SPECIAL SECTION

Echelon's Local Operating Network

Ken Davidson

Here's one for you die-hard Circuit Cellar fans who say you've been reading 'Ciarcia's Circuit Cellar" and CIRCUIT CELLAR INK for years: who is Echelon? If you said, "They make a CP/M replacement operating system that was used on the SB180 single-board computer Steve presented in the September '85 issue of BYTE," you would have been correct about four years ago. Echelon-the ZCPR3 people-closed up shop a few years back and passed the operating system on to others to take care of. Not long after they did, though, a new Echelon started making the news, but this new company had nothing to do with CP/M computers,

ISO Layer	LONTALK Protocol Services	Benefits
7. Application	Standard Network Variable Types	Ensures Compatibility and Interoperability
6. Presentation	Network Variables and Foreign Frame Transmission	Facilitates Use of LONTALK for Internetwork Gateways
5. Session	Request-Response Service	Guarantees that Desired Action has Occured
4. Transport	Acknowledged and Unacknowledged Unicast and Multicast	Reliabilty and Efficiency
	Authentication	Network Security
	Common Ordering Duplicate Detection	Elimination of Errors Caused by Noise and Lost Messages
3. Network	Addressing Learning Routers	Multimedia Networks, Easy Expansion and Reconfiguration
2. Data Link	Framing 16-bit CRC	Data Integrity
1.5 Media Access	Predictive CSMA with Optional Collision Detection and Optional Priority	Efficient Use of the Medium. Consistent Response Time Under Variable Network Loads, Immediate Network Access when Required
1. Physical	Twisted Pair, Power Line, Radio Frequency, Coaxial Cable, Infrared, Fiber Opbc Multiple Data Rates	Low-cost Installation on Multiple Media

Figure 1— Lon Works is *based on the ISO/OSI seven-layer network mode/.*

The new Echelon was touting a novelconceptinbuildingautomation: the local operating network, or LON (hence theircatchy name—EcheLON). They were promising many of the same ideas and features as the promoters of CEBus: a unified networking system that could be embedded into electronic devices that would let them talk to each other via a variety of communicationsmedia.Regardlessof who made the device, they would all speak the same language.

Echelon's approach was somewhat different from EIA's, though—spend enough R&D money to develop a complete system solution in a very short time, then spend even more money on a slick marketing campaign to sell it to the execs of the major manufacturers. Once you comer the market and everyone is licensing your proprietary scheme, you'll be able to pay back the investors and finally make some money.

I can't say that's a bad approach. I might even be interpreting things incorrectly. Only time will tell if they can get enough big companies to jump

on their bandwagon to make it all fly. Instead, let me try to give you an idea of what all this talk of LONs, neurons, LonTalk, and LonWorks is all about.

THE WORKS

All the elements in an Echelon-based system are known collectively as LonWorks. The major elements include the LonTalk protocol, Neuron chips, LonWorks transceivers, and a LonBuilder developer's workbench. Together, a complete network can be configured and designed into end products.

Like CEBus, LonWorks is based on the ISO/OSI seven-layer network model. Figure 1 illustrates what each of these levels is supposed to do and some Echelon-claimed benefits of each. These upper network layers are known collectively as LonTalk. A quick comparison of each of the layers and their functions will show a great many similarities to CEBus.

One big difference between the two is the use of network variables and Standard Network Variable Types (SNVTs) by LonTalk at the Application Layer. An SNVT definition consists of units, a range, and an increment. Some examples include a variable type of "temperature" consisting of Fahrenheit units, a range of ±3200, and an increment of 0.1 degree; or relative humidity with units of **percent, a range** of 0-100, and **an increment** of 1/256%. The vast majority of applications can be specified using SNVTs, but user are free to define anything they need.

Object-oriented concepts play a big role in the interoperability of the network. Nodes are thought of as objects, with the network variables as the object's inputs and outputs. Links between objects are made between inputs and outputs of the same type.

THE NERVOUS SYSTEM

Details of how the seven layers actually operate are very sketchy since Echelon wants to sell you their chips and development systems. At the core of most LONs is going to be one of Echelon's Neuron chips. The **neuron**

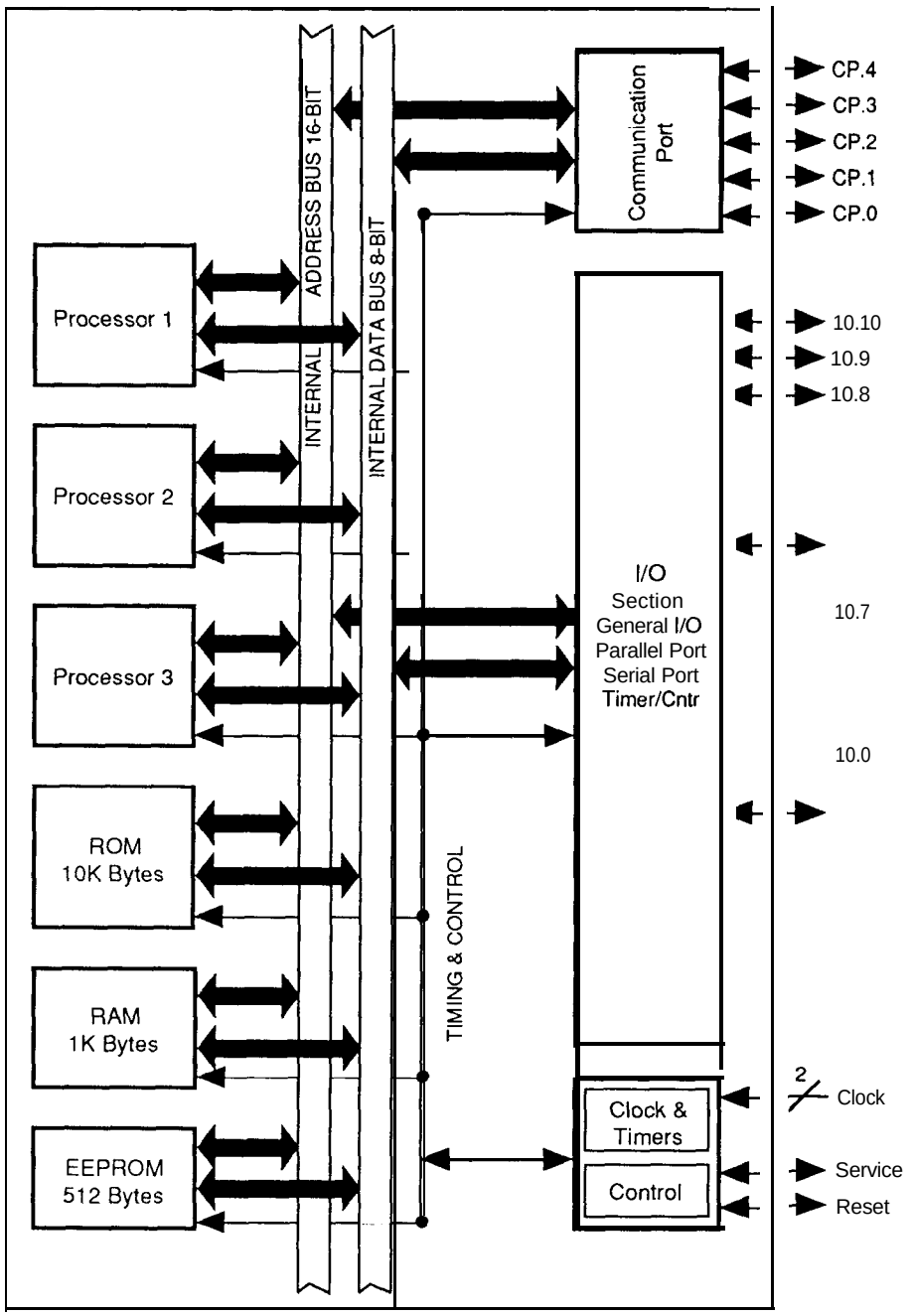

Figure 2—*The* **Neuron 3** *120 implements all but the Physical Layer on a single chip.*

implements all the layers except the Physical Layer, which I'll get to in a bit. There are currently two nearly identical chips available.

The Neuron 3120 is a complete self-contained chip as shown in Figure 2. It contains three microprocessors: two dedicated to LonTalk protocol processing and one dedicated to the node's application program. Also on the chip are 11 I/O lines, a programmable 16-bit counter/timer, 10K of masked ROM, 1K of RAM, 512 bytes of EEPROM, a 5-pin communications port for talking to the Physical Layer, a 48-bit ID unique to the chip, and assorted circuitry for doing wake up, watchdog timing, and so on. Note that the 48-bit chip ID translates to over 2.8 x 10^{14} IDs, so they're not likely to run out of IDs very soon. The chip comes in a 32-pin package.

The Neuron 3150 is identical but adds a second 16-bit counter/timer, another 1K of RAM (for a total of 2K), and requires external ROM. Up to 64K of external memory may be added with 42K going to the node application program. The package size increases to 64 pins.

Both chips are programmed in what is known as Neuron C; standard ANSI C with extensions added to support object-oriented programming, network variables and SNVTs, and some other features to make real-time processing easier.

Both chips are being manufactured by Motorola and Toshiba; the 3150 is supposed to be available in November while the 3120 won't be ready until the first quarter of '92. Motorola's part numbers are MC143120 and MC143150; Toshiba's are the TMPN3120 and TMPN3150.

The LonBuilder Developer's Workbench is available to aid in the development of LON nodes. Just be sure you're really serious before asking any prices, though.

GET PHYSICAL

At the Physical Layer, LonWorks Transceivers are used to communicate with the medium connected to the node. Again, as in CEBus, six media are defined: power line, twisted pair, infrared, radio frequency, coax, and fiber optic. Unfortunately, the physical layer is another area where details are hard to come by. Power line is defined as running at 9600 bps, RF at 5 kbps (30 feet indoors, 150 feet outdoors), and twisted pair at 78 kbps (4500 feet with 64 nodes) or at 1.25 Mbps (1500 feet with 64 nodes). With twisted pair, one pair is used for data while a second pair is used for power (when supplied to the nodes).

And that's about it. I've been able to find nothing on the other media, no chips, and no details. "Transceiver evaluation boards" for the three media mentioned above are supposed to be available, bu t you'll need good luck or great connections designing anything that has to make it into production soon. The modules also range in price from $400 for the twisted pair module up to $1500 for a single power line module.

Finally, the LonBuilder Developer's Workbench is available to aid in the development of LON nodes. There are complete tools available including an integrated development environment, a developer's kit that contains a Neuron C compiler and debugger, a network manager, and a protocol analyzer. Just be sure you're really serious about all this before asking **any** prices, though (the "starter kit" consisting of a development station, two neuron emulators, and neuron C goes for $14,965!).

BOTTOM LINE

Anyone who has seen Echelon's slick advertising or the video of the press conference in which the LON was rolled out or has attended one of their sales seminars would probably be quick to say that the LON will soon be used withevery piece of electronics to enter the home, business office, and factory. The future is here today and the LON is ready to make it happen.

Now step back a minute.

We have a proprietary networking scheme that forces you to use specific chips if you want to stay compatible. "But at least they have chips," you say? At $10 per chip (which is what Echelon is quoting), not to mention the cost of the transceiver and all the glue, you're going to drive the cost of a simple light switch up to many times its current low-tech cost. That may be fine for die-hard home automation fans, but not for the mass market. Industry insiders I've talked with also agree that implementing the LON won't likely be a cheap proposition.

And yes, they have chips (soon), but only for the upper networklayers. Transceivers are only available in the

form of evaluation modules. Like I said before, things aren't even close to being ready to be put into a piece of production equipment.

Will the LON squash the CEBus efforts? I don't think so. CEBus has a good headstart on industry recognition, and the system will likely be cheaper to implement. The CEBus upper network layers are fairly stable, and chips probably aren't far off. The Physical Layers appear to be much more stable than Echelon's, and chips definitely aren't far off. Echelon has a jumpondevelopment tools,but much of what they have is similar to what AISI had for CEBus two years ago (too bad AISI went belly up about a year ago), so there's no telling wha t may be waiting in the wings.

CEBus is also an open standard, so if someone wants to develop their own chips and tools, they have all the information necessary to do so. I would think the guys upstairs signing the checks would be more willing to back an open technology than a proprietary one.

Echelon also seems to be primarily targeting the commercial building market rather than home automation people. In fact, at a recent seminar of theirs that I attended, the lecturer was at times making fun of and downplaying home automation. He stated that he saw the market divided into three areas. One was bubbled-packed devices you could get at Radio Shack that would have limited functionality. The next would be the do-it-yourselfcrs. He described a typical member of this group as part of the "lunatic fringe" who now has a handful of X-10 devices and a computer who "can't get into too much trouble withasmallnetwork."Thethirdgroup consists of professional installers who know what they're doing.

This same lecturer also contradicted himself several times and told some outright lies about CEBus in an effort to downplay other players in the market.

Echelon has a short list of companies already backing their technology, including AT&T, Johnson Controls, Leviton, and Sony. However, all of the companies I just mentioned are also very active on the CEBus committee, so the big boys are keeping all their options open, Indeed, Echelon itself rarely misses a committee meeting.

Only time will tell who comes out ahead in the battle of home automation technologies, but my money is still on CEBus.

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4 19 Very Useful
420 Moderately Useful
421 Not Useful