PACKET RADIO DEMONSTRATIONS AS A SUPPLEMENT TO CLASSROOM INSTRUCTION1 IN TELECOMMUNICATIONS

by

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Abstract

During the past year the author has had the opportunity to use packet radio hardware and operations to demonstrate concepts taught in telecommunications courses at an upper-level university. This article provides a brief discussion of how this was accomplished. A description of the courses and their intended audience has been included.

Introduction

Corpus Christi State University is a state-supported upper-level institution with an enrollment of approximately 3,700 students. There are approximately 300 students majoring in computer science. About 100 are graduate students, and the remainder are seeking the bachelor% degree. Both the undergraduate and graduate curricula are oriented more toward applications of computing rather than theoretical computer science.

During the past year two different courses were offered. An undergraduate course, CS 442 Teleprocessing, deals primarily with terminology and various telecommunications software systems used on IBM mainframes. Data Communications Software Design by Malcom G. Lane is the textbook used in the course. A graduate course, CS 555 Telecommunications Systems, deals with more theoretical issues and in particular the networking of computer systems. The textbook is Computer Networks by Andrew S. Tanenbaum. Tanenbaum's book needs no introduction. Lane's text, which is based on the work of Tanenbaum and others, includes chapters network architectures, data link control protocols, and protocol definition.

It is important to note that unless the student has had experience with computer networking through his/her job, dialing into a local TELENET, TYMNET, or UNINET port may be as close as any have been to networking. None of the university's computers are interconnected,

Presentation of Packet Radio Hardware

The end of Tanenbaum Chapter 4 is an appropriate time for the first presentation of packet radio hardware. The few components in a Terminal Node Controller can be easily presented in a block-diagram approach. Thus, the student gets some concrete idea of how textbook examples might be realized. The fact that the physical level is implemented in hardware takes on new meaning. Data link layer functions such as framing can also be tied in particularly if time is taken to review the functions provided by most HDLC controllers. A parallel can be drawn between the functions performed by a TNC and a packet assembler/dissassembler during discussions of packet switched public data networks.

Now the function of hardware and software to be governed by the X.3, x.28, and x.29 standards can be more easily understood.

For actual on-the-air demonstrations approximately six stations were available. One TNC and radio was in the classroom. There was another system in another room in the same building. A station was on the air at the author's residence and a few other stations were on in the city.

Presentation of Packet Radio Protocols and Operations

While packet radio hardware in the form of a TNC reinforces certain concepts, the operational aspects of a packet radio network provide even more examples to solidify theory. When presenting the AX.25 protocol it is important to note that it was designed for a half-duplex broadcast medium as opposed to a full-duplex point-to-point link. A demonstration of such a network even in a relatively low traffic area such as Corpus Christi can be extremely beneficial.

It should also be noted at this point that previously published papers on amateur packet radio protocol and network development provide a large and pertinent collection of supplemental material. Most notable are the AX.25 Amateur Packet-Radio Link-Level Protocol Standard published by ARRL and the AMICON System Specification by H.S. Magnuski, KA6M.

Even, with only a few stations available, the problems of collisions and congestion in broadcast networks are apparent. The demonstration of digipeaters clearly shows the impact of end-to-end acknowledgements. The 0.19 theoretical maximum efficiency of a pure-broadcast network becomes entirely believable. Address assignment issues can be presented. Of course all these issues can be decided on a purely theoretical basis, but the demonstrations supplement the textbook material very well.

The operational demonstrations were given after Tanenbaum Chapter 6, Satellite and Packet Radio Networks. A discussion of the UoSAT-2 DCE, PACSAT, and JAS-1 spacecraft was included at this point.

Packet Radio and Satellites

With less than a month remaining in the graduate course last fall, our student programming team left for the ACM South Central Regional Programming Contest. Two students from the Telecommunications class were on the team. Imagine their surprise when the first problem statement began, "A text message has been received from the ACMSTAT satellite. The message is encoded as a file of packets named PACKETS.DAT. Each packet contains seven characters along with error-detection and correction information..." The team captain later reported many other teams remarking to themselves, "What is this... packets and satellites?". Did the demonstrations help? Only four of the forty-three teams completed the problem. The exposure to packet radio applications on earth and in space couldn't have hurt.

Conclusion

It has always been a personal goal of the mine to bring theory and application together. It is a rare opportunity when a hobby and a profession can be synthesized to accomplish that goal. From a teacher's point of view the important outcome was a few more concepts obviously more

clearly understood. From a radio amateur's point of view the important outcome was one licensed amateur and two more studying for the exam. Clearly it was a productive semester.

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