INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

X.160

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(07/94)

DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

PUBLIC DATA NETWORKS – MAINTENANCE

ARCHITECTURE FOR CUSTOMER NETWORK MANAGEMENT SERVICE FOR PUBLIC DATA NETWORKS

ITU-T Recommendation X.160

(Previously "CCITT Recommendation")

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation X.160 was prepared by ITU-T Study Group 7 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 1st July 1994.

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NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

ITU-T X-SERIES RECOMMENDATIONS

DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

(February 1994)

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SUMMARY

This Recommendation defines an architectural framework for a service to provide customers of network services with management capabilities. It also refers to Recommendations which directly relate to provision of the service. The service is called the Customer Network Management (CNM). It allows customers and service providers to interact by electronic means, for the transfer of management information relating to public data network services being used by a customer. Customer Network Management addresses the requirement for efficient and effective interaction between customers and service providers. A consistent reference point is provided regardless of network services being managed.

ARCHITECTURE FOR CUSTOMER NETWORK MANAGEMENT SERVICE FOR PUBLIC DATA NETWORKS

(Geneva, 1994)

1 Scope

This Recommendation is applicable to Customer Network Management (CNM) for Services provided by Public Data Networks. It may also apply to services provided by other networks. It defines the architectural framework for CNM making use of the concepts of Systems management, TMN and other related management standards. The relationship between the network service provider, network management, service management and the customer is presented in this Recommendation.

The scope of management information provided to the customer extends from specific instances of communication to a comprehensive view of all the services provided to the customer's organisation.

NOTE – Access control and security mechanisms are required and are for further study.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision, and parties to agreements based on this Recommendation are encouraged to investigate the possibility of applying the most recent editions of the Recommendations and other references listed below. Members of IEC and ISO maintain registers of currently valid International Standards. A list of currently valid ITU-T Recommendations is regularly published.

2.1 Identical Recommendations | International Standards

– CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems Management Overview.*

– CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model.*

– CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information.*

– CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines of the definition of managed objects.*

– CCITT Recommendation X.723 (1993) | ISO/IEC 10165-5:1993, *Information technology – Open Systems Interconnection – Structure of management information: Generic Management Information.*

– ITU-T Recommendation X.724 (1993) | ISO/IEC 10165-6:4, *Information technology – Structure of management information: Requirement and guidelines for Implementation Conformance Statement proformas associated with management information.*

– CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology – Open Systems Interconnection – Systems management: Object management function.*

– CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1993, *Information technology – Open Systems Interconnection – Systems management: State management function.*

– CCITT Recommendation X.732 (1992) | ISO/IEC 10164-3:1993, *Information technology – Open Systems Interconnection – Systems management: Attributes for representing relationships.*

– CCITT Recommendation X.733 (1992) | ISO/IEC 10164-4:1993, *Information technology – Open Systems Interconnection – Systems management: Alarm reporting function* plus Technical corrigendum 1 (1994).

– CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems management: Event report management function* plus Technical corrigendum 1 (1994).

– CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems management: Log control function.*

– CCITT Recommendation X.736 (1992) | ISO/IEC 10164-7:1992, *Information technology – Open Systems Interconnection – Systems management: Security alarm reporting function.*

– ITU-T Recommendation X.738 (1993) | ISO/IEC 10164-13, *Information technology – Open Systems Interconnection – Systems management: Summarization function.*

– ITU-T Recommendation X.739 (1993) | ISO/IEC 10164-11, *Information technology – Open Systems Interconnection – Systems management: Metric objects and attributes.*

– CCITT Recommendation X.740 (1992) | ISO/IEC 10164-8:1993, *Information technology – Open Systems Interconnection – Systems management: Security audit trail function.*

– ITU-T Recommendation X.745 (1993) | ISO/IEC 10164-12, *Information technology – Open Systems Interconnection – Systems management: Test management function.*

– CCITT Recommendation X.712 (1992) | ISO/IEC 9596-2:1993 – *Information technology – Open Systems Interconnection – Common management information protocol: Protocol implementation conformance statement (PICS) proforma.*

2.2   Paired Recommendations | International Standards

– CCITT Recommendation X.700 (1992) | ISO/IEC 7498-4:1989, *Management Framework for Open System Interconnection for CCITT applications.*

– CCITT Recommendation X.710 (1991) | ISO/IEC 9595:1991, *Common management information service definition for CCITT applications.*

– CCITT Recommendation X.711 (1991) | ISO/IEC 9596-1:1991, *Common management information protocol definition for CCITT applications.*

– ITU-T Recommendation X.283 (1993) | ISO/IEC 10733:1993, *Elements of Management Information Related to the OSI Network Layer.*

2.3   Additional references

– CCITT Recommendation F.400/X.400 (1992) | ISO/IEC 10021-1, *Message Handling System and Service Overview.*

– CCITT Recommendation F.435, *Message Handling: EDI Messaging Service.*

– CCITT Recommendation X.435 | ISO/IEC 10021-9, *Message Handling: EDI Messaging System.*

– ITU-T Recommendation X.282[1], *Elements of Management Information Related to the OSI Datalink Layer.*

– ITU-T Recommendation X.281[1], *Elements of Management Information Related to the OSI Physical Layer.*

– CCITT Recommendation M.3010 (1992), *Principles for a telecommunications management network.*

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[1] Presently at the stage of draft.

–   CCITT Recommendation M.3100, *Generic Network Information Model.*

–   ISO/IEC 9735: *Electronic data interchange for administration, commerce and transport (EDIFACT).*

–   ITU-T Recommendation X.161[2], *Definition of Customer Network Management services for public data networks.*

–   ITU-T Recommendation X.162[2], *Definition of Management Information for Customer Network Management service for public data networks.*

3   Definitions

For the purpose of this Recommendation, the following definitions apply:

3.1   Reference model definitions

This Recommendation makes use of the following terms defined in CCITT Recommendation X.200:

a)   open-systems;

b)   systems-management.

3.2   Management framework definitions

This Recommendation makes use of the following terms defined in CCITT Recommendations X.700 and X.701:

a)   Managed object;

b)   OSI environment;

c)   agent role;

d)   manager role;

e)   notification;

f)   managed object class.

3.3   Telecommunication Management Network definitions

This Recommendation makes use of the following terms defined in CCITT Recommendation M.3010:

a)   Telecommunication Management Network;

b)   X-interface.

3.4   Customer Network Management Service definitions

For the purpose of this Recommendation the following definitions apply:

3.4.1   Customer: The customer is the organization which has a business relationship with the service provider for the provision of network services to one or more end users.

3.4.2   CNM: CNM is a service which provides customers with the ability to access and in some cases modify management information relating to the services provided to them by the network.

3.4.3   CNM interface: A CNM interface is an interface between a Customer's Management Systems and a Service Provider's CNM System for the purpose of CNM.

3.4.4   CNM Service: A CNM service is a capability that is provided to the customer across the CNM interface by using CMIS, OSI Systems management functions and appropriate management information. Alternatively, it can be provided by exchanging EDI forms over MHS.

3.4.5   CNM Reference Point: A CNM Reference Point defines a service boundary between the Customer's Management Function and the Service Provider's CNM Function.

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[2]   Presently at the stage of draft.

3.4.6   CNM user: The Customer Network Management user is a person who is authorised to use the CNM services and through these participates in the management of the service provided to the customer by the network.

3.4.7   Customer's Management Function: The Customer's Management Function is the function that processes information related to CNM.

3.4.8   Service Provider's CNM Function: The Service Provider's CNM Function is the function that provides the CNM Services.

3.4.9   Customer's Management System: The Customer's Management System is the system that performs the Customer's Management Functions.

3.4.10   Service Provider's CNM System: The Service Provider's CNM System is the system that performs the Service Provider's CNM Functions.

4   Abbreviations

For the purpose of this Recommendation the following abbreviations are used:

CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CNM	Customer Network Management
CNMC	Customer Network Management interface using CMIP
CNME	Customer Network Management interface using EDI/MHS
DMI	Definition of management information
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange For Administration, Commerce and Transport
GDMO	Guidelines for the Definition of Managed Objects
MHS	Message Handling Systems
MS	Message Store
MTA	Message Transfer Agent
PDN	Public Data Network
SMASE	Systems Management Application Service Elements
TMN	Telecommunication Management Network
OSF	Operations System Function
OS	Operations System
CNMA	Architecture for Customer Network Management
CNMS	Customer Network Management services for public data networks
CNMI	Management Information for Customer Network Management service for public data networks

5   Conventions

The term **Management System** used in this Recommendation refers to either a Customer's Management System or a Service Provider's CNM System.

6 Overview of the Customer Network Management Service

6.1 Relationship between the Architecture, the Services and the Management Information documents

This Recommendation is one of a set of three Recommendations which directly specify the CNM:

- X.160 (CNMA) defines the architecture for CNM;

- X.161 (CNMS) defines the management services for CNM;

- X.162 (CNMI) defines the management information for CNM.

    NOTE – Draft ITU-T Recommendations X.161 and X.162 are to be approved.

6.2 Overview of CNM

The CNM provides customers with the ability to access, and in some cases modify, management information relating to the services provided by a network. For example, a customer may notify the provider of a service affecting fault and the provider may keep the customer informed of progress on repairing the fault, ultimately sending notification when the fault is cleared.

CNM may only be accessed by authorised customers. The service provider will take all necessary steps to ensure that an agreed level of security is maintained.

The management information provided to the customer is generally different from that used by the service provider to manage the network. It is less detailed since the customer is only concerned with management information relating to provision of its own service and is not concerned with the precise details of how the service is provided.

By accessing management information, an authorised customer will be able to indirectly monitor and control the resources involved in the provisioning of the network service.

7 CNM architecture

7.1 Overview of the functional architecture

CNM functional architecture is based on several function blocks. These blocks provides general functions needed for the provision of CNM. The CNM function block and customer's management function block which exchange management information are separated by the CNM reference point. The CNM function may be further refined in term of the functional components that comprise it.

The functional architecture identifies that a reference point may exist between the CNM function and the Network Management function. Nevertheless, this reference point is not within the scope of CNM Recommendations.

The CNM functional Architecture is shown in Figure 1

The CNM function may include the following functional components:

- CNM information;

- access control;

- management CNM application; and

- mapping.

The CNM information component contains a customer view of network services and other services management related information.
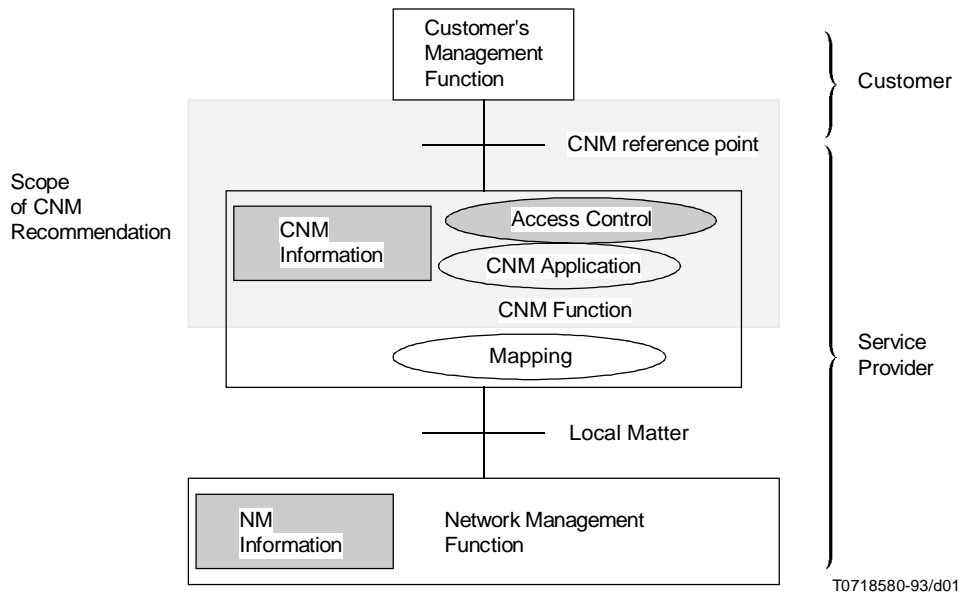
FIGURE 1/X.160

Functional Architecture of Customer Network Management

The access control functional component may include mechanism to restrict access to authorized customers. If access is not permitted, the service provider notifies the requester that access has been refused. At the same time, the reason for the refusal may be sent to the customer. The specification of this access control component is for further study.

The CNM application functional component will actually implement the CNM services that can be found in CNMS. The CNM application functional component acts always in the agent role. This functional component is not subject to standardization within the CNM Recommendations.

The mapping functional component may be required in order to provide the customer oriented view of the network management information. The service provider's view and the details of the mapping are beyond the scope of this Recommendation.

7.2   Physical Architecture

The CNM reference point does not itself define the protocol suite to be used for the exchange of information between function blocks. Currently, CNM services may be provided across two types of CNM interface: the CNMC interface or the CNME interface. These two interfaces are described below. A service provider may choose to implement only one or both interfaces. Other types of interfaces may be defined in the future, including short stacks.

The interfaces available with particular services are indicated in CNMS.

Since the reference point between the CNM function and the Network Management function is not part of CNM, the specification of the corresponding interface is a local matter and is outside the scope of this Recommendation and the associated Recommendations CNMS and CNMI.

7.2.1   Protocol at the CNMC interface

The CNMC interface is generally applicable. In particular, it is used where the supporting protocols must be interactive (with response time constraints), for meeting fault management and real time monitoring requirements.

The CNMC interface uses the CMIP protocol and provides/allows:

–   real time/asynchronous notification;

–   object oriented mechanism;

–   re-use of OSI Systems management software.

Further information on the CNMC interface is provided in Annex A.

7.2.2   Protocol at the CNME interface

The CNME interface is used where the supporting protocols need not be interactive/real time or the CNM service requires a contractual interaction between the customer and the service provider.

The CNME interface uses EDI with MHS as the supporting protocol and provides/allows:

–   re-use of existing EDI customer premises equipment;

–   buffering of messages;

–   use of mail boxes, thus avoiding the requirement to support the establishment of multiple associations between the CNM Customer and the CNM Provider;

–   protection against communication failures.

Further information on the CNME interface is provided in Annex B.

7.2.3   Example of a physical architecture

Depending on the services required, implementation of the functions may lead to a variety of physical configurations.

This example (see Figure 2) is only provided to assist in understanding how CNM may be implemented.
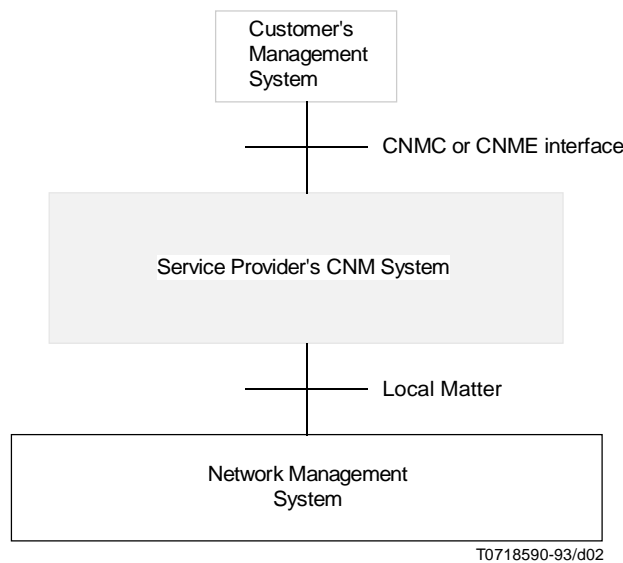
FIGURE 2/X.160

Example of physical architecture

7.3   Relationship of CNM and TMN

CNM may be provided within a TMN or non TMN environment.

Within a TMN environment, an Illustration of relationship between CNM and TMN Functional and Physical Architecture is shown in Figure 3.
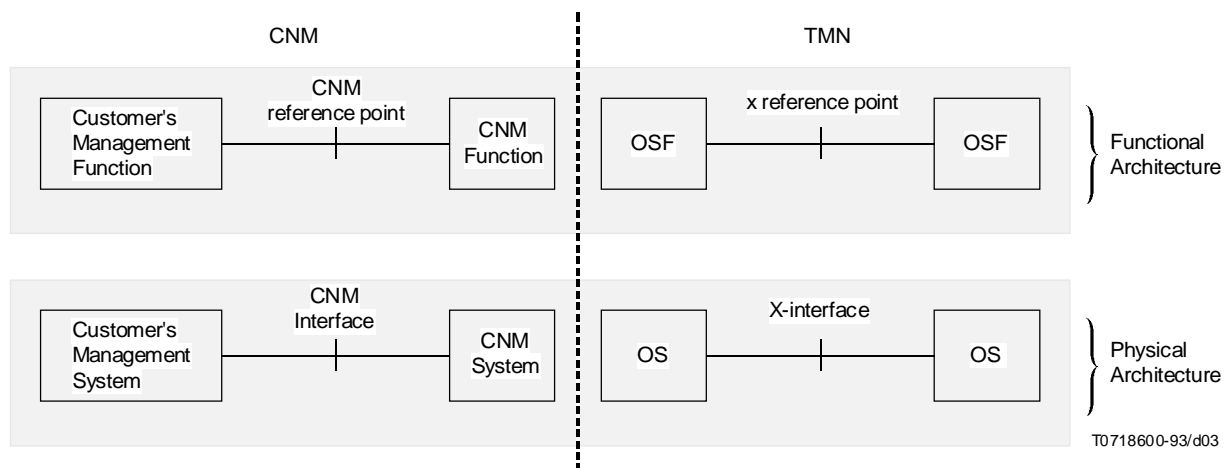
FIGURE 3/X.160

**Illustration of relationship between CNM and TMN
Functional and Physical Architecture**

Within the TMN environment the following relationships apply:

a) The Customer's Management Function and the CNM Function play the role of Operations System Functions (OSFs) that communicate via the x reference point;

b) The Customer's Management System and the Service provider's CNM System play the role of Operations Systems (OSs) that communicate via the X-interface;

c) In the TMN environment, the CNM information is part of the information model for the X-interface;

d) The protocols suites used in the TMN environment (e.g. CMIP) are also used by the customer's management system and the Service Provider's CNM System;

7.4 Relationship between CNM and other Standards/Recommendations

The relationship between the various Standards and/or Recommendations to be used for CNM is depicted in Figure 4. The different categories of Standards and/or Recommendations to be used for CNM are:

– those defining the architecture (CNMA, Recommendations X.700, X.701 and M.3010);

– those defining the services (CNMS);

– those defining the communication of management information (System management functions, CMIS, CMIP, Recommendation X.400/F.400);

– those defining the management information, (CNMI, EDIFACT, Management Information Model, GDMO, DMI, GMI, Recommendations M.3100, M.3020, X.283, draft X.282 and draft X.281).

7.5 Relationship to Systems Management

When CNM is provided across a CNMC interface, the concepts of the management communication and the encapsulation of managed information in a managed object are used as defined in the Systems management. Management Functions and management information will be used for defining CNM services, as far as the definitions can be applied. However, subclassing or adding necessary properties is permitted for the provision of CNM.
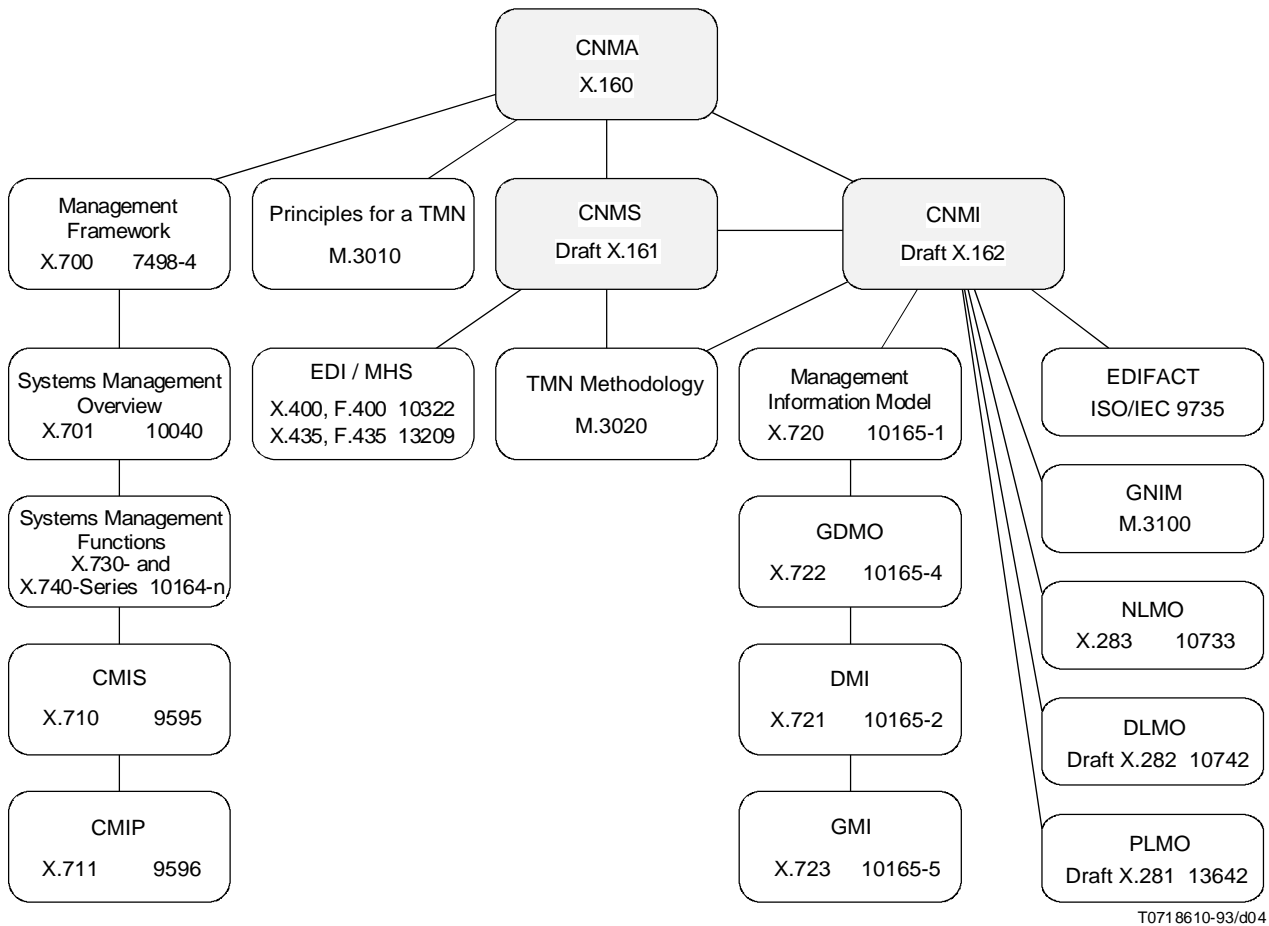
FIGURE 4/X.160

Relationship between CNM Recommendation and other Recommendations/Standards

7.6   Relationship to Layer Management

Management information defined in these Recommendations uses OSI related Management information for OSI layers (e.g. Recommendations X.283, X.282 and X.281) whenever possible.

7.7   Relationship to Message Handling Systems

When CNM is provided across a CNME interface, the Message Handling System provides a store and forward system to carry the EDIFACT interchanges with the services defined in the ITU-T Rec. F.400 / X.400 | ISO/IEC 10322 and ITU-T Rec. F.435/X.435.

7.8   Relationship to EDI

When CNM is provided across a CNME interface, the management information is conveyed using EDI messages when transferring via the Message Handling System. These EDI messages use the syntax and format defined in EDIFACT (ISO/IEC 9735).

8   Conformance to CNM

8.1   Conformance to CNMC

When the CNMC interface is used, an implementation for which conformance to a CNM service or a set of CNM services is claimed shall be conformant to the relevant conformance clauses in ITU-T Recommendation X.161 (e.g. conformance to International Standardized Profiles) and in ITU-T Recommendation X.162 (e.g. Managed Object support).

Systems implementing a CNMC interface shall conform to Annex A of CCITT Recommendation X.701.

8.2   Conformance to CNME

When the CNME interface is used, an implementation for which conformance to a CNM service or set of CNM services is claimed shall be conformant to the relevant conformance clauses in ITU-T Recommendation X.161 (e.g. conformance to International Standardized Profiles) and in ITU-T Recommendation X.162 (e.g. EDI form support).

Annex A

CNMC Interface

(This annex does not form an integral part of this Recommendation)

A.1   Use of CNMC Interface

A single CNM managing system, located on the customer premises, communicates across a CNM interface (named CNMC interface) to one or more managed systems located in the public data network using at least one association for each of the managed systems.

A single CNM Managed System may support simultaneous associations with several Managing Systems of different Customers.

A.2   OSI Systems Management Model

Each instance of management communications is modelled using the OSI Systems Management model specified in CCITT Recommendation X.701. It models the mechanism by which managed-object notifications and operations are communicated between open systems.

The manager role of the OSI System Management Model is supported for CNM by the Customer's Management System and the agent role is supported by the Service Provider's CNM System.

The interface used to access the CNM may be independent of the data communication service being managed.

Annex B

CNME Interface

(This annex does not form an integral part of this Recommendation)

B.1   Use of CNME Interface

In the MHS model, the CNM interface is named CNME interface and is realized (as shown in Figure B.1) by a subset of the functions defined by the Message Handling Systems (MHS). In this context, the purpose of MHS is to convey CNM information between the Customer's Management System and the Service Provider's CNM System in a store-and-forward manner. This annex describes such a scenario.
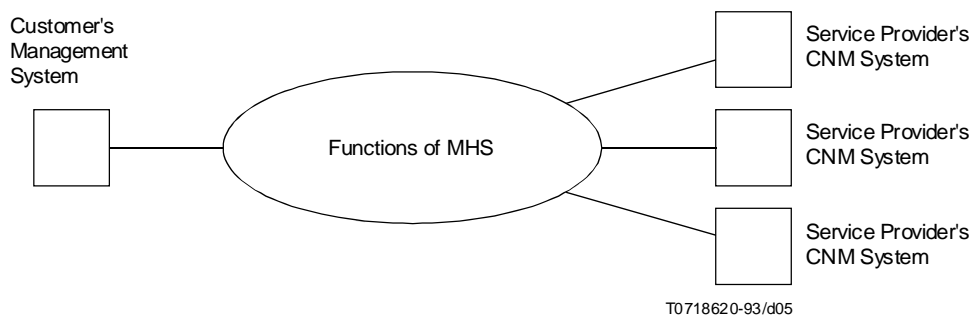
FIGURE B.1/X.160

CNME Interface Represented By MHS

The operator of the MHS may or may not be the same operator as the CNM Service provider.

In the context of CNM, the MHS comprises the Message Transfer System (MTS), user agents (UA) and message stores (MS). The MHS, in the context of CNM, does not make use of some functional entities (e.g. Access Units) defined in the X.400 model. The MHS-users interact with the UAs. The UAs, MSs and the MTS cooperate with one another to provide the transfer of management information in a store-and-forward manner (see Figure B.2).

The MTS comprises at least one functional object named Message Transfer Agent (MTA). One MTA provides one link in the MTS's store-and-forward chain.
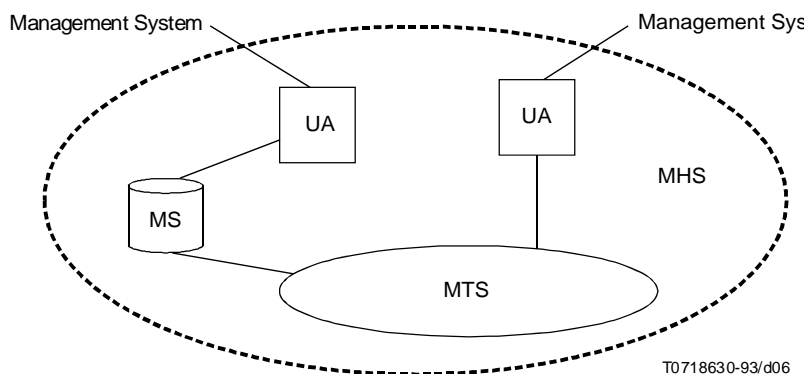

FIGURE B.2/X.160

The Message Handling System for CNM

B.2　CNME Transfer format

CNM information is transferred between the Customer's Management System and the Service Provider's CNM System using EDI messages defined in CCITT Recommendation X.435. These EDI messages are exchanged using the MHS supporting protocol and are defined in ISO 9735 (EDIFACT).

B.3　Characteristics of Management Systems

The Customer's Management System and the Service Provider's CNM System of the MHS model have certain characteristics. Examples are:

– The sender of management information can begin the transfer even if the receiver is "off-line," since the information is carried in a store-and-forward manner.

– The Customer's Management System and the Service Provider's CNM System may or may not use the same OSI messaging protocols. The Customer's Management System may choose one scenario (one of those presented in B.4) while the Service Provider's CNM System may choose the same or otherwise.

B.4　Scenarios for Management System and MHS interaction

This subclause specifies scenarios where a Customer's Management System and the Service Provider's CNM System can interact with MHS.

B.4.1　Interaction Using P7 Protocol

In Figure B.3, the Management System operates the CNM functions and UA that may be co-located within the same equipment (Management System). The interaction between them is a local matter depending on the Management System. The interaction between the UA and the MS is defined by the P7 protocol of the X.400-Series Recommendations.
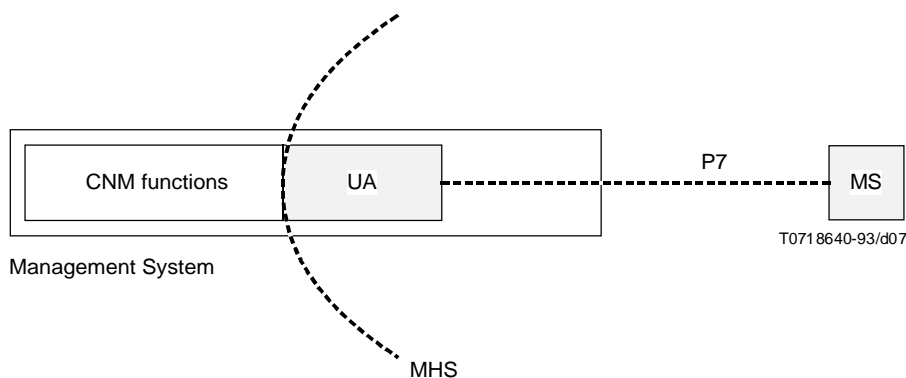

FIGURE B.3/X.160

Interaction using X.400 P7 Protocol

B.4.2　Interaction Using P3 Protocol

In Figure B.4, the Management System operates the CNM functions and UA that may be co-located in the same Management System's equipment. The interaction between them is a local matter depending on the Management System. The UA interacts with the MTA using the P3 protocol of the X.400-Series Recommendations.
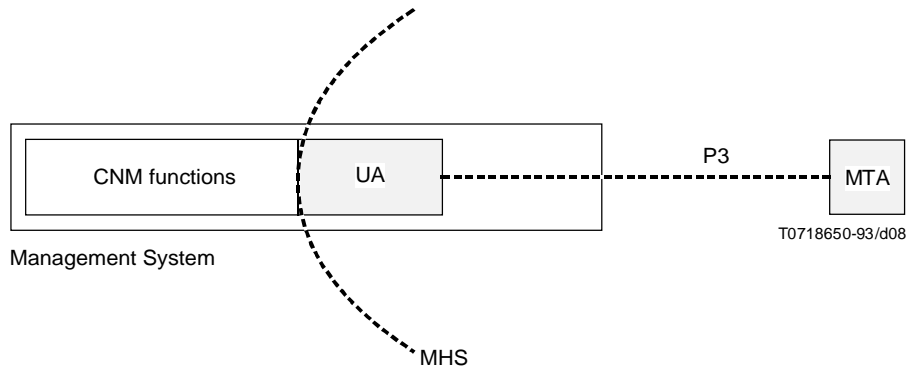
FIGURE B.4/X.160

Interaction using X.400 P3 Protocol

B.4.3   Interaction Using P1 Protocol

In Figure B.5, the Management System operates the CNM functions, UA and MTA, that may be co-located in the same equipment (Management System). The interaction between them is a local matter depending on the Management System. The two MTAs interact using the P1 protocol of the X.400-Series Recommendations. The two MTAs may belong to different MHS administration domains. The MTA within the Management System can serve other UAs that may or may not be used for management purposes.
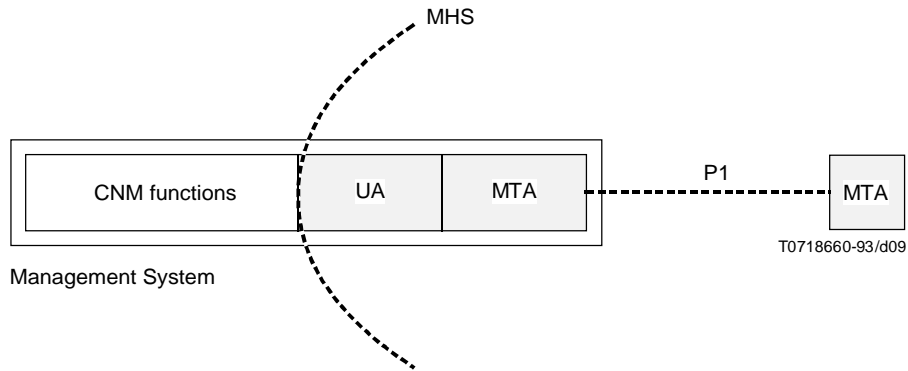

FIGURE B.5/X.160

Interaction using X.400 P1 Protocol