Network Working Group
Request for Comments: 1615
RARE Technical Report: 9
Category: Informational

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May 1994

Migrating from X.400(84) to X.400(88)

Status of this Memo

Scope

In the context of a European pilot for an X.400(88) messaging service, this document compares such a service to its X.400(84) predecessor. It is aimed at a technical audience with a knowledge of electronic mail in general and X.400 protocols in particular.

Abstract

This document compares X.400(88) to X.400(84) and describes what problems can be anticipated in the migration, especially considering the migration from the existing X.400(84) infrastructure created by the COSINE MHS project to an X.400(88) infrastructure. It not only describes the technical complications, but also the effect the transition will have on the end users, especially concerning interworking between end users of the 84 and the 88 services.

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1. New Functionality

Apart from the greater maturity of the standard and the fact that it makes proper use of the Presentation Layer, the principal features of most use to the European R&D world in X.400(88) not contained in X.400(84) are:

- A powerful mechanism for arbitrarily nested Distribution Lists including the ability for DL owners to control access to their lists and to control the destination of nondelivery reports. The current endemic use of DLs in the research community makes this a fundamental requirement.

- The Message Store (MS) and its associated protocol, P7. The Message Store provides a server for remote User Agents (UAs) on Workstations and PCs enabling messages to be held for their recipient, solving the problems of non-continuous availability and variability of network addresses of such UAs. It provides powerful selection mechanisms allowing the user to select messages from the store to be transferred to the workstation/PC. This facility is not catered for adequately by the P3 protocol of X.400(84) and provides a major incentive for transition.

- Use of X.500 Directories. Support for use of Directory Names in MHS will allow a transition from use of O/R Addresses to Directory Names when X.500 Directories become widespread, thus removing the need for users to know about MHS topological addressing components.

- The provision of message Security services including authentication, confidentiality, integrity and non-repudiation as well as secure access between MHS components may be important for a section of the research community.

- Redirection of messages, both by the recipient if temporarily unable to receive them, and by the originator in the event of failure to deliver to the intended recipient.

- Use of additional message body encodings such as ISO 8613 ODA (Office Document Architecture) reformattable documents or proprietary word processor formats.

- Physical Delivery services that cater for the delivery of an electronic message on a physical medium (such as paper) through the normal postal delivery services to a recipient who (presumably) does not use electronic mail.

- The use of different body parts. In addition to the extensible externally defined body parts, the most common types are predefined in the standard. In order to give end-users a real advantage as compared to other technologies, the following body-parts should be supported as a minimum:

  - IA5
  - Message
  - G3FAX
  - External
    - General Text
    - Others

  The last bullet should be interpreted as follows: all UAs should be configurable to use any type of externally defined body part, but as a minimum General Text can be generated and read.

- The use of extended character sets, both in O/R addresses and in the General Text extended bodypart. As a minimum, the character sets as described in the European profiles will be supported. A management domain may choose as an internal matter which character sets it wants to support in generating, but all user agents must be able to copy (in local address books and in replies) any O/R address, even if it contains character sets it cannot interpret itself.

2. OSI Supporting Layers

The development of OSI Upper Layer Architecture since 1984 allows the new MHS standards to sit on the complete OSI stack, unlike X.400(84). A new definition of the Reliable Transfer Service (RTS), ISO 9066, has a mode of operation, Normal-mode, which uses ACSE and the OSI Presentation Layer. It also defines another mode compatible with X.410(84) RTS that was intended only for interworking with X.400(84) systems.

However, there are differences between the conformance requirements of ISO MOTIS and CCITT X.400(88) for mandatory support for the complete OSI stack. ISO specify use of Normal-mode RTS as a mandatory requirement with X.410-mode RTS as an additional option, whereas CCITT require X.410-mode and have Normal-mode optional. The ISO standard identifies three MTA types to provide options in RTS modes:

- MTA Type A supports only Normal-mode RTS, and provides interworking within a PRMD and with other PRMDs (conforming to ISO 10021), and with ADMDs which have complete implementations of X.400(88) or which conform to ISO 10021.

- MTA Type B adds to the functionality of MTA type A the ability to interwork with ADMDs implementing only the minimal requirements of X.400(88), by requiring support for X.410-mode RTS in addition to Normal-mode.

- MTA Type C adds to the functionality of MTA type B the ability to interwork with external X.400(84) Management Domains (MDs, i.e., PRMDs and ADMDs), by requiring support for downgrading (see 5.1) to the X.400(84) P1 protocol.

The interworking between ISO and CCITT conformant systems is summarised in the following table:

		CCITT		
		X.400(84)	X.400(88) minimal implementation	X.400(88) complete implementation
ISO 10021/ MOTIS	MTA Type A	N	N	Y
	MTA Type B	N	Y	Y
	MTA Type C	Y	Y	Y

Table 1: Interworking ISO <-> CCITT systems

The RTS conformance difference would totally prevent interworking between the two versions of the standard if implementations never contained more than the minimum requirements for conformance, but in practice many 88 implementations will be extensions of 84 systems, and will thus support both modes of RTS. (At the moment we are aware of only one product that doesn't support Normal mode.)

Both ISO and CCITT standards require P7 (and P3) to be supported directly over the Remote Operations Service (ROS), ISO 9072, and use Normal-mode presentation (and not X.410-mode). Both allow optionally ROS over RTS (in case the Transport Service doesn't provide an adequately reliable service), again using Normal-mode and not X.410-mode.

CCITT made both Normal and X.410 mode mandatory in its X.400(92) version, and it is expected that the 94 version will have the X.410 mode as an option only.

3. General Extension Mechanism

One of the major assets in ISO 10021/X.400(88) is the extension mechanism. This is used to carry most of the extensions defined in these standards, but its principal benefit will be in reducing the trauma of transitions to future versions of the standards. Provided that implementations of the 88 standards do not try to place restrictions on the values that may be present, any future extension will be relayed by these implementations when appropriate (i.e., when the extension is not critical), thus providing a painless migration to new versions of the standards.

4. Interworking

4.1. Mixed 84/88 Domains

ISO 10021-6/X.419(88) defines rules for interworking with X.400(84), called downgrading. As X.400 specifies the interconnection of MDs, these rules define the actions necessary by an X.400(88) MD to communicate with an X.400(84) MD. The interworking rules thus apply at domain boundaries. Although it would not be difficult to extend these to rules to convert Internal Trace formats which might be thought a sufficient addition to allow mixed X.400(84)/X.400(88) domains, the problems involved in attempting to define mixed 84/88 domains are not quite that simple.

The principle problem is in precisely defining the standard that would be used between MTAs within an X.400(84) domain, as X.400(84) only defines the interconnection of MDs. In practice, MTA implementations either use X.400(84) unmodified, or X.400(84) with the addition of Internal Trace from the first MOTIS DIS (DIS 8883), or support MOTIS as defined in DIS 8505, DIS 8883, and DIS 9065. The second option is recommended in the NBS Implementors Agreements, and the third option is in conformance with the CEN/CENELEC MHS Functional Standard [1], which requires as a minimum tolerance of all "original MOTIS" protocol extensions. An 84 MD must decide which of these options it will adopt, and then require all its MTAs to adopt (or at least be compatible with) this choice. No doubt this is one of the reasons for the almost total absence currently of mixed- vendor X.400(84) MDs in the European R&D MHS community. The fact that none of these three options for communication between MTAs within a domain have any status within the standardisation bodies accounts for the absence from ISO 10021/X.400(88) of detailed rules for interworking within mixed 84/88 domains.

Use of the first option, unmodified X.400(84), carries the danger of undetectable routing loops occurring. Although these can only occur if MTAs have inconsistent routing tables, the absence of standardised methods of disseminating routing information makes this a possibility which if it occurred might cause severe disruption before being detected. The only addition to the interworking rules needed for this case is the deletion of Internal Trace when downgrading a message.

Use of the second option, X.400(84) plus Internal Trace, allows the detection and prevention of routing loops. Details of the mapping between original-MOTIS Internal Trace and the Internal Trace of ISO 10021 can be found in Annex A. This should be applied not only when downgrading from 88 to 84, but also in reverse when an 84 MPDU is received by the 84/88 Interworking MTA. If the 84 domain properly implements routing loop detection algorithms, then this will allow completely consistent reception of messages by an 84 recipient even after DL expansion or Redirection within that domain (but see also section 5.3). Unfortunately, the first DIS MOTIS like X.400(84) left far too much to inference, so not all implementors may have understood that routing loop detection algorithms must only consider that part of the trace after the last redirection flag in the trace sequence.

Use of the third option, tolerance of all original-MOTIS extensions, would in principle allow a still higher level of interworking between the 84 and 88 systems. However, no implementations are known which do more than relay the syntax of original-MOTIS extensions: there is no capability to generate these protocol elements or ability to correctly interpret their semantics.

The choice between the first two options for mixed domains can be left to individual management domains. It has no impact on other domains provided the topology recommended in section 5 is adopted.

4.2. Generation of OR-Name Extensions from X.400(84)

The interworking rules defined in DIS 10021-6/X.419 Annex B allow for delivery of 88 messages to 84 recipients, but do not make any 88 extensions available to 84 originators. In general this is an adequate strategy. Most 88 extensions provide optional services or have sensible defaults. The exception to this is the OR-Name extensions. These fall into three categories: the new CommonName attribute; fifteen new attributes for addressing physical delivery recipients; and alternative Teletex (T.61) encodings for all attributes that were defined as Printable Strings. Without some mechanism to generate these attributes, 84 originators are unable to address 88 recipients with OR-Addresses containing these attributes. Such a mechanism is defined in RARE Technical Report 3 ([2]), "X.400 1988 to 1984 downgrading".

Common-name appears likely to be a widely used attribute because it remedies a serious deficiency in the X.400(84) OR-Name: it provides an attribute suitable for naming Distribution Lists and roles, and even individuals where the constraints of the 84 personal-name structure are inappropriate or undesirable. As 84 originators will no doubt wish to be able to address 88 DLs (and roles), [2] defines a Domain Defined Attribute (DDA) to enable generation of common-name by 84 originators. This consists of a DDA with its type set to "common-name" and its value containing the Printable String encoding to be set into the 88 common-name attribute.

This requires that all European R&D MHS 88 MTAs capable of interworking with 84 systems shall be able to map the value of "common-name" DDA in OR-Names received from 84 systems to the 88 standard attribute extension component common-name, and vice versa.

X.400(84) originators will only be able to make use of this ability to address 88 common-name recipients if their system is capable of generating DDAs. Unfortunately, one of the many serious deficiencies with the CEN/CENELEC and CEPT 84 MHS Functional Standards ([1] and [3]), as originally published, is that this ability is not a requirement for all conformant systems. Thus if existing European R&D MHS X.400(84) users wish to be able to address a significant part of the ISO 10021/X.400(84) world they must explicitly ensure that their 84 systems are capable of generating DDAs. However, this will be a requirement in the revised versions of ENV 41201 and ENV 41202, which are to be published soon. There is no alternative mechanism for providing this functionality to 84 users. It is estimated that currently 95% of all European R&D MHS users are able to generate DDAs.

When messages are sent to both ISO 10021/X.400(88) and X.400(84) recipients outside the European R&D MHS community, this representation of common-name will not enable the external recipients to communicate directly unless their 84/88 interworking MTA also implements this mapping. However, use of this mapping within the European R&D MHS community has not reduced external connectivity, and provided RTR 3, RFC 1328 is universally implemented within this community it will enhance connectivity within the community.

As for the new Physical Delivery address attributes in X.400(88), RTR 3 (RFC1328) takes the following approach. A DDA with type "X400-88" is used, whose value is an std-or encoding of the address as defined in RARE Technical Report 2 ([4]), "Mapping between X.400(1988)/ISO 10021 and RFC 822". This allows source routing through an appropriate gateway. Where the generated address is longer than 128 characters, up to three overflow DDAs are used: X400-C1; X400-C2; X400-C3. This solution is general, and does not require co-operation, i.e., it can be implemented in the gateways only.

Note that the two DDA solutions mentioned above have the undesirable property that the P2 heading will still contain the DDA form, unless content upgrading is also done. In order to shield the user from cryptic DDAs, such content upgrading is in general recommended, also for nested forwarded messages, even though the available standards and profiles do not dictate this.

4.3. Distribution List Interworking with X.400(84)

Before all X.400(84) systems are upgraded to ISO 10021, the interaction of Distribution Lists with X.400(84) merits special attention as DLs are already widely used.

Nothing, apart perhaps from the inability to generate the DL's OR-Address if the DL uses the common-name attribute, prevents an X.400(84) originator from submitting a message to a DL.

X.400(84) users can also be members (i.e., recipients) of a DL. However, if the X.400(84) systems involved correctly implement routing loop detection, the X.400(84) recipient may not receive all messages sent to the DL. X.400(84) routing loop detection involves a recipient MD in scanning previous entries in a message's trace sequence for an occurrence of its own domain, and if such an entry is found the message is non-delivered. The new standards extend the trace information to contain flags to indicate DL-expansion and redirection, and re-define the routing loop detection algorithm to only examine trace elements from the last occurrence of either of these flags. Thus 88 systems allow a message to re-traverse an MD (or be relayed again by an MTA) after either DL-expansion or redirection. However, these flags cannot be included in X.400(84) trace, so are deleted on downgrading. Therefore the 84 DL recipient will receive all messages sent to the DL except those which had a common point in the path to the DL expansion point with the path from the expansion points to his UA. This common point is an MD in the case of a DL in another MD or an MTA in the case of a DL in the same MD. Although this is quite deterministic behaviour, the user is unlikely to understand it and instead regard it as erratic or inconsistent behaviour.

Another problem with X.400(84) DL members will be that delivery and non-delivery reports will be sent back directly to the originator of a message, rather than routed through the hierarchy of DL expansion points where they could have been routed to the DL administrator instead of (or as well as) the originator.

No general solution to this problem has yet been devised, despite much thought from a number of experts. The nub of the problem is that changing the downgrading rules to enable 84 recipients to receive all such messages also allows the possibility of undetectable infinite DL or redirection looping where there is an 84 transit domain.

A potential solution is to extend the DL expansion procedures to explicitly identify X.400(84) recipients and to treat them specially, at least by deleting all trace prior to the expansion point. This solution is only dangerous if another DL reached through an 84 transit domain is inadvertently configured as an 84 recipient, when infinite looping could occur. It does however impose the problems of 84 interworking into MHS components which need to know nothing even of the existence of X.400(84). It also requires changes to the Directory attribute mhs-dl-members to accommodate the indication that identifies the recipient as an X.400(84) user, unless European R&D MHS DLs are restricted to being implemented by local tables rather than making use of the Directory.

A similar change would be required for Redirection. However, the change for Redirection would have substantially more impact as it would require European R&D MHS-specific MHS protocol extensions to identify the redirected recipient as an X.400(84) user. If the European R&D MHS adopts a reasonable quality of MHS(88) service, all its MTAs would be capable of Redirection and all UAs would be capable of requesting originator-specified-alternate-recipient and thus be required to incorporate these non-standard additions. A special European R&D MHS modification affecting all MTAs and UAs seems impractical, too!

If the recommended European R&D MHS topology for MHS migration (See chapter 5) is adopted there will never be an X.400(84) transit domain (or MTA) between two ISO 10021 systems. This allows the deletion of trace prior to the last DL expansion or redirection to be performed as part of the downgrading, giving the X.400(84) user a consistent service. This solution has the advantage of only requiring changes at the convertors between X.400(84) and ISO 10021/X.400(88), where other European R&D MHS specific extensions have also been identified. A precise specification of this solution is given in Annex A.

Finally, problems might occur because some X.400(84) MTAs could object to messages containing more than one recipient with the same extension-id (called originally-requested-recipient-number in the new standards), since this was not defined in X.400(84). Note that X.400(84) only requires that all extension-id's be different at submission time, so 84 software that does not except messages with identical extension-id's for relaying or delivery must be considered broken.

4.4. P2 Interworking

RTR 3, RFC 1328 also defines the downgrading rules for P2 (IPM) interworking: The IPM service in X.400(1984) is usually provided by content type 2. In many cases, it will be useful for a gateway to downgrade P2 from content type 22 to 2. This will clearly need to be made dependent on the destination, as it is quite possible to carry content type 22 over P1(1984). The decision to make this downgrade will be on the basis of gateway configuration.

When a gateway downgrades from 22 to 2, the following should be done:

1. Strip any 1988 specific headings (language indication, and partial message indication).

2. Downgrade all O/R addresses, as described in Section 3.

3. If a directory name is present, there is no method to preserve the semantics within a 1984 O/R Address. However, it is possible to pass the information across, so that the information in the Distinguished Name can be informally displayed to the end user. This is done by appending a text representation of the Distinguished Name to the Free Form Name enclosed in round brackets. It is recommended that the "User Friendly Name" syntax is used to represent the Distinguished Name [5]. For example:

    (Steve Hardcastle-Kille, Computer Science,
    University College London, GB)

4. The issue of body part downgrade is discussed in Section 6.

Note that a message represented as content type 22 may have originated from [6]. The downgrade for this type of message can be improved. This is discussed in RTR 2, RFC 1327.

Note that the newer EWOS/ETSI recommendations specify further rules for downgrading, which are not all completely compatible with the rules in RTR 3, RFC 1328. This paper does not state which set of rules is preferred for the European R&D MHS, it only states that a choice will have to be made.

As the transition topology recommended for the European R&D MHS is to never use 84 transit systems between 88 systems, it is possible to improve on the P2 originator downgrading and resending scenario. The absence of 84 transit systems means that the necessity for a P1 downgrade implies that the recipient is on an 84 system, and thus that it is better to downgrade 88 P2 contents to 84 P2 rather than to relay it in the knowledge that it will not be delivered.

5. Topology for Migration

Having decided that a transition from X.400(84) is appropriate, it is necessary to consider the degree of planning and co- ordination required to preserve interworking during the transition.

It is assumed as a fundamental tenet that interworking must be preserved during the transition. This requires that one or more system in the European R&D MHS community must act as a protocol converter by implementing the rules for "Interworking with 1984 Systems" listed in Annex B of ISO 10021-6/X.419.

When downgrading from ISO 10021/X.400(88) to X.400(84) all extensions giving functionality beyond X.400(84) are discarded, or if a critical extension is present then downgrading fails and a non-delivery results. Thus, although it is possible to construct topologies of interconnected MTAs so that two 88 MTAs can only communicate by relaying through one or more 84 MTA, to maximise the quality of service which can be provided in the European R&D MHS community it is proposed that it require that no two European R&D MHS 88 MTAs shall need to communicate by relaying through a X.400(84) MTA. Furthermore, if this is extended to require that no two European R&D MHS 88 MTAs shall ever communicate by relaying through an X.400(84) MTA, then the European R&D MHS can provide enhanced interworking functionality to its X.400(84) users.

If mixed vintage 88 and 84 Management Domains (MDs) are created, the routing loop detection rules, which specify that a message shall not re-enter an MD it has previously traversed, require that downgrading is performed within that mixed vintage MD. That MD therefore requires at least one MTA capable of downgrading from 88 to 84. It is unlikely that every MTA within an MD will be configured to act as an entry-point to that MD from other MDs. However, the proposed European R&D MHS migration topology requires that as soon as a domain has an 88 MTA it shall also have an 88 entry point - this may, of course, be that same MTA.

Even for MDs operating all the same MHS vintage internally, providing entry-points for both MHS vintages will give considerable advantage in maximising the connectivity to other MDs. Initially, it will be particularly important for 88 MDs to be able to communicate with 84 only MDs, but as 88 becomes more widespread eventually the 84 MDs will become a minority for which the ability to support 88 will be important to maintain connectivity. For most practical MDs providing entry-points that implement options in the supporting layers will also be important. Support for at least the following is recommended at MD entry-points:

88-P1/Normal-mode RTS/CONS/X.25(84)
88-P1/Normal-mode RTS/RFC1006/TCP/IP
84-P1/X.25(80)
84-P1/RFC1006/TCP/IP

The above table omits layers where the choice is obvious (e.g., Transport class zero), or where no choice exists (e.g., RTS for 84-P1).

The requirement for no intermediate 84 systems does require that the European R&D MHS use direct PRMD to PRMD routing between 88 PRMDs at least until such time as all ADMDs will relay the 88 MHS protocols.

Finally, in order to keep routing co-ordination overhead to a minimum, an important requirement for the migration strategy is that only one common set of routing procedures is used for both 84 and 88 systems in the European R&D MHS.

6. Conclusion

1. The transition from X.400(84) to ISO 10021/X.400(88) is worthwhile for the European R&D MHS, to provide:

   - P7 Message Store to support remote UAs.
   - Distribution Lists.
   - Support for Directory Names.
   - Standardised external Body Part types.
   - Redirection.
   - Security.
   - Future extensibility.
   - Physical Delivery.

2. To minimise the number of transitions the European R&D MHS target should be ISO 10021 rather than CCITT X.400(88) - i.e., straight to use of the full OSI stack with Normal-mode RTS.

3. To give a useful quality of service, the European R&D MHS should not use minimal 88 MTAs which relay the syntax but understand none of the semantics of extensions. In particular, all European R&D MHS 88 MTAs should generate reports containing extensions copied from the subject message and route reports through the DL expansion hierarchy where appropriate.

4. The European R&D MHS should carefully plan the transition so that it is never necessary to relay through an 84 system to provide connectivity between any two 88 systems.

5. The European R&D MHS should consider the additional functionality that can be provided to X.400(84) users by adopting an enhanced specification of the interworking rules between X.400(84) and ISO 10021/X.400(88), and weigh this against the cost of building and maintaining its own convertors. The advantages to X.400(84) users are:

   - Ability to generate 88 common-name attribute, likely to be widely used for naming DLs.
   - Consistent reception of DL-expanded and Redirected messages.
   - Ability to receive extended 88 P2 contents automatically downgraded to 84 P2.

7. Security Considerations

Security issues are not discussed in this memo.

Appendix A - DL-expanded and Redirected Messages in X.400(84)

This Annex provides an additional to the rules for "Interworking with 1984 Systems" contained in Annex B of ISO 10021-6/X.419, to give X.400(84) recipients consistent reception of messages that have been expanded by a DL or redirected. It is applicable only if the transition topology for the European R&D MHS recommended in section 3 is adopted.

Replace the first paragraph of B.2.3 by:

If an other-actions element is present in any trace- information-elements, that other-actions element and all preceding trace-information-elements shall be deleted. If an other-actions element is present in any subject-intermediate-trace-information- elements, that other-actions element shall be deleted.

Appendix B - Bibliography

[1] ENV 41201, "Private MHS UA and MTA: PRMD to PRMD", CEN/CENELEC, 1988.

[2] Kille, S., "X.400 1988 to 1984 downgrading", RTR 3, RFC 1328, University College London, May 1992.

[3] ENV 41202, "Protocol for InterPersonal Messaging between MTAs accessing the Public MHS", CEPT, 1988.

[4] Kille, S. "Mapping between X.400(1988)/ISO 10021 and RFC 822", RTR 2, RFC 1327; University College London. May 1992.

[5] Kille, S., "Using the OSI Directory to achieve User Friendly Naming", RFC 1484, ISODE Consortium, July 1993.

[6] Crocker, D., "Standard for the Format of ARPA Internet Text Messages", STD 11, RFC 822, University of Delaware, August 1982.

[7] Craigie, J., "COSINE Study 8.2.2. Migration Strategy for X.400(84) to X.400(88)/MOTIS", Joint Network Team, 1988.

[8] Craigie, J., "ISO 10021-X.400(88): A Tutorial for those familiar with X.400(84)", Computer Networks and ISDN systems 16, 153-160, North-Holland, 1988.

[9] Manros, C.-U., "The X.400 Blue Book Companion", ISBN 1 871802 00 8, Technology Appraisals Ltd, 1989.

[10] CCITT Recommendations X.400 - X.430, "Data Communication Networks: Message Handling Systems", CCITT Red Book, Vol. VIII - Fasc. VIII.7, Malaga-Torremolinos, 1984.

[11] CCITT Recommendations X.400 - X.420 (ISO IS-10021), "Data Communication Networks: Message Handling Systems", CCITT Blue Book, Vol. VIII - Fasc. VIII.7, Melbourne, 1988.

Appendix C - MHS Terminology

Message Handling is performed by four types of functional entity: User Agents (UAs) which enable the user to compose, send, receive, read and otherwise process messages; Message Transfer Agents (MTAs) which provide store-and-forward relaying services; Message Stores (MSs) which act on behalf of UAs located remotely from their associated MTA (e.g., UAs on PCs or workstations); and Access Units (AUs) which interface MHS to other communications media (e.g., Telex, Teletex, Fax, Postal Services). Each UA (and MS, and AU) is served by a single MTA, which provides that user's interface into the Message Transfer Service (MTS).

Collections of MTAs (and their associated UAs, MSs and AUs) which are operated by or under the aegis of a single management authority are termed a Management Domain (MD). Two types of MD are defined: an ADMD, which provides a global public message relaying service directly or indirectly to all other ADMDs; and a PRMD operated by a private concern to serve its own users.

A Message is comprised of an envelope and its contents. Apart from the MTS content-conversion service, the content is not examined or modified by the MTS which uses the envelope alone to provide the information required to convey the message to its destination.

The MTS is the store-and-forward message relay service provided by the set of all MTAs. MTAs communicate with each other using the P1 Message Transfer protocol.

Appendix D - Abbreviations

ACSE	Association Control Service Element
ADMD	Administration Management Domain
ASCII	American Standard Code for Information Exchange
ASN.1	Abstract Syntax Notation One
AU	Access Unit
CCITT	Comite Consultatif International de Telegraphique et Telephonique
CEN	Comite Europeen de Normalisation
CENELEC	Comite Europeen de Normalisation Electrotechnique
CEPT	Conference Europeene des Postes et Telecommunications
CONS	Connection Oriented Network Service
COSINE	Co-operation for OSI networking in Europe
DL	Distribution List
DIS	Draft International Standard
EN	European Norm
ENV	Draft EN, European functional standard
IEC	International Electrotechnical Commission
IPM	Inter-Personal Message
IPMS	Inter-Personal Messaging Service
IPN	Inter-Personal Notification
ISO	International Organisation for Standardisation
JNT	Joint Network Team (UK)
JTC	Joint Technical Committee (ISO/IEC)
MD	Management Domain (either an ADMD or a PRMD)
MHS	Message Handling System
MOTIS	Message-Oriented Text Interchange Systems
MTA	Message Transfer Agent
MTL	Message Transfer Layer
MTS	Message Transfer System
NBS	National Bureau of Standardization
OSI	Open Systems Interconnection
PRMD	Private Management Domain
RARE	Reseaux Associes pour la Recherche Europeenne
RFC	Request for Comments
RTR	RARE Technical Report
RTS	Reliable Transfer Service
WG-MSG	RARE Working Group on Mail and Messaging

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