IRM PRESS
701 E. Chocolate Avenue, Hershey PA 17033-1117, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.irm-press.com
ITB9098

Chapter IX

The TCP/IP Game

Norman Pendegraft
University of Idaho, USA

ABSTRACT

This chapter describes a simulation game used to help students understand the operation of TCP/IP. In the game, students play various layers of TCP/IP on several machines and collaborate to transmit a message from one application to another. The game is used in a telecommunications management course taken primarily by MIS majors at the senior level. The game consumes about 1 hour, and anecdotal evidence suggests that it is helpful to the students.

INTRODUCTION

Many IS curricula offer a telecommunications management course. Our course attempts to balance the technical and managerial issues involved in TC management, and because of the large subject matter, time is limited for each topic. The technical topics include TCP/IP and the more general ISO layered model. It has been my experience that many students, exposed only to reading and lectures, do not understand the interaction between the layers, or why each is necessary, or how the whole package works. One possible solution is to have the students build a computer simulation of TCP/IP, however, such an assignment is time consuming and technically demanding. For all its value, it seems a misuse of the limited time available in this course. Another alternative is to create a simulated system and let students experiment with it. For example, Campbell (1996) simulated a computer and let students write assembly language programs to run on the computer. Yet another alternative is to develop a simulation game.

SIMULATION GAMING

Simulation gaming is predicated on the notion that students learn better from experience than from lectures and reading. It also introduces a sense of play into learning, which makes it fun, as it should be. Students are actively involved rather than passive, and the connections between pieces are often easier to see when experienced (Corbeil, 1989; Greenblat, 1988). After many years of experience using various games in class, the author has come to believe strongly in their value as pedagogical vehicles (see, for example, Butterfield & Pendegraft, 1996; Pendegraft & Watson, 1990). Informal student response to these games has been enthusiastic. Here, a simulation game was developed to let the students experience the operation of TCP/IP. The purpose of the simulation was to help the students understand the function of each layer and, in particular, to understand how the layers interact with each other.

TCP/IP

There are many excellent discussions of TCP/IP (for example, Hunt, 1998). This section is not intended to give a detailed or technical description of TCP/IP, but rather to clarify some of the simplifications imbedded in the simulation. In order to keep the simulation manageable, many of the specific functions are excluded from the simulation or are included only notionally: that is, they are dealt with via conversation between the students and the instructor.

TCP/IP is a layered packet switching protocol. Messages are broken into pieces (packets), each of which is sent to the destination independently of the other pieces. Each layer performs a set of functions, which together, result in a reliable communications connection. Each layer adds to the packets its own header containing information needed by the same layer at the receiving end. While each layer may take the packet from the higher layer and break it into smaller pieces, this is only done by the TCP layer in the simulation. Error correction is handled notionally. This simplifies the simulation and allows for focus on more important issues. A brief summary of each TCP layer follows.

Application Layer

The application layer includes processes like email, Web services, and database management systems. A port number identifies each application running on top of TCP/IP. Several well-known port numbers are used in the example.

The Domain Name Service (DNS) is an application layer service that converts domain names like www.whitehouse.gov or ebay.com into their IP addresses. DNS services are outside the scope of this exercise and are notional in the simulation. DNS information is assumed available to IP in the simulation.

TCP Layer

The transport control protocol (TCP) creates and maintains connections between machines. It breaks traffic into pieces called segments, calculates and appends a CRC (cyclical redundancy checksum) to each, and sends them to the next layer, IP. Each packet is addressed to the correct port (application) on the receiving machine. TCP on the receiving machine checks the CRC of each segment and acknowledges those correctly received. Those unacknowledged in time are resent. Error detection and retransmission are handled notionally