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DATA COMMUNICATION NETWORKS

MESSAGE HANDLING SYSTEMS – MESSAGE STORE: ABSTRACT-SERVICE DEFINITION

Recommendation X.413

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT 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 Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation X.413 was revised by Study Group VII and was approved under the Resolution No. 2 procedure on the 10th of September 1992.

CCITT NOTE

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

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INTRODUCTION

This Recommendation is one of a series of Recommendations defining Message Handling (MH) in a distributed open systems environment.

Message Handling provides for the exchange of messages between users on a store-and-forward basis. A message submitted by one user (the originator) is transferred through the message-transfer-system (MTS) and delivered to one or more other users (the recipients).

This Recommendation defines the Message Store abstract-service (MS abstract-service) which supports message-retrieval from a Message Store (MS) and indirect-message-submission through the MS in a Message Handling System (MHS). The MS abstract-service also provides message-administration services, as defined by the Message Transfer System (MTS) abstract-service.

This Recommendation has been produced by joint CCITT-ISO agreement. The corresponding International Standard is ISO/IEC 10021-5:1990, as amended by Technical Corrigenda 1, 2, 3 and 4. Annex G lists the differences between CCITT and ISO/IEC texts.

Recommendation X.413

MESSAGE HANDLING SYSTEMS:
MESSAGE STORE: ABSTRACT-SERVICE DEFINITION

(revised 1992)

SECTION 1 – GENERAL

1 Scope

This Recommendation defines the Message Store abstract-service. This abstract-service is provided by the Message Store access-protocol (specified in CCITT Rec. X.419 | ISO/IEC 10021-6) in conjunction with the MTS abstract-service (defined in CCITT Rec. X.411 | ISO/IEC 10021-4), together with the Remote Operations Service Element (ROSE) services (defined in CCITT Rec. X.219 | ISO/IEC 9072-1). The abstract-syntax-notation for the application-layer protocols used in this Recommendation is defined in CCITT Rec. X.208 | ISO 8824.

Other Recommendations define other aspects of the MHS. CCITT Rec. X.400 | ISO/IEC 10021-1 defines the user-oriented services provided by the MHS. CCITT Rec. X.402 | ISO/IEC 10021-2 provides an architectural overview of the MHS. CCITT Rec. X.407 | ISO/IEC 10021-3 provides a description of the abstract-service definition conventions used in MHS. CCITT Rec. X.420 | ISO/IEC 10021-7 defines the abstract-service for interpersonal messaging and defines the format of interpersonal-messages.

Section 2 of this Recommendation contains the Message Store abstract-service definition. Clause 6 describes the MS model. Clause 7 specifies the abstract-syntax-notation for the abstract-bind and the abstract-unbind-operations. Clause 8 specifies the abstract-syntax-notation for the operations of the abstract-service. Clause 9 specifies the abstract-syntax-notation for the errors of the abstract-service.

Section 3 of this Recommendation defines the general-attribute-types and general-auto-action-types related to the MS. Clause 10 contains an overview. Clause 11 specifies the abstract-syntax-notation for the general-attribute-types. Clause 12 specifies the abstract-syntax-notation for the general-auto-action-types.

Section 4 of this Recommendation describes the procedures for Message Store and the ports realization. Clause 13 contains an overview. Clause 14 describes how the Message Store abstract-service is supplied. Clause 15 describes how the Message Transfer System abstract-service is consumed. Clause 16 describes how the MS ports are realized.

No requirement is made for conformance to this Recommendation.

2 Normative references

The following CCITT Recommendations and International Standards 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 Standards are subject to revision, and parties to agreements based on this Recommendation are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The CCITT Secretariat maintains a list of the currently valid CCITT Recommendations.

2.1 *Reference model references*

– CCITT Recommendation X.200 (1988), *Reference Model of Open Systems Interconnection for CCITT Applications*

  ISO 7498:1984/Cor. 1:1988 *Information processing systems – Open Systems Interconnection – Basic Reference Model – Technical Corrigendum 1.*

2.2 *Presentation references*

– CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1)*

ISO/IEC 8824:1990, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1).*

2.3 *Remote Operations references*

– CCITT Recommendation X.219 (1988), *Remote Operations: Model, Notation and Service Definition*

ISO/IEC 9072-1:1989, *Information processing systems – Text Communication – Remote Operations – Part 1: Model, notation and service definition.*

2.4 *Directory references*

– CCITT Recommendation X.500 (1988), *The Directory – Overview of concepts, models and services*

ISO/IEC 9594-1:1990, *Information technology – Open systems Interconnection – The Directory – Part 1: Overview of concepts, models and services.*

– CCITT Recommendation X.501 (1988), *The Directory – Models*

ISO/IEC 9594-2:1990, *Information technology – Open Systems Interconnection – The Directory – Part 2*: *Models*.

– CCITT Recommendation X.509 (1988), *The Directory – Authentication Framework*

ISO. IEC 9594-8:1990, *Information technology – Open Systems Interconnection – The Directory – Part 8: Authentication framework.*

– CCITT Recommendation X.511 (1988), *The Directory – Abstract Service Definition*

ISO/IEC 9594-3:1990, *Information technology – Open Systems Interconnection – The Directory – Part 3*: *Abstract Service Definition*.

– CCITT Recommendation X.518 (1988), *The Directory – Procedures for Distributed Operation*

ISO/IEC 9594-4:1990, *Information technology – Open Systems Interconnection – The Directory – Part 4*: *Procedures for Distributed Operation.*

– CCITT Recommendation X.519 (1988), *The Directory – Protocol Specifications*

ISO/IEC 9594-5:1990, *Information technology – Open Systems Interconnection – The Directory – Part 5: Protocol specifications.*

– CCITT Recommendation X.520 (1988), *The Directory – Selected attribute types.*

ISO/IEC 9594-6:1990, *Information technology – Open Systems Interconnection – The Directory – Part 6: Selected attribute types.*

– CCITT Recommendation X.521 (1988), *The Directory – Selected object classes.*

ISO/IEC 9594-7:1990, *Information technology – Open systems Interconnection – The Directory – Part 7: Selected Object Classes.*

2.5 *Message Handling references*

– CCITT Recommendation X.400 (1992), *Message handling services; Message handling system and service overview*

ISO/IEC 10021-1:1990, *Information technology – Text Communication – Message Oriented Text Interchange Systems (MOTIS) – Part 1: Systems and Service Overview.*

– CCITT Recommendation X.402 (1992), *Message handling systems: Overall architecture*

ISO/IEC 10021-2:1990, *Information technology – Text Communication – Message Oriented Text Interchange Systems (Motis) – Part 2: Overall Architecture.*

– CCITT Recommendation X.407 (1988), *Message handling systems: Abstract service definition conventions*

  ISO/IEC 10021-3:1990, *Information technology – Text Communication – Message Oriented Text Interchange Systems (MOTIS) – Part 3: Abstract Service Definition Conventions.*

– CCITT Recommendation X.411 (1992), *Message handling systems: Message transfer system: Abstract service definition and procedures*

  ISO/IEC 10021-4:1990, *Information technology – Text Communication – Message Oriented Text Interchange Systems (MOTIS) – Part 4: Message Transfer System – Abstract Service Definition and Procedures.*

– CCITT Recommendation X.419 (1992), *Message handling systems: Protocol specifications*

  ISO/IEC 10021-6:1990, *Information technology – Text Communication – Message Oriented Text Interchange Systems (MOTIS) – Part 6: Protocol Specifications.*

– CCITT Recommendation X.420 (1992), *Message handling systems: Interpersonal messaging system*

  ISO/IEC 10021-7:1990, *Information technology – Text Communication – Message Oriented Text Interchange Systems (MOTIS) – Part 7: Interpersonal Messaging System.*

3 Definitions

3.1 *Common Definitions for MHS*

For a list of the common definitions for MHS refer to CCITT Rec. X.402 | ISO/IEC 10021-2.

3.2 *Message Store Definitions*

For the purpose of this Recommendation the following definitions apply:

3.2.1 **abstract-association**

An abstract binding between two communication partners; in this Recommendation the binding between a UA and an MS for the provision of the MS abstract-service, or between an MS and an MTA for the provision of the MTS abstract-service.

3.2.2 **abstract-bind-parameters**

Parameters defined in this Recommendation which are contained in the abstract-bind operation.

3.2.3 **abstract-unbind-parameters**

Parameters defined in this Recommendation which are contained in the abstract-unbind operation.

3.2.4 **administration port**

The port offering the administration (for MTS) set of abstract-service within the MS abstract-service.

3.2.5 **Alert abstract-operation**

An abstract-operation which allows the MS to signal, based on selection criteria, to the UA that messages or reports are waiting in the MS. Can only be issued on an existing abstract-association.

3.2.6 **attribute**

The information of a particular type appearing in an entry in an information-base.

3.2.7 **attribute-type**

That component of an attribute which indicates the class of information given by that attribute.

3.2.8 **attribute-value**

A particular instance of that class of information indicated by an attribute type.

3.2.9 **attribute-value-assertion**

A proposition, which may be true, false, or undefined, concerning the values of attributes in an entry.

3.2.10 **auto-action**

Actions, that can be performed automatically by the MS, based on previously registered information from the MS-owner via the UA.

3.2.11 **auto-action-type**

An auto-action-type is used to indicate the type of auto-action, e.g. alert.

3.2.12 **auto-alert**

Auto-alert is the auto-action within the MS, which triggers an alert abstract-operation or another action by the MS.

3.2.13 **auto-forward**

Auto-forward is the auto-action within the MS, which triggers a message to be auto-forwarded to another recipient (or other recipients) by the MS.

3.2.14 **child-entry**

An entry, other than the main-entry in an information-base. The parent-entry for a child-entry can be either the main-entry or another child-entry, depending on the number of entry levels in each case.

3.2.15 **child-sequence-number**

A sequence-number in a parent-entry pointing to a child-entry. A parent-entry can have more than one child-sequence-number value, depending on the number of child-entries.

3.2.16 **conditional (C) component**

An ASN.1 element which shall be present in an instance of its class as dictated by this Recommendation. See **grade**.

3.2.17 **content-length**

An attribute which gives the length of the content of a delivered-message (or returned-content).

3.2.18 **content-returned**

An attribute which signals that a delivered-report (or a delivered-message) contained a returned content.

3.2.19 **converted EITs**

An attribute identifying the encoded-information-types of the message content after conversion.

3.2.20 **creation-time**

An attribute which gives the creation-time (by the MS) of an entry.

3.2.21 **Delete abstract-operation**

An abstract-operation used to delete one or more entries from an information-base.

3.2.22 **delivered-EITs**

A multi-valued attribute, giving information about EITs in a delivered-message.

3.2.23 **delivered-message entry**

An entry in the stored-messages information-base resulting from a delivered-message.

3.2.24 **delivered-report entry**

An entry in the stored-messages information-base resulting from a delivered-report.

3.2.25 **entry**

An information set in an information-base. See main-entry, parent-entry and child-entry for further classification of entries.

3.2.26 **entry-information**

A parameter, used in abstract-operations, which conveys selected information from an entry.

3.2.27 **entry-information-selection**

A parameter, used in abstract-operations, which indicates what information from an entry is being requested.

3.2.28 **entry-status**

An attribute giving information about the processing status of that entry. Possible values are new, listed or processed.

3.2.29 **entry-type**

An attribute which signals if an entry is associated with a delivered-message or a delivered-report.

3.2.30 **Fetch abstract-operation**

An abstract-operation which allows one entry to be fetched from the stored-messages information-base.

3.2.31 **fetch-restrictions**

Restrictions, imposed by the UA, on what kind of messages it is prepared to receive as a result of fetch. The possible restrictions are on message-length, content-types and EITs.

3.2.32 **filter**

A parameter, used in abstract-operations, to test a particular entry in an information-base and is either satisfied or not by that entry.

3.2.33 **filter-item**

An assertion about the presence or value(s) of an attribute of a particular type in an entry under test. Each such assertion is either true, false *or undefined*.

3.2.34 **forwarding-request**

This is a parameter that may be present in a Message-submission abstract-operation, invoked by the UA, to request that a message is forwarded from the MS.

3.2.35 **general-attribute**

A set of MS attributes which are valid for all types of messages and reports, independent of content-type. Only these MS attributes are explicitly defined in this Recommendation.

3.2.36 **general-auto-action**

Auto-actions which are valid for all types of messages and reports, independent of content-type. Only these auto-actions are explicitly defined in this Recommendation.

3.2.37 **grade**

Defined in CCITT Rec. X.402 | ISO/IEC 10021-2.

3.2.38 **Indirect-submission port**

The port offering the indirect-submission abstract-service within the MS abstract-service. The Indirect-submission abstract-service offers the same services as the Message-submission abstract-service (from the MTS abstract-service) with the added functionality of forwarding messages residing in the MS.

3.2.39 **information-base**

Objects within the MS which store information relevant to the MS abstract-service, e.g. the stored-messages information-base, which stores the messages and reports that have been delivered into the MS.

3.2.40 **information-base-type**

The type of information-base, e.g. the stored-messages.

3.2.41 **limit**

A component in the selector parameter which identifies the maximum number of selected entries to be returned in the result of an abstract-operation.

3.2.42 **list abstract-operation**

An abstract-operation which allows a selection of entries from an information-base and requested attribute information to be returned for those entries.

3.2.43 **listed**

An entry-status value.

3.2.44 **macro**

See CCITT Rec. X.208 | ISO/IEC 8824.

3.2.45 **main-entry**

For each successful abstract-operation which creates information-base entries, there is always one main-entry. Further, or more detailed, information resulting from the same abstract-operation can be stored in child-entries.

3.2.46 **mandatory (M) component**

An ASN.1 element which shall always be present in an instance of its class. See **grade**.

3.2.47 **matching**

The process of comparing the value supplied in an attribute-value-assertion with the value of the indicated attribute-type stored in the MS or deciding whether the indicated attribute-type is present.

3.2.48 **Message Retrieval Service Element (MRSE)**

The application-service-element by means of which a receiving UA effects retrieval of messages from an MS, or any of various related tasks.

3.2.49 **MS**

Message Store, also used as a shorter form for “MS abstract-service-provide”.

3.2.50 **MS abstract-service**

The set of capabilities that the MS offers to its users by means of its ports.

3.2.51 **MS abstract-service-user**

The user of the MS abstract-service. This is the UA.

3.2.52 **MS abstract-service-provider**

The MS which provides the MS abstract-service.

3.2.53 **MS-user**

A shorter form for “MS abstract-service-user”.

3.2.54 **Message-submission abstract-operation**

An abstract-operation which allows the UA to submit a message to the MTS via the MS, and/or to forward a message from the MS to the MTS.

3.2.55 **multi-valued attribute**

An attribute which can have several values associated with it.

3.2.56 **new**

An entry-status value.

3.2.57 **optional (O) component**

An ASN.1 element which shall be present in an instance of its class at the discretion of the object (e.g. user) supplying that instance. See **grade**.

3.2.58 **original-EITs**

An attribute identifying the original encoded-information-types of the message content.

3.2.59 **override**

A component of the selector parameter indicating that the previously registered-restrictions for this abstract-operation should not apply for this instance of this abstract-operation.

3.2.60 **parent-entry**

A parent-entry has one or more child-entries, which were created as a result of the same abstract-operation. If a parent-entry is not a child-entry of another parent-entry, it is a main entry.

3.2.61 **parent-sequence-number**

A sequence-number in a child-entry pointing to its parent-entry. There can only be one parent-sequence-number in a child-entry.

3.2.62 **partial-attribute-request**

A component of the entry-information-selection which enables the return of only selected values of a multi-valued attribute.

3.2.63 **position**

Positions are parameters used to specify a bound of a range.

3.2.64 **processed**

An entry-status value.

3.2.65 **range**

A parameter, used in abstract-operations, to select a contiguous sequence of entries from an information-base.

3.2.66 **Register-MS abstract-operation**

An abstract-operation which allows the UA to register certain information, relevant to the UA-MS interworking, in the MS.

3.2.67 **registration**

Information which is registered in the MS and stored (until changed by the Register-MS abstract-operation) between abstract-associations. See Register-MS abstract-operation.

3.2.68 **registration-identifier**

An identifier for one particular set of registration-parameters for an auto-action-type.

3.2.69 **Retrieval Port**

The port offering the retrieval set of abstract-services within the MS abstract-service.

3.2.70 **returned-content entry**

An entry-type in the stored-messages information-base which contains the returned content from a previously submitted message.

3.2.71 **selector**

A parameter, used in abstract-operations, to select entries from an information-base.

3.2.72 **sequence-number**

An attribute which uniquely identifies an entry. Sequence-numbers are allocated in ascending order.

3.2.73 **single-valued attribute**

An attribute which can only have one value associated with it.

3.2.74 **span**

A component in the Summarize abstract-operation result containing the lowest and highest sequence-numbers of the entries that matched the selection criteria.

3.2.75 **stored-messages**

The most important information-base in this Recommendation, used to store entries containing messages and reports delivered by the MTS to the MS.

3.2.76 **subscription**

A long-term agreement between the MS supplier or administrator and the MS customers (MS-owners) on the availability and use of optional MS features such as optional services and attributes. This Recommendation, assumes that such a mechanism is provided, but does not prescribe or offer any standardized method for how to provide this.

3.2.77 **substring**

A filter-item used to specify a string of characters which appear (in the same given order) in a value of an attribute.

3.2.78 **Summarize abstract-operation**

An abstract-operation which allows a quick overview of the kind and number of entries which are currently stored in an information-base.

3.2.79 **synopsis**

A content specific attribute that may be used to show how child-entries, containing parts of the content, are related to each other and the main-entry. The attribute has to be specified in the Recommendation, which describes the content-type, e.g. see IPM-synopsis defined in Rec. X.420 | ISO/IEC 10021-7.

4 Abbreviations

ASN.1	Abstract Syntax Notation One
AVA	Attribute-value-assertion
C	Conditional
DL	Distribution-list
EIT	Encoded-information-type(s)
IPMS	Interpersonal messaging system
M	Mandatory
M	Multi-valued
MASE	Message Administration Service Element
MDSE	Message Delivery Service Element
MH	Message Handling
MHS	Message Handling System
MOTIS	Message Oriented Text Interchange System
MRSE	Message Retrieval Service Element
MS	Message Store
MSSE	Message Submission Service Element
MT	Message Transfer
MTA	Message Transfer Agent
MTS	Message Transfer System
N	No
O	Optional
O/R	Originator/recipient
P	Present
ROS	Remote Operations Service
ROSE	Remote Operations Service Element
S	Single-valued
UA	User Agent
UTC	Coordinated Universal Time
Y	Yes

5 Conventions

This Recommendation uses the descriptive conventions listed in the following four subclauses.

5.1 *Conventions for abstract-services*

This Recommendation uses the following ASN.1-based descriptive conventions for the indicated purposes:

1) ASN.1 itself, to specify the abstract-syntax of information-bases and their components, and common data-types.

2) The ASN.1 PORT macro and associated abstract-service definition conventions of CCITT Rec. X.407 | ISO/IEC 10021-3, to specify the Retrieval Port.

3) The ASN.1 ABSTRACT-BIND, ABSTRACT-UNBIND, ABSTRACT-OPERATION, and ABSTRACT-ERROR macros and associated abstract-service definition conventions of CCITT Rec. X.407 | ISO/IEC 10021-3, to specify the MS abstract-service.

Whenever this Recommendation describes a class of data structure having components, each component is categorized as one of the following **grades**:

1) **Mandatory** (M:) A mandatory component shall be present in every instance of the class.

2) **Optional** (O): An optional component shall be present in an instance of the class at the discretion of the object (e.g. user) supplying that instance.

3) **Conditional** (C): A conditional component shall be present in an instance of the class as dictated by this Recommendation.

5.2 *Conventions for attribute-types used in Table 1/X.413 of clause 11*

This Recommendation uses the conventions listed below in its definition of the attribute-types for the MS abstract-service.

For the column headed "*Single/Multi-valued*" the following values can occur:

S single-valued

M multi-valued.

For the column headed "*Support level by the MS and access UA*" the following values can occur:

M mandatory

O optional

For the columns headed "*Presence in delivered message entry*", "*Presence in delivered report entry*", and "*Presence in returned message entry*", the presence of each attribute-type is described by one of the following values:

P *always present* in the entry because:

– it is mandatory for generation by the MS; or

– it is a mandatory or defaulted parameter in the relevant abstract-operation.

C *conditionally present* in the entry. It would be present because:

– it is supported by the MS and subscribed to by the user and;

– it was present in an optional parameter in the relevant abstract-operation.

– *always absent*, otherwise.

For the columns headed "*Available for list, alert*" and "*Available for summarize*", the following values can occur:

N no

Y yes

5.3 *Conventions for attribute-types used in Table 2/X.413 of clause 11*

This Recommendation uses the conventions listed below in its definition of the attribute-type for the MS abstract-service. Clause 11 includes the table that lists the attribute-types.

For the column headed "*Single/multi-valued*" the following values can occur:

S single-valued

M multi-valued

For the column headed "*Source generated by*" the following values can occur:

MD MessageDelivery abstract-operation

MS MessageStore

RD ReportDelivery abstract-operation

5.4 *Font conventions for text in general*

Throughout this Recommendation, terms are rendered in **bold** when defined, without emphasis upon all other occasions. Terms that are proper nouns are capitalized, generic terms are not. Multi-word generic terms are hyphenated.

5.5 *Font conventions for ASN.1 definitions*

Throughout this Recommendation, ASN.1 definitions are written in a different (**bold**) font than the rest of the document in order to highlight the difference between normal text and ASN.1 definitions. The font used for ASN.1 definitions is also one size smaller than the ordinary text. When ASN.1 protocol elements and elements values are described in accompanying text, their names are rendered in **bold**.

5.6 *Rules for ASN.1 definitions*

ASN.1 definitions appears both in the body of the document to aid the exposition, and again, formally in Annexes for reference. If differences are found between the ASN.1 used in the exposition and that formally defined in the corresponding annex, a specified error is indicated.

SECTION 2 – MESSAGE STORE ABSTRACT-SERVICE DEFINITION

6 Message Store model

The Message store (MS) is modelled as an atomic object, which acts as a provider of services to an MS abstract-service-user (i.e. a User Agent), and as a user of services provided by the Message Transfer System (MTS).

The MS serves an intermediary role between the UA and the MTS. Its primary function is to accept delivery of messages on behalf of a single MHS end-user, and to retain them for subsequent retrieval by the end-user's UA. The MS also provides indirect message-submission and message-administration services to the UA, in effect, via "pass-through" to the MTS. This enables the MS to provide additional functionality compared to submission directly to the MTA; such a forwarding of messages residing in the MS and logging facilities.

Like the UA, the MS acts on behalf of only a single MHS end-user; i.e. it does not provide common or shared multi-user MS service.

The MS is described using an abstract model in order to define the services provided by the MS – the Message Store abstract-service. Figure 1/X.413 shows the MS abstract-service in relation to its user and to the Message Transfer System abstract-service. In this figure, the open boxes represent the consumption of the abstract service, and the closed boxes represent the supply of the abstract service.

For an introduction and description of the abstract-service concept and its definition conventions, see CCITT Rec. X.407 | ISO/IEC 10021-3.

In secure messaging the MS is treated as a separate object with a unique identity and has separate key (or a set of keys) to the UA.

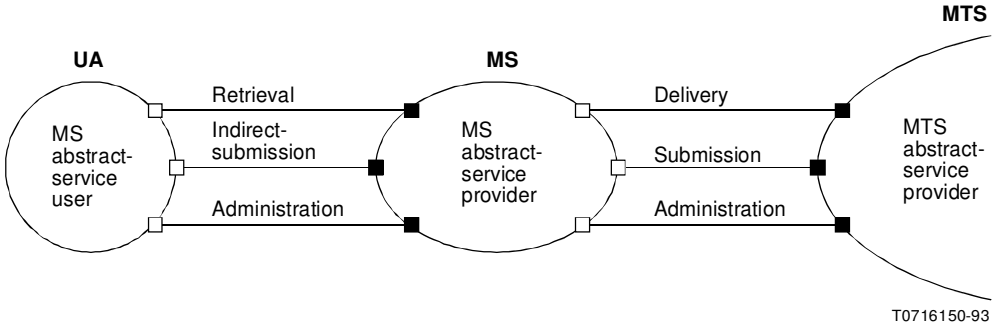

FIGURE 1/X.413

Message store abstract-service

6.1 *Message Store object*

The MS is modelled as an atomic object. It supplies the MS Retrieval Port abstract-services to the MS abstract-service-user. Acting as a "surrogate" MTS abstract-service-provider, the MS also supplies the MTS submission and administration abstract-services to the MS abstract-service-user (MS-user), and acting as a UA "surrogate", it consumes the MTS Delivery Port, Submission Port, and Administration Port abstract-services in its role as MTS abstract-service user.

The formal definition for the **Message Store object** is as follows:

```
mS OBJECT
    PORTS { retrieval[S],
            indirectSubmission[S],
            administration[S],
            delivery[C],
            submission[C],
            administration[C] }
    ::= id-ot-ms
```

The **MS-user** is also modelled as an object. It consumes the MS Retrieval Port and Indirect-submission Port abstract-services and the Administration Port abstract-services provided transparently by the MS.

```
msUser OBJECT
    PORTS { retrieval[C],
            indirectSubmission[C],
            administration[C] }
::= id-ot-ms-user
```

6.2 *Message Store ports*

An MS provides the **Retrieval**, **Indirect-submission**, and **Administration Ports** to the MS abstract-service user. The collection of capabilities provided by these ports provides the MS abstract-service. The retrieval capabilities are unique to the MS. These capabilities include obtaining information on, fetching (in whole or in part), and deleting messages residing in the MS. Additional capabilities are provided for registering certain MS provided automatic actions (i.e. auto-forwarding and alert).

Note – A future version of this Recommendation may define additional message management services performed by the MS on the UA's behalf, for logging incoming and outgoing messages, and for auto-correlating notifications with logging information about outgoing messages.

In order to provide the services described in 6.1 to an MS-user, the MS interacts, on behalf of the MS-user, with the MTS abstract-service, and acts as a consumer of the MTS Delivery, Submission and Administration Ports. The abstract-services provided by the MTS ports are defined in clause 8 of CCITT Rec. X.411 | ISO/IEC 10021-4.

By means of the abstract-bind operation, the MS authenticates an MS-user before providing it with any of the above retrieval capabilities. Similarly, the MTS abstract-services shall authenticate the MTS abstract-service user before extending its services to the MTS abstract-service-user.

With the exception of the Retrieval Port provided Alert service and the Indirect-submission Port provided Submission-control service, all the services provided by the MS abstract-service are invoked by the MS-user and performed by the MS.

Security-labels may be assigned to the MS in line with the security-policy in force. The security-policy may also define how security-labels are to be used to enforce the security-policy. If security-labels are assigned to the MS, the handling of stored messages and reports bearing message-security labels may be affected by the security-policy in force. If security-labels are not assigned to the MS, the handling of stored-messages and reports is discretionary.

If security-contexts are established between the UA and the MS, and between the MS and the MTA, the security-label that is assigned to a message or probe is confined by the security-context in line with the security-policy in force. If security-contexts are not established the assignment of a message-security-label to a message or probe is at the discretion of the originator.

6.2.1 *Retrieval Port*

The **Retrieval Port** is defined as follows:

```
retrievalPORT
CONSUMER INVOKES {
        Summarize,
        List,
        Fetch,
        Delete,
        Register-MS }
SUPPLIER INVOKES {
        Alert }
::= id-pt-retrieval
```

The details of the **Retrieval Port** abstract-services are described in clauses 7 to 9.

6.2.2 *Indirect-submission Port*

The **Indirect-submission Port** is defined as follows:

```
indirectSubmissionPORT ::= submission
```

The **Indirect-submission Port** makes use of the Submission Port abstract-services defined in 8.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

6.2.3 *Administration Port*

The **Administration Port** is defined in 8.4 of CCITT Rec. X.411 | ISO/IEC 10021-4.

The Change-credentials abstract-service operates end-to-end between the MS-user and the MTS-service-provider, and passes through the MS. The MS stores the new credentials for use when it subsequently binds with the MTA. If the MS-user needs to update the credentials it uses when binding to the MS, then the Register-MS abstract-operation is used (see 8.6).

6.3 *Information model*

This subclause describes the information model used by the MS. It models **information-bases**, which consist of **entries**, which consist of **attributes**.

6.3.1 *Information-bases*

The MS stores and maintains **information-bases.** An **information-base** in the MS is a "data-base" containing all the **entries** representing constituent objects of a particular category or categories.

This Recommendation defines and describes the **stored-messages information-base**. This holds information derived from message-deliveries and report-deliveries to the MS across the MTS Delivery Port, and is described in 6.4.

Note – A future version of this Recommendation defines additional information-bases for logging, called inlog and outlog.

```
InformationBase ::= INTEGER {
    stored-messages   (0),
    inlog             (1),
    outlog            (2) } (0 . . ub-information-bases)
```

6.3.2 *Entries*

Each information-base is organized as a sequence of **entries**. An **entry** represents a single object (such as a delivered message) within the **information-base**.

Each entry is identified by means of its **sequence-number**, unique within an **information-base**, and generated by the MS as new entries are created. Within an **information-base**, the MS generates the **sequence-numbers** in ascending order without cycling, and they are never re-used.

```
SequenceNumber ::= INTEGER (0 . . ub-messages)
```

Note – For example, the MS may choose to allocate **sequence-numbers** by using the time to a sufficient granularity to ensure uniqueness.

6.3.3 *Attributes*

6.3.3.1 *Introduction*

An **entry** consists of a set of **attributes**. This is depicted in Figure 2/X.413.

Each **attribute** provides a piece of information about, or derived from, the data to which the **entry** corresponds. One such piece of information is the **sequence-number** of the **entry** itself, and another is the **creation-time**.

An **attribute** consists of an **attribute-type**, which identifies the class of information given by an **attribute**, and the corresponding **attribute-value(s)**, which are particular instances of that class appearing in the **entry**.

```
Attribute ::= SEQUENCE {
    type        AttributeType,
    values      SEQUENCE SIZE (1 . . ub-attribute-values) OF AttributeValue }
```

Note – Thus, for example, in a delivered-message-entry (described in 6.4) the **attribute-type** could be the message's **priority**, and a corresponding **attribute-value** could be **urgent**.

All **attributes** in an **entry** must be of distinct **attribute-types**.

For some **attribute-types**, an **attribute** may only contain a single **attribute-value**. Such an **attribute-type** is said to be **single-valued**. For others, an **attribute** may contain one or more **attribute-values**, all of the same ASN.1 data-type. Such an **attribute-type** is said to be **multi-valued**. Whether an **attribute-type** is **single-valued** or **multi-valued** is stated when the **attribute-type** is defined (see 6.3.3.2).

Note 2 – Thus, for example, the **attribute-type** for the **originator-name attribute** (described in 11.2.28) is **single-valued**, whereas that for **other-recipient-names** (described in 11.2.29) is **multi-valued**.

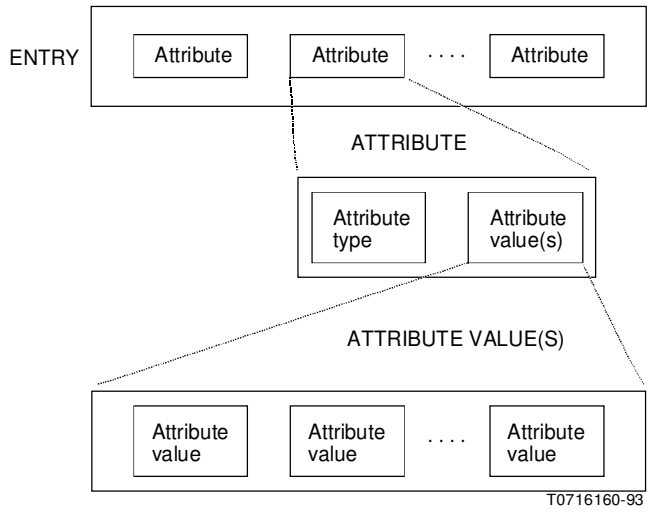

FIGURE 2/X.413

Components of an entry

6.3.3.2 *Attribute-type*

Some **attribute-types** will be internationally standardized. Other **attribute-types** will be defined by national administrative authorities and private organizations. This implies that a number of separate authorities will be responsible for assigning types in a way that ensures that each is distinct from all other assigned types. This is accomplished by identifying each **attribute-type** with an object-identifier when the **attribute-type** is defined.

AttributeType ::= OBJECT IDENTIFIER

Certain general-purpose **attribute-types** for the stored-messages information-base are defined in clause 11. Such **attribute-types** are known as **general-attribute-types** and attributes of these types as **general-attributes**.

6.3.3.3 *Attribute-values*

Defining an **attribute-type** also involves specifying the ASN.1 data-type to which every value in such attributes shall conform. The data-type of an **attribute-value** for the **attribute-type** is defined through the object-identifier for the **attribute-type**.

AttributeType ::= ANY

6.3.3.4 *Attribute-type definition and the ATTRIBUTE Macro*

The definition of an **attribute-type** involves:

a) assigning an object identifier to the **attribute-type**;

b) indicating the ASN.1 data-type of an **attribute-value**;

c) indicating whether an **attribute** of this **attribute-type** may have more than one value;

d) indicating whether an **attribute** of this **attribute-type** may be used for filtering using equality, substrings, and/or ordering relations (see 8.1.2).

Note – A filter may always test for the presence or absence in an entry of an **attribute** of a particular **attribute-type**.

The following ASN.1 macro is used to define an **attribute-type**. The formal definition of this macro is given in CCITT Rec. X.501 | ISO/IEC 9594-2 and is documented here as an aid to the reader.

```
ATTRIBUTE MACRO     ::=
BEGIN

TYPE NOTATION       ::=  AttributeSyntax Multivalued | empty
VALUE NOTATION      ::=  value (VALUE OBJECT IDENTIFIER)

AttributeSyntax     ::=  "WITH ATTRIBUTE-SYNTAX" SyntaxChoice
SyntaxChoice        ::=  value (ATTRIBUTE-SYNTAX) Constraint | type MatchTypes

Constraint          ::=  "(" ConstraintAlternative ")" | empty
ConstraintAlternative ::= StringConstraint | IntegerConstraint
StringConstraint    ::=  "SIZE" "(" SizeConstraint ")"
SizeConstraint      ::=  SingleValue | Range
SingleValue         ::=  value (INTEGER)
Range               ::=  value (INTEGER) ".." value (INTEGER)
IntegerConstraint   ::=  "(" Range ")"

MatchTypes          ::=  "MATCHES FOR" Matches | empty
Matches             ::=  Match Matches | Match
Match               ::=  "EQUALITY" | "SUBSTRINGS" | "ORDERING"

Multivalued         ::=  "SINGLE VALUE" | "MULTI VALUE" | empty

END
```

The correspondence between the parts of the definition, as listed above, and the various pieces of the notation introduced by the **ATTRIBUTE** macro, is as follows:

a) **MACRO value**: The **object-identifier** which is used to identify an attribute.

b) **Attribute-syntax**: Notes which syntax-choice has been made.

c) **Syntax-choice**: Notes whether the attribute is defined externally or internally. The syntax of all the attributes defined in this Recommendation is defined internally, which means using the choice **typeMatchTypes**.

d) **Multivalued**: denotes whether the attribute is single or multi-valued.

e) **Match-types**: Gives the data-type of the contents of the attribute, and describes whether the attribute can be matched **("MATCHES FOR")** for **equality ("EQUALITY")**, for **substrings ("SUBSTRINGS")**, and for an **ordering** relation **("ORDERING")**.

Matching for this Recommendation is restricted as follows:

i) **EQUALITY** is applicable to any attribute-syntax. The presented value shall conform to the data-type of the attribute-syntax;

ii) **SUBSTRING** is applicable to any attribute-syntax with a **string** data type. The presented value shall be a sequence ("SEQUENCE OF"), each of whose elements conforms to the data-type; and

iii) **ORDERING** is applicable to any attribute-syntax for which a rule can be defined that will allow a presented value to be described as less than *or* equal to, or greater than *or equal to* a target value. The presented value must conform to the data-type of the attribute-syntax. MS uses this for the INTEGER and UTCTime data types. For UTCTime, the ordering is chronological, not alphabetical.

The remaining choices and parameters of the **ATTRIBUTE** macro are not used in this Recommendation.

6.3.4 *Main-entries, parent-entries, and child-entries*

Although entries in a single information-base are generally independent of each other, the MS information model allows such entries to be related to one another. One entry, a **child-entry**, may be the child of another, its **parent-entry**, in a tree-structured relationship. An entry which is not a **child-entry** is termed a **main-entry**.

This relationship is recorded by means of two special general-attributes:

a) **parent-sequence-number**: This single-valued attribute gives the sequence-number of a **child-entry's parent-entry**. It is absent from a **main-entry**. Its definition is given in 11.2.30.

b) **child-sequence-numbers**: This multi-valued attribute gives the sequence-numbers of all the **child-entries** of a **parent-entry**. It is absent from an entry which is not a **parent-entry**. Its definition is given in § 11.2.1.

The abstract-operations of the MS abstract-service (see clause 8) act by default only on **main-entries**. Some may be directed to act on all entries, both **main-entries** and **child-entries**. In particular, the argument of a Delete abstract-operation (see 8.5) may only select **main-entries**, in which case the **main-entry** and all its children and children's children, etc. will also be deleted.

Note – This concept allows, for example, those body-parts of an Interpersonal message which contain a forwarded message (for details see 19.1 of CCITT Rec. X.420 | ISO/IEC 10021-7) to be represented by individual **child-entries**. The **content general-attribute** of the **main-entry** will comprise the complete **content**, so the data representing that message body-part is logically present in more than one **entry**.

6.4 *Stored-messages*

The **stored-messages information-base** acts as a repository for information obtained from the MessageDelivery and ReportDelivery abstract-operations of the Delivery Port. It contains entries for delivered messages (**delivered-message-entries**), of an open-ended number of content-types, and for reports (**delivered-report-entries**). An entry in the **stored-message-information-base** is created by the MS when a message or report is delivered to the MS. For more details of these entries and how they are generated, see clauses 11 and 15.

To draw information from the content of a message, the MS must know the content's syntax and semantics, as signaled via the content-type. In general, a particular instance of the MS has knowledge of zero or more content-types. When an MS encounters a message of whose content-type it has insufficient knowledge, it is unable to generate any content-type-specific attributes in the message's entry.

A delivered-message or an arriving notification may result in a main-entry and one or more levels of child-entries. The one case defined by this Recommendation is when a non-delivery notification contains a returned-content (the **delivered-report** entry is the main-entry and the returned-content is its child-entry, known as a **returned-content entry**).

The rules for how a message-content may be split across several entries is specific to each content-type. A content-specific **synopsis-attribute** may be used to show how the main-entry and the corresponding child-entries are related. When such an attribute is defined, it appears in the Recommendation which defines the content-type itself. The **synopsis-attribute** is constructed by the MS.

Note – For Interpersonal Messaging (CCITT Rec. X.420 | ISO/IEC 10021-7), nested IP-messages within an IP-message are each represented by a child-entry. The **ipm-synopsis** attribute-type is an example of a content-specific **synopsis-attribute-type**.

An important property of an entry in the stored-messages information-base is its **entry-status**. It is created and maintained by the MS. It can take the following values:

a) **New**: The message has neither been **listed** by a UA nor has it been automatically **processed** by the MS.

b) **Listed**: Information about the message has been returned to the UA in either a list abstract-operation or a Fetch abstract-operation, but the message has not yet been completely **processed**.

c) **Processed**: Either a UA has "completely fetched" the message, or the MS has performed an auto-action on it and the definition of that auto-action causes a change of entry-status. (Note that some auto-actions result in the message being deleted). The exact definition of "completely fetched" is content-specific and is defined in the corresponding content-specific Recommendation.

The **entry-status** of a (non-)delivery-notification becomes **processed** when the delivered-report-envelope is retrieved.

The definition for **entry-status** is as follows:

```
EntryStatus ::= INTEGER {
    new         (0),
    listed      (1),
    processed   (2) }
```

The entry-status of a child-entry is maintained according to the same rules as apply to a main-entry. A change in the entry-status of an entry may result from operations performed on the entry's parent or child-entry. If a child-entry is logically present in an attribute of its parent-entry, the retrieval of the attribute is regarded as equivalent to the retrieval of all attributes of the child-entry. If an attribute of an entry is logically present in one or more childentries, then retrieval of all those child-entries is equivalent to retrieval of the attribute.

6.5 *Auto-actions*

6.5.1 *Introduction*

This subclause defines a framework for the automatic actions (**auto-actions**) which may be registered with the MS or controlled by subscription.

An **auto-action** is an action that will occur automatically whenever the associated criteria have been satisfied. The criteria may be conveyed to the MS by means of registration or subscription. The result of an action being invoked is visible externally to the MS. **Auto-actions** are registered in the MS using the Register-MS abstract-operation (see 8.6).

Each class of auto-action is identified by means of an **auto-action-type**. Associated with the registration of an **auto-action**, there is a corresponding **auto-action-registration-parameter**, which are the parameters needed by the MS to perform the registered **auto-action** automatically. The registration of an **auto-action** requires the use of an **auto-action-registration-identifier** to identify the particular registration.

```
AutoActionRegistration ::= SEQUENCE {
    type                    AutoActionType,
    registration-identifier [0]  INTEGER (1 . . ub-per-auto-action) DEFAULT 1,
    registration-parameter  [1]  ANY DEFINED BY type }
```

Even if an auto-action has a defined **auto-action-registration-parameter**, any criteria and other parameters needed for its performance may be conveyed to the MS by means of subscription. However, some **auto-actions** may require that the MS supports registration of its **registration-parameter** by means of the Register-MS abstract-operation (see 8.6).

6.5.2 *Auto-action-type*

Some **auto-action-types** will be internationally standardized. Other **auto-action-types** will be defined by national administrative authorities and private organizations. This implies that a number of separate authorities will be responsible for assigning types in a way that ensures that each is distinct from all other assigned **auto-action-types**. This is accomplished by identifying each **auto-action-type** with an object identifier when the **auto-action-type** is defined.

```
AutoActionType ::= OBJECT IDENTIFIER
```

Certain general-purpose **auto-action-types** are defined in clause 12. Such **auto-action-types** are known as **general-auto-action-types** and **auto-actions** of these types as **general-auto-actions**.

6.5.3 *Auto-action-registration-parameter*

Defining an **auto-action-type** also involves specifying the ASN.1 data-type to which the **auto-action-registration-parameter** shall conform. The data-type of a **registration-parameter** is defined through the object identifier for the **auto-action-type**.

6.5.4 *Auto-action-type definition and the AUTO-ACTION macro*

The definition of an **auto-action-type** involves:

a) assigning an object identifier to the auto-action-type;

b) indicating the ASN.1 data-type of the **auto-action-registration-parameter**.

The following ASN.1 macro may (but need not be) used to define an **auto-action-type**:

```
AUTO-ACTION MACRO ::=
BEGIN
    TYPE NOTATION      ::=  Registration
    VALUE NOTATION     ::=  value (VALUE OBJECT IDENTIFIER)
    Registration       ::=  "REGISTRATION PARAMETER IS" type
END
```

The correspondence between the parts of the definition, as listed above, and the various pieces of the notation introduced by the AUTO-ACTION macro, is as follows:

a) **Registration**: gives the data-type of the registration parameters association with an auto-action.

b) **Value**: the object identifier which is used to identify the auto-action.

Note – No support is provided in the macro for defining the interaction (if any) between different registrations of the same (or different) **auto-actions**.

6.6 *Forwarding of messages*

The MS-user makes use of the message-submission abstract-operation and its parameters as defined in 8.2 of CCITT Rec. X.411 | ISO/IEC 10021-4 to request that a message stored in the MS be explicitly forwarded to other users.

The **forwarding-request parameter** is defined using the EXTENSION macro defined in clause 9 of CCITT Rec. X.411 | ISO/IEC 10021-4 as follows:

```
forwarding-request EXTENSION
    SequenceNumber
    CRITICAL FOR SUBMISSION
    ::= 36
```

If the **Sequence-Number** supplied does not match that of an entry in the **stored-messages information-base**, or matches an entry that is unsuitable for forwarding, this is reported using the **Inconsistent-request** abstract-error of 8.2.2.7 of CCITT Rec. X.411 | ISO/IEC 10021-4.

7 Abstract-bind and abstract-unbind operations

7.1 *Abstract-bind-operation*

The **MS-bind abstract-bind-operation** binds the Indirect-submission, Retrieval and Administration Ports of the MS-user (consumer) to the MS (supplier). The initiator (of the MS-Bind) is the MS-user, while the responder is the MS itself. Information exchanged in the argument and result of MS-Bind shall apply for the duration of the abstract-association. MS-bind is defined as follows:

```
MSBind ::= ABSTRACT-BIND
    TO { indirectSubmission[S], retrieval[S], administration[S] }
    BIND
        ARGUMENT    MSBindArgument
        RESULT      MSBindResult
        BIND-ERROR  MSBindError
```

Only one abstract-association may exist at any one time between the MS and the MS-user.

Note – Mechanisms for the handling of multiple associations are for further study.

7.1.1 *Abstract-bind-argument*

The **abstract-bind-argument** parameters are used to identify, authenticate and set the security-context for an MS abstract-service-user. They also contain a set of restrictions for entries to be returned as result of a Fetch abstract-operation, and finally, a request to be informed of the auto-action-types, attribute-types and content-types to which the MS-user has subscribed.

The definition of these parameters is as follows:

```
MSBindArgument ::= SET {
    initiator-name              ORAddressAndOrDirectoryName,
    initiator-credentials       [2] InitiatorCredentials,
    security-context            [3] IMPLICIT SecurityContext OPTIONAL,
    fetch-restriction           [4] Restrictions OPTIONAL -- default is none --,
    ms-configuration-request    [5] BOOLEAN DEFAULT FALSE }
```

1) **Initiator-name** (C): This argument contains the name of the initiator of the association and is supplied by the initiator. This argument is defined further in 8.1.1.1.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) **Initiator-credentials** (M): This parameter contains the **credentials** of the initiator of the association. It shall be generated by the initiator of the abstract-association.

   The **initiator-credentials** may be used by the responder to authenticate the identity of the initiator (see CCITT Rec. X.509 | ISO/IEC 9594-8).

   If only **simple-authentication** is used, the **initiator-credentials** comprise a simple password. The password is defined further in 8.5.11 of CCITT Rec. X.411 | ISO/IEC 10021-4.

   If **strong-authentication** is used, the **initiator-credentials** comprise an **initiator-bind-token**, and, optionally, an **initiator-certificate**. The **initiator-bind-token** and **initiator-certificate** are defined further in 8.1.1.1.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4. The **initiator-credentials** of the MS-user may differ from the **initiator-credentials** used in the MTS-bind as defined in 8.1.1.1.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) **Security-context** (O): This parameter identifies the **security-context** that the initiator of the abstract-association proposes to operate at. It is generated by the initiator of the abstract-association. The **security-context** is defined further in 8.1.1.1.1.3 of CCITT Rec. X.411 | ISO/IEC 10021-4.

The **security-context** comprises one or more **security-labels** that define the sensitivity of interactions that may occur between the MS abstract-service-user and the MS-abstract-service for the duration of the abstract-association, in line with the **security-policy** in force. The **security-context** shall be one that is allowed by the registered **user-security-labels** of the MS-abstract-service-user and by the **security-labels** with the MS.

In the absence of this parameter, **security-contexts** are not established between the MS-abstract-service-user and the MS-abstract-service, and the sensitivity of interactions that may occur between the MS abstract-service user and the MS abstract-service is at the discretion of the invoker of the abstract-service.

4) **Fetch-restrictions** (O): This contains the restrictions on entries to be returned as result of a Fetch abstract-operation. The **fetch-restrictions** remain set until an abstract-unbind-operation is issued.

In the absence of this argument, the default is that no **fetch-restrictions** need to be performed.

This argument consists of the following components:

```
Restrictions ::= SET {
allowed-content-types       [0]  SET SIZE (1 . . ub-content-types) OF OBJECT IDENTIFIER
                                 OPTIONAL
                                 -- default is no restriction --,
allowed-EITs                [1]  MS-EITs OPTIONAL -- default is no restriction --,
maximum-content-length      [2]  ContentLength OPTIONAL -- default is no restriction -- }
```

a) **Allowed-content-types** (C): The content-types that the MS abstract-service-user is prepared to accept as result of a Fetch abstract-operation. Any message with a content-type other than the ones specified will not be returned, but result in an error, unless the Fetch abstract-operation has explicitly overridden the restriction.

In the absence of this component, the default is that no **fetch-restrictions** on content-types need to be performed.

b) **Allowed-EITs** (C): The encoded-information-types that the MS abstract-service-user is prepared to accept as result of a Fetch abstract-operation. If a message contains encoded-information-types other than the ones specified, a filtering will take place so that disallowed EIT parts are not returned along with the text of the message. If the whole message consists of disallowed EITs, an error will be reported. No filtering will take place if the Fetch abstract-operation has explicitly overridden the restriction.

```
MS-EITs ::= SET SIZE (1 . . ub-encoded-information-types) OF MS-EIT

MS-EIT ::= OBJECT IDENTIFIER
```

In the absence of this component, the default is that no **fetch-restrictions** on encoded-information-types need to be performed.

c) **Maximum-content-length** (C): The maximum content length that the MS-abstract-service-user is prepared to accept as result of a Fetch abstract-operation. Any message with a **content-length** exceeding the one specified will not be returned, but result in an error, unless the Fetch abstract-operation has explicitly overridden the restriction.

In the absence of this component, the default is that no **fetch-restrictions** on **content-length** need to be performed.

5) **MS-configuration-request** (C): This parameter specifies whether the MS is requested to return information which identifies the auto-action types, optional attribute-types, and content-types to which the MS-user has subscribed, and which consequently are available in the course of the abstract-association.

In the absence of this component, the default is false which indicates that no such request is being made.

7.1.2 *Abstract-bind-result*

The abstract-bind-result parameters are as follows:

```
MSBindResult ::= SET {
    responder-credentials       [2]  ResponderCredentials,
    available-auto-actions      [3]  SET SIZE (1 . . ub-auto-actions) OF AutoActionType OPTIONAL,
    available-attribute-types   [4]  SET SIZE (1 . . ub-attributes-supported) OF AttributeType
                                     OPTIONAL,
    alert-indication            [5]  BOOLEAN DEFAULT FALSE,
    content-types-supported     [6]  SET SIZE (1 . . ub-content-types) OF OBJECT IDENTIFIER
                                     OPTIONAL }
```

1) **Responder-credentials** (M): This parameter contains the credentials of the responder of the abstract-association. It shall be generated by the responder of the abstract-association.

   The **responder-credentials** may be used by the initiator to authenticate the identity of the responder (see CCITT Rec. X.509 | ISO/IEC 9594-8).

   If only **simple-authentication** is used, the **responder-credentials** comprise a simple **password** associated with the responder. The **password** is defined further in 8.5.11 of CCITT Rec. X.411 | ISO/IEC 10021-4.

   If **strong-authentication** is used, the **responder-credentials** comprise a **responder-bind-token**, generated by the responder of the abstract-association. The **responder-bind-token** is defined further in 8.1.1.1.2.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) **Available-auto-actions** (C): This identifies the set of auto-action-types to which the MS-user has subscribed. It is present if requested in the abstract-bind-argument and at least one auto-action-type is available; it is absent otherwise.

3) **Available-attribute-types** (C): This identifies the set of attribute-types to which the MS-user has subscribed. It is present if requested in the abstract-bind-argument and at least one attribute-type is available; it is absent otherwise.

4) **Alert-indication** (C): If true then an **alert** condition has occurred since the last successful **Alert-indication**.

5) **Content-types-supported** (C): This identifies the set of content-types to which the MS-user has subscribed, and for which the MS offers specific support, as defined in the relevant content-specific Recommendation. A message whose content-type is absent from this set may still be submitted, or may be delivered and subsequently retrieved. In the latter case, none of the content-specific attribute-types or auto-action-types defined for that content-type will be available to the MS-user.

   This parameter is present if requested in the abstract-bind-argument and at least one content-type is supported; it is absent otherwise.

7.1.3 *Abstract-bind-errors*

An **MS-bind-error** reports a problem in attempting to establish an abstract-association.

The definition of the errors is:

```
MSBindError ::= ENUMERATED {
    authentication-error                (0),
    unacceptable-security-context       (1),
    unable-to-establish-association     (2) }
```

1) **Authentication-error** (C): This error reports that an abstract-association cannot be established because the initiator's **credentials** are not acceptable or are improperly specified.

   The **authentication-error** has no parameters.

2) **Unacceptable-security-context** (C): This error reports that the **security-context** proposed by the initiator of the abstract-association is unacceptable to the responder.

The **unacceptable-security-context** error has no parameters.

3) **Unable-to-establish-association** (C): This error reports that the responder has rejected the initiator's attempt to establish an abstract-association.

The **unable-to-establish-association** error has no parameters.

7.2 *Abstract-unbind-operation*

The **MS-unbind abstract-unbind-operation** closes the abstract-association. The issuing of an **abstract-unbind-operation** results in the relaxation of any **fetch-restrictions** that were specified in the **abstract-bind-operation** argument. There is no argument, result, or error associated with the **abstract-unbind-operation**.

```
MSUnbind ::= ABSTRACT-UNBIND
        FROM { indirectSubmission[S], retrieval[S], administration[S] }
```

8 Abstract-operations

This clause defines the following **abstract-operations** available at the Retrieval Port:

a) Summarize;

b) List;

c) Fetch;

d) Delete;

e) Register-MS;

f) Alert.

The MS is the MS abstract-service-provider of each of these **abstract-operations**. For the formal definition of the Retrieval Port, see 6.2.

The abstract-operations may be performed asynchronously subject to the following conditions. The Delete and Register-MS abstract-operations shall not be performed until all outstanding abstract-operations have been completed. Additionally these abstract-operations are performed in the order in which they are invoked and are required to complete prior to any other abstract-operations being performed. As a consequence of this and the fact that the List and Fetch abstract-operations change the status of a message entry, the results of the Summarize, List and Fetch abstract-operations may be non-deterministic.

8.1 *Common-data-types used in abstract-operations*

This subclause defines a number of **common data-types** which are used in several of the **abstract-operations** defined in the remainder of clause 8. Many of the **abstract-operations** also make use of entries and attributes as defined in 6.3.

The common data-types defined in this Recommendation are:

a) Range;

b) Filter;

c) Selector;

d) Entry Information Selection;

e) Entry Information.

8.1.1 *Range*

A **range** parameter is used to select a contiguous sequence of entries from an information-base.

```
Range ::= CHOICE {
        sequence-number-range   [0]   NumberRange,
        creation-time-range     [1]   TimeRange }

NumberRange ::= SEQUENCE {
        from    [0]   SequenceNumber OPTIONAL -- omitted means no lower bound --,
        to      [1]   SequenceNumber OPTIONAL -- omitted means no upper bound -- }

TimeRange ::= SEQUENCE {
        from    [0]   CreationTime OPTIONAL -- omitted means no lower bound --,
        to      [1]   CreationTime OPTIONAL -- omitted means no upper bound -- }

CreationTime ::= UTCTime
```

The components of range have the following meanings:

1) **Sequence-number-range** (C), and

2) **Creation-time-range** (C): Both of these parameters identify the contiguous sequence of entries to be selected. The **sequence-number-range** is given in terms of **sequence-numbers**, and the **creation-time-range** is given in terms of **creation-times**. The **creation-time** of an entry is the time at which the MS generated the entry. The **sequence numbers** of successive entries are always in ascending order, but several adjacent entries may have the same **creation time**. The parameters of both **number-range** and **time-range** have the following meanings:

   a) **From** (O): This is the lower bound for the **range**.

      In the absence of this component, the default is **no lower bound**, and the selection starts with the earliest message (lowest **sequence-number**) in the information-base.

   b) **To** (O): This is the upper bound for the **range**.

      In the absence of this component, the default is **no upper bound**, and the selection finishes with the latest message (highest **sequence-number**) in the information-base.

8.1.2 *Filters*

8.1.2.1 *Filter*

A **filter** parameter applies a test to a particular entry and is either satisfied or not by the entry. The **filter** is expressed in terms of assertions about the presence or value(s) of certain attributes of the entry, and is satisfied if and only if it evaluates to **true**. A **filter** may be **true**, **false**, or **undefined**.

```
Filter ::= CHOICE {
        item    [0]   FilterItem,
        and     [1]   SET OF Filter,
        or      [2]   SET OF Filter,
        not     [3]   Filter }
```

A **filter** is either a **filter-item**, or an expression involving simpler **filters** composed together using the logical operators **and**, **or**, and **not**.

a) A **filter** which is a **filter-item** has the value of the **filter-item** (i.e. **true**, **false**, or **undefined**).

b) A **filter** which is the **and** of a set of **filters** is **true** if the set is empty or if each **filter** is **true**; it is **false** if at least one **filter** is **false**; otherwise it is **undefined** (i.e. at least one **filter** is **undefined** and no **filters** are **false**).

c) A **filter** which is the **or** of a set of **filters** is **false** if the set is empty or if each **filter** is **false**; it is **true** if at least one **filter** is **true**; otherwise it is **undefined** (i.e. at least one filter is **undefined** and no **filters** are **true**).

d) A **filter** which is the **not** of a **filter** is **true** if the **filter** is **false**; **false** if it is **true**; and **undefined** if it is **undefined**.

8.1.2.2 *Filter-item*

A **filter-item** is an assertion about the presence or value(s) of an attribute of a particular type in the entry under test. Each such assertion is **true, false**, or **undefined**.

```
FilterItem ::= CHOICE {
    equality            [0]  AttributeValueAssertion,
    substrings          [1]  SEQUENCE {
        type                     AttributeType,
        strings                  SEQUENCE OF CHOICE {
            initial                  [0]  AttributeValue,
            any                      [1]  AttributeValue,
            final                    [2]  AttributeValue } },
    greater-or-equal    [2]  AttributeValueAssertion,
    less-or-equal       [3]  AttributeValueAssertion,
    present             [4]  AttributeType,
    approximate-match   [5]  AttributeValueAssertion }
```

Every **filter-item** includes an attribute-type which identifies the particular attribute concerned.

Any assertion about the value of such an attribute is only defined if the attribute-type is known by the evaluating mechanism, and the purported attribute-value(s) conforms to the attribute syntax defined for that attribute-type. Where the conditions are not met, the **filter-item** is undefined.

Assertions about the value of an attribute are evaluated using the matching rules associated with the attribute syntax defined for that attribute-type, see 6.3.3.4. A matching rule not defined for a particular attribute syntax cannot be used to make assertions about the attribute. Where this conditions is not met, the **filter-item** is undefined.

A **filter-item** may be undefined, as described above. Otherwise, where the **filter-item** asserts:

a) **equality**, it is **true** if and only if there is a value of the attribute which is equal to that asserted;

b) **substrings**, it is **true** if and only if there is a value of the attribute in which the specified **substrings** appear in the given order. The **substrings** must be non-overlapping, and may (but need not) be separated from the ends of the attribute-value and from one another by zero or more **string** elements.

   If **initial** is present, the substring shall match the initial substring of the attribute-value; if **final** is present, the substring shall match the final substring of the attribute-value; if **any** is present, the substring shall match any in the attribute-value.

c) **greater-or-equal**, it is **true** if and only if the relative ordering (as defined by the appropriate ordering algorithm) places some value of the attribute after (i.e. greater than) or equal to the supplied value;

d) **less-or-equal**, it is **true** if and only if the relative ordering (as defined by the appropriate ordering algorithm) places some value of the attribute before (i.e. less than) or equal to the supplied value *after or equal to (i.e.* "*greater than*"*)* any value of the attribute;

e) **present**, it is **true** if and only if such an attribute is present in the entry;

f) **approximate-match**, it is **true** if and only if there is a value of the attribute which matches that which is asserted by some locally-defined approximate matching algorithm (e.g. spelling variations, phonetic match, etc.). There are no specific guide-lines for approximate matching in this version of this Recommendation. If **approximate match** is not supported, this **filter-item** should be treated as match for **equality**.

Note – If no matching rules are given in the attribute definition, this means that only the presence of the attribute can be tested in a **filter-item**.

8.1.2.3 *Attribute-value-assertion*

An **attribute-value-assertion** (*AVA*) is a proposition, which may be **true**, **false**, or **undefined**, concerning the values of an entry. It is evaluated using a matching rule specified for the type, and which is appropriate for the context in which the **attribute-value-assertion** is evaluated. It involves an attribute-type and an attribute-value:

```
AttributeValueAssertion ::= SEQUENCE {
    type        AttributeType,
    value       AttributeValue }
```

and is

a) **undefined**, if any of the following holds:

1) the attribute-type is unknown;

2) the attribute syntax for the type has no matching rule;

3) the value does not conform to the data type of the attribute syntax;

Note – 2) and 3) normally indicate a faulty AVA; 1) however, may occur as a local situation (e.g. a particular MS does not support that particular attribute-type).

b) **true**, if the entry contains an attribute of that attribute-type, one of whose attribute-values matches that attribute-value;

c) **false**, otherwise.

8.1.3 *Selector*

A **selector** parameter is used to select entries from an information-base. The selection operates in three stages. Firstly, the total set of entries in the information-base may be restricted to a particular contiguous set by specifying its range. Secondly, entries from within this set may be selected by specifying a filter which the selected entry shall satisfy. Thirdly, a limit may be placed on the number of entries thus selected; in this case, it is those entries with the lowest sequence-numbers which are selected.

```
Selector ::= SET {
    child-entries   [0]  BOOLEAN DEFAULT FALSE,
    range           [1]  Range OPTIONAL -- default is unbounded --,
    filter          [2]  Filter OPTIONAL -- default is all entries within the specified range --,
    limit           [3]  INTEGER (1 . . ub-messages) OPTIONAL,
    override        [4]  OverrideRestrictions OPTIONAL -- default is that any fetch-restrictions in force
                         do apply -- }
```

The components of selector have the following meanings:

1) **Child-entries** (O): If **false**, only main-entries are considered for selection. If **true**, both main-entries and child-entries are considered for selection.

   In the absence of this component, the default is only main-entries are considered.

2) **Range** (O): The abstract-syntax-notation of **range** is given in 8.1.1.

   In the absence of this component, the default is unbounded.

3) **Filter** (O): The abstract-syntax-notation of **filter** is given in 8.1.2.

   In the absence of this component, the default is all entries within the specified range.

4) **Limit** (O): This allows the specification of an upper limit on how many entries shall be selected.

   In the absence of this component, there is no limit on the number of entries selected.

   Note – The primary role of the limit is to protect against huge results from an abstract-operation as a consequence of badly formulated selections. It can also be used to give back an exact number of information-sets to fit a particular output-device.

5) Override (O): If an override of any of the **fetch-restrictions** is required, the corresponding component(s) of **override-restrictions** shall be present.

```
OverrideRestrictions ::= BIT STRING {
    overrideContentTypesRestriction      (0),
    overrideEITsRestriction              (1),
    overrideContentLengthRestriction     (2) } (SIZE (1 . . ub-information-bases))
```

   The bits of override-restrictions have the following meaning:

   a) **Override-content-types-restriction** (M): This bit must be set to 1 if the **fetch-restrictions** on content-types shall be overridden.

      If this bit is set to 0, the **fetch-restrictions** on content-types as specified in the abstract-bind-operation will be applied.

   b) **Override-EITs-restriction** (M): This bit shall be set to 1 if the **fetch-restrictions** on encoded-information-types shall be overridden.

      If this bit is set to 0, the **fetch-restrictions** on encoded-information-types as specified in the abstract-bind-operation will be applied.

   c) **Override-content-length-restriction** (M): This bit shall be set to 1 if the **fetch-restrictions** on content-length shall be overridden.

      If this bit is set to 0, the **fetch-restrictions** on content-length as specified in the abstract-bind-operation will be applied.

      In the absence of **override-restrictions**, the default is that all the **fetch-restrictions** as specified in the abstract-bind-operation will be applied.

8.1.4 *Entry-information-selection*

An **entry-information-selection** parameter indicates what information from an entry is being requested.

```
EntryInformationSelection ::= SET SIZE (0 . . ub-per-entry) OF AttributeSelection
```

An empty set indicates that information about the entry itself, rather than the attributes of entry, is being requested.

```
AttributeSelection ::= SET {
        type    AttributeType,

        from    [0]     INTEGER (1 . . ub-attribute-values) OPTIONAL -- used if type is multi valued --,
        count   [1]     INTEGER (1 . . ub-attribute-values) OPTIONAL -- used if type is multi valued -- }
```

The components of **attribute-selection** have the following meaning:

1) **Type** (M): This indicates the attribute-type of the attribute.

2) **From** (O): When an attribute is multi-valued, this integer gives the relative position of the first value to be returned. If it specifies a value beyond those present in the attribute, no values are returned. This component may only be present if the attribute-type is multi-valued. If it is omitted, values starting at the first value are returned.

3) **Count** (O): When an attribute is multi-valued, this integer gives the number of values to be returned. If there are less than **count** values present in the attribute, all values are returned. This component may only be present if the attribute-type is multi-valued. If it is omitted, there is no limit as to how many values are returned.

8.1.5 *Entry-information*

An **entry-information** parameter conveys selected information from an entry.

```
EntryInformation ::= SEQUENCE {
        sequence-number     SequenceNumber,
        attributes          SET SIZE (1 . . ub-per-entry) OF Attribute OPTIONAL }
```

The components of **entry-information** have the following meanings:

1) **Sequence-number** (M): The sequence-number identifying the entry. See § 6.3.2.2.

2) **Attributes** (O): The set of selected attributes from the entry. Where explicitly requested by a partial-attribute-request, a selected attribute that is defined to be multi-valued may contain a subset of all the attribute-values in the attribute as stored in the entry. This parameter is absent if information from the selected messages is not requested, for example, when the MS-abstract-service-user wants only the sequence-numbers of the selected messages.

8.2 *Summarize abstract-operation*

The **Summarize abstract-operation** returns summary counts of selected entries in an information-base. In addition to these summaries, a count of the entries selected, and their lowest and highest sequence-numbers are also returned. Zero or more individual summaries may be requested.

The **summarize abstract-operation** will only be successful when the information-base permits access according to the security-context and the enforced security-policy.

The attributes that may be used for summaries are restricted. For the general-attributes in the stored-messages information-base, the restrictions are given in Table 1/X.413.

```
Summarize ::= ABSTRACT-OPERATION
        ARGUMENT    SummarizeArgument
        RESULT      SummarizeResult
        ERRORS {
                AttributeError,
                InvalidParametersError,
                RangeError,
                SecurityError,
                SequenceNumberError,
                ServiceError }
```

Note – An example of the summarize abstract-operation is given in Annex F.

8.2.1 *Summarize-argument*

```
SummarizeArgument ::= SET {
    information-base-type  [0]  InformationBase DEFAULT stored-messages,
    selector               [1]  Selector,
    summary-requests       [2]  SEQUENCE SIZE (1 . . ub-summaries) OF AttributeType OPTIONAL
                                -- absent if no summaries are requested -- }
```

The components of **summarize-argument** have the following meanings:

1) **Information-base-type** (O): This specifies which information-base is addressed by the abstract-operation. See 6.3.1.

   In the absence of the **information-base-type** component, the default is stored-messages.

2) **Selector** (M): This is a set of selection criteria to determine which entries shall be summarized. See 8.1.3.

3) **Summary-requests** (O): This is the sequence of attribute-types for which summaries are requested. This parameter is only present if a summary is requested.

8.2.2 *Summarize-result*

Should the request succeed, the **summarize-result** will be returned.

```
SummarizeResult ::= SET {
    next       [0]  SequenceNumber OPTIONAL,
    count      [1]  INTEGER (0 . . ub-messages) -- of the entries selected --,
    span       [2]  Span OPTIONAL -- of the entries selected, omitted if count is zero --,
    summaries  [3]  SEQUENCE SIZE (1 . . ub-summaries) OF Summary OPTIONAL }
```

The components of **summarize-result** have the following meanings:

1) **Next** (C): This is returned in the case where the number of entries selected would have been greater if it were not for the limit specified in the selector. The component contains the sequence-number for the next entry that would have been selected.

2) **Count** (M): This is an integer giving the count of entries that matched the selection criteria.

3) **Span** (C): This contains the lowest and highest sequence-numbers of the entries that matched the selection criteria. It is absent if there are no such entries.

```
Span ::= SEQUENCE {
    lowest     [0]  SequenceNumber,
    highest    [1]  SequenceNumber }
```

   The components of **span** have the following meanings:

   a) **Lowest** (M): This is the starting-point for the **span**, given as a sequence-number (see 6.3.2.2).

   b) **Highest** (M): This is the end-point for the **span** given as a sequence-number (see 6.3.2.2).

4) **Summaries** (C): One **summary** is returned for each **summary-request**. The **summaries** are returned in the order that they were requested.

```
Summary ::= SET {
    absent   [0]  INTEGER (1 . . ub-messages) OPTIONAL -- count of entries where the attribute is
                  absent --,
    present  [1]  SET SIZE (1 . . ub-attribute-values) OF -- one for each attribute value present --
                      SEQUENCE {
                          type     AttributeType,
                          value    ANY DEFINED BY type,
                          count    INTEGER (1 . . ub-messages) } OPTIONAL }
```

The components of **summary** have the following meanings:

a) **Absent** (C): A count of the entries that do not contain an attribute of the attribute-type specified in the request. It is omitted if there are no such entries.

b) **Present** (C): A summary of the entries that contain an attribute of the attribute-type specified, broken down by the attribute-values actually present. It is omitted if there are no such entries.

The components of **present** have the following meanings:

i) **Type** (M): The type of the attribute.

ii) **Value** (M): The attribute-value for which the count is given.

iii) **Count** (M): A count of entries with this attribute-value.

8.2.3 *Summarize abstract-errors*

Should the request fail, one of the listed abstract-errors will be reported. The circumstances under which the particular abstract-errors will be reported are defined in clause 9.

8.3 *List abstract-operation*

The **List-abstract-operation** is used to search a selected information-base for entries of interest and to return selected information from those entries.

The **List-abstract-operation** will only be successful when the information-base permits access according to the security-context and the enforced security policy.

The information that may be selected for entries in an information-base may be restricted. For the general-attributes in the stored-messages information-base, the restrictions are given in Table 1/X.413.

```
List ::= ABSTRACT-OPERATION
    ARGUMENT    ListArgument
    RESULT      ListResult
    ERRORS {
        AttributeError,
        InvalidParametersError,
        RangeError,
        SecurityError,
        SequenceNumberError,
        ServiceError }
```

8.3.1 *List-argument*

```
ListArgument ::= SET {
    information-base-type   [0]  InformationBase DEFAULT stored-messages,
    selector                [1]  Selector,
    requested-attributes    [3]  EntryInformationSelection OPTIONAL }
```

The components of **list-argument** have the following meanings:

1) **Information-base-type** (O): This specifies which information-base is addressed by the abstract-operation. See 6.3.1.

In the absence of the **information-base-type** component, the default is stored-messages.

2) **Selector** (M): This is a set of selection criteria to determine which entries shall be returned. See 8.1.3.

3) **Requested-attributes** (O): This indicates what information from the selected entries is to be returned in the result. See 8.1.4.

If this parameter is absent, the registered set of **list-attribute-defaults** is used. See 8.6.1 for more information on these defaults.

8.3.2 *List-result*

Should the request succeed, the **list-result** will be returned.

```
ListResult ::= SET {
    next          [0]  SequenceNumber OPTIONAL,
    requested     [1]  SEQUENCE SIZE (1 . . ub-messages) OF EntryInformation OPTIONAL
                       -- omitted if none found -- }
```

The components of **list-result** have the following meanings:

1) **Next** (C): This is returned in the case where the number of entries selected would have been greater if it were not for the limit specified in the selector. The component contains the sequence-number for the next entry that would have been selected.

2) **Requested** (C): This conveys the requested entry-information (see 8.1.5) from each selected entry (one or more), in ascending order of sequence-number. It is not present in the case that a search was performed and no entry was selected.

8.3.3 *List abstract-errors*

Should the request fail, one of the listed abstract-errors will be reported. The circumstances under which the particular abstract-errors will be reported are defined in clause 9.

8.4 *Fetch abstract-operation*

The **Fetch-abstract-operation** is used to return selected information from a specific entry in an information-base. Alternatively, it is used to return selected information from the first entry from among several entries of interest; in this case the sequence-numbers of the other selected entries are also returned. The **Fetch abstract-operation** will only be successful when information-bases permitted by the security-context and the security-policy in force are requested.

Information from an entry can be fetched several times, until the entry is explicitly deleted using the Delete abstract-operation.

```
Fetch ::= ABSTRACT-OPERATION
    ARGUMENT        FetchArgument
    RESULT          FetchResult
    ERRORS {
        AttributeError,
        FetchRestrictionError,
        InvalidParametersError,
        RangeError,
        SecurityError,
        SequenceNumberError,
        ServiceError }
```

8.4.1 *Fetch-argument*

```
FetchArgument ::= SET {
    information-base-type  [0]  InformationBase DEFAULT stored-messages,
    item                        CHOICE {
                                    search    [1]  Selector,
                                    precise   [2]  SequenceNumber },
    requested-attributes   [3]  EntryInformationSelection OPTIONAL }
```

The components of **fetch-argument** have the following meanings:

1) **Information-base-type** (O): This specifies which information-base is addressed by the abstract-operation. See § 6.3.1.

   In the absence of the **information-base-type** component, the default is stored-messages.

2) **Item** (M): One of the components described below must be specified in order to determine which entry to fetch:

   a) **Search** (C): This is a selector specifying a set of entries of which the one with the lowest sequence-number is the entry to be fetched. See § 8.1.3.

   b) **Precise** (C): This is the sequence-number of the entry to be fetched. See § 6.3.2.2.

3) **Requested-attributes** (O): This indicates what information from the selected entry is to be returned in the result (see 8.1.4).

   If this parameter is absent, the registered set of **fetch-attribute-defaults** is used. See 8.6.1 for more information on these defaults.

8.4.2 *Fetch-result*

Should the request succeed, the **fetch-result** will be returned.

```
FetchResult ::= SET {
    entry-information    [0]    EntryInformation OPTIONAL -- if an entry was selected --,
    list                 [1]    SEQUENCE SIZE (1 . . ub-messages) OF SequenceNumber
                                OPTIONAL,
    next                 [2]    SequenceNumber OPTIONAL }
```

The components of **fetch-result** have the following meanings:

1) **Entry-information** (C): This is the set of all those requested attributes that are present in the selected entry. See 8.1.5. It is not present in the case that a search was performed and no entry was selected.

2) **List** (C): This is returned in the case that a search was performed and more than one entry was found that matched the search selector. The list gives the sequence numbers, in ascending order, of these further entries.

3) **Next** (C): This is returned in the case where the number of entries selected would have been greater if it were not for the limit specified in the selector. The component contains the sequence-number for the next entry that would have been selected.

8.4.3 *Fetch abstract-errors*

Should the request fail, one of the listed abstract-errors will be reported. The circumstances under which the particular abstract-errors will be reported are defined in clause 9.

8.5 *Delete abstract-operation*

The **Delete abstract-operation** is used to delete selected entries from an information-base. A main-entry and all its dependent child-entries may only be deleted together. This is achieved by specifying just the main-entry as an argument. The **Delete abstract-operation** will only be successful when operating on those information-bases permitted by the security-context and the security-policy in force.

For specific information-bases, there may be restrictions on which entries may be deleted. In addition, content specific actions may be taken as defined in the corresponding Recommendation which defines the content-type. For the stored-messages, no entry may be deleted if its entry-status (see 6.4) is “new”. The entry-status of any child-entry associated with a main-entry shall not be considered when performing the **Delete abstract-operation**.

```
Delete ::= ABSTRACT-OPERATION
        ARGUMENT    DeleteArgument
        RESULT      DeleteResult
        ERRORS {
            DeleteError,
            InvalidParametersError,
            RangeError,
            SecurityError,
            SequenceNumberError,
            ServiceError }
```

8.5.1 *Delete-argument*

```
DeleteArgument ::= SET {
        information-base-type  [0] InformationBase DEFAULT stored-messages,
        items                  CHOICE {
            selector               [1]    Selector,
            sequence-numbers       [2]    SET SIZE (1 . . ub-messages) OF SequenceNumber } }
```

The components of **delete-argument** have the following meanings:

1) **Information-base-type** (O): This specifies which information-base is addressed by the abstract-operation. See 6.3.1.

   In the absence of the **information-base-type** component, the default is stored-messages.

2) **Items** (M): One of the components described below shall be specified in order to determine which entries to delete.

   a) **Selector** (C): See 8.1.3.

   b) **Sequence-numbers** (C): An unordered list of **sequence-numbers**. See 6.3.2.2.

8.5.2 *Delete-result*

Should the request succeed, the **delete-result** will be returned. There are no parameters.

```
DeleteResult ::= NULL
```

8.5.3 *Delete abstract-errors*

Should the request fail, one of the listed abstract-errors will be reported. The circumstances under which the particular abstract-errors will be reported are defined in clause 9.

8.6 *Register-MS abstract-operation*

The **Register-MS abstract-operation** is used to register or deregister various information with the MS:

a) auto-actions;

b) default list of attribute-types;

c) new credentials;

d) new set of user-security labels.

```
Register-MS ::= ABSTRACT-OPERATION
        ARGUMENT      Register-MSArgument
        RESULT        Register-MSResult
        ERRORS {
            AtrributeError,
            AutoActionRequestError,
            InvalidParametersError,
            SecurityError,
            ServiceError }
```

8.6.1 *Register-MS-argument*

```
Register-MS-Arguments ::= SET {
    auto-action-registrations       [0]  SET SIZE (1 . . ub-auto-registrations) OF AutoActionRegistration
                                         OPTIONAL,
    auto-action-deregistrations     [1]  SET SIZE (1 . . ub-auto-registrations) OF AutoActionDeregistration
                                         OPTIONAL,
    list-attribute-defaults         [2]  SET SIZE (1 . . ub-default-registrations) OF AttributeType
                                         OPTIONAL,
    fetch-attribute-defaults        [3]  SET SIZE (1 . . ub-default-registrations) OF AttributeType
                                         OPTIONAL,
    change-credentials              [4]  SEQUENCE {
                old-credentials              [0] Credentials,
                new-credentials              [1] Credentials } OPTIONAL
            -- same CHOICE as for old-credentials --,
    user-security-labels            [5]  SET SIZE (1 . . ub-labels-and-redirections) OF SecurityLabel
                                         OPTIONAL }
```

The components of **register-MS-argument** have the following meanings:

1) **Auto-action-registrations** (O): This is a set of **auto-action-registration** (see 6.5.1), one for each auto-action to be registered. The new auto-action **registration-parameter** supersedes any previously registered auto-action (if any) with that **registration-identifier** and auto-action **type**.

   In the absence of **auto-action-registrations**, the default is that no new auto-actions are registered.

2) **Auto-action-deregistrations** (O): This is a set of **auto-action-deregistration**, one for each auto-action to be deregistered. Any auto-action with **registration-identifier** and auto-action **type** matching those in an **auto-action-deregistration** is deregistered.

   ```
   AutoActionDeregistration ::= SEQUENCE {
       type                        AutoActionType
       registration-identifier     [0]  INTEGER (1 . . ub-per-auto-action) DEFAULT 1 }
   ```

   In the absence of **auto-action-deregistrations**, the default is that no registered auto-actions are deregistered.

3) **List-attribute-defaults** (O): This specifies a default set of attribute-types to indicate which attributes should be returned for any subsequent List abstract-operation if the entry-information-selection argument is absent.

   In the absence of **list-attribute-defaults**, the default is that there is no change to the registered default (if any). The **list-attribute-defaults** are the empty set until explicitly changed by the MS-user via the Register-MS abstract-operation.

4) **Fetch-attribute-defaults** (O): This specifies a default set of attribute-types to indicate which attributes should be returned for any subsequent Fetch abstract-operation if the entry-information-selection argument is absent.

   In the absence of **fetch-attribute-defaults**, the default is that there is no change to the registered default (if any). The **fetch-attribute-defaults** are the empty set until explicitly changed by the MS-user via the Register-MS abstract-operation.

5) **Change-credentials** (O): The old and new credentials if a **change-credentials** is requested.

The **old-credentials** are the end user's current credentials, and the **new-credentials** are the credentials the end user would like to change to.

In the absence of this argument, the default is that previously registered credentials remain unchanged.

The credentials of the MS-user may differ from the **initiator-credentials** detailed in 8.1.1.1.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

6) **User-security-labels** (O): This contains the **security-label(s)** of the MS abstract-service-user, if they are to be changed. It may be generated by the MS abstract-service-user.

In the absence of this argument, the **user-security-labels** remain unchanged.

Note that some **security-policies** may only permit the **user-security-labels** to be changed in this way if a secure link is employed. Other local means of changing the **user-security-labels** in a secure manner may be provided. **User-security-labels** is defined in 8.4.1.1.1.7 of CCITT Rec. X.411 | ISO/IEC 10021-4.

Security-label is defined in clause 9 of CCITT Rec. X.411 | ISO/IEC 10021-4.

8.6.2 *Register-MS-result*

Should the request succeed, the **register-MS-result** will be returned. There are no parameters.

```
Register-MSResult ::= NULL
```

8.6.3 *Register-MS abstract-errors*

Should the request fail, one of the listed abstract-errors will be reported. The circumstances under which the particular abstract-errors will be reported are defined in clause 9.

8.7 *Alert abstract-operation*

The **Alert abstract-operation** enables the MS abstract-service-provider to immediately inform the MS abstract-service-user of a new entry having been entered into the MS, whose attributes match the selection criteria of one of the **auto-alert-registrations** (see 12.2) previously supplied using a Register-MS abstract-operation (see 8.6).

The **Alert abstract-operation** may be invoked during an existing abstract-association initiated by the UA, and only as a result of new entries created after the establishment of the abstract-association.

Entries matching the selection criteria which have been created between abstract-associations will be indicated in the result of the next abstract-bind-operation for the abstract-association. No **alert abstract-operation** will be invoked for these entries. See clause 7.

The **alert abstract-operation** will only be successful when the information-base permits access according to the security-context and the enforced security-policy.

```
Alert ::= ABSTRACT-OPERATION
    ARGUMENT        AlertArgument
    RESULT          AlertResult
    ERRORS {
        SecurityError }
```

8.7.1 *Alert-argument*

```
AlertArgument ::= SET {
        alert-registration-identifier  [0]  INTEGER (1 . . ub-auto-actions),
        new-entry                      [2]  EntryInformation OPTIONAL }
```

The components of the **alert-argument** have the following meanings:

1) **Alert-registration-identifier** (M): Identifies which of the **auto-alert-registrations** resulted in the alert (see 6.5 and 12.2).

2) **New-entry** (O): This conveys the information from the new entry which was requested in the **auto-alert-registration-parameter** (see 12.2). It is absent when the MS abstract-service-user did not specify **requested-attributes** in the **auto-alert-registration-parameter**.

8.7.2 *Alert-result*

Should the request succeed, the **alert-result** will be returned.

```
AlertResult ::= NULL
```

8.7.3 *Alert abstract-errors*

Should the request fail, one of the listed abstract-errors will be reported. The circumstances under which the particular abstract-errors will be reported are defined in clause 9.

9 Abstract-errors

This clause defines the following **abstract-errors** associated with using the abstract-operations at the Retrieval Port:

a) AttributeError;

b) AutoActionRequestError;

c) DeleteError;

d) FetchRestrictionError;

e) InvalidParametersError;

f) RangeError;

g) SecurityError;

h) SequenceNumberError;

i) ServiceError.

9.1 *Error precedence*

The performer of an abstract-operation is not required to continue processing the message beyond the point at which an error has been detected. This allows an implementation to choose whether to continue the processing of errors.

Note – An implication of this rule is that the first error encountered may differ for repeated instances of the same abstract-operation, as there is not necessarily a specific logical order in which to process it.

9.2 *Attribute-error*

An **attribute-error** reports an attribute related problem.

```
AttributeError ::= ABSTRACT-ERROR
    PARAMETER SET {
        problems        [0]  SET SIZE (1 . . ub-per-entry) OF SET {
            problem             [0]  AttributeProblem,
            type                [1]  AttributeType,
            value               [2]  ANY DEFINED BY type OPTIONAL } }

AttributeProblem ::= INTEGER {
    invalid-attribute-value             (0),
    unavailable-attribute-type          (1),
    inappropriate-matching              (2),
    attribute-type-not-subscribed       (3),
    inappropriate-for-operation         (4) }  (0 . . ub-error-reasons)
```

The parameter has the following meaning:

1) **Problems** (M): The particular problems encountered. Any number of individual problems may be indicated, each problem being accompanied by an indication of the attribute-type, and, if necessary to avoid ambiguity, the value which caused the problem:

   a) **Invalid-attribute-value** (C): A purported attribute-value specified as an argument of the abstract-operation does not conform to the data-type defined for the attribute-type concerned.

   b) **Unavailable-attribute-type** (C): A purported attribute-type used as an argument of the abstract-operation is not one of those which is supported by the MS abstract-service-provider. If the MS abstract-service-provider is able to carry out the operation anyway, it is not prohibited from doing so.

   c) **Inappropriate-matching** (C): The filter contains a filter-item in which an attribute is matched using an operation (equality, ordering, or substrings) that is not defined for that attribute.

   d) **Attribute-type-not-subscribed** (C): An attribute-type used as an argument of the abstract-operation is not one of those to which the MS abstract-service-user has subscribed.

      Note – A change of the subscription is not necessarily reflected in the attributes present in an entry created before the change.

   e) **Inappropriate-for-operation** (C): An attribute-type used as an argument of the abstract-operation is unsuitable for its required use.

9.3 *Auto-action-request-error*

An **Auto-action-request-error** reports a problem related to registration of an auto-action.

```
AutoActionRequestError ::= ABSTRACT-ERROR
    PARAMETER SET {
        problems        [0]  SET SIZE (1 . . ub-auto-registrations) OF SET {
            problem             [0]  AutoActionRequestProblem,
            type                [1]  AutoActionType } }

AutoActionRequestProblem ::= INTEGER {
    unavailable-auto-action-type            (0),
    auto-action-type-not-subscribed         (1) } (0 . . ub-error-reasons)
```

The parameter has the following meaning:

1) **Problems** (M): The particular problems encountered. Any numbers of individual problems may be indicated, each problem being accompanied by an indication of the auto-action-type which caused the problem:

   a) **Unavailable-auto-action-type**: An auto-action-type used as an argument of the abstract-operation is not one of those which is supported by the MS abstract-service-provider.

   b) **Action-type-not-subscribed**: An action-type used as an argument of the abstract-operation is not one of those to which the MS abstract-service-user has subscribed.

9.4 *Delete-error*

A **delete-error** reports a problem in an attempt to delete one or more entries from an information-base.

```
DeleteError ::= ABSTRACT-ERROR
    PARAMETER SET {
        problems          [0]    SET SIZE (1 . . ub-messages) OF SET {
            problem               [0]    DeleteProblem,
            sequence-number       [1]    SequenceNumber } }

DeleteProblem ::= INTEGER {
        child-entry-specified         (0),
        delete-restriction-problem    (1) } (0 . . ub-error-reasons)
```

The parameter has the following meaning:

1) **Problems** (M): The particular problems encountered. Any number of individual problems may be indicated, each problem being accompanied by an indication of the sequence-number of the entry which caused the problem:

   a) **Child-entry-specified**: An attempt has been made to delete a child-entry.

   b) **Delete-restriction-problem**: An attempt has been made to violate a restriction specified for the Delete abstract-operation (see 8.5).

9.5 *Fetch-restriction-error*

A **Fetch-restriction-error** reports an attempt to violate a restriction associated with the Fetch abstract-operation.

```
FetchRestrictionError ::= ABSTRACT-ERROR
    PARAMETER SET {
        problems [0]          SET SIZE (1 . . ub-default-registrations) OF SET {
            problem               [3]    FetchRestrictionProblem,
            restriction           CHOICE {
                content-type          [0]    OBJECT IDENTIFIER,
                eit                   [1]    MS-EITs,
                content-length        [2]    ContentLength } } }

FetchRestrictionProblem ::= INTEGER {
    content-type-problem      (1),
    eit-problem               (2),
    content-length-problem    (3) } (0 . . ub-error-reasons)
```

The parameter has the following meaning:

1) **Problems** (M): The particular problems encountered. Any number of individual problems may be indicated, each problem being accompanied by an indication of the offending content-type, encoded-information-type or content-length which caused the problem:

   a) **Content-type-problem** (C): The content-type of the message being fetched is disallowed by the **fetch-restrictions** currently in force.

   b) **EIT-problem** (C): The encoded-information-types requested in the Fetch abstract-operation are disallowed by the **fetch-restrictions** currently in force.

   c) **Content-length-problem** (C): The content-length of the message being fetched is longer than that allowed by the **fetch-restrictions** currently in force.

9.6 *Invalid-parameters-error*

An **invalid-parameters-error** reports a semantic problem in the set of parameters received. This error would be used, for example, to report that an optional parameter was present in the wrong context, or to report that a value for one of the parameters is inappropriate.

```
InvalidParametersError ::= ABSTRACT-ERROR
        PARAMETER NULL
```

This error has no parameters.

9.7 *Range-error*

A **Range-error** reports a problem related to the **range** specified in a selector as an argument to an abstract-operation.

```
RangeError ::= ABSTRACT-ERROR
        PARAMETER SET {
          problem       [0]     RangeProblem }

RangeProblem ::= INTEGER {
        reversed            (0) } (0 . . ub-error-reasons)
```

The parameter has the following meaning:

1) **Problems** (M): The particular problems encountered:

   a) **Reversed** (C): The upper bound indicated a sequence-number or creation-time before that indicated by the lower bound.

9.8 *Security-error*

A **Security-error** reports that the requested abstract-operation cannot be provided because it would violate the security-policy in force. This error is defined in CCITT Rec. X.411 | ISO/IEC 10021-4.

9.9 *Sequence-number-error*

A **Sequence-number-error** reports a problem related to the sequence-number specified in an argument to an abstract-operation.

```
SequenceNumberError ::= ABSTRACT-ERROR
        PARAMETER SET {
          problems     [1]     SET SIZE (1 . . ub-messages) OF SET {
                problem                    [0]     SequenceNumberProblem,
                sequence-number            [1]     SequenceNumber } }

SequenceNumberProblem ::= INTEGER {
          no-such-entry                 (0) } (0 . . ub-error-reasons)
```

The parameter has the following meaning:

1) **Problems** (M) : The particular problems encountered. Any number of individual problems may be indicated, each problem being accompanied by an indication of the sequence-numbers which caused the problem:

   No-such-entry : The sequence-number supplied does not match that of any entry in the information-base.

9.10 *Service-error*

A **Service-error** reports an error related to the provision of the service.

```
ServiceError ::= ABSTRACT-ERROR
        PARAMETER SET {
            problem         [0]   ServiceProblem }

ServiceProblem ::= INTEGER {
        busy                      (0),
        unavailable               (1),
        unwilling-to-perform      (2) } (0 . . ub-error-reasons)
```

The parameter has the following meaning:

1) **Problem** (M): The particular problem encountered:

   a) **Busy** (C): The MS, or some part of it, is presently too busy to perform the requested abstract-operation, but may be able to do so after a short while.

   b) **Unavailable** (C): The MS, or some part of it, is presently unavailable.

   c) **Unwilling-to-perform** (C): The MS is not prepared to execute this request, because it would lead to excessive consumption of resources.

10 Overview

The MS information-model and the attribute and auto-action concepts were introduced in § 6.3.3 and § 6.5. Clause 11 defines the **general-attribute-types** which are specified for MS. Clause 12 defines the **general-auto-action-types** which are specified for MS.

11 General-attribute-types

The **general-attribute-types** are valid for all message content-types. Other attribute-types, which are content-specific, are defined in their respective Recommendation, e.g. the IPMS-specific attribute-types for MS are defined in Annex C of CCITT Rec. X.420 | ISO/IEC 10021-7.

11.1 *General-attribute-types overview*

The **general-attributes** that may occur in a stored-messages information-base entry are listed in Table 1/X.413. They are constructed mainly from the parameter information from the MessageDelivery and ReportDelivery abstract-operations of the MTS abstract-service as defined in clause 8 of CCITT Rec. X.411 | ISO/IEC 10021-4, and such attributes are correspondingly named. Some **general-attributes** are generated, and some of these also maintained, by the MS.

Table 1/X.413 defines the various **general-attributes** and defines the following for each attribute-type:

– whether the attribute-type is single-valued or multi-valued;

– whether or not support by the MS and the accessing UA is mandatory or optional;

– whether the attribute-type is always present, conditionally present, or absent in a delivered-message entry, a delivered-report entry, or a returned-content entry respectively;

– whether or not the attribute-type can be returned in a List or an Alert abstract-operation;

– whether or not the attribute-type may be used in a Summarize abstract-operation.

Note – Only for simple ASN.1 data-types.

For a more detailed description of the classification in Table 1/X.413 refer to the conventions in § 5.2.

An optional attribute-type is only supported by an MS if the support of that attribute-type has successfully been subscribed to (which implies that the MS and the accessing UA supports that attribute). Subscription to optional attribute-types can be per attribute-type per UA.

Attribute-type defined as present in a delivered-message entry may not always be present in a child-entry. The rules governing the presence of attribute-types in child-entries may be supplemented in the Recommendation which defines the content-type of the child-entry.

All attributes supported are available to the Fetch abstract-operation subject to subscription.

11.2 *Description of the general-attribute-types*

The following subclauses contain a short description of each **general-attribute-type** together with its abstract-syntax using the ATTRIBUTE macro described in 6.3.

It should be noted that some **general-attributes** are used primarily for filtering and listing purposes while others can contain more complex (further structured ASN.1 data-types) and potentially voluminous information. Only a few **general-attributes** are suitable for summaries.

TABLE 1/X.413

General-attribute-types for the Delivery Information-base

Attribute-type-name	Single/ Multi valued	Support level by MS and access UA	Presence in delivered message entry	Presence in delivered report entry	Presence in returned content entry	Available for list, alert	Available for summarize
Child-sequence-numbers	M	M	C	C	C	Y	N
Content	S	M	P	–	P	N	N
Content-confidentiality-algorithm-identifier	S	O	C	–	–	Y	N
Content-correlator	S	O	–	C	–	Y	N
Content-identifier	S	O	C	C	–	Y	N
Content-integrity-check	S	O	C	–	–	Y	N
Content-length	S	O	P	–	P	Y	N
Content-returned	S	O	–	P	–	Y	Y
Content-type	S	M	P	C	C	Y	Y
Conversion-with-loss-prohibited	S	O	C	–	–	Y	N
Converted-EITs	M	O	C	–	–	Y	N
Creation-time	S	M	P	P	P	Y	N
Delivered-EITs	M	O	P	–	–	Y	N
Delivery-flags	S	O	P	–	–	Y	N
DL-expansion-history	M	O	C	C	–	Y	N
Entry-status	S	M	P	P	P	Y	Y
Entry-type	S	M	P	P	P	Y	Y
Intended-recipient-name	S	O	C	–	–	Y	N
Message-delivery-envelope	S	M	P	–	–	N	N
Message-delivery-identifier	S	O	P	–	–	Y	N
Message-delivery-time	S	O	P	–	–	Y	N
Message-origin-authentication-check	S	O	C	–	–	Y	N
Message-security-label	S	O	C	C	–	Y	N
Message-submission-time	S	O	P	–	–	Y	N
Message-token	S	O	C	–	–	Y	N
Original-EITs	M	O	C	C	–	Y	N
Originator-certificate	S	O	C	–	–	Y	N
Originator-name	S	O	P	–	–	Y	N
Other-recipient-names	M	O	C	–	–	Y	N
Parent-sequence-number	S	M	C	–	P	Y	N
Per-recipient-report-delivery-fields	M	M	–	P	–	Y	N
Priority	S	O	P	–	–	Y	Y
Proof-of-delivery-request	S	O	C	–	–	Y	N
Redirection-history	M	O	C	–	–	Y	N
Report-delivery-envelope	S	M	–	P	–	N	N
Reporting-DL-name	S	O	–	C	–	Y	N
Reporting-MTA-certificate	S	O	–	C	–	Y	N
Report-origin-authentication-check	S	O	–	C	–	Y	N
Security-classification	S	O	C	C	–	Y	Y
Sequence-number	S	M	P	P	P	Y	N
Subject-submission-identifier	S	M	–	P	–	Y	N
This-recipient-name	S	O	P	–	–	Y	N

11.2.1 *Child-sequence-numbers*

This general-attribute, which is multi-valued, contains one or more ”pointers” to the next level of child-entries, if such exist. It is generated by the MS. It is present in a parent-entry that has one or more child-entries associated with it. It is absent in an entry without child-entries.

ms-child-sequence-numbers ATTRIBUTE
WITH ATTRIBUTE-SYNTAX-SequenceNumber
MULTI VALUE
::= id-att-child-sequence-numbers

11.2.2 *Content*

This general-attribute contains the complete content of a message as delivered by the MessageDelivery abstract-operation or as a **returned-content** by the ReportDelivery abstract-operation. In the latter case, the content general-attribute is created in the returned-content child-entry, and not in the delivered-report entry itself. For more details see 8.2.1.1.1.37 and 8.3.1.2.1.14 of CCITT Rec. X.411 | ISO/IEC 10021-4.

ms-content ATTRIBUTE
WITH ATTRIBUTE-SYNTAX Content
SINGLE VALUE
::= id-att-content

11.2.3 *Content-confidentiality-algorithm-identifier*

This general attribute contains the **algorithm-identifier** used by the originator of the message to encrypt the message content. It may be generated by the originator of the message. For further details see 8.5.10 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-content-confidentiality-algorithm-identifier ATTRIBUTE
WITH ATTRIBUTE-SYNTAX AlgorithmIdentifier
SINGLE VALUE
::= id-att-content-confidentiality-algorithm-identifier

11.2.4 *Content-correlator*

This general-attribute contains information to enable correlation of the content of the message. It may be generated by the originating UA. For more details see 8.2.1.1.1.36 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-content-correlator ATTRIBUTE
WITH ATTRIBUTE-SYNTAX ContentCorrelator
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-content-correlator

11.2.5 *Content-identifier*

This general-attribute contains an identifier for the content of the message. It may be generated by the originating UA. For more details see 8.2.1.1.1.35 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-content-identifier ATTRIBUTE
WITH ATTRIBUTE-SYNTAX ContentIdentifier
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-content-identifier

11.2.6 *Content-integrity-check*

This general attribute provides the recipient(s) of the message with a means of validating that the message content has not been modified. It may be generated by the originator of the message and may specify a different value for each recipient of the message. For further details see 8.2.1.1.1.28 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-content-integrity-check ATTRIBUTE
WITH ATTRIBUTE-SYNTAX ContentintegrityCheck
SINGLE VALUE
::= id-att-content-integrity-check

11.2.7 *Content-length*

This general-attribute gives the length of the content in octets of a message as delivered by the MessageDelivery abstract-operation or of a returned-content (if any) notified by the ReportDelivery abstract- operation. Where there is no such returned-content, this attribute is absent. It is generated by the MS.

ms-content-length ATTRIBUTE
WITH ATTRIBUTE-SYNTAX ContentLength
MATCHES FOR ORDERING
SINGLE VALUE
::= id-att-content-length

11.2.8 *Content-returned*

This general-attribute indicates whether a content has been returned in the ReportDelivery abstract-operation. It is generated by the MS.

ms-content-returned ATTRIBUTE
WITH ATTRIBUTE-SYNTAX BOOLEAN
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-content-returned

11.2.9 *Content-type*

This general-attribute is generated from the content-type in the MessageDelivery or ReportDelivery abstract-operation. See also 8.2.1.1.1.34 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-content-type ATTRIBUTE
WITH ATTRIBUTE-SYNTAX OBJECT IDENTIFIER
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-content-type

11.2.10 *Conversion-with-loss-prohibited*

This general-attribute contains information about whether conversion with loss of information was allowed or prohibited. For further details see 8.2.1.1.1.10 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-conversion-with-loss-prohibited ATTRIBUTE
WITH ATTRIBUTE-SYNTAX ConversionWithLossProhibited
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-conversion-with-loss-prohibited

11.2.11 *Converted-EITs*

This general-attribute, which is multi-valued, identifies the encoded-information-types of the content after conversion, as indicated by MessageDelivery abstract-operation. It is generated from the **converted-encoded-information-types** from the MessageDelivery abstract-operation. It is absent if no conversion took place. For more details see 8.3.1.1.1.8 and 8.3.1.2.1.5 of CCITT Rec. X.411 | ISO/IEC 10021-4.

ms-converted-EITs ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MS-EIT
MATCHES FOR EQUALITY
MULTI VALUE
::= id-att-converted-EITs

11.2.12 *Creation-time*

This general-attribute gives the time when the entry was created in the MS. It is generated by the MS

Note – Two or more consecutive entries may have the same creation-time.

ms-creation-time ATTRIBUTE
WITH ATTRIBUTE-SYNTAX CreationTime
MATCHES FOR EQUALITY ORDERING
SINGLE VALUE
::= id-att-creation-time

11.2.13 *Delivered-EITs*

This general-attribute, which is multi-valued, identifies the encoded-information-types in the content of the message as delivered. It is generated by the MS based on information about the original-EITs and the converted-EITs in the MessageDelivery abstract-operation.

ms-delivered-EITs ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MS-EIT
MATCHES FOR EQUALITY
MULTI VALUE
::= id-att-delivered-EITs

11.2.14 *Delivery-flags*

This general-attribute contains information of the delivery. Presently, it is only used for indicating implicit-conversion of the content. For more details see 8.2.1.1.1.9 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-delivery-flags ATTRIBUTE
WITH ATTRIBUTE-SYNTAX DeliveryFlags
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-delivery-flags

11.2.15 *DL-expansion-history*

This general-attribute, which is multi-valued, is used to show the history of distribution-list expansion. If present in a delivered-message, it contains one or more distribution-list names used during the expansion process. It is absent if the MessageDelivery to this recipient did not involve any expansion of a distribution-list. If however it is present in a delivered-report, it contains the originator name and one or more distribution-list names used during the expansion process. It is absent if the subject message, upon which the ReportDelivery is based, did not involve any expansion of a distribution-list. For more details see 8.3.1.1.1.7 and 8.3.1.2.1.3 of CCITT Rec. X.411 | ISO/IEC 10021-4.

mt-dl-expansion-history ATTRIBUTE
WITH ATTRIBUTE-SYNTAX DLExpansion
MULTI VALUE
::= id-att-dl-expansion-history

11.2.16 *Entry-status*

This general-attribute contains the current status of an entry in the stored-messages information-base. It is created and maintained by he MS. For more details see 6.4.

ms-entry-status ATTRIBUTE
WITH ATTRIBUTE-SYNTAX EntryStatus
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-entry-status

11.2.17 *Entry-type*

This general-attribute contains information about whether an entry concerns a delivered message or a delivered report. It is generated by the MS.

```
ms-entry-type ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX EntryType
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-entry-type

EntryType ::= INTEGER {
        delivered-message       (0),
        delivered-report        (1),
        returned-content        (2) } (0 . . ub-entry-types)
```

11.2.18 *Intended-recipient-name*

This general-attribute contains the O/R-name of the originally intended recipient if the message has been redirected, with each value representing one redirection. For more details see 8.3.1.1.1.4 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-intended-recipient-name ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ORName
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-intended-recipient-name
```

11.2.19 *Message-delivery-envelope*

This general-attribute contains the complete message-delivery-envelope of a message as delivered by the MessageDelivery abstract-operation. For more details see clause 9 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-message-delivery-envelope ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MessageDeliveryEnvelope
        SINGLE VALUE
        ::= id-att-message-delivery-envelope
```

11.2.20 *Message-delivery-identifier*

This general-attribute contains the **message-delivery-identifier** from the MessageDelivery abstract-operation. For more details see 8.3.1.1.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-message-delivery-identifier ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MessageDeliveryIdentifier
        SINGLE VALUE
        ::= id-att-message-delivery-identifier
```

11.2.21 *Message-delivery-time*

This general-attribute contains the **message-delivery-time** from the MessageDelivery abstract-operation. For more details see 8.3.1.1.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

Note - There is no general-attribute corresponding to the delivery-time parameter of the ReportDelivery abstract-operation, because in order to be useful, this delivery-time must be correlated with the name of the recipient the message was delivered to. This information is included in the per-recipient-report-delivery-fields general-attribute.

```
mt-message-delivery-time ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MessageDeliveryTime
        MATCHES FOR EQUALITY ORDERING
        SINGLE VALUE
        ::= id-att-message-delivery-time
```

11.2.22 *Message-origin-authentication-check*

This general attribute is computed using the algorithm identified by the message-origin-authentication-identifier. It provides the recipient(s) of the message with a means of authenticating the origin of the message and may be generated by the originator of the message. For further details see 8.2.1.1.1.29 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-message-origin-authentication-check ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MessageOriginAuthenticationCheck
        SINGLE VALUE
        ::= id-att-message-origin-authentication-check
```

11.2.23 *Message-security-label*

This general attribute comprises a set of security attributes which may include a security-policy-identifier, a security-classification, a privacy-mark, and a set of security-categories. For further details see 8.2.1.1.1.30 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-message-security-label ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MessageSecurityLabel
        SINGLE VALUE
        ::= id-att-message-security-label
```

11.2.24 *Message-submission-time*

This general-attribute contains the **message-submission-time** from a MessageDelivery abstract-operation. For more details see 8.2.1.1.2.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-message-submission-time ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MessageSubmissionTime
        MATCHES FOR EQUALITY ORDERING
        SINGLE VALUE
        ::= id-att-message-submission-time
```

11.2.25 *Message-token*

This general attribute contains the token associated with the message. It is generated by the originator of the message and may contain a different value for each recipient of the message. For further details see 8.2.1.1.1.26 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-message-token ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MessageToken
        SINGLE VALUE
        ::= id-att-message-token
```

11.2.26 *Original-EITs*

This general-attribute, which is multi-valued, identifies the **encoded-information-types** in the content of the message as submitted. It is generated from the **original encoded-information-types** from the MessageDelivery or ReportDelivery abstract-operation. For more details see 8.2.1.1.1.33 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
ms-original-EITs ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MS-EIT
        MATCHES FOR EQUALITY
        MULTI VALUE
        ::= id-att-original-EITs
```

11.2.27 *Originator-certificate*

This general attribute, contains the certificate of the originator of the message. It is generated by a trusted source (e.g. a certification-authority), and may be supplied by the originator of the message. For further details see 8.2.1.1.1.25 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-originator-certificate ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX Originator-Certificate
        SINGLE VALUE
        ::= id-att-originator-certificate
```

11.2.28 *Originator-name*

This general-attribute contains the O/R-name of the originator from the MessageDelivery abstract-operation. For more details see 8.2.1.1.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-originator-name ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ORName
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-originator-name
```

11.2.29 *Other-recipient-names*

This general-attribute, which is multi-valued, contains the O/R-names of all other specified recipients, if any, of the message from the MessageDelivery abstract-operation. For more details see 8.3.1.1.1.6 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-other-recipient-names ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ORName
        MATCHES FOR EQUALITY
        MULTI VALUE
        ::= id-att-other-recipient-names
```

11.2.30 *Parent-sequence-number*

This general-attribute, points to a parent-entry. It is generated by the MS. It is always present in a child-entry and is absent in a main-entry.

```
ms-parent-sequence-number ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX SequenceNumber
        MATCHES FOR EQUALITY ORDERING
        SINGLE VALUE
        ::= id-att-parent-sequence-number
```

11.2.31 *Per-recipient-report-delivery-fields*

This general-attribute, which is multi-valued, contains report information on a per-recipient basis from the ReportDelivery abstract-operation. For more details see 8.3.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-per-recipient-report-delivery-fields ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX PerRecipientReportDeliveryFields
        MUTLI VALUE
        ::= id-att-per-recipient-report-delivery-fields
```

11.2.32 *Priority*

This general-attribute contains the relative **priority** of the message from the MessageDelivery abstract-operation. If no value is supplied in the MessageDelivery abstract-operation parameter, the MS uses its default value when generating this attribute. For more details see 8.2.1.1.1.8 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-priority ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX Priority
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-priority
```

11.2.33 *Proof-of-delivery-request*

This general attribute indicates whether or not the originator of the message requires **proof-of-delivery** of the message to the recipient. It may be generated by the originator of the message and may specify a different value for each recipient of the message. For more details see 8.2.1.1.1.32 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-proof-of-delivery-request ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ProofOfDeliveryRequest
        SINGLE VALUE
        ::= id-att-proof-of-delivery-request
```

11.2.34 *Redirection-history*

The general-attribute, which is multi-valued, contains the history of recipient redirection(s) with reasons(s) from the MessageDelivery abstract-operation. For more details see 8.3.1.1.1.5 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-redirection-history ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX Redirection
        MULTI VALUE
        ::= id-att-redirection-history.
```

11.2.35 *Report-delivery-envelope*

This general-attribute contains all the parameters from the ReportDelivery abstract-operation, except for the returned-content (if present). For more details see 8.3.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-report-delivery-envelope ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportDeliveryEnvelope
        SINGLE VALUE
        ::= id-att-report-delivery-envelope
```

11.2.36 *Reporting-DL-name*

This general-attribute contains the O/R-name of the distribution-list that forwarded the report to the owner of this distribution-list. For more details see 8.3.1.2.1.4 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-reporting-DL-name ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportingDLName
        SINGLE VALUE
        ::= id-att-reporting-DL-name
```

11.2.37 *Reporting-MTA-certificate*

This general-attribute contains the certificate of the MTA that generated the report. For more details see 8.3.1.2.1.12 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-reporting-MTA-certificate ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportingMTACertificate
        SINGLE VALUE
        ::= id-att-reporting-MTA-certificate
```

11.2.38 *Report-origin-authentication-check*

The general-attribute provides a means of authenticating the origin of the report. For more details see 8.3.1.2.1.13 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-report-origin-authentication-check ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportOriginAuthenticationCheck
        SINGLE VALUE
        ::= id-att-report-origin-authentication-check
```

11.2.39 *Security-classification*

This general-attribute comprises the security-classification parameter from the message-security-label. It is defined as a separate attribute to allow its use in the Summarize abstract-operation. For more details see 8.5.9 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-security-classification ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX SecurityClassification
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-security-classification
```

11.2.40 *Sequence-number*

This general-attribute is used to identify the entry itself. It is allocated by the MS when the entry is created. For more details see 6.3.2.

```
ms-sequence-number ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX SequenceNumber
        MATCHES FOR EQUALITY ORDERING
        SINGLE VALUE
        ::= id-att-sequence-number
```

11.2.41 *Subject-submission-identifier*

This general-attribute contains the message-submission-identifier or the probe-submission-identifier of the subject of the report. For more details see 8.3.1.2.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-subject-submission-identifier ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX SubjectSubmissionIdentifier
        SINGLE VALUE
        ::= id-att-subject-submission-identifier
```

11.2.42 *This-recipient-name*

This general-attribute contains the O/R-name of this (MS) recipient from the MessageDelivery abstract-operation. For more details see 8.3.1.1.1.3 of CCITT Rec. X.411 | ISO/IEC 10021-4.

```
mt-this-recipient-name ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ORName
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-this-recipient-name
```

11.3 *Generation of the general-attributes*

This subclause describes how the general-attributes are generated. The information is presented in Table 2/X.413. For a description of the classification used, see 5.3.

11.4 *Attribute-types subscription*

Attribute-type subscription is a local matter. If the attribute-type subscription is changed, then the UA may receive all of the attributes in the original subscription for messages present in the MS at the time the subscription was changed. The handling of these unsubscribed attributes is a local matter. Similarly, when a new attribute is subscribed to, the UA may not receive this attribute for messages in the MS when the subscription occurred.

TABLE 2/X.413

Generation of the General-attribute-types

Attribute-type-name	Single/ Multi valued	Source parameter	Source generated by	Generation rules
Child-sequence-numbers	M	–	MS	A value is generated for each corresponding child-entry that a parent-entry has
Content	S	content returned-content	MD RD	The attribute-value in the delivered-message entry is the value of the source parameter The attribute-value in the returned-content child-entry of the delivered report entry is the value of the source parameter
Content-confidentiality-algorithm-identifier	S	content-confidentiality-algorithm-identifier	MD	The attribute-value is the value of the source parameter
Content-correlator	S	content-correlator	RD	The attribute-value is the value of the source parameter
Content-identifier	S	content-identifier	MD RD	The attribute-value is the value of the source parameter
Content-integrity-check	S	content-integrity-check	MD	The attribute-value is the value of the source parameter
Content-length	S	–	MS	The (approximate) size of the stored content in octets based on the delivered or returned content
Content-returned	S	–	MS	The value is set to **true** if returned-content is present in a ReportDelivery and to **false** if not present
Content-type	S	content-type	MD RD	If represented by OBJECT IDENTIFIER, the value of the parameter. If represented by INTEGER, converted to the corresponding OBJECT IDENTIFIER
Conversion-with-loss-prohibited	S	conversion-with-loss-prohibited	MD	The attribute-value is the value of the source parameter
Converted-EITs	M	converted-encoded-information-types	MD	A corresponding value is generated from each bit that is set to 1 in the built-in-encoded-information-types parameter and from each ExternalEncoded InformationType present in the external-encoded-information-type parameter
Creation-time	S	–	MS	The time of creation of the entry
Delivered-EITs	M	Converted-EITs and Original EITs general attributes and converted-encoded-information-types	MS	Converted-EITs if converted-encoded-information-types is present, else Original-EITs
Delivery-flags	S	delivery-flags	MD	The attribute-value is the value of the source parameter. If there are no delivery-flags in the MD, generate a default value with no flags set
DL-expansion-history	M	DL-expansion-history originator-and-DL-expansion-history	MD RD	A corresponding value is generated from each component of the SEQUENCE A corresponding value is generated from each component of the SEQUENCE

TABLE 2/X.413 *(cont.)*

Attribute-type-name	Single/ Multi valued	Source parameter	Source generated by	Generation rules
Entry-status	S	–	MS	Generated when the entry is created with the value "new"
Entry-type	S	MessageDelivery ARGUMENT ReportDelivery ARGUMENT	MS MS	The value is set to "delivered-message". The value is set to "delivered-report". If a returned-content is present, a child-entry, which contains the returned-content is created and given a delivered-entry-type of "returned-content"
Intended-recipient-name	S	intended-recipient-name	MD	The attribute-value is the value of the source parameter
Message-delivery-envelope	S	Message Delivery Envelope	MD	The attribute-value is the value of the source parameter
Message-delivery-identifier	S	message-delivery-identifier	MD	The attribute-value is the value of the source parameter
Message-delivery-time	S	message-delivery-time	MD	The attribute-value is the value of the source parameter
Message-origin-authentication-check	S	message-origin-authentication-check	MD	The attribute-value is the value of the source parameter
Message-security-label	S	message-security-label	MD RD	The attribute-value is the value of the source parameter
Message-submission-time	S	message-submission-time	MD	The attribute-value is the value of the source parameter
Message-token	S	message-token	MD	The attribute-value is the value of the source parameter
Original-EITs	M	original-encoded-information-types	MD RD	A corresponding value is generated from each bit that is set to 1 in the built-in-encoded-information-types parameter and from each ExternalEncoded InformationType present in the external-encoded-information-types parameter
Originator-certificate	S	originator-certificate	MD	The attribute-value is the value of the source parameter
Originator-name	S	originator-name	MD	The attribute-value is the value of the source parameter
Other-recipient-names	M	other-recipient-names	MD	A corresponding value is generated from each component of the SEQUENCE
Parent-sequence-number	S	–	MS	When creating a child-entry, this attribute is generated with the corresponding parent-entry's sequence-number as value
Per-recipient-report-delivery-fields	M	per-recipient-fields	RD	A corresponding value is generated from each component of the SEQUENCE
Priority	S	priority	MD	The attribute-value is the value of the source parameter
Proof-of-delivery-request	S	proof-of-delivery-request	MD	The attribute-value is the value of the source parameter
Redirection-history	M	redirection-history	MD	A corresponding value is generated from each component of the SEQUENCE
Report-delivery-envelope	S	Report Delivery Envelope	RD	The attribute-value is the value of the source parameter

TABLE 2/X.413 *(end)*

Attribute-type-name	Single/ Multi valued	Source parameter	Source generated by	Generation rules
Reporting-DL-name	S	reporting-DL-name	RD	The attribute-value is the value of the source parameter
Reporting-MTA-certificate	S	reporting-MTA-certificate	RD	The attribute-value is the value of the source parameter
Report-origin-authentication-check	S	report-origin-authentication-check	RD	The attribute-value is the value of the source parameter
Security-classification	S	security-classification	MD RD	The attribute-value is the value of the source parameter
Sequence-number	S	–	MS	When creating an entry, the MS assigns a unique value for this attribute in ascending order
Subject-submission-identifier	S	subject-submission-identifier	RD	The attribute-value is the value of the source parameter
This-recipient-name	S	this-recipient-name	MD	The attribute-value is the value of the source parameter

Note – When a message-delivery entry is created, there are no separate general-attributes generated for Physical Delivery and Delivery Method Arguments, because the information in these arguments are not relevant to the MS. However, the UA can retrieve all the information contained in these arguments by retrieving the Message-delivery-envelope general-attribute.

12 General-auto-action-types

The **general-auto-action-types** are valid for all message content-types. However, their detailed effect may be content-specific, and so the procedure descriptions given in this Recommendation may need to be supplemented in their respective Recommendations, e.g. the IPMS-specific procedure for the **auto-forward general-auto-action-type** is described in 19.4 of CCITT Rec. X.420 | ISO/IEC 10021-7. Other **auto-action-types**, which are content-specific, may be defined in their respective Recommendations.

Auto-actions are introduced in 6.5 and are registered and deregistered using the Register-MS abstract-operation described in 8.6. Alternatively, registration information may be conveyed to the MS by means of subscription.

The following **general-auto-action-types** are defined:

a) Auto-forward;

b) Auto-alert.

The operation of **auto-actions** may be affected by the implementation of a security-policy.

The following subclauses contain a short description of each **general-auto-action-type** together with its abstract-syntax using the AUTO-ACTION macro defined in 6.5.

12.1 *Auto-forward*

The **auto-forward auto-action** enables the MS abstract-service-provider to automatically **forward** any message that has been delivered into the stored-messages information base. The exact definition of forwarding is content-specific, but it always involves the submission of a new message incorporating the delivered content to the MTS abstract-service.

Note – In the next version of this Recommendation, the Auto-forward auto-action will be classified as IPM-specific and moved to CCITT Rec. X.420 | ISO/IEC 10021-7.

The **auto-forward auto-action-type** allows one or more sets of **auto-forward** parameters to be registered with the MS, each identified by its **auto-forward-registration-identifier**. Each **auto-forward-registration-parameter** specifies criteria to determine whether it applies to a particular delivered message, and if so a copy of the message is **auto-forwarded** using the Message-submission abstract-operation. That is to say, if a message matches more than one set of criteria, the message is **auto-forwarded** that many times.

The **auto-forward-registration-parameter** specifies whether the main-entry (and any associated child-entries) corresponding to the message is to be deleted after **auto-forwarding**. If any of the parameters acted upon indicates no-deletion (or if any of the submissions fail), then the entry is not deleted.

```
auto-forward AUTO-ACTION
        REGISTRATION PARAMETER IS AutoForwardRegistrationParameter
        ::= id-act-auto-forward

AutoForwardRegistrationParameter ::= SET {
        filter                      [0] Filter OPTIONAL,
        auto-forward-arguments      [1] AutoForwardArguments,
        delete-after-auto-forwarding [2] BOOLEAN DEFAULT FALSE,
        other-parameters            [3] OCTET STRING OPTIONAL },

AutoForwardArguments ::= SET {
        COMPONENTS OF PerMessageAutoForwardFields,
        per-recipient-fields        [1] IMPLICIT SEQUENCE (1..ub-recipients) OF
                                        PerRecipient-AutoForwardFields }

PerMessageAutoForwardFields ::= SET {
        originator-name             OriginatorName,
        content-identifier          ContentIdentifier OPTIONAL,
        priority                    Priority OPTIONAL,
        per-message-indicators      PerMessageIndicators OPTIONAL
        deferred-delivery-time      [0] IMPLICIT DeferredDeliveryTime OPTIONAL,
        extensions                  [2] IMPLICIT PerMessageSubmissionExtensions
                                        DEFAULT { } }

PerRecipientAutoForwardFields ::= SET {
        recipient-name          RecipientName,
        originator-report-request   [0] IMPLICIT OriginatorReportRequest,
        explicit-conversion         [1] IMPLICIT ExplicitConversion OPTIONAL,
        extensions                  [2] IMPLICIT PerRecipientMessageSubmissionExtensions
                                        DEFAULT { } }
```

The parameters of the **auto-forward-registration-parameter** have the following meanings:

1) **Filter** (O): This is a set of criteria which a new entry representing a delivered message must satisfy for the MS abstract-service-provider to **auto-forward** it using this set of parameters.

   The absence of this parameter indicates that all new entries are **auto-forwarded**.

2) **Auto-forward-arguments** (M): This is a set of arguments registered to be used for each Message-submission abstract operation (see 8.2.1.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4). Any argument which is not registered, not mandatory, and not specifically mentioned below, will be absent from each Message-submission.

   If **conversion-with-loss-prohibited** is registered with the value **conversion-with-loss-allowed**, either by explicit registration of the value, or if it is not registered and thus assumes this value by default, the value used for each Message-submission abstract-operation shall be the value of the corresponding Message-delivery argument. If it is registered with the value **conversion-with-loss-prohibited**, this value shall be used for each Message-submission abstract-operation.

   If **implicit-conversion-prohibited** is registered with the value "zero", indicating that implicit conversion is allowed, or if no value is registered, the value used for each Message-submission abstract-

operation shall be the value of the corresponding Message-delivery argument. If it is registered with the value "one", indicating that implicit conversion is prohibited, this value shall be used for each Message-submission abstract-operation.

If the following arguments are not registered, their presence as Message-submission arguments depends upon the presence of the corresponding Message-delivery arguments, their values being transformed where appropriate: **message-token**, **content-confidentiality-algorithm-identifier**, **content-integrity-check**, **message-origin-authentication-check**, **message-security-label**, and **priority**.

Certain Message-submission arguments shall not be registered. These are: **proof-of-submission-request**, **original-encoded-information-types**, **content-type**, and **content**.

3) **Delete-after-auto-forwarding** (O): This indicates whether an entry should be deleted or not, once the submission has succeeded.

The absence of this parameter indicates that the message should not be deleted.

4) **Other-parameters** (O): This content-specific parameter need not be present. When it is present, the information it contains will be used during the **auto-forwarding** procedure.

Note - Thus, for example, with Interpersonal Messaging, this parameter may contain the **auto-forward-comment** that is returned in the non-receipt notification, a user specified prefix and a cover-note accompanying the IP-message being auto-forwarded. For a description of **auto-forward-comment** usage, see 19.4 of CCITT Rec. X.420 | ISO/IEC 10021-7.

Support of the **auto-forward auto-action** by an MS, or UA accessing an MS, requires that it supports registration of the **auto-forward-registration-parameter** via the Register-MS abstract-operation.

12.2 *Auto-alert*

The **auto-alert auto-action** enables the MS abstract-service-provider to automatically alert the user behind the MS abstract-service-user of the delivery of any message that has been delivered into the stored-messages information-base.

The **auto-alert auto-action-type** allows one or more sets of **auto-alert** parameters to be registered with the MS, each identified by its **auto-alert-registration-identifier**. Each **auto-alert-registration-parameter** specifies criteria to determine whether it applies to a particular delivered-message or delivered-report. If a message matched the filter of more than one auto-alert-registration, the matching registration with the lowest auto-alert-registration-identifier is processed, and if at least one address (or the UA) has been alerted successfully, no other registrations are processed. If none of these addresses can be successfully alerted, the auto-alert registration with the next higher identifier is processed. This continues until either at least one or more addresses of a registration has been successfully alerted or the list of registrations is exhausted.

The **alert abstract-operation** will only be invoked if the alert-addresses in the auto-alert-registration is considered to have the UA as a member [see 2) below]. If this alert-abstract-operation succeeds, any other address contained in the auto-alert registration will not be alerted.

```
auto-alert AUTO-ACTION

        REGISTRATION PARAMETER IS AutoAlertRegistrationParameter

        ::= id-act-auto-alert

AutoAlertRegistrationParameter ::= SET {

        filter                  [0]  Filter OPTIONAL,

        alert-addresses         [1]  SEQUENCE SIZE (1..ub-alert-addresses) OF AlertAddress
                                     OPTIONAL,

        requested-attributes    [2]  EntryInformationSelection OPTIONAL }
```

The parameters of the **auto-alert-registration-parameter** have the following meanings:

1) **Filter** (O): This is a set of criteria which a new entry representing a delivered-message or delivered-report shall satisfy for the MS abstract-service-provider to **auto-alert** it using this set of parameters.

   The absence of this parameter indicates that **auto-alert** will be performed for all new delivered-message or delivered-report entries.

2) **Alert-addresses** (O): This argument identifies the types of **alert** service to be invoked, together with any information required to access the particular instances of those **alert** services, and any further information that needs to be conveyed during those **alerts**.

   Absence of this argument will default the Alert abstract-operation to informing the MS abstract-service-user of the existence of an alert-condition either by using the Alert abstract-operation (see 8.7), (which is only possible if an abstract-association already exists between the MS abstract-service-user and the MS abstract-service-provider) or by flagging in the abstract-bind-operation next time the MS abstract-service-user establishes an abstract-association (see clause 7). If the parameter requested-attributes is present, the MS abstract-service-user (UA) will be considered as being among the addresses to be alerted.

   Some types of **alert** will be internationally standardized. Others will be defined by national administrative authorities and private organizations. This implies that a number of separate authorities will be responsible for assigning types in a way that ensures that each is distinct from all other assigned types. This is accomplished by identifying each type with an object-identifier when the type is defined, and defining the ASN.1 data-type of the auxiliary addressing information.

   The **alert-qualifier** contains any further information that needs to be conveyed during the auto-alert. Absence of this parameter means that no additional information will be conveyed to the MS abstract-service-user.

```
AlertAddress ::= SEQUENCE {
        address             EXTERNAL,
        alert-qualifier     OCTET STRING OPTIONAL },
```

3) **Requested-attributes** (O): This indicates what information from the selected entries is to be included with the auto-alert. See 8.1.4.

   The absence of this parameter implies that only the **alert-registration-identifier** will be present in the **alert-argument**.

13 Overview

This section describes the procedures for the MS and the port realization. It contains a description of the consumption of the MTS abstract-service in clause 14. The provision of the MS abstract-service is described in clause 15. The port realization in the form of Service Elements is described in clause 16.

The performance of the abstract-operations described in clauses 14 and 15 shall be subject to the requirements of the security-policy (if one is in force), which applies to the MTS abstract-services and to the MS abstract-services.

14 Consumption of the Message Transfer abstract-service

This clause specifies how an MS shall consume the MTS abstract-service which is defined in clause 8 of CCITT Rec. X.411 | ISO/IEC 10021-4. Covered are its consumption of the MTS delivery, Submission, and Administration Ports.

14.1 *Consumption of the Delivery Port abstract-services*

This clause covers the performance of the MessageDelivery and ReportDelivery abstract-operations, and the invocation of the DeliveryControl abstract-operation. The MS consumption of the DeliveryPort abstract-services assumes that an abstract-association exists between the DeliveryPort supplier (the MTA) and the DeliveryPort consumer (the MS). The performance of the abstract-operations is in sequential order; no parallel processing takes place. Error cases are not described.

14.1.1 *Performance of the MessageDelivery abstract-operation*

When the MS receives a MessageDelivery abstract-operation from the MTA, it performs the following steps:

1) Creates a new entry (and conditionally one or more child-entries) and sets the entry-status to new.

2) Returns a MessageDelivery result to the MTA to indicate that the delivery was successful. The MessageDelivery result shall contain proof-of-delivery information if the delivered-message contains a proof-of-delivery-request argument. This proof-of-delivery may be computed using the subject-MS-secret key; for more details see 8.5.7 and 8.3.1.1.2.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) The next step is to examine if any auto-actions are activated. The auto-actions are partly content-specific and are therefore also described in the content-specific Recommendation. The content-specific description must contain rules about the order in which the auto-actions are to be performed. The performance of an auto-action may result in changes of entry-status, alerts, submissions, new entries being created and in the possible deletion of the delivered-message or other messages from the MS. See 12.1.

   a) If auto-forwarding criteria are registered by the Register-MS abstract-operation, the new entry is matched against the criteria specified. The matching is made sequentially for each specified set of selection criteria. For every "hit" a new message is generated and submitted from the MS to the MTA using the MessageSubmission abstract-operation. See 15.2.1.

      The rules for how to construct the new forwarded message are again content-specific and hence described in the respective content-specific Recommendation. Other content-specific events may also be performed at this stage (e.g. suppression of looping of auto-forwarded messages and the issuing of a non-receipt-notification as described for IPMS in 19.4 of CCITT Rec. X.420 | ISO/IEC 10021-7). Depending on the argument-values of the Register-MS abstract-operation for auto-forwarding, a copy of the delivered-message may be retained in the MS. If the auto-forward submission is unsuccessful, a copy is always retained.

      Note - The handling of a result or error from such a submission is a local matter.

b) If auto-alert-registrations have been made via the register-MS abstract-operation, the new entry is matched against the filter of each registration specified. The matching is made sequentially for each registration. If a "hit" is found, an attempt is made to invoke an Alert abstract-operation from the MS to the UA. This can only be done if there is an existing abstract-association between the MS and the UA. If no abstract-association exists, the MS may have other local or non-standardized means to invoke an alert. When attempts have been made to alert all of the addresses registered for the first matching registration parameter, and at least one of the alerts succeeded, the Alert auto-action has successfully completed, and no further alert registrations are processed. If there was no path found to give the alert, the MS sets the alert-flag, which is reported to the UA when an abstract-association is next time initiated by the UA to the MS.

Note - If the delivered-message was deleted as a result of an auto-forwarding action in a), the auto-alert is obviously not performed.

4) Only after the above steps have been performed is the new entry made visible outside the MS over the Retrieval Port. If the delivered-message was deleted as a result of an auto-action, any sequence-number which was allocated in step 1) is not re-used (in order not to conflict with possible future logging extensions).

14.1.2 *Performance of the ReportDelivery abstract-operation*

When the MS receives a ReportDelivery abstract-operation from the MTA, it performs the following steps:

1) Creates a new entry (and conditionally one or more child-entries) and sets the entry-status to new.

2) Returns a ReportDelivery result to the MTA to indicate that the delivery was successful. The ReportDelivery result has no parameters. For details see 8.3.1.2.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) Next, if any auto-actions or other internal procedures are activated, they are performed. These are either general or content-specific, the latter being described in the respective content-specific Recommendations.

14.1.3 *Invocation of the DeliveryControl abstract-operation*

If the MS wants to temporarily stop the MTA from passing messages and reports, or to alter the maximum-content-length or lowest-priority of messages and reports from the MTA, it performs the following steps:

1) It invokes a DeliveryControl abstract-operation, containing the parameters to be changed. For details see 8.3.1.3 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It gets a result back when the MTS abstract-service has accepted the changes. The result contains information about whether messages and/or reports are waiting in the MTA, due to the current restrictions. For details see 8.3.1.3.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) When the MS is able to accept any waiting messages and/or reports again, it should invoke a new DeliveryControl abstract-operation to relax the restrictions. The effects of a DeliveryControl abstract-operation are cancelled when either a new DeliveryControl abstract-operation alters the restrictions or when the abstract-association is released.

14.1.4 *Generation rules for general-attributes*

Attributes shall be generated when a message or report is delivered, and may be generated when an auto-action is performed.

All mandatory attributes are generated, see Table 1/X.413. Optional attributes are generated only if implemented by the MS and subscribed by the user. The generated attributes form a new entry, or in some cases a parent-entry and one or more child-entries, see 6.3.4. The following kinds of general-attributes may be generated:

a) general-attributes generated by the MS itself (e.g. sequence number);

b) general-attributes generated from components of the message-delivery-envelope and report-delivery-envelope. For components which are not present, but for which default values are defined, a general-attribute containing the default value is generated.

See Table 2/X.413 and 11.3 for the rules on how the general-attribute are generated. The generation rules for content-specific attributes are described in the respective content-specific Recommendations, e.g. the IPMS-specific attributes are described in Annex C of CCITT Rec. X.420 | ISO/IEC 10021-7).

14.2 *Consumption of the Submission Port abstract-services*

This clause covers the invocation of the MessageSubmission, ProbeSubmission, and CancelDeferredDelivery abstract-operations, and the consumption of the SubmissionControl abstract-operation. The MS abstract-service consumption of the Submission Port abstract-services assumes that an abstract-association exists between the Submission Port Supplier (the MTA) and the Submission Port consumer (the MS). The performance of the abstract-operations is in sequential order, no parallel processing takes place. Error cases are not described.

14.2.1 *Invocation of the MessageSubmission abstract-operation*

The initiation of a MessageSubmission abstract-association can be either from an auto-action within the MS or because the UA invoked a MessageSubmission abstract-operation to the MS. In order to submit the message to the MTA the MS performs the following steps:

1) If the MessageSubmission argument does not contain the forwarding-request extension (see 6.6), it invokes a MessageSubmission abstract-operation, containing the message to be submitted and its associated parameters. For details see 8.2.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4. Otherwise, checks to see that the entry is a delivered-message and incorporates information from one delivered-message entry in the stored-messages information-base, and then invokes the MessageSubmission abstract-operation with the new content. Forwarding of entries that are not delivered-messages may be the subject of future standardization.

   Note that although this forwarding-request is generic, it is not necessarily meaningful for all content-types. Where it is meaningful, the content-type of the referenced delivered-messages entry shall be appropriate for incorporation into the content argument.

2) It gets a MessageSubmission result back when the MTA has accepted the submission. The MessageSubmission result contains among others information about identification of and submission-time for the submitted message. For details see 8.2.1.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) If the MessageSubmission abstract-operation was triggered by a corresponding MessageSubmission abstract-operation to the MS from the UA, the result of the abstract-operation is passed back to the UA in the form of a MessageSubmission result issued by the MS. This behaviour guarantees that the message has actually been accepted by the MTA before the result is given back to the UA.

4) If the MTA has not accepted the message submission due to problems such as an invalid sequence number or inappropriate content-type, the MS will generate an error of InconsistentRequest. Note that all errors generated by the MTA are relayed through to the UA.

5) If a security-policy is in force, then to ensure that such a security-policy is not violated during message submission, the message-security-label is checked against the security-context by the MS. If the message submission is barred either by the security-policy or by temporary security restrictions, a security-error shall be indicated.

14.2.2 *Invocation of the ProbeSubmission abstract-operation*

A ProbeSubmission abstract-operation is initiated because the UA invoked a ProbeSubmission abstract-operation to the MS. In order to submit the probe to the MTA, the MS performs the following steps:

1) It invokes a ProbeSubmission abstract-operation, containing the probe to be submitted and its associated parameters. For details see 8.2.1.2.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It gets a ProbeSubmission result back when the MTA has accepted the submission. The result contains among others information about identification of and submission-time for the submitted probe. For details see 8.2.1.2.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) The result of the abstract-operation is passed back to the UA in the form of a ProbeSubmission result issued by the MS. This behaviour guarantees that the probe has actually got accepted by the MTA before the result is given back to the UA.

4) If a security-policy is in force, then to ensure that such a security-policy is not violated during ProbeSubmission, the message-security-label of the Probe is checked against the security-context by the MS. If the ProbeSubmission is barred either by the security-policy or by temporary security restrictions, a ProbeSubmission error is generated.

14.2.3 *Invocation of the CancelDeferredDelivery abstract-operation*

A CancelDeferredDelivery abstract-operation is initiated because the UA invoked a CancelDeferredDelivery abstract-operation to the MS. In order to send the cancel to the MTA, the MS performs the following steps:

1) It invokes a CancelDeferredDelivery abstract-operation, containing the cancel to be submitted and its associated parameters. For details see 8.2.1.3.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It gets a result back when the MTA has accepted the cancel. The result returned is empty as an indication of success.

3) The result of the abstract-operation is passed back to the UA in the form of a CancelDeferredDelivery result issued by the MS.

14.2.4 *Performance of the SubmissionControl abstract-operation*

If the MTA wants to temporarily stop the MS from submitting messages or probes, or to alter the maximum-content-length or lowest priority of messages from the MS it invokes a SubmissionControl abstract-operation, for details see 8.2.1.4.1 of CCITT Rec. X.411 | ISO/IEC 10021-4, to the MS. The MS checks if there is already an existing abstract-association between the MS and UA. If not, the MTA is informed by a Remote-bin-error that change of submission control cannot take place at present. If there is, the MS reacts with the following steps:

1) It invokes a corresponding SubmissionControl abstract-operation from the MS to the UA.

2) It waits for the UA to send back a SubmissionControl result which contains information about whether messages or probes are waiting in the UA, due to the current restrictions. For details see 8.2.1.4.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) The MS sends back a SubmissionControl result to the MTA, containing information from the UA.

4) When the MTS is able to accept any messages or probes again, it should invoke a new SubmissionControl abstract-operation to relax the restrictions. The effects of a SubmissionControl abstract-operation are cancelled when either a new SubmissionControl abstract-operation alters the restrictions or when the abstract-association is released. The MS then invokes a corresponding SubmissionControl abstract-operation to the UA and waits for the SubmissionControl result.

14.3 *Consumption of the Administration Port abstract-services*

This clause covers the performance of the register and ChangeCredentials abstract-operations. The consumption of the Administration Port abstract-services assumes that an abstract-association exists between the Administration Port supplier (the MTA) and the Administration Port consumer (the MS). The performance of the abstract-operations is in sequential order; no parallel processing takes place. Error cases are not described.

The MS use of the Administration Port is subject to the security-policy in force.

14.3.1 *Invocation of the Register abstract-operation*

A register abstract-operation is initiated because the UA invoked a Register abstract-operation to the MS. In order to send the registration to the MTA, the MS performs the following steps:

1) It invokes a Register abstract-operation, containing the new data to be registered. For details see 8.4.1.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It gets a result back when the MTA has accepted the registration. The result returned is empty as an indication of success.

3) The scope of the permitted changes by the UA via the MS to the user-security-label arguments shall be confined to the security-policy in force.

14.3.2 *Invocation of the ChangeCredentials abstract-operation*

A ChangeCredentials abstract-operation is initiated because the UA invoked a ChangeCredentials abstract-operation to the MS. In order to relay the new credentials to the MTA from the UA, the MS performs the following steps:

1) It invokes a ChangeCredentials abstract-operation on the MTA, containing the new credentials to be registered. For details see 8.4.1.2.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It gets a ChangeCredentials result back when the MTA has accepted the change. If successful, the MS stores the new credentials. The ChangeCredentials result or resultant error from the MTA is relayed to the UA and is empty as an indication of success.

14.3.3 *Performance of the ChangeCredentials abstract-operation*

When the MS receives a ChangeCredentials abstract-operation and its associated arguments from the MTA, it performs the following steps:

1) It establishes that the argument information is valid for a ChangeCredentials abstract-operation. For details see 8.4.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It checks if there is already an existing abstract-association between the MS and the UA. If an abstract-association between the MS and the UA does not exist, the MTA is informed by an error that change of credentials can not take place at present and no further steps are processed.

3) If the abstract-association between the MS and UA exists, the MS invokes a ChangeCredentials abstract-operation to the UA.

4) If the UA sends back an empty ChangeCredentials result, indicating success, the MS sends back a corresponding ChangeCredentials result indicating success to the MTA and stores the credentials. If the UA returns an error, this is relayed to the MTA to indicate that error. Note that the MS never sends back an indication of success to the MTA until it has received the corresponding result back from the UA first.

15 Supply of the Message Store abstract-service

This clause specifies how a MS supplies the MS abstract-service. Covered are its supply of the Retrieval, Indirect-submission, and Administration Ports.

15.1 *Supply of the Retrieval Port abstract-services*

This clause covers the supply of the Summarize, List, Fetch, Delete, Register-MS, and Alert abstract-operations. The MS abstract-service supply of the Retrieval Port abstract-services assumes that an abstract-association exists between the Retrieval Port supplier (the MS) and the Retrieval Port consumer (the UA). The performance of the abstract-operations is in sequential order; no parallel processing takes place. Not all error cases are described.

15.1.1 *Performance of the Summarize abstract-operation*

When the MS receives a Summarize abstract-operation from the UA, it performs the following steps:

1) Establishes which information-base the Summarize abstract-operation addresses.

2) Checks if there are any entries in the information-base. If it is empty, a Summarize result with zero length is returned and no further steps are performed.

3) Checks that the supplied argument general-attributes and any content-specific attributes recognized by the MS are valid for a Summarize abstract-operation. For details see 8.2.1.

4) Accumulates counts in accordance with the supplied argument general attributes and any content-specific attributes recognized by the MS.

5) Returns the Summarize result to the UA. For details see 8.2.2.

6) If a security-policy is in force, then to ensure that such a security-policy is not violated during the Summarize abstract-operation, the security classification of the security label is checked against the security-context by the MS. If a summarize is barred by the security-policy, the Summarize abstract-operation shall be abandoned and a security error shall be indicated.

15.1.2 *Performance of the List abstract-operation*

When the MS receives a List abstract-operation from the UA, it performs the following steps:

1) Establishes which information-base the List abstract-operation addresses.

2) Checks that the supplied argument general-attributes and any content-specific attributes recognized by the MS are valid for a list abstract-operation. For details see 8.3.1.

3) Identifies zero or more entries as requested in the argument of the abstract-operation, up to any supplied limit. Child-entries to a parent-entry are excluded, unless explicitly selected in the argument.

4) If a set of requested general-attributes has been specified as arguments in the abstract-operation, these general-attributes are returned, if present, to the UA for each selected entry. If no request has been done, the default List abstract-operation values, as specified with a previous Register-MS abstract-operation, are returned, if present. For more details see 8.3.2. The entry-status of each selected message is set to listed.

5) If a security-policy is in force, then to ensure that such a security-policy is not violated during the List abstract-operation, the message-security-label is checked against the security-context by the MS. If the list is barred either by the security-policy or by temporary security restrictions, the List abstract-operation shall be abandoned and a security error shall be indicated.

15.1.3 *Performance of the Fetch abstract-operation*

When the MS receives a Fetch abstract-operation from the UA, it performs the following steps:

1) Establishes which information-base the Fetch abstract-operation addresses.

2) Checks that the supplied argument general-attributes and any content-specific attributes recognized by the MS are valid for a fetch abstract-operation. For details see 8.4.1.

3) Identifies zero or more entries as requested in the argument of the abstract-operation, up to any supplied limit. Child-entries to a parent-entry are excluded, unless explicitly selected in the argument.

4) the fetch-restrictions established by the abstract-bind (unless overridden) are applied to determine whether the entry may be returned or an error results. See 7.1.1, point 4).

5) If a set of requested attributes have been specified as arguments in the abstract-operation, these attributes are returned, if present, to the UA for the first selected entry. If no requested attributes are specified, the default Fetch abstract-operation values, as specified with a previous Register-MS abstract-operation, are returned, if present. The allowed-EITs in the Fetch-restrictions on the abstract-bind may limit the information returned. For details see 7.1.1. If several entries that match the search criteria are found, the sequence-numbers for the second and following entries are returned in increasing order. If there were more matching entries than in the specified limit, the next sequence number beyond the limit is also returned. For more details see 8.4.2.

6) If a security-policy is in force, then to ensure that such a security-policy is not violated during the Fetch abstract-operation, the message-security-label is checked against the security-context by the MS. If the Fetch abstract-operation is barred either by the security-policy or by temporary security restriction, the Fetch abstract-operation shall be abandoned and a security error shall be indicated.

15.1.4 *Performance of the Delete abstract-operation*

When the MS receives a Delete abstract-operation from the UA, it performs the following steps:

1) Establishes which information-base the Delete abstract-operation addresses.

2) Checks that the supplied arguments are valid for a delete abstract-operation. For details see 8.5.1.

3) Identifies the entry or list of entries requested in the argument of the abstract-operation.

4) If any of the entries has delete restrictions, see 8.5, none of the deletions takes place. Otherwise all deletions are performed and an empty Delete result returned to the UA as indication of success.

15.1.5 *Performance of the Register-MS abstract-operation*

When the MS receives a Register-MS abstract-operation from the UA, it performs the following steps:

1) Checks that the supplied arguments are valid for a Register-MS abstract-operation. For details see 8.6.1.

2) Replaces any old parameters with the corresponding new ones. Auto-actions have effect on transactions, such as message-deliveries and report-deliveries, that occur after the initiation or deletion of auto-action requests; there is no processing of entries that already reside in the MS at that point in time.

3) Sends back an empty Register-MS result to the UA to indicate that the abstract-operation has been performed successfully.

4) If a security-policy is in force, then the Register-MS abstract-operation shall be subject to such a policy. Some security-policies may only permit user-security-labels to be changed if a secure link is employed. Other local means of changing the user-security-labels in a secure manner may be provided.

15.1.6 *Invocation of the Alert abstract-operation*

The invocation of the alert abstract-operation is as a result of the consumption of the Delivery Port abstract-service (see 14.1.1).

If the Auto-alert auto-action is initiated by the UA, by an earlier Register-MS abstract-operation, the MS abstract-service performs the following steps:

1) Checks if an abstract-association exists. If not, the MS will never establish an abstract-association, and no Alert abstract-operation can be invoked.

2) If an abstract-association exists, the MS invokes the abstract-operation containing the relevant argument information, for details see 8.7.1, and waits for a empty alert result to be returned by the UA as an indication of success.

3) If an abstract-association does not exist, there is a possibility to use a non-standardized protocol to inform the user. The alert signal in this case may be given on the user's terminal, but can alternatively be given on a telephone, a beeper or any other suitable terminal equipment associated with the user. The latter method can also be used in cases where the Alert abstract-operation has not been implemented.

4) If a security-policy is in force, then to ensure that such a security-policy is not violated during the alert, the message-security-label is checked against the security-context by the MS. If the alert abstract-operation is barred either by the security-policy or by temporary security restrictions, the action taken shall be defined by the security-policy in force.

15.2 *Supply of the Indirect-submission Port abstract-services*

This clause covers the performance of the MessageSubmission, ProbeSubmission, and CancelDeferred Delivery abstract-operations, and the invocation of the SubmissionControl abstract-operation. The MS abstract-service supply of the Indirect-submission Port abstract-services assumes that an abstract-association exists between the Indirect-submission Port supplier (the MS) and the Indirect-submission Port consumer (the UA). The performance of the abstract-operations is in sequential order; no parallel processing takes place. Not all error cases are described.

15.2.1 *Performance of the MessageSubmission abstract-operation*

When the MS receives a MessageSubmission abstract-operation and its associated arguments from the UA, it performs the following steps:

1) It establishes that the argument information is valid for a MessageSubmission abstract-operation. For details see 8.2.1.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It checks the arguments to establish if the message content was supplied by the UA or if it has to be inserted by the MS (i.e., if the forwarding-request extension is present). In the latter case, if the entry is a delivered-message entry, the corresponding message is inserted and the MS-related arguments deleted. Forwarding of entries that are not delivered-messages may be the subject of future standardization.

3) It checks if there is already an existing abstract-association between the MS and the MTA. If not, the MS initiates such an abstract-association. If an abstract-association cannot be established, the UA is informed by an error that submission can not take place at present and no further steps are processed.

4) If the abstract-association between the MS and the MTA exists, the MS invokes a MessageSubmission abstract-operation to the MTA, after any modifications mentioned in step 2).

5) If the MTA sends back a MessageSubmission result (for details see 8.2.1.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4) indicating success, the MS sends back a corresponding MessageSubmission result indicating success to the UA. Note that the MS never sends back an indication of success to the UA until it has received the corresponding result back from the MTA first. This is to insure a consistent service from a user point of view, viz., that a submission always means that the responsibility for the message has been taken over by the MTA when the result comes back.

6) The MS may either choose to terminate the abstract-association with the MTA after a certain period of inactivity, or when the UA terminates its corresponding abstract-association with the MS.

15.2.2 *Performance of the ProbeSubmission abstract-operation*

When the MS receives a ProbeSubmission abstract-operation and its associated arguments from the UA, it performs the following steps:

1) It establishes that the argument information is valid for a ProbeSubmission abstract-operation. For details see 8.2.1.2.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It checks if there is already an existing abstract-association between the MS and the MTA. If not, the MS initiates such an abstract-association. If an abstract-association cannot be established, the UA is informed by an error that submission can not take place at present and no further steps are processed.

3) If the abstract-association between the MS and the MTA exists, the MS invokes a ProbeSubmission abstract-operation to the MTA.

4) If the MTA sends back a ProbeSubmission result, for details see 8.2.1.2.2 of CCITT Rec. X.411 | ISO/IEC 10021-4, indicating success, the MS sends back a corresponding ProbeSubmission result indicating success to the UA. Note that the MS never sends back an indication of success to the UA until it has received the corresponding result back from the MTA first. This is to ensure a consistent service from a user point of view, viz., that a submission always means that the responsibility for the probe has been taken over by the MTS when the result comes back.

5) The MS may either choose to terminate the abstract-association with the MTA after a certain period of inactivity, or when the UA terminates its corresponding abstract-association with the MS.

15.2.3 *Performance of the CancelDeferredDelivery abstract-operation*

When the MS receives a CancelDeferredDelivery abstract-operation and its associated arguments from the UA, it performs the following steps:

1) It establishes that the argument information is valid for a CancelDeferredDelivery abstract-operation. For details see 8.2.1.3.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It checks if there is already an existing abstract-association between the MS and the MTA. If not, the MS initiates such an abstract-association. If an abstract-association cannot be established, the UA is informed by an error that CancelDeferredDelivery can not take place at present and no further steps are processed.

3) If the abstract-association between the MS and the MTA exists, the MS invokes a CancelDeferredDelivery abstract-operation to the MTA.

4) If the MTA sends back a CancelDeferredDelivery result, for details, see 8.2.1.3.2 of CCITT Rec. X.411 | ISO/IEC 10021-4, indicating success, the MS sends back a corresponding CancelDeferredDelivery result indicating success to the UA. Note that the MS never sends back an indication of success to the UA until it has received the corresponding result back from the MTA first. This is to insure a consistent service from a user point of view, viz., that the responsibility for the cancel deferred delivery has been taken over by the MTS, when the result comes back.

5) The MS may either choose to terminate the abstract-association with the MTA after a certain period of inactivity, or when the UA terminates its corresponding abstract-association with the MS.

15.2.4 *Invocation of the SubmissionControl abstract-operation*

If the MS receives a SubmissionControl abstract-operation from the MTA, or if the MS for some internal reasons wants to temporarily stop the UA from submitting messages or probes, or to alter the maximum-length or lowest-priority of messages from the UA, the MS performs the following steps:

1) It invokes a SubmissionControl abstract-operation to the UA. For details see 8.2.1.4.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It waits for a SubmissionControl result, for details see 8.2.1.4.2 of CCITT Rec. X.411 | ISO/IEC 10021-4, from the UA confirming the acceptance of the SubmissionControl abstract-operation.

3) If the SubmissionControl abstract-operation had been triggered by a corresponding abstract-operation from the MTA to the MS, the SubmissionControl result from the UA is passed on from the MS to the MTA.

15.3 *Supply of the Administration Port abstract-services*

This clause covers the performance of the Register and ChangeCredentials abstract-operations. The MS abstract-service supply of the Administration Port abstract-services assumes that an abstract-association exists between the Indirect-submission Port supplier (the MS) and the Indirect-submission Port consumer (the UA). The performance of the abstract-operations is in sequential order; no parallel processing takes place. Not all error cases are described.

15.3.1 *Performance of the Register abstract-operation*

When the MS receives a Register abstract-operation and its associated arguments from the UA, it performs the following steps:

1) It establishes that the argument information is valid for a Register abstract-operation. For details see 8.4.1.1.1 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It checks if there is already an existing abstract-association between the MS and the MTA. If not, the MS initiates such an abstract-association. If an abstract-association cannot be established, the UA is informed by an error that register can not take place at present and no further steps are processed.

3) If the abstract-association between the MS and the MTA exists, the MS invokes a Register abstract-operation to the MTA.

4) If the MTA sends back a Register result, for details see 8.4.1.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4, indicating success, the MS sends back a corresponding Register result indicating success to the UA. Note that the MS never sends back an indication of success to the UA until it has received the corresponding result back from the MTA first. This is to ensure a consistent service from a user point of view, viz., that the responsibility for the register has been taken over by the MTS, when the result comes back.

5) The MS may either choose to terminate abstract-association with the MTA after a certain period of inactivity, or when the UA terminates its corresponding abstract-association with the MS.

6) The scope of permitted changes by the UA via the MS to the user-security-labels shall be confined by the security-policy in force. Some security-policies may only permit user-security-labels to be changed in this way if a secure link is employed. Other local means of changing user-security-labels in a secure manner may be provided.

15.3.2 *Invocation of the ChangeCredentials abstract-operation*

A ChangeCredentials abstract-operation is initiated because the MTA invoked a ChangeCredentials abstract-operation to the MS. In order to relay the new-credentials to the UA from the MTA, the MS performs the following steps:

1) It establishes that the argument information is valid for a ChangeCredentials abstract-operation. For details see 8.4.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4. If the old credentials are incorrect and the new credentials are not acceptable, an error is returned and no further processing takes place.

2) It invokes a ChangeCredentials abstract-operation on the UA containing the new credentials to be registered. For details see 8.4.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

3) It gets a ChangeCredentials result back when the UA has accepted the change and stores the new credentials. The ChangeCredentials result or resultant error from the UA is relayed to the MTA.

15.3.3 *Performance of the ChangeCredentials abstract-operation*

When the MS receives a ChangeCredentials abstract-operation and its associated arguments from the UA, it performs the following steps:

1) It establishes that the argument information is valid for a ChangeCredentials abstract-operation. For details see 8.4.1.2 of CCITT Rec. X.411 | ISO/IEC 10021-4.

2) It checks if there is already an existing abstract-association between the MS and the MTA. If not, the MS initiates such an abstract-association. If an abstract-association cannot be established, the UA is informed by an error that change of credentials can not take place at present and no further steps are processed.

3) If the abstract-association between the MS and MTA exists, the MS invokes a ChangeCredentials abstract-operation to the MTA.

4) If the MTA sends back an empty ChangeCredentials result, indicating success, the MS sends back a corresponding ChangeCredentials result indicating success to the UA and stores the credentials. If the MTA returns an error, this is relayed to the UA to indicate that error. Note that the MS never sends back an indication of success to the UA until it has received the corresponding result back from the MTA first.

5) The MS may either choose to terminate the abstract-association with the MTA after a certain period of inactivity, or when the UA terminates its corresponding abstract-association with the MS.

16 Ports realization

This clause describes how the retrieval, the Submission and the Administration Ports of the MS abstract-service are provided. For a description of how the MTS abstract-service provides the delivery, the Submission and the Administration ports, refer to clause 8 of CCITT Rec. X.411 | ISO/IEC 10021-4.

16.1 *Retrieval Port*

The Retrieval Port abstract-services are realized on a one-to-one basis between abstract-operations and real operations in the Message Retrieval Service Element (MRSE) which is documented in CCITT Rec. X.419 | ISO/IEC 10021-6.

16.2 *Indirect-submission Port*

The Indirect-submission Port abstract-services are realized on a one-to-one basis between abstract-operations and real operations in the Message Submission Service Element (MSSE) which is documented in CCITT Rec. X.419 | ISO/IEC 10021-6.

16.3 *Administration Port*

The Administration Port abstract-services are realized on a one-to-one basis between abstract-operations and real operations in the Message Administration Service Element (MASE) which is documented in CCITT Rec. X.419 | ISO/IEC 10021-6.

ANNEX A

(to Recommendation X.413)

Formal assignment of Object Identifiers

(This annex forms an integral part of this Recommendation)

All Object Identifiers this Recommendation assigns are formally assigned in the present annex using ASN.1. The specified values are cited in the ASN.1 modules of subsequent annexes.

This annex is definitive for all values except those for ASN.1 modules and for the whole subject matter of this Recommendation. The definitive assignments for the former occur in the modules themselves. The latter is fixed. Other references to the values assigned to modules appear in IMPORT clauses.

```
MSObjectIdentifiers { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) object-identifiers(0) }
DEFINITIONS ::=
BEGIN


-- Prologue
-- Exports everything

IMPORTS
        ID, id-ms
            FROM MHSObjectIdentifiers { joint-iso-ccitt mhs-motis(6) arch(5) modules(0) object-identifiers(0) };


-- Categories

id-mod  -- modules          --  ID ::= { id-ms 0 }
id-ot   -- objects          --  ID ::= { id-ms 1 }
id-pt   -- port types       --  ID ::= { id-ms 2 }
id-att  -- attribute types  --  ID ::= { id-ms 3 }
id-act  -- auto-action types --  ID ::= { id-ms 4 }


-- Modules

id-mod-object-identifiers       ID ::= { id-mod 0 } -- not definitive
id-mod-abstract-service         ID ::= { id-mod 1 } -- not definitive
id-mod-attribute-types          ID ::= { id-mod 2 } -- not definitive
id-mod-action-types             ID ::= { id-mod 3 } -- not definitive
id-mod-upper-bounds             ID ::= { id-mod 4 } -- not definitive


-- Objects

id-ot-ms                        ID ::= { id-ot 0 }
id-ot-ms-user                   ID ::= { id-ot 1 }


-- Port types

id-pt-retrieval                 ID ::= { id-pt 0 }
```

-- Attribute types

id-att-child-sequence-numbers **ID ::= { id-att 0 }**
id-att-content **ID ::= { id-att 1 }**
id-att-content-confidentiality-algorithm-identifier **ID ::= { id-att 2 }**
id-att-content-correlator **ID ::= { id-att 3 }**
id-att-content-identifier **ID ::= { id-att 4 }**
id-att-content-integrity-check **ID ::= { id-att 5 }**
id-att-content-length **ID ::= { id-att 6 }**
id-att-content-returned **ID ::= { id-att 7 }**
id-att-content-type **ID ::= { id-att 8 }**
id-att-conversion-with-loss-prohibited **ID ::= { id-att 9 }**
id-att-converted-EITs **ID ::= { id-att 10 }**
id-att-creation-time **ID ::= { id-att 11 }**
id-att-delivered-EITs **ID ::= { id-att 12 }**
id-att-delivery-flags **ID ::= { id-att 13 }**
id-att-dl-expansion-history **ID ::= { id-att 14 }**
id-att-entry-status **ID ::= { id-att 15 }**
id-att-entry-type **ID ::= { id-att 16 }**
id-att-intended-recipient-name **ID ::= { id-att 17 }**
id-att-message-delivery-envelope **ID ::= { id-att 18 }**
id-att-message-delivery-identifier **ID ::= { id-att 19 }**
id-att-message-delivery-time **ID ::= { id-att 20 }**
id-att-message-origin-authentication-check **ID ::= { id-att 21 }**
id-att-message-security-label **ID ::= { id-att 22 }**
id-att-message-submission-time **ID ::= { id-att 23 }**
id-att-message-token **ID ::= { id-att 24 }**
id-att-original-EITs **ID ::= { id-att 25 }**
id-att-originator-certificate **ID ::= { id-att 26 }**
id-att-originator-name **ID ::= { id-att 27 }**
id-att-other-recipient-names **ID ::= { id-att 28 }**
id-att-parent-sequence-number **ID ::= { id-att 29 }**
id-att-per-recipient-report-delivery-fields **ID ::= { id-att 30 }**
id-att-priority **ID ::= { id-att 31 }**
id-att-priority-of-delivery-request **ID ::= { id-att 32 }**
id-att-redirection-history **ID ::= { id-att 33 }**
id-att-report-delivery-envelope, **ID ::= { id-att 34 }**
id-att-reporting-DL-name **ID ::= { id-att 35 }**
id-att-reporting-MTA-certificate **ID ::= { id-att 36 }**
id-att-report-origin-authentication-check **ID ::= { id-att 37 }**
id-att-security-classification **ID ::= { id-att 38 }**
id-att-sequence-number **ID ::= { id-att 39 }**
id-att-subject-submission-identifier **ID ::= { id-att 40 }**
id-att-this-recipient-name **ID ::= { id-att 41 }**

-- Auto-action types

id-act-auto-forward **ID ::= { id-act 0 }**
id-act-auto-alert **ID ::= { id-act 1 }**

END *-- of MSObjectIdentifiers*

ANNEX B

(to Recommendation X.413)

Formal definition of the Message Store abstract-service

(This annex forms an integral part of this Recommendation)

This annex, a supplement to Section 2, formally defines the Message Store abstract-service. It employs ASN.1 and the OBJECT, PORT, ABSTRACT-BIND, ABSTRACT-UNBIND, ABSTRACT-OPERATION, and ABSTRACT-ERROR macros of CCITT Rec. X.407 | ISO/IEC 10021-3.

Note – The use of the ABSTRACT-BIND, ABSTRACT-UNBIND, ABSTRACT-OPERATION, and ABSTRACT-ERROR macros, which are derived from the BIND, UNBIND, OPERATION and ERROR macros of ROS, does not imply that the abstract-operations and abstract-errors are invoked and reported across the boundary between open-systems in every instance. However, frequently this will be done. Just how this is accomplished is the subject of CCITT Rec. X.419 | ISO/IEC 10021-6.

```
MSAbstractService { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) abstract-service(1) }
DEFINITIONS ::=

BEGIN

-- Prologue
-- Exports everything

IMPORTS


-- Abstract-services macros

ABSTRACT-BIND, ABSTRACT-ERROR, ABSTRACT-OPERATION, ABSTRACT-UNBIND, OBJECT, PORT
        FROM AbstractServiceNotation { joint-iso-ccitt mhs-motis(6) asdc(2) modules(0) notation(1) }


-- MS ports

administration, delivery, submission,


-- MTS macro

EXTENSION,


-- MTS abstract-service-data types

ContentLength, Credentials, InitiatorCredentials, ORAddressAndOrDirectoryName,
ResponderCredentials, SecurityContext, SecurityError, SecurityLabel
        FROM MTSAbstractService { joint-iso-ccitt mhs-motis(6) mts(3) modules(0) mts-abstract-service(1) }


-- MS-objects

id-ot-ms, id-ot-ms-user, id-pt-retrieval
        FROM MSObjectIdentifiers { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) object-identifiers(0) }


-- MS abstract-service upperbound

ub-attributes-supported, ub-attribute-values, ub-auto-actions, ub-auto-registrations,
ub-default-registrations, ub-error-reasons, ub-information-bases, ub-messages,
ub-nested-filters, ub-per-auto-action, ub-per-entry, ub-summaries
        FROM MSUpperBounds { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) upper-bounds(4) }
```

```
-- MTS abstract-service upperbound

ub-content-types, ub-encoded-information-types, ub-labels-and-redirections
        FROM MTSUpperBounds { joint-iso-ccitt mhs-motis(6) mts(3) modules(0) upper-bounds(3) };

-- MS Abstract Objects

MS OBJECT
        PORTS { retrieval[S],
                        indirectSubmission[S],
                        administration[S],
                        delivery[C],
                        submission[C],
                        administration[C] }
        ::= id-ot-ms

msUser OBJECT
        PORTS { retrieval[C],
                        indirectSubmission[C],
                        administration[C] }
        ::= id-ot-ms-user


-- Port types

indirectSubmission PORT ::= submission

retrieval PORT
        CONSUMER INVOKES {
                        Summarize,
                        List,
                        Fetch,
                        Delete,
                        Register-MS }
        SUPPLIER INVOKES {
                        Alert }
        ::= id-pt-retrieval


-- Macros

AUTO-ACTION MACRO ::=
BEGIN
        TYPE NOTATION    ::=  Registration
        VALUE NOTATION   ::=  value (VALUE OBJECT IDENTIFIER)
        Registration     ::=  "REGISTRATION PARAMETER IS" type
END


-- Common data-types related to the information model

InformationBase ::= INTEGER {
                        stored-messages    (0),
                        inlog              (1),
                        outlog             (2) } (0. .ub-information-bases)

SequenceNumber ::= INTEGER (0. .ub-messages)

CreationTime ::= UTCTime

Attribute ::= SEQUENCE {
                        type            AttributeType,
                        values SEQUENCE SIZE (1. .ub-attribute-values) OF Attribute Value }

AttributeType ::= OBJECT IDENTIFIER

Attribute Value::= ANY
```

```
AutoActionRegistration ::= SEQUENCE {
        type                            AutoActionType,
        registration-identifier         [0] INTEGER (1. .ub-per-auto-action) DEFAULT 1,
        registration-parameter          [1] ANY DEFINED BY type }

AutoActionType ::= OBJECT IDENTIFIER

EntryStatus ::= INTEGER {
        new             (0),
        listed          (1),
        processed       (2) }


-- Abstract-bind

MSBind ::= ABSTRACT-BIND
        TO { indirectSubmission[S], retrieval[S], administration[S] }
        BIND
                ARGUMENT        MSBindArgument
                RESULT          MSBindResult
                BIND-ERROR      MSBindError

MSUnbind ::= ABSTRACT-UNBIND
        FROM { indirectSubmission[S], retrieval[S], administration[S] }

MSBindArgument ::= SET {
        initiator-name                  ORAddressAndOrDirectoryName,
        initiator-credentials           [2] InitiatorCredentials,
        security-context                [3] IMPLICIT SecurityContext OPTIONAL,
        fetch-restrictions              [4] Restrictions OPTIONAL -- default is none --,
        ms-configuration-request        [5] BOOLEAN DEFAULT FALSE }

Restrictions ::= SET {
        allowed-content-types           [0] SET SIZE (1. .ub-content-types) OF OBJECT IDENTIFIER OPTIONAL
                                        -- default is no restriction --,
        allowed-EITs                    [1] MS-EITs OPTIONAL -- default is no restriction --,
        maximum-content-length          [2] ContentLength OPTIONAL -- default is no restriction -- }

MS-EITs ::= SET SIZE (1. .ub-encoded-information-types) OF MS-EIT

MS-EIT ::= OBJECT IDENTIFIER

MSBindResult ::= SET {
        responder-credentials           [2] ResponderCredentials,
        available-auto-actions          [3] SET SIZE (1. .ub-auto-actions) OF AutoActionType OPTIONAL,
        available-attribute-types       [4] SET SIZE (1. .ub-attributes-supported) OF AttributeType OPTIONAL,
        alert-indication                [5] BOOLEAN DEFAULT FALSE,
        content-types-supported         [6] SET SIZE (1. .ub-content-types) OF OBJECT IDENTIFIER OPTIONAL }

MSBindError ::= ENUMERATED {
        authentication-error            (0),
        unacceptable-security-context   (1),
        unable-to-establish-association (2) }


-- Common data-types for abstract-operations

Range ::= CHOICE {
        sequence-number-range           [0] NumberRange,
        creation-time-range             [1] TimeRange }

NumberRange ::= SEQUENCE {
        from            [0] SequenceNumber OPTIONAL -- omitted means no lower bound --,
        to              [1] SequenceNumber OPTIONAL -- omitted means no upper bound -- }
```

```
TimeRange ::= SEQUENCE {
        from            [0] CreationTime OPTIONAL -- omitted means no lower bound --,
        to              [1] CreationTime OPTIONAL -- omitted means no upper bound -- }

Filter ::= CHOICE {
        item            [0] FilterItem,
        and             [1] SET OF Filter,
        or              [2] SET OF Filter,
        not             [3] Filter }

FilterItem ::= CHOICE {
        equality                        [0] AttributeValueAssertion,
        substrings                      [1] SEQUENCE {
                type                    AttributeType,
                strings                         SEQUENCE OF CHOICE {
                        initial                 [0] AttributeValue,
                        any                     [1] AttributeValue,
                        final                   [2] AttributeValue } },
        greater-or-equal                [2] AttributeValueAssertion,
        less-or-equal           [3] AttributeValueAssertion,
        present                         [4] AttributeType,
        approximate-match               [5] AttributeValueAssertion }

AttributeValueAssertion ::= SEQUENCE {
        type            AttributeType,
        value           AttributeValue }

Selector ::= SET {
        child-entries   [0] BOOLEAN DEFAULT FALSE,
        range           [1] Range OPTIONAL -- default is unbounded --,
        filter          [2] Filter OPTIONAL -- default is all entries within the specified range --,
        limit           [3] INTEGER (1. .ub-messages) OPTIONAL,
        override        [4] OverrideRestrictions OPTIONAL -- default is that any fetch-restrictions in force do apply  -- }

OverrideRestrictions ::= BIT STRING {
        overrideContentTypesRestriction (0),
        overrideEITsRestriction         (1),
        overrideContentLengthRestriction  (2) } (SIZE (1. .ub-information-bases))

EntryInformationSelection::= SET SIZE(0. .ub-per-entry) OF AttributeSelection

AttributeSelection ::= SET {
        type            AttributeType,
        from            [0] INTEGER (1. .ub-attribute-values) OPTIONAL -- used if type is multi valued --,
        count           [1] INTEGER (1. .ub-attribute-values) OPTIONAL -- used if type is multi valued -- }

EntryInformation ::= SEQUENCE {
        sequence-number   SequenceNumber,
        attributes        SET SIZE (1. .ub-per-entry) OF Attribute OPTIONAL }

-- Forwarding-request parameter for indirect-submission

forwarding-request EXTENSION
        SequenceNumber
        CRITICAL FOR SUBMISSION
        ::= 36

-- Abstract-operations

Summarize ::= ABSTRACT-OPERATION
        ARGUMENT        SummarizeArgument
        RESULT          SummarizeResult
        ERRORS {
                        AttributeError,
                        InvalidParametersError,
                        RangeError,
                        SecurityError,
                        SequenceNumberError,
                        ServiceError }
```

```
SummarizeArgument ::= SET {
        information-base-type       [0] InformationBase DEFAULT stored-messages,
        selector                    [1] Selector,
        summary-requests            [2] SEQUENCE SIZE (1. .ub-summaries) OF Attribute Type OPTIONAL
                -- absent if no summaries are requested -- }

SummarizeResult ::= SET {
        next            [0] SequenceNumber OPTIONAL,
        count           [1] INTEGER (0. .ub-messages) -- of the entries selected --,
        span            [2] Span OPTIONAL -- of the entries selected, omitted if count is zero --,
        summaries       [3] SEQUENCE SIZE (1. .ub-summaries) OF Summary OPTIONAL }

Span ::= SEQUENCE {
        lowest[0] SequenceNumber,
        highest         [1] SequenceNumber }

Summary ::= SET {
        absent          [0] INTEGER (1. .ub-messages) OPTIONAL -- count of entries where the attribute is absent --,
        present         [1] SET SIZE (1. .ub-attribute-values) OF -- one for each attribute value present --
                                SEQUENCE {
                                        type    AttributeType,
                                        value   ANY DEFINED BY type,
                                        count   INTEGER (1. .ub-messages) } OPTIONAL }

List ::= ABSTRACT-OPERATION
        ARGUMENT                    ListArgument
        RESULT                      ListResult
        ERRORS {
                AttributeError,
                InvalidParametersError,
                RangeError,
                SecurityError,
                SequenceNumberError,
                ServiceError }

ListArgument ::= SET {
        information-base-type       [0] InformationBase DEFAULT stored-messages,
        selector                    [1] Selector,
        requested-attributes        [3] EntryInformationSelection OPTIONAL }

ListResult ::= SET {
        next            [0] SequenceNumber OPTIONAL,
        requested       [1] SEQUENCE SIZE (1. .ub-messages) OF EntryInformation OPTIONAL -- omitted if none
                            found -- }

--

Fetch ::= ABSTRACT-OPERATION
        ARGUMENT                    FetchArgument
        RESULT                      FetchResult
        ERRORS {
                AttributeError,
                FetchRestrictionError,
                InvalidParametersError,
                RangeError,
                SecurityError,
                SequenceNumberError,
                ServiceError }

FetchArgument ::= SET {
        information-base-type       [0] InformationBase DEFAULT stored-messages,
        item                            CHOICE {
                search                              [1] Selector,
                precise                             [2] SequenceNumber },
        requested-attributes        [3] EntryInformationSelection OPTIONAL }
```

```
FetchResult ::= SET {
        entry-information           [0] EntryInformation OPTIONAL -- if an entry was selected --,
        list                        [1] SEQUENCE SIZE (1. .ub-messages) OF SequenceNumber OPTIONAL,
        next                        [2] SequenceNumber OPTIONAL }

--

Delete ::= ABSTRACT-OPERATION
                ARGUMENT                DeleteArgument
                RESULT                  DeleteResult
                ERRORS {
                        DeleteError,
                        InvalidParametersError,
                        RangeError,
                        SecurityError,
                        SequenceNumberError,
                        ServiceError }

DeleteArgument ::= SET {
        information-base-type   [0] InformationBaseDEFAULT stored-messages,
        items                           CHOICE {
                        selector                        [1] Selector
                        sequence-numbers                [2] SET SIZE (1. .ub-messages) OF SequenceNumber } }

DeleteResult ::= NULL

--

Register-MS ::= ABSTRACT-OPERATION
                    ARGUMENT            Register-MSArgument
                    RESULT              Register-MSResult
                    ERRORS {
                        AttributeError,
                        AutoActionRequestError,
                        InvalidParametersError,
                        SecurityError,
                        ServiceError }

Register-MSArgument ::= SET {
        auto-action-registrations   [0] SET SIZE (1. .ub-auto-registrations) OF AutoActionRegistration
                                        OPTIONAL,
        auto-action-deregistrations [1] SET SIZE (1. .ub-auto-registrations) OF AutoActionDeregistration
                                        OPTIONAL,
        list-attribute-defaults     [2] SET SIZE (1. .ub-default-registrations) OF AttributeType OPTIONAL,
        fetch-attribute-defaults    [3] SET SIZE (1. .ub-default-registrations) OF AttributeType OPTIONAL,
        change-credentials          [4] SEQUENCE {
                        old-credentials     [0] Credentials,
                        new-credentials     [1] Credentials } OPTIONAL
                -- same CHOICE as for old credentials --,
        user-security-labels[5] SET SIZE (1. .ub-labels-and-redirections) OF SecurityLabel OPTIONAL }

AutoActionDeregistration ::= SEQUENCE {
        type                    AutoActionType,
        registration-identifier     [0] INTEGER (1. .ub-per-auto-action), DEFAULT 1 }

Register-MSResult ::= NULL

--

Alert ::= ABSTRACT-OPERATION
                ARGUMENT            AlertArgument
                RESULT              AlertResult
                ERRORS {
                        SecurityError }

AlertArgument ::= SET {
        alert-registration-identifier   [0] INTEGER (1. .ub-auto-actions),
        new-entry                       [2] EntryInformation OPTIONAL }

AlertResult ::= NULL
```

```
-- Abstract-errors

AttributeError ::= ABSTRACT-ERROR
        PARAMETER SET {
                problems        [0] SET SIZE (1. .ub-per-entry) OF SET {
                        problem         [0] AttributeProblem,
                        type            [1] AttributeType,
                        value           [2] ANY DEFINED BY type OPTIONAL } }

AttributeProblem ::= INTEGER {
        invalid-attribute-value         (0),
        unavailable-attribute-type      (1),
        inappropriate-matching          (2),
        attribute-type-not-subscribed   (3),
        inappropriate-for-operation     (4) } (0. .ub-error-reasons)

--

AutoActionRequestError ::= ABSTRACT-ERROR
        PARAMETER SET {
                problems        [0] SET SIZE (1. .ub-auto-registrations) OF SET {
                        problem         [0] AutoActionRequestProblem,
                        type            [1] AutoActionType } }

AutoActionRequestProblem ::= INTEGER {
        unavailable-auto-action-type    (0),
        auto-action-type-not-subscribed (1) } (0. .ub-error-reasons)

--

DeleteError ::= ABSTRACT-ERROR
        PARAMETER SET {
                problems        [0] SET SIZE (1. .ub-messages) OF SET {
                        problem                 [0] DeleteProblem,
                        sequence-number         [1] SequenceNumber } }

DeleteProblem ::= INTEGER {
        child-entry-specified           (0),
        delete-restriction-problem (1) } (0. .ub-error-reasons)

--

FetchRestrictionError ::= ABSTRACT-ERROR
        PARAMETER SET {
                problems        [0] SET SIZE (1. .ub-default-registrations) OF SET {
                        problem         [3] FetchRestrictionProblem,
                        restriction     CHOICE {
                            content-type            [1] OBJECT IDENTIFIER ,
                            eit                     [2] MS-EITs,
                            content-length          [3] ContentLength } } }

FetchRestrictionProblem ::= INTEGER {
        content-type-problem            (1),
        eit-problem                     (2),
        content-length-problem          (3) } (0. .ub-error-reasons)

--

InvalidParametersError ::= ABSTRACT-ERROR
        PARAMETER    NULL

--

RangeError ::= ABSTRACT-ERROR
        PARAMETER SET {
                problem         [0] RangeProblem }


RangeProblem ::= INTEGER {
        reversed        (0) } (0. .ub-error-reasons)
```

```
--

SequenceNumberError ::= ABSTRACT-ERROR
        PARAMETER SET {
                problems          [1] SET SIZE (1. .ub-messages) OF SET {
                        problem               [0] SequenceNumberProblem,
                        sequence-number   [1] SequenceNumber } }

SequenceNumberProblem ::= INTEGER {
        no-such-entry          (0) } (0. .ub-error-reasons)

--

ServiceError ::= ABSTRACT-ERROR
        PARAMETER SET {
                problem         [0] ServiceProblem }

ServiceProblem ::= INTEGER {
        busy                    (0),
        unavailable             (1),
        unwilling-to-perform  (2) } (0. .ub-error-reasons)

END -- of MSAbstractService
```

ANNEX C

(to Recommendation X.413)

Formal definition of general-attribute-types

(This annex forms an integral part of this Recommendation)

This annex, a supplement to Section 3, formally defines the general-attribute-types applicable to all forms of Message Handling, rather than just one. It employs ASN.1 and the ATTRIBUTE macro.

```
MSGeneralAttributeTypes { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) general-attribute-types(2) }
DEFINITIONS ::=

BEGIN

-- Prologue
-- Exports everything

IMPORTS
        -- General-attribute-type object identifiers
          id-att-child-sequence-numbers, id-att-content, id-att-content-confidentiality-algorithm-identifier,
          id-att-content-correlator, id-att-content-identifier, id-att-content-integrity-check, id-att-content-length,
          id-att-content-returned, id-att-content-type, id-att-conversion-with-loss-prohibited, id-att-converted-EITs,
          id-att-creation-time, id-att-delivered-EITs, id-att-delivery-flags, id-att-dl-expansion-history,
          id-att-entry-status, id-att-entry-type, id-att-intended-recipient-name, id-att-message-delivery-envelope,
          id-att-message-delivery-identifier, id-att-message-delivery-time, id-att-message-origin-authentication-
          check,
          id-att-message-security-label, id-att-message-submission-time, id-att-message-token, id-att-original-EITs,
          id-att-originator-certificate, id-att-originator-name, id-att-other-recipient-names,
          id-att-parent-sequence-number, id-att-per-recipient-report-delivery-fields, id-att-priority, id-att-proof-of-
          delivery-request, id-att-redirection-history,
          id-att-report-delivery-envelope, id-att-reporting-DL-name, id-att-reporting-MTA-certificate,
          id-att-report-origin-authentication-check, id-att-security-classification, id-att-sequence-number, id-att-
          subject-submission-identifier,
          id-att-this-recipient-name
                FROM MSObjectIdentifiers { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) object-identifiers(0) }
```

```
        -- Attribute macros
            ATTRIBUTE, ATTRIBUTE-SYNTAX
                    FROM InformationFramework { joint-iso-ccitt ds(5) modules(1) informationFramework(1) }

        -- MS abstract-service data-types
            CreationTime, EntryStatus, MS-EIT, SequenceNumber
                    FROM MSAbstractService { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) abstract-service(1) }

        -- Authentication-service data-types
            AlgorithmIdentifier
                    FROM AuthenticationFramework { joint-iso-ccitt ds(5) modules(1) authentication-Framework(7) }

        -- MTS abstract-service data-types
            Content, ContentCorrelator, ContentIdentifier, ContentIntegrityCheck, ContentLength,
            ConversionWithLossProhibited, DeliveryFlags, DLExpansion, MessageDeliveryEnvelope,
            MessageDeliveryIdentifier, MessageDeliveryTime, MessageOriginAuthenticationCheck,
            MessageSecurityLabel, MessageSubmissionTime, MessageToken, OriginatorCertificate, ORName,
            PerRecipientReportDeliveryFields, Priority, ProofOfDeliveryRequest, RedirectionHistory,
            ReportDeliveryEnvelope, ReportingDLName, ReportingMTACertificate,
            ReportOriginAuthenticationCheck, SecurityClassification, subjectSubmissionIdentifier
                    FROM MTSAbstractService { joint-iso-ccitt mhs-motis(6) mts(3) modules(0)
                    mts-abstract-service(1) }

        -- MS abstract-service upperbound
            ub-entry-types
                    FROM MSUpperBounds { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) upper-bounds(4) };

    -- Attribute-types

    ms-child-sequence-numbers ATTRIBUTE
            WITH ATTRIBUTE-SYNTAX SequenceNumber
            MULTI VALUE
            ::= id-att-child-sequence-numbers

    ms-content ATTRIBUTE
            WITH ATTRIBUTE-SYNTAX Content
            SINGLE VALUE
            ::= id-att-content

    mt-content-confidentiality-algorithm-identifier ATTRIBUTE
            WITH ATTRIBUTE-SYNTAX AlgorithmIdentifier
            SINGLE VALUE
            ::= id-att-content-confidentiality-algorithm-identifier

    mt-content-correlator ATTRIBUTE
            WITH ATTRIBUTE-SYNTAX ContentCorrelator
            MATCHES FOR EQUALITY
            SINGLE VALUE
            ::= id-att-content-correlator

    mt-content-identifier ATTRIBUTE
            WITH ATTRIBUTE-SYNTAX ContentIdentifier
            MATCHES FOR EQUALITY
            SINGLE VALUE
            ::= id-att-content-identifier

    mt-content-integrity-check ATTRIBUTE
            WITH ATTRIBUTE-SYNTAX ContentIntegrityCheck
            SINGLE VALUE
            ::= id-att-content-integrity-check

    ms-content-length ATTRIBUTE
            WITH ATTRIBUTE-SYNTAX ContentLength
            MATCHES FOR ORDERING
            SINGLE VALUE
            ::= id-att-content-length
```

```
ms-content-returned ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX BOOLEAN
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-content-returned

mt-content-type ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX OBJECT IDENTIFIER
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-content-type

mt-conversion-with-loss-prohibited ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ConversionWithLossProhibited
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-conversion-with-loss-prohibited

ms-converted-EITs ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MS-EIT
        MATCHES FOR EQUALITY
        MULTI VALUE
        ::= id-att-converted-EITs

ms-creation-time ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX CreationTime
        MATCHES FOR EQUALITY ORDERING
        SINGLE VALUE
        ::= id-att-creation-time

ms-delivered-EITs ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX MS-EIT
        MATCHES FOR EQUALITY
        MULTI VALUE
        ::= id-att-delivered-EITs

mt-delivery-flags ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX DeliveryFlags
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-delivery-flags

mt-dl-expansion-history ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX DLExpansion
        MULTI VALUE
        ::= id-att-dl-expansion-history

ms-entry-status ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX EntryStatus
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-entry-status

ms-entry-type ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX EntryType
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-entry-type

EntryType ::= INTEGER {
        delivered-message       (0),
        delivered-report(1),
        returned-content        (2) (0. .ub-entry-types)

mt-intended-recipient-name ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ORName
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-intended-recipient-name
```

mt-message-delivery-envelope ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MessageDeliveryEnvelope
SINGLE VALUE
::= id-att-message-delivery-envelope

mt-message-delivery-identifier ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MessageDeliveryIdentifier
SINGLE VALUE
::= id-att-message-delivery-identifier

mt-message-delivery-time ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MessageDeliveryTime
MATCHES FOR EQUALITY ORDERING
SINGLE VALUE
::= id-att-message-delivery-time

mt-message-origin-authentication-check ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MessageOriginAuthenticationCheck
SINGLE VALUE
::= id-att-message-origin-authentication-check

mt-message-security-label ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MessageSecurityLabel
SINGLE VALUE
::= id-att-message-security-label

mt-message-submission-time ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MessageSubmissionTime
MATCHES FOR EQUALITY ORDERING
SINGLE VALUE
::= id-att-message-submission-time

mt-message-token ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MessageToken
SINGLE VALUE
::= id-att-message-token

ms-original-EITs ATTRIBUTE
WITH ATTRIBUTE-SYNTAX MS-EIT
MATCHES FOR EQUALITY
MULTI VALUE
::= id-att-original-EITs

mt-originator-certificate ATTRIBUTE
WITH ATTRIBUTE-SYNTAX OriginatorCertificate
SINGLE VALUE
::= id-att-originator-certificate

mt-originator-name ATTRIBUTE
WITH ATTRIBUTE-SYNTAX ORName
MATCHES FOR EQUALITY
SINGLE VALUE
::= id-att-originator-name

mt-other-recipient-names ATTRIBUTE
WITH ATTRIBUTE-SYNTAX ORName
MATCHES FOR EQUALITY
MULTI VALUE
::= id-att-other-recipient-names

ms-parent-sequence-number ATTRIBUTE
WITH ATTRIBUTE-SYNTAX SequenceNumber
MATCHES FOR EQUALITY ORDERING
SINGLE VALUE
::= id-att-parent-sequence-number

mt-per-recipient-report-delivery-fields ATTRIBUTE
WITH ATTRIBUTE-SYNTAX PerRecipientReportDeliveryFields
MULTI VALUE
::= id-att-per-recipient-report-delivery-fields

```
mt-priority ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX Priority
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-priority

mt-proof-of-delivery-request ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ProofOfDeliveryRequest
        SINGLE VALUE
        ::= id-att-proof-of-delivery-request

mt-redirection-history ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX RedirectionHistory
        MULTI VALUE
        ::= id-att-redirection-history

mt-report-delivery-envelope ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportDeliveryEnvelope
        SINGLE VALUE
        ::= id-att-report-delivery-envelope

mt-reporting-DL-name ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportingDLName
        SINGLE VALUE
        ::= id-att-reporting-DL-name

mt-reporting-MTA-certificate ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportingMTACertificate
        SINGLE VALUE
        ::= id-att-reporting-MTA-certificate

mt-report-origin-authentication-check ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ReportOriginAuthenticationCheck
        SINGLE VALUE
        ::= id-att-report-origin-authentication-check

mt-security-classification ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX SecurityClassification
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-security-classification

ms-sequence-number ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX SequenceNumber
        MATCHES FOR EQUALITY ORDERING
        SINGLE VALUE
        ::= id-att-sequence-number

mt-subject-submission-identifier ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX SubjectSubmissionIdentifier
        SINGLE VALUE
        ::= id-att-subject-submission-identifier

mt-this-recipient-name ATTRIBUTE
        WITH ATTRIBUTE-SYNTAX ORName
        MATCHES FOR EQUALITY
        SINGLE VALUE
        ::= id-att-this-recipient-name

END -- of MSGeneralAttributeTypes
```

ANNEX D

(to Recommendation X.413)

Formal definition of general-auto-action-types

(This annex forms an integral part of this Recommendation)

This annex, a supplement to Section 3, formally defines the general-auto-action-types applicable to all forms of Message Handling, rather than just one. It employs ASN.1 and the AUTO-ACTION macro.

```
MSGeneralAutoActionTypes { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) general-auto-action-types(3) }
DEFINITIONS ::=

BEGIN

-- Prologue


EXPORTS
        -- General-auto-action-types
           auto-forward, auto-alert;

IMPORTS
        -- General-auto-action-type object identifiers
           id-act-auto-forward, id-act-auto-alert
                FROM MSObjectIdentifiers { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) object-identifiers(0) }

        -- Auto-action macro
           AUTO-ACTION,

        -- MS abstract-service data-types
           Filter, EntryInformationSelection
                FROM MSAbstractService { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) abstract-service(1) }

        -- MTS abstract-service data-types
           ContentIdentifier, DeferredDeliveryTime, ExplicitConversion, OriginatorName, OriginatorReportRequest,
           PerMessageIndicators, PerMessageSubmissionExtensions, PerRecipientMessageSubmissionExtensions,
           Priority, RecipientName
                FROM MTSAbstractService { joint-iso-ccitt mhs-motis(6) mts(3) modules(0) mts-abstract-service(1) }

        -- MTS upper bounds
           ub-recipients
        --
                FROM MTSUpperBounds {joint-iso-ccitt mhs-motis(6) mts(3) modules(0) upper-bounds(3) }

        -- MS abstract-service upperbound
           ub-alert-addresses
                FROM MSUpperBounds { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) upper-bounds(4) };

        -- Action-types
           auto-forward AUTO-ACTION
                REGISTRATION PARAMETER IS AutoForwardRegistrationParameter
                ::= id-act-auto-forward

AutoForwardRegistrationParameter ::= SET {
                filter                          [0] Filter OPTIONAL,
                auto-forward-arguments          [1] AutoForwardArguments,
                delete-after-auto-forwarding    [2] BOOLEAN DEFAULT TRUE,
                other-parameters                [3] OCTET STRING OPTIONAL }

AutoForwardArguments ::= SET {
                COMPONENTS OF PerMessageAutoForwardFields,
                per-recipient-fields            [1] IMPLICIT SEQUENCE SIZE (1. .ub-recipients) OF PerRecipient-
                                                    AutoForwardFields }
```

```
PerMessageAutoForwardFields ::= SET {
        originator-name             OriginatorName,
        content-identifier          ContentIdentifier OPTIONAL,
        priority                    Priority OPTIONAL,
        per-message-indicators      PerMessageIndicators OPTIONAL,
        deferred-delivery-time      [0] IMPLICIT DeferredDeliveryTime OPTIONAL,
        extensions                  [2] IMPLICIT PerMessageSubmissionExtensions DEFAULT { } }

PerRecipientAutoForwardFields ::= SET {
        recipient-name              RecipientName,
        originator-report-request   [0] IMPLICIT OriginatorReportRequest,
        explicit-conversion         [1] IMPLICIT ExplicitConversion OPTIONAL,
        extensions                  [2] IMPLICIT PerRecipientMessageSubmissionExtensions DEFAULT { } }

auto-alert AUTO-ACTION
        REGISTRATION PARAMETER IS AutoAlertRegistrationParameter
        ::= id-act-auto-alert

AutoAlertRegistrationParameter ::= SET {
        filter                      [0] Filter OPTIONAL,
        alert-addresses             [1] SEQUENCE SIZE (1. .ub-alert-addresses) OF AlertAddress
                                        OPTIONAL,
        requested-attributes        [2] EntryInformationSelection OPTIONAL }

AlertAddress ::= SEQUENCE {
        address             EXTERNAL,
        alert-qualifier     OCTET STRING OPTIONAL }

END -- of MSGeneralAutoActionTypes
```

ANNEX E

(to Recommendation X.413)

Formal definition of MS parameter upper bounds

(This annex forms an integral part of this Recommendation)

This annex defines for reference purpose the upper bounds of various variable length data types whose abstract syntaxes are defined in ASN.1 modules in the body of this Recommendation.

```
MSUpperBounds { joint-iso-ccitt mhs-motis(6) ms(4) modules(0) upper-bounds(4) }
DEFINITIONS IMPLICIT TAGS ::=

BEGIN

-- Prologue
-- Exports everything

IMPORTS -- nothing --;

-- Upper bounds
ub-alert-addresses      INTEGER ::= 16
ub-attribute-values     INTEGER ::= 32767       -- (2^15 –1) the largest integer representable in 16 bits --
ub-attributes-supported INTEGER ::= 1024
ub-auto-actions         INTEGER ::= 16
ub-auto-registrations   INTEGER ::= 1024
ub-default-registrations INTEGER ::= 1024
ub-entry-types          INTEGER ::= 16
ub-error-reasons        INTEGER ::= 16
ub-information-bases    INTEGER ::= 16
ub-messagesINTEGER ::= 2147483647       -- (2^31 –1) the largest integer representable in 32 bits --
ub-nested-filters       INTEGER ::= 32
ub-per-auto-action      INTEGER ::= 32767       -- (2^15 –1) the largest integer representable in 16 bits --
ub-per-entry            INTEGER ::= 1024
ub-summaries            INTEGER ::= 16

END -- of MSUpperBounds
```

ANNEX F

(to Recommendation X.413)

Example of the Summarize abstract-operation

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

This annex contains an example of the use of the Summarize abstract-operation.

F.1 *The entries in the example MS*

Consider an MS containing the following entries, one entry per line. The columns show the values of the indicated attribute-types. A "–" indicates that the attribute is absent from the entry.

TABLE F-1/X.413

Stored-messages in the example

Sequence number	Entry-type	Entry-status	Priority
3	message	listed	urgent
5	message	listed	low
8	report	listed	–
10	message	listed	normal
15	report	new	–
18	message	new	normal
20	message	new	urgent
22	message	new	normal
23	message	new	normal

Note — Even if the Priority in a MessageDeliveryEnvelope of a message is omitted and defaulted to "normal", the corresponding attribute is present with its value set to the default.

F.2 *An example of a request for summary*

Suppose the requirement is to summarize all the "new" entries by priority. The required result is the following list of counts. The numbers in parenthesis are sequence-numbers of the messages contributing to that count. See Table F-2/X.413.

TABLE F-2/X.413

Expected Result from the Summarize abstract-operation

Priority	Count
–	1 (15)
urgent	1 (20)
normal	4 (15,18,22,23)
low	0

The components of the summarize-argument should be set as follows:

selector:

filter: entry-status = new

summary-requests attribute type = Priority

The components of the summarize-result might be as follows:

count: 5

span:

lowest: 15

highest: 23

summaries:

{ absent: 1

present: { value = normal, count = 3 }

{ value = urgent, count = 1 } }

ANNEX G

(to Recommendation X.413)

Differences between CCITT Recommendation X.413 (1992) and ISO/IEC 10021-5:1990

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

This annex identifies the known differences between CCITT Rec. X.413:1992 and ISO/IEC 10021-5:1990.

1) The CCITT text contains a restriction in 7.1 that only one abstract-association may exist at any one time between the MS and the MS-user. This restriction is not included in the ISO/IEC text.

2) Those parts of the ASN.1 Notation which express upper bounds and are documented in Annex E, are not considered to be an integral part of ISO/IEC 10021-5:1990, but are an integral part of CCITT Rec. X.413 (1992).

   In ISO/IEC, this level of functionality is the responsibility of the Special Group on Functional Standardization, which publishes Internationally Standardized Profiles (ISPs), containing, e.g. upper bounds for protocol elements.