

1993

N94-24406

NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM

MARSHALL SPACE FLIGHT CENTER
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

INTEROPERABILITY THROUGH STANDARDIZATION:
ELECTRONIC MAIL, AND X WINDOW SYSTEMS

Prepared By: Ashok T. Amin

Academic Rank: Associate Professor

Institution and
Department: University of Alabama in Huntsville
Computer Science Department

MSFC Colleague: Alan Forney

NASA/MSFC:

Office: Information Systems Office
Division: Systems Engineering and Integration Division

1.0 Introduction

Since the introduction of computing machines, there has been continual advances in computer and communication technologies and approaching limits. The user interface has evolved from a row of switches, character based interface using teletype terminals and then video terminals, to present day graphical user interface. It is expected that next significant advances will come in the availability of services, such as electronic mail and directory services, as the standards for applications are developed and in the 'easy to use' interfaces, such as Graphical User Interface for example Window and X Window, which are being standardized.

Various proprietary electronic mail (email) systems are in use within organizations at each center of NASA . Each systems provides email services to users within an organization, however the support for email services across organizations and across centers exists at centers to a varying degree and is often not easy to use. A recent NASA email initiative is intended "to provide a simple way to send email across organizational boundaries without disruption of installed base" [4]. The initiative calls for integration of existing organizational email systems through gateways connected by a message switch, supporting X.400 and SMTP protocols, to create a NASA wide email system and for implementation of NASA wide email directory services based on OSI standard X.500. A brief overview of MSFC efforts as a part of this initiative are described.

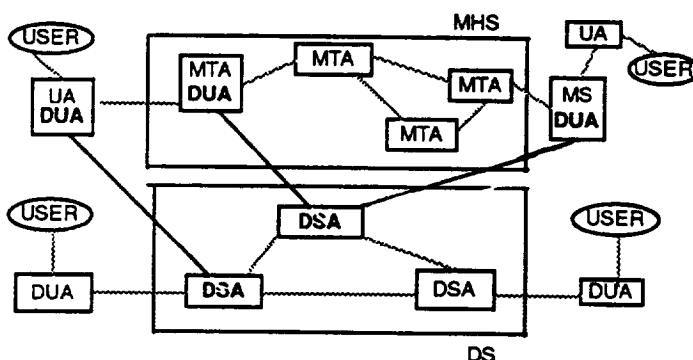
Window based graphical user interfaces make computers easy to use. X window protocol has been developed at Massachusetts Institute of Technology in 1984/1985 to provide uniform window based interface in a distributed computing environment with heterogeneous computers. It has since become a standard supported by a number of major manufacturers. X Window systems, terminals and workstations, and X Window applications are becoming available. However impact of its use in the Local Area Network environment on the network traffic are not well understood. It is expected that the use of X Window systems will increase at MSFC especially for Unix based systems. An overview of X window protocol is presented and its impact on the network traffic is examined. It is proposed that an analytical model of X window systems in the network environment be developed and validated through the use of measurements to generate application and user profiles.

2.0 NASA Email Initiative

NASA centers typically have one or more types of proprietary email systems such as ccMail, Quick Mail, All-In-One, etc.. Providing email service to users on different email systems within and across centers can be problematic. NASA email initiative is intended to provide easy-to-use email services for exchange of messages between users within and across centers and to facilitate use of email services by providing directory services for email addresses. The implementation of the initiative is based on use of standards- X.400 for Message Handling and X.500 for Directory services [5].

Standards for Message Handling and Directory Services

The model of the Message Handling System (MHS), shown in Figure 1, is based on the familiar postal mail system. A MHS consists of User Agents (UA) which interface with Message Transfer Agents (MTA) of the Message Transfer Subsystems (MTS), and a Message Store (MS) for storage of messages in transit. The X.400 standard defines protocols for communication between MTAs, for access to MTA by MS and UA, and for access to MS by UA. It supports text, voice, facsimile, teletext, videotex etc., and provides for non-repudiation of submission and delivery. A justifiable criticism of the X.400 is lack of standards for the user interface to the UA since it is envisioned that email will be universal service in the sense that a telephone service is universal. Further utility of email system depends mainly on the functionality its UA provides to the user.



Message Handling System and Directory System.
Figure 1.

The model of the directory service, shown in Figure 1, is based on the familiar telephone directory services. The directory system consists of Directory Services Agents (DSA) and Directory User Agents (DUA). The directory is distributed and each part of the directory is expected to be assigned to a DSA, however a DSA may be assigned more than one part. The X.500 defines protocols for DSA access by DUA and for communication between DSAs. It supports authentication of user and of the information. Here again the user interface to DUA has not been defined. Though the directory is intended to contain information about objects such as persons, organizations, processes, in the communication system, it is expected that MHS will be a major user of the directory services for interpersonal message service. An integrated view of the two system is depicted in Figure 1 where DUA may be integrated with MHS components.

MSFC Implementation of the Email Initiative

Email systems at MSFC may be classified based whether they are managed by Information System Office (ISO) or not. The ISO managed email systems are interconnected through a hierarchy of gateways leading to a central switch (also serves as DEC X.400 gateway) which routes email to destination email system gateway within MSFC or outside typically to other centers. The user agents of these systems provide a

highly functional user interface. However the addressing schemes used by these systems are different. Of the email systems not managed by ISO, Unix based email systems using Simple Message Transfer Protocol (SMTP) have universal connectivity to other email systems using SMTP over the Internet.

A message switch is central to the implementation at MSFC. The switch, a CDC EP/IX Mail*Hub, supports X.400 and SMTP, fax gateways, has integrated X.500 directory, and provides for address translation between X.400 and SMTP. It will provide for interoperability across all email systems at MSFC and facilitate simple addressing based on first-name and last-name through the X.500 directory services. The Electronic Mail Implementation Group has defined requirements on the content of the directory entry, and directory access servers. However except for query-by-mail, no requirements for DUA for on-line directory access by users have been specified.

3.0 X Window Systems in Local Area Network Environment

Graphical user interfaces (GUI) have revolutionized the user interaction with computer. In comparison with the character based interface, GUI is easy to use and learning to use a new application is even easier. The X window system, which implements X window protocol, provides a device independent pixel based graphics for management of hierarchical, resizable windows. The protocol can be used over any reliable byte stream. X window system permits multiple applications running simultaneously on local and remote hosts to manipulate its window on the display. It was originally developed for use with distributed applications.

Client/Server Computing

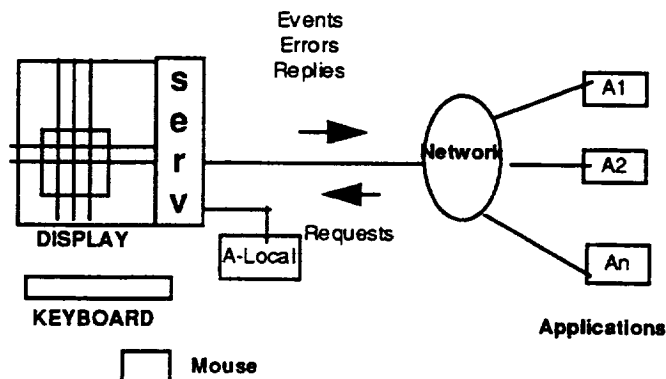
Information systems are moving from centralized mainframe computing to file server based computing in which specialized processors manage a file store and provide file services to PCs and work stations interconnected over a Local Area Network (LAN). X window systems are available in the form of X terminals and X work stations and PCs. X terminals are employed in a client/server architecture for Army's RCAS in which X terminals, file servers and application servers are interconnected over a LAN, and various sites are interconnected over a dedicated lines. Little is known about the traffic implications of X window systems in the network environment.

X Window Protocol and Networking

X window protocol is used for communication between a client application running on local host or a remote host and the X server of the X window system. It was intended to support distributed applications. Therefore, it has been designed to be efficient in the network environment. Figure 2 shows a view of X window system operation from a network traffic perspective.

A client sends draw requests and information requests to the server, and the X server sends user inputs (events), replies, and error reports to the appropriate client. The events and error reports are of 32 byte size, while requests and replies are multiples of 4 byte size with a reply being at least 32 byte in size. The server manages windows, does all drawing, and interfaces with the device drivers to get keyboard and the mouse inputs.

It also manages off-screen memory, window, fonts, cursors, and the colormaps. The graphic context, the information about how graphic requests are to be interpreted is



X Window System in a Network
Figure 2.

cached by the server, so that this information need not be sent over the network for each graphic request to be interpreted. Other similar abstractions stored in the server include window- allows server to manage which parts of the screen are displaying which parts of which window, Pixmap- an off screen virtual drawing surface that must be copied into a window to become visible, color map- which allows user to easily specify color for graphic requests.

Previous studies on the traffic impact of the X window protocol in the academic environment showed that the protocol is very efficient and impact on the network traffic is not significant. However, measurements are needed in non-academic environments to better understand the traffic impact. Little is known about the traffic impact in an when X window systems coexist with PCs in a file server environment. Development of analytical models and measurements to validate models are suggested for further work in this area.

References

- [1] Standard object attribute formats for NASA X.500 directory implementations, version 1, Electronic Messaging Group, June 25, 1993.
- [2] Dunwoody J. C. and Linton M. A., "A Dynamic Profile of Window System Usage", IEEE Symposium on Local Area Networks, pp.90-99, 1988.
- [3] Nye A., "Networking and the X Window System", in Unix Networking (Eds. S. G. Kochan and P. H. Wood), Hayden Books, 1989.
- [4] Lynn J. C., "NASA-Wide Electronic Mail (E-Mail) Initiative", Memorandum to Information Resource Oversight Council (IORC) Members, June 11, 1993.
- [5] Plattner B., Lanz C., Muller M., and Walter T., X400 Message Handling, Addison-Wesley, 1991.
- [6] Scheifler R. W. and Gettys J., "The X Window System", ACM transactions on Graphics, vol.5, no.2, pp.79-109, 1986.