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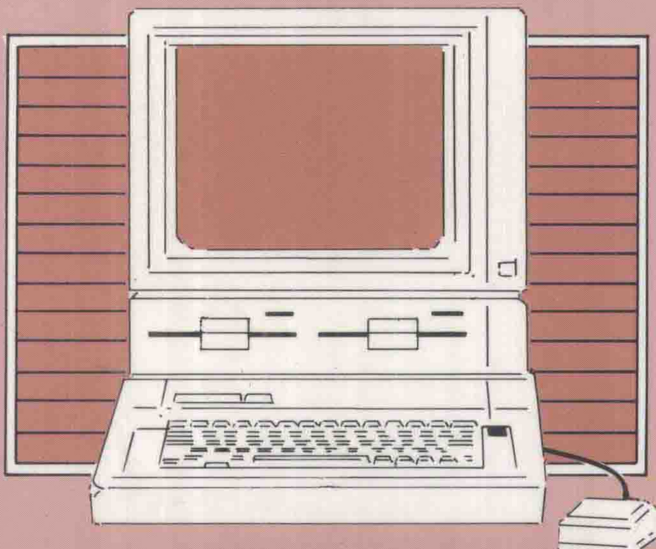

APPLE COMPUTERS IN LIBRARIES

VOLUME 3
COMMUNICATIONS AND NETWORKING

CHARD FENSTERER

Meckler

Essential Guide to Apple Computers In Libraries

Volume 3
Communications and Networking

by
Richard Fensterer

Meckler

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Richard Fensterer

Preface

Why Communicate?

If you use a microcomputer, you may have used it to write reports, sort lists and predict financial trends. You might have played a fantasy game or sent overdue notices to your patrons. If you have used your computer for any length of time, and have had to send it away for service, you probably have found that it is tough to get along without it. Indeed, the microcomputer has improved the efficiency of almost any task that it has been assigned to.

But a microcomputer can only manage so much data on its own. To achieve big tasks, such as book charging in a large library, it must be able to communicate with other computers located within and outside of your facility.

Computers communicate by sending electrical signals to each other. Sometimes, a special communications cable connects two or more machines. This works well if the computers are across the room from each other, but if the computers are on opposite sides of town, or even in other counties or states, they must communicate on channels that are already in existence. It would be overwhelmingly expensive for a library, even with unlimited financial resources, to install dedicated computer cables to connect buildings that are located more than a few thousand feet apart. Even if such a network were installed, it would be difficult to expand or modify.

Thankfully, there are already communications channels in existence and accessing one can be as simple as picking up your telephone and dialing. But the telephone lines are not the only way that computers can communicate. Many cable television systems also have the ability to carry data . In fact some of these "cable companies" have furnished their subscribers with personal computers on which they can perform banking transactions, shop, play games and participate in informal polls.

Today, you can link computers from different cities to allow all of them to share a common group of data. That collection of data is called a "data base". You can also link computers within your building so they can share common files such as borrower records, personnel records, budgets, an on-line catalog, etc.

I should point out that the inclusion of a piece of software or hardware in this books does not constitute an endorsement on the part of myself or the publisher. This is because everybody's communications requirements may be different, and what may work well for one application, may not be the best solution for another.

All specifications included in this book are subject to change without notice. The computer industry is developing at a very rapid rate. Sometimes what you order today and receive next month is obsolete by the time the warranty card is sent in!

In this book, we will discuss the mechanics of data communications, the equipment that you and procedures that you will have to follow to get "on-line". We will show you how to install an AppleTalk network and give you a tour to a database service. We will even throw in a few "war stories", so stay tuned...

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1
Binary and ASCII

When I was in elementary school, my teacher decided to teach us a set of new number systems. One day, she showed us a number system that consisted of nothing but zeros and ones. She called it the base two system and gave us an assignment to write all of the numbers from 1 to 20 in base two. It was all very confusing. Why would anybody want to use this system? After all, I thought that the number system with ten digits in it worked well enough. I did the assignment, the years went by and I went to college. While at college, I decided to take a computer course and the professor introduced the class to a number system with only zeros and ones in it! It looked very familiar, but he called it the "binary" number system.

Everybody in the class looked puzzled, until he explained why the binary number system is used in computers. The early computers used vacuum tubes and/or mechanical relays. In order for the computer to represent a number it must turn on certain tubes or activate certain relays.

A mechanical relay is like an automatic switch. A switch is connected to an electro-magnetic coil. When electricity is applied to the coil, a lever is pulled toward it and the switch contacts close, completing the circuit. Electro-mechanical relays are not used for computer memory anymore, and in fact have not been used in years. Because of their mechanical nature, they tended to wear out quickly and compared to vacuum tubes were much slower.

Vacuum tubes resemble light bulbs. They are made of glass, but if you examine one, you will find that they are made up of many parts. The vacuum tube also has the ability to switch electricity on and off, but unlike a relay, there are no moving parts inside. You can think of them as an electron valve, which is what they are called in Britain. Vacuum tubes were used in computers in the early days, but were later replaced by transistors.

Transistors have the ability to switch electricity, but are smaller than vacuum tubes and use less electricity to accomplish their task. Vacuum tubes also have a tendency to burn out much more quickly than a transistor, so switching to transistors made computers more reliable, more efficient and to some degree, faster since a transistor can react more quickly than a vacuum tube.

Today, computers use integrated circuit chips. On an integrated circuit, or IC, are etched many transistor-like components. With large scale integration (LSI) over a million transistors can be etched on a wafer of silicon about the size of your thumbnail. With the introduction of ICs, computers again became smaller and more reliable, since there were fewer connections holding the machine together. Another improvement came with the IC. Entire circuits that used to fill a box the size of a file cabinet could now be manufactured like cookies, so the

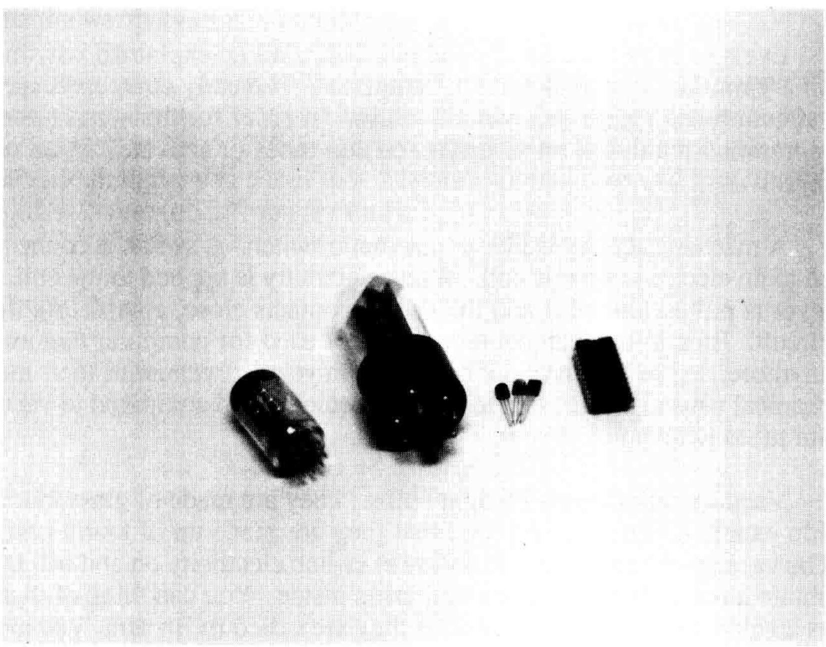

Figure 1.1 Early computers used vacuum tubes (left) and mechanical relays to store data. Later machines used transistors (center). Today, most computers use Integrated Circuit Chips (right) for their memory storage.

price of the computer was lowered dramatically. Because the complexity of assembling a computer went from building a machine that filled a room, to a machine that could reside on one printed circuit board that would fit in an attache case, much less labor was involved in the assembly. Today, most printed circuit boards are assembled by robots. Imagine that! a computer controlled device building another computer!

Here is why a computer uses the binary number system. Switches can only have two states, on and off. If a computer has to represent the number 254 in the base ten or decimal number system, it would need to use three rows of vacuum tubes, each containing nine tubes. In the right row, four tubes would be on and five would be off. In the center row, five tubes would be on and the other four would be off. In the left row, only two tubes would be on. So what we have is 27 tubes wired into our computer to represent 2 hundreds, 5 tens and 4 ones. Of those 27 tubes, 11 are being used.

If we were to use the binary system, we would be able to represent 254 with one row of eight tubes. The first tube on the right would represent 1. The tubes to the left of it would represent 2,4,8,16,32,64 and 128 respectively. The number 254 would have the rightmost tube off and all others on because 2+4+8+16+32+64+128=254. If we were to add one to the number, all eight tubes would be on.

So by using the binary system, computers could be simplified, even if programming them was more complicated. By using fewer tubes, the computer could be built less expensively. With fewer tubes, the computers needed less electricity and generated less heat. With less heat, air-conditioning costs could be lowered. Fewer tubes also meant fewer burned out tubes, so the computer was more reliable.

Computers still use the binary system, but unless you program in binary machine language, you never use the binary system. Today, we use a computer language such as BASIC to write programs. The computer still works in binary, but the computer handles all of the translation between BASIC and binary. Because the binary system contains only zeroes and ones, the computer can easily translate to other number systems. Since it would be very easy to make a mistake when keying in all of those zeroes and ones, most programmers that program in machine language use the base sixteen or hexidecimal number system.

The Hexidecimal System

In the Hexidecimal system, there are sixteen digits. The numerals 0 through 9 are used to represent the first ten digits, just like in the decimal system. To represent the next six numbers, the letters A,B,C,D,E and F are used.

In the binary system, each position for a 0 or 1 is referred to as a binary digit, or bit. A string of 8 bits is usually referred to as a byte. A Hexidecimal number can be represented with exactly 2 bytes, and with two bytes linked together, the number 65535. The Apple II series computers are known as 8-bit computers. The Apple Macintosh is a 32 bit computer, so it can handle much larger numbers with more precision.

In the introduction, (you did read the introduction, didn't you?) we said that computers communicate by sending electrical signals through a communications channel. A channel can be a telephone wire, a coaxial cable (like the cable television companies use), a glass fiber, or the public airwaves.

ASCII

In order for computers to communicate, they must, like people, use a language. Also like people, the computer on each end of the communications channel must recognize and be able to use the language. Most computers send their data over the communications channel using a code. The code that most computers in the United States use is the ASCII code. ASCII stands for the American Standard Code for Information Interchange. ASCII is pronounced "ask key".

In the ASCII code, every character on the keyboard is assigned a numeric code. A table listing the standard ASCII code is published at the end of this book. Since the codes are all standardized, the code for a character on one computer is the same as the code for the same character on another computer. The codes are not only used for communicating with other computers, but are used for communicating with peripheral devices, such as printers and disk drives as well.

Computers use ASCII to manipulate data on their own. Many computer keyboards have ASCII encoders built into them. This allows the keyboard to transmit a code to the computer's main circuit board. Since the code can be sent over a relatively simple cable connection between the computer and the keyboard, manufacturing costs can be cut and the reliability is increased because of simplified circuitry. An encoded keyboard also reduces the workload on the computer's microprocessor, since the keyboard handles the translation between key presses and ASCII all by itself.

There are actually more codes than there are keys on the computer's keyboard. Some codes do other things like designate the end of a file, beep the computer's speaker or send a line feed. There are separate codes for upper and lower case letters. Some computers use extended ASCII codes. The codes 0-127 are pretty much standard with all computers. They include all of the alpha-numeric characters, as well as many "control characters" that issue commands such as carriage returns and line feeds. The codes 128-255 are generally used by computer manufacturers to display other characters on the screen. The Atari 8-bit computers use these codes for graphics characters. These codes can be used as "tokens" to represent commands in BASIC programs. The commands for "print", "input", "read", etc. can be reduced to single characters. This speeds up data transmission and saves disk and memory space. You may be wondering why we mention Atari in an Apple book. Computers can communicate, remember? On the IBM computers, the ASCII codes from 128-255 represent graphics characters. These characters are used to customize screens with the boxes and lines that are so familiar in IBM software.

Serial and Parallel Communications

There are several ways that data can be transmitted. The two most common ways are serial and parallel. Let's take a look at each.

With serial communications, data is sent bit by bit. Most computers use serial data transmission to communicate with one another over a network or over long distances. The Apple computers also use serial communications to send data to the ImageWriter printers.

When files are sent serially from one computer to another, a protocol is used. A protocol is a set of rules that governs how each computer will send the data and how they will check for errors in the transmission. The device that sends the data and the device that receives the data keep track of the number of data bits that have been sent. Both computers must agree on this number. The computers must also let each other know when the data transmission is over and another set of data can be sent. This process is called handshaking.

The two most common serial transmission standards are RS-232C and RS-422, both of which have been adopted by the EIA. The EIA is the Electronic Industries Association and is a group made up of equipment manufacturers to develop standards to allow devices made by different manufacturers to communicate. These standards are not limited to computers. Some equipment that is designed to perform tasks under computer control, such as video editing equipment, can also communicate with the outside world via an RS-232 or RS-422 port. If you have a SuperSerial card installed in your Apple II series computer, you have the ability to communicate with the RS-232 standard. The Apple IIGS, IIc, Macintosh Plus, Macintosh SE and Macintosh II are equipped with serial ports for communications with modems and printers. The Macintosh computers and the Apple IIGS can be used on the AppleTalk Network.

Parallel communications send data a byte at a time. Many printers use a parallel interface. All parallel connections have separate wires for each data bit to be sent concurrently. Usually, there are 8 data lines to transmit 8 bit bytes, a ground line and other lines for handshaking. If you already have a parallel printer and wish to use it with your Macintosh, you may be able to add a serial port to your printer. In some cases, the printer manufacturer may already have an upgrade package available. Third party vendors also make serial interfaces for parallel printers. Hanzon Data, Inc. makes add on serial to parallel adapters for Epson MX, FX, RX and LX series printers. They also make serial interfaces for Panasonic KX-P1090, KX-P1091 and KX-P1092 printers.

These interfaces plug directly into the printer, so no soldering or modifications to the printer's wiring is necessary. According to Hanzon, all you need are the tools necessary to gain access to the inside of your printer, such as a screwdriver or nut driver.

Hanzon interfaces work in two modes, the printer's original mode, be that either Epson or Panasonic, and the Apple mode, where the printer emulates an Apple ImageWriter.

Hanzon also sells printer buffers. A printer buffer is a box that is wired between your computer and your printer. It contains memory and appears to the computer as a very fast printer. To the printer, the buffer looks like a computer. The computer sends printer data to the buffer and the buffer then feeds it to the printer. This frees up your computer to accomplish other tasks. Hanzon sells a 64K and 256K print buffer. Both models have provisions for upgrades that double their internal memory.

You might be wondering why anybody would buy a print buffer when they can get a software print spooler that does essentially the same thing for less money. A hardware print spooler offers some advantages over a software spooler. One big advantage is that a hardware buffer is a standalone device, so printing from it doesn't place a burden on the computer's microprocessor. By contrast, some software based print spoolers tend to slow the computer down while it is running another program. Stand-alone buffers also don't use any of the computer's memory or disk space. As far as the computer is concerned, it has already sent the file and the file has been printed.

There is a special type of port that also uses parallel data transfer. It is called the SCSI (pronounced "Scuzzy") network. SCSI stands for Small Computer Systems Interface and is a special network protocol, or set of rules, that was designed by the American National Standards Institute. The SCSI network allows users to interface devices that are built by different manufacturers into one system. A SCSI hard disk can be connected to either an Apple IIe with a SCSI interface card or to a Macintosh Plus, Macintosh SE, Macintosh II, or other SCSI equipped computer directly. SCSI interfaces are available for other computers, including older Macintoshes and Apple II series computers.

You can attach more than one SCSI device to a computer at a time. We will discuss SCSI networks in detail later in this book.