APPENDIX A

BUSINESS DATA COMMUNICATIONS PROJECTS

Many instructors believe that research or implementation projects are crucial to the clear understanding of the concepts of data and computer communications. Without projects, it may be difficult for students to grasp some of the basic concepts and interactions among components. Projects reinforce the concepts introduced in the book, give the student a greater appreciation of the how protocols and transmission schemes work, and can motivate students and give them confidence that they have mastered the material.

In this text, I have tried to present the concepts as clearly as possible and have provided nearly 200 homework problems to reinforce those concepts. Many instructors will wish to supplement this material with projects. This appendix provides some guidance in that regard and describes support material available in the instructor's supplement. The support material covers six types of projects and other student exercises:

- Animations and animation projects
- Practical exercises
- Wireshark projects
- Research projects
- Reading/report assignments
- Writing assignments

A.1 ANIMATIONS AND ANIMATION PROJECTS

Animations provide a powerful tool for understanding the complex mechanisms of network protocols. A total of 12 Web-based animations are used to illustrate protocol behavior. Each animation allows the users to step through the operation of the protocol by selecting the next step at each point in the protocol exchange. Table A.1 lists the animations by chapter. At appropriate places in the textbook, the animations are indicated by an icon so that the student can invoke the animation at the proper point in studying the book. The animations will be made available to professors at the **Instructor's Resource Center** (**IRC**) for this book in such a way as to enable online access by students.

The animations can be used in two ways. In a **passive mode**, the student can click more or less randomly on the next step at each point in the animation and watch as the given concept or principle is illustrated. The **active mode** can be used for two types of assignments. First, the student can be given a specific set of steps to invoke and watch the animation and then be asked to analyze and comment on the results. Second, the student can be given a specific endpoint and required to devise a sequence of steps that achieve the desired result. The instructor's supplement includes a set of assignments for each of the animations, plus suggested solutions so that instructors can assess the student's work.

These animations were developed at the University of Stirling in Scotland by Iain Robin and Ken Turner, with contributions from Paul Johnson and Kenneth Whyte [TURN01]. Larry Tan of the University of Stirling developed the animation assignments.

Table A.1 Business Data Communications Animations by Chapter

Chapter 4—The Internet	
Boot Protocol Simulator	A simple connection-less protocol, typically used by a diskless workstation to discover its Internet address and/or the name of its bootstrap file.
Chapter 5—TCP/IP	
TCP Client/Server Simulator	The use of TCP to support client/server interaction.
TCP Peer-to-Peer Simulator	The use of TCP to support peer-to-peer interaction.
UDP Simulator	Demonstrates UDP operation.
IP Simulator	Demonstrates IP operation.
Trivial File Transfer Protocol Simulator	Demonstrates TFTP operation.
Chapter 7—Internet-Based Applications	
SMTP Simulator	Simulator deals with main commands: HELO, MAIL FROM, RCPT TO, DATA, QUIT.
HTTP Simulator	Simulator deals with main commands: GET, HEAD, POST, PUT.
Chapter 17—Data Link Control and Multiplexing	
Alternating Bit Protocol Simulator	A connection-less protocol for transferring messages in one direction between a pair of protocol entities. It is a simple form of the Sliding Window Protocol with a window size of 1.
Sliding Window Protocol (3-column Simulator)	Illustrates sliding-window operation without showing the end users.
Sliding Window Protocol (5-column Simulator)	Illustrates sliding-window operation showing the end users.
Abracadabra Protocol Simulator	A connection-oriented protocol that allows data to be sent in either direction using the Alternating Bit Protocol.

A.2 PRACTICAL EXERCISES

The instructor's supplement includes Web pages that provide a set of practical exercises for an introduction to the use of IP over a LAN. The exercises naturally follow one another and build on the experience of the previous exercises. They do not, however, need to be attempted one after another. The four exercises may more easily be done on four separate occasions. The practical exercises are designed to help the student understand the operation of an Ethernet LAN and an IP network. The exercises involve using simple network commands available on most computers. About an hour is needed to perform all four exercises. The exercises cover the following topics: your own network connection, computers on your LAN, computers on remote networks, and the Internet.

A.3 WIRESHARK PROJECTS

Wireshark, formerly known as Ethereal, is used by network professionals around the world for troubleshooting, analysis, software and protocol development, and education. It has all of the standard features you would expect in a protocol analyzer and several features not seen in any other product. Its open source license allows talented experts in the networking community to add enhancements. It runs on all popular computing platforms, including UNIX, Linux, Windows, and Mac OS X.

Wireshark is ideal for allowing students to study the behavior of protocols not only because of its many features and multiplatform capability but also because students may subsequently use Wireshark in their professional life.

The IRC includes a Student User's Manual and a set of project assignments for Wireshark created specifically for use with *Business Data Communications*. In addition, there is a very useful video tutorial that introduces the student to the use of Wireshark.

Michael Harris of Indiana University initially developed the Ethereal exercises and user's guide. Dave Bremer of Otago Polytechnic in New Zealand updated the material for the most recent Wireshark release; he also developed the online video tutorial.

A.4 RESEARCH PROJECTS

An effective way of reinforcing basic concepts from the course and for teaching students research skills is to assign a research project. Such a project could involve a literature search as well as a Web search of vendor products, research lab activities, and standardization efforts. Projects could be assigned to teams or, for smaller projects, to individuals. In any case, it is best to require some sort of project proposal early in the term, giving the instructor time to evaluate the proposal for appropriate topic and appropriate level of effort. Student handouts for research projects should include

- A format for the proposal
- A format for the final report
- A schedule with intermediate and final deadlines
- A list of possible project topics

The students can select one of the listed topics or devise their own comparable project. The instructor's supplement includes a suggested format for the proposal and final report plus a list of possible research topics.

A.5 READING/REPORT ASSIGNMENTS

Another excellent way to reinforce concepts from the course and to give students research experience is to assign papers from the literature to be read and analyzed. The IRC site includes a suggested list of papers to be assigned, organized by chapter.

The IRC provides a copy of each of the papers. The IRC also includes a suggested assignment wording.

A.6 WRITING ASSIGNMENTS

Writing assignments can have a powerful multiplier effect in the learning process in a technical discipline such as data communications and networking. Adherents of the Writing Across the Curriculum (WAC) movement (http://wac.colostate.edu/) report substantial benefits of writing assignments in facilitating learning. Writing assignments lead to more detailed and complete thinking about a particular topic. In addition, writing assignments help to overcome the tendency of students to pursue a subject with a minimum of personal engagement, just learning facts and problem-solving techniques without obtaining a deep understanding of the subject matter.

The IRC contains a number of suggested writing assignments, organized by chapter. Instructors may ultimately find that this is the most important part of their approach to teaching the material. I would greatly appreciate any feedback on this area and any suggestions for additional writing assignments.