricted	4
Advanced MHS Access 9.6 kbit/s	Data packet duplex synchronous 9.6 kbit/s	cct mode service data unit integrity unrestricted 12 kbit/s FR non transparent	16 kbit/s	cct mode service data unit integrity 64 kbit/s unrestricted	4
Videotex access profile 1	Data cct duplex asynchronous access 1200/75 bit/s	cct mode unstructured unrestricted 6 kbit/s HR, 12 kbit/s FR non transparent	8 kbit/s HR 16 kbit/s FR	cct mode structured 64 kbit/s unrestricted	3

TABLE 6 (cont'd): Relationship between Teleservices and GSM PLMN connection types

NA: Not Applicable FR: Full Rate channel HR: Half Rate channel

Teleservice in GSM PLMN	Access at Mobile station	Radio interface connection element	Intermediate rate RA1 to RA2 at the BSS-MSC interface	BSS-MSC connection element	Protocol model in fig. 6
Videotex access profile 2	Data cct duplex asynchronous access 1200/75 bit/s	cct mode unstructured unrestricted 6 kbit/s HR, 12 kbit/s FR non transparent	8 kbit/s HR 16 kbit/s FR	cct mode structured 64 kbit/s unrestricted	3
Videotex access profile 3	Data cct duplex asynchronous access 1200/75 bit/s	cct mode unstructured unrestricted 6 kbit/s HR, 12 kbit/s FR non transparent	8 kbit/s HR 16 kbit/s FR	cct mode structured 64 kbit/s unrestricted	3
Teletex	Data packet duplex synchronous access 2.4 kbit/s	cct mode service data unit integrity unrestricted 6 kbit/s HR, 12 kbit/s FR non transparent	8 kbit/s HR 16 kbit/s FR	cct mode service data unit integrity 64 kbit/s unrestricted	2
Alternate Speech/ Facsimile Group 3	Data cct duplex synchronous access alternate speech/ group 3 fax	cct mode speech alter-nating with unstuctured unrestricted 6 or 12 kbit/s on FR non transparent	speech NA 8 kbit/s HR 16 kbit/s FR	cct mode structured 64 kbit/s alternate speech/ unrestricted	6 and 7

<u>TABLE 6</u> (cont'd): Relationship between Teleservices and GSM PLMN connection types

NA: Not Applicable FR: Full Rate channel HR: Half Rate channel

ANNEX TO REC. GSM 03.10

LIST OF DEFINITIONS OF GSM PLMN CONNECTION TYPE ATTRIBUTES AND VALUES

1.. Attribute definition and their values

Information transfer mode:

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

Values: - Circuit
- Packet

Information transfer capability:

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

Values: - Unrestricted digital information
- Speech
- Alternate speech/unrestricted digital

Information transfer rate:

This attribute describes either the bit rate (circuit mode) or the throughput (packet mode, for further study). It refers to the transfer of digital information on a GSM PLMN connection.

Values: - Appropriate bit rate
- Throughput rate

Establishment of connection:

This attribute describes the mode of establishment used to establish and release GSM PLMN connections.

Values: - Switched

Symmetry:

This attribute describes the relationship of information flow between two (or more) access points or reference points involved in a GSM PLMN connection.

Values: - Bidirectional symmetric

Connection configuration:

This attribute describes the spatial arrangement for transferring information on a given GSM PLMN connection.

Values: - Point-to-point

Structure:

This attribute refers to the capability of a GSM PLMN 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: - 8 kHz integrity
- Service data unit integrity
- Unstructured

Channel rate:

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

Values: - Name of channel (designation) and/or the corresponding bit rate

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

Connection control protocol, information transfer coding/protocol (layer 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.

2. Definition of values

Unrestricted digital data information:

Transfer of information sequence of bits at its specified bit rate without alteration.

This implies: - bit sequence independence
- digit sequence integrity
- bit integrity.

Speech:

Digital representation of speech coded according to a specified encoding rule (e.g. A Law, GSM 06-series)

Switched connection:

A GSM PLMN circuit switched connection is set up at any time on demand via a digital channel in response to signalling information received from subscriber, other MSCs or other networks, i.e. on a per call basis.

Bidirectional symmetric:

This value applies when the information flow characteristics provided by the GSM PLMN 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 only two end points are provided by the connection.

Multipoint connection:

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

8 kHz integrity:

This value applies when:

i) at each user-network interface, intervals of 125 us are implicitly or explicitly demarcated and

ii) all bits submitted within a single demarcated 125 us interval are delivered within a corresponding single demarcated 125 us interval.

Service data unit integrity:

This value applies when:

i) at each user-network interface, protocols provide a mechanism for identifying the boundaries of service data units (e.g. X.25 complete packet sequence) and

ii) all bits submitted within a single service data unit are delivered in a corresponding service data unit.

Unstructured:

This value is applicable when the GSM PLMN connection neither provides structural boundaries nor preserves structural integrity.

APPENDIX TO REC. GSM 03.10

LOCATION OF THE TRANSCODING AND RA2 FUNCTIONS

The location of the transcoding and data rate adaptation functions used to convert from the data rate used on the radio interface to the 64 kbits/s required by the MSC, is considered in this appendix. There are three alternatives which are equally valid from a connection type point of view. The selection of which alternative to use is not considered in GSM Recommendation 03.10. The alternatives are shown in Figure 7.

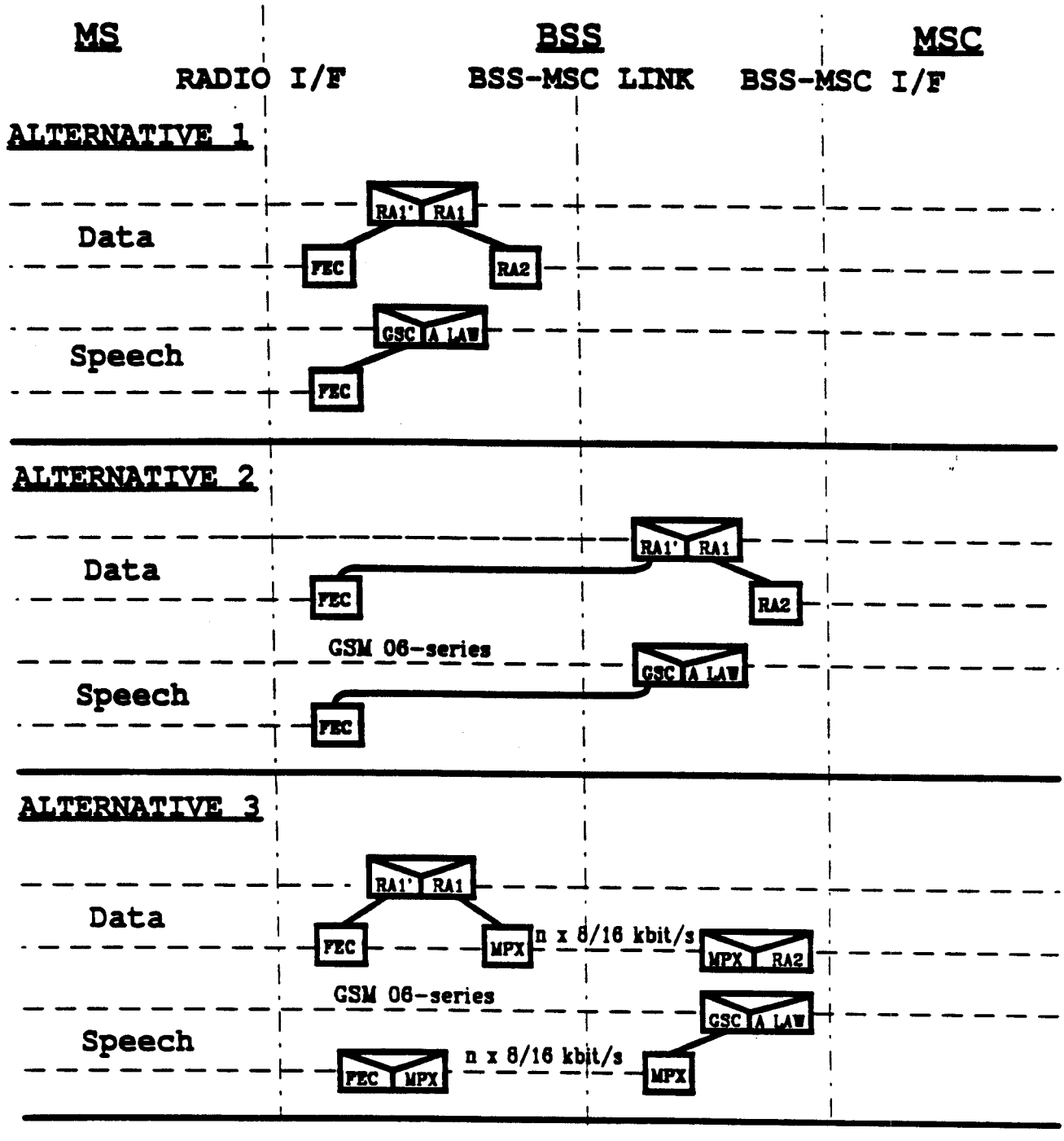
Alternative 1 assumes that all the transcoding and data rate adaptation is located at the BSS end of the BSS to MSC link.

Alternative 2 assumes that all the transcoding and data rate adaptation is located at the MSC end of the BSS to MSC link and gives no indication how the information is carried on the link.

Alternative 3 assumes that the information is transferred on the BSS to MSC link in 8 or 16 kbit/s channels using one of the sub-multiplexing schemes described in CCITT Recommendation I.460. The same sub-multiplexing scheme is used for both speech and data.

It should be noted that in all of the alternatives the transcoding and data rate adaptation are performed on the BSS side of the BSS to MSC interface and is therefore considered to be a function of the BSS.

In all three alternatives, the interface at the MSC is always based on 64 k bit/s without sub-multiplexing.



Legend:

GSC=GSM speech codec
FEC=Forward error correction
MPX=Multiplex/demultiplex

Figure 7: Location of transcoding and rate adaptation