TECHNICAL REPORT

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Information technology — Message Handling Systems (MHS): MHS Routing — Guide for messaging systems managers

Technologies de l'information — Systèmes de messagerie (MHS): Routage MHS — Guide pour résponsables de systèmes de messagerie

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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Attention is drawn to the possibility that some of the elements of this part of ISO/IEC TR 10021 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TR 10021-11 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.404.

ISO/IEC TR 10021 consists of the following parts, under the general title *Information technology — Message Handling Systems (MHS)*:

— *Part 1: System and Service Overview*

— *Part 2: Overall architecture*

— *Part 3: Abstract Service Definition Conventions*

— *Part 4: Message transfer system: Abstract service definition and procedures*

— *Part 5: Message store: Abstract service definition*

— *Part 6: Protocol specifications*

— *Part 7: Interpersonal messaging system*

— *Part 8: Electronic Data Interchange Messaging Service*

— *Part 9: Electronic Data Interchange Messaging System*

— *Part 10: MHS routing*

— *Part 11: MHS Routing — Guide for messaging systems managers*

Annexes A and B of this part of ISO/IEC 10021 are for information only.

Introduction

This Recommendation | Technical Report is one of a set of Recommendations | number of parts of ISO/IEC 10021 defining Message Handling in a distributed open systems environment.

ITU-T Rec. X.412 | ISO/IEC 10021-10 defines a method for routing messages through the Message Handling System (MHS). This Recommendation | Technical Report provides guidance for Configuring MTS Routing using the Directory, and suggests the characteristics of a Directory User Agent for managing that process. It allows OR-address plans, MTA interconnection topology and the management structures applied to MHS to be dealt with independently of each other whilst remaining within a co-ordinated framework.

TECHNICAL REPORT

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – MESSAGE HANDLING SYSTEMS (MHS): MHS ROUTING – GUIDE FOR MESSAGING SYSTEM MANAGERS

1 Scope

This Recommendation | Technical Report specifies the means by which the administrator of various aspects of an MHS system may configure information into the directory for MTAs to use to determine the routing of messages.

ITU-T Rec. X.412 | ISO/IEC 10021-10 provides a set of directory structures that may be configured in many different ways to support a particular MHS routing strategy. In order to illustrate the use of these directory structures, this document contains advice on how an MHS Administrator might organize the configuration of directory trees and entries in the directory. In particular, it contains suggestions on the following:

– The types, construction and location of different OR-address subtrees that may be needed;

– The location of routing collective and MTA entries in the directory.

Other ways of using the routing capabilities specified in ITU-T Rec. X.412 | ISO/IEC 10021-10 are also valid.

Other Recommendations | International Standards define other aspects of the MHS. ITU-T Rec. F.400/X.400 | ISO/IEC 10021-1 defines the user-oriented services provided by the MHS. ITU-T Rec. X.402 | ISO/IEC 10021-2 provides an architectural overview of the MHS. ITU-T Rec. X.411 | ISO/IEC 10021-4 defines the abstract-service of the Message Transfer System. ITU-T Rec. X.412 | ISO/IEC 10021-10 defines MHS Routing using the directory.

2 Normative References

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | Technical Report. 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 | Technical Report 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 Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

– ITU-T Recommendation X.216 (1994) | ISO/IEC 8822:1994, *Information technology – Open Systems Interconnection – Presentation service definition.*

– ITU-T Recommendation X.402 (1995) | ISO/IEC 10021-2:1996, *Information technology – Message Handling Systems (MHS): Overall architecture.*

– ITU-T Recommendation X.412 (1999) | ISO/IEC 10021-10:1998, *Information technology – Message Handling Systems (MHS): MHS routing.*

– ITU-T Recommendation X.500 (1997) | ISO/IEC 9594-1:1998, *Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services.*

2.2 Paired Recommendations | International Standards equivalent in technical content

– CCITT Recommendation X.208 (1998), *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).*

- ITU-T Recommendation F.400/X.400 (1999), *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: System and service overview.*

3 Definitions

For the purposes of this Recommendation | Technical Report, the following definitions apply.

3.1 MHS definitions

The following terms are formally defined in ITU-T Rec. X.402 | ISO/IEC 10021-2:

- OR-address;
- MTA;
- MTS;
- MHS;
- Message Store;
- User Agent;
- P7;
- P3;
- MD;
- ADMD;
- PRMD;
- Security Context.

3.2 ASN.1 definitions

The following term is formally defined in ITU-T Rec. X.208 | ISO/IEC 8824:

- ASN.1.

3.3 Directory definitions

The following terms are formally defined in ITU-T Rec. X.500 | ISO/IEC 9594:

- Directory Name;
- Relative Distinguished Name.

3.4 Presentation Service definitions

The following term is formally defined in ITU-T Rec. X.216 | ISO/IEC 8822:

- Presentation Service Access Point.

3.5 MHS-routing definitions

The following terms are formally defined in ITU-T Rec. X.412 | ISO/IEC 10021-10:

- Connection Group;
- Enumerated Connection Group;
- Next Level Complete;
- Routing collective;
- Routing-MTA;
- Target MTA;
- Un-enumerated Connection Group.

3.6 MHS Routing Methodology Definitions

The following terms are defined in clauses 6 to 10 of this Recommendation | Technical Report:

3.6.1 adjacent MTA: An MTA that is directly connected (i.e. through some connection group) to the current MTA.

3.6.2 administrator: A person or role which manages a particular routing collective in the MHS.

3.6.3 current MTA: The MTA taking a routing decision for a message.

3.6.4 exit MTA: A routing MTA within the routing collective which has access to connection groups allowing it to transfer messages to MTAs outside a routing collective. In an extreme case, each MTA in a routing collective might be an Exit MTA.

3.6.5 external OR-address subtree: An OR-address subtree which holds routing information to parts of the MTS lying outside the routing collective under construction.

3.6.6 external Route: A route from a routing collective Exit MTA to another MTA outside the routing collective.

3.6.7 internal Route: A route between two MTAs within a routing collective.

3.6.8 mailbox: term used to indicate the delivery point for messages located by an OR-address. This may be a P7 accessed message store, a P3 accessed user agent or a proprietary protocol accessed user process. The distinction between these variants is irrelevant to MHS routing.

3.6.9 OR-address plan: A plan of OR-address attribute types used to identify an organization's departments, divisions and users of MHS. An OR-address plan is specified by the Organisational and MHS administrators to select the particular OR-address forms and attributes for use within the organisation from all those possibilities that are specified in the MHS base standards. Organizational Administrator are persons or roles which manage non-MHS aspects of an organization, but who place requirements on an MHS system.

3.6.10 reference OR-address subtree: an OR-address subtree that contains a routing collective's internal routing and message delivery information.

3.6.11 registration Authority: An administrative role which ensures that OR-addresses are unambiguous, i.e. that each OR-address is allocated to one and only one user.

3.6.12 routing Information: Information held in OR-address subtrees which instructs an MTA on how to process a message for a particular OR-address.

NOTE – This is more general than the ASN.1 construct 'routing advice', since it is oriented to the discrete actions that an administrator will take, and includes Recipient MD Assigned Alternate Recipients etc.

3.6.13 top level routing collective: A routing collective which does not belong to a superior routing collective.

4 Abbreviations

For the purposes of this Recommendation | Technical Report, the following abbreviations apply.

ISDN	Integrated Services Digital Network
LAN	Local Area Network
PSDN	Packet Switched Digital Network
PSTN	Public Switched Telephone Network

5 Overview

5.1 The role of MHS Routing

Message Handling Systems exchange messages between users on a store-and-forward basis. A message submitted by one user (the originator) will be transferred through one or more Message Transfer Agents (MTAs) in the Message-Transfer-System (MTS) and delivered to one or more other users (the recipients). The sequence of MTAs through which a message is transferred on its way from originator to recipient is the message's route. The originator does not specify

the route but identifies the recipient in the MTS by means of an unambiguous Originator/Recipient Address (OR-address) or directory name which is translated by the directory into the recipient's OR-Address. A recipient's OR-Address indirectly specifies which MTA the recipient is attached to. Each user is supported by a single MTA that is responsible for delivering messages addressed to the user. Each MTA that handles a message on its way towards its destination uses the recipient's OR-address on the message's envelope to select the most appropriate subsequent route. This process eventually leads to the delivering MTA.

To achieve store and forward messaging, each MTA is configured with routing information indicating the OR-addresses for which it has delivery responsibility and also the routes through adjacent MTAs which should be taken towards all other OR-addresses. In general, each MTA requires different routing information to reflect its location and connectivity within the MTS with respect to MTAs supporting other OR-addresses.

5.2 Administrative Roles

MTAs are configured with routing information by MHS administrators. The information that (possibly different) administrators supply to their MTAs should be co-ordinated to ensure that each message is correctly and efficiently routed towards its recipients, and that routing conflicts and loops do not occur.

MHS routing is influenced by a number of different organizational roles:

- an organizational administrator who is primarily concerned with the operational aspects of the organisation, and regards MHS as a resource. Organisational administrators specify requirements of MHS, but do not get involved in the realisation of MHS;

- an MHS Administrator who is directly responsible for all aspects of the installation and operation of the MHS, including the connectivity between MTAs etc.;

- an administrative role to ensure the allocation of unambiguous OR-addresses to MHS users. This role is formally identified as a 'RegistrationAuthority'. However its realisation, and the way it is administered will vary from organization to organization, and it will also vary according to the type of OR-address attribute being administered and the type of users the attributes are being registered for.

The MHS requirements are determined primarily by organizational administrators, and the MHS routing strategy supporting those requirements is designed and configured by MHS administrators. In some cases, the MHS administrator's role may be further subdivided e.g. into those who deal with creating and managing mailboxes and those who are primarily involved in managing MTAs and their interconnectivity.

In addition, a registration authority is also assumed to be responsible for registering the OR-addresses assigned to users, ensuring that they are unambiguous and that the OR-addresses conform to the OR-address plan. Each registration authority will administer values for some OR-address attributes within the scope of one or more well defined sets of OR-addresses. Some registration authorities will act at higher levels in the global OR-address space (e.g. to register Country Names, PRMD Names, ADMD Names and organization Names). Others will act at lower levels, (e.g. to register organization Names, organizational Unit Names, Personal Names etc. within ADMDs, PRMDs, organizations etc.). Registration of Country names, MD names and Organisation names is performed by a hierarchy of formal registration authorities. However, the way that the remaining OR-address attributes are administered within an organization may be less formal, and it will differ dependent on the type of organization.

The sole collective technical requirement of registration authorities as far as MHS routing is concerned is that all OR-addresses should be unambiguous – i.e. no two MHS users should be allocated (or granted) the same OR-address.

In some organizations, one or more of the above roles may be carried out by the same department or person, however they will often be dispersed and, for the purposes of this Recommendation | Technical Report the functions they carry out are regarded as separate and independent of each other.

Organizational administrators are concerned with the day to day business of the organization and regard the MHS as a facility to support the organization. They are not directly involved in MHS administration. They determine the internal structure of the organization into departments, and the distribution of the organization and the departments over different geographically dispersed sites. In doing this, they determine the geographical site at which each MHS user is located. Their primary concerns with MHS routing are:

- that the MHS supports an OR-address plan which reflects each user's departmental or site location[1)];
- that the OR-address plan makes it easy to guess a user's OR-address; and
- that OR-addresses are stable and do not need to be changed when users are relocated or connected to a different MTA.

It is essential that the OR-address plan is determined by these factors alone, and that these requirements are not compromised by any MHS configuration choices or limitations imposed by MHS products or services. The organizational administrator's input into the MHS routing design is therefore a specification of an OR-address plan suited to the organization, and, for each user, a specification of the geographical and departmental locations and the user's OR-address.

MHS administrators are concerned with supporting the messaging requirements specified by organizational administrators. There are two independent aspects of the MHS administrator's role:

- To develop and maintain the interconnectivity of MTAs together with a message routing strategy which supports the organization's OR-address plan. These must take into consideration the geographical distribution of the organization and the available MHS systems and data communications links connecting the organization's different sites;
- Configuring each user's MHS OR-addresses and mailbox at a particular location and with an OR-address specified by the organizational administrator.

It should be noted that an organization's operational internal structure, which should be the sole factor determining its OR-address plan, is often quite different to the organizational structure of the MHS administration, and it may be different again to the topology of MTA interconnections. It is therefore important that the three following aspects of MHS routing design should be maintained independently of each other, and that:

- the OR-address plan can be constructed to reflect the requirements of the organizational administrator, and to provide as short an OR-address as is possible whilst remaining intuitively 'guessable' by users. This aim should not be compromised by any aspects of the design or configuration of the MHS;

- an MHS administrative structure can be constructed to fulfil the requirements of the organizational administration, recognizing that it may be centralised or devolved, and may need to be quite different to the organization's structure as specified by the organizational administrator (e.g. it must allow for cases where individual organizational departments are distributed over different geographical locations and served by different MTAs);
- the OR-address plan remains independent of the topology of the MTS.

5.3 The Role of the MHS Routing Standard

In the absence of ITU-T Rec. X.412 | ISO/IEC 10021-10, different MTA products tended to adopt different approaches to routing and often, no tools were provided to support the specification of an overall routing strategy among groups of MTAs. This was particularly so in multi-vendor environments in which MTS designs were often compromised because the specification of the OR-address space and MTS topology and message routing could not be done independently of each other. In these cases, to achieve a workable routing strategy, each MTA had to be assigned the delivery responsibility for a complete OR-address space (e.g. by assigning delivery responsibility for all OR-addresses containing a particular OU Name to a particular MTA). This strategy creates an unfortunate binding between the OR-address space and the topology of the MTS, and had a number of disadvantages:

1) Distribution of an organizational department's users over several MTAs forced MHS administrators to introduce unnecessary extra OR-address attributes into the OR-address plan. These attributes were of no real significance within the organization but were necessary to identify the delivering MTA (e.g. by adding extra Organizational Unit attributes to distinguish between the different MTAs which supported a single organizational department, so that each MTA had delivery responsibility for all OR-addresses containing a particular value of the extra attribute);

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1) Organizational administrators can choose whether to develop an OR-address plan reflecting the departmental structure or geographic distribution of the Organization, or they can choose a mixture of both.

2) Routing strategies often had to be constructed that concentrated routing knowledge in central MTAs, and required that all message traffic should pass through that MTA. This inhibited direct routing between the originator and recipient's MTAs, it introduced a single point of failure, and was the source of potential traffic overload situations and unnecessarily long delivery delay times;

3) When users had to be relocated to another MTA (e.g. because they were moved to another building or site or department), their OR-address had to be changed to reflect the fact that they were served by a different MTA;

4) It was sometimes not possible to determine whether an OR-address was valid, other than by passing the message through all MTAs in an area of the MTS until all possibilities had been tried.

MHS administrators were also confronted with a variety of different mechanisms to configure different MTAs, and many MTA products placed restrictions on the OR-address plans that they could specify.

5.4 The advantages of using MHS Routing

ITU-T Rec. X.412 | ISO/IEC 10021-10, and this Recommendation | Technical Report, specify MHS routing and routing techniques using the directory. The directory enables the information required for MTA routing decisions to be held in a standardized, distributed store which can be accessed by each MTA using a standardized access protocol. Using the directory in this way to support MHS routing has a number of advantages for the administration of ADMDs and PRMDs:

a) It allows MHS and organizational administrators to allocate shorter OR-addresses which remain stable over longer time periods. This is particularly important where a department within an organization (e.g. identified by a particular organizational Unit OR-address attribute value) is geographically distributed, or where it is necessary to spread the processing load of a large department over two or more MTAs;

b) It allows enhancement of MTS performance, since although it might be considered that use of the directory is an overhead, the method can improve the performance of MTS routing because of its ability to select more direct routes and reduce the number of MTAs which have to be traversed by messages;

c) The MHS administrator can avoid single points of failure (i.e. by avoiding the need to configure star connectivity to centralised MTAs, or having to route in a 'hierarchic' fashion as dictated by the OR-addresses attributes);

d) It is possible to construct alternate routes from any MTA to any destination in order to avoid congested areas or system failures;

e) It allows MHS administrators to avoid routing strategies which lead to traffic congestion situations;

f) It provides a uniform approach and a single method to ease the MHS administrative tasks of routing by providing a standard (abstract) interface to the routing controls of MTAs through a single point of access to the directory which may be remote from the MTAs being configured;

g) It can be used for ADMDs and PRMDs to exchange routing information identifying which MTAs should be used as entry points into the MD and it will be of particular use where the single space country name or 'XX' country code are in use. Such information may assist other MDs to make optimum routing choices.

Because of these characteristics, MHS administrators using systems that conform to the MHS-Routing standards and this methodology can provide a better user service to the organization and MHS users.

6 MHS Routing Concepts

6.1 Introduction

This clause introduces MHS Routing administrators to the concepts of the MHS Routing Standard (ITU-T Rec. X.412 | ISO/IEC 10021-10). Clause 6 of ITU-T Rec. X.412 | ISO/IEC 10021-10 contains a more formal and detailed description. The following concepts are explained here:

1) MHS;

2) MHS Routing and the MHS Routing problem;

3) The Directory;

4) The rationale for a Directory based solution;

5) The Model of Directory Based MHS Routing;

6) Directory schema configuration for MHS Routing.

6.2 MHS

Message Handling Systems (MHS) enable users to exchange messages on a store-and-forward basis. A message submitted on behalf of one user, the originator, is conveyed by the Message Transfer System (MTS) and subsequently delivered to the agents of one or more other users, the recipients. The MTS comprises a collection of Message Transfer Agents (MTAs). The MTAs are highly distributed, and connected directly or indirectly to each other in a networked fashion. A message will traverse one or more MTAs on its journey from its originator to its recipient.

MHS routing takes place in the OSI Application Layer (i.e. in MTAs), and is distinct from network layer routing (MHS routing deals with complete messages, the Network layer routes data streams that carry messages between different MTAs).

A more complete description of the MHS is provided in ITU-T Rec. F.400/X.400 | ISO/IEC 10021-1.

6.3 The Message Routing Problem

In MHS, the message originator does not specify a path through different MTAs to reach a recipient, but specifies the recipient’s OR-address (or a directory name that is used to determine the OR-address from the directory). An OR-address consists of a set of OR-address attributes, each of which identifies a particular characteristic of the recipient, e.g. Country, Management Domain, Organization, Personal Name etc.

It is the responsibility of each MTA to determine the next MTA to which the message should be transferred to progress the message’s journey to its recipient. Any given MTA is connected to a number of other MTAs, and an MTA routing a particular message must choose another MTA to which it will forward the message towards its destination. Some choices will be more efficient than others. The selection of the next MTA is based on the recipient’s OR-address. Routing is therefore the process of selecting, given an OR-address, the MTA to which the message should next be transferred. The path taken between an originator and recipient may vary on different occasions, since there will in general be a number of possible paths through different MTAs between them, and factors such as congestion and availability may influence route selection dynamically.

MHS Routing presents a number of significant problems:

– MHS is envisaged as a global service and therefore has a very large OR-address space. It is not feasible to configure MTAs with direct routing knowledge for all possible OR-addresses because of the size of the information and the logistics of distributing OR-address update information;

– MTAs are often sparsely connected (i.e. they do not all directly connect to each other) because it is not feasible to provide a single underlying data communications network to connect all of them. In the absence of complete MTA interconnectivity, this has the implication that different MTAs need to have different routing information dependent on their location with respect to each recipient’s delivering MTA and OR-address;

– Different MTAs require different levels of detail about different OR-addresses. An MTA that is responsible for a set of OR-addresses must have all the delivery information in detail. However, an MTA that is remote from the delivering MTA will only need to know the identity of the delivering MTA or some other MTA on a path towards the delivering MTA.

Because of these problems, MTA implementations have tended to simplify their routing strategy by binding the delivery responsibilities for complete OR-address spaces summarized by a particular OR-address attribute value to a particular MTA (e.g. where an MTA has delivery responsibility for a complete Organizational Unit). Whilst this approach may be efficient in terms of administration, it causes a number of problems e.g.:

1) Where the personnel of a particular organization’s department (e.g. the sales force) are geographically widely distributed, MHS administrators may need to impose further unnecessary layers of Organizational Unit attributes (or some other attribute) in the OR-address plan to represent that geographic distribution, and to enable MTAs to identify the correct delivering MTA;

2) When user’s move location (geographically), their OR-address may need to change to one served by the MTA at the new location;