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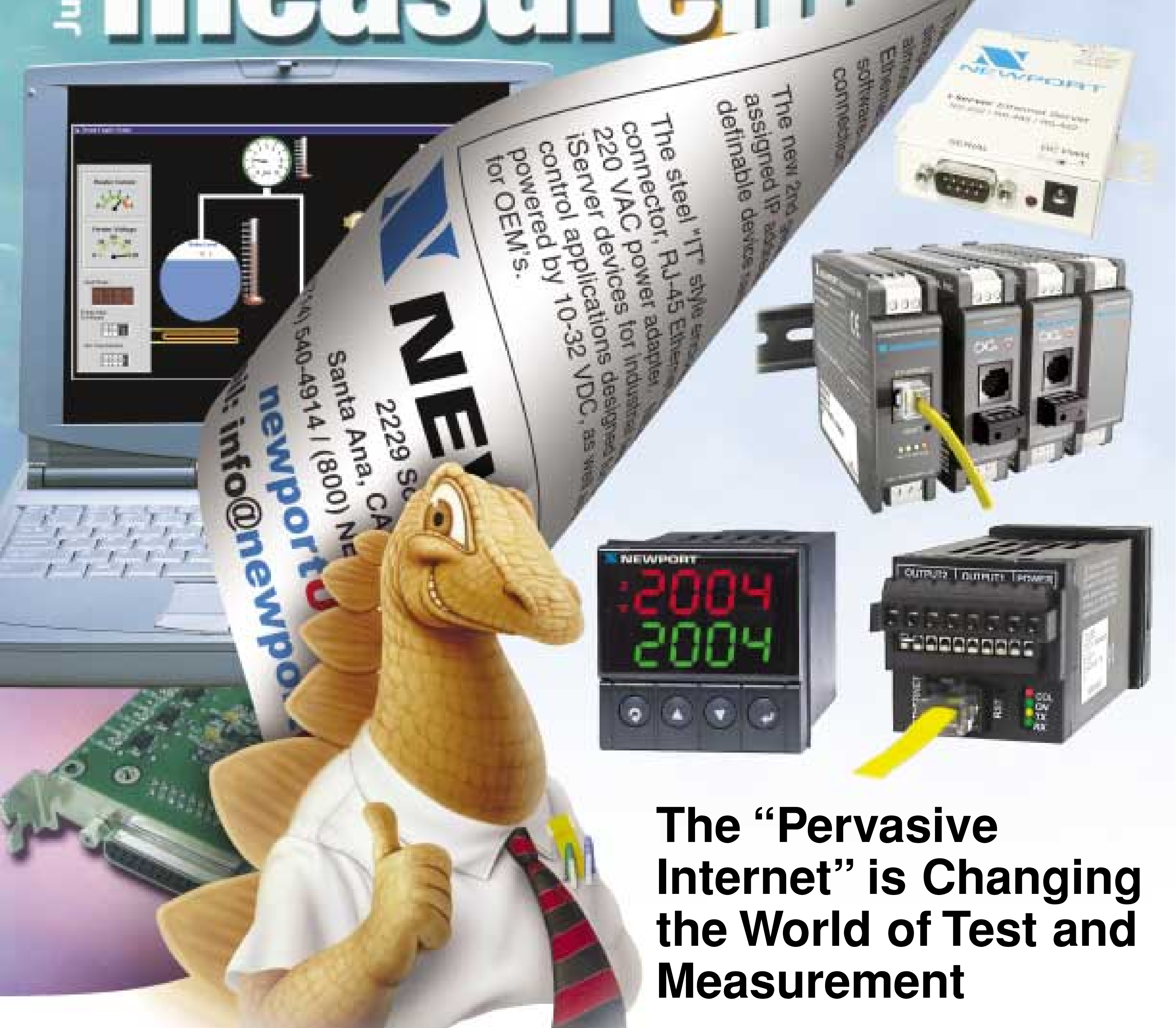

The "Pervasive Internet" is Changing the World of Test and Measurement

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In 1973 Bob Metcalfe invented Ethernet. That same year, Bob Kahn and Vincent Cerf invented what became TCP/IP. In 1986 Al Gore invented the Internet. Now in the 21st Century, the rest of us are finding some very useful ways to use it.

That brief history is not entirely accurate. Crediting Metcalfe, Kahn, and Cerf without recognizing other collaborators isn't fair to the thousands of engineers and scientists who made important contributions.

Of course Al Gore didn't invent the Internet, and he never claimed that he did. But the story was repeated so often by comedians and political partisans that it might as well have been true.

Looking back on the relatively brief history of the Internet helps us to visualize where we're going. The Internet is already changing the way we conduct business, do our jobs, and plan our recreational activities. For some people it is a recreational activity.

It evolved from a network connecting a handful of expensive mainframes and supercomputers, to a network connecting millions of personal computers. That evolution will likely continue in the same direction. The next iteration should be a network connecting billions of electronic devices—including test and measurement instrumentation.

The original architects of the Internet realized they were doing something important. But they didn't accurately predict it would lead to where we are today. They were thinking about connecting a few multi-million dollar computers at a handful of elite research universities, corporations and the Department of Defense. They weren't thinking about connecting a hundred million personal computers. The personal computer hadn't been invented yet.

Vincent Cerf: "The somewhat embarrassing thing is that the… original design of 1973 and 1974 contemplated a total of 256 networks. There was only one LAN at PARC, [Xerox Corp.'s Palo Alto Research Center] and all the other networks were regional or nationwide networks. We didn't think there would be more than 256 research networks involved."

How the Internet Came to Be; Vinton Cerf, as told to Bernard Aboba Copyright (C) 1993 Vinton Cerf.

With 20-20 hindsight, it's easy for us to see that the visionaries of the 1970's were short-sighted in their development of an Internet to connect a handful of local networks and ultra-sophisticated computers--sophisticated by the standards of their day. With the benefit of that hindsight, we would be even more myopic to imagine the future Internet as simply an evolution of the status quo—a network exclusively of computers.

A growing selection of meters, controllers, signal conditioners, and transmitters are available with Ethernet/Internet capability.

From a recent article in the Washington Post: (Shannon Henry Thursday, May 23, 2002; Page E01)

"Robert Kahn, one of the fathers of the Internet, laughs when he hears people describe the network in modern-day terms. Many, he says, see it as being synonymous with AOL.

"There are a lot of people who think the Internet happened in the '90s," says Kahn. Actually, its history is far more extensive. By the same token, present-day AOL does not begin to define the almost boundless future of the medium. All great inventions take years to be explored and appreciated, he says. The age of this technology has only just begun".

"It's the tip of the iceberg now," says Kahn. Or as Vincent Cerf said simply, "We ain't seen nothin' yet."

In his book, Beyond Engineering: How Society Shapes Technology, Robert Pool offers an explanation for why it's difficult for us to anticipate how new technology will actually be used: "People get stuck in old ways of thinking and find it hard to get out. Faced with a new invention, their first reaction is to see how it fits in the old system. When Marchese Guglielmo Marconi began to work on radio communications, he saw it as a supplement to the existing system of telephones and telegraphs which would be used where it was impossible to string wires. The idea of broadcasting from a central transmitter to many receivers would not come until later. Such inertia explains why Bell's telephone was much harder to appreciate at first than Edison's light bulb. Electric lamps would replace an existing technology—gas lighting—that was widely recognized as unsatisfactory, but the telephone would do a job that had never been done before and whose value was hard to foresee. It takes more imagination than most people possess to recognize an unmet human need or want and to realize that a particular invention will satisfy it."

In 1990, Senator Al Gore's argument for why our country should finance an information superhighway, is an excellent example of that flawed perspective—trying to fit the future application to the technology of the status quo.

"Supercomputers are the steam locomotives of the information age," then-Senator Gore was quoted as saying in one article published in 1990. "In the Industrial Age, steam locomotives didn't do much good until the railroad tracks were laid down across the nation. Similarly, we now have supercomputers going into the seventh generation of supercomputers, but we don't have the interstate highways that we need to connect them.

"Within four years, the top-of-the-line US $20 million supercomputers will cost less than $400,000. A few years after that, they will be in the $10,000 to $20,000 range." *(Wired Magazine. March 11, 1999):*

In Gore's imagination of 1990, and probably that of many contemporaries, the Internet would be a way to connect a few $20 million supercomputers at universities and defense establishments around the country. Gore didn't seem to visualize an Internet connecting twenty million or more personal computers. Ironically, he did predict a staggering free-fall in the cost of supercomputers, from $20 million to $10-20 thousand. That leads to an obvious conclusion: When the cost of computing capability falls by 99.9%, that should precipitate an explosion in the number of computers used for all types of applications.

In 1965 Intel founder Gordon Moore famously predicted (or perhaps promised) that silicon device densities would double every eighteen months. "Moore's Law" has held up ever since, although some experts are wondering when that phenomenon will physically "hit the wall" and what technology will replace silicon. Moore's Law has meant that today we can have 20 million transistors in the space required for 20 thousand transistors fifteen years ago. Or from another perspective: If there were a quantity of silicon devices that cost a total of $20 million to produce sixteen years ago, a functionally equivalent quantity of devices could be produced today for only $20 thousand. My extrapolation of Moore's Law might be off by a few years, a few million dollars or few million transistors, but the general concept is sound. Recognizing this phenomenon helps us understand what has occurred, and what will occur.

Devices as small as 1/16 DIN temperature controllers (48mm x 48mm panel cutout) can be connected directly to an Ethernet LAN and the Internet.

"Metcalfe's Law" states that the value of a network grows exponentially with the number of nodes connected to it. Bob Metcalfe's "law" is more an insightful observation, than a prediction like Moore's. And today the observation seems quite obvious. Compared to what it is worth today, the worldwide network of telephones wasn't too valuable when Bell and Watson had the only two nodes in the world, and they were both in the same building. The Internet would be of small significance if it connected less than 256 sites around the U.S. as originally conceived.

Controllers and meters with Embedded Internet can serve Active Web pages to any computer on an Ethernet LAN or the Internet.

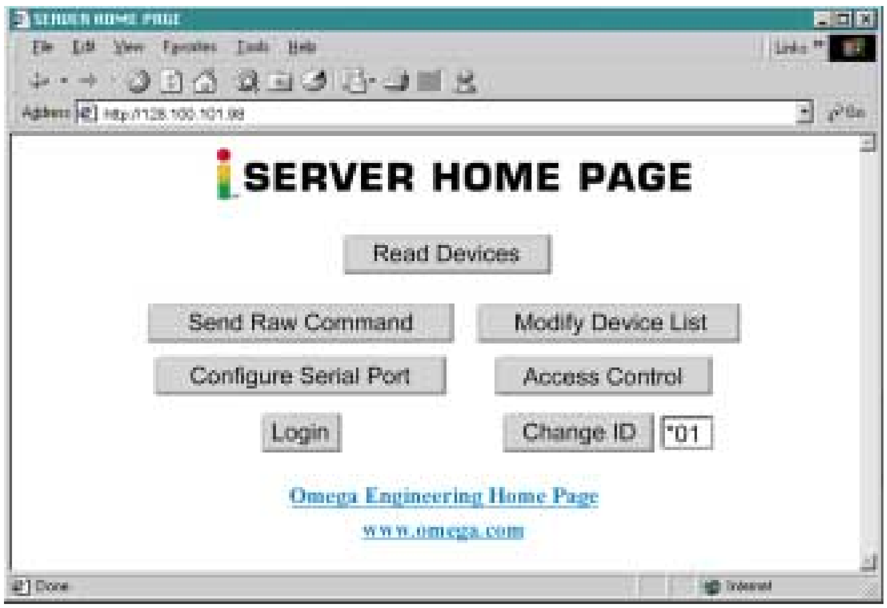
What do Moore's Law and Metcalfe's Law mean to the world of test, measurement, industrial process control and automation? What is the significance of the past evolution of the Internet to what it will be in the future?

It's probably safe to cite another law to make a reasonable and conservative prediction: A body in motion will continue moving at the same speed and in the same direction—in the absence of external forces. The Internet is literally in motion. And it will likely continue in the same direction it has been moving since its inception. From a network connecting a handful of exotic computers, to a network connecting millions of inexpensive computers, the Internet will evolve into a network for billions of electronic devices—other than computers.

Exactly what kind of electronic devices will be at the center of this Internet universe is being debated. But there's no question that the movers and shakers of the computer industry agree that the future Internet will be primarily a network of electronic devices—other than computers. In their keynote speeches at Comdex last November, the CEO's of leading technology companies offered their spin on the future. Jorma Ollila, the CEO of Nokia predicted the cellular phone would be at the center of the Internet universe. Kunitake Ando, president of Sony, said his company's main technology focus was to network-enable the whole variety of electronic devices Sony manufactures. Bill Gates seemed to make the case that PC's running Microsoft Windows, along with the Microsoft Xbox game player will be at the hub of the Internet experience along with a wide assortment of Internet appliances. Regardless of their differences, there is still a general consensus that the future of the Internet involves the networking of billions of electronic devices.

Specific visions of the future of the Internet from the leaders of companies such as Nokia, Cisco, Intel, HP, Microsoft, or Sony are more than simple predictions. These people might be entirely wrong, and have been before, but they do intend to make it happen and have enormous resources behind them.

Harbor Research, a research and consulting company, has been studying and publishing whitepapers on the "Pervasive Internet:" There were approximately 5 billion microprocessors sold in 2000, and only 120 million of them (roughly 2.5%) were intended for PC's.



Devices with Embedded Internet can serve Active Web pages to any computer by typing the IP address or unique name in a Web browser.

In the near future, digital intelligence and connectivity will be designed into every electronic device of any consequence.

"The penetration of billions of Internet-enabled microprocessors into the items of everyday life and work is leading to the creation of a globally deployed 'digital nervous system' in which devices can sense, monitor, analyze and communicate, controlling themselves and each other. As the economy becomes increasingly information-driven, suppliers uniquely positioned to leverage the information derived from Internet-enabled devices will reap substantial rewards. Those who fail to ride this next wave of the digital revolution will perish."

Since 1965, NEWPORT has been a leading technological innovator in designing electronic instrumentation for test, measurement, process control and automation. NEWPORT signal conditioners, transmitters, controllers and meters cover a broad selection of signal inputs: process/DC voltage & current, strain, temperature from thermocouples, RTD's, and non-contact infrared detectors, frequency, pulse, AC voltage and current, analytical measurements including pH and much more.

At NEWPORT, we believe that the Internet will soon be as pervasive and transparent as electricity. The word "Internet" might become quaint and old-fashioned like "horseless carriage" to be replaced by a new word yet to be discovered. Or perhaps the old word will survive with an entirely new meaning, like "highway."

In August, 2000 at the ISA Expo in New Orleans, NEWPORT unveiled the world's first panel meters, controllers, and signal conditioners with an embedded Web server.

The NEWPORT iSeries devices connect directly to an Ethernet network with a standard RJ-45 connector and can send and receive data in standard TCP/IP packets.

The NEWPORT devices can serve Web pages over an Ethernet LAN or the Internet making it possible to monitor and control a process through a Web browser (such as Microsoft Internet Explorer) from anywhere in the facility or anywhere in the world.

As an example, the manager of Test Engineering in our own facility installed the new iSeries devices to control the burn-in ovens. (All NEWPORT products go through a 24-hour burn-in cycle prior to calibration as part of the quality assurance procedures.)

With the iSeries temperature controllers, the test engineering team can monitor temperatures, log data, change set points or alarm points, turn ovens on or off, or make other changes from anywhere on the LAN or the Internet.

There is no special software running on the test engineers' computers, nothing other than a Web browser.

In fact, the NEWPORT controller can even send an email to the engineer (or anyone he chooses) alerting him to an alarm condition or updating the status.

The engineer could receive a message from his NEWPORT controller on an Internet enabled pager or cell phone.

Among the thousands of iSeries customers, the NEWPORT Ethernet/Internet technology was immediately adopted for a multitude of test and measurement applications by engineers at: Argonne, Battelle, Los Alamos, Fermilab, White Sands, Intel, Motorola, Lockheed Martin, Boeing, Raytheon, TRW, Northrop, Bosch, General Electric, General Dynamics and General Motors among others.

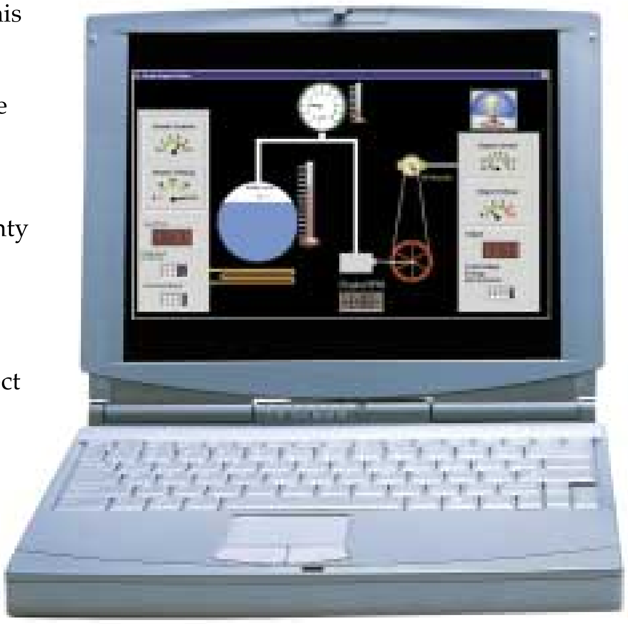
Of course there are other ways to accomplish the same result. What's remarkable about the NEWPORT breakthrough is that all this is accomplished without connecting the instrument to a computer. The NEWPORT iSeries device (meter or controller) connects directly to the Ethernet Network-not to the serial port of a computer functioning as a "server" and "master" to "slave" instruments connected through serial communications.

These small NEWPORT instruments are full stand-alone Internet appliances. The Ethernet and Web Server capability is actually embedded in the device.

Just as important as what these instruments can do, is what they cost. The Internet/Web Server capability is a $50 option on a $200-$300 meter or controller. In the years ahead this capability will cost even less.

The phenomenon that made this possible is explained by Moore's Law and Metcalfe's Law. The microcontroller at the heart of the Newport technology is an advanced descendant from the same microprocessor in the first personal computer I bought twenty years ago. That computer cost $3000. Today, this type of microcontroller costs $2-$10.

Most computers did not connect to a network of any kind twenty years ago, or even ten years ago. Today, most of us agree with the slogan of Sun Microsystems, "the network IS the computer." Today, Ethernet/Internet connectivity is a required feature of any new Windows compatible computer, and it's hard to imagine anyone buying a computer that could not be connected.

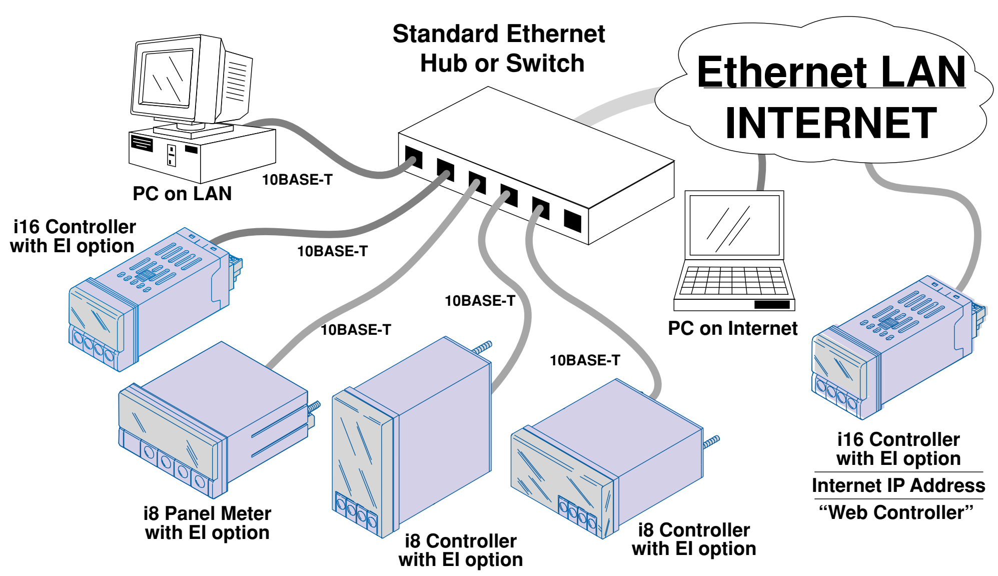


OPC standardization makes it easier to integrate networkable instruments with popular Test & Measurement and Process Control software.

Ethernet is the natural standard for connecting test and measurement instrumentation, as well as the standard for equipment that test and measurement devices are built into.

Customers of these OEM's (Original Equipment Manufacturers) will expect their products to be connected to and controlled over the Ethernet network.

Burn-in ovens at NEWPORT are monitored and controlled by the test engineering dept. over an Ethernet LAN. The printed circuit board assemblies for all NEWPORT products go through a 24-hour burn-in and thermal cycling prior to test and calibration.



Meters and controllers connect directly to an Ethernet LAN or Internet as nodes on the network, same as a PC.

TCP/IP (Transmission Control Protocol/Internet Protocol) is also a natural standard for communicating over an Ethernet LAN and the Internet, in part because that's the protocol most often being used. The open standards, and natural compatibility of TCP/IP with all existing computers makes it easy to get started and easy to maintain. However, an Ethernet LAN and the Internet can physically carry other protocols. There will be reasons for choosing a different communications protocol for different applications, but one that is still carried over Ethernet/Internet.

As Vincent Cerf pointed out, (Same Interview):

"Once you get a sufficient degree of connectivity, it becomes more advantageous to link to this highly connected thing and tunnel through it rather than to build a system in parallel. So BITNET, FidoNet, AppleTalk, SNA, Novell IPX, and DECNet tunneling are a consequence of the enormous connectivity of the Internet."

Manufacturers of test, measurement, control, and automation products have promoted a variety of proprietary networking schemes and fieldbuses. Some of these might survive, but it's impossible that any of these will rival the wide-spread adoption of Ethernet.

In his book, Only the Paranoid Survive, Andy Grove of Intel outlined the evolution of the computer industry. At one time it was dominated by a handful of vertically integrated suppliers such as Burroughs, Sperry, Honeywell, and of course IBM. These companies supplied every piece hardware and software in the complete proprietary system. For example, a customer with one manufacturer's computer could not buy printers or disk drives from another manufacturer. That business model didn't survive. In today's computer industry, companies such as Intel and Microsoft compete and try to dominate across a horizontal strata of products such as processors, software, memory, disk drives, printers, or monitors for example. Their products are components of a complete system that are compatible with all other manufacturers' products. The world of test, measurement, control and automation will evolve in the same fashion.

An encouraging trend towards compatibility that will greatly benefit end-users is the adoption of common integration standards reflected in "OPC". The OPC foundation describes it as follows: "OPC (originally OLE for Process Control) is an industry standard created with the collaboration of a number a leading worldwide automation and hardware software suppliers working in cooperation with Microsoft.

"The OPC Specification is a non-proprietary technical specification that defines a set of standard interfaces based upon Microsoft's OLE/COM technology. The application of the OPC standard interface makes possible interoperability between automation/control applications, field systems/devices and business/office applications.

To put it more simply, a customer should be able to choose any combination of OPC compliant hardware and software, and the system will be easily integrated. It is now extremely easy to use Newport meters, controllers, or signal conditioners with a wide variety of popular software from Omega, Wonderware, Rockwell Automation, Iconics, Intellution, GE Cimplicity, National Instruments and more.

Since introducing the "embedded Internet" technology in our instrumentation, NEWPORT has received many inquiries from OEM's who are interested in connecting their own products such as time-clocks and bar code readers to Ethernet and the Internet. We have also heard from end-users who want to easily connect all kinds of existing devices that have serial communications capability to an Ethernet network. As a result of that interest, NEWPORT introduced the "iServer" products that simply and easily connect virtually any RS-232 or RS-485 device to an Ethernet LAN and the Internet. These iServer products are available in enclosures for industrial or commercial environments. Newport also offers a PCB subassembly for OEM applications.

At NEWPORT, we do believe "the internet changes everything," and "we ain't seen nothin' yet."

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