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**Digital cellular telecommunications system (Phase 2);  
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Part 2: Common aspects of GSM/DCS 1800  
Network Management  
(GSM 12.01)**

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## Foreword

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

This ETS provides a survey of the GSM network management interfaces and describes the relevant protocol profiles for Q3 and Qx interfaces within the Digital cellular telecommunications system. This ETS corresponds to GSM technical specification, GSM 12.01, version 4.4.1 and is part 2 of a 2 part ETS as described below:

GSM 12.00                      ETS 300 612-1: "Digital cellular telecommunication system (Phase 2); Network Management (NM); Part 1: Objectives and structure of Network Management".

**GSM 12.01                      ETS 300 612-2: "Digital cellular telecommunication system (Phase 2); Network Management (NM); Part 2: Common aspects of GSM Network Management".**

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

<b>Transposition dates</b>	
Date of adoption of this ETS:	31 August 1996
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## 1 Scope

This European Telecommunication Standard (ETS) provides the survey of the GSM Network Management (NM) interfaces in accordance with the requirements in the GSM standards and with the architectural concept and methodology defined in GSM 12.00 (ETS 300 612-1) [80].

NOTE: The requirements for GSM covers the requirements for a DCS 1800 network as well.

The various possibilities for transfer of NM messages between the NM entities and Network Elements (NEs) are outlined in this standard, and the requirements are set up for an OSI protocol stack appropriate for a GSM TMN.

This ETS describes the relevant protocol profiles for Q3 and Qx interfaces.

## 2 Normative references

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

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An overview of the GSM NM ETS is given in GSM 12.00 (ETS 300 612-1)[80], Objectives and Structure of Network Management (NM).

### 3 Abbreviations

For the puposes of this ETS the following abbreviations apply.

A	Agent
AARE	A-ASSOCIATE-RESPONSE
AARQ	A-ASSOCIATE-REQUEST
ACPM	Association Control Protocol Machine
ACSE	Association Control Service Element
AE	Application Entity
AEQ	Application Entity Qualifier
AET	Application Entity Title
AFI	Authority and Format Identifier
APDU	Application Protocol Data Unit
API	Application Programming Interface
APQ	Application Process Qualifier
ASE	Application Service Element
ASN.1	(CCITT) Abstract Syntax Notation One
AT	Application Title
BA	Basic Access
BSC	Base Station Controller
BSS	Base Station System
BSSOMAP	BSS Operation and Maintenance Application Part
BTS	Base Transceiver Station
CCITT	International Telegraph and Telephone Consultative Commitee
CLNS	Connectionless-Mode Network Service
CMIP	Common Management Information Protocol
CMIP-DU	Common Management Information Protocol Data Unit
CMIS	Common Management Information Service
CMISE	Common Management Information Service Element
CONS	Connection-Mode Network Service
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
CUG	Closed User Group
DAF	Destination Address Field
DCE	Data Communication Equipment
DCF	Data Communication Function
DCS 1800	Digital Cellular System 1800 MHz
DEAF	Destination Extended Address Field
DIS	Draft International Standard (of ISO)
DISP	Draft International Standardized Profile
DSP	Domain Specific Part
DTE	Data Terminal Equipment
ETSI	European Telecommunications Standards Institute
FTAM	File Transfer Access and Management
GT	Global Title
GSM	Global System for Mobile Communication
ICF	Information Conversion Function
ID	Identifier
IDI	Initial Domain Identifier
IP	Internet Protocol
IS	International Standard (of ISO)
ISDN	Integrated Services Digital Network
ISO	International Standards Organization
ISP	International Standardized Profile
LAN	Local Area Network
LAPB	Link Access Procedure - Balanced
LAPD	Link Access Procedure on the D-channel
LLC	Logical Link Control
M	Manager
MAC	Media Access Control
MAF	Management Application Function
MAPDU	Management Application Protocol Data Unit
MCF	Message Conversion Function

MF	Mediation Function
MMI	Man-machine Interface
MO	Managed Object
MSC	GSM Mobile-services Switching Centre
MTP	Message Transfer Part
MUX	Multiplexer
NE	Network Element
NEF	Network Element Function
NM	Network Management
NMC	Network Management Centre
NSAP	Network Service Access Point
OG	Organisation Number
O&M	Operations and Maintenance
OMAP	(CCITT) Operations, Maintenance and Administration Part
OMC	Operations and Maintenance Centre
OS	Operation System
OSF	Operations System Functions
OSI	Open Systems Interconnection
OSINET	OSI Network
PAD	Packet Assembler and Disassembler
PICS	Protocol Implementation Conformance Statement
PRA	Primary Rate Access
PSAP	Presentation Service Access Point
PSPDN	Packet Switched Public Data Network
QAF	Q Adaptor Function
QOS	Quality Of Service
ROSE	Remote Operation Service Element
SAF	Source Address Field
SAPI	Service Access Point Indicator
SCCP	(CCITT) Signalling Connection Control Part
SEAF	Service Extended Address Field
SLP	Single Link Procedure
SM ASE	Specific Management Application Service Element
SMAE	System Management Application Entity
SMAP	System Management Application Process
SMG	Special Mobile Group
SN	Sub Network
SPI	Subsequent Protocol Identifier
SS7	(CCITT) Signalling System No.7
SSS	Subscriber Switching Subsystem
SW	Soft Ware
TMN	Telecommunications Management Network
TRAU	Transcoder and Rate Adaptation Unit
TS	Transport Service
TSAP	Transport Service Access Point
VASS	Value Added Service Supplier

## **4 GSM Network Management**

GSM 12.00 [80] describes the concepts of the Telecommunications Management Network which are applicable to the management of a GSM network. This clause introduces the techniques which may be employed in the translation of those concepts into a practical implementation of a TMN.

### **4.1 General TMN Structural aspects**

#### **4.1.1 Reference Points versus Interfaces**

The M.3010 [1] defined TMN assists in the definition of functionality required to be supported by the management network. This functionality is described in terms of discrete function blocks, viz. the OSF, DCF, MF, QAF, NEF, etc. These function blocks may be structured hierarchically. Between each related pair of function blocks, the interaction (typically a manager-agent relationship) is represented by a reference point.

The actual implementation of M.3010 reference points into interfaces may take following forms:

- a) Reference points realized across a physical communications link, i.e. the manager and agent functions are implemented on different hardware devices.
- b) Reference points realized in software, i.e. manager and agent functions are implemented on the same device, and are accessible via a well-defined open API.

The definition of the relationship between the manager and agent functions forms the basis for the context and standardization of the TMN interfaces described in the 12-series of recommendations.

#### **4.1.2 Hierarchical Interworking between Function Blocks**

The function blocks which are defined in draft CCITT M.3010 [1], and described in GSM 12.00 [80], may exist in hierarchical structures. The levels of the hierarchy can be roughly equated with the layers of the logically layered architecture. Figure 1 shows some examples of different structures which the TMN allows. Wherever there is a boundary between two discrete functions there is a reference point defined. Assuming that the functions contained within each function block at a particular level within the hierarchy, in terms of its relationship to the serviced reference points, are equivalent, then a function block in one stack could interact with a function block in any other stack through its adjacent reference points. This is shown by the oblique lines. Obviously, however, this would also require the object models and instances thereof on both sides to be supported.

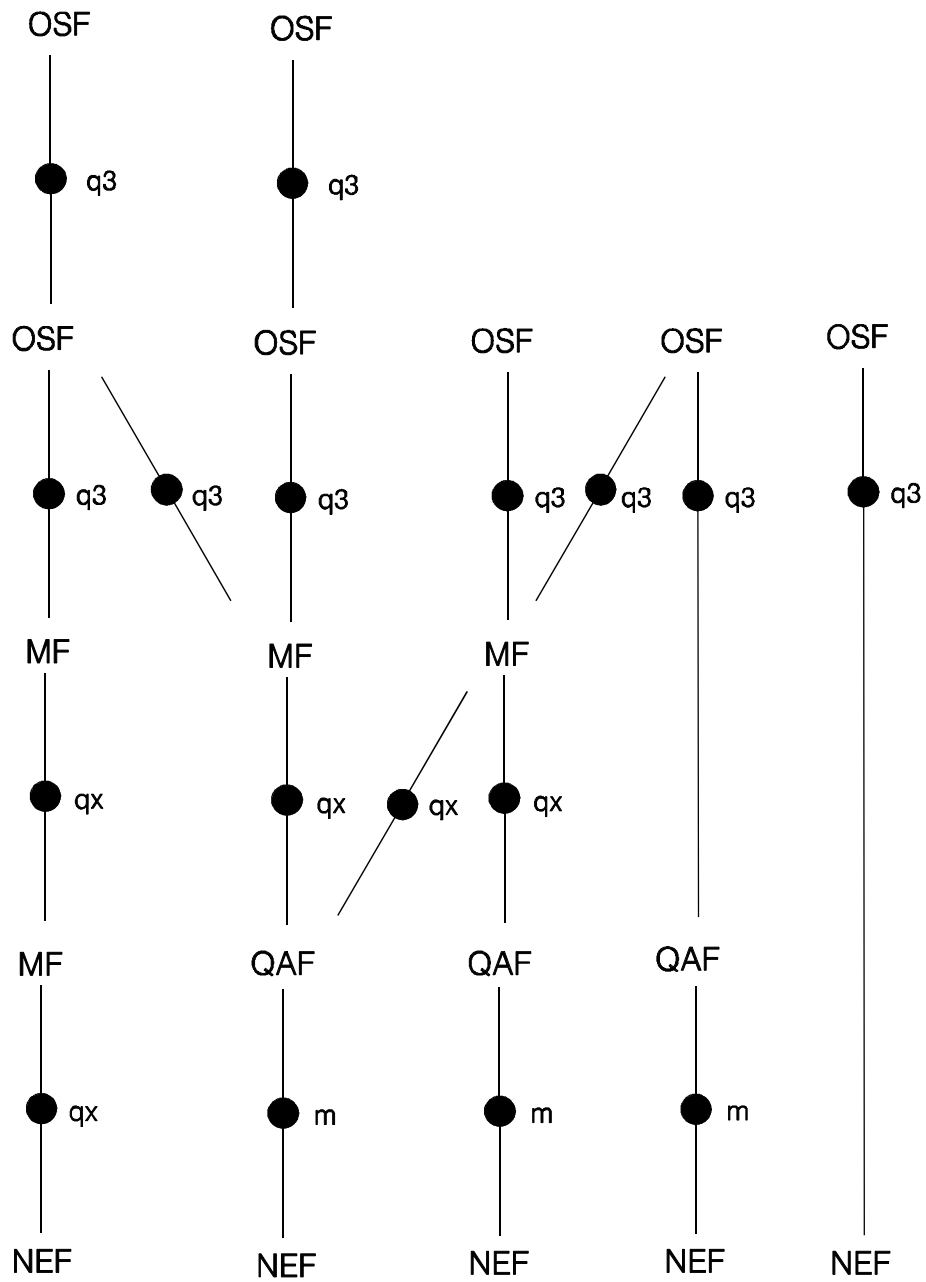


Figure 1: Example functional hierarchies Inter-acting through Reference Points

4.1.3 Implementation of Interfaces According to M.3010

Figure 2 shows various levels of functionality involved in the management of network element functionality, implemented in a number of different devices. The devices are shown by enclosing boxes. Each device, according to M.3010 [1], can adopt a name which reflects the primary function of the device, but this naming is arbitrary and is an implementation decision. A network element may also contain OS functions but retain the name of the network element functions. (They will often be called OMCs and NMCs. As can be seen from the figure, the precise role of an OMC device, as the first OS remote from the network element, may be more or less complex depending on the specific implementation.)

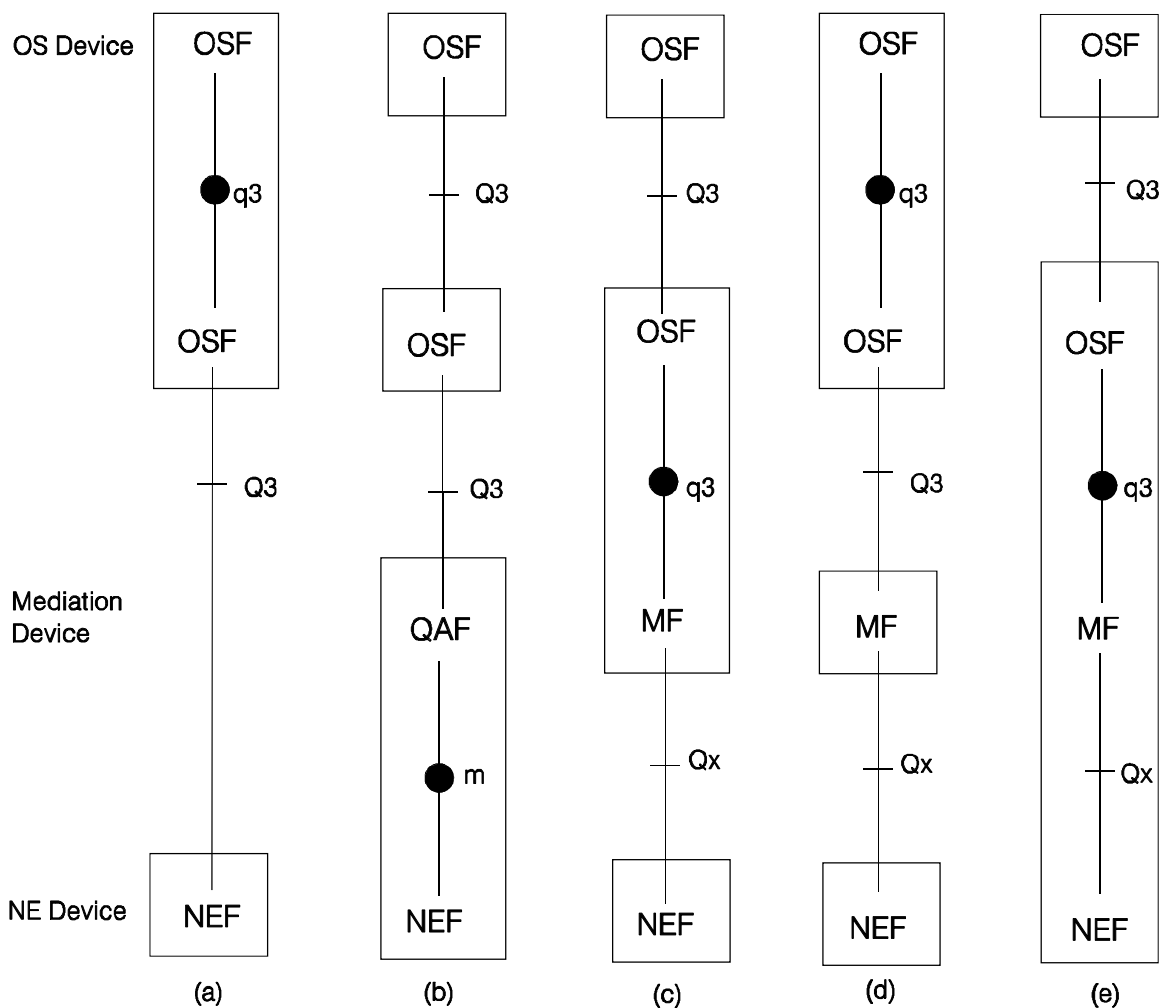
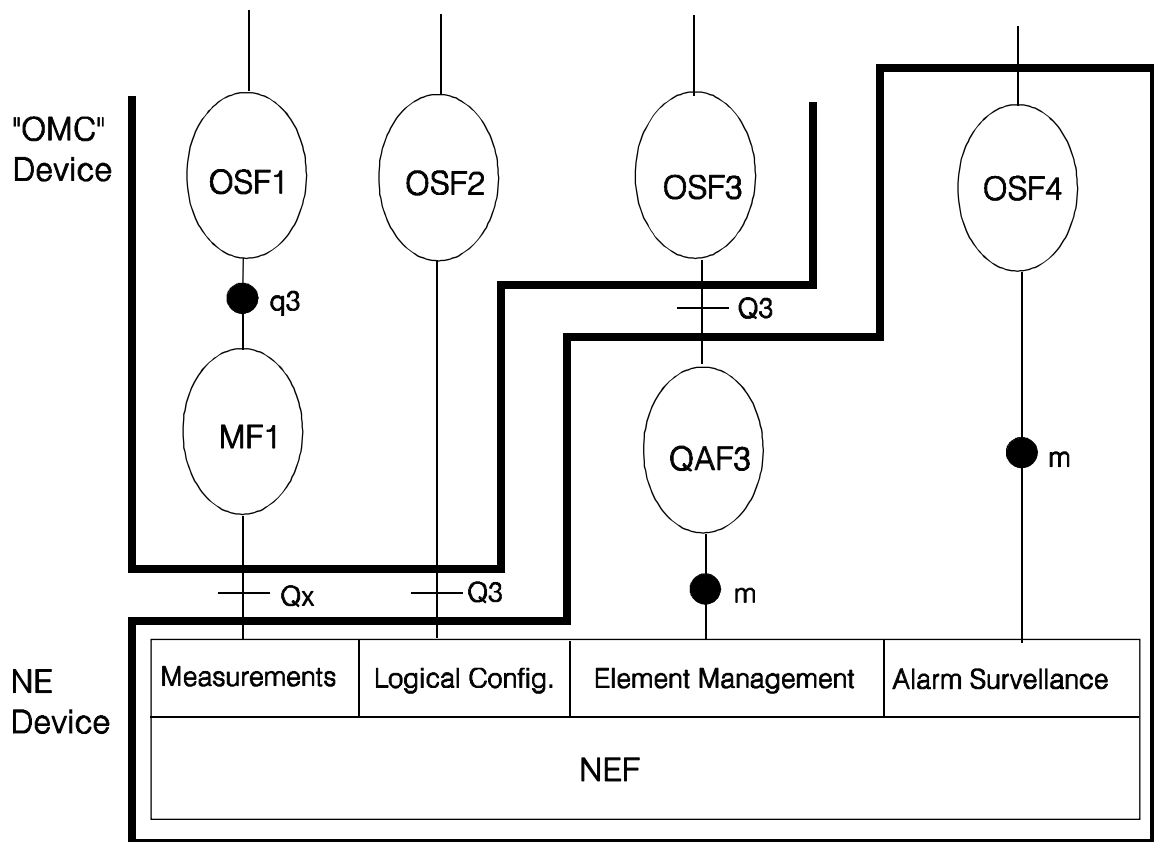


Figure 2: Example functional groupings



Figure 3 shows a decomposition of a general OSF into more specific OSFs which represent different functional areas. Each OSF contains the management functionality necessary for the specific functional area, i.e. OSF1 is responsible for managing performance measurements, OSF2 manages the logical configuration, etc.



**Figure 3: Example functional relationship**

The managed network element has been designed, in this example, to include certain function blocks of the conceptual TMN. "OMC" device contains OSFs and a MF.

The external interface of the NE device is, therefore, the sum of the interfaces ( $Q_x + Q_3 + Q_3$ ) relevant to the various components, and these may or may not be implemented together. OSF4, which is shown contained within the NE device, may or may not interface to a higher level management device or function. QAF3 has been implemented in the NE device to convert an existing non-standard interface to a standardized interface.

## 4.2 Implementation requirements

The implementation requirements are derived out of GSM 12.00 [80], clause 3.

In this context this document shall specify a suitable subset of a Q3 and Qx profile defined as

- the implemented subset of the layer services profiles;
- the implemented subset of the layer protocols profiles;
- the application service and protocols profiles;
- the conformance requirements of the specified services;
- the conformance requirements of the specified profile.

### 4.2.1 GSM Phase 2 implementation requirements for the Q3 Interface

The degree of implementation freedom allowed for by the present CCITT M.3010 TMN model [1], as has been described in the previous paragraphs, is simply too large to come to any significant level of multi-vendor inter-operability.

For example, in figure 2 the OS in column (a) could interface to the NE in column (b) as they both claim to support the same Q3 interface, provided that these are supported by the same object model using a common message set. However, if the reference point contained within the OS in column (a) is not discernible then it could not interface to the lower layer OS in column (b) without redevelopment for that purpose.

It is therefore essential to uniquely define the grouping of the different functional areas supporting the different layers within the logically layered architecture, in order to provide for interoperability in multi-vendor environments.

The following introduces the requirements for a standardized GSM Phase 2 Q3 interface, as the example the OMC - BSS interface is described.

The phase 2 target reference model for the BSS is defined as single OSF and BSS NEF, interfacing with each other via a single accessible q3 reference point/Q3 interface, as depicted in figure 4 below:

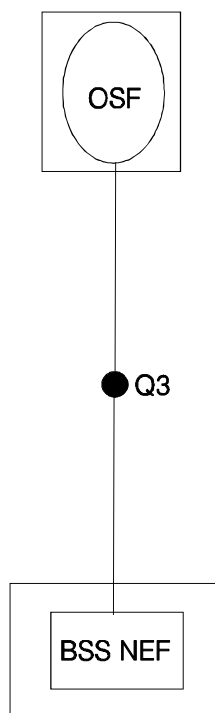
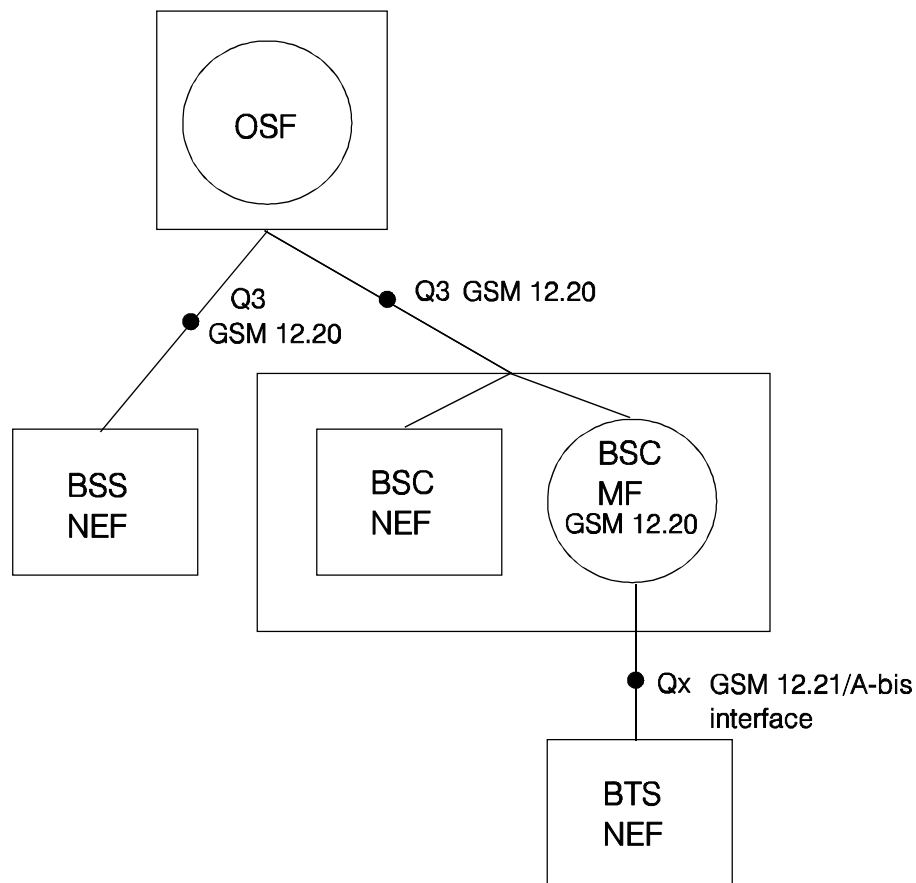


Figure 4: BSS Reference Model for Phase 2

The BSS can be implemented either as:

- 1) a single BSS NEF, which directly interacts with the OSF through the Q3 interface
- or:
- 2)
    - a) the BSC NEF and the BSC MF, which directly interacts with the OSF through the Q3 interface;
    - and
    - b) the BTS NEF, which interacts with the BSC MF through the Qx (Abis) interface,

which is depicted in figure 5:

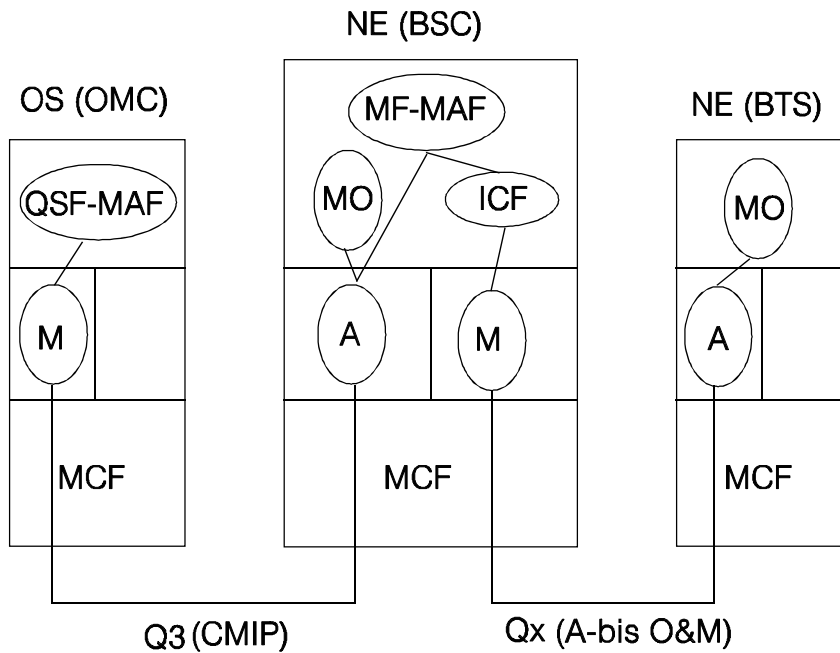


**Figure 5: Allowed BSS Context Models for Phase 2**

The BSS object model and message set are defined in GSM 12.20 [81], while the O&M application part of the BTS NEF is described in GSM 12.21 [82]. The Mediation Function, which converts the BTS relevant parts of the OSF BSS Q3 information model to the BTS Qx information model, is described in GSM 12.22 [83].

**4.2.2 GSM Phase 2 implementation requirements for the Qx Interface**

The GSM TMN model for the second type of BSS implementation, described in the previous subclause (figure 5), relates as depicted in figure 6 to the CCITT M.3010 model:



**Figure 6: GSM Phase 2 Q3/Qx Interface Model**

The GSM phase 2 Qx NM interface is a GSM specific standard which supports management of different manufacturers equipment. However GSM 12.22 [83] is necessary to ensure the interoperability.

Note that the Qx NM interface does not support a full 7 layer OSI/CMIP protocol stack, but uses a simple LAPD based application protocol for reasons of costs and simplicity.

**4.2.3 GSM Phase 2 implementation requirements for interworking between Q3 and Qx Interfaces**

The interworking between the BSC MF and the BTS NEF (see figure 6), as related to CCITT M.3010, consists of:

- a) MF - MAF  
 These are functions supported to OSF application functions, of which tests and SW management are specified in GSM 12.22 [83].
- b) ICF;  
 The information conversion, i.e. transformation of the BTS aspects of the OSF - BSC information model to the information model at the BTS side of the A bis interface, as described in GSM 12.22 [83].

## 5 GSM Network Management Interfaces

### 5.1 General

The achievement of network management functions requires information transfers between the GSM network elements and OS.

The selection and construction of the necessary protocol(s) is based upon the attributes of the functions and message types.

Consideration should be made of:

- security;
- integrity;
- message volume;
- message length;
- priority;
- dependence;

### 5.2 NM Interfaces within a GSM Network

#### 5.2.1 Q3 Interface

CCITT Q.811 [2] and Q.812 [3] specify a variety of Q3 interface implementations with the possibility for the GSM operator to put together those network services necessary for a given GSM network.

For layer 1 - 3 four examples are detailed, i.e.

- SS7 of CCITT;
- X.25 network;
- ISDN;
- OSI-LAN.

The X.25 network can be realized by means of a dedicated network, or the PSPDN in either an open or closed access mode.

If the Network Management information transfer between the BSS and the OMC utilizes the GSM A interface as specified in GSM 08.06 [73] and 08.08 [74], then the GSM 08.08 [74] specified protocol stack shall apply, i.e. MTP, SCCP and BSSOMAP.

The GSM 08.08 [74] specified BSSOMAP is interpreted as layer 4 to 7 according to figure 8.

Theoretically it is possible to use SS7 based BSSOMAP in between the BSS and MSC and use X.25 based BSSOMAP in between the MSC and the OMC. In this case address translation shall take place at the MSC as described in Annex B.

For ISDN the OSI Connection-Mode Network Service (OSI - CONS2, OSI -CONS3, and OSI CONS4) are specified according to CCITT Q.811 [2].

For OSI-LAN this ETS specifies the use of OSI Connectionless-Mode Network Service (CLNS1) on top of the LLC and MAC sublayers. For the MAC sublayer CSMA/CD is used. CSMA/CD is often referred to as "Ethernet".

#### 5.2.2 Qx Interface

If the A-bis interface is implemented, the NM interface shall be a Qx interface according to M.3010 [1] and shall be supported as described in GSM 12.21 [82].

For implementation requirements for this Qx interface see clause 5.

### 5.3 The Man Machine Interface (MMI)

Generally CCITT Z.300 series shall apply.

NOTE: A standardized MMI is not prospective. The reference to CCITT Z.300 series reflects the syntax and semantic part and does not define the actual MMI.

However it is essential that any MMI contains efficient tools. For example MMIs could make use of other techniques such as macro interpreter and window techniques to facilitate appropriate operation of any NE.

## **6 GSM Network Management protocols and services at the Q3 Interface**

### **6.1 General**

The specification of NM and the supporting TMN is based upon the OSI seven layer model and utilizes the defined protocols, procedures and services. The recommended array is described in figure 8.

### **6.2 Communication Model For Management Information Transfer**

#### **6.2.1 General**

In each Network Element the set of functions in charge of Network Management are known as the System Management Application Processes (SMAPs). The communication between peer management application processes is achieved using System Management Application Entities (SMAEs).

The SMAE is a set of Application Service Elements (ASE) providing services and protocols for management information transfer between open systems (see figure 7).

The SMAE includes both management related Application Service Elements and other ASEs required to support the previous category or providing direct services to the SMAPs.

OSI management Application Service Elements consist of:

- specific Management Application Service Elements, depending on the managed area;
- the Common Management Application Service Element.

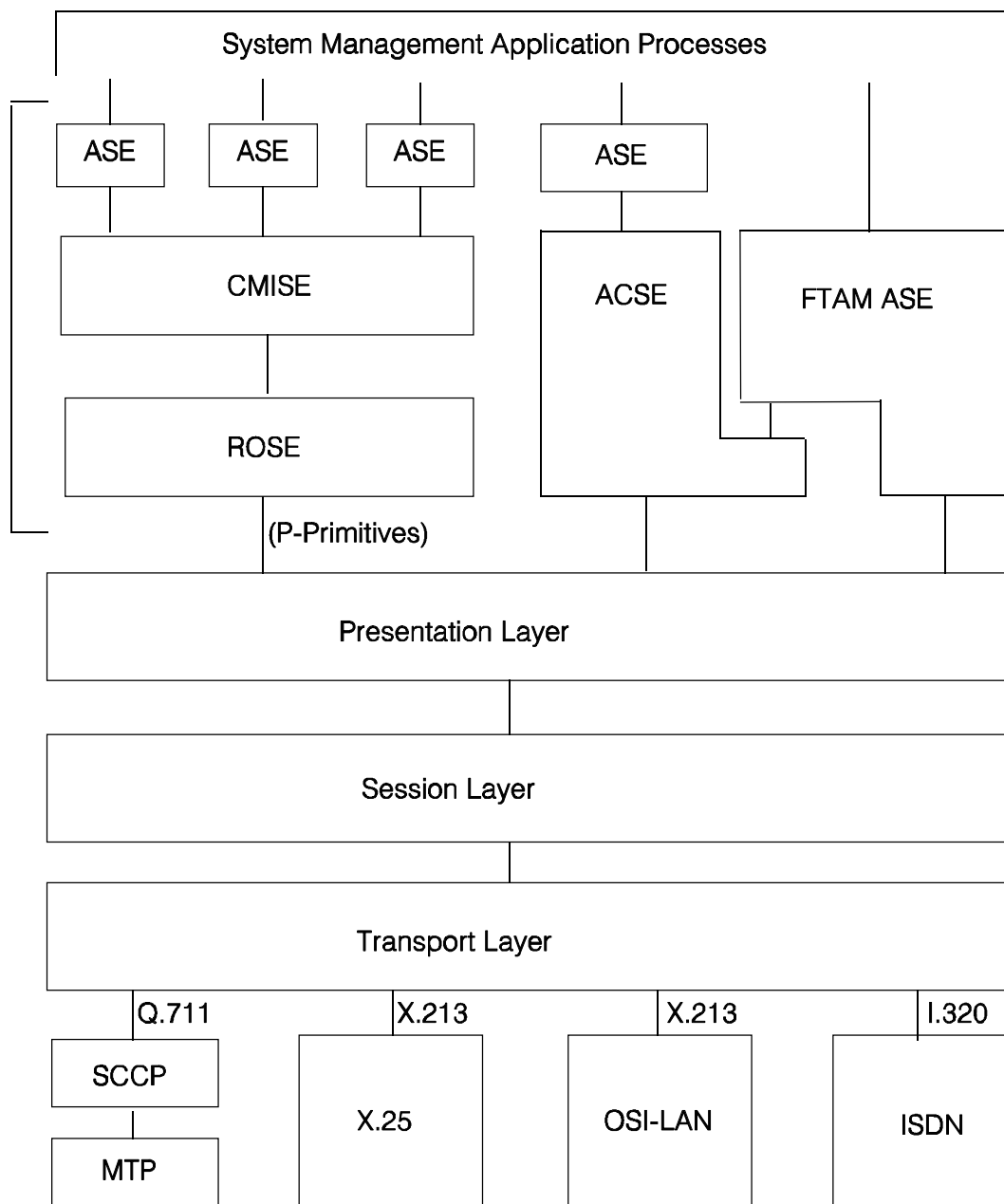
Although Signalling System No. 7 is used in a GSM network, the Operation, Maintenance and Administration Part (OMAP) described in CCITT Q.795 [34] is not considered as part of the GSM SMAP.

All information transfer services for the GSM SMAP can be accommodated using CMIS or FTAM.

NOTE: OMAP may be required to be implemented in GSM Network Elements as part of the CCITT SS7 implementation.

#### **6.2.2 Common Management Application Services Element (CMISE)**

The Common Management Information Service Element (CMISE), version 2, is defined in documents ISO IS 9595/IS 9596 [16], [17]. See also CCITT X.710 and X.711. This ASE provides services and protocol for the transfer of Common Management Information Protocol Data Units (CMIP-DUs). It can be regarded as a means for the exchange of information and commands for management purposes in a common manner.



**Figure 7: OSI Framework for Network Management**

CMISE provides two types of information transfer service:

- a) A management notification service - used to convey management information applicable to notifications generated by a managed object;

The following service is defined:

- 1) M-EVENT-REPORT (confirmed/unconfirmed).
- b) A management operation service - used to convey management information applicable to operations directed at a managed object;



The following services are defined:

- 1) M-GET (confirmed);
- 2) M-SET (confirmed/non confirmed);
- 3) M-ACTION (confirmed/non confirmed);
- 4) M-CREATE (confirmed);
- 5) M-DELETE (confirmed);
- 6) M-CANCEL-GET (confirmed).

CMISE does not provide separate services for the establishment and release of application associations. The CMISE-service-user relies on the services of ACSE for the control of application associations.

During the association establishment phase, various ASEs may exchange initialisation information to establish an association using ACSE. The application context specifies the rules required for co-ordinating the information belonging to different ASEs, embedded in ACSE user information service parameters. The application context, presentation and session requirements are conveyed using parameters of the A-ASSOCIATE service.

The A-RELEASE and A-ABORT services of ACSE are used for the termination of an association. These may be invoked by either of the CMISE-service-users.

How CMISE-service-users, CMISE, ACSE, ROSE and Presentation Layer interact is explained in subclause 6.2.4.

### **6.2.3 Specific Management Application Service Element**

Specific Management Application Services Elements are CMISE users and provide a means to exchange Management Application Protocol Data Units (MAPDUs) between SMAPs.

### **6.2.4 Description of how CMISE, ACSE, ROSE and OSI Presentation Layer Interact**

In an OSI environment, communication between application processes takes the form of communication between two application entities (AEs). CMISE is used to transfer systems management information between peer AEs. CMISE needs the services of ROSE and the Presentation Layer to do this. See figure 7.

ACSE controls the application association (establishment, release, abort) between two AEs. ACSE services A-ASSOCIATE, A-RELEASE and

A-ABORT are used to set up and tear down an association. The ACSE services are invoked by the CMISE-service-users, i.e. CMISE does not provide separate services for the control of application associations. The Presentation Service provides the transfer mechanism and ACSE primitives in turn, map onto the P-CONNECT, P-RELEASE and P-U-ABORT Presentation services.

ROSE controls the communication between peer AEs over an association set up and controlled by ACSE. CMISE primitives map onto the RO-INVOKE service of ROSE to carry out an operation and map onto RO-RESULT to return the result. If the operation was unsuccessful or some other problem was detected, the reply would be carried by either RO-ERROR, RO-REJECT-U or RO-REJECT-P services of ROSE. ROSE primitives, in turn, map onto the user data field of the P-DATA Presentation service.

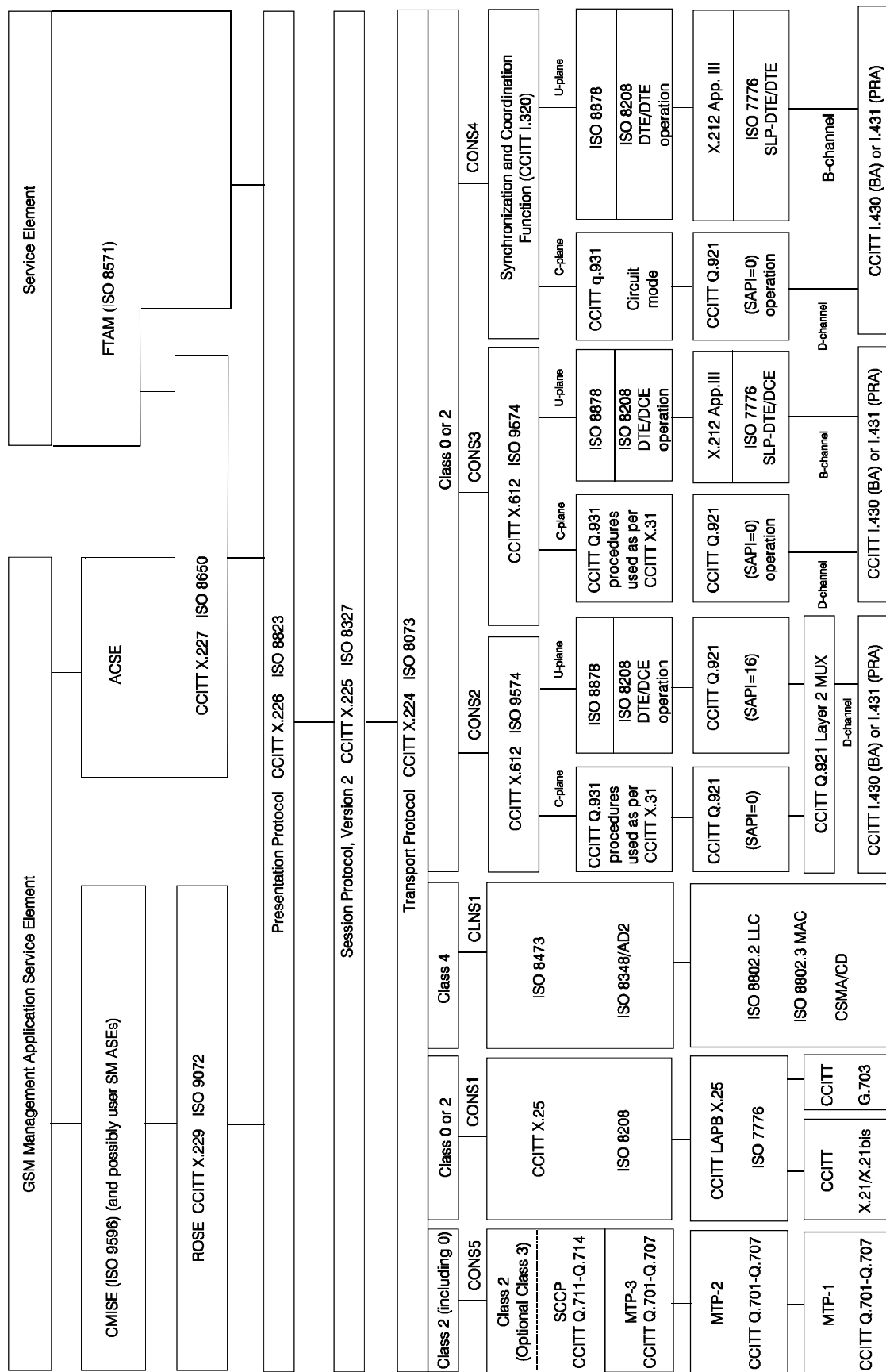


Figure 8: Protocol Array for GSM NM Support

### 6.3 Protocol capabilities

The following capabilities are required from the protocol stack implemented in each GSM Network Elements, to support the GSM System Management Application Process (GSM SMAP). See also figure 8.

#### 6.3.1 Naming and addressing capability

##### 6.3.1.1 General aspects

The addressing capability allows a user to address applications unambiguously in all Network Elements in the GSM TMN.

The addressing schemes for layer 4 to 7 are valid, independent from the network service to be used (Signalling System No.7 [19] or X.25 [38]).

##### 6.3.1.2 SCCP addressing

The user of the Signalling Connection Control Part SCCP [29] (network users) shall use the Global Title (GT) according to CCITT Q.713 [31] for transfer of management messages in the Signalling System No. 7 network.

##### 6.3.1.3 X.25 addressing

The users of X.25 network layer (network users) should use a numbering plan according to CCITT X.121 [39] for transfer of management messages in the X.25 network.

The sub-addressing in X.25, if needed, should be done as described in CCITT X.25, Appendix IV.

##### 6.3.1.4 OSI-LAN addressing

The ISO-IP addressing shall use the OSINET format for the NSAP structure, as detailed below.

**Table 1 OSI-LAN addressing**

Field Position	Name	Content	Length	Type
1	AFI	Value = 47 (ISO 6523-ICD)	2 (1 octet)	Decimal
2	IDI	Value = 4	4 (2 octets)	Decimal
3 (I in DSP)	OG	Organisation Number	4 (2 octets)	Hexadecimal
4	SN	Subnetwork	4 (2 octets)	Hexadecimal
5	ID	Station Identifier	12 (6 octets)	Hexadecimal
6	Sel	Network Selector	2 (1 octet)	Hexadecimal

##### 6.3.1.5 ISDN addressing

The user of ISDN shall use a numbering plan according to CCITT E.164 [18] for the transfer of management messages.

##### 6.3.1.6 Transport addressing

The users of the Transport Layer (TS users) shall use a system of addressing which is mapped onto the addressing scheme of the supporting Network Service. A TS user shall use a specific transport-address to refer unambiguously to a specific Transport Service Access Point (TSAP).

##### 6.3.1.7 Addressing on the application layer

The addressing capabilities of the application layer are required to comply with the naming and addressing definitions of CCITT X.217/X.227 [54], [55].

The application-entity-title, composed of application-process-title and application-entity qualifier, may be included in the A-ASSOCIATE-REQUEST (AARQ) and A-ASSOCIATE-RESPONSE (AARE) Application Protocol Data Units (APDUs) as specified in CCITT X.227 [55].

The presentation address (PSAP Identifier) to be issued by the requesting Association Control Protocol Machine (ACPM) in P-CONNECT request primitive may be derived from the application-entity-title received in A-ASSOCIATE request primitive, or it may be passed in the called presentation address parameter of the A-ASSOCIATE request primitive, i.e. mapping of application-entity title on PSAP Identifier may be done by the ACPM or its service-user as a local issue.

#### **6.3.1.8 Implementation example**

An example for implementation of an addressing scheme is provided in Annex B.

This example is for guidance only.

#### **6.3.2 Connection-oriented communication capability**

This capability establishes a connection, either physical or logical, for the purpose of transporting management information between two application entities. This is required to support Common Management Information Services (CMIS) [16], File Transfer, Access and Management (FTAM) [7], [8], [9], [10].

#### **6.3.3 Connectionless communication capability**

This capability allows the transfer of management information between two application entities without the establishment of a connection.

This is required to support Common Management Information Services (CMIS) [16], File Transfer, Access and Management (FTAM) [7], [8], [9], [10].

#### **6.3.4 File Transfer Capability**

This capability provides the means for communications between network management applications requiring file transfers. This is required, for example, for software downloading or transfer of statistics. This capability can be provided by the File Transfer Access and Management Application Service Element (FTAM ASE), defined in ISO IS 8571 [7], [8], [9], [10], and the Association Control Service Element (ACSE), defined in CCITT X.217 [54] and X.227 [55]. The use of adequate lower layers is assumed, especially the use of a presentation service in accordance with CCITT X.216 [52].

#### **6.3.5 Remote Operation Handling**

This capability allows a user to request that a particular operation be performed in another node which has to report the outcome. This capability is an application layer capability and can be provided by CMIS defined in ISO IS 9595-2 [16] and IS 9596-2 [17].

### **6.4 Implementation requirements**

#### **6.4.1 General**

The recommended protocol stack to support a Q3 interface is defined in CCITT Q. 811 [2] and Q. 812 [3]. It conforms to the layer structure specified by the OSI reference model.

The service and protocol definitions selected for the first implementation phase of the Q3 interface in the GSM TMN are specified in the following subclauses.

See also figure 8 (Protocol array for GSM NM support).

#### **6.4.2 Layer 1 to 3**

Layer 1 to 3 of any network used on the Q3 interface shall as a minimum provide the mandatory Network Services defined in CCITT X.211 [44], X.212 [45] and X.213 [46].

Below three examples are detailed, i.e. CCITT Signalling System No. 7, X.25, and ISDN.

#### 6.4.2.1 Requirements specific to CCITT Signalling System No.7

The CCITT Signalling System No.7 Message Transfer Part (MTP) shall generally comply to CCITT Q.701 - Q.709 [20], [21], [22], [23], [24], [25], [26], [27], [28].

The CCITT Signalling System No.7 Signalling Connection Control Part (SCCP) shall generally comply to CCITT Q.711 - Q.714. [29], [30], [31], [32]. For the Q3 interface, SCCP Class 2 is required and Class 3 is optional.

#### 6.4.2.2 Requirements specific to the A Interface

For the A interface layer 1, 2 and 3 are specified in GSM 08.04 [72], 08.06 [73] and 08.08 [74] respectively. SCCP Class 2 is required on the A interface and Class 3 is optional.

#### 6.4.2.3 Requirements specific to X.25

The service definition for the physical layer shall be in accordance with CCITT X.211 [44].

The physical interface shall be in accordance with:

- CCITT X.21/X.21bis for speed  $\leq$  64 kbit/s [36], [37]
- or CCITT G.703 for speed  $\geq$  64 kbit/s [4].

The service provided by the data link shall be in accordance with CCITT X.212 [45].

The data link protocol shall be in accordance to CCITT X.25 [38] supporting the LAPB procedure.

The network protocol shall conform to the CCITT X.25 [38]. In addition the provisions of CCITT X.223 [47] shall apply.

The following CCITT optional user facilities are mandatory:

(all references are related to CCITT X.25)

- Flow control parameter negotiation (section 6.12)
- Throughput class negotiation (section 6.13)
- Closed user group (section 6.14.1)
- Closed user group selection (section 6.14.6)
- Reverse charging (section 6.18)
- Reverse charging acceptance (section 6.19)
- Network user identification subscription (section 6.21.1)

The following CCITT optional user facilities are desirable, for reasons indicated:

- D bit modification (section 6.3)  
(important when data transfer integrity is essential, e.g. billing data)
- One-way logical channel outgoing (section 6.7)  
(for security reasons)
- One-way logical channel incoming (section 6.8)  
(for security reasons)
- Fast-select (section 6.16)  
(for small volume data transfer)
- Fast-select acceptance (section 6.17)

NOTE: If X.25 permanent connections/leased lines have to be used between a Management System and the GSM Network Elements, it is required that either the Management System or the NEs are capable of acting as DCE (relevant to both data link layer and packet layer).

#### 6.4.2.4 Requirements specific to ISDN

For the ISDN option three interfaces are applicable according to CCITT Q.811 [2], i.e. CONS2, CONS3, and CONS4.

For GSM TMN all requirements for the ISDN interfaces, as specified in CCITT Q.811, shall apply. See also references [61 to 68].

#### 6.4.3 Transport layer

The transport layer service shall conform to CCITT X.214 [48].

The transport protocol shall provide the set of functions defined for Protocol Class 2. According to the CCITT conformance requirements Class 0 shall also be available. Class 4 is to be used for OSI-LAN.

The protocol selection (class and options) during connection establishment shall be based on:

- user requirements through subscription of QOS service parameters (which may be fixed per user); and
- the network service provided, recommended default settings:
  - class 2 for SCCP (in order to provide end-to-end flow control);
  - class 2 for X.25 PSPDN or ISDN (multiplexing enabled; non-use of explicit flow control option may be selected if the network provides end-to-end flow control);
  - class 0 for X.25 PSPDN or permanent connection or ISDN (multiplexing not required);
  - class 4 for OSI-LAN.

The transport layer protocol implementation shall conform to CCITT X.224 [49], subsection 14, as follows:

Class 0: All mandatory procedures shall be available.  
Class 2: All mandatory and optional procedures shall be available.  
Class 4: All mandatory and optional procedures shall be available.

#### 6.4.4 Session layer

The session layer service shall conform to CCITT X.215 [50]. The required functional units are:

- KERNEL;
- DUPLEX.

If the requirements are for Recovery the following functional units are required as well:

- MINOR SYNCHRONIZE;
- RESYNCHRONIZE.

The protocol shall be in accordance to CCITT X.225 [51].

To ensure the possibility to exchange all the data required for simultaneous establishment of session, presentation and application connections, version 2 of the session protocol is required.

#### 6.4.5 Presentation layer

The presentation layer service shall conform to CCITT X.216 [52].

According to the conformance requirements of CCITT X.226 [53] the following session functional units shall be supported (in accordance to the session layer requirements):

- KERNEL;
- DUPLEX.

If the requirements are for Recovery the following functional units are required as well:

- MINOR SYNCHRONIZE;
- RESYNCHRONIZE.

The following presentation functional unit shall be implemented:

- KERNEL.

The presentation protocol shall be in accordance to CCITT X.226 [53].

Abstract Syntax Notation One (ASN.1) as defined in CCITT X.208 [41] and the accompanying "Basic Encoding Rules" as defined in CCITT X.209 [42] shall be applied for the specification of application protocols and to derive the transfer syntax of the Application Protocol Data Units (APDUs).

#### **6.4.6 Application layer**

The application layer shall be structured as defined in ISO DIS 9545 [15].

The application entity shall include the following Application Services Elements:

- 1) Association Control Service Element (ACSE).

The services provided by ACSE shall comply with CCITT X.217 [54].

The protocol shall be in accordance with CCITT X.227 [55]. Only normal operation mode is required (i.e. not X.410/1984 [59]).

The specification of ACSE protocol for the GSM ASE services shall be in accordance with ISO DISP 11183-1 [14].

The specification of ACSE protocol for the FTAM services shall be in accordance with ISO ISP 10607-1 [11].

- 2) Remote Operation Service Element (ROSE)

The services provided by ROSE shall comply with in CCITT X.219 [56], all services being mandatory.

The protocol shall be in accordance with CCITT X.229 [57]. The implementation of ROSE shall support the mapping of ROSE APDUs onto presentation services. All four APDUs specified in X.229 are mandatory

The specification of ROSE protocol for the CMISE services shall be in accordance with ISO DISP 11183-1 [14].

- 3) Common Management Information Service Element (CMISE)

The services provided by CMISE shall comply with ISO IS 9595-2 [16], all functional units being mandatory, with the exception of Extended Service.

The specification of the CMISE protocol profile shall be in accordance with ISO DISP 11183-1 [14].

- 4) File Transfer Access and Management Service Element (FTAM)

The services provided by FTAM shall comply with ISO IS 8571-3 [9].

The GSM ISP for File Transfer shall be in accordance with ISO ISP 10607-1 to ISO ISP 10607-3. [11], [12], [13].

The following options shall be supported:

- File Service Level: EXTERNAL;
- Functional Units: KERNEL;  
READ;  
GROUPING;
  
- optionally: WRITE (insert and extend);  
LIMITED FILE MANAGEMENT;  
FILE ACCESS;  
ERROR RECOVERY.

NOTE: Only KERNEL, READ and GROUPING functional units are necessary for NM applications, when they use FTAM for file transfer between Management System and NE.

RECOVERY functional units are invisible at the external file service level.

Local data management and mapping between the virtual file store and the real file store are out of the scope of this standard. Applications or user in a network node may e.g. create files or modify attributes locally, but this is not visible at the interfaces between Management System and NEs.

- Service Classes: FILE TRANSFER;
  
- optionally: TRANSFER AND MANAGEMENT;  
FILE ACCESS.
  
- Role: RESPONDER;  
and INITIATOR.

The FTAM file attributes and document types shall comply with ISO IS 8571-2 [8]. The following options shall be supported:

- Attribute Groups: KERNEL;  
STORAGE;  
SECURITY.
  
- Document Types: UNSTRUCTURED TEXT;  
UNSTRUCTURED BINARY.

NOTE: Only unstructured document types are used by NM applications. Other document types are optional.

## 6.5 The use of QOS parameters in OSI layer services and protocols

The Quality of Service negotiation shall, if implemented, be in accordance with the OSI principles, i.e. the QOS profile shall follow CCITT X.211 - X.215. [44], [45], [46], [48], [50].

The QOS parameters shall be mapped and coded as specified in CCITT X.223 [47] and X. 224 [49].

### 6.5.1 General

The term "Quality of Service" (QOS) is in the service definitions for each layer in the OSI Reference Model used to refer to certain characteristics of a connection as observed between the endpoints of that connection. QOS describes aspects of a connection which are attributable solely to a particular service provider. Hence, these aspects are independent of the service-user behaviour which does not impact the QOS provided during the life-time of the connection.

In the service definitions of each layer of the OSI Reference Model the same definition of QOS is used. Each service-provider at layer 3 to 7 has a mandatory subscription to a set of QOS parameters. However, only layer 3 to 5 provide explicit procedures to handle these parameters. According to CCITT X.216 [52] and X.217 [54], the QOS parameters of the presentation services and the ACSE services are specified according to the definitions of the QOS parameters of the session services.



The procedures on layer 3 to 5 for handling of QOS parameters are specified in the respective service definitions (CCITT X.213 to X.215 [46], [48], [50]), and eventually in the protocol definitions

(CCITT X.25/X.223 [38], [47] and X.224 [49]) if QOS negotiation procedures are provided by the peer protocols.

In the following subclauses the use of the QOS parameters in the service primitives and in the protocol mechanisms of the different layers are described in more detail.

#### **6.5.2 Quality of Session Service**

The session connection QOS negotiation procedures, if provided, shall be in accordance with CCITT X.215 [50].

Appropriate QOS parameters of S-CONNECT service shall be provided and mapped on the QOS parameters of T-CONNECT service.

In general, QOS parameters should be made available if required by lower layers.

#### **6.5.3 Quality of Transport Service**

The transport connection QOS negotiation procedures, if provided, shall be in accordance with CCITT X.214 [48] and X.224 [49].

No particular values, or classes of values, for the QOS parameters are specified, and may be considered as system dependent matters. QOS negotiation procedures on a per Transport Connection basis are not required as mandatory.

Appropriate QOS parameters of T-CONNECT service shall be provided in order to select the Transport Protocol Class preferred by the users.

In general, QOS parameters should be made available if required by lower layers.

#### **6.5.4 Quality of Network Service**

The network connection QOS negotiation procedures, if provided, shall be in accordance with CCITT X.213 [46], and as specified in the network layer protocol provided (X.25/SCCP).

No particular values, or classes of values, for the QOS parameters are specified, and may be considered as system dependent matters. QOS negotiation procedures on a per Network Connection basis are not required as mandatory.

#### **6.5.5 Quality of Data Link Service**

The Data Link Connection QOS negotiation procedures, if provided, shall be in accordance with CCITT X.212 [45].

QOS negotiation procedures on a per Data Link Connection basis are not required as mandatory.

#### **6.5.6 Quality of Physical Service**

The Physical Connection QOS negotiation procedures, if provided, shall be in accordance with CCITT X.211 [44].

QOS negotiation procedures on a per Physical Connection basis are not required as mandatory.

## 7 Implementation requirements for the Qx NM Interface

### 7.1 General

The general requirements for the A-bis interface as given in GSM 08.51 and 08.52 [75] state that the A-bis interface shall be an open interface, also in respect to transfer of Network Management information. The requirements put forward in the following subclauses are related to the support needed in order to provide communication facilities for NM information transfer on the A-bis interface.

For the GSM A-bis interface, a specific protocol array can be found in figure 9.

### 7.2 Layer 1

For GSM NM information transfer on the GSM A-bis interface (BSC-BTS) GSM 08.54 [76] applies for layer 1, no additional requirements are defined.

### 7.3 Layer 2

For GSM NM information transfer on the GSM A-bis interface (BSC-BTS) GSM 08.56 [77] applies for Layer 2, no additional requirements are defined.

### 7.4 Layer 3

For GSM NM information transfer on the GSM A-bis interface (BSC-BTS) GSM 08.58 [78] applies in general for Layer 3. GSM 12.21 [82] specifies in detail the management procedures, the definition of management information (i.e. layout of the NM messages), and the communication protocol. Four different NM categories are specified as shown in figure 9.

MMI transfer across the A-bis interface shall be in accordance with the requirements, detailed in GSM 12.21 [82], i.e. only transparent transport of proprietary MMI messages is supported.

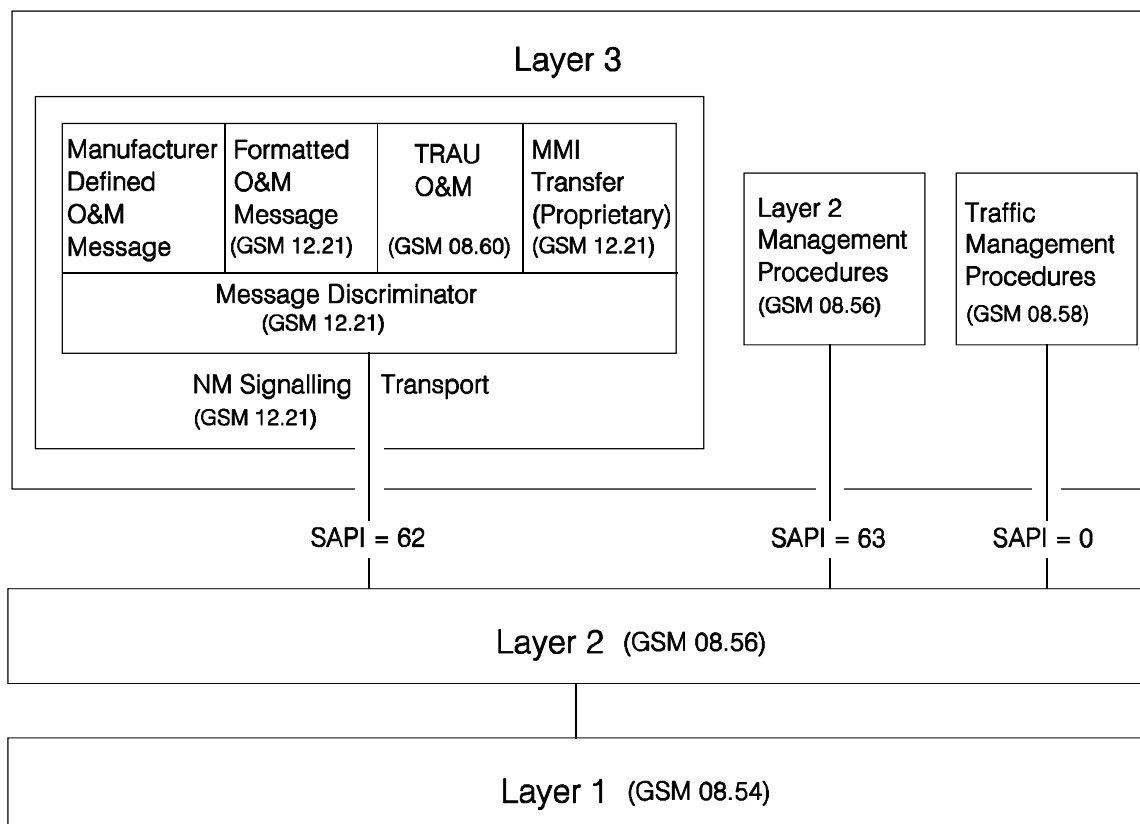


Figure 9: Protocol Array for GSM Network Management support on the A-bis Interface

## 8 Inter-TMN operation

### 8.1 General

The interfacing between the GSM Management System and any non-GSM management system is a GSM operator concern and is outside the scope of the present 12 series of specifications.

However, it should be possible for existing Management Systems to access GSM Management System(s) via a data communication network.

This interface corresponds to the X type of interface and shall be in accordance with CCITT M.3010 [1].

### 8.2 Interface to other Management Systems

It is possible for TMNs belonging to different Operators to interwork. This facet of operation is supported in the conceptual TMN model by the x reference point and the corresponding X interface. In the context of GSM network management, typical uses of the X interface may include inter-Operator accounting and interfacing to Value Added Service Suppliers (VASS). This topic is for further study and description in GSM 12.00 [80].

It may also be of benefit to the TMN designer to consider GSM network management as not one but several TMNs which are interconnected. This can be achieved by the use of the x reference point but, as the definition of the relationship represented by the reference point may be internal to one Operator, it is not considered a suitable candidate for standardization.

figure 10 shows two examples of the use of the X interface. Control of the actual network is exercised by the owner of that network; all exchanges of information occur at layers in the architecture which can assume responsibility for the control. This control would provide a restricted view of the managed objects and management functions available to the X interface. The examples show the X interface supporting peer-to-peer communication within a layer.

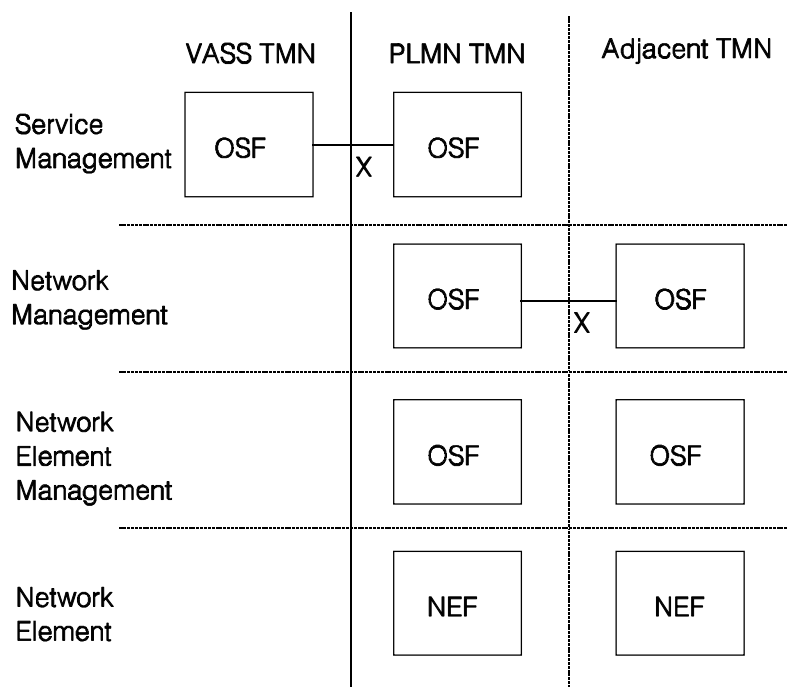


Figure 10: Examples of the X Interface across domains

**Annex A (informative): GSM Protocol Conformance Statements (PICS)**

A PICS proforma specification is seen as a matter for the involved GSM operator.

Guidance for that specification can be found in X.290 Appendix III. [58].

## **Annex B (informative): Example for Implementation of an Addressing Scheme**

### **B.1 Network Addresses**

#### **B.1.1 X.25**

An X.25 PSPDN is used for transferring NM information between the Management System and Network Elements.

##### **B.1.1.1 Transport layer as subsequent protocol**

- Network Service Access Points (NSAPs) are in the address fields (DAF and SAF) of call packets;
- NSAP format is X.121;
- Subsequent Protocol Identifier (SPI) is empty;
- Extended address fields are not used.

##### **B.1.1.2 PAD as subsequent protocol**

- SPI is 01;
- in other respects as above.

##### **B.1.1.3 X.25-SCCP interworking as subsequent protocol**

NOTE: This is not visible for the BSC.

NM information transfer between the Management System and the BSS can be routed via the MSC. If X.25 is used between the Management System and the MSC, and CCITT Signalling System No.7 between the MSC and the BSS, there should be an interworking function in the MSC. The interworking function should perform address translation.

- NSAPs are in the extended address fields (DEAF and SEAF) of call packets;
- SPI will be allocated from unused space;
- $NSAP = AFI + IDI + DSP$ ;
- Authority and Format Identifier (AFI) = 36;
- Initial Domain Identifier (IDI) is in X.121 format;
- Domain Specific Part (DSP) contains the E.164 number of a BSS;
- In the direction SCCP -> X.25 the interworking function should perform translation from E.164 number and/or subsystem number to X.121 number.

##### **B.1.2 SCCP**

- NSAP format is E.164;
- Transport layer and SCCP-X.25 interworking as subsequent protocols should both have their own Global Title value and Subsystem Number. (This is not visible for the BSC.)

### **B.2 Upper layer addresses**

When a Network Element is realized by distributed computer units, or when front-end processors are used to handle lower layer protocols, it is necessary (or useful, at least) to have separate TSAPs or NSAPs for each application.

### B.3 Application Entity Title (AET)

- AET is an alphanumerical string of 1 to 16 characters;
- AET = AT + AEQ
- AT = System Title + APQ;  
(CMISE/ROSE/ACSE or FTAM/ACSE);  
+ Application Process Qualifier - APQ;  
(e.g. fault management);
- It should be possible to allocate a value at least for the following APQs:
  - fault management;
  - configuration management;
  - performance management;
  - Accounting management;
  - security management.

NOTE: FTAM and CMISE should use separate application associations. However, multiplexing is possible in transport layer.

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