No. 21, June 1995

SERIAL AND PARALLEL

This time we will deal with how a computer communicates with the outside world through it's ports and the cables connected to them. Why this topic? Because my ARES group (OZARES) recently had an exercise in which we set up and used several packet stations, and cabling gave us some trouble. One station was delayed in getting on the air for nearly two hours until we solved the problem, which turned out to be a bad cable. So, this time we will begin the topic and next time I will describe how to build and test your own cables. Hopefully, it will save you some time and grief, even if you are not dealing with packet - perhaps with just a printer or external modem problem.

First, what is this "serial" and "parallel" stuff we hear about when computer ports are discussed? The ports are, of course, those funny looking connectors on the back of your machine, usually called a D-shell connector because they resemble the letter D turned on a side. But what does the "serial" and "parallel" refer to? Really, it is quite simple. Those two words describe how data is sent down wires.

Suppose your computer is to send the letter A out a port. The letter A, like all other letters, characters and symbols, is represented in your computer as a series of 8 on/off switches. There is nothing complicated about this arrangement; you probably have a bank of 4 on/off switches in your house somewhere. One in mine controls two lights, the wall outlets and a ceiling fan. Computers basically work with banks of 8. Each switch can either be in the on position or the off position. The particular "pattern" that represents the letter A is as follows:

SWITCH NUMBER	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
State (0/1)	0	1	0	0	0	0	0	1
State(-/+)	-	+	-	-	-	-	-	+
State(ofF/oN)	f	n	f	f	f	f	f	n
State(-/✹)	-	✹	-	-	-	-	-	✹

I have numbered the switches from 1 to 8 (with the first on the right and the eighth on the left), and indicated whether it is on or off using several different methods. A switch is on if it is labeled with a 1 or + or n (oN) or ✹; it is off if labeled with a 0 or - or f (ofF).

So that is the pattern for the letter A (in caps). But a lower case a is different. The pattern is:

SWITCH NUMBER	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
State (0/1)	0	1	1	0	0	0	0	1
State(-/+)	-	+	+	-	-	-	-	+
State(ofF/oN)	f	n	n	f	f	f	f	n
State(-/✹)	-	✹	✹	-	-	-	-	✹

See the difference? The sixth switch is on for the lower case letter and off for the upper case. That is the only difference. By the way, these are the actual binary representations of A and a; they are the actual ways these symbols are represented in your computer. Your computer knows, that if it is to show you these symbols on the screen, it must convert these binary numbers (which it can understand) to the funny looking angles and squiggles (A and a), which we humans can understand. Interestingly, the very first computers that were built had no such translation capability, and the humans that worked with them had to understand the binary patterns shown above. I bet every one of them wore glasses at the end of their careers!

Well now, if your computer is to send one of these symbols out a port, it really must send a pattern which represents the on or off state of 8 different switches. It can do that two different ways. First, it can send the 8 switch states down a single wire, like 8 people walking down a hall, which is so narrow that they are required to walk single file. That is serial data, which means just that; single file, one after the other.

Alternatively, if 8 wires are available instead of just one, your computer can send all the data in one batch. This is like 8 people walking down a very wide hall shoulder to shoulder - they are walking in parallel.

There you are. We have described serial and parallel ports (and cables). Now, if WB9RQR is not full of hot air, a serial cable will require fewer wires than a parallel. Correct! A standard parallel cable requires at least 16 conductors while a standard serial cable requires 9. Why not 8 and 1? Well, the other conductors are used for other messages that are necessary when sending data, such as: "here comes a series of 8 switch states" and "I just sent you the 8th in a bank of 8 switch states" and "I am ready to receive data" and "I am out of paper" and the like. Also, we hams know there has to be a signal ground, so a cable with only one conductor is not very practical.

Now that you understand serial and parallel, you are ready for cable building. Next month's installment will give you the wiring diagrams for standard serial and parallel cables, plus my own special formula for a "universal" serial cable that guarantees you will not have to stop your project to go to Radio Shack for one of those darned adapters.