



Lab 3.1.9a Communications Circuits – Instructor Version

Objective

- Design a simple communication system that is fast and reliable.
- Build the system using common materials.
- Test the system.

Background / Preparation

For reliable communications to take place on a network, things like the physical method of signaling and the meaning of each signal or series of signals must be defined ahead of time. Create a simple physical network and agree on some basic rules for communication in order to send and receive data. This will be a digital network based on the American Standard Code for Information Interchange (ASCII). It will be similar to the old telegraph Morse code-based systems. In these older systems the only means of communicating over long distances was by sending a series of dots and dashes as electrical signals over wires between locations. Although the technology used will be more simple than real systems, many of the key concepts of data communications between computers will arise. This lab will also help to clarify the functions of the layers of the OSI model.

Each team must design, build, and test a communications circuit with another team. The goals are to communicate as much data, as quickly and with as few errors, as possible. During this communication, spoken, written, or nonverbal communication of any kind, is not allowed. The only communication allowed is over the wire. The teams must agree on the physical connections and on the coding to use. One team will send a message to the other team. The other team must interpret the intended message without knowing ahead of time what the message was. Keep the OSI model in mind as the system is designed.

Prior to starting the lab, the teacher or lab assistant should have one multimeter available for each team of students and various items for construction of a simple communication network. Work in teams of two to four.

The following resources will be required. Review the purpose of each of the following required items because it will help in the design of the network.

Network Construction Item Required	Purpose
Fluke 110, 12B or equivalent multimeter	For testing communication connections
20' Category 5 UTP cable	For the physical communications lines. The cabling medium.
ASCII chart	To help with coding and interpretation of signals. If there is no hardcopy of the 7-bit ASCII code chart, search the Internet for the words "ASCII chart".
Light switch	To activate the signaling device in order to create the digital on/off, binary, signals

6v light bulbs with bulb bases or LEDs with resistors	To act as the signaling device
6v lantern battery	To power the signaling device
Wire cutters or wire strippers	To adjust the length and prepare the ends of the communication lines

Layer 1 issues

Connect two pairs of wire in order to have communication in both directions, half or full duplex.

Layer 2 issues

Communicate a frame start and stop sequence. This is a sequence of bits that is different than the character and the number bits transmitted.

Layer 3 issues

Invent an addressing scheme for hosts and networks, if it is more than point-to-point communication.

Layer 4 issues

Include some form of control to regulate quality of service. For example, error correction, acknowledgment, windowing, or flow controls.

Layer 5 issues

Implement a way of synchronizing or pausing long conversations.

Layer 6 issues

Use a means of data representation. For example, ASCII encoded as optical bits.

Layer 7 issues

Be able to communicate an idea supplied by the instructor or invent a message.

Reflection

1. What issues arose as the communications system was being built, that apply to data communications between computers?

Some students may have issues interpreting the ASCII tables available throughout the Internet. Many charts do not have a binary representation for ASCII characters. This is useful because students are using light bulbs that have two states, off and on illustrating binary zero or one.

Once the students have found a useful ASCII chart, they still have to work out a system so that each knows when the data in the message or control information is being transmitted. For example, how does someone tell a source or destination to slow down or stop sending traffic?

2. Analyze the communications system in terms of the OSI layers.

Most of the analysis would reflect the explanation above.

The physical layer involves the construction of the communication circuit. After the physical circuit is established, the signals sent must be given a meaning. The data link layer must communicate what kind of information is being sent. The network layer would provide a system of addressing to clearly state the source and destination addresses. The transport layer information must provide a means of correcting errors and maintaining a useful traffic flow. The session layer provides a means of allowing the source and destination to control the beginning, ending and suspension of the communication session. The presentation layer gives structure to the actual message by use of the ASCII table. Finally, the application layer is the original source of the message to be transmitted. In this case, that is the instructor.