

## **Networking and Engineering Overview**

*Jim Leighton, Manager, Networking and Engineering*

### **Whatever Happened to ESnet?**

As I noted in last year's annual review article, the Network and Engineering staff at NMFEEC has been directed to plan, design, implement, and operate a data communications network to serve the nationwide Energy Research community supported by the Office of Energy Research (OER). This new networking effort has been designated the Energy Sciences Network, or ESnet. Although most members of the NMFEEC community may not yet have seen much impact from these activities, we have had a very busy year working on the many aspects of implementing such a large project.

### **Design**

The overall design of the network was essentially finished during the early part of 1987. We have documented the design through a large number of semiformal "functional specification" documents. Each document is written by the person(s) charged with that aspect of the design, and then submitted to a peer review to ensure correctness and compatibility with the other aspects of the design. We have also collected these functional specification documents along with some introductory and overview material into a somewhat weighty "External Reference Manual."

We held a very successful formal network design review with a number of external invited reviewers on February 5-6, 1987 at Livermore. We passed the review with "flying colors" and received some good comments and recommendations from the reviewers—each of which was subsequently considered for incorporation into the design.

### **Hardware**

We were finally able to complete contractual and financial requirements to take delivery of the first shipment of new hardware in May 1987. We have arranged a very flexible procurement procedure with DEC that allows us to take delivery of approximately 100 micro-VAX based network nodes over a period of about 30 months, with quarterly deliveries of approximately 10 nodes. This arrangement allows us to change configurations to meet the anticipated variety in configurations, and to take advantage of new hardware that becomes available during the 30 month delivery schedule. We are now considering, for example, substituting the recently announced micro-VAX III CPUs in some of the nodes.

### **Software Development**

Software development using the C programming language is now well under way. We have upgraded the VAX 8600 to an 8650 to support the software development environment. We have also installed several of the delivered micro-VAXes on a debug Ethernet and provided the programming staff offices with multiple terminal connections. The programmers can edit, compile, and build programs on the 8650, download to the target micro-VAX (using DECnet capabilities) and then run and debug their software interactively, all in the safety and comfort of their very own offices.

## ESnet Steering Committee

An ESnet steering committee has been formed (1) to help plan for the new programs to be supported by ESnet, (2) to receive requirements from new and existing users, and (3) to facilitate a coordinated transition to the new network. The Steering Committee consists of representatives of the programs in Basic Energy Sciences, Fusion Energy, Health and Environmental Research, High Energy and Nuclear Physics, and the Office of Scientific Computing.

One of the first activities of the Steering Committee has been to clarify the goals of the ESnet:

- Support of interdisciplinary research collaborations
- Support distributed computing requirements
- Provide flexibility and interoperability for multi-vendor environments
- Provide access to ER research facilities
- Evolve toward interagency computer networking
- Avoid redundant computer network support costs

The initial meetings of the Steering Committee were very productive and resulted in action in the following areas:

- An initial backbone structure for the ESnet has been agreed upon (see Figure 1 at the end of this article).
- An interim X.25-based backbone has been agreed upon (shown as dotted lines in Figure 1).
- Plans for international links are in progress.

## International Links

Interconnections to foreign locations have been identified by the Steering Committee as one of the highest priority requirements. I have made two trips to Europe this year (I know, I know—tough assignment, but someone ...) along with steering committee staff members. On the first trip, we visited a number of sites in the U.K., Switzerland, and West Germany to better understand networking in and between these and other European countries. The purpose of the second trip was to explore and select one or more working technical solution(s) with the DFN (German Research Network), an organization that is coordinating network activities in West Germany for us. Our progress to date in this area looks like:

- A 64-K bits per second satellite link to CERN (the European Center for Nuclear Research) near Geneva Switzerland, is expected to be installed in January 1988. This will initially link to the X.25 backbone.
- A 64-K bits per second satellite link into West Germany is currently under discussion. It would serve as a trunk line into West Germany with distribution inside Germany handled by Public Data Networking and/or leased lines to the approximately ten German locations identified. It would also link to the X.25 backbone and be accessible for MFEnet sites via one or more gateway hosts.

- A more general access into all of Europe is desired for the longer term. Possible approaches to this are being discussed.
- A low-speed, 9.6-K bits per second Public Data Network link to Nagoya, Japan from the MFEnet is currently in place, with very restricted user access. We are considering a more general connection to provide broader access to a variety of Japanese sites using a 64-K bits per second satellite trunk.

## What's an ITER?

President Reagan and USSR Secretary Gorbachev (how's that for world class name dropping?) called for the "widest practical development of international cooperation" in fusion energy during their November 1985 summit meeting in Geneva. This has promoted a recent proposal for a joint international design of an International Thermonuclear Experimental Reactor (ITER) by the four partners, Europe, Japan, the United States, and the USSR.

The plan for this joint design effort calls for a home-based design center for each partner, and one shared international design center. The international center location has been selected as Garching, West Germany. Coincidentally, Garching is one the the higher priority German sites selected for ESnet access. We will be meeting with representatives of the U.S. team to help provide communications between the international design center and the U.S. design center, which also, coincidentally, is to be located at LLNL. We will also be working with the Japanese team to help facilitate communications between the Japanese and U.S. teams.

## 1988 Plans

Now you are probably saying to yourself that this really is *very* exciting stuff, but it would be even more exciting if we knew when we could expect to see something running. Well, I just happen to be ready to outline our schedule for the next two years:

**January 1988:** We believe that the new approach ESnet is taking will require much closer coordination with people responsible for the local area networking at each site. Accordingly, we are planning to convene a new committee in January, with sites involved in Phase I (see below) of ESnet deployment. ("Boy, a new committee, that is exciting!" you are probably saying to yourself.) Additional site members will be added to the committee as the implementation continues.

**Phase 0 (January–March 1988):** We expect to bring up all the sites on the X.25 backbone, including Brookhaven National Laboratory (BNL), CERN, Fermi National Accelerator Laboratory (FNAL), Florida State University (FSU), Lawrence Berkeley Laboratory (LBL), Lawrence Livermore National Laboratory (LLNL), and the Massachusetts Institute of Technology (MIT). Additional foreign sites will be added during the year.

**Demonstration (March 1988):** During the MFESIG meeting to be held at LBL, we expect to demonstrate some "beta release" capabilities of ESnet.

**Phase I (June–September 1988):** We will begin deploying and installing a terrestrial 56-K bits per second backbone for ESnet. Sites affected include Argonne National Laboratory (ANL), FSU, GA Technologies, Los Alamos National Laboratory, LBL, MFECC, Princeton Plasma Physics Laboratory, and the University of Texas at Austin. No sites will be disconnected from MFEnet during this phase.

**Phase II (October–December 1988):** We will complete the ESnet backbone and connect additional sites to the backbone. This phase will require some sites to be disconnected from MFEnet. The MFEnet to ESnet transition gateway must be installed during this phase. Additional sites affected include CEBAF, FNAL, MIT, Oak Ridge National Laboratory, and UCLA.

**Phase III (Calendar Year 1989):** We will continue to switch major hub sites from MFEnet to MFEnet II, along with all secondary sites connected through those hub sites.

### So You Want More Detail

The three groups that comprise the Networking and Engineering enterprise are led by Barry Howard, Paul Lund, and Tim Voss. Although the ESnet activity is clearly our highest priority, other activities are also required. The following articles describe the work of these three groups.

# ESnet

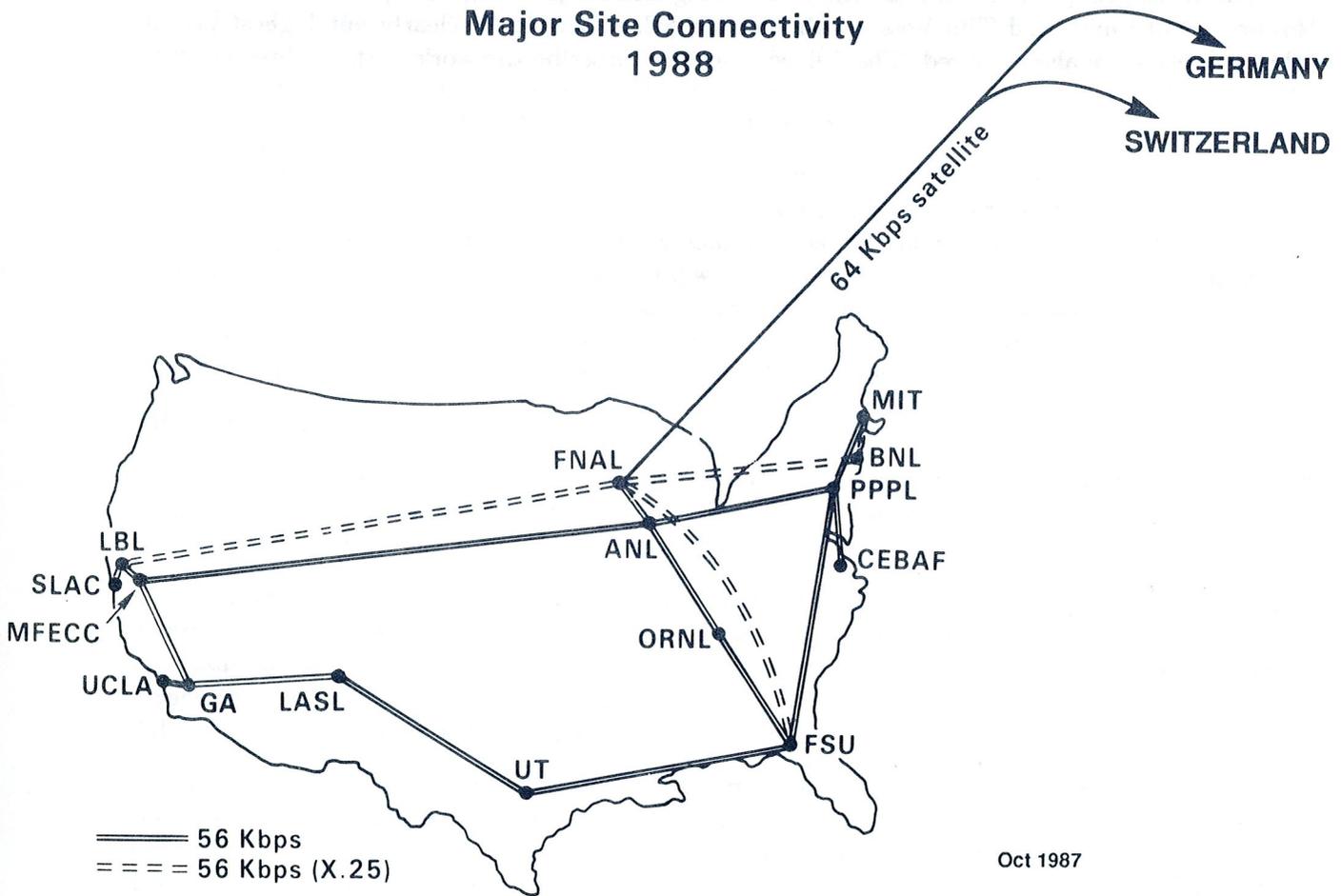


Figure 1. ESnet—major sites to be connected in 1988.