THE EVALUATION OF LOCAL AREA NETWORK DESIGNS THROUGH SIMULATION

Richard G. Born
Northern Illinois University

The widespread growth in the use of local area networks (LANs) is not surprising when considering that three-quarters of the traditional information distribution needs of an organization are within departments or shared among departments. Current LANs even demand access beyond department boundaries and are reaching into the factory and process control applications. Therefore, the managerial analysis of the capabilities of proposed LANs as well as the analysis of competing LAN designs is becoming more complex. As a result, many organizations are finding that it is advantageous to simulate a proposed LAN or internetwork of several LANs prior to implementation. This paper addresses how a special-purpose LAN simulation and modeling tool, LANNET II.5, can be used by data communications management to answer a variety of questions that frequently arise when considering decisions related to the implementation of LANs in an organization. Such a tool would also be appropriate for use by management information systems (MIS) students in a business data communications course, as it allows concentration on the nature of the activities of LAN users without the need for programming.

The advent of the microprocessor in the early 1970s and the development of the first microcomputer systems in the late 1970s spurred the growth of distributed computing that characterized the first half of the 1980s. As the decade progressed, however, it rapidly became clear that an essential element was missing--connectivity. Microcomputer users began to realize that they needed to communicate with each other as well as with the centralized data processing facilities of the organization. The era of what might be called distributed connectivity had begun and continues to this day.

The local area network (LAN) has played a major role in distributed connectivity as it has allowed microcomputer users within a relatively small geographic area, such as a building or group of buildings, to communicate with one another. Many of the earliest LANs served a variety of office automation functions including electronic filing, scheduling, data base inquiry, word processing, and information dissemination (McGovern, 1988; Stallings, 1990; Stamper, 1990). The benefits of such an arrangement are widely known and include the sharing of expensive equipment such as printers, plotters, and storage devices, as well as the sharing of software, files, and data bases. Other benefits were an
increase in the productivity and performance of work groups as a result of electronic messaging and the spawning of new applications that provide innovative solutions to everyday business problems (Allan, 1989; McGovern, 1988).

More recently, LANs have also been making their tracks in factory applications (Heisterberg, 1988; Stamper, 1989). These include computer aided design (CAD) in the automobile and aerospace industries and computer aided manufacturing (CAM) and its associated control of assembly line operations, robots, manufacturing processes, and machinery. Another important goal of LANs in the factory is the integration of a factory’s data bases: material handling, labor reporting, quality control, tool and machine maintenance, work-in-progress inventory control, and material requirements.

Along with the increasing use of LANs in the office and factory, as well as the associated need for internetworking these LANs into an integrated corporate network, came a variety of puzzling questions:

• What LAN protocol is best for a particular environment? Should the protocol be a collision based Ethernet or a token based ring or bus?
• What is the maximum number of users that the LAN can support for the data entry function?
• How will internetworking two LANs via a bridge, router, or gateway affect traffic patterns on the individual LANs?
• What will be the effect on current LAN traffic if data base query capability is added to the existing application repertoire of E-mail and data entry?
• What will be the effect on LAN traffic if CAD/CAM applications are implemented that involve a significant number of high volume image transfers?
• Will the response times provided by the LAN be within the acceptable limits established by management and users prior to LAN implementation?
• What storage capacity will be required by the file server so that it may adequately serve the needs of all users?

All of the above questions share the common thread of being concerned with some aspect of the performance of a LAN. They all involve the analysis of the capabilities of proposed LANs in addition to the analysis of the performance of competing LAN designs. The nature of these questions also suggests that it may, in many cases, be appropriate for management to provide for simulation of LANs and their expected traffic patterns before investing tens-of-thousands of dollars into their acquisition and implementation.

This article discusses how a special-purpose LAN simulation tool, LANNET II.5, may be used by data communications management to address questions such as those just posed (LANNET, 1990). For a variety of reasons, LANNET II.5 is also an excellent package for teaching LAN modeling and analysis to students of management information systems (MIS). First, since no programming is required, the student can concentrate on the activities of the LAN users as well as the characteristics of the workstations in use by the users. Second, the package allows for easy animation of the LAN so that one can follow a visual trace of events on the LAN as they occur. Finally, the developer of LANNET II.5, CACI Products Company, offers worldwide university support for its product.

The next section of this article describes, in general terms, the nature of LAN simulation as it is accomplished through LANNET II.5. The final section takes the reader on a tour of an example LAN that illustrates how the data communications manager or MIS student might think through the simulation of a LAN. In addition, the final section analyzes some of the performance data that are generated as a result of simulation of the example LAN.

The Nature of LAN Simulation

Figure 1 shows how a local area network
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