X.400(1988) for the Academic and Research Community in Europe

A report by the RARE Task Force on X.400(1988)
of the RARE Working Group on Mail & Messaging

Status of this Memo

1. Abstract

The European research and development community, as represented by
the member research networks of RARE, has lead the deployment within
the global R&D community of X.400 electronic messaging services, as
specified in the international recommendations CCITT X.400(1984), for
more than five years. As a result of providing such services to the
European R&D users it has become clear that there is an existing and
ever increasing demand from these users for new and enhanced
electronic messaging services and product to be used to communicate
within the R&D community but within commercial service providers and
organisations as well.

It is also clear that new services, such as Multimedia messaging and
Secure messaging, and the resulting products promise dramatic
benefits and opportunities, for not only the R&D community but also
for the wider commercial, industrial and public communities, in terms
of facilitating innovative ways of working and living which can only
enhance the missions and goals of the respective communities. Not
least the establishment of globally pervasive messaging services
between all users, R&D and commercial, is facilitated by the early
adoption of such advanced new services. An indication of the
importance of such a messaging service can be appreciated if one
considers that in many organizations (especially commercially based)
messaging may be the only method to communicate between independent
organizations due to security considerations and lower layer network
differences.

The Commission of European Communities (CEC) VALUE subprogram II has
been established to support initiatives relating to the development
and adaptation of R&D networks in member states. Amongst other

initiatives the VALUE program supports X.400 initiatives in certain
countries. VALUE support has so far been limited to X.400(1984)
initiatives, as X.400(1984) has up until now been the dominating OSI
services. However as X.400(1988) implementations have started to
appear a VALUE funded study of the X.400(1988) aspects of messaging
and their impact on the R&D community was felt necessary. This report
is one of the results of that study.

The report documents the results of a task force on X.400(1988)
deployment of the RARE Mails and Messaging Work Group during the
period from November 1992 until October 1993. Open reviews of the
report have occurred in the RARE Mail and Messaging Work Group and
within the IETF X.400ops Working Group.

The scope of the report is limited to deployment of X.400(1988)
services, and as such the report does not contain any recommendations
on development and deployment of Internet RFC 822 / MIME/ PEM related
(pilot) services. However, since the report shows that both
X.400(1988) and RFC 822 / MIME / PEM will be developed and used
within the European R&D community, such a pilot should also
considered. Note: RFC 822 is also known as Internet STD 11.

Circulation of this report is unlimited. Comments on this report may
be sent to the e-mail distribution list:

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  X.400:   S=wg-msg;O=rare;P=surf;A=400net;C=nl;

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2. Management Summary

   This document reports the results of study of the X.400(1988) aspects
   of messaging and their impact on the R&D community. The study was
   funded by the CEC under VALUE Subprogram II and has been carried out
   by a task force on the RARE Mail Working Group. The document is
   targeted at technical decision makers as well as those who would fund
   activity in this area.

   The document presents the existing situation as regards the
   predominate messaging technologies within Europe. These are presented
   within the context of a number of large messaging communities that
   are using these technologies:

     - RFC 822,
     - X.400(1984),
     - Mail-11 and
     - PC LAN messaging

Three major European communities are referenced:

  - Commercial service providers
  - R&D community
  - Commercial organisations using messaging services.

The report states the following facts:

  - The resources, human or financial, to operate multiple wide
    area messaging services connecting together independent
    organisations are high. As such it is desirable to try and
    keep to a minimum the number of such services. This statement
    is true for the R&D community but is also highly likely to be
    valid for the general European industry.

  - There are two publicly available technological standards
    that can be used by open communities, such as the R&D
    community and public service providers: the X.400(1984 and
    1988) recommendations and the Internet RFC 822 / MIME / PEM
    standards.

  - There is an established very large global user base of
    Internet RFC 822 and X.400(1984) messaging services. Both
    services have their own momentum within different parts of
    the user community, both are still developing and growing
    fast.

The report concludes that X.400(1988) will be the preferred protocol
for inter organizational connection for European industry and
government and parts of the European R&D community. RFC 822 / MIME /
PEM will be the preferred protocol suite for inter-organisational
connection for the Internet community and, as products are already
widely available, it is the preferred protocol for parts of the
European R&D community.

The goal of European pervasive messaging - incorporating Industry,
Government and Academia - would be best accommodated and reached by
the establishment of a single messaging service. However taking the
above into account, this is not feasible, as X.400(84 and 88) and RFC
822(and MIME) based services will be around for a long time to come.
To increase the functionality of Wide Area E-mail services there is a
clear necessity to:

  - migrate RFC 822 services to a RFC 822 / MIME / PEM service.
    A MIME based service offers more functionality to the user
    than a plain RFC 822 service.

  - migrate existing X.400 services to a X.400(1988) service.

Due to the lack of scalability of the X.400(1984) service in
terms of extra functionality, it will become increasingly
difficult to meet the needs of research users of existing
X.400(1984) services unless an X.400(1988) service is put
into place.

- provide a transparent gateway between X.400(1988) and RFC
  822/MIME/PEM. For the European R&D community it is essential
  to have a transparent gateway between the X.400(1988) service
  and the RFC 822 / MIME / PEM service, thus ensuring
  connectivity between these two services with a maximum
  functionality.

Such a gateway is technically feasible and it is an essential part of
an unified E-mail service. Without such a standardised gateway the
overall E-mail service would deteriorate.

The lack of open standards for the PC LAN messaging systems
discourages their use as 'backbone' messaging technologies within
open communities. However the products that these systems deliver to
end users ensures that their already large share of the messaging
market will continue to exist for some time. Thus it is also
essential that strategies that allow these systems to be 'seamlessly'
integrated within the global messaging community are put in place.
Not least due to the indications that the main messaging vendors are
developing X.400(1988) and RFC 822/MIME gateways, a strategy to link
these systems together via X.400 and RFC 822 should be developed.

The report concludes with a set of recommendations, the main one
being the establishment of a X.400(1988) European pilot messaging
service for the R&D community. This pilot should include the
establishment of a transparent gateway service between X.400(1988)
and RFC 822/MIME. The goal of a European pilot is to ensure the
successful deployment of a European wide operational X.400(1988)
service that is pervasive and meets the needs of users. By collecting
together the issues related to the establishment of a European
X.400(1988) service, this report acts as a focal point and stimulant
for discussion on this topic within the R&D community. In the report
a summary of the benefits and problems of each of the above messaging
technologies within the context of achieving a global messaging
service, of which the R&D community is one part, is presented.
Further the document identifies issues, strategies and
recommendations related to the migration and coexistence of these
technologies within the scope of mainly the European R&D community
but also in relation to other messaging communities. A cost / benefit
analysis on the establishment of a European wide pilot X.400(1988)
messaging service is also presented. Finally a reading list of
references related to this subject has been compiled.

The report does not include any recommendations on development and
deployment of RFC 822 / MIME / PEM related (pilot) services, as these
are outside of the scope of the Task Force. However, since the report
shows that both X.400(1988) and RFC 822 / MIME / PEM will be
developed and used within the European R&D community, such a pilot
should also be considered.

3. Framework for the report

With the belief that user demands for new messaging services such as
Multimedia and Secure Messaging would develop, the RARE community
(together with other communities; most notably the Internet
Engineering Task Force (IETF)) has over the preceding years
experimented in new messaging and related technologies. Experiments
and pilots, have been performed in messaging services e.g., as
recommended by CCITT X.400(1988) and Directory Services based upon
the CCITT X.500(1988) recommendations.

The results of such pilots and experiments indicate that it is now
opportune to commence a pilot X.400(1988) messaging service for the
European R&D community. The major goals of the pilot being, to

  - establish a large scale European wide pilot messaging
    service based on X.400(1988).

  - collaborate with and facilitate the commencement of similar
    pilot services within diverse communities; both R&D and non-
    R&D (e.g., commercial ADMDs and PRMDs, etc.); both European
    and non-European (e.g., North American , Asian, etc.).

  - encourage and assist the development and deployment of a
    wide variety of commercial and public domain X.400(1988)
    messaging products that meet the user's needs, for instance
    X.400(1988) products such as User Agents (UAs), Message
    Stores (MSs), Message Transfer Agents (MTAs) and gateways
    between X.400(1988) services and other widespread messaging
    services i.e., RFC 822, Mail-11 and proprietary.

  - prove that such a service and products efficiently meets the
    existing and expected demands for new messaging services by
    European R&D users. And as such determine the steps for a
    European deployment of an operational X.400(1988) messaging
    service.

  - determine the needed steps to facilitate migration for the
    existing operational R&D X.400(1984) based messaging service,
    as represented by the R&D MHS service (the former COSINE
    MHS), RFC 822 / MIME / PEM based messaging services and the

HEPnet / SPAN Mail-11 based messaging service to an
operational X.400(1988) messaging service. It is self evident
that during such migrations, transition steps must be
included that allow a period of coexistence, at the highest
possible service level, between X.400(1988), X.400(1984), RFC
822 / MIME and HEPnet / SPAN Mail-11 services.

- determine the needed steps that allow proprietary messaging
  systems, that are widely deployed within the European R&D
  community to be integrated at as high as possible service
  level, by an X.400(1988) infrastructure.

This report identifies the issues involved in such a pilot service.
It is not a concrete proposal for such a project but the report
discusses advantages and disadvantages, costs and enefits and
migration issues for deploying a X.400(1988) service. As such it is a
discussion and feasibility paper on the creation of a large scale
European wide pilot X.400(1988) messaging service for the European
R&D community.

4. Present situation of European Messaging

4.1. Messaging services

Electronic messaging within Europe can be viewed as a number of
messaging services communities. Three important communities comprise,

- Commercial e-mail networks,
- Research e-mail networks and
- PC LAN messaging systems.

Commercial e-mail networks are classified as either ADMDs or PRMDs.
ADMDs and PRMDs are operating in nearly every European country.

- ADMD services (or public commercial e-mail services) are
  provided by over 50 service providers which have
  interconnected using the X.400(1984) protocols. The topology
  between these ADMDs, although not yet 'mesh', can be stated
  as progressing quite rapidly to this optimum goal. However
  there is still a way to go before ADMDs provide full European
  connectivity.

- PRMDs (or private commercial e-mail service providers) have
  interconnected to ADMDs and other PRMDs predominantly using
  the X.400(1984) protocols but also with proprietary
  protocols.

Research networks are providing messaging services in every European
country. These R&D service providers are operated as either ADMDs or
PRMDs and are using both X.400(1984) protocols and Internet RFC 822
protocols to connect to each other.

Moreover, there are also large R&D communities (i.e., HEPnet and
SPAN) using proprietary protocols (i.e., DECnet Phase IV and Mail-11)
as their main messaging systems. The DECnet IV based communities are
now migrating to DECnet Phase V (OSI connectionless protocol stack),
which provides X.400(1988) (plus X.400(1984)) as a major messaging
system. In general, all these services are totally interconnected.
As such it is a statement of fact that there exists within the
European R&D community, two parallel interconnected messaging
infrastructures based upon X.400(1984) and RFC 822. However
interconnections between the R&D messaging community and the majority
of the European commercial service providers use the X.400(1984)
protocols.

It is also clear that the commercial world mostly makes inter-
organizational messaging interconnections using the X.400(1984)
protocols. And also that the commercial messaging world is not as
totally interconnected as the R&D messaging community. Finally, for
a number of commercial and public organisations there is often a
mandatory requirement to use X.400 for messaging interconnections.

The usage of PC LAN messaging systems is increasing very rapidly
within the academic and commercial communities. In general, PC LAN
messaging services within both communities do not use X.400(1984) or
RFC 822 messaging systems but systems based upon proprietary
protocols. The PC LAN messaging systems can be considered more as
'Islands of Messaging' that gateway to the commercial and R&D
messaging services by using X.400(1984) or RFC 822 gateways. PC LAN
messaging systems within commercial organisations connect to
commercial service providers also via proprietary protocols. The PC
LAN messaging services, although probably comprising the largest
number of users, are in general poorly integrated with the global
messaging service (The Dutch, UK and Italian academic communities
confirm that there appears to be many such 'Islands' of PC LAN
messaging systems within their networks.).

4.2. Requirements for messaging

Experience with existing global e-mail services has proven that with
the increased use of messaging, there follows an awareness of extra
requirements for related services. These requirements can be
classified into 'User based Requirements' and 'Service Provider based
Requirements' to either support, or exploit, high quality messaging
services. These requirements are elaborated upon within this chapter.

4.2.1. User Oriented

   The only thing a user requires is an easy to use, well integrated,
   user interface to electronic mail. Usually the user does not care
   what protocol is used. However there are certain inherent
   requirements to the functionality that can be identified as user
   requirements. The main user requirements identified are:

   - Distribution Lists (DLs)

      A widely perceived omission from the X.400(1984) recommendations
      was the lack of support of DLs. Distribution lists allow users to
      enlist themselves onto electronic mail expander lists
      (distribution lists). A message to such a distribution list will
      automatically, and without significant delay, be sent on to anyone
      whose electronic mail address is on that list. Such a list can be
      a public list, that is meant for discussions on a specific
      subject, much like a sort of "magazine". However the list can also
      be a "closed" list, containing only a selected set of people who
      need to communicate privately, e.g., a project-team.

   - Multinational language and Multimedia support

      European users have for many years been frustrated in their
      inability to use their national character sets when communicating
      using messaging systems. The problems within e-mail systems that
      were causing this character set frustration are at their base the
      same problem that would get in the way of Multimedia messaging
      like:

         - lack of binary data support
         - lack of standardised encoding schema's
         - definition of multiple body-parts

      The enormous potential of Multimedia systems and services
      (especially within the commercial community as evidenced by the
      enormous press publicity and mega-mergers positioning companies to
      exploit this technology but also within the government spheres
      i.e., the U.S.A. Government's 'Information Superhighway'
      initiative) has acted as a spur to make rapid progress in solving
      the problems in this area.

   - White pages Directory Service

      A white pages directory service provides a unique but very basic
      and important service; a way to store and find information about
      people and resources that is analogous to a telephone service's
      paper based directory i.e., White Pages. User's E-mail addresses

can be stored for subsequent retrieval by E-mail systems.

- EDI

    EDI today is not extensively used within the academic environment.
    However there is a distinct potential within the academic
    community to reduce costs and improve services with EDI. Potential
    EDI uses could be,

        - EDI between universities
        - EDI between universities and government
        - EDI between universities and lower level educational
          institutions (e.g., student records)
        - Commercial EDI using the Internet as an infrastructure.

    The significance of maintaining end to end integrity (especially
    security aspects) of the EDI messages mandates that no gateways
    should be used between originator and recipient.

- Support of Security services

    E-mail as it is currently used is far from secure. To allow for
    serious usage of E-mail security issues need to be addressed,
    like:

        - integrity; making sure that the message is transferred
          intact, without any changes or additions.
        - encryption; making sure the message content is only
          decipherable by the intended recipient.
        - authentication; making sure that the originator and/or
          recipient are authenticated.

4.2.2. Service provider viewpoint

    The task force believes the following points as being the most
    significant service provider requirements:

- Network Management

    This area is still very new, in terms of offering standardised
    protocols, services and products for management. However a minimum
    'goal' is to provide for central management functions that will
    allow providers to offer a better quality of service. There is
    presently ongoing work within the IETF Working Group MADMAN to
    define SNMP monitoring and managing of E-mail systems, gateways
    and X.500 directory systems. A number of management areas that
    need to be worked upon include: QOS, Service Level Agreements
    (SLAs), Multiple system queue management, Accounting, Routing Co-

ordination and Message Tracing.

- Support of MTA routing

    Dynamic routing from MTA to MTA, relieves the necessity to
    maintain large routing tables, especially within a large PRMD, or
    community of PRMDs (like the R&D MHS community).

- Address mapping between RFC 822 and X.400

    The widespread use of X.500 or DNS for mapping, allows a reduction
    of manpower for centrally co-ordinating globally consistent
    X.400-to-RFC-822 mapping tables and distributes the responsibility
    for updating the mapping rules. This should allow mapping rules to
    change when needed and to be available immediately.

- UA capabilities registration

    The use of the directory to register UA capabilities for
    X.400(1988), X.400(1984) and RFC 822 / MIME / PEM systems is a
    very desirable benefit for users in terms of speeding the
    deployment of new messaging services (e.g., Multimedia Messaging).

4.3. Messaging capabilities

Due to the problems of gatewaying within a multi-protocol messaging
environment, the great majority of R&D E-mail users are reduced to
using only InterPersonal Messaging (IPM) services based upon the
exchange of message body parts using CCITT character set IA5 (US
ASCII).

Within the R&D community recent work to meet user requirements for
non ASCII messaging services - as documented above - has resulted in
enhancements to the messaging services based upon RFC 822 protocols.
The enhancements provide Multimedia support via the Multipurpose
Internet Mail Extensions (MIME) and the prospect in the very near
future of secure messaging via Privacy Enhanced Mail (PEM).
Deployment of the MIME enhanced RFC 822 based services, via
distribution of software and the setting up of the needed
organisational structures, has commenced. The PEM enhancements are in
a large scale pilot phase e.g., VALUE PASSWORD project.

In the case of X.400(1984) the usage of non ASCII body parts is
mostly effected by bilateral agreement between recipient and
originator, through use of body part 14. In practice this restricts
the exchange of non ASCII body parts to those cases where the
recipient and the originator use the same bilateral agreement or else
the originator includes an ASCII message explaining the included

content type. Besides IPM there is a growing usage of EDI on top of
X.400(1984).

With the above X.400(1984) deficiencies in mind, X.400(1988) has been
specified by the CCITT / ISO to meet new user demands. X.400(1988)
provides support for various different body parts, enhanced security
features, international character set support capabilities and
support of X.500 Directory Services. Due to the technological
potential of these standards to satisfy user needs for new messaging
services, the R&D community has been experimenting and piloting
X.400(1988) and X.500(1988) services. As there is a strong
dependency of X.400(1988) messaging upon X.500(1988) directory
services, the necessary precondition to supply these user demands is
a deployed and operational X.500(1988) directory service. Piloting
and deployment of the X.500(1988) directory service within the R&D
community has been successfully initiated and co-ordinated by the
COSINE and the VALUE PARADISE projects.

Similarly, secure messaging has been addressed by the VALUE PASSWORD
project and the RARE and IETF communities. Work to solve problems
related to directory support of X.400(1988) messaging has been
pursued within the IETF and RARE. The relevant RARE and IETF work
groups (e.g., RARE WG-MSG, IETF MHS-DS, etc.) have also worked to
produce any needed enhancements to the base X.400(1988) and
X.500(1988) standards. Last but not least it should not be
overlooked that X.400(1988), as compared to X.400(1984), provides a
comprehensive basis for gatewaying to and from RFC 822 / MIME / PEM
and PC LAN messaging services. To that respect the IETF has defined
standards for gatewaying Multimedia mail between RFC 822 / MIME / PEM
and X.400(1988). As RFC 822 / MIME / PEM is now being deployed on the
Internet, deployment of X.400(1988) services is needed to assure
multimedia and secure messaging connectivity for the European R&D
community.

5. Possible solutions for providing globally pervasive messaging

As can be now seen, a correlation of the present situation to the
requirements of the user, shows that the current messaging services
do not match the needs of users. To try to meet these needs a number
of developments within various messaging technology areas are
occurring. The following messaging technological areas, due to the
present installed user base within the R&D community, are considered
relevant:

  - PC LAN E-mail systems such as Lotus cc:Mail, Microsoft Mail
    and Novell MHS
  - RFC 822 / MIME / PEM E-mail services
  - X.400(1988) messaging services

Ongoing developments within each of the above technological areas provide new messaging options for the R&D community. The ability of each technological area to provide solutions for user and service provider requirements is summarised within this chapter.

5.1. PC LAN E-mail systems

Currently the usage of PC LAN E-mail systems is mostly for internal communication within an organisation. External connections, if present at all, to public service providers or other organisations is mostly through gateways to X.400(1984) or RFC 822. The use of a PC LAN E-mail system in terms of an infrastructure for interconnecting E-mail systems of different hues is not common within the Research community. Recent experience, from amongst others the Dutch Research network - SURFnet - [14] and the Norwegian Directorate for Public Management - Statskonsult - [18], has shown that a number of problems (i.e., limited functionality, high operational management cost, etc.) can be expected should these PC LAN E-mail systems be used as an E-mail infrastructure. (The use of native X.400 protocols for PC LAN E-mail systems would avoid the usage of gateways and would thus alleviate many of these problems.) A summary of those problems and some relevant issues follows:

- Interconnecting heterogeneous PC LAN messaging systems

    One very distinct benefit for E-mail users of all hues is the potential to integrate heterogeneous PC LAN messaging systems with a minimum loss of service (e.g., multimedia services) by connecting them via X.400(1988) (or RFC 822/MIME/SMTP). X.400(1988) is already being used, or under active development, for connecting together PC LAN messaging systems in a number of environments (e.g., Apple Macintoshes, DEC, Microsoft, Lotus, etc.). This tendency to gateway PC LAN messaging systems via X.400(1988) will increase and is one of the benefits that X.400(1988) brings to global multiprotocol messaging.

- Multimedia and binary data support

    The benefit of E-mail systems using these PC LAN systems is that the user interfaces are usually well integrated in the users standard working environment. Using a proprietary protocol these systems allow not only text (ASCII) but also binary, word processor, video, audio and other types of files to be transported. To reap the benefits of this multimedia / binary data transfer it would normally require that the same type of gateway is used by sender and receiver. Transporting these same files to another type of PC LAN E-mail system is not possible through the

current gateways without some information loss. In effect PC LAN
E-mail system's X.400 (or RFC 822) gateways from different vendors
perform acceptably only for text body parts. True heterogeneous
multimedia PC LAN messaging needs gateways to X.400(1988)'s
service.

- Application Programming Interfaces

  To help solve the problem of portability for Mail Enabled
  Applications Microsoft, Lotus, Novell, XAPIA and X/OPEN have been
  working on a number of standards for the Application Interface to
  mail transport protocols (i.e., Mail Application Programming
  Interface - MAPI, Vendor Independent Messaging - VIM, Common Mail
  Calls - CMC). These efforts are structured independent of the
  existing 'Wide-Area' or inter organisational E-mail protocols of
  X.400(1984) and RFC 822. However the MAPI, VIM and CMC efforts,
  due to their proposers (respectively Microsoft, Lotus and X/OPEN),
  do look like they will provide the stimulant to various software
  developers to develop more portable applications plus allow the
  rich functionality of X.400(1988) to be accessed by these
  applications thus reducing the need for gatewaying to X.400(1988).

- Security

  As the PC LAN E-mail systems require gateways for connectivity,
  they pose a problem with regard to encrypted messages. Gatewaying
  of secure messages is normally not possible. The gatewaying of
  secure messages is a general problem of gatewaying from one mail
  system to any other system and is not specific to PC LAN E-mail
  systems.

- Directory Services

  To date mostly proprietary directory services have been deployed
  that do not match the needs of the users in terms of access
  controls for data, distributed and decentralised across
  organisations. X.500 based services promise solutions to such
  needs. As a result various suppliers have announced support of
  X.500 directory services for their E-mail products. However,
  should these interfaces be delayed then support of an inter
  organisational 'White Pages' services requires either,

  - directory information exchange products (i.e., directory
    gateways) deployed between a proprietary system and an X.500
    directory system

         - gateways between de-facto market based proprietary
           standards, such as Retix Directory Exchange (DX) or
           Soft*switch's Directory Synchronisation (DS), and X.500
           protocols

         - duplicated directories i.e., one proprietary and one X.500
           need to be operated.

   It should be stressed that gatewaying mechanisms and products are
   often problematic due to the lack of an open standard on the
   proprietary messaging system and or directory system. (As an aside it
   is thus essential to establish an operational X.500 infrastructure,
   including E-mail user interfaces that can transparently access this
   Directory Service, as soon as possible.)

5.2. RFC 822, MIME and PEM services

   RFC 822 messaging services are widely deployed within the R&D
   community. There is ongoing work to extend RFC 822 to meet user
   requirements. Some of these extensions are elaborated upon within
   this chapter.

   - Distribution lists

     RFC 822 allows for the usage of DLs. Management of DLs is not
     (yet) standardised.

   - RFC 822 multimedia messaging via MIME

     With the arrival of MIME, the RFC 822 service has an additional
     protocol standard that addresses Multimedia messaging very
     comprehensively. In terms of user needs, MIME now allows messaging
     body parts to comprise multinational character sets and binary
     data. Multi-body part messages are also supported. One of MIME's
     real strengths, in terms of deployment within the existing RFC 822
     service, is that it achieves its goals by overlaying its services
     over the existing RFC 822 service and thus mandating no changes to
     the in place RFC 822 infrastructure. This greatly simplifies the
     MIME deployment.

   - RFC 822 secure messaging via PEM

     Just as MIME has brought multimedia messaging to RFC 822 services,
     Privacy Enhanced Mail (PEM) is bringing secure messaging to RFC
     822 services. PEM also has used the same approach as MIME to
     deploy secure messaging within RFC 822 services; overlay PEM
     services over the existing RFC 822 services without requiring
     changes to the RFC 822 infrastructure. PEM brings confidentiality

and integrity of messages to RFC 822 users. However a number of
problems with PEM, and X.400(1988) as well, still need to be
solved before secure messaging can be considered to be an
operational service. These problems are independent of the secure
messaging protocol (i.e., PEM or X.400(1988)) and deal mainly with
distribution of secret keys to the end users. There is very active
work going on within the IETF to solve these problems.

- MIME and PEM

  There are still problems for messages that are simultaneously a
  multimedia message, as per MIME, and a secure message, as per PEM.
  A PEM encoded MIME message does not allow gatewaying to other
  messaging environments and therefore does not allow any of the
  features inherent within MIME to be exploited along the message
  path. A MIME message that contains PEM encoded body parts can be
  gatewayed but the integrity of the entire message is then not
  guaranteed. This is a real deficiency of both existing approaches
  as it is essential that users are able to simultaneously use
  multimedia and secure messaging. However, once again, the IETF is
  working very hard on solving these problems and solutions can be
  expected, although the solution of the gatewaying of PEM messages
  to other E-mail systems is still unclear.

- Dynamic and distributed messaging routing via the Domain Name
  System (DNS)

  RFC 822 messaging benefits greatly by having a dynamic and
  distributed mechanism to assist in message routing i.e., Domain
  Name System (DNS). With the support of the DNS, RFC 822 MTAs are
  able to directly route to other RFC 822 MTAs and thus deliver
  messages with a minimum of delay. In practice mail often still
  traverses multiple RFC 822 MTAs for a number of reasons e.g., Mail
  Hubs provided for users who turn their machine off when they go
  home, Firewall Hubs for security reasons, etc. However it is
  commonly accepted that between RFC 822 mail hubs the delivery of
  messages is very fast. Typically resolution of routing decisions
  occurs in less than one minute and very often within seconds. In
  general the DNS service is a very valuable service that functions
  well in practice.

- Support for Character sets

  Together with the MIME specification for content types, an
  extension for RFC 822 headers was defined that allows for usage of
  multiple character sets in names, subject etc. in RFC 822 headers
  [9]. This allows (European) users to use their preferred character
  set to support their language not only in the contents of a

message but also in the headers.

- MIME capable gateways

  It is clear that to provide a seamless service to all users regardless of whether they are using RFC 822 or X.400 services, a widely available set of well run and standardised RFC 822 to X.400 gateways must be in place. For InterPersonal Messaging (IPM) based on US ASCII there are already a large number of such standardised (i.e., X.400-to-RFC 822) gateways deployed. To ensure seamless gatewaying between MIME and X.400 multimedia users, these existing text based gateways must be either upgraded to or replaced with multimedia messaging gateways. A number of proposed Internet standards to solve these problems, for both X.400(1984) and X.400(1988) and generated within the MIMEMHS work group of the IETF, have been completed [4].

- Access to fax, teletex, telex or physical delivery

  For the moment, there is no standardised way for RFC 822 users to access gateways to the above services except by indirect access to X.400(1988) systems (i.e., concatenated gateways of RFC 822 to X.400(1988) and then onwards to the appropriate X.400(1988) Access Unit). Although even this indirect method would require some further work on standardising mappings between RFC 822 addresses and X.400(1992)'s X.121 addresses. As well some experiments within the RFC 822 world are occurring on routing fax messages.

- Operational support

  Generally, RFC 822 messaging services are delivered on a 'best effort' basis and thus service level agreements requesting stringent response times to operational problems or guaranteed delivery times for messages are difficult to agree. This phenomena might be a result of the distribution and delegation of authority to organisations updating the RFC 822 MTA's routing mechanism i.e., DNS. As a result it makes it hard to reach a 'one stop shopping' agreement for RFC 822 messaging services.

- Notifications

  The RFC 822 service provides a minimum amount of base protocol support for messaging users. It could be argued that the RFC 822 protocol is simplified by this choice and thus software that implements the standard need be smaller in size and easier to build. However some features e.g., delivery & receipt notifications and UA capabilities registration, would be commonly accepted as being desirable from a user standpoint and thus

desirable extensions to RFC 822. Some operational problems
relating to reliability could be minimised by technology that has
a standardised support for positive and negative notifications of
messages. RFC 822, as compared to X.400, technology does not yet
support positive notifications (although there is work starting
within the IETF to extend RFC 822 to support delivery
notifications). However within RFC 821 transport system (i.e.,
SMTP) there are standardised negative notifications that work
well. Alternatively X.400 technology, deployed over TCP/IP (using
STD 35, RFC 1006), may help to address the lack of adequate
service quality - notification support - when using E-mail within
the Internet.

- Portability of RFC 822 products

   There are only a few mailbox formats in general use by RFC 822
   software, one being the 'bin/mail' format and the other 'MH'
   format. This 'standard' mailbox format is a definite benefit for
   RFC 822 users as it allows them to change RFC 822 UAs (e.g.,
   upgrading to MIME RFC 822 UAs) whilst not compromising or
   converting their existing archived mail, which may comprise 1000s
   of archived messages.

- System support for RFC 822 products

   Normally, RFC 822 MTAs and UAs come pre-installed on UNIX
   workstations. As a result, users are spared the effort of
   installing RFC 822 MTA software. If for some reason, a user or
   mail administrator should wish to install a different MTA or UA to
   the pre-installed system, there exists a large number of easily
   available (i.e., via widespread distribution amongst many FTP and
   other information servers) public domain RFC 822 MTAs and UAs.

   Both of the above points encourages the spread and eases the
   installation of software for the RFC 822 messaging service and in
   many ways explains the size and importance of the installed base
   of RFC 822 systems. To illustrate the extent of RFC 822 / MIME
   products, a non-comprehensive list of available MIME enhanced RFC
   822 products follows; ELM 2.4, MH 6.8, Sun Mailtool, HP Mpower
   Desktop, Lotus cc:Mail (unconfirmed), Zcode Zmail, Frontier
   Super-TCP for Windows, PMDF (VAX VMS), Pine, C-Client (library
   routines), Metamail (viewer only), Andrew-MIME gateway.

- UA capability registration

   The IETF MHS-DS working group has defined how X.400 and RFC 822
   User Agent capabilities can be stored in X.500 directory services.
   This work is still ongoing.

5.3. X.400 - 1984 and 1988

   X.400(1988) substantially upgrades and enhances the X.400(1984)
   standards. A number of new functions have been incorporated within
   X.400(1988). A description of the most important features of X.400 -
   1984 and 1988 - follows.

   - Notifications

      X.400(1984) provides four notifications - positive and negative
      delivery notifications and positive and negative receipt
      notifications. These notifications allow users to ensure
      successful message delivery or that the message was read. The
      delivery notifications are also used by service operators in their
      fault escalation procedures.

   - Binary Data Transfer

      X.400(1984) allows binary data transfer to be transported without
      the necessity of character encoding. The ability to transfer files
      of whatever type is a valuable end user service. As well the lack
      of any necessary character encoding allows users to utilise the
      received data without needing any character decoding software.

   - Multiple Body Parts

      The ability to send multiple body parts within one message gives
      the user the ability to send multiple logical components within
      one message. This is a natural mechanism for users as it mirrors
      the real life situation of being able to send within one message,
      a letter, a word processor file, a spreadsheet file, etc.

   - Feature rich messaging model

      The features of X.400 are very rich. This provides benefits for
      users as vendors are able to provide applications that can utilise
      these extensive features in an interoperable manner due to the
      standardisation of the features within X.400.

   - Clear messaging model

      X.400(1984), as one of its most wide reaching achievements, has
      popularised within the market a consistent and clear model to
      describe message handling systems. The decomposition of a message
      handling system into UAs, MSs, MTAs, MTS - ADMDs and PRMDs and
      Access Units / Gateways has proved to be an extremely useful tool
      for users and vendors to understand and communicate their
      messaging needs or solutions.

- Multiple lower layer networks

    X.400 has embraced the concept that there are different technology
    lower layer networks. This concept even allows multiple logical
    networks of the same technology to be supported. X.400 allows the
    messaging service to fully function even though the underlying
    network is varying. In the real world of a non-uniform network
    layer this is an extremely powerful capability.

The list of major X.400(1988) extensions to X.400(1984) follows:

- Distribution Lists (DLs)

    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 non delivery reports. The
    current endemic use of DLs in the R&D community makes this a
    fundamental requirement for any service. X.400(1988) uses X.500 to
    provide a standardised support for DLs, although there have been
    some needed standardised enhancements relating to the CCITT
    defined DLs by the IETF MHS-DS work group. The provision of
    powerful nesting capabilities plus management mechanisms for DL
    owners within X.400(1988) DLs are features providing attractive
    benefits for users and DL managers. There is already 'running
    code', via the COSINE Explode project which is implementing the
    MHS-DS based enhancements. The project builds upon experience
    gained within a number of networks e.g., JNT and provides:

        - implementation of MHS-DS enhancements related to the
          X.400(1988) DLs
        - archiving of messages received by a DL.
        - access by users to the DL archive via e-mail.
        - subscription to a DL by users via e-mail.

- Message Store (MS)

    The Message Store provides a server for remote UAs on workstations
    and PCs enabling messages to be held for their recipient, solving
    the problems of non-continuous availability of such UAs. The
    message store allows mobile workers, small offices and local
    schools to become active messaging users in a cost effective
    manner. The message store provides powerful selection mechanisms
    allowing the user to select messages to be transferred between the
    store and the workstation. This facility is not catered for
    adequately by the P3 protocol of X.400(1984) and provides a major
    incentive for transition.

- X.500 Directory names

    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 ability for X.400(1988) messages to contain directory names
    instead of the O/R addresses is a powerful feature for users as it
    frees them of the necessity to insert O/R addresses containing
    routing information but allows them to insert the more natural
    directory names. However, the management of the large amounts of
    distributed data contained within the directory is problematic in
    that it involves a number of organisational issues and not just
    software issues. A number of X.400(1988) UAs which allow users to
    insert directory names instead of O/R addresses have already been
    developed.

- Support for EDI

    Through the definition of Pedi, as defined in X.435, X.400(1988)
    offers integrated support for EDI messaging. The CEC TEDIS program
    has mandated X.400 as the main carrier for EDI, and standardised
    how EDI transactions are inserted into X.400 messages (i.e., Pedi
    and P2). This provides a strong incentive to provide native
    X.400(1988) services to users and applications thus encouraging
    commercial EDI traffic to migrate to X.400(1988).

- Secure Messaging

    The provision of secure messaging services including
    authentication, confidentiality, integrity and non-repudiation as
    well as secure access between MHS components are important
    benefits for the R&D community. The base standards are adequate
    for security, however organisational and software issues need
    still to be solved. Organisational issues of globally scaling the
    distribution of secret keys is still unsolved. Software issues of
    how end users will be able to comfortably and securely input
    secret keys of length 512 -> 1024 bits into security software need
    to be solved.

- Multimedia

    The definition of a number of additional body parts plus the
    ability to define new body parts (e.g., Word Processor formats,
    Excel documents, etc.) provides the basis for multimedia services
    over X.400(1988). As well, the newly defined General Text body
    part supports multinational character sets (except for ISO 10646)

without the need for transmission encoding. However, unlike MIME, X.400(1988) is only specifying a standard for multimedia messaging. To achieve multimedia document exchange, there is a further text exchange standard such as ODIF, Hytime, etc., needed.

- Character set support for extended addressing

  A highly desirable potential benefit for European R&D users is provided by the extended character set support(i.e., T.61) within addresses. Nearly all European languages, except for Greek and Cyrillic, are supported by the T.61 teletex encoding. Further extensions to X.400 for support of extended character sets has been defined by the RARE WG on character sets and RARE WG on messaging [15].

- Physical Delivery Services

  This standardised method for a message to be delivered on a physical medium, such as paper, through the normal postal service is useful when trying to reach a very wide number of (non-electronically reachable) recipients. In effect this service provides an ability to 'go the last mile' and communicate with users previously not easily reachable e.g., farmers, etc.

- General Extension Mechanism

  One of the major assets of X.400(1988) 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 X.400(1988) standards do not try to place restrictions on the values that may be present, any future extension will be relayed by these implementations when the extension is not critical, thus providing a painless migration to new versions (1992 and beyond) of the standards.

- UA Capability Registration

  With the extra functionality available to X.400(1988 and especially 1992) UAs (i.e., extra non-IA5 body parts, secure messaging, etc.) it is expected that the demand to register UA capabilities will increase. In that respect X.400(1988)'s ability to query X.500, where such capabilities would be stored, is a significant potential benefit for users.

    - X.500 support for MTA routing

        The piloting of X.500 to support MTA routing within the R&D
        community has already commenced, on a small experimental scale,
        via the Longbud project co-ordinated by the IETF MHS-DS work
        group. Some concrete benefits promised by X.500 based routing are:

        - routing based upon content types, security, transport stacks
          and other criteria allow optimum routing paths to a
          destination MTA to be chosen. (There is presently no such
          similar capability within the DNS).

        - allowing the routing information to be inserted and modified
          in a distributed manner reduces (if not eliminates) the
          necessity of central distribution of static routing tables.
          The consequent reduction in manpower to co-ordinate MTA
          routing plus the increase in scalability of the service
          allows a truly global messaging service to be put in place.

6. Migration to X.400(1988)

   What is clear from the previous chapters is that;

        - The resources, human or financial, to operate multiple wide
          area messaging services connecting together independent
          organisations are high. As such it is desirable to try and
          keep to a minimum the number of such services. This statement
          is true for the R&D community but is also highly likely to be
          valid for the general European industry.

        - There are two publicly available technological standards
          that can be used by open communities, such as the R&D
          community and public service providers: the X.400(1984 and
          1988) recommendations and the Internet RFC 822 / MIME / PEM
          standards.

        - There is an established very large global user base of
          Internet RFC 822 and X.400(1984) messaging services. Both
          services have their own momentum within different parts of
          the user community, both are still developing and growing
          fast.

   From the above discussion, it is clear that the infrastructure
   services that have to be supported within these open communities, and
   especially within the R&D community, are RFC 822 / MIME / PEM,
   X.400(1984) and X.400(1988). X.400(1988) will be the preferred
   protocol for inter-organisational connection for European industry
   and government and parts of the European R&D community. RFC 822 /

MIME / PEM will be the preferred protocol suite for inter-
organisational connection for the Internet community and, as products
are already widely available, it is the preferred protocol for parts
of the European R&D community.

The goal of European pervasive messaging - incorporating Industry,
Government and Academia - would be best accommodated and reached by
the establishment of a single messaging service. However taking the
above into account, this is not feasible, as X.400 and RFC 822 based
services will be around for a long time to come. To increase the
functionality of Wide Area E-mail services there is a clear necessity
to:

    - migrate RFC 822 services to a RFC 822 / MIME / PEM service.
      A MIME based service offers more functionality to the user
      than a plain RFC 822 service.

    - migrate existing X.400 services to a X.400(1988) service.
      Due to the lack of scalability of the X.400(1984) service in
      terms of extra functionality, it will become increasingly
      difficult to meet the needs of research users of existing
      X.400(1984) services unless an X.400(1988) service is put
      into place.

    - provide a transparent gateway between X.400(1988) and RFC
      822/MIME/PEM. For the European R&D community it is essential
      to have a transparent gateway between the X.400(1988) service
      and the RFC 822 / MIME / PEM service, thus ensuring
      connectivity between these two services with a maximum
      functionality.

Such a gateway is technically feasible and it is an essential part of
an unified E-mail service. Without such a standardised gateway the
overall E-mail service would deteriorate.

The lack of open standards for the PC LAN messaging systems
discourages their use as 'backbone' messaging technologies within
open communities. However the products that these systems deliver to
end users ensures that their already large share of the messaging
market will continue to exist for some time. Thus it is also
essential that strategies that allow these systems to be 'seamlessly'
integrated within the global messaging community are put in place.
Not least due to the indications that the main messaging vendors are
developing X.400(1988) and RFC 822/MIME gateways, a strategy to link
these systems together via X.400(1988) and RFC 822/MIME should be
developed.

To make migration to a X.400(1988) service feasible, extensive
migration and coexistence options for various non-X.400(1988) users
have to be developed. Main issue in each migration strategy remains
the co-operation of the users. The migration needs to be user-driven,
i.e., the users need to be convinced of the added functionality
(versus the cost) of migrating towards X.400(1988). A detailed
summary of the different issues and possible problems involved in the
transition to a X.400(1988) based messaging service, with respect to
what are commonly accepted as the four most important messaging
services: RFC 822, MIME and PEM; X.400(1984); MAIL-11 and PC LAN
messaging systems are presented in this chapter.

6.1. PC LAN E-mail systems

To provide coexistence and migration the usage of gateways is
unavoidable. The quality of these gateways, with regard to:

- Transparency (gatewaying multimedia messages, transparent
  addressing)
- Manageability
- Reliability

has to be improved. Ultimately through usage of APIs like MAPI and
CMC, the users interface hopefully will become independent of the
mail protocol that is used. It will then be expected to be possible
to let the user retain his preferred mail user interface, while the
protocol used migrates to X.400(1988).

Via the use of these APIs it may be possible to access the full
features of X.400(1988) while retaining a proprietary PC LAN UAs.
This way a PC LAN can be easily connected to a X.400(1988) backbone.
This usage of APIs to ease migration for end users should be
encouraged.

The migration of PC LAN E-mail systems will likely be driven by the
commercial vendors of mail enabled applications, such as UAs, Work
Group Systems, Task Flow Systems plus X.400(1988) MTAs and gateways
able to serve these applications via these new APIs.

6.2. RFC 822, MIME and PEM services

A migration from RFC 822 / MIME and PEM services to X.400(1988) needs
to be formulated for those management domains that wish to effect
this change. As well a long term transition and coexistence phase
needs to be accommodated due to the existing base of RFC 822 users.
An understanding of the issues involved in migrating from RFC 822 to
X.400(1988) messaging services is essential before any rational
decisions on migration can occur. Certainly one, if not the main,

issue in such a migration is that the migration must allow a
transition period where maximum functionality between both services
exists. Any migration must be aware that RFC 822 messaging services
are a 'moving target'.

- Ease of transition as perceived by an RFC 822 user mandates
  that the user's existing mail folders are converted into the
  new mail product's folder system flawlessly.

- The RFC 822's user's e-mail address should remain the same
  even after a migration. (i.e., the user keeps the same address
  that has two different notation forms: X.400 and RFC 822).

- Users contemplating a migration will be stimulated to do so
  if they experience no loss of service as regards MIME and
  X.400(1988) gatewaying; are still able to insert RFC 822
  style addresses into the X.400(1988) UA and are provided with
  high performance X.400-to-RFC 822 gateways.

- The added connectivity provided by X.400(1984 or 1988)
  gateways to fax, telex, post etc. plus additional X.400 users
  that the user is able to reach easily (whilst not losing
  connectivity to RFC 822 addresses) plus the additional
  functionality of X.400(1988) possible when communicating with
  X.400(1988) users will also act as a stimulant to a
  migration.

- The functionality provided by RFC 822 / MIME products will
  be the yardstick that an RFC 822 user compares an offered
  X.400(1988) product with. As such X.400(1988) products must
  provide some basic and important functions like: Character
  Set support via GeneralText; Multimedia capability via
  Extended Body Parts; low message delays within the seconds
  time scales and ease of configuration of products. At present
  there is no RFC 822 equivalent to X.400 delivery and receipt
  notifications and as such these functions are seen as extra
  functionality by the user.

- A follow on to the extra functionality point above is that
  present RFC 822 users, most likely commercial users, that
  want to be able to use EDI or other mail enabled applications
  that need security, message audits and positive confirmations
  will be encouraged to migrate to X.400(1988). A decision to
  use X.400(1988) in this case would be especially attractive
  for those commercial RFC 822 users that are already operating
  multiple lower layer networks. As X.400(1988) accommodates
  multiple different network layers easily, the cost to migrate
  could be considered quite small.

6.3. X.400(1984) services

A number of problems can be identified in a migration from
X.400(1984) to X.400(1988). They are summarised as,

- OSI supporting layers are mandatory in the ISO10021 MOTIS
  standard, while the support of the complete OSI stack (normal
  mode) is optional in the otherwise equivalent CCITT
  X.400(1988) specifications. It is thus recommended that the
  migration from X.400(1984) should be straight to ISO 10021
  i.e., straight to use of the full OSI stack with normal mode
  RTS.

- There is a negative impact on quality of service caused by
  implementation decisions related to the 'General Extension
  Mechanism'. To overcome this negative impact no minimal
  X.400(1988) MTAs, which relay the syntax but understand none
  of the semantics of extensions, should be used.

- All X.400(1988) MTAs should generate reports containing the
  extensions that are present in the original message and route
  such reports through the DL expansion hierarchy where
  appropriate.

- Choice of standards to be used within mixed X.400(1984 and
  1988) management domains needs to accommodate in one option
  the danger of undetectable routing loops from incorrectly
  configured routing entries and in another option the problem
  that systems that have fixed the routing loop problem may not
  all be consistently implemented due to ambiguities within the
  standards. The choice of which of these two options a
  management domain uses internally has no impact on external
  management domains.

- DDA support is needed by X.400(1984) systems to address
  X.400(1988) Common Name Attribute users [2].

- Minimum loss of service quality mandates that downgrading of
  X.400(1988) body parts to X.400(1984) bodyparts be done
  according to the MIMEMHS specifications [4].

- To enhance connectivity to both X.400(1984 and 1988)
  management domains without degradation of X.400(1988)
  service, management domain entry points that support both
  X.400(1984 and 1988) are recommended.

- Ensuring that no X.400(1988) MTAs transit via X.400(1984)
  MTAs. This allows no degradation of X.400(1988) service
  quality [17].

The consequence of the last point is that the existing European
Research X.400(1984) - formerly COSINE MHS - MTA RELAY backbone
should be one of the first MTA communities to migrate to X.400(1988).

6.4. Mail-11 services

The Mail-11 (also known as DECnet mail) e-mail service is the major
e-mail service used within the High Energy Physics and Space Physics
Analysis Networks (i.e., HEPnet and SPAN) and is the native e-mail
service present on VMS operating systems. The Mail-11 service is
considered the most popular service by the large HEPnet / SPAN
community. Mail-11 provides also large and easy to use gateways to
other E-mail protocols, like X.400 (84), RFC 822 (SMTP over TCP/IP,
DECnet and X.25, BSMTP over NJE), and PC LAN E-mail services.

Jointly with the "old style" Mail-11 UA, the DECnet Phase V (OSI
CLNS) service provides the native capability to run X.400 (88) and
X.400(1984) services. There is thus the potential for X.400 (88)
services to become available as soon as the HEPnet / SPAN community
migrates to DECnet Phase V. However the availability of VMS based UAs
for the X.400(1988) service is still very limited and is thus forcing
users to continue to stay with their Mail-11 UA (and thus the Mail-11
service).

Users in HEPnet / SPAN are demanding enhancements to their mail
services to support multimedia and delivery / read receipt services.
This is a strong driving factor for good X.400(1988) UAs to become
available soon to allow users to properly use the available
X.400(1988) service of DECnet Phase V.

7. Benefits of migrating to X.400(1988) and the involved costs

The actual as compared to the potential benefits of migrating from
one's existing mail system to a new mail protocol is very dependent
on good products, good organisation of the migration and a degree of
commitment that the transition is worth the cost. Quantifiable and
accurate cost / benefit ratios for such a migration are not possible
within the decentralised European R&D environment and as such are not
generated.

We have in this chapter listed the benefits that such a migration to
X.400(1988) achieves. We have also given an indication of the
relative costs of such a migration. Provided that there are good
products, and taken in conjunction with the recommendations of

Chapter 8 and Appendices A and B, the task force is confident that these potential benefits will translate into actual benefits and be worth the costs incurred.

Benefits

Below is a list of non-technically oriented benefits and the features of X.400(1988) that enable these benefits to occur. The benefit of,

- efficient and innovative communication within Europe is assisted by establishing an X.400(1988) messaging service that integrates European industry, government and academia;

- an increase in business efficiency by the use of EDI (for example automatic processing of business forms, exchange of business contracts, etc.) is enhanced by the security aspects of X.400(1988) i.e., non-repudiation, authentication, confidentiality, integrity plus secure access between MHS components.

- allowing European users to communicate in their native European languages is brought about by the GeneralText body part of X.400(1988).

- remote users and Small and Medium size Enterprises(SME) using e-mail for electronic commerce is encouraged by reducing the entry level costs for use of e-mail. An SME's use of Remote UAs in conjunction with a service provider's MS -instead of purchasing their own MTA - is accommodated by X.400(1988).

- providing global messaging for all e-mail users, but recognising the existing market realities of heterogeneous e-mail systems, would be enhanced by the establishment of gateways to X.400(1988).

- being able to recover costs by charging and accounting for messaging services back to users - this is especially important for commercial service providers - is brought about by the message auditing capabilities of X.400(1988).

- communication with users that have no access to E-mail (for example if such users are defined within Distribution Lists) is enhanced by X.400(1988)'s support for gateways to physical delivery, fax, telex, teletex, etc.

- building upon the existing X.400(1984) infrastructure (i.e.,
  reduction of establishment costs) is brought about by
  migrating the X.400(1984) infrastructure to X.400(1988).

- a reduction in manpower (and thus costs) to manage a global
  messaging service is brought about by the messaging service's
  ability to utilise the global distributed directory for
  management information.

- the messaging infrastructure to meet new user requirements
  is enhanced by the support for General Extensible Mechanism.

- making E-mail more user friendly is brought about by a
  messaging service that allows the use of the more natural
  directory names in E-mail addresses.

- increased effectiveness of messaging by the use of DLs is
  brought about by X.400(1988)'s support of powerful nesting
  capabilities and management for DLs.

- an increase in global message delivery performance and
  reliability is enhanced by the ability of X.400(1988) to use
  X.500 for MTA routing.

- more messages being successfully delivered to mobile or
  transient users is enhanced by the provision of the Message
  Store.

- multimedia use is enhanced by the ability to define new body
  parts and to support multiple types of binary data such as
  audio and video.

- establishing optimum and seamless conversion of messages
  based upon the capabilities of a user is brought about by the
  ability of X.400(1988) to act upon UA capabilities.

Costs

   The generic costs to establish an X.400(1988) pilot service can be
   broken down into:

      - a cost per backbone of RELAY MTAs (as used by the European
        research community - the former Cosine MHS service),
      - a cost per service provider,
      - a cost per organisation,
      - a cost per user and
      - a cost per user MTA for migrating to X.400(1988).

To bring about the benefits, mentioned above, certain costs will be
incurred and they are summarised below:

- Cost per backbone of RELAY MTAs (as used by the European
  research community - the former Cosine MHS service)

    - The equipment costs of migrating backbone RELAY MTAs.

    - The establishment of some sort of organisational /
      project group to oversee a backbone RELAY MTA pilot.

  As most of the RELAY MTAs are already X.400(1988) capable, there
  is already a MHS Co-ordination service in place that could be used
  for this function and the number of backbone RELAY MTAs is less
  than 100 in number the cost for migrating the RELAY MTA backbone
  is considered relatively low.

- Cost per service provider

    - If the RELAY MTA backbone (formerly Cosine MHS) is
      migrated towards X.400(1988), then the remaining cost
      for a service provider for migrating the infrastructure
      towards X.400(1988) is relatively low.

    - The operational costs for organisational issues, for
      example dealing with OID registrations, is low if
      national R&D service providers act as a clearinghouse
      for their own national R&D institutions e.g.,
      Universities.

- Cost per organisation, end user and MTA

    - The operational costs of migrating end users and their
      MTAs in management domains to X.400(1988) are higher
      than the costs involved with migrating the
      infrastructure. This is due to the order of at least 10
      to 100 times more MTAs, as compared to the service
      providers, that would be involved with a migration to
      X.400(1988). As the infrastructure needs to migrate
      first, the costs for the end user MTAs can be reduced
      by profiting from the migration experience of the
      service providers.

    - The education and training costs for users and system
      managers are significant, due to the amount of end
      users and end user MTAs. Any marginal cost savings per
      user which can be made, e.g., by deployment of automated
      tools, should be considered due to the large overall

savings that accrue.

- The costs of any potential disruption of the end user's messaging service are high - due to the huge numbers of end users involved - and as such only a very well managed, phased and planned migration should be considered.

- Software costs

- The costs for software development are outside the scope of this report. However it is clear that cost needs to be incurred in order to provide software that is easy to install and use. As a result of the work of the task force a list of possibly needed components and likely changes to existing components can be proposed,

Modifications, but not new developments, to software for:

- X.400(1988) MTAs, X.400(1988) UAs, DSAs, DUAs and MSs.

New software developments for:

- MIME to MHS Gateways, X.400(1988) network management, mailbox conversion, PC LAN directory synchronisation, PC LAN gateways and UA capability registration.

- The distribution costs for any new software (for the European R&D community) are low if usual academic distribution methods - FTP servers, E-mail Based servers, Gopher, World Wide Web and Archie - are used.

Summary

Migration towards a X.400(1988) service needs to evolve from the inside (the messaging backbone) outward (to the end user MTAs and end users themselves). Due to the numbers involved both the costs and the benefits associated with the migration increase as the migration evolves towards the end users.

The benefits of migrating to a X.400(1988) service are a feature rich well defined open standard with high functionality , scalability, use of directory, multimedia and secure messaging capability. The costs for migrating a RELAY MTA backbone can be considered relatively low whilst the migration of end user MTAs and the migration of the end

users themselves are relatively high. These costs should of course be
balanced against the cost of a disrupted service that one might get
if no migration occurs at all and the current service (e.g.,
X.400(1984)) reaches the limits of its scalability and/or
functionality.

It is important to realise that if end users themselves do not
experience direct feedback of the benefits from X.400(1988), this may
make the organisational motivation needed to effect such a migration
difficult to achieve. In effect, the establishment of a pilot
X.400(1988) service is and should be driven by the requirements of
end users and thus achieving end user benefits - as listed above -
must be given a higher priority within a X.400(1988) service than
solely the extra service provider benefits.

8. Main Recommendations

The RARE WG-MSG Task Force on 'The Establishment of an X.400(1988)
Pan European Pilot Messaging Service' has identified a number of high
level recommendations for establishing such a
 service. The main high level recommendations are listed within this
chapter. A more detailed elaboration of these main recommendations is
given in Appendix A. Appendix A is provided for policy makers wishing
more background on the main recommendations. As well, a list of very
detailed guidelines, plus some issues requiring further
investigation, is given in Appendix B. Appendix B will be especially
useful for personnel seeking detailed technical guidelines which are
consistent with the main high level recommendations.

Recommendations

   - Establish a X.400(1988) pilot service encompassing European
     Commercial, Government and Academic bodies. Such a pilot
     service to be co-ordinated by using an industry forum where
     all parties could meet. The use of an existing forum, where
     user organisations are well represented, is desirable if
     commercial end users organisation's requirements are to be
     met. The forum should also be open to non-European
     participants.

   - X.400(1988) end user services should be provided as well as
     a X.400(1988) backbone RELAY MTA service within a X.400(1988)
     pilot service. The end user services should be given a high
     priority.

   - Help an already emerging market place in X.400(1988)
     products to prosper by ensuring that a suitable supply of
     high quality X.400(1988) public domain software is available.

The Internet has proven, that public domain software, free of
any commercial restrictions, is further rapidly developed, by
Small and Medium Size Enterprises (SMEs), into derivative
products suitable for the commercial market.

- Any pilot service should be well co-ordinated and result
  driven but utilise a distributed market oriented approach. It
  is considered very difficult to organise and plan such a
  pilot under the assumption of a single centrally funded body
  i.e., driven from the 'top'. A more 'market driven' or
  distributed organisation is considered feasible, and likely
  to succeed, if all the market 'players' are fully involved
  i.e., a 'bottom' up approach.

- For the academic community - and ever more for the
  commercial community - there is a business need to ensure near
  total and 'perfect' integration with the existing and also
  evolving RFC 822 based services.

- For the academic community a rapid migration of the existing
  X.400(1984) backbone RELAY MTAs, used within the European R&D
  X.400(1984) service, - formerly the COSINE MHS service - is
  considered urgent. This migration will provide a 'bootstrap'
  path for academic organisations to internationally pilot
  X.400(1988) services. Such end user piloting is not
  considered feasible if X.400(1984) backbone RELAY MTAs are
  used for an X.400(1988) service (see Reference [17] for
  technical details).

The report does not include any recommendations on development and
deployment of RFC 822 / MIME / PEM related (pilot) services, as these
are outside of the scope of the Task Force. However, since both
X.400(1988) and RFC 822 / MIME / PEM will be developed and used
within the European R&D community, such a pilot should also be
considered.

9. Security Considerations

Security issues are not discussed in this memo.

10. Reading List and Bibliography

   This section contains a list of relevant reference documents that can
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11. Terminology

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
EMA	Electronic Messaging Association
EN	European Norm
ENV	Draft EN, European functional standard
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force [20]
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
MHS-DS	Message Handling Systems use of Directory Service Working Group from the IETF
MIME	Multi-purpose Internet Mail Extensions (extensions to RFC 822) [6]
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
PEM	Privacy Enhanced Mail [10]
PRMD	Private Management Domain
RARE	Reseaux Associes pour la Recherche Europeenne
RFC	Request For Comments (series of Internet publications)
RFC 822	RFC describing Internet Message format for Electronic mail
RTR	RARE Technical Report (series of RARE publications)
RTS	Reliable Transfer Service
WG-MSG	RARE Working Group on Mail and Messaging

Appendix A - Elaboration on the main recommendations

   The main recommendations of the report are elaborated upon in more
   detail within this appendix.

      - In order to provide a globally pervasive messaging service,
        it is recommended to establish a well operated Pan-European
        X.400(1988) pilot backbone comprising MTAs and MSs,
        connecting partners within Industry, Commercial Service
        Providers, Academia and Public Bodies (CEC, National
        Governments, etc.). The pilot should be open to global
        participation.

      - In order to maintain the widest connectivity with the
        highest possible functionality, gateways should be installed
        that gateway between X.400(1988) and RFC 822/MIME. These
        gateways should follow the specifications of RFC 1327 [1] and
        RFC 1494 et al. [4]. Experience with these gateways should be
        fed back into the appropriate RARE and IETF Working Groups to
        improve the standards.

      - In order that the 'business needs' of non-R&D organisations
        can be inserted at an early stage into the goals of the pilot
        and ensuring that the success of the pilot in meeting these
        goals can be measured and disseminated i.e., to encourage the
        active participation of non-R&D organisations within the
        pilot, it is recommended that an open forum comprising
        industry, service providers, public bodies and academia
        should be used. Preferably an existing forum where end users
        are heavily involved is desirable.

      - In order for meaningful co-operation between bodies affected
        by the pilot to occur and thus hopefully reducing unnecessary
        duplications, it is recommended that there are close liaisons
        and contacts between at least the IETF, RARE, EARN, EUnet,
        RIPE, Y-NET, EEMA, EMA, EWOS, OIW, CEN/CENELEC, ISO, CCITT,
        CEC and European governmental bodies and those involved
        within the pilot. The suggested mechanism for a meaningful
        liaison is that enough participants of the above
        organisations attend the common forum mentioned above. It is
        also suggested that as much as possible e-mail distribution
        lists be used to communicate between forum participants.

      - In order that the pilot have measurable results, it is
        recommended that the pilot shall be implemented in phases. It
        is considered that at least two phases are needed:

        - phase 1 - initial short start up phase with a small
          number of participants. The result of this phase is
          that any needed procedures, co-ordination mechanisms,
          etc. are put into place for the large scale piloting of
          phase 2.

        - phase 2 - phase with a wide Pan-European participation.
          The result of this phase should be a proof of scaling
          of the pilot X.400(1988) service i.e., the goals of the
          pilot as defined in Chapter 1 are met. It is expected
          that upon successful completion of this phase a natural
          evolution to a global deployment of a X.400(1988)
          service will have started.

   - In order to rapidly complete phase 1 of the pilot and that
     the pilot is at least Pan-European in scope, it is
     recommended that; a number of R&D service providers, one each
     from several European countries; at least 2 North American
     R&D service providers; at least 1 Japanese R&D service
     provider and a small number of commercial service providers
     and commercial organisations are actively involved in phase
     1.

   - In order to stimulate the creation of an economically viable
     market place for X.400(1988) products (i.e., MTAs, UAs, etc.)
     (i.e., users are willing to purchase such products), it is
     recommended that a suitable minimum number of new software
     implementations and or modifications to existing software
     implementations be funded. The resulting software to be
     inserted into the Public Domain free of any financial
     restrictions on further commercial exploitation. By using
     this mechanism, Small and Medium Size Enterprises (SMEs) will
     be encouraged to commercially exploit such products.

   - Due to the strong influence of the R&D community within the
     pilot plus the desire to produce standardised products
     quickly and pragmatically, it is recommended that any
     standards proposed within the scope of an X.400(1988) pilot
     (for example standards re: character sets and body parts
     gatewayed to and from X.400(1988) and RFC 822 / MIME) are
     conformant to and candidates for Internet standardisation. As
     a concrete example of the standardisation process, this means
     that at least two independent software implementations, for
     each product category, (of which one product preferably in
     the Public Domain) must be proven as interworking to a
     proposed standard before the proposed standard can be
     elevated to draft standard [20].

- To ensure that there is a market driven demand for
  X.400(1988) products within the commercial market place, it
  is recommended that the maximum number of Public Domain
  implementations that are funded, by any one public funding
  organisation, is two. It is desirable that at least one other
  product, preferably commercially based and not within the
  Public Domain, is produced.

- In order that any necessary information required for the
  effective operation of the X.400(1988) pilot, including not
  least OID assignments, mapping rules, information about
  interconnection partners, naming authority information be
  made widely available, it is recommended that an
  electronically accessible information base be established.

- In order that any necessary organisational issues needed for
  a deployment of an X.400(1988) service have a body in place
  to deal with this issue, it is recommended that the pilot
  either identify and list which bodies are responsible for
  which issues or else actively ensure that a suitable body is
  being put in place.

Appendix B - A number of detailed guidelines.

   The Task Force has the following detailed guidelines:

Product and operational service guidelines

- To ensure that there is no degradation of X.400(1988)
  service between X.400(1988) originators and destinations, the
  topology of the MTS must be such that no X.400(1984) MTA acts
  as a relay between any two X.400(1988) users.

- As the existing R&D X.400(1984) service (formerly COSINE
  MHS) now comprises a large number of X.400(1988) capable
  RELAYs, it would be relatively straight forward that the
  existing COSINE MHS RELAYs be one of the first communities
  that are migrated to X.400(1988) capabilities. This would
  ensure that X.400(1988) MTAs using the RELAY backbone
  experience no loss of service.

- To be able to operate an X.400(1988) service a properly
  operated X.400(1988) infrastructure should be established,
  consisting of X.400(1988) MTAs, X.400(1988) MTAs with
  downgrading capabilities according to RTR 3, Message Store
  services and gateways to RFC 822 based upon RTR 2 and
  extended gatewaying functionality for multimedia mail.

- To ensure maximum use of the OSI supporting layers plus
  support of normal mode RTS, it is recommended that a
  migration to ISO 10021 is effected i.e., straight to use of
  the full OSI stack with normal mode RTS.

- To ensure maximum quality of service as impacted by
  implementation decisions related to the 'General Extension
  Mechanism', it is recommended that no minimal X.400(1988)
  MTAs, which relay the syntax but understand none of the
  semantics of extensions, should be used.

- It is recommended that all X.400(1988) MTAs should generate
  reports containing extensions copied from the subject message
  and route reports through the DL expansion hierarchy where
  appropriate.

- It is recommended that all X.400(1984) UAs are able to
  generate and display DDAs. This will allow such systems to
  address X.400(1988) Common Name Attribute users.

- To enhance connectivity to both X.400(1984 and 1988)
  management domains without degradation of X.400(1988)
  service, management domain entry points that support both
  X.400(1984 and 1988) are recommended.

- To ensure total connectivity between RFC 822 domains
  migrating to X.400(1988), it is recommended that a local
  X.400-to-RFC-822 gateway is made operational or a reliable
  service agreement for the external provision of such a
  gateway is effected before any migration begins.

Migration utilities needed

- It is considered very helpful if conversion utilities that
  allow a flawless conversion of an RFC 822 user's existing
  mail folders to a X.400(1988) product's folder system be
  implemented. However further investigation is needed before
  recommending that such tools be made a mandatory part of any
  funded software development.

- It is recommended that the ease of configuration of
  X.400(1988) products is made as automatic as possible.
  Consideration should be given to a) modern user interfaces b)
  automatic processing of 'old RFC 822' configuration files
  into the 'new X.400(1988)' configuration files i.e., a reuse
  of the user's previous options and configurations should be
  the result. If a 'simple' configuration interface is needed
  it should be as compatible as possible with the present RFC

822 mailer's i.e., this concretely means editing of ASCII
files.

Issues for further study

The pilot X.400(1988) messaging service must ensure that the issues
listed below are either being investigated by an appropriate body or
if not initiate actions to properly address them. The issues have
been grouped under Products, Organisational and Deployment.

- Products

    - Any X.500 DSAs, DUAs, APIs e.g., LDAP, etc. changes
      needed to support X.400(1988) messaging.

    - X.400(1988) MTAs, UAs, MSs, gateways to RFC 822/MIME
      and X.400(1984) plus gateways to other messaging
      systems e.g., Microsoft Mail, Lotus cc:Mail, etc.

    - User Interfaces that integrate X.400(1988) UAs and
      X.500 DUAs with user applications such as Word
      Processors, etc.

    - E-mail network management software both for users and
      administrators

- Organisational

    - trusted network for security (i.e., the distribution of
      security keys) and whether this trusted network should
      or can be the same as the PEM trusted network presently
      under deployment.

    - usage of PEM within X.400(1988).

    - PEM to and from X.400(1988) gatewaying.

    - how to register and publicise object IDs for
      X.400(1988).

    - addresses are well publicised of PRMD and ADMD
      registration authorities.

    - creation and modification authority for X.400-to-RFC-
      822 mapping rules is defined.

    - creation and modification authority for MTA routing
      rules is defined.

- what methods should be used to liaison to other bodies like IETF, ISO, EEMA, EMA, etc.

- ensuring that any Public Domain software needed for the X.400(1988) service is distributed widely, quickly and efficiently.

- Deployment

- which services should start such a migration (i.e., COSINE MHS RELAYs, Universities, other).

- the topology of the X.400(1988) MTS.

- addressing of users between X.400(1984 and 1988) and RFC 822 e.g., how will X.400(1988) T.61 address components be processed by X.400(1984) and RFC 822 systems.

- which X.400(1988) body parts MUST be supported by the research community.

- if any new APIs - or modified APIs - are needed for X.400(1988) and messaging in general.

- the specifications and development of any needed Public Domain software.

- what existing Public Domain software should be modified to accommodate X.400(1988) systems.

- how rapidly to deploy the X.400(1988) service.

- ensuring that there is 'little or no loss of service' in any migration from X.400(1984), or RFC 822, to X.400(1988).

- considering what Value Added Services, based upon X.400(1988), could be started to encourage uptake of X.400(1988).

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