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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

Public data networks – Maintenance

## Network-network management services for data networks

ITU-T Recommendation X.171

(Formerly CCITT Recommendation)

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**ITU-T Recommendation X.171**

# Network-network management services for data networks


## Summary

This Recommendation defines management services exchanged at the boundary between two networks based on the Network-Network Management (NNM) architecture defined in ITU-T X.170. The defined management services are generic and can be applied to many kinds of service networks. They are described irrespective of underlying management protocols.



## Source

ITU-T Recommendation X.171 was prepared by ITU-T Study Group 7 (1997-2000) and approved under the WTSC Resolution 1 procedure on 31 March 2000.

## FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

## NOTE

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

## INTELLECTUAL PROPERTY RIGHTS

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

## CONTENTS

**ITU-T Recommendation X.171**

# Network-network management services for data networks

## 1 Scope

This Recommendation is one of a set of Recommendations dealing with Network-Network Management Interface for data networks, which include:

– the definition of the architectural framework to exchange management information for the provision of total Customer Network Management (CNM) Services by the carrier accommodating its subscribers;

– the description of management services between two networks;

– the definition of management information elements, such as the managed object (MO) classes, attribute types, action types, notification types;

– compliance requirements placed on other ITU-T Recommendations definitions;

– conformance requirements.

When a carrier provides CNM Services, there may be requirements to exchange management information or operations with its adjacent network related to internetwork communication. This Recommendation resolves such requirements for the provision of total management services at the NNM interface.

This Recommendation makes use of the principles of the CNM and the TMN X-Interface. Within this overall framework, it meets requirements specific to data networks and the provision of CNM Services.

## 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; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

### 2.1 Identical Recommendations | International Standards

– ITU-T X.701 (1997) | ISO/IEC 10040:1998, *Information technology – Open Systems Interconnection – Systems management overview*.

– ITU-T X.710 (1997) | ISO/IEC 9595:1998, *Information technology – Open Systems Interconnection – Common Management Information Service*.

– ITU-T X.711 (1997) | ISO/IEC 9596-1:1998, *Information technology – Open Systems Interconnection – Common Management Information Protocol: Specification*.

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

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

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

– ITU-T X.742 (1995) | ISO/IEC 10164-10:1995, *Information technology – Open Systems Interconnection – Systems management: Usage metering function for accounting purposes*.

### 2.2 Additional references

– ITU-T M.3010 (1996), *Principles for a telecommunications management network (TMN)*.

– ITU-T M.3020 (1995), *TMN interface specification methodology*.

– ITU-T M.3400 (1997), *TMN management functions*.

– ITU-T Q.822 (1994), *Stage 1, stage 2 and stage 3 description for the Q3 interface – Performance management*.

– ITU-T X.160 (1996), *Architecture for customer network management service for public data networks*.

– ITU-T X.161 (1997), *Definition of customer network management services for public data networks*.

– ITU-T X.170 (1999), *Network-network management architecture for data networks*.

– ITU-T X.790 (1995), *Trouble management function for ITU-T applications*.

## 3 Definitions

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

### 3.1 ITU-T X.160 definitions

This Recommendation makes use of the following terms defined in ITU-T X.160:

– Customer Network Management (CNM);

– CNM Service.

### 3.2 ITU-T X.170 definitions

This Recommendation makes use of the following terms defined in ITU-T X.170:

– Network-Network Management (NNM);

– NNM agent;

– NNM Interface;

– NNM manager;

– NNM service provider.

### 3.3 ITU-T X.701 Management Framework definitions

This Recommendation makes use of the following terms defined in ITU-T X.701 | ISO/IEC 10040:

– agent;

– managed object;

– manager;

– notification.

### 3.4 ITU-T X.710 CMIS definitions

This Recommendation makes use of the following terms defined in ITU-T X.710 | ISO/IEC 9595:

– Attribute;

– M-REPORT operation.

## 4 Abbreviations

This Recommendation uses the following abbreviations:

CMISE Common Management Information Service Element

CNM Customer Network Management

EDI Electronic Data Interchange

EFD Event Forwarding Discriminator (see also ITU-T X.721 | ISO/IEC 10165-2)

MO Managed Object

NNM Network-Network Management

NNMI Network-Network Management Interface

ODMA Open Distributed Management Architecture

QoS Quality of Service

SNMP Simple Network Management Protocol

## 5 Conventions

This Recommendation does not use any specific conventions.

## 6 Overview of NNM Services

An NNM Service is a capability that is provided to a CNM Service provider across an NNM Interface. An NNM Service is provided, for example, by using CMISE, OSI Systems Management Functions and appropriate management information. Alternatively, an NNM Service can be provided based on EDI, ODMA and SNMP.

The services currently defined in this Recommendation are those services which are considered to be of most importance for NNM service users, and are therefore priorities for provision. Further services are identified but are considered to be of lower priority. Other NNM Services may be added in future and additional business requirements have been identified.

The NNM Services defined in this Recommendation are, for convenience, classified into five groups:

– Fault Management;

– Accounting Management;

– Configuration Management;

– Performance Management;

– Security Management.

This Recommendation should be read in conjunction with ITU-T X.170 which defines the NNM architecture.

## 7 NNM Services definitions

The following clauses describe the NNM Services that may be provided across the NNM Interfaces.

When the service is provided across the NNM Interface, the description is made in accordance with the TMN Interface specification methodology, i.e., ITU-T M.3020. In the case of the CMISE-based interface, the term NNM Service is fully equivalent to the term TMN Management function set and the associated management information may be defined in another ITU-T Recommendation. When the service is provided across another interface, the terminology is not equivalent to CMISE, but made as similar as possible.

### 7.1 Fault Management

#### 7.1.1 NNM Alarm Notification Service

##### 7.1.1.1 Service definition

The NNM Alarm Notification Service provides an NNM manager with the capability to be notified when a failure or event occurred which affects internetwork communication of subscribers.

Alarms related to internetwork communication may be notified to the NNM manager from the NNM agent in another network involved in it.

##### 7.1.1.2 Functional description

The following functions are associated with the Alarm Notification Service; some of them are optional, as shown in Table 1:

a) *Report Alarm Function*

This function sends an NNM manager alarms related to internetwork communication. Alarms may include communication faults, degradation of QoS, processing error of the network, equipment faults and abnormality of communication environment. The NNM agent informs the NNM manager of a spontaneous occurrence of an alarm.

b) *Report State Change Function*

This function sends an NNM manager event reports related to state change of internetwork communications of a specific NNM manager. The NNM agent informs the NNM manager of a state change.

c) *Inhibit/Allow Alarm and State Change Reporting Function*

This function controls the suspension and resumption of alarm reporting by the NNM manager's request. The NNM manager instructs the NNM agent to suspend/resume alarm and state change reporting.

d) *Condition Alarm and State Change Reporting Function*

This function allows to modify criteria for reporting events (alarms or state change reports). Criteria may include the time of events, the type of events, the resource name from which alarms are emitted, the type of problem or cause, and severity of the fault. The NNM manager instructs the NNM agent to assign filtering criteria with the values it provides.

e) *Request Alarm and State Change Reporting Conditions Function*

This function allows the NNM manager to request the NNM agent to send the current assignment of the filtering criteria it specifies.

##### 7.1.1.3 NNM Alarm Notification Service description

The NNM Alarm Notification Service is described in Table 1.

**Table 1/X.171 – NNM Alarm Notification Service**

| Function | Support | Purpose |
|---|---|---|
| Report Alarm | M | Alarm Reporting |
| Report State Change | O | State Change Reporting |
| Inhibit/Allow Alarm and State Change Reporting | O | Suspend/Resume Alarm and State Change Reporting |
| Condition Alarm and State Change Reporting | O | Initiate/Terminate Alarm and State Change Reporting<br>Set the EFD attributes |
| Request Alarm and State Change Reporting Conditions | O | Get the EFD attributes |

Alarm Reporting: There are several types of alarm notifications as defined in ITU-T X.733 | ISO/IEC 10164-4:

– Communications alarm;
– Quality of service alarm;
– Processing error alarm;
– Equipment alarm;
– Environment alarm.

The alarms provide a number of mandatory and optional parameters. For information, representative active parameters including the following:

– Event type;
– Event time;
– Probable cause;
– Specific problems;
– Perceived severity.

Complete lists of these parameters are contained in Table 1/X.733.

State Change Reporting: The state change reports also provide a number of mandatory and optional parameters. For information, representative parameters include the following as defined in ITU-T X.731:

– Event type;
– Event time;
– Attribute identifier;
– New attribute value.

Complete lists of these parameters are contained in Table 2/X.731.

Suspend/Resume Alarm and State Change Reporting: This service allows the NNM manager to only modify the administrative state of the EFD object, which may be pre-defined.

The Suspend Alarm and State Change Reporting Service allows the NNM manager to inhibit the reporting of alarms and state change by setting the administrative state attribute to "locked". This service supports the Inhibit Alarm and State Change Reporting Function.

The Resume Alarm and State Change Reporting Service allows the managing system to allow the reporting of alarms and state change by setting the administrative state attribute to "unlocked". This service supports the Allow Alarm and State Change Reporting Function.

Initiate/Terminate Alarm and State Change Reporting: The Initiate Alarm and State Change Reporting Service allows the NNM manager to create an instance of the EFD object class in the Service Provider's NNM agent. This service supports the Condition Alarm Reporting Function identified in this Recommendation.

The Terminate Alarm and State Change Reporting Service allows an NNM manager to delete an instance of the EFD object class in the Service Provider's NNM agent. This service supports the Condition Alarm Reporting Function identified in this Recommendation.

When an *a priori* agreement exists between the NNM manager and the service provider NNM agent for pre-defined Ends, the Initiate and Terminate Alarm and State Change Reporting Services may be omitted. In this case, the Alarm and State Change Report Service starts automatically at system initialisation.

Set the EFD attributes Service: The Set EFD attributes Service is a service that allows an NNM manager to set the attribute values of a specified instance of an EFD object class in the NNM agent, thus allowing it to alter the criteria used to determine those alarm and state changes that are reported. This service supports the condition alarm reporting function identified in this Recommendation.

The attributes that can be handled to change the criteria of the event discrimination by an NNM manager operation are listed in ITU-T X.734 | ISO/IEC 10164-5.

Get the EFD attributes Service: The Get EFD attributes Service is a service that allows an NNM manager to get the attributes values of a specified instance of an EFD managed object class in the Service Provider's NNM agent. This service supports the Request Alarm and State Change Reporting Conditions Function defined in this Recommendation.

### 7.1.2 NNM Fault History Service

#### 7.1.2.1 Service definition

The NNM Fault History Service provides an NNM manager with the capability to retrieve its own fault history log records stored at the NNM agent side. The report contains information related to failure or event occurrence which affect internetwork communication.

This service may be used, for example, for particular events with low severity which have been recorded or logged within the fault history log but which have not been sent to the NNM manager.

Fault history logs related to the NNM manager's internetwork communication may be accumulated in the NNM agent and may be accessed from the NNM manager. This service may be provided if the network of the NNM agent has registration information or service ordering data for internetwork communication. In that case, the service is provided on a demand basis.

#### 7.1.2.2 Functional description

The following functions are associated with the Fault History Service. Some of them are optional, as shown in Table 2:

a) *Retrieve Fault History Log Records Function*

This function accumulates alarms related to an NNM manager in the form of a fault log record. Log records include communications faults; degradation of QoS, processing error of the network, equipment faults, abnormality of communication environment, creation/deletion of the NNM manager dedicated resources and change of their states. The NNM manager may retrieve his own fault history log records stored in the NNM agent.

b) *Selection of Specific Fault Log Records Function*

This function selects specific fault log records based on requested filtering condition. An NNM manager may select specific fault log records that satisfy filtering conditions.

c) *Modify the Criteria for Logging Fault Log Records Function*

This function modifies criteria for logging fault log records. An NNM manager may instruct the NNM agent to modify the criteria for logging fault log records.

**Table 2/X.171 – NNM Fault History Service**

| Function | Support | Purpose |
|---|---|---|
| Retrieve Fault History Log Records | M | Fault Log Retrieval |
| Selection of Specific Fault Log Record | O | Fault Log Selective Retrieval |
| Modify the Criteria for Logging Fault Log Record | O | Fault Log Logging Criteria Change |

### 7.1.3 NNM Trouble Report Service

Trouble Report Service definitions shall be based on ITU-T X.790.

### 7.1.4 NNM Loop Set-up Service

#### 7.1.4.1 Service definition

The NNM Loop Set-up Service provides an NNM manager with the capability to set a loop-back point in the network, trunk lines between two networks for the purpose of loop-back test.

At the both ends of the internode trunk lines, a loop-back point may be set. This operation is performed on a demand basis.

#### 7.1.4.2 Functional description

The following functions are associated with the Loop Set-up Service. Some of them are optional, as shown in Table 3:

a) *Set/Reset Loop-Back Point Function*

This function controls the set and reset of a loop-back point. The position of the loop-back point can be specified by a request. A loop-back point can be set at either end of the two networks.

NOTE – The service provider only sets a loop-back point, and the NNM manager DTE itself executes tests by sending and receiving test signals. Any kind of test that uses loop-back point may be performed, e.g., a loop-back test or echo tests.

**Table 3/X.171 – NNM Loop Set Up Service**

| Function | Support | Purpose |
|---|---|---|
| Set/Reset Loop-Back Point | M | Loop-Back Point Activation/Deactivation |

### 7.1.5 NNM Test Host Service

This service is for further study.

### 7.1.6 NNM Protocol Monitoring Service

#### 7.1.6.1 Service definition

At the internode trunks and the remote DTE subscriber line, protocol sequences may be monitored. This operation is performed on a demand basis.

Specific procedures are for further study.

## 7.2 Configuration Management

### 7.2.1 NNM Configuration Inquiry Service

This service is for further study.

### 7.2.2 NNM Reconfiguration Service

#### 7.2.2.1 Service definition

The NNM Reconfiguration Service provides an NNM manager with the capability to modify parameters associated with configurable aspects of their network services, and in some cases, to create and delete configurable resources. Reconfiguration may take effect immediately as a result of direct action by the NNM manager or on a delayed basis as a result of actions by the NNM agent. In both cases the NNM agent may implement security mechanisms.

#### 7.2.2.2 Functional description

The following functions are associated with the Reconfiguration Service. Some of them are optional, as shown in Table 4.

a) *Set Configuration Parameters Function*

The immediate reconfiguration function is associated with reconfiguration service and it is mandatory. This function allows the NNM manager to directly and immediately modify the configuration of the NNM agent resources. The NNM agent resources that can actually be modified will be defined on a bilabial agreement basis. By this function, resources are not created, nor deleted.

b) *Report Configuration Change Function*

This function is used for the NNM manager to confirm that the resources to be modified have been set with the values it provides.

c) *Control Delayed Reconfiguration Function*

This function modifies the configuration of the NNM manager resources or service profiles on a delayed basis. Creation and deletion of resources may be also allowed. Modification may be negotiated between the NNM agent and an NNM manager. For this purpose, ITU-T X.161 Service Request Service shall be used.

**Table 4/X.171 – NNM Service Reconfiguration Service**

| Function | Support | Purpose |
|---|---|---|
| Set Configuration Parameters | M | |
| Report Configuration Change | O | Configuration Setting |
| Control Delayed Reconfiguration | O | Configuration Setting Service Request<br>Configuration Setting Reporting |

The configuration setting service allows an NNM manager to get and modify the NNM manager resources.

The configuration setting reporting service is used by the NNM agent to confirm that the NNM manager resources to be modified have been set with the values it provides.

NOTE 1 – The Set Configuration Parameter function is mandatory for the NNM interface.

NOTE 2 – The Control Delayed Reconfiguration function is mandatory for the NNM interface.

### 7.2.3 NNM Ordering Service

#### 7.2.3.1 Service definition

The NNM Ordering Service provides an NNM manager with the capability to request and manage orders with the NNM agent.

Capabilities include:

– creating service orders with scheduling requirements;

– receiving provisioning status;

– amending service orders (where appropriate);

– attaching NNM manager reference information; and

– creating, modifying and deleting PVCs.

Ordering of service items that are not chargeable or that the NNM agent specifies may take effect immediately as a result of direct action by the NNM manager or on a delayed basis as a result of direct actions by the NNM agent. Otherwise, ordering shall take effect after negotiation between the NNM manager and the NNM agent. In both cases the NNM agent may implement a security mechanism.

#### 7.2.3.2 Functional description

In the case of ordering service on a delayed basis, negotiation and validation mechanisms may be implemented by the NNM agent. These mechanisms may be provided using the Service Request service defined in ITU-T X.161.

The following functions are associated with the Ordering Service. Some of them are optional, as shown in Table 5.

a) *Control Immediate Ordering Function*

This function directly and immediately modifies service profile items that are specified by the NNM manager.

b) *Control Negotiated Ordering Function*

This function creates and modifies a service ordering items through negotiation and validation mechanisms.

For controlling this function, ITU-T X.161 Service Request Function shall be used.

c) *Control Negotiated Cancellation Function*

This function deletes and suspends on-going service orders or operational services through negotiation and validation mechanisms.

For controlling this function, ITU-T X.161 Service Request Function shall be used.

**Table 5/X.171 – NNM Ordering Service**

| Function | Support | Purpose |
|---|---|---|
| Control Immediate Ordering | O | Ordering of Service Items Through Direct Access |
| Control Negotiated Ordering | M | Ordering of Service Items Through Negotiation and Validation |
| Control Negotiated Cancellation | M | Cancellation of on-going Service Orders or Operational Services |

### 7.2.4 NNM Inventory Inquiry Service

This service is for further study.

## 7.3 Accounting Management

### 7.3.1 NNM Usage Metering Accounting Service

#### 7.3.1.1 Service definition

The NNM Usage Metering Accounting Service provides an NNM manager with the capability to retrieve usage records of a specific subscriber. These records are automatically created as a consequence of the occurrence of accountable events internetwork communication. An accounting record contains information elements and counters that identify the subscriber, the used resources, the usage time and the usage volume.

The NNM manager may retrieve usage information related to the internetwork communication on a demand basis.

#### 7.3.1.2 Functional description

a) *Retrieve Accounting Records Function*

The Retrieve Accounting Records function is associated with NNM Usage Metering Accounting Service (see Table 6) and is mandatory. Through this function, an NNM manager may retrieve its usage accounting records stored in the NNM agent. It may select records by using the filtering mechanism.

**Table 6/X.171 – NNM Usage Metering Accounting Service**

| Function | Support | Purpose |
|---|---|---|
| Retrieve Accounting Records | M | Usage Metering Record Retrieval |

## 7.4 Performance Management

### 7.4.1 NNM Traffic Information Service

#### 7.4.1.1 Service definition

This service provides an NNM manager with capability to retrieve traffic information (statistical data). It may control how to collect traffic data, as well as specify what traffic item is required.

The NNM manager may retrieve some of traffic information items. The management information is transferred either on a demand basis or on a periodic basis.

#### 7.4.1.2 Functional description

The following functions are associated with the Traffic Information Service. Some of them are optional, as shown in Table 7.

Traffic data collection refers to the ability of the NNM agent to collect the various traffic data relating to a single monitored entity in the network. The following specific functions are associated with the collection activity:

a) *Assign Traffic Data Collection Interval Function*

This function assigns the duration of the traffic data collection interval for a given entity. By creating an object for collecting data (current data object), this interval is assigned.

b) *Assign History Duration Function*

This function assigns the duration during which to maintain a specific record of traffic historical data. The maximum number of records is based on the agreement between two networks. The stored data are kept for a certain period also agreed by two networks.

c) *Retrieve Traffic Data Function*

By this function current or historical traffic data information on a given monitored entity or set of monitored entities is retrieved.

NOTE – Traffic data that may be handled by this service are based on the agreement between two networks.

Examples are:

– callAttempt;
– callConnected;
– callTimeouts;
– clearTimeouts;
– dataPacketsReceived;
– dataPacketsSent;
– octetsReceivedCounter;
– octetsSentCounter;
– protocolErrorsAccusedOf;
– protocolErrorsDetectedLocally;
– service provider InitiatedDisconnects;
– service provider InitiatedResets;
– resetTimeouts;
– remotelyInitiatedResets ;
– remotelyInitiatedRestarts;
– segmentsReceived;
– segmentsSent.

d) *Suspend/Resume Traffic Data Collection Function*

Through this function, an NNM manager may instruct the NNM agent to suspend/resume the traffic data collection activity for a given monitored entity.

e) *Schedule Traffic Data Collection Function*

This function controls the scheduling the traffic data collection activity for a given entity or set of entities. For the time being, only the daily scheduling by which an NNM manager may collect traffic data at the same hour and minute every day, and the duration scheduling, by which an NNM manager may specify the start time and stop time for traffic data collection, are provided.

f) *Suppress Zero Function*

This function suppresses all zero data in the requested historical data on the agent side, and sends them to the NNM manager.

**Table 7/X.171 – NNM Traffic Information Services**

| Functions | Support | Purpose |
|---|---|---|
| – Assign Collection Interval<br>– Assign History Duration<br>– Retrieve Traffic Data | M | Traffic Data Retrieval |
| Suspend/Resume Traffic Data Collection | O | Traffic Data Collection Suspension/Resumption |
| Schedule Traffic Data Collection | O | Traffic Data Collection Scheduling |
| Suppress All Zero Data | O | Zero Suppression |

### 7.4.2 CNM Quality of Service Information Service

#### 7.4.2.1 Service definition

The NNM manager may retrieve some of traffic information items. The management information is transferred either on a demand basis or on a periodic basis. Specific procedures are for further study.

#### 7.4.2.2 Functional description

For further study.

### 7.4.3 NNM Network Statistics Service

#### 7.4.3.1 Service definition

The NNM Network Statistics Service allows the NNM manager to receive aggregated information about the traffic inside the NNM agent's network and about the usage of the components of the network.

#### 7.4.3.2 Functional description

The NNM manager may retrieve some processed traffic information items. The management information is transferred either on a demand basis or on a periodic basis.

## 7.5 Security Management

NNM security related services are for further study.

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