

**THE USE OF COMPUTER SIMULATION AS A PEDAGOGICAL AID
IN TEACHING MANAGEMENT INFORMATION SYSTEMS**

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ABSTRACT

Information Technology (IT) is a term that subsumes the traditional areas of computers and telecommunications. The Management Information Systems (MIS) course is rapidly evolving into an Information Technology (IT) course for all business majors. A key portion of this course is intended to introduce students to the major telecommunications technologies that are an integral part of networking. This paper focuses on computer simulation designed to facilitate the rapid learning of the many new technologies in telecommunications. Simulation tools such as NETVIZ and GRAFNET have been evaluated and will be demonstrated and discussed. Future MIS courses need to be supplemented with this type of software so that students will gain familiarity with the basic principles and design of modern networking. Such software is now being employed routinely by the practitioners in industry to model modern networks.

INTRODUCTION

In the new information age society is increasingly dominated by Information Technology (IT), the merging of computers and communications. Value in business is increased by knowledge and the speed of movement of that knowledge. Such knowledge (or information) increases the value in a product, and not labor as in Ricardo's labor theory of value (Fitzgerald and Dennis, 1996). Management Information Systems (MIS) courses were one of the first manifestations of this phenomenon and are included in most business curricula (Stallings, 1994).

Management Information Systems were introduced in the 1970s, they were quickly supplemented by Decision Support Systems, Expert Systems, and Executive Information

Systems. These systems were all computer based. When IT developed in the 1980s, a new technical area emerged. Networking was necessary to tie together the many new PCs in the corporation. An increasing number of companies decided to transition their major business applications with Local Area Networks (LANs), Metropolitan Networks (MANs), and most recently, to Wide Area Networks (Vargo and Hunt, 1996). Even the most powerful applications that used to run on mainframes are today running on networks. Industries such as the airlines, banking, and most utilities are all heavily reliant on networks in the 1990s (Rowe, 1991).

To provide business students with an appreciation of various networked applications, it is necessary to introduce networking into the MIS course. Since networking relies heavily on telecommunications, many books used for the MIS course have telecommunications in at least one chapter. Since telecommunications is a subject to which entire college courses are devoted, adequate coverage is a major challenge. One way to bridge the gap is to consider using computer simulation.

**THE TELECOMMUNICATIONS
CHALLENGE**

There are several excellent textbooks that can supplement the normal textbook in a traditional MIS course. A fairly simple treatment at the undergraduate level is Business Telecommunications (Rowe, 1996). This text does an excellent job of explaining the technical details of telecommunications, as well as the important role of standards.

At the graduate level Business Data Communications and Networking (Fitzgerald and

Dennis, 1996) is an excellent textbook that goes into more detail, especially in networking. Modern networking technologies such as frame relay, Asynchronous Transfer Mode (ATM), collapsed backbone Local Area Networks (LANs), and switched networks are among the subjects that receive excellent coverage. Another good treatment of telecommunications and networking at the graduate level is Telecommunications in Business (Vargo, 1996). Other good textbooks such as Computer Networks (Tanenbaum, 1996) are available, but are advanced treatments and more appropriate for computer scientists.

There are practical problems in requiring a telecommunications textbook. It is difficult to justify having students buy both a MIS/IT textbook e.g. Information Technology (O'Brien, 1996) and an expensive telecommunications textbook. Even if students buy both textbooks, there is insufficient time in the course to cover enough telecommunications material to afford even a cursory coverage of networking. The chapter in the IT textbook is normally an overview of telecommunications.

Clearly, a different approach is required to be able to provide students with adequate coverage of telecommunications and networking. To be able to provide students with even a rudimentary understanding of networks requires instruction on such topics as: (1) the public switched network; (2) basic data communications concepts and technology e.g. modems, multiplexers, routers, and bridges; (3) basic standards and protocols (e.g. Open System Interconnection Model); and (4) network management. These topics are a minimal subset with many important areas omitted. Other subjects requiring attention include private branch exchanges (PBXs), media (fiber optics, coaxial cable etc.), critical applications (i.e. Electronic Data Interchange, Electronic Funds Transfer, and E-Mail) and the Internet. (Ramos, Schroeder and Beheler, 1996). Without a major reduction in the traditional MIS areas, it is not possible to cover networking adequately. Fortunately, there is a

solution to this problem. By employing simulation the networking pedagogical gap can be bridged.

DISCUSSION

One approach that has been employed successfully in both MBA and Executive MBA programs has been to employ computer simulation models. Such models are useful in presenting telecommunications material. The use of simulation results in a major reduction of the time that it takes to cover the telecommunications and networking material.

Specifically, graphical simulation software aids exists to facilitate the understanding of the role of such key components as routers, bridges, multiplexers, repeaters and private branch exchanges (PBXs). Even more important is the integration of these components into viable networks. In this role graphical simulation tools excel. The rapid learning of important networking concepts is made much easier by the use of simulation software.

GRAFNET PLUS

One package that has been employed is called *GRAFNET Plus*. This software is effective in drawing network maps. In a restricted version, it is free to schools for educational purposes. It is a graphics-based simulation tool that requires Microsoft Windows and an IBM compatible computer as a platform. Included are maps that span the entire world. It is capable of recording, documenting and showing communications networks that cover an entire country or a local area. Besides the actual maps, it can be used to create and maintain a database of all network nodes and links. This software package systematically plots the network on geographical maps. It is then possible to "drill down into" a specific state, or selected region. The ability to generate extensive reports of network parameters is an added bonus. Excellent network graphs and reports can be displayed on the screen or sent to a printer (Fitzgerald. 1996).

GRAFNET Plus is simple to demonstrate and easy for students to learn. Simple pull-down menus and dialog boxes provide a rich assortment of features. Map information for relating telephone numbers to appropriate map coordinates is in the software. For international map locations, the user enters the country code, and the appropriate telephone number. Alternately, a user can specify the geographical location of a node by its latitude and longitude. Using convenient pull-down menus, the user can link the nodes with circuits, adding other information, such as whether the node is a gateway, multiplexer or some other piece of hardware.

NETVIZ

NETVIZ is a Windows-based program that offers users (primarily network administrators) a simple and powerful tool for complete documentation of all systems. In the past network administrators had to resort to drawing programs to create network diagrams. This often resulted in the administrators losing track of essential configuration management details. Often administrators used separate spreadsheets and databases to organize the necessary details. Unfortunately, this approach resulted in the loss of a “top-down” capability to see how network components fit together.

While GRAFNET can satisfy both graphical and detailed requirements of a network, NETVIZ offers additional functionality. It is a flexible package that integrates drag-and-drop graphics with a way to dynamically manage a network. It has additional tools that facilitate the rapid learning of the package and the ability to display data in a number of different formats. This includes the capability to drill all the way down to a network component.

Both packages offer quick and convenient tools to learn the basic concepts of networking. Examples of actual networks can be easily demonstrated using the graphical capabilities of both GRAFNET and NETVIZ. Starting with a wide-area network (WAN), students can quickly grasp the major

building blocks and key concepts. The superimposing of WANs on maps of the United States enhances realism and understanding.

By drilling down into each major city or local area, it is possible to demonstrate networking at each level. Students quickly recognize the role of routers and gateways. They begin to understand how cities can be efficiently wired up with fiber (e.g. Fiber Distributed Data Interface or FDDI) to accommodate multiple users. Within buildings it is easy to demonstrate how Local Area Networks (LANs) have evolved from relatively simple segments to modern “collapsed backbone” networks (Fitzgerald and Dennis, 1996). Using an embedded database, it is possible to tailor every component by type and configuration. This ability to define the attributes for components on the network is a major teaching vehicle.

STUDENT ASSIGNMENT

It is very important that the material just learned be reinforced by a written assignment. At the end of the telecommunications class students can be given a student version of either software package along with: (1) the networks just demonstrated in class; and (2) a reference book from either GRAFNET or NETVIZ. These materials are adequate for the students to complete an assignment in which they must do the following:

1. Prepare a wide area network in the United States assuming you are the “XYZ Company”.
2. Locate office buildings in 18 major cities
3. Link four of the cities with a frame relay system. Five others are connected by satellite and the remaining with an X.25 system.
4. Drill down into two cities and configure at least three office buildings in each city with LANs.
5. Exercise the software in a creative way with a rich assortment of devices from the nodes palette.
6. Print out the network and submit a cover letter to the VP of Information Services. This letter will propose this network as a solution to the company’s needs.

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Students are asked to work in teams of two (one three person team is permitted if the number of the class is odd). Collaboration between teams is not permitted once writing is initiated on the assignment by either team. Maximum emphasis (twenty percent of the grade or more) is placed on creativity and ingenuity. Students are encouraged to research existing networks that have been installed and to use this information in their design work.

RESULTS

With few exceptions the written assignment has been an unqualified success. Some students initially encountered difficulty in loading the student version of the software. However, having a help number to call resolved all difficulties. Once the students learned how easy it was to manipulate the icons and the keystrokes to accomplish the graphical diagram, a great deal of enthusiasm and learning ensued. Students reported that this exercise is one of the highlights of the MIS course at the Master's level.

There has not been an opportunity to try it on undergraduates. However, it was used six times at the graduate level.

Student work has run the gamut from acceptable to truly outstanding. All students were able to complete the assignment. Some students produced fairly sophisticated networks and their learning was accordingly high. A typical student comment was "I never knew what the network people were talking about before; now I have the ability to actually discuss network issues with them".

CONCLUSIONS

The use of graphical simulation is an excellent aid to supplement the teaching of networks and telecommunications. All future MIS (IT) courses need to be supplemented with simulation software. Through the effective use of such software it is possible for students to rapidly gain familiarity with the basic principles and design of modern networking. Such simulation software is now being routinely used by practitioners in industry to model modern networks. The student version of this simulation software is ideal for use in the modern classroom

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