PRODUCT REVIEW

The laboratory networking dilemma

from W.H. Jennings

Computer networking in the research laboratory is still a rarity. But growing demands for shared resources may prompt laboratories to make the connection . . . the question is when and how.

WITH the advent of microcomputers, data acquisition and control became dominated by systems dedicated to or embedded within the research instrument. The constraints of real-time operation and the limited computational capacity of these systems favours the transfer of raw data files to another machine for computationally intensive processing. While most scientists are familiar with this sort of transfer, local area networks that make the various computers within a department accessible to all department staff are still uncommon. Yet many research laboratories could benefit enormously from systems that distribute data to the computer most appropriate for a particular computational task.

Presently, moving data between machines is often accomplished by media transfer using magnetic tape or some form of disk. the difficulties of media transfer have encouraged the development of file transfer techniques that use serial transmission to transport data, often via telephone lines. Although vendors have been dragging their feet in devising common file format and transfer protocols for larger machines, several reasonably documented protocols exist for personal computers, and some of these have been adapted to large machines. There is then the potential for any computer-based laboratory instrument to transfer data to a departmental host machine or even some remote computer.

But realizing this potential at a level truly useful to laboratory scientists requires networking technology, and this technology is in flux. Herein lies the first element of the dilemma: when is it appropriate for a laboratory to implement a computer network?

Choosing the moment

Unfortunately, very few laboratories have the luxury of implementing a network *de novo* because of the computer-based instruments and/or the relatively expensive departmental computers they may have already accumulated. Interconnecting a variety of vendors' products, some of which may be obsolete, can pose problems. And of the many network products now available, there is probably no one product that is appropriate for all laboratory applications.

Nonetheless, rather straightforward means are available to remedy most of these complications, even though in some cases the solutions may be only marginally adequate. Networks are intrinsically expandable and extensible and their future value may be far more important than present economic or productivity gains. Current network standards offer both physical connectivity with fairly long lifetimes and protocols that, being software, can be upgraded. There is then no compelling argument here to wait for further developments.

In fact, the decision to implement a laboratory network does not depend so much on issues of technology as on the commitment of laboratory personnel and funding. Even though its tangible portions may be limited to cables and connectors, a network requires considerable management and support, and in most labs these functions must be provided by existing personnel. Because the majority of networks are implemented at the departmental level rather than in top administrative or corporate echelons, the laboratories that will share the network usually have to dip into their own financial and personnel resources to sustain it.

The department that has decided to commit itself to networking confronts the second element of the dilemma: how can a laboratory network its computer resources? A variety of consultants and manufacturers provide technology support for networking projects, but the development of in-house expertise is desirable for both implementation and subsequent operations management.

Casting the net

The volume and characteristics of the data handled within a laboratory will determine a rough lower limit for network capacity. Generous margins should be added to allow expansion. Where very high data volume is required, a limited local network with a gateway to other networks can be a worthwhile option.

"Dumb" terminals and instruments that cannot be upgraded with a network interface can gain network access through terminal concentrators, which accept RS-232 serial transmissions and perform the necessary hardware and software functions to interface to the network. This access is limited in functionality and speed; however, it is adequate for the majority of these devices.

The nearly ubiquitous personal computer can be connected either directly through an interface card or indirectly through a terminal concentrator. Terminal emulation software disguises the personal computer so that it appears to a remote computer as one of a variety of popular terminals. The networked PC can thus perform interactive file manipulation and execute programs on the remote system. Most emulation software provides for file transfer to or from the remote as well.

Techniques for access and sharing of files and programs throughout a network are being extensively tested on advanced networks of more than 1,000 nodes. Meanwhile the next generation of computer systems, the personal workstation, is beginning to appear in the research laboratory. This device has a large memory, high resolution graphics and computational power exceeding that of some minicomputers. Most are sold with a network interface and AT&T's operating system UNIX, which already contains many networking functions.

The goal of networking is to make efficient use of computer resources, providing access to any level of computational power that the user might require without the bother of juggling cables, connections or conversions. For any laboratory ready to commit modest resources, this goal is already in sight. □

Computer networks at work

Du Pont Experimental Station Wilmington, Delaware	**An Ethernet system connects 40 buildings over 150 acres**
Upjohn pharmaceutical R&D complex Kalamazoo, Michigan	**A network comprised of 5 km of cable is tied to seven systems in separate facilities**
General Motors research facility Warren, Michigan	**Over 300 IBM and DEC microcomputers are linked by a minicomputer intermediary**

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