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ESnet Site Coordinating Committee (ESCC)
Energy Sciences Network (ESnet)

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Recommendations for the Phase I Deployment of OSI Directory Services (X.500) and OSI Message Handling Services (X.400) within the ESnet Community

Status of this Memo

This memo provides information for the Internet community. It does not specify an Internet standard. Distribution of this memo is unlimited.

Overview

The Energy Sciences Network (ESnet) is a nation-wide computer data communications network managed and funded by the United States Department of Energy, Office of Energy Research (U.S. DOE/OER), for the purpose of supporting multiple program, open scientific research. ESnet is intended to facilitate remote access to major Energy Research (ER) scientific facilities, provide needed information dissemination among scientific collaborators throughout all ER programs, and provide widespread access to existing ER supercomputer facilities.

Coordination of ER-wide network-related technical activities over the ESnet backbone is achieved through the ESnet Site Coordinating Committee (ESCC). This committee is comprised of one technical contact person from each backbone site, as well as some members of the ESnet management and networking staff. As the need for new levels of ESnet services arise, the ESCC typically creates task forces to investigate and research issues relating to these new services. Each task force usually results in a whitepaper which makes recommendations to the ESnet community on how these services should be deployed to meet the mission of DOE/OER.

This RFC is a near verbatim copy of the whitepaper produced by the ESnet Site Coordinating Committee's X.500/X.400 Task Force.

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ESnet Site Coordinating Committee X.500/X.400 Task Force

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Status of this Document

This document makes recommendations for the Phase I deployment of OSI Directory Services and OSI Message Handling Services within the ESnet Community. This document is available via anonymous FTP on the ESnet Information Server (nic.es.net, 128.55.32.3) in the directory [ANONYMOUS.ESNET-DOC] in the file ESNET-X500-X400-VERSION-1-1.TXT. The distribution of this document is unlimited.

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The following individuals have participated in and contributed to the ESCC X.500/X.400 Task Force. Several of these individuals have also authored portions of this document. See Appendix H for additional information regarding task force members and contributing authors.

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1. Introduction

1.1. Abstract and Introduction

This document recommends an initial approach for the Phase I deployment of OSI Directory Services (X.500) and OSI Message Handling Services (X.400) within the ESnet community. It is anticipated that directly connected ESnet backbone sites will participate and follow the suggestions set forth in this document.

Section 7 of the "ESnet Program Plan" (DOE/OER-0486T, dated March 1991) cites the need for further research and investigation in the areas of electronic mail and directory services. The ESCC X.500/X.400 Task Force was created to address this need. Additionally, the task force is addressing the issues of a coordinated, interoperable deployment of OSI Directory Services and OSI Message Handling within the entire ESnet community. Since only a small subset of this community is actively pursuing these avenues, considerable effort must be made to establish the necessary "base" to build upon. If directly connected ESnet sites participate in these services, a consistent transition path will be ensured and the services provided will be mutually valuable and useful.

X.500 and X.400 are continuously evolving standards, and are typically updated every four years. U.S. GOSIP (Government OSI Profile) Requirements are updated to define additional functionality as needed by the U.S. Federal Government, usually every two years. As the X.500 and X.400 standards evolve and U.S. GOSIP Requirements are extended, consideration must be given as to the effect this may have on these existing services in the ESnet community. At these cross-roads, or when a sizeable increase in service functionality is desired, another "phase of deployment" may be in order. In this sense, there isn’t a specific "final phase" goal, but rather several new releases (updates) to the level of existing services.

1.2. Structure of this Document

X.500 is presented first. The issues of DSA (Directory Service Agent) deployment, DSA registration, naming schema, involvement in the PSI White Pages Pilot Project, recommended object classes, recommended attribute types, information security, search optimization, user friendly naming and update frequency are addressed.

In the area of X.400, issues relating to MTA (Message Transfer Agent) deployment, ESnet X.400 well-known entry points, ESnet backbone site X.400 well-known entry points, MTA registration, naming hierarchy, PRMD peering, bidirectional X.400-SMTP relaying and

private/commercial X.400 routing are discussed.

Finally, the issues in name registration with ANSI (American National Standards Institute), GSA (General Services Administration) and the U.S. Department of Commerce, Patent and Trademark Office (PTO) are discussed.

2. X.500 - OSI Directory Services

2.1. Brief Tutorial

X.500 is a CCITT/ISO standard which defines a global solution for the distribution and retrieval of information (directory service). The X.500 standard includes the following characteristics: decentralized management, powerful searching capabilities, a single global namespace, and a structured framework for the storage of information. The 1988 version of the X.500 standard specifies four models to define the Directory Service: the Information Model, the Functional Model, the Organizational Model and the Security Model. As is the nature of International standards, work continues on the 1992 X.500 standard agreements.

The Information Model specifies how information is defined in the directory. The Directory holds information objects, which contain information about "interesting" objects in the real-world. These objects are modeled as entries in an information base, the Directory Information Base (DIB). Each entry contains information about one object: ie, a person, a network, or an organization. An entry is constructed from a set of attributes each of which holds a single piece of information about the object. For example, to build an entry for a person the attributes might include "surname", "telephoneNumber", "postalAddress", "rfc822Mailbox" (SMTP mail address), "mhsORAddresses" (X.400 mail address) and "facsimileTelephoneNumber". Each attribute has an attribute syntax which describes the data that the attribute contains, for example, an alphanumeric string or photo data. The OSI Directory is extensible in that it defines several common types of objects and attributes and allows the definition of new ones as new applications are developed that make use of the Directory. Directory entries are arranged in a hierarchical structure, the Directory Information Tree (DIT). It is this structure which is used to uniquely name entries. The name of an entry is its Distinguished Name (DN). It is formed by taking the DN of the parent’s entry, and adding the the Relative Distinguished Name (RDN) of the entry. Along the path, the RDNs are collected, each naming an arc in the path. Therefore, a DN for an entry is built by tracing the path from the root of the DIT to the entry.

The Functional Model defines how the information is stored in the

directory, and how users access the information. There are two components of this model: the Directory User Agent (DUA), an application-process which interacts with the Directory on behalf of the user, and the Directory System Agent (DSA), which holds a particular subset of the Directory Information Tree and provides an access point to the Directory for a DUA.

The Organizational Model of the OSI Directory describes the service in terms of the policy defined between entities and the information they hold. The model defines how portions of the DIT map onto DSAs. A Directory Management Domain (DMD) consists of one or more DSAs, which collectively hold and manage a portion of the DIT.

The Security Model defines two types of security for Directory data: Simple Authentication (using passwords) and Strong Authentication (using cryptographic keys). Authentication techniques are invoked when a user or process attempts a Directory operation through a DUA.

2.2. Participation in the PSI White Pages Pilot Project

The PSI White Pages Pilot Project is currently the most well-established X.500 pilot project within the United States. For the country=US portion of the DIT, PSI currently has over 80 organization names registered. Of these, several are ESnet-related.

The PSI White Pages Pilot Project is also connected to the Pilot International Directory Service, PARADISE. This pilot project interconnects X.500 Directory Services between Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and Yugoslavia. The combined totals for all of these countries (including the United States) as of December 1991 are:

DSAs:	301
Organizations:	2,132
White Pages Entries:	581,104

Considering the large degree of national, and international, connectivity within the PSI White Pages Pilot Project, it is recommended that directly connected ESnet backbone sites join this pilot project.

2.3. Recommended X.500 Implementation

Interoperability testing has not been performed on most X.500 implementations. Further, some X.500 functions are not mature standards and are often added by implementors as noninteroperable

extensions.

To ensure interoperability for the entire ESnet community, the University College London's publicly available X.500 implementation (QUIPU) is recommended. This product is known to run on several UNIX-derivative platforms, operates over CLNS and RFC-1006 (with RFC-1006 being the currently recommended stack), and is currently in wide-spread use around the United States and Europe, including several ESnet backbone sites.

Appendix C contains information on how to obtain QUIPU.

A later phase deployment of X.500 services within the ESnet community will recommend products (either commercial or public domain) which pass conformance and interoperability tests.

2.4. Naming Structure

As participants in the PSI White Pages Pilot Project, ESnet backbone sites will align with the naming structure used by the Pilot. This structure is based upon a naming scheme for the US portion of the DIT developed by the North American Directory Forum (NADF) and documented in RFC-1255. Using this scheme, an organization with national standing would be listed directly under the US node in the global DIT. Organizations chartered by the U.S. Congress as well as organizations who have alphanumeric nameforms registered with ANSI are said to have national standing. Therefore, a backbone site which is a national laboratory would be listed under country=US:

@c=US@o=Lawrence Livermore National Laboratory

As would a site with an ANSI-registered organization name:

@c=US@o=National Energy Research Supercomputer Center

A university would be listed below the state in which it is located:

@c=US@st=Florida@o=Florida State University

And a commercial entity would be listed under the city or state in which it is doing business, or "Doing Business As", depending upon where its DBA is registered:

@c=US@st=California@o=General Atomics
(or)
@c=US@st=California@l=San Diego@o=General Atomics

A list of the current ESnet backbone sites, and their locations, is

provided in Appendix E.

Directly connected ESnet backbone sites will be responsible for administering objects which reside below their respective portions of the DIT. Essentially, they must provide their own "Name Registration Authority". Although this may appear as an arduous task, it is nothing more than the establishment of a procedure for naming, which ensures that duplicate entries do not occur at the same level within a sub-tree of the DIT. For example, the Name Registration Authority for MIT could create an Organizational Unit named "Computer Science". This would appear in the DIT as:

@c=US@st=Massachusetts@o=MIT@ou=Computer Science

Similarly, all other names created under the "@c=US@st=Massachusetts@o=MIT" portion of the DIT would be administered by the same MIT Name Registration Authority. This ensures that every Organizational Unit under "@c=US@st=Massachusetts@o=MIT" is unique. By default, each ESnet Site Coordinator is assumed to be the Name Registration Official for their respective site. If an ESnet Site Coordinator does not wish to act in this capacity, they may designate another individual, at their site, as the Name Registration Official.

2.4.1. Implications of the Adoption of RFC-1255 by PSI

The North American Directory Forum (NADF) is comprised of commercial vendors positioning themselves to offer commercial X.500 Directory Services. The NADF has produced several documents since its formation. The ones of notable interest are those which define the structure and naming rules for the commercially operated DIT under country=US. Specifically, for an Organization to exist directly under c=US, it must be an organization with national-standing. From pages 12-13 of RFC-1255, national-standing is defined in the following way:

> "An organization is said to have national-standing if it is chartered (created and named) by the U.S. Congress. An example of such an organization might be a national laboratory. There is no other entity which is empowered by government to confer national-standing on organizations. However, ANSI maintains an alphanumeric nameform registration of organizations, and this will be used as the public directory service basis for conferring national-standing on private organizations."

Thus, it appears that National Laboratories (e.g. LBL, LLNL) are considered organizations with national-standing. However, those ESnet backbone sites which are not National Laboratories may wish to

register with ANSI to have their organization list directly under c=US, but only if this is what they desire. It is important to note that NADF is not a registration authority, but a group of service providers defining a set of rules for information sharing and mutual interoperability in a commercial environment.

For further information on registering with ANSI, GSA or the U.S. Patent and Trademark office, refer to Section 4 of this document. For more information on PSI, refer to Appendix A.

2.4.2. Universities and Commercial Entities

Several of the ESnet backbone sites are not National Laboratories (e.g. CIT, FSU, GA, ISU, MIT, NYU, UCLA and UTA). Typically, at these sites, a small collection of researchers are involved in performing DOE/OER funded research. Thus, this set of researchers at a given site may not adequately represent the total X.500 community at their facility. Additionally, ESnet Site Coordinators at these facilities may not be authorized to act as the Name Registration Official for their site. So the question is, how do these sites participate in the recommended Phase I deployment of ESnet X.500 services. There are two possible solutions for this dilemma:

1. If the site is not currently operating an X.500 DSA, the ESnet Site Coordinator may be able to establish and administer a DSA to master the DOE/OER portion of the site's local DIT, e.g. "@c=US@st=<st>@o=<site>@ou=Physics". Before attempting this action, it would be prudent for the Site Coordinator to notify or seek approval from some responsible entity. At such time that the site wishes to manage its own organization within the X.500 DIT, the ESnet Site Coordinator would have to make arrangements to put option 2 into effect.

2. If the site is currently operating an X.500 DSA, the ESnet Site Coordinator may be able to work out an agreement with the current DSA administrator to administer a portion of the site's local DIT which would represent the DOE/OER community at that site. For example, if the site were already administering the organization "@c=US@st= Massachusetts@o=Massachusetts Institute of Technology", the ESnet Site Coordinator might then be able to administer the organizational unit "@c=US@st=Massachusetts@o=Massachusetts Institute of Technology@ ou=Physics".

2.4.3. Naming Structure Below the o=<site> Level

The structure of the subtree below the organization's node in the DIT is a matter for the local organization to decide. A site's DSA

manager will probably want to enlist input from others within the organization before deciding how to structure the local DIT.

Some organizations currently participating in the Pilot have established a simple structure, choosing to limit the number of organizational units and levels of hierarchy. Often this is done in order to optimize search performance. This approach has the added benefit of insulating the local DIT from administrative restructuring within the organization. Others have chosen to closely model their organization's departmental structure. Often this approach seems more natural and can enhance the information obtained from browsing the Directory.

Below are experiences from current DSA managers, describing the way they structured their local DIT and the reasons for doing so. A site may find this information helpful in determining how to structure their local DIT. Ultimately this decision will depend upon the needs of the local organization and expectations of Directory usage.

Valdis Kletnieks of the Virginia Polytechnic Institute:

> "For Virginia Tech, it turned out to be a reasonably straightforward process. Basically, the University is organized on a College/Department basis. We decided to model that "real" structure in the DIT for two major reasons:
>
> "(a) It duplicates the way we do business, so interfacing the X.500 directory with the "real world" is easier.
>
> "(b) With 600+ departmental units and 11,000+ people (to be 30,000+ once we add students), a "zero" (everybody at top) or "one" deep (600 departments at top) arrangement just didn't hack it - it was deemed necessary that you be able to do a some 120 or 140 county office entries under the Extension service, it's a BIT unwieldy there). However, with some 20 college-level entries at the top, and the "average" college having 30 departments, and the "average" department being from 10 to 40 people, it works out pretty well."

Jeff Tannehill of Duke University:

> "Our DIT is flat. We get the entire database of people at Duke from Tel-Com and just put everyone directly under "O=Duke University".
>
> "Actually, there is an exception, when the DSA was first set up and we had not received a database yet, I configured the DIT to include "OU=Computer Science", under which myself and one other

System Administrator have entries. Upon getting the database for everyone else I decided not to attempt to separate the people in the database into multiple ou's."

Joe Carlson of Lawrence Livermore National Laboratory:

"We tried both flat (actually all under the same OU) and splitting based on internal department name and ended up with flat. Our primary reason was load and search times, which were 2-3 times faster for flat organization."

Paul Mauvais of Portland State University:

"We originally set up our DIT by simply loading our campus phone book into one level down from the top (e.g. OU=Faculty and Staff, OU=Students, OU=Computing Services).

"I'd love to have an easy way to convert our flat faculty and staff area into departments and colleges, but the time to convert the data into the separate OU's is probably more than I have right now."

Mohamed Ellozy of Dana-Farber Cancer Institute:

"Here we have a phone database that includes department, so we got the ou's with no effort. We thus never went the flat space way."

Dan Moline of TRW:

"Well - we're still in the process of defining our DIT. TRW comes under the international companies DBA. Our part under the PSI White Pages Pilot defines the DIT for our space and defense organization here in Redondo Beach (however, I organized the structure to adhere to TRW corporate). We input from our manpower DB for our S&D personnel. We're trying to get corporate's DB for possible input.

"However, arranging your DIT by organizations (at least for corps) presents a problem; things are always being reorganized! We were DSO now we're SSO!!! We still have some of our old domain name for DNS tied to organizations that have not existed for years!

"So we are currently redesigning our DIT to try to fit NADF 175 (something more geographically). Our reasoning was that organizations may change but buildings and localities do not."

Ruth Lang of SRI:

> "There has been no SRI-wide policy or decision to participate in the PSI White Pages Pilot. @c=US@O=SRI International supports the information for one OU only (i.e., a local policy and decision). In order to not give the false impression that all SRI information was contained under this O=SRI International, I used OU=Network Information Systems Center. If I were to structure the DIT for all of SRI, I'm sure that my thinking would yield a much different structure."

Russ Wright of Lawrence Berkeley Laboratory:

> "Since we don't have much organizational information in current staff database, I have to stick to a fairly flat structure. I have two OUs. One is for permanent staff, the other is for guests (there is a flag in our database that is set for guests).
>
> "I may add an additional level of OUs to our current structure. The top level would contain different 'types' of information. For example, one OU may be 'Personnel', another may be called publications). Staff and Guests would reside under the Personnel OU."

Peter Yee of NASA Ames:

> "I broke up my DIT at the NASA Center level. NASA is made of nearly 20 Centers and Facilities. The decision to break up at this level was driven by several factors:
>
> "1. Control of the local portion of the DIT should reside with the Center in question, particularly since the Center probably supplies the data in question and controls the matching DSA.
>
> "2. Each Center ranges in size from 1,000 to 16,000 persons. This seems to be the range that works well on moderate sized UNIX servers. Smaller would be a waste, larger would require too much memory.
>
> "3. Representatives from several Centers have contacted me asking if they could run their own DSAs so that they can experiment with X.500. Thus the relevant DSA needs to be under their control."

2.5. Information Stored in X.500

The Phase I deployment of X.500 should be limited to "white pages"-

type information about people. Other types of objects can be added in later Phases, or added dynamically as the need arises.

To make X.500 truly useful to the ESnet community as a White Pages service, it is recommended that the following minimum information should be stored in the X.500 database:

Information	ASN.1 Attribute Type	Example
Locator Info	commonName	Allen Sturtevant
	surname	Sturtevant
	postalAddress	LLNL P.O. Box 5509, L-561 Livermore, CA 94551
	telephoneNumber	+1 510 422 8266
	facsimileTelephoneNumber	+1 510 422 0435
E-Mail Info	rfc822Mailbox	Sturtevant@es.net
	mhsORAddresses	/PN=Allen Sturtevant/O=NERSC/ /PRMD=ESnet/ADMD= /C=US/
	otherMailbox	DECnet: ESNIC::APS

The above list of attributes comprises a minimum set which is recommended for a person's entry. However, you may chose to omit some attributes for reasons of privacy or legality. Note that the X.500 standard requires that the surname and commonName attributes be present. If an individual's phone number and/or address cannot be provided, they should be replaced by the site's "Information Phone Number" and postal address to allow some means of contacting the person.

2.5.1. Information Security

It is understood that placing this type of information in X.500 is equivalent to putting the "Company Phone Book" on-line in the Internet. Different sites may treat this information differently. Some may view it as confidential, while others may view this data as open to the public. In any case, it was recommended that ESnet sites discuss the implications with their respective legal departments before actually making their information openly available. There currently exists minimal access control in several X.500 implementations.

2.6. Accessing the X.500 Directory Service

The PSI White Pages Pilot Project software provides numerous interfaces to the information in the X.500 Directory. Non-interactive access mechanisms (e.g. WHOIS, FINGER and Electronic

Mail) make use of capabilities or services which already reside on many workstations and hosts. Such hosts could immediately take advantage of the X.500 service with no additional software or reconfiguration needed. However, since these methods are non-interactive, they only provide a way to search for and read information in the Directory but no way to modify information.

2.6.1. Directory Service via WHOIS

The Pilot Project software allows you to configure the X.500 Directory service to be made available via a network port offering an emulation of the SRI-NIC WHOIS service. UNIX-based hosts and VMS hosts running Multinet typically come configured with the WHOIS service. Users at their workstations would then be able to issue a simple WHOIS command to a known host running a DSA to retrieve information about colleagues at their site or at other ESnet sites. For example, the command:

```
whois -h wp.lbl.gov wright
```

will return information about Russ Wright at Lawrence Berkeley Lab. It is recommended that all sites which bring up such a service, should provide an alias name for the host running their DSA of the form <wp.site.domain> for consistency within the ESnet community.

2.6.2. Directory Service via Electronic Mail

The Pilot Project software also allows the X.500 Directory service to be made available via electronic mail. A user who sends an electronic mail message to a known host running a DSA containing a WHOIS-like command on the subject line, would then receive a return mail message containing the results of their query.

2.6.3. Directory Service via FINGER

The X.500 Directory service could also be made available via the FINGER service. Although this access method does not come with the PSI Pilot Project software, several sites have already implemented a FINGER interface to the X.500 Directory. For ease of use and consistency, a single FINGER interface should be selected, then individual implementations within the ESnet community should conform to this interface.

2.6.4. Directory Service via Specialized Applications

Many X.500 Directory User Agents (DUAs) are widely available. Some of these come with the PSI Pilot Project software. Other DUAs, which have been developed by third parties to fit into the pilot software,

are publicly available. These user agents support interactive access to the X.500 Directory allowing browsing, searching, listing and modifying data in the Directory. However, in most cases, use of these DUAs requires the Pilot Project software be installed on the host system. Only a few of these DUAs and their capabilities are described below.

- o DISH - A User Agent which provides a textual interface to the X.500 Directory. It gives full access to all elements of the Directory Access Protocol (DAP) and as such may be complex for novice users. DISH is most useful to the DSA administrator.

- o FRED - A User Agent which has been optimized for "white pages" types of queries. The FRED program is meant to be similar to the WHOIS network service. FRED supports reading, searching, and modifying information in the X.500 Directory.

- o POD - An X-windows based User Agent intended for novice users. POD relies heavily on the concept of the user "navigating" around the DIT. Pod supports reading and searching. There are no facilities to add entries or to modify the RDNs of entries, though most other entry modifications are allowed.

2.6.5. Directory Service from PCs and MACs

Smaller workstations and personal computers lack the computing power or necessary software to implement a full OSI protocol stack. As a consequence, several "light-weight" protocols have been developed whereby the DAP runs on a capable workstation and exports a simpler interface to other end-systems. One such "light weight" protocol, the Directory Assistance Service (DAS), is incorporated in the PSI Pilot Project software. Another "light weight" protocol, DIXIE, was developed at the University of Michigan. Publicly available User Agents for both the MAC and PC have been developed using the DA-service and the DIXIE protocol. So long as you have the Pilot Project software running on one host, you can provide these User Agents on many end-systems without having to install the Pilot software on all those end-systems.

For further information about available Directory User Agents, see RFC-1292, "Catalog of Available X.500 Implementations".

2.7. Services Provided by ESnet

Currently, there are several ESnet backbone sites which are operating their own DSAs within the PSI White Pages Pilot Project. It is anticipated that directly connected ESnet backbone sites will eventually install and operate their own X.500 DSAs. In the interim,

ESnet will provide complete support for ESnet backbone sites which presently do not have the time, expertise or equipment to establish X.500 services. The mechanism for doing this is described in Section 2.7.5 below. Additionally, ESnet will provide a variety of services in support of the entire X.500 community. These are also described in the following sections.

2.7.1. X.500 Operations Mailing List

ESnet maintains a mailing list for the discussion of relevant X.500 topics. This mailing list provides a means for sharing information, experiences, and expertise about X.500 in the ESnet community. New sites joining the ESnet X.500 community will be announced on the mailing list. New DSA administrators will be able to solicit help from more experienced administrators. When a site brings up a new X.500 DSA, the DSA manager should notify the ESnet DSA manager so as to ensure they are promptly added to the mailing list.

```
General discussion:  x500-ops@es.net
To subscribe:        x500-ops-request@es.net
```

2.7.2. Accessing the X.500 Directory

ESnet has made the X.500 service openly available to the entire ESnet community via each of the access methods described in Section 2.6 above. Host WP.ES.NET provides TELNET access, FINGER and WHOIS emulations, querying via electronic mail, as well as remote access via light-weight protocols. By making these services widely available, we hope to acquaint more users with the features and capabilities of X.500.

To try out some of the X.500 User Agents, simply TELNET to WP.ES.NET and login as user "fred"; no password is required. You have the choice of running the Fred or Pod User Agents. Fred provides a command line interface while Pod provides an X-windows based interface. You can browse through the global X.500 DIT, search for persons in various organizations, and even modify your own entry if you have one.

Host WP.ES.NET also provides access to the X.500 Directory via emulations of the FINGER and WHOIS utilities. These interfaces support a user-friendly-naming (UFN) scheme that simplifies the syntax necessary to search for persons in other organizations. The following WHOIS command lines illustrate searching for persons at various ESnet sites, utilizing the UFN syntax (similar FINGER command lines could also be constructed):

```
whois -h wp.es.net leighton,nersc
whois -h wp.es.net servey,doe
whois -h wp.es.net logg,slac
whois -h wp.es.net "russ wright",lbl
```

For further information about User Friendly Naming, see Steve Hardcastle-Kille's working document titled, "Using the OSI Directory to Achieve User Friendly Naming".

2.7.3. Backbone Site Aliases

As ESnet backbone sites join the X.500 pilot, their organizations' entries will be placed in various parts of the DIT. For example, National Laboratories will be placed directly under the c=US portion of the DIT, while universities and commercial entities will most likely be placed under localities, such as states or cities.

In order to facilitate searching for the ESnet community as a whole, ESnet backbone sites will also be listed as organizational units under the node "@c=US@o=Energy Sciences Network". These entries will actually be aliases which point to the site's "real" organizational entry. Therefore, ESnet backbone sites will be listed in two different places in the DIT and one could search for them in either location.

2.7.4. Multiprotocol Stack Support

OSI applications currently run over many different transport/network protocols, a factor which hinders communication between OSI end nodes. In order to facilitate communication, the ISODE may be configured at compile time to support any combination of the following stacks:

```
RFC-1006 over TCP/IP
TP0      over X.25
TP0      over X.25 (84)
TP0      over the TP0-bridge
TP4      over CLNP
```

Within the ESnet community, the stacks of interest are RFC-1006 over TCP/IP, TP4 over CLNP, and TP0 over X.25. If a backbone site's DSA is not running over all three of these stacks, it may eventually receive referrals to a DSA that it can not connect to directly, so the operation can not proceed. Since the ESnet DSAs will be configured to operate over all of the "stacks of interest," they can serve as relay DSAs between site DSAs that do not have direct connectivity. The site's DSA manager will need to contact the ESnet DSA manager to arrange for this relaying to occur. Backbone sites

will be encouraged to eventually provide as many of the three stacks of interest as possible.

2.7.5. Managing a Site's X.500 Information

For sites which do not initially wish to operate their own DSA, ESnet's DSA will master their site's portion of the DIT, enabling the site to join the PSI Pilot Project and the ESnet X.500 community. In order to accomplish this, the site must provide the ESnet DSA manager with information about the people to be included in the X.500 Directory. This information can usually be obtained from your Site's Personnel Database.

ESnet will only maintain a limited amount of information on behalf of each person to be represented in the Directory. The attribute types listed in the table in Section 2.5 show the maximum amount of information which the ESnet DSA will support for a person's entry in the Directory. This set of attribute types is a small subset of the attribute types offered by the PSI Pilot Project software. Therefore, if a site wishes to include additional attribute types, they should consider installing and operating their own DSA.

The format of the information to be provided to the ESnet DSA manager is as follows: the data should be contained in a flat, ASCII text file, one record (line) per person, with a specified delimiter separating the fields of the record. More detailed information and a sample of a site-supplied data file can be found in Appendix D.

2.7.5.1. Open Availability of Site Information

Although the PSI Pilot Project allows you to control who may access Directory objects and their attributes, any information you provide about persons at your site to be stored in the ESnet DSA will be considered world readable. This policy is necessary in order to minimize the administrative cost of managing potentially many organizational objects within the ESnet DSA. If your site decides that it does not wish to have certain information about its employees publicly known (e.g. work telephone number) then you should not provide this information to the ESnet DSA manager or you should consider installing and administering your own DSA.

2.7.5.2. Access Methods for Local Users

Backbone sites which choose the option of having the ESnet DSA master their organization's X.500 information should make the availability of the X.500 service known to their local users. All of the methods described in Section 2.7.2 are available for use, but none of these methods will assume the query is relative to the local site.

To facilitate querying relative to the local environment, the site will need to make one host available to run the emulation of the FINGER service. Although the resulting query will ultimately be directed to the remote ESnet DSA, the search will appear to be local to the users at that site. For example, a user on a workstation at site XYZ could type the following, omitting their local domain name as this is implied:

```
finger jones@wp
```

This will retrieve information about user Jones at site XYZ (wp is the name or alias of a host at site XYZ, i.e. wp.XYZ.GOV). The site coordinator will need to contact the ESnet DSA manager to arrange the set up for this service.

2.7.5.3. Limitations of Using ESnet Services

Since the ESnet DSA will potentially be mastering information on behalf of numerous backbone sites, limits will need to be placed on the volume of site information stored in the ESnet DSAs. These are enforced to ensure DSA responsiveness, as well as to reduce administrative maintenance. The limits are:

Item	Maximum Limit
X.500 Organizations	1
Organizational Units	50
Organizational Unit Depth	3
Object Entries	5,000
Update Frequency	1 Month
Aliases	n/a
Object/Attribute Access Control	n/a

One week before each monthly update cycle, a message will be sent on the x500-ops@es.net mailer to remind the sites that an update cycle is approaching. If no changes are required to the site information, the reminder message can be ignored and the existing version of this information will be used. If the information is to be updated, a complete replacement of all information must be supplied to the ESnet DSA manager before the next update cycle. More detailed information and a sample of a site-supplied data file can be found in Appendix D.

2.8. ESnet Running a Level-0 DSA for c=US

For ESnet to provide high quality X.500 services to the ESnet community, the ESnet DSAs must operate as Level-0 (first level) DSAs. It is currently planned that these DSAs will act as slave, Level-0 DSAs to PSI’s master, Level-0 DSAs. Once the ESnet DSAs are in

production service, it is recommended that directly connected ESnet backbone sites operating their own X.500 DSAs configure them with one of the ESnet DSAs as their parent DSA. This provides several advantages to the ESnet community:

1. The ESnet DSAs will be monitored by the NERSC's 24-hour Operations Staff. Additionally, ESnet plans to deploy two (2) DSAs in geographically disperse locations to ensure reliability and availability.

2. All queries to Level-0 DSAs remain within the ESnet high-speed backbone.

3. If network connectivity is lost to all external Level-0 DSAs, X.500 Level-0 connectivity will still exist within the ESnet backbone.

2.9. X.500 Registration Requirements

X.500 organization names must be nationally unique if they appear directly below the c=US level in the DIT structure. Nationally unique names must be registered through an appropriate registration authority, i.e., one which grants nationally unique names.

X.500 organizational unit names need to be unique relative to the node directly superior to them in the DIT. Registration of these names should be conducted through the "owner" of the superior node.

The registration of X.500 names below the organization level are usually a local matter. However, all siblings under a given node in the DIT must have unique RDNs.

See Section 4 for a more complete description of OSI registration issues and procedures.

2.10. Future X.500 Issues to be Considered

2.10.1. ADDMDS Interoperating with PRDMDS

This is a problem which currently does not have an answer. The issue of Administrative Directory Management Domains (ADDMDs) interacting with Private Directory Management Domains (PRDMDs) is just beginning to be investigated by several groups interested in solving this problem.

2.10.2. X.400 Interaction with X.500

The current level of understanding is that X.400 can benefit from the

use of X.500 in two ways:

1. Lookup of message recipient information.

2. Lookup of message routing information.

X.400 technology and products, as they stand today, do not support both of these features in a fully integrated fashion across multiple vendors. As the standards and technology evolve, consideration will have to be given in applying these new functions to the production ESnet X.500/X.400 services environment.

2.10.3. Use of X.500 for NIC Information

Work is currently being performed in the IETF to place NIC information on-line in an Internet-based X.500 service.

2.10.4. Use of X.500 for Non-White Pages Information

The PSI White Pages Pilot Project has caused increasing and popular use of X.500 as a white pages services within the Internet community. However, the X.500 standard provides for much more than just this service. Application processes, devices and security objects are just a few of the objects to be considered for future incorporation in the global X.500 database.

2.10.5. Introduction of New X.500 Implementations

Thought will have to be given to the use of commercial X.500 products in the future as QUIPU (the implementation recommended in this paper) may not meet all of the needs of the ESnet community. As commercial products mature and become stable, they will have to be incorporated into the ESnet X.500 service in a way which ensures interoperability and reliability.

2.10.6. Interaction of X.500 and DECdns

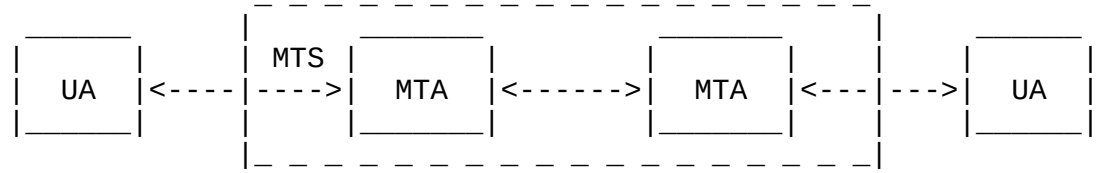
There is every indication that DECdns and X.500 will interoperate in some fashion in the future. Since there is an evolving DECdns namespace (i.e. OMNI) and an evolving X.500 DIT (i.e. NADF), some consideration should be given to how these two name trees will interact. All of this will be driven by the Digital Equipment Corporation’s decisions on how to expand and incorporate its DECdns product with X.500.

3. X.400 - OSI Message Handling Services

3.1. Brief Tutorial

In 1984 CCITT defined a set of protocols for the exchange of electronic messages called Message Handling Systems (MHS) and is described in their X.400 series of recommendations. ISO incorporated these recommendations in their standards (ISO 10021). The name used by ISO for their system was MOTIS (Message-Oriented Text Interchange Systems). In 1988 CCITT worked to align their X.400 recommendations with ISO 10021. Currently when people discuss messaging systems they use the term X.400. These two systems are designed for the general purpose of exchanging electronic messages in a store and forward environment. The principle use being made of this system today is to support electronic mail. This section will give an overview of X.400 as used for electronic mail. In the following sections, the term X.400 will be used to describe both the X.400 and MOTIS systems.

The basic model used by X.400 MHS is that of a Message Transfer System (MTS) accessed via a User Agent (UA). A UA is an application that interacts with the Message Transfer System to submit messages on behalf of a user. A user is referred to as either an Originator (when sending a message) or a Recipient (when receiving one). The process starts out when an Originator prepares a message with the assistance of their UA. The UA then submits the message to the MTS for delivery. The MTS then delivers the message to one or more Recipient UAs.



The MTS provides the general store-and-forward message transfer service. It is made up of a number of distributed Message Transfer Agents (MTA). Operating together, the MTAs relay the messages and deliver them to the intended recipient UAs, which then makes the messages available to the recipient (user).

The basic structure of an X.400 message is an envelope and content (i.e. message). The envelope carries information to be used when transferring the message through the MTS. The content is the piece of information that the originating UA wishes delivered to the recipient UA. There are a number of content types that can be carried in X.400 envelopes. The standard user message content type defined by X.400 is called the Interpersonal (IP) message. An IP

message consists of two parts, the heading and body. The heading contains the message control information. The body contains the user message. The body may consist of a number of different body parts. For example one IP message could carry voice, text, Telex and facsimile body parts.

The Management domain (MD) concept within the X.400 recommendations defines the ownership, operational and control boundary of an X.400 administration. The collection consisting of at least one MTA and zero or more UAs owned by an organization or public provider constitutes a management domain (MD). If the MD is managed by a public provider it is called an Administration Management Domain (ADMD). The MD managed by a company or organization is called a Private Management Domain (PRMD). A Private MD is considered to exist entirely within one country. Within that country a PRMD may have access to one or more ADMDs.

Each MD must ensure that every user (i.e UA) in the MD has at least one name. This name is called the Originator/Recipient (O/R) Name. O/R Names are constructed from a set of standard attributes:

- Country Name
- Administration Management Domain
- Private Management Domain
- Organization Name
- Organizational Unit Name
- Surname
- Given name
- Initials
- Generational Qualifier

An O/R name must locate one unambiguous O/R UA if the message is to be routed correctly through the Message Transfer Service. Currently each MD along the route a message takes determines the next MD’s MTA to which the message should be transferred. No attempt is made to establish the full route for a message, either in the originating MD or in any other MD that acquires the store and forward responsibility for the message.

Messages are relayed by each MD on the basis of the Management domain

portion of their O/R Name until arrival at the recipient MD. At which point, the other attributes in the name are used to further route to the recipient UA. Internal routing within a MD is the responsibility of each MD.

3.2. ESnet X.400 Logical Backbone

Currently within the ESnet community message handling services are implemented with a number of different mail products, resulting in what is classically known as an "n-squared" problem. For example, let's say that LLNL only uses QuickMail on site, PPPL only uses MAIL-11 (VMS MAIL), and CEBAF only uses SMTP mail. For LLNL to send mail to PPPL and CEBAF, is must support MAIL-11 and SMTP locally on-site. Likewise for PPPL to send mail to LLNL and CEBAF, it must support MAIL-11 and QuickMail locally. Identically, this scenario exists for CEBAF.

To alleviate this problem, a logical X.400 backbone must be established through out the entire ESnet backbone. Then, each ESnet backbone site will be responsible for only providing connectivity between it's local mail domains (QuickMail, MAIL-11, SMTP Mail, or even native X.400) and the logical X.400 backbone. One of the long-term goals is to establish X.400 as the "common denominator" between directly connected ESnet backbone sites.

3.3. Naming Structure

The name-spaces for X.500 and X.400 are completely different and are structured to meet different needs. The X.500 name-space is typically organized to allow quick, optimized searching; while the X.400 ORname is used to forward an X.400 message through several "levels" of MTAs (X.400 Message Transfer Agents).

ESnet backbone sites will participate in the X.400 environment through one of two options; either participating in the ESnet Private Management Domain (PRMD) or operating a site PRMD. For most sites, utilizing the ESnet PRMD will be the simpler and preferable choice.

3.3.1. Participating in the ESnet Private Management Domain

ESnet backbone sites participating in the ESnet PRMD will have an X.400 name syntax as follows:

/.../O=<site>/PRMD=ESnet/ADMD= /C=US/

A few examples of a possible X.400 ORnames using the above syntax are:

/PN=Smith/OU=Computations/O=LLNL/PRMD=ESnet/ADMD= /C=US/
/PN=Jones/OU=Physics/O=PPPL/PRMD=ESnet/ADMD= /C=US/

These sites will operate an MTA at the /O=<organization> level in the name hierarchy.

3.3.2. Operating a Site Private Management Domain

ESnet backbone sites which operate a PRMD will have an X.400 name syntax as follows:

/.../O=<org>/PRMD=<site>/ADMD= /C=US/

A few examples of a possible X.400 ORnames using the above syntax are:

/PN=Smith/O=Computations/PRMD=LLNL/ADMD= /C=US/
/PN=Jones/O=Physics/PRMD=PPPL/ADMD= /C=US/

These sites will operate an MTA at the /PRMD=<PRMD> level in the name hierarchy. This MTA will peer with the ESnet PRMD MTA.

3.3.3. Detailed Name Structure

GOSIP places several limits on allowable ORnames. After the /O=<organization> name, up to four levels of /OU=<organizational_unit> names are allowed. The ORname string is then completed with the /PN=<personal_name> field.

All ORname fields must use characters from the ISO printable character set. Additionally, the following name length restrictions apply:

PRMD Names	16 characters
Organization Names	64 characters
Organizational Unit Names	32 characters
Personal Names	64 characters

NOTE: A 40 character limit for Personal Names is now being studied by the CCITT.

Within these name constraints, the architecting of an organization’s name space is a local matter. Sites are encouraged to consider ease of use and stability when determining their naming structure.

3.4. X.400 Routing

In the IP environment a SMTP MTA could use the Domain Name Service

(DNS) to locate connection information for the host closest to the recipient. With X.400, MTAs must know the remote MTAs name and password along with connection information. This is because of access control requirements on some X.400 systems. In X.400 MHS this information will, at some future date, be provided by X.500. In the mean time the routing and connection process within the X.400 community is table driven. This solution requires a coordination and distribution effort to ensure a quick and reliable update of these tables.

The current thinking on the problem of X.400 routing is to decompose the X.400 address space into a hierarchy, with each node in this hierarchy representing the entry point for an X.400 domain. These nodes have been commonly called Well Known Entry Points (WEPs). Each of these WEPs represent one X.400 MHS domain. For example:

```
/O=LBL/PRMD=ESnet/ADMD= /C=US/
/O=NERSC/PRMD=ESnet/ADMD= /C=US/
/PRMD=ESnet/ADMD= /C=US/
/PRMD=ANL/ADMD= /C=US/
/PRMD=PNL/ADMD= /C=US/
```

To minimize the number of hops between Originators and Recipients it is the current recommendation of the X.400 community that every PRMD peer with all other PRMDs.

The ESnet backbone will provide connectivity between multiple PRMDs (the ESnet PRMD and any site operated PRMDs), each with associated well-know entry point MTAs. Each of these PRMD-level MTAs must be configured with routing and mapping information about each other to enable peer-to-peer PRMD routing. These routing tables should be updated immediately upon the discovery of new/changed X.400 connectivity information. These tables will be made available to the ESnet community via the ESnet Information Server. Once placed on-line, a notification message announcing the availability of this new routing information will be sent to every WEP owner via the E-mail mechanism described in Section 3.5.1. It is recommended that WEP administrators should retrieve this new routing information and update their MTAs within 10 working days.

The well-known entry point MTA for each PRMD can route down to an Organizational level MTA or laterally to the well-known entry point of a peer PRMD MTA.

For example, the ESnet MTA would route a message with the address:

```
/PN=Funk/OU=CS/O=PPPL/PRMD=ESnet/ADMD= /C=US/
```

to a well-known entry point for PPPL (O=PPPL). PPPL must own and operate their own X.400 MTA, and it must be configured to accept X.400 messages from the ESnet MTA. Thus, the interpretation of remaining "/PN=Funk/OU=CS" is left to the PPPL MTA to route.

Mail sent from PPPL's MTA would be routed to the ESnet's MTA (PRMD) to be eventually routed to its destination.

The ESnet MTA will also route to peer MTAs which are well-known entry points for other PRMDs (e.g. ESnet backbone site PRMDs, XNREN, Hughes Air Craft, NASA, CDC). For example, the ESnet MTA would route a message with the address:

/PN=Smith/OU=MS/O=RL/PRMD=PNL/ADMD= /C=US/

to a well-known entry point for PNL (PRMD=PNL). PNL must own and operate their own X.400 MTA, and it must be configured to accept X.400 messages from the ESnet MTA (as well as possibly other PRMDs). Thus, the interpretation of the remaining "/PN=SMITH/OU=MS/O=RL" is left to the PNL MTA to route.

Mail sent from PNL's MTA (PRMD) would be routed to the well-known entry point for the PRMD indicated in the destination address.

Additionally, a site operated PRMD must be able to route mail to any other peer-PRMD within the ESnet community.

3.4.1. Responsibilities in Operating an X.400 PRMD MTA

If the X.400 world were to operate exactly as the standard recommends, PRMDs would only peer with other PRMDs when connectivity is available and traffic demand is sufficient, and would utilize ADMD services to reach all other PRMDs. In reality, many PRMDs will not subscribe to an ADMD service and will only be reachable through PRMD peering.

Most communities, such as the ESnet, desire the fullest PRMD interconnectivity possible to minimize the need for ADMD services. Community PRMD operational requirements stem from a policy of achieving large scale peering among PRMD operators within the community.

Work is continuing in the IETF X.400 Operations Working Group to produce an RFC that specifies the operational requirements that must be implemented by X.400 Management Domains. "Requirements for X.400 Management Domains (MDs) Operating in the Global Research and Development X.400 Service", this document is listed in Appendix G. ESnet will comply with all the requirements outlined in this

document. It is the recommendation that all ESnet PRMDs follow the requirements specified in this document.

As an overview, this document specifies that each PRMD will provide at least one WEP and that all PRMDs must be interconnected. There are a number of PRMDs in the International X.400 service that have different communication stack requirements. For example:

	Stack 1	Stack 2	Stack 3	Stack 4
Transport Layer 4	TP0	TP4	RFC-1006	TP0
Network Service 1-3	X.25	CLNS	TCP/IP	CONS

To meet the requirement that all PRMDs must be interconnected a PRMD must support one or more of the above stacks. For stacks that are not supported the PRMD must negotiate with another PRMD or ADMD to relay messages to a Management Domain that does support the other stacks.

The PRMD requirements also suggest that PRMDs support downgrading of X.400 1988 to X.400 1984. Also, the PRMD must be reachable from the Internet Mail service. This means the PRMD must maintain an Internet Mail/X.400 gateway.

In all cases, members of the ESnet community who operate a PRMD should notify ESnet of the WEP and MTA information required to perform peering.

3.4.2. Responsibilities in Operating an X.400 Organizational MTA

ESnet will provide PRMD service to the ESnet community. ESnet will peer with the other PRMDs in the International X.400 service and provide a WEP for the ESnet community. An Organization/site needs to decide if they are going to comply with the above PRMD requirements or act as an organization associated to the ESnet PRMD. Minimally, an organizational MTA will only have to support one of the protocol stacks provided by it associated PRMD. But in all cases, the site will need to provide a WEP and register/list their MTA(s) with ESnet.

3.5. Services Provided by ESnet

ESnet will provide PRMD service to those members of the ESnet community who desire it. ESnet will peer with other PRMDs in the International community (e.g. XNREN, Hughes Air Craft, NASA, CDC) and provide a WEP for the ESnet community; the intent is to provide the fullest PRMD level X.400 services.

ESnet will deploy two, PRMD level, X.400 MTAs in geographically

disperse locations. These MTAs will be able to forward mail for directly connected ESnet backbone sites, as well as to and from the peered PRMDs.

3.5.1. X.400 Operations Mailing List

ESnet will provide an X.400 operations mailer for announcements and to allow the sharing of X.400 operational information in the ESnet community.

General discussion: x400-ops@es.net
To subscribe: x400-ops-request@es.net

3.5.2. MTA Routing Table on ESnet Information Server

ESnet will maintain forwarding information about ESnet community MTAs at the /PRMD=<PRMD> or /O=<organization> levels (depending on what level the site MTA is operating). This information will be available for use in configuring directly connected ESnet site operated MTAs. This information will be made available in a machine independent format on the ESnet Information Server.

3.5.3. MTA Routing Table Format

The ESnet staff will determine the details of information format, update frequency, obtaining, and disseminating the information based on operational experience and constraints.

3.5.4. Gateway Services and Multiprotocol Stack Support

The ESnet MTAs will minimally support bidirectional SMTP-X.400 mail gateway capabilities, and will operate over the OSI CLNS protocol (as defined by GOSIP) and RFC-1006 stacks. Configuration and operation of mail protocol gateway functions will be governed by the ESnet staff.

Backbone site MTAs which service ORnames at the /O=<site> level under the ESnet PRMD must utilize one of the ESnet PRMD supported protocol stacks. This requirement assures that all users of the ESnet PRMD will be able to communicate to one another via the ESnet PRMD MTA.

Backbone site MTAs which service ORnames in PRMDs other than /PRMD=ESnet must utilize the OSI CLNS stack for GOSIP conformance. Use of the RFC-1006 stack is optional. This requirement assures that all PRMDs in the ESnet community will be able to peer with the ESnet PRMD.

3.5.5. Registering/Listing your PRMD or Organizational MTA with ESnet

To provide for the connection and routing requirements in X.400 you will need to register/list your MTA with ESnet. This information will be maintained in tables on the ESnet Information Server. ESnet will also maintain information on the International X.400 service. ESnet will use the same format for information as maintained by the International X.400 service. This is described in detail in a IETF X.400 operations paper "Routing Coordination for X.400 MHS Services within a Multiprotocol/Multinetwork Environment". This paper is a working draft, see Appendix G. It describes a machine independent form for distribution of X.400 information.

There are three tables that must be maintained and exchanged by the top level WEPS.

1. The Community Document

2. The WEP Document

3. The Domain Document

ESnet will submit these documents to the International X.400 community on behalf of the ESnet Community. If an ESnet PRMD wishes to peer with the International PRMDs they will need to submit these documents to that community.

The Community document is used to list the central coordination point and file server where all MHS documents will be stored. It also lists the communication stacks used by the MHS community. This document will be submitted to the International X.400 service by ESnet for the ESnet Community. ESnet PRMDs and Organizations do not need to submit this form to ESnet. If an ESnet PRMD wishes to peer with the International X.400 service then they must submit this form to that community.

Each ESnet MHS domain will need to submit a WEP and Domain Document to ESnet. The WEP document is used to list the WEPs used by an ESnet MHS domain. It will contain all the information that is needed for MTA connection and access control. ESnet will submit the ESnet community WEP and Domain Documents to the International X.400 service. The WEP document consists of a list of WEPs, with the following information for each one:

- The MTA Name

- Password

- Which MTS supported
- Which standard, 84 and/or 88
- Connection information outbound
- Connection information inbound
- Computer system information
- Point of contact

The Domain Document specifies all the X.400 domains managed by a site. It indicates the person responsible and which WEP services which Domain. This document contains the following information repeated for each Domain:

- X.400 Domain
- Point of Contact
- Relaying WEP(s)

3.6. X.400 Message Routing Between ADMDS and PRMDS

While ESnet will provide X.400 routing service for systems, it cannot provide routing via commercial X.400 carriers at this time. The FTS-2000 charge for routing X.400 messages is $.45 (US) plus X.25 packet charges. This could result in a charge of several dollars for large messages, a real possibility with the multi-media capacity of X.400. The payment of this fee is not within the charter of ESnet and the provision of a charging mechanism to charge member sites is not currently contemplated.

3.7. X.400 Registration Requirements

It is recommended by the CCITT that all X.400 PRMD names be nationally unique. This is a current CCITT agreement and allows direct PRMD-PRMD peer routing. Since national uniqueness is required, registration should be performed through an appropriate registration authority (such as ANSI).

X.400 organization names must be unique within a PRMD. There is no need for national uniqueness. Registration of an X.400 organization name should be conducted through the PRMD operator.

The registration of X.400 names below the organization level are usually a local matter. Uniqueness within the context of a superior

name should always be maintained.

See Section 4 for a more complete description of OSI registration issues and procedures.

3.8. Future X.400 Issues to be Considered

3.8.1. X.400 Mail Routing to International DOE Researchers

Currently there are DOE researchers located in Switzerland, Japan, Germany, China and Brazil. PRMD level connectivity to these international locations does not exist presently. Since ESnet is not chartered to pay for commercial X.400 services on behalf of the ESnet community, "buying" this service is not a viable option.

There are efforts taking place to provide international X.400 service over the (international) Internet. Once this becomes fully operational, further research will have to be performed to see if this provides the X.400 connectivity needed to support the DOE researchers located abroad.

3.8.2. X.400 (1984) and X.400 (1988)

The ESnet MTAs will initially support the 1984 version of the X.400 standard. As the use of 1988 X.400 becomes more prevalent, support for the newer standard will need to be addressed. One important point, once the ESnet MTAs become 1988 X.400 compliant, they will also have so support "downgrading" to 1984 X.400 to ensure reliable X.400 mail delivery to the ESnet community.

3.8.3. X.400 Interaction with X.500

This is discussed in Section 2.10.2.

4. OSI Name Registration and Issues

Implementing OSI services requires that certain information objects (e.g., people, information processing systems and applications) must be unambiguously identifiable on a global basis. These objects may be defined by a variety of organizations, e.g., ISO/IEC, CCITT, commercial, and government.

To meet this requirement ISO/IEC and CCITT have established a hierarchical structure of names (a tree). The top level of the naming tree, shared by ISO and CCITT, represents the global naming-domain. Naming domains are managed by registration authorities. A registration authority can delegate authority for part of its naming-domain to another (lower level) registration authority, thus

forming the tree.

Each object can be given a unique and unambiguous name by registering the object's name with an OSI registration authority at an appropriate level in the naming tree.

OSI name registration authorities and their procedures are expected to change over time. Since names are intended to be stable, these changes (hopefully!) will have minimal impact on existing OSI name registrations.

This section describes the role of OSI registration authorities, the difference between a "registration" and a "notification", and sources of nationally unique names. Information about three OSI name registration authorities; the American National Standards Institute (ANSI), the General Services Administration (GSA), and the U.S. Department of Energy (U.S. DOE); are given.

Registration of a name often requires stating a "right" to that name. However, an OSI name registration does not guarantee legal name rights. Name rights should be reviewed by legal experts prior to registration. Information about the U.S. Department of Commerce, Patent and Trademark Office (PTO) (potentially useful in asserting or defending name rights) is given below.

4.1. Registration Authorities

OSI names are obtained through OSI name registration authorities by a registration process. The selection of which particular registration authority to use is determined by the desired level of the OSI name in the naming hierarchy, possible restrictions on the names allocated by each registration authority, and the applicability rules (will they service your request) of each registration authority.

An OSI name registration authority allocates OSI names from the particular naming-domain it controls. Every registration authority can trace its naming authority to its parent registration authority, and ultimately to the top (global) level of the naming hierarchy.

4.2. Registration Versus Notification

Registering an OSI name guarantees its uniqueness and lack of ambiguity. For a name to be useful however, other parties (besides the registration authority) will need to be notified of the name and its usage.

There is a clear distinction between registration (obtaining an OSI name) and notification (informing others of a name and its use).

Often the term "registration" is used to describe both activities, this is a potential source of confusion.

For example, NADF and PSI (see Section 2) are not OSI registration authorities. NADF may operate state registration authorities in the future, if delegated that administrative right by the states. PSI operates an X.500 pilot project and needs to be notified of registered names when organizations join their pilot.

X.400 ADMD operators are also not OSI registration authorities, although they accept notification of X.400 PRMD names used by their customers.

The PTO is not an OSI registration authority. PTO names have no meaning in an OSI context.

4.3. Sources of Nationally Unique Name Registration

There are four potential sources of nationally unique names which are of interest to the ESnet community. These are ANSI, GSA, U.S. DOE and the states. An overview of the ANSI, GSA, and U.S. DOE procedures are given in later sections.

In order to maintain national uniqueness "constructed name syntax" is used by GSA, U.S. DOE, and the states. The form of each name is shown below, "name" is the name presented to the registration authority for registration.

1. ANSI names are of the form "name".

2. GSA names are of the form "GOV+name".

3. U.S. DOE names are of the form "GOV+USDOE+name".

4. State names are of the form "CA+name" (using California).

State name registration authorities are not in operation at this time. The use of U.S. DOE as a nationally unique name registration source is not recommended due to the awkwardness of a double constructed name.

4.4. How to Apply for ANSI Organization Names

ANSI is the root U.S. source of OSI recognized nationally unique organization names. ANSI registration costs $2500 and results in both an alphanumeric name and an associated numeric name. These names may be used for a variety of purposes in X.400, X.500, and other OSI services.

For ANSI OSI organization name registration forms and instructions, you should send your request to:

American National Standards Institute, Inc.
Attn: Beth Somerville
OSI Registration Coordinator
11 West 42nd Street
New York, NY 10036
Phone: (212) 642-4976

ANSI registration procedures include a 90 day public review period during which name requests can be easily challenged.

There is a mechanism to forward ANSI requests to the GSA, it is discussed in the GSA section below.

4.5. How to Apply for GSA Organization Names

GSA is the registration authority for government use of GOSIP, their registration services are free for federal government organizations. Names assigned by GSA always begin with the characters "GOV+" and are limited to 16 characters. By agreement with ANSI, these GSA assigned names are national unique.

For GSA OSI Organization Name registration forms and instructions, you should send your request to:

General Services Administration
Office of Telecommunications Services
Registration Services, Room 1221-L KBA
18th and F Streets, N.W.
Washington, D.C. 20405

4.5.1. GSA Designated Agency Representatives

When preparing the GSA registration form a designated agency representative must sign where it says "Registration Official Name and Signature". GSA will refuse requests missing this signature.

The GSA designated Agency Representative for the Department of Energy is:

Steve Hackman
Electronics Engineer
U.S. Department of Energy
AD-241.3/GTN
Washington, D.C. 20585
Office Phone: (301) 903-6111
Office FAX: (301) 903-4125
E-Mail: hackman@gosip.xosi.doe.gov

4.5.2. Forwarding of ANSI Registrations to GSA

ANSI registration requests can be forwarded automatically to the GSA. This is the equivalent of registering with both ANSI and GSA. The result is two nationally unique OSI name registrations, "name" from ANSI and "GOV+name" from GSA.

There is no GOSIP requirement for GSA registration but many feel the additional GSA registration may be useful.

Assuming your organization is a federal government organization, answer the last three questions on the ANSI registration form as shown below:

1. Do you wish the information supplied in the request to remain confidential? NO.

2. Do you wish to have your organization name registered with the U.S. GOSIP Registration Authority (a.k.a. GSA)? YES.

3. Is your organization an organization of the Federal Government? YES.

You must indicate on the application form the approval of the GSA designated agency representative (Steve Hackman). He does not sign as "Signature of Requestor", but some notation of his approval must be attached or GSA will reject the forwarded application.

4.6. How to Apply for U.S. DOE Organization Names

ESnet sites are encouraged to review the DOE GOSIP procedures and guidelines in planning their GOSIP activities. This document does not conflict with current DOE GOSIP policies.

DOE can assign nationally unique names which are prefixed by the string "GOV+USDOE+". Use of this name source is not recommended; there is no apparent advantage in using U.S. DOE over GSA as a source of nationally unique names.

Copies of current U.S. DOE GOSIP policies, guidelines, and registration forms may be obtained through site DOE naming authorities or Steve Hackman.

4.7. Why Apply for a Trademark with the PTO?

Legal issues may arise concerning the rights to use a desired name. OSI name registrations are not intended to "legally protect" name usage rights; that is not their function.

Consultation with legal experts concerning the rights to use a name being registered is strongly advised, this recommendation does not offer specific legal guidance. Applying for a trademark may be considered as a means to assert or protect the rights to a name.

Per the PTO trademark application instructions there may be several benefits in obtaining a trademark.

- The filing date of the application is a constructive date of first use of the mark in commerce (this gives registrant nationwide priority as of the date).
- The right to sue in Federal court for trademark infringement.
- Constructive notice of claim of ownership.
- Limited grounds for attacking a registration once it is five years old.

4.8. How to Apply for a Trademark with the PTO

You should obtain a trademark application and detailed instructions from the U.S. Department of Commerce, Patent and Trademark Office. This can be done by mailing your request to the address below, or calling the PTO at the phone number below:

U.S. Department of Commerce
Patent and Trademark Office
Washington, D.C. 20231
Phone: (703) 557-INFO

NOTE: The following information is based on ESnet experience in filing for a trademark based on prior use.

After you receive your application, you will need to perform the following steps.

1. Complete the written application form. If you have more than

one name you are filing, you must complete a separate form for each name.

2. Provide a black-and-white drawing of the mark. In the case where there is no artwork, only text, the text must be centered on the page in uppercase.

3. Provide a check in the amount of $175 (for each application) made payable to the Commissioner of Patents and Trademarks.

4. Provide three specimens showing actual use of the mark on or in connection with the goods or services.

The class of goods/services associated with this trademark must be specified on the registration form. The currently defined classes of services are:

35 Advertising and business.
36 Insurance and financial.
37 Construction and repair.
38 Communication.
39 Transportation and storage.
40 Material treatment.
41 Education and entertainment.
42 Miscellaneous.

So, for example, there could be two (or more) "ESnet" trademarks, with each trademark associated with a different service class. Thus, trademarks are not nationally unique.

Before submitting your form, you should see if your trademark is already registered to someone else (for the service class you specified). This is typically done by your legal department through the PTO Trademark Search Library.

Since the PTO form is a legal document, you must involve your legal department and the documents may only be signed by someone who is a legally recognized representative of your organization. For example, in applying for the service mark "ESnet", the "Applicant Name" was "The Regents of the University of California", and the legally recognized representative was Dr. John Nuckolls, the director of the Lawrence Livermore National Laboratory.

4.9. Future Name Registration Issues to be Considered

4.9.1. ANSI Registered ADMD and PRMD Names

There are discussions in the ANSI and CCITT communities revolving

around the idea of having a formal registration of all ADMD and PRMD Names (not just ANSI Organization Names). The ideas being exchanged include having a separate ANSI national registry for these names, and having to pay a periodic "license" fee. This is just in the idea discussion phase now, but it may impact the cost of ANSI ADMD and PRMD Name registration in the near future.

Glossary

AA - See ADMINISTRATIVE AUTHORITY.

ADDMD - See ADMINISTRATIVE DIRECTORY MANAGEMENT DOMAIN.

ADMD - See ADMINISTRATION MANAGEMENT DOMAIN.

ADMINISTRATION - An Administration denotes a public telecommunications administration or other organization offering public telecommunications services.

ADMINISTRATION MANAGEMENT DOMAIN - An Administrative Management Domain (ADMD) is a management domain managed by an Administration; generally one of the common carriers (e.g. AT&T, MCI, U.S. Sprint, etc.).

ADMINISTRATIVE AUTHORITY - An entity which has administrative control over all entries stored within a single Directory System Agent (DSA).

ADMINISTRATIVE DIRECTORY MANAGEMENT DOMAIN - An Administrative Directory Management Domain (ADDMD) is a Directory Management Domain (DMD) which is managed by an administration.

AE - See APPLICATION ENTITY.

ALIAS - An entry of the class "alias" containing information used to provide an alternative name for an object.

ANSI - The American National Standards Institute. ANSI is the official representative of the United States to ISO.

AP - See APPLICATION PROCESS.

APPLICATION ENTITY - An application entity is the OSI portion of an Application Process (AP).

APPLICATION LAYER - The application layer is the portion of an OSI system ultimately responsible for managing communication between application processes (APs).

APPLICATION PROCESS - An application process is an object executing in a real system (computer).

APPLICATION SERVICE ELEMENT - An application service element (ASE) is the building block of an application entity (AE). Each AE consists of one or more service elements, as defined by its application context.

ASE - See APPLICATION SERVICE ELEMENT.

ATTRIBUTE - An attribute is the information of a particular type concerning an object and appearing in an entry describing that object in the Directory Information base (DIB).

ATTRIBUTE TYPE - An attribute type is that component of an attribute which indicates the class of information given by that attribute.

ATTRIBUTE VALUE - An attribute value is a particular instance of the class of information indicated by an attribute type.

BASE ATTRIBUTE SET - A minimum set of attributes whose values unambiguously identify a particular management domain.

BODY - The body of the IP-message is the information the user wishes to communicate.

CCITT - An international standards making organization specializing in international communications standards and chartered by the United Nations. "CCITT" is a french acronym meaning the International Telephone and Telegraph Consultative Committee.

CHAINING - Chaining is a mode of interaction optionally used by a Directory System Agent (DSA) which cannot perform an operation itself. The DSA chains by invoking the operation of another DSA and then relaying the outcome to the original requestor.

CLNP - The OSI Connectionless Network Protocol. CLNP’s use is required by GOSIP.

CONTENT - The piece of information that the originating User Agent (UA) wishes delivered to the recipient UA. For inter-personal messaging (IPM) UAs, the content consists of either an IP message or an IPM-status-report.

COOPERATING USER AGENT - A User Agent (UA) that cooperates with another recipient’s UA in order to facilitate the communication between originator and recipient.

DAP - See DIRECTORY ACCESS PROTOCOL.

DELIVERY - The interaction by which the Message Transfer Agent (MTA) transfers to a recipient User Agent (UA) the content of a message plus the delivery envelope.

DELIVERY ENVELOPE - The envelope which contains the information related to the delivery of the message.

DESCRIPTIVE NAME - A name that denotes one and only one user in the Message Handling System (MHS).

DIB - See DIRECTORY INFORMATION BASE.

DIRECTORY - The Directory is a repository of information about objects and which provides directory services to its users which allow access to the information.

DIRECTORY ACCESS PROTOCOL - The Directory Access Protocol (DAP) is the protocol used between a Directory user Agent (DUA) and a Directory System Agent (DSA).

DIRECTORY ENTRY - A Directory Entry is a part of the Directory Information Base (DIB) which contains information about an object.

DIRECTORY INFORMATION BASE - The Directory Information Base (DIB) is the complete set of information to which the Directory provides access and which includes all pieces of information which can be read or manipulated using the operations of the Directory.

DIRECTORY INFORMATION TREE - The Directory Information Tree (DIT) is the Directory Information Base (DIB), considered as a tree, whose vertices (other than the root) are the Directory entries.

DIRECTORY MANAGEMENT DOMAIN - A Directory Management Domain (DMD) is a collection of one or more Directory System Agents (DSAs) and zero or more Directory User Agents (DUAs) which is managed by a single organization.

DIRECTORY SYSTEM AGENT - A Directory System Agent (DSA) is an OSI application process which is part of the Directory.

DIRECTORY SYSTEM PROTOCOL - The Directory System Protocol (DSP) is the protocol used between two Directory System Agents (DSAs).

DIRECTORY USER - A Directory user is the entity or person that accesses the Directory.

DIRECTORY USER AGENT - A Directory User Agent (DUA) is an OSI application process which represents the user in accessing the Directory.

DISTINGUISHED NAME - The distinguished name of a given object is the sequence of relative distinguished names (RDNs) of an entry which represents the object and those of all of its superior entries (in descending order).

DIT - See DIRECTORY INFORMATION TREE.

DMD - See DIRECTORY MANAGEMENT DOMAIN.

DN - See DISTINGUISHED NAME.

DNS - See DOMAIN NAME SERVICE.

DOMAIN NAME SERVICE - A hierarchical, distributed naming service currently used in the Internet. DNS names typically take the form of <machine.site.domain>, where <.domain> may be ".COM", ".EDU", ".GOV", ".MIL", ".NET", ".ORG" or ".<country-code>".

DSA - See DIRECTORY SYSTEM AGENT.

DSP - See DIRECTORY SYSTEM PROTOCOL.

DUA - See DIRECTORY USER AGENT.

ENCODED INFORMATION TYPE - It is the code and format of information that appears in the body of an IP-message (examples of coded information types are Telex, TIFO (Group 4 Facsimile), and voice).

ENVELOPE - A place in which the information to be used in the submission, delivery and relaying of a message is contained.

FIPS - Federal Information Processing Standard. FIPS are produced by NIST and specify a standard for the federal government, most FIPS reference other formal standards from ANSI, IEEE, ISO or CCITT.

GOSIP - The Government Open System Interconnection (OSI) Profile. GOSIP is a FIPS which defines the elements of OSI to be required by government purchasers and how those elements should be implemented. GOSIP is based on OSI standards and OIW implementor’s agreements.

HEADING - The heading of an IP-message is the control information that characterizes an IP-message.

INTERPERSONAL MESSAGING - Interpersonal Messaging (IPM) is communication

between persons by exchanging messages.

INTERPERSONAL MESSAGING SERVICE - The set of service elements which enable users to exchange interpersonal messages.

INTERPERSONAL MESSAGING SYSTEM - An Interpersonal Messaging System (IPMS) is the collection of User Agents (UAs) and Message Transfer Agents (MTAs), which provide the Interpersonal Messaging Service.

IP - A non-OSI network protocol, the Internet Protocol, used extensively in the Internet. CLNP is the OSI alternative to IP.

IP-MESSAGE - An IP-message carries information generated by and transferred between Interpersonal Messaging (IPM) User Agents (UAs). An IP-message contains a Heading and a Body.

IPM - See INTERPERSONAL MESSAGING.

IPM-STATUS-REPORT - The pieces of information generated by an Interpersonal Messaging (IPM) User Agent Entity (UAE) and transferred to another IPM UAE, either to be used by that UAE or to be conveyed to the user.

IPMS - See INTERPERSONAL MESSAGING SYSTEM.

ISO - An international standards making organization which, among other things, develops OSI standards.

MANAGEMENT DOMAIN - The set of Message Handling System (MHS) entities managed by an Administration or organization that includes at least one Message Transfer Agent (MTA).

MD - See MANAGEMENT DOMAIN.

MESSAGE - In the context of Message Handling Systems (MHSs), the unit of information transferred by the Message Transfer System (MTS). It consists of an envelope and a content.

MESSAGE HANDLING ADDRESS - An Originator/Recipient (O/R) address which is comprised of an Administrative Management Domain (ADMD), a country name, and a set of user attributes.

MESSAGE HANDLING SYSTEM - The set of User Agents (UAs) plus the Message Transfer System (MTS).

MESSAGE TRANSFER AGENT - The functional component that, together with the other Message Transfer Agents (MTAs), constitutes the Message Transfer System (MTS). The MTAs provide message transfer service

elements by: (1) interacting with originating User Agents (UAs) via the submission dialogue, (2) relaying messages to other MTAs based upon recipient designations, and (3) interacting with recipient UAs via the delivery dialogue.

MESSAGE TRANSFER AGENT ENTITY - The Message Transfer Agent Entity (MTAE) is an entity, located in an MTA, that is responsible for controlling the Message Transfer Layer (MTL). It controls the operation of the protocol to other peer entities in the MTL.

MESSAGE TRANSFER LAYER - The Message Transfer Layer (MTL) is a layer in the Application layer that provides Message Transfer System (MTS) service elements. These services are provided by means of the services of the layer below plus the functionality of the entities in the layer, namely the Message Transfer Agent Entities (MTAEs) and the Submission and Delivery Entities (SDEs).

MESSAGE TRANSFER PROTOCOL - The Message Transfer Protocol (P1) is the protocol which defines the relaying of messages between Message Transfer Agents (MTAs) and other interactions necessary to provide Message Transfer layer (MTL) services.

MESSAGE TRANSFER SERVICE - The Message Transfer Service is the set of optional service elements provided by the Message Transfer System (MTS).

MESSAGE TRANSFER SYSTEM - The Message Transfer System (MTS) is the collection of Message Transfer Agents (MTAs), which provide the Message Transfer Service elements.

MHS - See MESSAGE HANDLING SYSTEM.

MTA - See MESSAGE TRANSFER AGENT.

MTAE - See MESSAGE TRANSFER AGENT ENTITY.

MTL - See MESSAGE TRANSFER LAYER.

MTS - See MESSAGE TRANSFER SYSTEM.

MULTICASTING - Multicasting is a mode of interaction which may optionally be used by a Directory System Agent (DSA) which cannot perform an operation itself. The DSA multicasts the operation (i.e. it invokes the operation of several other DSAs (in series or in parallel) and passes an appropriate outcome to the original requestor).

NAME - A name is a construct that singles out a particular object from

all other objects. A name must be unambiguous (i.e. denote just one object); however, it need not be unique (i.e. be the only name which unambiguously denotes the object).

NIST - The national institute of standards, a government organization which develops, endorses, and promulgates standards for use by the U.S. government.

O/R ADDRESS - See ORIGINATOR/RECIPIENT ADDRESS.

O/R NAME - See ORIGINATOR/RECIPIENT NAME.

OBJECT (OF INTEREST) - Anything in some "world", generally the world of telecommunications and information processing or some part thereof, which is identifiable (i.e. can be named), and which it is of interest to hold information on in the Directory Information Base (DIB).

OIW - The OSI Implementors workshop. OIW is one of three regional workshops (OIW, EWOS, AOW), which specifies implementation agreements for base OSI standards. OIW's participants are mostly from the Americas and the OIW is jointly sponsored by the IEEE (Institute of Electrical and Electronic Engineers) and NIST.

OPEN SYSTEMS INTERCONNECTION - A term referring to the capability of interconnecting different systems.

ORIGINATING USER AGENT - The Originating User Agent (UA) is a UA that submits to the Message Transfer System (MTS) a message to be transferred.

ORIGINATOR - A user, a human being or computer process, from whom the Message Handling System (MHS) accepts a message.

ORIGINATOR/RECIPIENT ADDRESS - A descriptive name for a User Agent (UA) that contains certain characteristics which help the Message Transfer System (MTS) to locate the UA's point of attachment. An Originator/Recipient (O/R) address is a type of O/R name.

ORIGINATOR/RECIPIENT NAME - The Originator/Recipient Name (O/R Name) is the descriptive name for a User Agent (UA).

OSI - See OPEN SYSTEMS INTERCONNECTION.

PRDMD - See PRIVATE DIRECTORY MANAGEMENT DOMAIN.

PRIMITIVE NAME - A name assigned by a naming authority. Primitive names are components of descriptive names.

PRIVATE DIRECTORY MANAGEMENT DOMAIN - A Private Directory Management Domain (PRDMD) is a Directory Management Domain which is managed by an organization other than an administration.

PRIVATE MANAGEMENT DOMAIN - A Private Management Domain (PRMD) is a management domain managed by a company or non-commercial organization.

PRMD - See PRIVATE MANAGEMENT DOMAIN.

RDN - See RELATIVE DISTINGUISHED NAME.

RECIPIENT - A user, a human being or computer process, who receives a message from the Message Handling System (MHS).

RECIPIENT USER AGENT - A User Agent (UA) to which a message is delivered or that is specified for delivery.

REFERRAL - A referral is an outcome which can be returned by a Directory System Agent (DSA) which cannot perform an operation itself, and which identifies one or more other DSAs more able to perform the operation.

RELATIVE DISTINGUISHED NAME - A Relative Distinguished Name (RDN) is a set of attribute value assertions, each of which is true, concerning the distinguished values of a particular entry.

RELAYING - The interaction by which one Message Transfer Agent (MTA) transfers to another MTA the content of a message plus the relaying envelope.

RELAYING ENVELOPE - The envelope which contains the information related to the operation of the Message Transfer System (MTS) plus the service elements requested by the originating User Agent (UA).

RFC - Request for Comments. The RFC’s are documents used to propose or specify internet community standards.

ROOT - The vertex that is not the final vertex of any arc is referred to as the root vertex (or informally as the root) of the tree.

SCHEMA - The Directory Schema is the set of rules and constraints concerning the Directory Information Tree (DIT) structure, object class definitions, attribute types, and syntaxes which characterize the Directory Information base (DIB).

SDE - See SUBMISSION AND DELIVERY ENTITY.

SMTP - Simple Mail Transfer Protocol. An e-mail protocol frequently used by the Internet community.

SUBMISSION - The interaction by which an originating User Agent (UA) transfers to a Message Transfer Agent (MTA) the contents of a message plus the submission envelope.

SUBMISSION AND DELIVERY ENTITY - The Submission and Delivery Entity (SDE) is an entity located in the Message Transfer Layer (MTL), co-resident with a User Agent (UA) and not with a Message Transfer Agent (MTA), and responsible for controlling the submission and delivery interactions with a Message Transfer Agent Entity (MTAE).

SUBMISSION AND DELIVERY PROTOCOL - The Submission and Delivery Protocol (P3) is the protocol which governs communication between a Submission and Delivery Entity (SDE) and a Message Transfer Agent Entity (MTAE).

SUBMISSION ENVELOPE - The envelope which contains the information the Message Transfer System (MTS) requires to provide the requested service elements.

TCP - A non-OSI transport protocol, the Transmission Control Protocol, used extensively in the Internet. TP4 is the OSI alternative to TCP.

TP0 - An OSI transport protocol specified by GOSIP and generally used with connection-oriented networks.

TP4 - An OSI transport protocol specified by GOSIP and generally used with connectionless networks such as CLNP.

TREE - A tree is a set of points (vertices), and a set of directed lines (arcs); each arc leads from a vertex V to a vertex V'. The vertices V and V' are said to be the initial and final vertices of an arc a from V to V'. In a tree, several different arcs may have the same initial vertex, but not the same final vertex.

UA - See USER AGENT.

UAE - See USER AGENT ENTITY.

UAL - See USER AGENT LAYER.

USER - A person or computer application or process who makes use of a Message Handling System (MHS).

USER AGENT - Typically, the User Agent (UA) is a set of computer

processes (for example, an editor, a file system, a word processor) that are used to create, inspect, and manage the storage of messages. There is typically one user per User Agent (UA). During message preparation, the originator communicates with his UA via an input/output (I/O) device (for example, a keyboard, display, printer, facsimile machine, and/or telephone). Also by means of these devices, the UA communicates to its user messages received from the Message Transfer System (MTS). To send and receive messages, the UA interacts with the MTS via the submission and delivery protocol.

USER AGENT ENTITY - A User Agent Entity (UAE) is an entity in the User Agent Layer (UAL) of the Application Layer that controls the protocol associated with cooperating UAL services. It exchanges control information with the Message Transfer Agent Entity (MTAE) or the Submission and Delivery Entity (SDE) in the layer below. The control information is the information the Message Transfer layer (MTL) requires to create the appropriate envelope and thus provide the desired message transfer service elements.

USER AGENT LAYER - The User Agent Layer (UAL) is the layer that contains the User Agent Entities (UAEs).

X.25 - A packet switched network standard often used by public providers and optional in GOSIP.

Appendix A: Current Activities in X.500

NOTE: The following are edited excerpts from the IETF Directory Services Monthly reports as well as a few IETF scope documents. Effort has been taken to make sure this information is current as of late 1991. At the end of each section are lists of anonymous FTP and/or an e-mail address if more information is desired.

IETF DISI
(Directory Information Services Infrastructure Working Group)

The Directory Information Services (pilot) Infrastructure Working Group is chartered to facilitate the deployment in the Internet of Directory Services based on implementations of the X.500 standards. It will facilitate this deployment by producing informational RFCs intended to serve as a Directory Services "Administrator's Guide". These RFCs will relate the current usage and scope of the X.500 standard and Directory Services in North America and the world, and will contain information on the procurement, installation, and operation of various implementations of the X.500 standard. As the various implementations of the X.500 standard work equally well over TCP/IP and CLNP, the DISI working group shall not mandate specific

implementations or transport protocols.

DISI is an offshoot of the OSI Directory Services group, and, accordingly, is a combined effort of the OSI Integration Area and User Services Area of the IETF. The current OSIDS working group was chartered to smooth out technical differences in information storage schema and difficulties in the interoperability and coherence of various X.500 implementations. The DISI group is concerned solely with expanding the Directory Services infrastructure. As DISI will be providing information to facilitate the building of infrastructure with an eye towards truly operational status, DISI will need to form liaisons with COSINE, PARADISE, and perhaps the RARE WG3.

As a final document, the DISI working group shall write a charter for a new working group concerned with user services, integration, maintenance and operations of Directory Services, the Operations and Infrastructure of Directory Services (OIDS) Group.

One particular DISI document you may be interested in is a catalogue of the various X.500 implementations:

```
   Title     : Catalog of Available X.500 Implementations
   Author(s) : R. Lang, R. Wright
   Filename  : rfc1292.txt
   Pages     : 103
```

This document is available on the ESnet Information Server in the [ANONYMOUS.RFCS] directory.

Mailing list address:
   General Discussion: disi@merit.edu
   To Subscribe: disi-request@merit.edu
Anonymous FTP site address: (e-mail archive is here)
   merit.edu

IETF OSI-DS (OSI Directory Service Working Group)

The OSI-DS group works on issues relating to building an OSI Directory Service using X.500 and its deployment on the Internet. Whilst this group is not directly concerned with piloting, the focus is practical, and technical work needed as a pre-requisite to deployment of an open Directory will be considered.

The major goal of this WG is to provide the technical framework for a Directory Service infrastructure on the Internet. This infrastructure should be based on the OSI Directory (X.500). It is intended that this infrastructure can be used by many applications. Whilst this WG is not directly concerned with operation of services,

close liaison is expected with those groups which do operate pilots and services.

Liaisons have been established with RARE WG3, NIST, CCITT/ISO IEC, North American Directory Forum.

X.500 (1984) / ISO 9594 does not have sufficient functionality for full deployment on the Internet. This group identifies areas where extensions are required.

It is a basic aim of the group to be aligned to appropriate base standards and functional standards. Any activity should be undertaken in the light of ongoing standardization activity. Areas which should be examined include:

- Replication
- Knowledge Representation
- Schema Management
- Access Control
- Authentication
- Distributed operations for partially connected DSAs
- Presentation Address Handling

Mailing list address:
General Discussion: osi-ds@cs.ucl.ac.uk
To Subscribe: osi-ds-request@cs.ucl.ac.uk
Anonymous FTP site address: (all OSI-DS documents and e-mail archive
cs.ucl.ac.uk are here)

FOX (Field Operational X.500 Project)

The FOX project is a DARPA funded effort to provide a basis for operational X.500 deployment in the NREN/Internet. This work is being carried out at Merit, NYSERnet/PSI, SRI and ISI. ISI is the main contractor and responsible for project oversight.

There are two primary thrusts of the FOX project:

1. X.500 Infrastructure: It is important that multiple interoperable platforms be available for deployment. FOX plans to examine and test the interoperability of the QUIPU and NIST-X.500 (Custos) implementations, and DNANS-X.500 if

possible. In addition, FOX will explore X.500 interfaces to conventional database systems (one target is Sybase), an alternate OS platform (VM) for X.500 servers, and X-window based user interfaces.

2. X.500 Applications: A long-range goal is to facilitate the use of X.500 for real Internet applications. FOX will first focus on making network infrastructure information available through X.500. This includes network and AS site contacts, topology information, and the NIC WHOIS service.

A centrally managed X.500 version will be the first phase of a WHOIS service. Providing an X.500 version of a well-known widely-used service should promote the use of X.500 by Internet users. In addition, this effort will provide experience in designing X.500 applications. However, the manageability of this scheme will be short-lived, so the next step will be a design for a distributed version of WHOIS.

Finally, it is critical for Internet X.500 efforts to be aligned with directory service efforts that are ongoing in other communities. FOX participants are involved in, or are otherwise tracking these efforts, and information about FOX activities will be publicly available.

NADF (North American Directory Forum)

The North American Directory Forum (NADF) is a collection of organizations which offer, or plan to offer, public Directory services in North America, based on the CCITT X.500 Recommendations.

The NADF has produced a document, NADF-175, "A Naming Scheme for c=US", which has been issued as RFC-1255.

The NADF-175 document proposes the use of existing civil infrastructure for naming objects under c=US. This has the advantage of using existing registration authorities and not establishing any new ones (the document simply maps names assigned by existing authorities into different portions of the c=US DIT). The document is intended as the basis for X.500 names in the U.S. for the long-term; it is important that interested parties get a copy, review it, and return comments.

A second output, which is still undergoing development, is NADF-128, a preliminary draft on "Mapping the DIT onto Multiple ADDMDs". This describes how the c=US portion of the DIT is mapped onto DSAs and what service-providers must minimally share in order to achieve a working public directory. The next revision of this document will

likely be ASCII-ized and published as an informational RFC.

NIST (National Institute of Standards and Technology)

NIST is involved in several X.500 activities: standards, pilot deployment, and development of an X.500 implementation, Custos. The objective is to see X.500 widely deployed and used in the U.S. Government. X.500 is expected to be in the next release of the U.S. Government OSI Profile (GOSIP). In the standards efforts, emphasis is on access control and replication; the other activities are described in some detail below.

- NIST/GSA X.500 Pilot Deployment: NIST and GSA are collaborating in the creation of a U.S. Government X.500 pilot deployment. To date, two meetings have been held. At the second, held on April 25th at NIST, significant progress was made towards refining an initial draft schema developed by NIST. A number of government agency requirements will be included in the next schema revision. Once the schema is defined, agencies will begin collecting data for loading into the directory. Initially, NIST will offer to host agency data on Custos DSAs running at NIST. Eventually, agencies are expected to obtain and operate DSAs.

- CUSTOS: The NIST X.500 public-domain implementation, Custos, is implemented on ISODE, although it otherwise bears no relation to QUIPU. One of its more interesting features is that the DBMS interface is SQL, and we provide a simple DBMS as part of Custos to support the DSA. Information can be optionally loaded into memory, and the memory usage is reasonably efficient on a per-entry basis.

OIW (OSI Implementor’s Workshop)

The OSI Implementor’s Workshop (OIW) is an open public forum for technical issues, concerned with the timely development of implementation agreements based on emerging international OSI standards. The Workshop accepts as input the specifications of emerging standards for protocols, and produces as output agreements on the implementation and testing particulars of these protocols. This process is expected to expedite the development of OSI protocols and to promote interoperability of independently manufactured data communications equipment.

The Workshop organizes its work through Special Interest Groups (SIGs) that prepare technical documentation. The SIGs are encouraged to coordinate with standards organizations and user groups, and to seek widespread technical consensus on implementation agreements

through international discussions and liaison activities.

The Directory SIG of the Workshop produces agreements on the implementation of Directory protocols based on ISO 9594 and CCITT X.500 Recommendations. There are three major areas that the SIG is working on for 1991: access control, replication, and distributed operations.

Mailing list address:
General Discussion: dssig@nisc.sri.com
To Subscribe: dssig-request@nisc.sri.com

PARADISE Project

The PARADISE project is based at the Department of Computer Science, University College London (UCL).

PARADISE is a sub-project of the broader COSINE project sponsored under the umbrella of EUREKA by eighteen participating countries and aimed at promoting OSI to the academic, industrial and governmental research and development organizations in Europe. The countries involved are those of the EC, EFTA plus Yugoslavia; that is: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Holland, Ireland, Italy, Luxembourg, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and Yugoslavia.

The partners funded by PARADISE besides UCL are:

- The Networks Group at the University of London Computer Centre (ULCC), which is a service-oriented organization providing a range of facilities to the academic community in London and the entry point into the UK for IXI, the COSINE international X.25 backbone;

- X-Tel Services Ltd, a software company based in Nottingham which currently provides service support to the UK Academic X.500 pilot; and

- PTT Telematic Systems from the Netherlands, which in turn has subcontracted the Swiss and Finnish PTTs, and whose involvement is to create a forum for discussion on X.500 among the European carrier administrations.

The project also aims to have representation from all the participating countries, which in the majority of cases are the existing X.500 national pilots.

Of the 18 countries involved, at least 12 are registered in the White

Pages Pilot Project. Most countries are using the QUIPU implementation developed at UCL. However, a French group has developed PIZARRO, which will form the basis of the emerging French pilot. In Italy, a Torino-based company Systems Wizards are using DirWiz, which is currently the sole representative from Italy in the tree.

Mailing list address:
helpdesk@paradise.ulcc.ac.uk

PSI White Pages Pilot Project

The White Pages Pilot Project is the first production-quality field test of the OSI Directory (X.500). The pilot currently has a few hundred organizations (more each month) and is based on OSI TP4 over TCP/IP (RFC-1006).

Anonymous FTP site address: (Most X.500 pilot project software is
uu.psi.com here as well as more information)

ANSI ASC X3T5.4 (Directory Ad Hoc Group)

The American National Standards Institute (ANSI) Accredited Standards Committee (ASC) X3T5.4. This group reviews the Proposed Draft Amendments (PDAMs) for extensions to the International Consultative Committee for Telegraphy and Telephony (CCITT) X.500 Recommendations/International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 9594.

Appendix B: Current Activities in X.400

NOTE: The following are edited excerpts from the IETF X.400 Services Monthly reports as well as a few IETF scope documents. Effort has been taken to make sure this information is current as of February 1992. At the end of each section are lists of anonymous FTP and/or an e-mail address if more information is desired.

IETF OSIX400 (IETF OSI X.400 Working Group)

The IETF OSI X.400 Working Group is chartered to identify and provide solutions for problems encountered when operating X.400 in a dual protocol internet. This charter includes pure X.400 operational issues as well as X.400 <-> RFC 822 gateway (ala RFC 987) issues.

Mailing list address:
General Discussion: ietf-osi-x400@cs.wisc.edu
To Subscribe: ietf-osi-x400-request@cs.wisc.edu

IETF X400OPS (IETF X.400 Operations Working Group)

X.400 management domains are being deployed today on the Internet. There is a need for coordination of the various efforts to insure that they can interoperate and collectively provide an Internet-wide X.400 message transfer service connected to the existing Internet mail service. The overall goal of this group is to insure interoperability between Internet X.400 management domains and to the existing Internet mail service. The specific task of this group is to produce a document that specifies the requirements and conventions of operational Internet PRMDs.

Mailing list address:
General Discussion: ietf-osi-x400ops@pilot.cs.wisc.edu
To Subscribe: ietf-osi-x400ops-request@pilot.cs.wisc.edu

IETF MHS-DS (IETF Message Handling Services - Directory Services)

The MHS-DS Group works on issues relating to Message Handling Service use of Directory Services. The Message Handling Services are primarily X.400, but issues relating to RFC 822 and RFC 822 interworking, in as far as use of the Directory is concerned, are in the scope of the Group. Directory Services means the services based on X.500 as specified by the OSI-DS group (RFCs 1274, 1275, 1276, 1277, 1278, 1297). The major aim of this group is to define a set of specifications to enable effective large scale deployment of X.400. While this Group is not directly concerned with piloting, the focus is practical, and implementations of this work by members of the Group is expected.

Mailing list address:
General Discussion: mhs-ds@mercury.udev.cdc.com
To Subscribe: mhs-ds-request@mercury.udev.cdc.com
Anonymous FTP site address: (e-mail archive is here)
mercury.udev.cdc.com

XNREN X.400 Pilot Project

The Internet X.400 Project at the University of Wisconsin is funded by NSF. We are working on two main areas:

1. Supporting the operational use of X.400.

2. Working with others to define organizational procedures necessary to operate X.400 on a large scale in the Internet.

To support the use of X.400, we are operating a PRMD, assisting sites in running PP or the Wisconsin Argo X.400 software packages, and

running an X.400 Message Transfer Agent (MTA) which is connected to U.S. and international MTAs using RFC1006/TCP/IP. Internet sites are invited to join our PRMD or establish X.400 connections with us. The organizational work is being done jointly by IETF working groups and RARE Working Group 1.

Mailing list address:
General Discussion: x400-project-team@cs.wisc.edu

RARE WG1 (RARE Working Group 1 - Message Handling Systems)

RARE (Reseaux Associes pour la Recherche Europeenne) Working Group 1, Message Handling Systems, creates and promotes a European infrastructure for a message handling service within the European research community, with connections to the global environment. Membership of the Working Group is by nomination from the national networking organizations, together with a number of invited experts.

CCITT SG-D MHS-MD (CCITT Study Group D, MHS Management Domains)

This group initially pursues the development of the rules for registering MHS management Domain names within the US. This group also pursues developing a set of voluntary agreements for North American operators of these management domains which will allow the US to uphold its Telecommunications treaty obligations while the industry maintains e-mail as an Information Processing service. The specific aspect of the treaty that is immediate concern to this group is that subscribers of MHS services in other countries, especially those countries who treat MHS as a Telecommunications service, must be able to reach MHS users in this country regardless of how their message enters the US and regardless of how many domains are involved in the transfer of the message to the intended recipient.

The US State Department presently considers MHS (e-mail) as an Information Processing service. Some other countries consider any MHS (e-mail) service to be a Telecommunications service and hence, CCITT treaty obligations apply.

NIST/GSA Interagency X.400 Connectivity Project

The goal of this project is to assist the members of the Federal Information Resource Management Policy Council (FIRMPoC) in establishing electronic mail connectivity based on X.400. The outcome of this project is to continue, as the National Institute of Standards and Technology (NIST) has done in the past, providing Federal agencies with assistance in establishing electronic mail connectivity. This project is sponsored by the General Services

Administration (GSA).

Appendix C: How to Obtain QUIPU, PP and ISODE

ISODE/QUIPU 7.0

This software supports the development of certain kinds of OSI protocols and applications. Here are the details:

- The ISODE is not proprietary, but it is not in the public domain. This was necessary to include a "hold harmless" clause in the release. The upshot of all this is that anyone can get a copy of the release and do anything they want with it, but no one takes any responsibility whatsoever for any (mis)use.

- The ISODE runs on native Berkeley (4.2, 4.3) and AT&T System V systems, in addition to various other UNIX-like operating systems. No kernel modifications are required.

- Current modules include:

  - OSI transport service (TP0 on top of TCP, X.25 and CONS; TP4 for SunLink OSI)

  - OSI session, presentation, and association control services

  - ASN.1 abstract syntax/transfer notation tools, including:

    1. Remote operations stub-generator (front-end for remote operations)

    2. Structure-generator (ASN.1 to C)

    3. Element-parser (basic encoding rules)

  - OSI reliable transfer and remote operations services

  - OSI directory services

  - OSI file transfer, access and management

  - FTAM/FTP gateway

  - OSI virtual terminal (basic class, TELNET profile)

- ISODE 7.0 consists of final "IS" level implementations with the exception of VT which is a DIS implementation. The ISODE also

contains implementations of the 1984 X.400 versions of ROS and RTS.

- Although the ISODE is not "supported" per se, it does have a problem reporting address, Bug-ISODE@XTEL.CO.UK. Bug reports (and fixes) are welcome by the way.

- The discussion group ISODE@NISC.SRI.COM is used as an open forum on ISODE. Contact ISODE-Request@NISC.SRI.COM to be added to this list.

- The primary documentation for this release consists of a five volume User's Manual (approx. 1000 pages) and a set of UNIX manual pages. The sources to the User's Manual are in LaTeX format. In addition, there are a number of notes, papers, and presentations included in the documentation set, again in either LaTeX or SLiTeX format. If you do not have LaTeX, you should probably get a hardcopy from one of the distribution sites below.

ISODE/QUIPU Distribution Sites

The FTP or FTAM distributions of ISODE-7.0 consists of 3 files. The source and main ISODE-7.0 distribution is in the file ISODE-7.tar.Z which is approximately 4.7MB in size.

LaTeX source for the entire document set can be found in the ISODE-7-doc.tar.Z file (3.5MB). A list of documents can be found in the doc/ directory of the source tree.

A Postscript version of the five volume manual can be found in the ISODE-7-ps.tar.Z file (4.3MB).

If you can FTP to the Internet, then use anonymous FTP to uu.psi.com [136.161.128.3] to retrieve the files in BINARY mode from the ISODE/ directory.

Additional PSI White Pages Pilot Software

The 'usconfig' program configures a DSA which understands some of the NADF naming rules. This software is primarily intended for creating directory hierarchies for DSAs from scratch. The add-on software is available via anonymous FTP from uu.psi.com in:

wp/src/wpp-addon.tar.Z

Whether you choose to use 'usconfig' or not, please retrieve and install the addon, and follow the instructions therein. You might

want to retrieve pilot-ps.tar.Z again also, as it contains an updated Administrator Guide.

Note that the wpp-addon.tar.Z file needs to be installed on top of the ISODE 7.0 distribution; it does not duplicate any of the ISODE 7.0, you need to retrieve and generate that too.

PP 6.0

PP is a Message Transfer Agent, intended for high volume message switching, protocol conversion, and format conversion. It is targeted for use in an operational environment, but is also be useful for investigating message related applications. Good management features are a major aspect of this system. PP supports the 1984 and 1988 versions of the CCITT X.400 / ISO 10021 services and protocols. Many existing RFC-822 based protocols are supported, along with RFC-1148bis conversion to X.400. PP is an appropriate replacement for MMDF or Sendmail. This is the second public release of PP, and includes substantial changes based on feedback from using PP on many sites.

- PP is not proprietary and can be used for any purpose. The only restriction is that suing of the authors for any damage the code may cause is not allowed.

- PP runs on a range of UNIX and UNIX-like operating systems, including SUNOS, Ultrix, and BSD. A full list of platforms on which PP is know to run is included in the distribution.

- Current modules include:

  - X.400 (1984) P1 protocol.

  - X.400 (1988) P1 protocol.

  - Simple mail transfer protocol (SMTP), conformant to host requirements.

  - JNT mail (grey book) Protocol.

  - UUCP mail transfer.

  - DECNET Mail-11 transfer

  - Distribution list expansion and maintenance, using either a file based mechanism or an X.500 directory.

  - RFC 822-based local delivery.

- Delivery time processing of messages.

- Conversion between X.400 and RFC-822 according to the latest revision of RFC-1148, known as RFC-1148bis.

- Conversion support for reformatting body parts and headers.

- X-Window and line-based management console.

- Message Authorization checking.

- Reformatting support for "mail hub" operation.

- X.500-based distribution list facility using the QUIPU directory.

- FAX interworking

o No User Agents (UAs) are included with PP. However, procedural access to the MTA is documented, to encourage others to write or to port UAs. Several existing UAs, such as MH, may be used with PP.

o It is expected that a Message Store to be used in conjunction with PP (PPMS), and an associated X-Windows User Agent (XUA) will be released on beta test in first quarter 92.

o The core routing of PP 6.0 is table based. DNS is used by the SMTP channel. The next version of PP will support Directory Based routing, which may use X.500 or DNS.

o PP 6.0 requires ISODE 7.0.

o X-Windows release X11R4 (or greater) is needed by some of the management tools. PP can be operated without these tools.

o Although PP is not "supported" per se (but see later), it does have a problem reporting address (bug reports (and fixes) are welcome):

```
RFC-822:  PP-SUPPORT@CS.UCL.AC.UK
X.400:    S=PP-Support; OU=CS; O=UCL;
          PRMD=UK.AC; ADMD= ; C=GB;
```

o The discussion group PP-PEOPLE@CS.UCL.AC.UK is used as an open forum on PP; Contact PP-PEOPLE-REQUEST@CS.UCL.AC.UK to be added to this list.

- The primary documentation for this release consists of a three and a half volume User's Manual (approx. 300 pages) and a set of UNIX manual pages. The sources to the User's Manual are in LaTeX format.

PP Distribution Sites

If you can FTP to the Internet from outside Europe, then use anonymous FTP to uu.psi.com [136.161.128.3] to retrieve the file pp-6.tar.Z in binary mode from the ISODE/ directory. This file is the tar image after being run through the compress program and is approximately 3Mb in size.

If you can FTP to the Internet from Europe, then use anonymous FTP to archive.eu.net [192.16.202.1] to retrieve the file pp-6.tar.Z in binary mode from the network/ISODE/ directory. This file is the tar image after being run through the compress program and is approximately 3Mb in size.

ISODE/QUIPU and PP Platforms as of December 1991

Machine	OS	ISODE	PP	Stacks	Notes
CCUR 6000	RTU 5.0	7.0	Yes!	TCP	1
CCUR 6000	RTU 6.0	7.0	Yes!	TCP X25 CLNS	2
CDC 4000 Series	EP/IX 1.3.2 EP/IX 1.4.1	6.6+		TCP CLNS X25	3
COMPAQ 386/25	SCO Unix 5.2	6.0		TCP	
COMPAQ 386	BSD	7.0		TCP X25	4
Convex C120	ConvexOS 8.1	7.0		TCP	5
DEC Vax	2nd Berkeley Network rel	7.0		TCP X25	
DEC	DECnet-ULTRIX V5.0	7.0		TCP CLNS	6
DEC	Ultrix 3.1D Ultrix 4.0	7.0	5.2	TCP X25	7

	Ultrix 4.1				
DEC	Ultrix 4.2	7.0		TCP X25 CLNS	
DEC	VMS v5.x	7.0		TCP X25	
DG Avion	DGUX 4.30	7.0		TCP	8
Encore Multimax 3xx Encore Multimax 5xx	UMAX V 2.2h	6.0		TCP	9
Encore NP1	UTX/32 3.1a	7.0		TCP X25	10
Encore PN6000 Encore PN9000	UTX/32 2.1b	6.0		TCP X25	9
HP/9000/3xx	HP/UX 6.0 HP-UX 7.05 B	7.0		TCP	11
HP/9000/8xx	HP-UX 7.00	7.0		TCP X25	11
IBM 3090	AIX/370 1.2.1	7.0		TCP	12
IBM PS/2	AIX 1.2.1	6.7		TCP	13
IBM RS/6000	AIX 3.1 AIX 3.0	6.8		TCP	
ICL	DRS/6000	7.0	5.2	TCP	14
Macintosh	A/UX 2.0.1	7.0		TCP	
Macintosh	MacOS V6.x	6.0		TCP	15
Mips 4-52	ATT-V3-0	7.0	5.2	TCP	16
NeXT		7.0	5.2	TCP	17
ORION/Clipper		6.8		TCP	
Olivetti LSX-3020	X/OS 2.1	6.7b	5.0	TCP X25	1

Pyramid 9800 Pyramid MIS	OSx 5.1 (4.3BSD/SVR3.2)	7.0	5.2	TCP	18
SEQUENT	DYNIX V3.0.18	7.0		TCP	8
Sony News-1750	NEWS-OS 3.3 NEWS-OS 4.0c	6.8		TCP	
Sun4 Sun3	SunOS 4.1 SunOS 4.1.1 SunOS 4.0.3c	7.0	5.2	TCP X25 CONS CLNS	

Notes:

1. NOT SNMP or VT

2. Little tested

3. Official upper layer

4. Prototype only!

5. Planned port

6. Being worked on!

7. 3.1D binaries compiled under 4.2

8. Only QUIPU confirmed

9. Not QUIPU

10. Need "-Dregister=" in CONFIG.make

11. Need bug-fix no. 5 from bug-ISODE@xtel.co.uk. not SNMP,VT or FTAM-FTP gateway

12. No VT, QUIPU not tested

13. Models 80 and 95

14. NOT SNMP or VT,PP and X.25 requires patches available from X-Tel

15. Using MacTCP

16. Only QUIPU tested, built using BSD43 config

17. Need bug-fix no. 6 from bug-ISODE@xtel.co.uk

18. Built using BSD config, no VT or SNMP

The above tables do not refer to beta releases of ISODE and PP more recent than the public ISODE-7.0 or PP-5.2 releases. The above table is generated from reports sent to bug-ISODE and pp-support. There is no guarantee the information is correct.

Appendix D: Sample X.500 Input File and Restricted Character List

Below is a sample datafile that illustrates the format for providing data about persons at your site to be loaded into the ESnet DSA. Following the sample datafile is a detailed explanation of the format and content of the file. We have tried to be as flexible as possible in defining the format of the file, given the constraints imposed by an automated process. We would appreciate feedback on the format of the file and will try to accommodate any specific needs you may have to any extent that is reasonable.

```
#
#        Sample Data File for Bulk Loading X.500 Database
#
# delimiter character is ","                                    1
# field 1 is commonName                                         2
# field 2 is phone extension                                    3
#   area code for all numbers is 510                            4
#   prefix for all numbers is 422                               5
# field 3 is rfc822Mailbox                                      6
# field 4 is facsimileTelephoneNumber                           7
# default facsimileTelephoneNumber is (510) 422-3333            8
# postalAddress for all entries is:                             9
#     National Energy Research Supercomputer Center            10
#     P.O. Box 5509                                            11
#     Livermore, California 94552                              12
#
Chris Anderson,1915,anderson@ws1.nersc.gov,                    13
Lila Brown,5680,brownl@ws2.nersc.gov,                          14
Bob Green,4474,,                                               15
Max Jones,4488,elvis@presley.nersc.gov,5104224444              16
Dave Smith,9818,smithd@ws3.nersc.gov,                          17
Cathy White,4016,snow@white.nersc.gov,                         18
<end-of-file>
```

Comment lines at the beginning of the file convey relevant formatting information.

Following comment lines, each data line contains information about one person.

Fields within a single data line are separated by a delimiter character. You specify the delimiter character you wish to use in the comment section; be sure to choose a delimiter which does not appear as a legitimate character in any field of a data line.

You may provide all or part of the attribute types listed in the table in Section 2.5 (commonName is required). In the comment section, you must indicate which attribute types are contained in each field of a data line.

Each data line must contain the same number of fields and the same order of fields (i.e. same order of attribute types). Two successive delimiters indicated a null value (eof is a considered a field delimiter).

The characters "=", "&", "$", and "#" are NEVER allowed in any attribute value.

Below is a discussion of relevant lines of the sample datafile.

Line 1 The delimiter character is identified as a comma (,).

Line 2 Field # 1 is identified as containing the commonName attribute.

Line 3 Field # 2 is identified as containing the telephoneNumber attribute. The actual data value is a 4-digit extension.

Lines 4,5 Identify the area code and prefix which apply to all 4-digit extensions in the datafile. If your actual data values already contain area code and/or prefix, then there would be no need to indicate default values.

Line 6 Field # 3 is identified as containing the rfc822Mailbox attribute.

Line 7 Field # 4 is identified as containing the facsimileTelephoneNumber attribute.

Line 8 Identifies the default value for facsimileTelephoneNumber. If field 4 is missing in a data line, the default value will be applied.

Lines 9-12 Identify the value of the postalAddress attribute which

applies to all entries.

```
Line 13  commonName= Chris Anderson
         surName= Anderson
         telephoneNumber= 510-422-1915
         rfc822MailBox= anderson@ws1.nersc.gov
         facsimileTelephoneNumber= 510-422-3333
         postalAddress= National Energy Research Supercomputer Center
                        P.O. Box 5509
                        Livermore, California 94552

Line 14  commonName= Lila Brown
         surName= Brown
         telephoneNumber= 510-422-5680
         rfc822MailBox= brownl@ws2.nersc.gov
         facsimileTelephoneNumber= 510-422-3333
         postalAddress= National Energy Research Supercomputer Center
                        P.O. Box 5509
                        Livermore, California 94552

Line 15  commonName= Bob Green
         surName= Green
         telephoneNumber= 510-422-4474
         rfc822MailBox=
         facsimileTelephoneNumber= 510-422-3333
         postalAddress= National Energy Research Supercomputer Center
                        P.O. Box 5509
                        Livermore, California 94552

Line 16  commonName= Max Jones
         surName= Jones
         telephoneNumber= 510-422-4488
         rfc822MailBox= elvis@presley.nersc.gov
         facsimileTelephoneNumber= 510-422-4444
         postalAddress= National Energy Research Supercomputer Center
                        P.O. Box 5509
                        Livermore, California 94552

Line 17  commonName= Dave Smith
         surName= Smith
         telephoneNumber= 510-422-9818
         rfc822MailBox= smithd@ws3.nersc.gov
         facsimileTelephoneNumber= 510-422-3333
         postalAddress= National Energy Research Supercomputer Center
                        P.O. Box 5509
                        Livermore, California 94552
```

```
Line 18  commonName= Cathy White
         surName= White
         telephoneNumber= 510-422-4016
         rfc822MailBox= snow@white.nersc.gov
         facsimileTelephoneNumber= 510-422-3333
         postalAddress= National Energy Research Supercomputer Center
                        P.O. Box 5509
                        Livermore, California 94552
```

Appendix E: ESnet Backbone Sites

Government Agencies

U.S. Department of Energy, Office of Energy Research (DOE)
Germantown, Maryland USA

U.S. Department of Energy, San Francisco Office (SAN)
Oakland, California USA

National Laboratories

NASA Ames Research Center (AMES, FIX-WEST)
Mountain View, California USA

Argonne National Laboratory (ANL)
Argonne, Illinois USA

Brookhaven National Laboratory (BNL)
Upton, New York USA

Continuous Electron Beam Accelerator Facility (CEBAF)
Newport News, Virginia USA

Fermi National Accelerator Laboratory (FNAL)
Batavia, Illinois USA

Lawrence Berkeley Laboratory (LBL)
Berkeley, California USA

Lawrence Livermore National Laboratory (LLNL)
Livermore, California USA

Los Alamos National Laboratory (LANL)
Los Alamos, New Mexico USA

Oak Ridge National Laboratory (ORNL)
Oak Ridge, Tennessee USA

Pacific Northwest Laboratory (PNL)
Richland, Washington USA

Princeton Plasma Physics Laboratory (PPPL)
Princeton, New Jersey USA

Sandia National Laboratory, Albuquerque (SNLA)
Albuquerque, New Mexico USA

Stanford Linear Accelerator Center (SLAC)
Menlo Park, California USA

Superconducting Super Collider (SSC)
Dallas, Texas USA

Universities

California Institute of Technology (CIT)
Pasadena, California USA

Florida State University (FSU)
Tallahassee, Florida USA

Iowa State University (ISU)
Ames, Iowa USA

Massachusetts Institute of Technology (MIT)
Cambridge, Massachusetts USA

New York University (NYU)
Upton, New York USA

Oak Ridge Associated Universities (ORAU)
Oak Ridge, Tennessee USA

University of California, Los Angeles (UCLA)
Westwood, California USA

University of Maryland (UMD, FIX-EAST)
College Park, Maryland USA

University of Texas, Austin (UTA)
Austin, Texas USA

Commercial Entities

General Atomics (GA)
San Diego, California USA

Office of Science and Technology Information (OSTI)
Oak Ridge, Tennessee USA

Science Applications, Incorporated (SAIC)
McLean, Virginia USA

Appendix F: Local Site Contacts for DOE Naming Authorities

Below is a list of all Department of Energy GOSIP Site Authorities for OSI registration and addressing. This information was obtained from the DoE GOSIP On-Line Information System (DOE-GOIS), dated November 18, 1991.

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Appendix G: Recommended Reading

RFCs (Request For Comments)

The following RFCs may be obtained from the ESnet Information Server. They are stored in the directory [ANONYMOUS.RFCS]. They may be retrieved via anonymous FTP (nic.es.net, 128.55.32.3) or DECnet copy (ESNIC::, 41.174).

RFC1328 X.400 1988 to 1984 downgrading. Hardcastle-Kille, S.E. 1992 May; 5 p. (Format: TXT=10006 bytes)

RFC1327 Mapping Between X.400 (1988) /ISO 10021 and RFC 822. Hardcastle-Kille, S.E. 1992 May; 113 p. (Format: TXT=228598 bytes)

RFC1309 Technical overview of directory services using the X.500 protocol. Weider, C.; Reynolds, J.K.; Heker, S. 1992 March; 4 p. (Format: TXT=35694 bytes)

RFC1308 Executive Introduction to Directory Services Using the X.500 Protocol. Weider, C.; Reynolds, J.K. 1992 March; 4 p. (Format: TXT=9392 bytes)

RFC1295 North American Directory Forum. User bill of rights for entries and listing in the public directory. 1992 January; 2 p. (Format: TXT=3502 bytes)

RFC1292 Lang, R.; Wright, R. Catalog of Available X.500 Implementations. 1991 December; 103 p. (Format: TXT=129468 bytes)

RFC1279 Hardcastle-Kille, S.E. X.500 and domains. 1991 November; 13 p. (Format: TXT=26669, PS=170029 bytes)

RFC1278 Hardcastle-Kille, S.E. String encoding of presentation address. 1991 November; 5 p. (Format: TXT=10256, PS=128696 bytes)

RFC1277 Hardcastle-Kille, S.E. Encoding network addresses to support operations over non-OSI lower layers. 1991 November; 10 p. (Format: TXT=22254, PS=176169 bytes)

RFC1276 Hardcastle-Kille, S.E. Replication and distributed operations extensions to provide an Internet directory using X.500. 1991 November; 17 p. (Format: TXT=33731, PS=217170 bytes)

RFC1275 Hardcastle-Kille, S.E. Replication requirements to provide an Internet directory using X.500. 1991 November; 2 p. (Format: TXT=4616, PS=83736 bytes)

RFC1274 Kille, S.E.; Barker, P. COSINE and Internet X.500 schema. 1991 November; 60 p. (Format: TXT=92827 bytes)

RFC1255 North American Directory Forum. Naming scheme for c=US. 1991 September; 25 p. (Format: TXT=53783 bytes) (Obsoletes RFC 1218)

RFC1249 Howes, T.; Smith, M.; Beecher, B. DIXIE protocol specification. 1991 August; 10 p. (Format: TXT=20693 bytes)

RFC1202 Rose, M.T. Directory Assistance service. 1991 February; 11 p. (Format: TXT=21645 bytes)

RFC1006 Rose, M.T.; Cass, D.E. ISO transport services on top of the TCP: Version 3. 1987 May; 17 p. (Format: TXT=31935 bytes)

Non Published Working Notes

"A String Representation of Distinguished Names", S.E. Hardcastle-Kille, 01/30/1992.

The OSI Directory uses distinguished names as the primary keys to entries in the directory. Distinguished Names are encoded in ASN.1. When a distinguished name is communicated between to users not using a directory protocol (e.g., in a mail message), there is a need to have a user-oriented string representation of distinguished name.

"An Access Control Approach for Searching and Listing", S.E. Hardcastle-Kille, T. Howes, 09/23/1991.

This memo defines an extended ACL (Access Control List) mechanism for the OSI Directory. It is intended to meet strong operational requirements to restrict searching and listing externally, while allowing much more freedom within an organization. In particular, this mechanism makes it possible to restrict searches to certain sets of attributes, and to prevent "trawling": the disclosure of large organizational data or structure information by repeated searches or lists. This capability is necessary for organizations that want to hide their internal structure, or to prevent dumping of their entire database. This memo describes functionality beyond, but compatible with, that expected in the 1992 X.500 standard.

"Building an Internet Directory using X.500", S. Kille, 01/07/1991.

The IETF has established a Working Group on OSI Directory Services. A major component of the initial work of this group is to establish a technical framework for establishing a Directory Service on the

Internet, making use of the X.500 protocols and services. This document summarizes the strategy established by the Working Group, and describes a number of RFCs which will be written in order to establish the technical framework.

"Directory Requirements for COSINE and Internet Pilots (OSI-DS 18)", S.E. Hardcastle-Kille, 07/09/1991.

This document specifies operational requirements for DUAs and DSAs in the Internet and COSINE communities. This document summarizes conformance requirements. In most cases, technical detail is handled by reference to other documents. This document refers to core directory infrastructure. Each application using the directory may impose additional requirements.

"DSA Naming", S.E. Hardcastle-Kille, 01/24/1992.

This document describes a few problems with DSA Naming as currently deployed in pilot exercises, and suggests a new approach. This approach is suggested for use in the Internet Directory Pilot, which overcomes a number of existing problems, and is an important component for the next stage in increase of scale.

"Handling QOS (Quality of service) in the Directory", S.E. Kille, 08/29/1991.

This document describes a mechanism for specifying the Quality of Service for DSA Operations and Data in the Internet Pilot Directory Service "Building and internet directory using X.500".

"Interim Directory Tree Structure for Network Infrastructure Information", Chris Weider, Mark Knopper, Ruth Lang, 06/14/1991.

As work progresses on incorporating WHOIS and Network Infrastructure information into X.500, we thought it would be useful to document the current DIT structure for this information, along with some thoughts on future expansion and organization of this subtree of the DIT. The first section of this document describes the current structure, the second section the possible expansion of the structure.

"Interim Schema for Network Infrastructure Information in X.500 New name: Encoding Network Addresses to support operation ov", Chris Weider, Mark Knopper, 06/14/1991.

As the OSI Directory progresses into an operational structure which is being increasingly used as a primary resource for Directory Information, it was perceived that having the Internet Site

Contacts and some limited network information in the Directory would be immediately useful and would also provide the preliminary framework for some distributed NIC functions. This paper describes the interim schema used to contain this information.

"Naming Guidelines for Directory Pilots", P. Barker, S.E. Kille, 01/30/1992.

Deployment of a Directory will benefit from following certain guidelines. This document defines a number of naming guidelines. Alignment to these guidelines will be recommended for national pilots.

"OSI NSAP Address Format For Use In The Internet", R Colella, R Callon, 02/13/1991.

The Internet is moving towards a multi-protocol environment that includes OSI. To support OSI, it is necessary to address network layer entities and network service users. The basic principles of OSI Network Layer addressing and Network Service Access Points (NSAPs) are defined in Addendum 2 to the OSI Network service definition. This document recommends a structure for the Domain Specific Part of NSAP addresses for use in the Internet that is consistent with these principles.

"Representing Public Archives in the Directory", Wengyik Yeong, 12/04/1991.

The proliferation of publicly accessible archives in the Internet has created an ever-widening gap between the fact of the existence of such archives, and knowledge about the existence and contents of these archives in the user community. Related to this problem is the problem of also providing users with the necessary information on the mechanisms available to retrieve such archives. In order for the Internet user community to better avail themselves of this class of resources, there is a need for these gaps in knowledge to be bridged.

"Schema for Information Resource Description in X.500", Chris Weider, 06/14/1991.

The authors are interested in allowing distributed access and updating for Information Resource Description information to users of the Internet. This paper discusses the schema used to hold the Information Resource Description information. The new attributes are taken from the US-MARC fields, and subfields, with the mapping described in the text.

"Schema for NIC Profile Information in X.500", Chris Weider, Mark Knopper, 06/14/1991.

The authors of this document, in conjunction with the chairs of the IETF Network Information Services Infrastructure (NISI) group, would like to implement a Directory of Network Information Centers, or NICs. This will enable NICs to find each other easily, will allow users with access to a DSA to find out where NICs are, and will in general facilitate the distribution of information about the Internet and some of its infrastructure. This document proposes a set of standard schema for this information.

"Using the OSI Directory to Achieve User Friendly Naming", S. Kille, 01/30/1992.

The OSI Directory has user friendly naming as a goal. A simple minded usage of the directory does not achieve this. Two aspects not achieved are: 1) A user oriented notation and 2) Guessability. This proposal sets out some conventions for representing names in a friendly manner, and shows how this can be used to achieve really friendly naming. This then leads to a specification of a standard format for representing names, and to procedures to resolve them. This leads to a specification which allows directory names to be communicated between humans. The format in this specification is identical to that defined in the reference of "A String Representation of Distinguished Name", and it is intended that these specifications are compatible.

"Requirements for X.400 Management Domains (MDs) Operating in the Global Research and Development X.400 Service", R. Hagens, 11/12/1991.

This document specifies a set of minimal operational requirements that must be implemented by all Management Domains (MDs) in the Global R&D X.400 Service. This document defines the core operational requirements; in some cases, technical detail is handled by reference to other documents. The Global R&D X.400 Service is defined as all organizations which meet the requirements described in this document.

"Routing Coordination for X.400 MHS Services within a Multiprotocol/Multinetwork Environment", U. Eppenberger, 10/25/1992.

The X.400 addresses do start to appear on business cards. The different MHS service providers are not well interconnected and coordinated which makes it a very hard job for the MHS managers to know where to route all the new addresses. A big number of X.400 implementations support different lower layer stacks. Taking into

account the variety of existing large transport networks, there is now the chance of implementing a worldwide message handling service using the same electronic mail standard and therefore without the need of gateways with service reduction and without the restriction to a single common transport network. This document proposes how messages can travel over different networks by using multi stack MTAs as relays. Document formats and coordination procedures bridge the gap until an X.500 directory service is ready to store the needed connectivity and routing information.

International Standards Documents

International Consultative Committee for Telephone and Telegraph. Open Systems Interconnection - The Directory. X.500 Series Recommendations. December, 1988.

(also published as)

ISO/IEC. Information Technology - Open Systems Interconnection - The Directory. International Standard 9594. 1989.

International Consultative Committee for Telephone and Telegraph. Data Communication Networks - Message Handling Systems. X.400 Series Recommendations. Geneva 1985.

International Consultative Committee for Telephone and Telegraph. Data Communication Networks - Message Handling Systems. X.400 Series Recommendations. Melbourne, 1988.

NIST Documents
(National Institute of Standards and Technology Documents)

The following documents can be retrieved from the ESnet Information Server in directory [ANONYMOUS.NIST].

Government Open Systems Interconnection Profile (GOSIP) Version 1, National Institute of Standards and Technology, Federal Information Processing Standards Publication #146, August, 1988.

Government Open Systems Interconnection Profile (GOSIP) Version 2, National Institute of Standards and Technology, October, 1990.

DOE Documents

The following documents prepared by the DOE GOSIP Migration Working Group can be retrieved from the ESnet Information Server in directory [ANONYMOUS.DOE-GOSIP].

U.S. Department of Energy. Government Open Systems Interconnection Profile. Transition Strategy. DOE GOSIP Document # GW-ST-008. November, 1990.

U.S. Department of Energy. Government Open Systems Interconnection Profile. Transition Plan. DOE GOSIP Document # GW_PN_005. November, 1990.

U.S. Department of Energy. Government Open Systems Interconnection Profile. Procedures and Guidelines. DOE GOSIP Document # GW-PR-007. April, 1991.

IETF Working Groups

Three IETF working groups, OSI X.400, OSI-DS and MHS-DS have been working in in X.400 and X.500. Minutes of meetings, descriptions of the working groups' charters and goals, information about mailing lists, and other pertinent documents can be retrieved from the ESnet Information Server in the directories [ANONYMOUS.IETF.OSIDS], [ANONYMOUS.IETF.OSIX400] and [ANONYMOUS.IETF.MHSMS].

Others

Marshall T. Rose, Julian P. Onions and Colin J. Robbins. The ISO Development Environment: User's Manual, 1991. ISODE Documentation Set.

Marshall T. Rose and Wengyik Yeong. PSI White Pages Pilot Project: Administrator's Guide, 1991. ISODE Documentation Set.

Marshall T. Rose. The Open Book: A Practical Perspective on Open Systems Interconnection. Prentice-hall, 1990. ISBN 0-13-643016-3.

Marshall T. Rose. The Little Black Book: Mail Bonding with OSI Directory Services. Prentice-hall, 1991. ISBN 0-13-683219-5.

Alan Turner and Paul Gjefle, Pacfic Northwest Laboratory. Performance Analysis of an OSI X.500 (QUIPU) Directory Service Implmentation. 1992. Available on nic.es.net in the directory [ANONYMOUS.ESNET-DOC]QUIPU-PERF.PS

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Security Considerations

Security issues are discussed in sections 2.5.1 and 2.7.5.1 of this memo.

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