M.I.T. Laboratory for Computer Science

Computer Systems Research Division

September 26, 1979

Request for Comments No. 176

COMPUTER SYSTEMS RESEARCH: Activities as of Fall, 1979

by J. H. Saltzer

The Computer Systems Research group, in conjunction with the Programming Methodology, Technical Services, and Real-Time Systems groups, is engaged in pragmatic experimental studies of future computer system organization, based on a high speed data communication network linking ubiquitous desk-top "personal" computers with one another and with dedicated, specialized "server" computers.

Last year the Technical Services group developed and installed a 1 Mbit/sec ring network, linking several minicomputers, and software protocol development began. This year, the ring network will be upgraded to 8 Mbit/sec. The real-time group's "nu" desktop computers will be added to the network, along with several Xerox "Alto" personal computers. Several local networks will be linked by an internetwork gateway, providing a distributed system hardware base for software and protocol experimentation.

Development is beginning on two dedicated server computers: an "authentication" server that reliably identifies network participants to one another, and a "file" server that stores community and group files. The authentication server will be used to explore issues of cryptographic key distribution. The file server has several novel research aspects. It is intended to appear to every user as an extension of the file system of his own desktop computer. It is also intended to coordinate simultaneous update attempts among different users and with other instances of itself using a transaction-like "commit" protocol. (Thoughts about using video disk hardware are also being entertained.) As time, resources, and energy permit, there are a variety of other dedicated server computers that have been proposed for experimentation: a Telex gateway, a WWV time-standard receiver, a network maintenance computer, a telephone-book-like name resolver, and a resource usage accountant.

Programming in this distributed environment seems to require new approaches from both the language and the operating system direction, to provide more appropriate language semantics as well as tools such as distributed library support and support for debugging across a network. It appears that an object-oriented approach is potentially the most effective one, so the programming technology group has proposed a set of extensions to the CLU language to adapt it for distributed system programming. A nu-terminal code generator for the CLU compiler is underway, and a similar code generator for the Alto is proposed. Thinking about other programming support tools is in a preliminary stage. The intended result of this activity is a kind of programming and operating system that makes distributed application development easier.

To understand better the requirements of distributed applications, some example applications are being designed and implemented. One of these is a distributed calendar management system; another is a programming development library system.

The interconnection of several high speed networks also offers an opportunity to explore the problems involved in future data communication networks that will link very many (say 10,000) nodes somewhat like a telephone private branch exchange. Protocols required for naming, message routing, and interchange with "foreign" networks are currently the subject of extensive debate. Development of sound proposals is the current goal, with experimental implementation to follow.

Suggested readings for further information

1) July 1978-June 1979 Annual reports of the Computer Systems Research, Programming Technology, Technical Services, and Real-Time Systems groups.

2) Reed, D.P., "Naming and Synchronization in a Decentralized Computer System," LCS-TR-205.

3) Montgomery, W.A., "Robust Concurrency Control for a Distributed Information System," LCS-TR-207.

4) Svobodova, et al., "Distributed Computer Systems; Structure and Semantics," LCS-TR-215.

5) Saltzer, J.H., "Version two local network interface design considerations."

6) Clark, D.D., et al., "An Introduction to Local Area Networks," Proc. IEEE 66, 11, (November, 1978) pp. 1497-1517.

7) Reed, D.P., "Implementing Atomic Actions on Decentralized Data," to be published in ACM Operating Systems Review.

Items 1) and 5) are currently internal working papers that are available on request.

Who is doing what:

Gail Arens, graduate student (room NE43-510, x3-6042).
Design and implementation of a stable storage system for CLU objects on the DECSystem 20. Looking for a Master's thesis topic.

Noel Chiappa, staff member (room NE43-540, x3-6018).
Design and implementation of local network and gateway software for PDP-11/UNIX systems. Member of ARPA Internet/TCP working group.

David Clark, research associate (room NE43-511, x3-6003).
Coordination of task assignments for entire group, and liaison with other groups. Implementation of transmission control protocol for Multics. Member of ARPA Internet/TCP working group. Supervisor of undergraduate employees and of many graduate theses. Interest in all aspects of distributed system design.

Wayne Gramlich, graduate student (room NE43-510, x3-6042).
Documenting the proposed CLU compiler implementation for the Z-8000 micro computer. Design and implementation of printer spooling software as a testbed for investigating program reliability issues.

Irene Greif, assistant professor (room NE43-522, x3-5987).
Interested in software design language support for distributed applications. Implementing a distributed calendar system to explore problems of communication in distributed applications. Leading undergraduate research group in design and implementation of an authentication server.

Stephen Kent, graduate student (room NE43-508, x3-6005).
Specialist on cryptographic key distribution and authentication systems. Working on Ph.D. thesis on protecting software that is to be used on a personal computer.

Kirpal Khalsa, undergraduate student (room NE43-502, x3-6061).
Implementing software for an LSI-11 terminal interface controller that provides terminal access to the ring network.

Allen Luniewski, graduate student (room NE43-509, x3-6006).
Finishing a Ph.D. thesis on an object-oriented architecture for a personal computer.

Elizabeth Martin, staff member, (room NE43-501, x3-6011).
Implementing higher level software protocols for the local networks on the PDP-11/UNIX systems.

Andrew Mendelsohn, graduate student (room NE43-510, x3-6042).
In the middle of a Master's thesis on designing user interfaces for a distributed system.

David Reed, assistant professor (room NE43-507, x3-6004).
Leading design and implementation of a file server and of a CLU code generator for the "nu" personal computer. Interested in all aspects of distributed system design. Liaison between CSR, Programming Methodology, and RTS groups. Investigating object-oriented storage system architectures.

Jerome Saltzer, professor and group leader (room NE43-505, x3-6016).
Coordinating all activities of group and liaison with other groups. Coordinating installation and use of Xerox Alto personal computers, and internetwork links. Thinking about implementation of campus-wide network; interested in special servers and novel user interfaces.

Karen Sollins, graduate student (room NE43-508, x3-6005).
Implementing "trivial file transfer protocol" for DECSystem 20 on local network. Trying to figure out whether or not distributed objects can be turned into a Ph.D. thesis topic.

Liba Svobodova, assistant professor (Room NE43-513, x3-6039).
Integration of recovery, reliability, and update coordination semantics to produce robust distributed systems. Semantics of programming of distributed systems. Design and implementation of a file server.