

- d. In addition to reducing delay, what are reasons to use message segmentation?
  - e. Discuss the drawbacks of message segmentation.
- P32. Consider Problem P31 and assume that the propagation delay is 250 ms. Recalculate the total time needed to transfer the source data with and without segmentation. Is segmentation more beneficial or less if there is propagation delay?
- P33. Consider sending a large file of  $F$  bits from Host A to Host B. There are three links (and two switches) between A and B, and the links are uncongested (that is, no queuing delays). Host A segments the file into segments of  $S$  bits each and adds 80 bits of header to each segment, forming packets of  $L = 80 + S$  bits. Each link has a transmission rate of  $R$  bps. Find the value of  $S$  that minimizes the delay of moving the file from Host A to Host B. Disregard propagation delay.
- P34. Early versions of TCP combined functions for both forwarding and reliable delivery. How are these TCP variants located in the ISO/OSI protocol stack? Why were forwarding functions later separated from TCP? What were the consequences?

## Wireshark Lab

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*“Tell me and I forget. Show me and I remember. Involve me and I understand.”*  
Chinese proverb

One’s understanding of network protocols can often be greatly deepened by seeing them in action and by playing around with them—observing the sequence of messages exchanged between two protocol entities, delving into the details of protocol operation, causing protocols to perform certain actions, and observing these actions and their consequences. This can be done in simulated scenarios or in a real network environment such as the Internet. The Java applets at the textbook Web site take the first approach. In the Wireshark labs, we’ll take the latter approach. You’ll run network applications in various scenarios using a computer on your desk, at home, or in a lab. You’ll observe the network protocols in your computer, interacting and exchanging messages with protocol entities executing elsewhere in the Internet. Thus, you and your computer will be an integral part of these live labs. You’ll observe—and you’ll learn—by doing.

The basic tool for observing the messages exchanged between executing protocol entities is called a **packet sniffer**. As the name suggests, a packet sniffer passively copies (sniffs) messages being sent from and received by your computer; it also displays the contents of the various protocol fields of these captured messages. A screenshot of the Wireshark packet sniffer is shown in Figure 1.28. Wireshark is a free packet sniffer that runs on Windows, Linux/Unix, and Mac computers.