INDUSTRY FEATURE

CompactPCI Systems CEO Challenge

In this article Brough Turner takes a look at what is needed in 2001 to ensure the continued success of CompactPCI. As one of the original proponents of CompactPCI in the telecommunications industry, Brough appeals to the CompactPCI community to continue its efforts at standardization and open source.

A cosponsor of the Telecom Interest Subcommittee of PICMG, Brough has been a tireless promoter of CompactPCI for the telecommunications market. Often characterized as a visionary, Brough's foresight has brought about the creation of the Open Telecom initiative (www.opentelecom.org) to boost CompactPCI adoption by making hot swap software source code widely available.

Accordingly, we at CompactPCI Systems Magazine decided to query other CEO's as to what they saw as their challenge for 2001. Following Brough's article, we have included the responses from 37 movers and shakers in the CompactPCI industry. They have shared with us their opinions on how their companies will focus their energy in the upcoming year to meet these demands.

Inside this section:

Natural MicroSystems

CompactPCI evolution

By Brough Turner,
Senior Vice President, Chief Technology Officer and cofounder of Natural MicroSystems

www.nmss.com

CompactPCI is a wonderful success story, at last. Initially standardized in 1994, the idea grew slowly at first. According to Venture Development Corporation, 1997 board sales were less than $20M worldwide. The great thing about CompactPCI was that it leveraged mass-market computer technology for industrial applications. This provided access to a wide variety of standard components – chips and modules and, more importantly, software. The slow initial adoption rates may have been due, in part, to an early focus on just a few, moderate growth markets like embedded industrial control (factory automation, traffic lights, and so on). In 1997 and 1998, the focus for CompactPCI shifted to telecommunications and the completion of the specifications required for telecom applications, i.e., the computer telephony specification and the hot swap specification. Today, CompactPCI is at least a $500M industry and is projected to reach $2B in annual revenues by 2004 – and its biggest application is telecommunications.

This growth has occurred even though today's CompactPCI standards address only a limited subset of the telecommunications market. Today's CompactPCI telecom standard supports only traditional TDM telephony, and while the capacity is theoretically 2048 simultaneous conversations, many practical systems use the telephony bus for multiple board-to-board connections, resulting in systems that are limited to less than one thousand channels. More significantly, there are no standard configurations for packet telephony, or in fact for any kind of packet communications, even though packet-based telecom is the wave of the future.

Alternative schemes to get around these limitations are emerging. But many of these new proposals are vendor-specific, so there is a risk that the industry will fragment. That would be a pity. If the industry can agree on a single architecture for the evolution of CompactPCI, the whole market will grow much more rapidly than currently projected. What is needed in 2001 is a concerted effort by everyone in the community to develop and agree upon a single architecture, with a minimum number of variants, that covers the maximum range of telecommunications applications. Ideally, this effort should happen through the PCI Industrial Manufacturers Group (PICMG), the body that controls the CompactPCI specifications.

This article outlines alternatives and suggests a path that could bring us to such a common architecture. First, it's worth considering what is needed. The simple list includes:

- Inter-slot packet transport
- More capacity for PCI and CT Bus (H.110)
- Improved support for highly available systems

Secondly, it's worth listing requirements or desirable attributes of any solution:

- Evolution (not revolution), i.e., maintain compatibility, or at least interoperability, with existing products
- Leverage mass-market technology wherever possible

High availability extensions

Of the requirements listed above, high availability is already well advanced. Peripheral card hot swap works. Hot swap software works and is being standardized by PICMG subcommittee 2.12. Redundant CT Bus clocks work. The use of redundant system controllers is being addressed in a PICMG working group (PICMG 2.13). And finally, there is a trend towards systems where each board is autonomous and the system controller is merely a management device that is no longer critical for system availability.

PACKET SOLUTIONS

Infiniband

The first thing that comes to mind is a potential new PC I/O standard, called Infiniband, which is being heavily promoted by Intel. Infiniband will be a scalable interconnection fabric made up of high-speed serial links and switches. For CompactPCI, an industrial standard that leverages mass market PC technology, Infiniband sounds like a natural. Unfortunately, there is strong reason to believe that widespread adoption of Infiniband will take more than five years, so an interim solution is needed.

While the Infiniband specification is still in development, the technology is broadly defined. It's a complete break from PCI, so its adoption will require all new hardware and all new device driver software, as well as some new operating system internals. PCI and USB are earlier examples of I/O standards that required new hardware and new software. Both took over six years from definition to widespread adoption, so Infiniband is unlikely to be widely available before 2006. As an additional problem, Infiniband proponents are focusing their early attention on high-end disk I/O, just at a time when Gigabit Ethernet is providing a serious challenge to Fibre Channel for high-end disk I/O. So, deployment strategies are likely to change several times before Infiniband succeeds. On the other hand, with Intel's backing, Infiniband is likely to succeed, eventually.

And we should leverage Infiniband when it arrives, but current opportunities can't wait for 5+ years.

Other high-speed, switched serial interconnects

In addition to Infiniband, there are many similar serial I/O schemes available or being defined. Most of these are being driven by the need to interconnect chips to achieve high speeds in packet routers. Some, such as RapidIO, are being standardized in other industry trade associations. But they are not likely to become PC standards and, with the exception of StarGen (discussed below), they are neither software nor hardware compatible with current CompactPCI.

IP packets over PCI

In order to provide packet-based communications between multiple CPUs in a single CompactPCI chassis, Ziatech has proposed a standard way to tunnel IP packets through the PCI bus. Ziatech calls their product CompactNET™ and there is a PICMG group (2.14) working on standardizing the idea. Unfortunately, because it uses the PCI bus, it doesn't scale. Using all the PCI bus capacity, the scheme peaks at about 400 Mbps. Still, this may be a good way to handle control or management functions. And, if there is a way to scale PCI (see below), then PICMG 2.14 may become more important.

ATM Cellbus

Transwitch has defined an ATM bus, called CellBus™, that they use to connect their ATM chips together. Several years ago, Transwitch and AMP published an applications note showing how CellBus could be implemented on the P3/J3 connectors of CompactPCI. As ATM technology, this may be a good match for ATM-based systems, but it requires costly per-board overhead to adapt IP or Ethernet traffic to ATM. In addition, CellBus is limited to about 1.2 Gbps and it's a Transwitch proprietary and patented protocol. Perhaps as a result, CellBus hasn't gained significant share in the CompactPCI market.

Ethernet

At last, here is an alternative that actually leverages mass-market technology. Indeed, this is such a reasonable idea that many manufacturers have already put some form of Ethernet into their CompactPCI systems. And, in late 2000, a PICMG subcommittee (PICMG 2.16) formed under the leadership of Performance Technologies to work towards standardizing a scheme, using J3/P3, that provides redundant point-to-point Ethernet links running separately from each slot to two special slots that hold redundant Ethernet switch cards. Thus, a 20-slot backplane would have two switch cards and 36 Ethernet links (two links to each of the 18 other slots). This will be an important standard. And, while implementations will likely begin with 100 Mbps Ethernet, there is potential to scale to Gigabit Ethernet, providing considerable upside.

Beyond this proposal, there are further Ethernet ideas based on a full mesh of point-to-point links, where every slot has multiple separate Ethernet connections to every other slot and every board includes an Ethernet switch. Motorola Computer Group has already built such a chassis. However, their current implementation uses J4/P4, so it is incompatible with the existing CompactPCI for telecom standard. They have also chosen a different kind of connector for J4/P4 in hopes that they will be able to run Gigabit Ethernet using fewer, higher speed pins than normal Gigabit Ethernet. This is somewhat risky and loses some of the value of mass-market Gigabit Ethernet. But, as an approach, it suggests further work that PICMG 2.16 should investigate – when they have completed their first specification!

Beyond H.110

The current CT Bus, also known as H.110, has an aggregate capacity of 320

Mbps. There has been some discussion of speeding up the bus from its current 8 Mbps per serial stream. Unfortunately, PICMG's backplane simulations show that this won't work reliably, even at 16 Mbps, unless the CT Bus is made much shorter (many fewer slots). Also, such a speed-up would only increases the capacity to a modest 640 Mbps.

More interesting is the idea of segmenting the H.110 bus and providing high-speed switching and bridging between segments. The ATM Ring card from Natural MicroSystems is one way to provide switched interconnection between H.110 buses using 155 Mbps ATM links. But without relatively expensive ATM switches, it only scales to 2000 or so conversations – no more than the basic H.110 bus itself.

Interconnecting H.110 segments over Gigabit Ethernet is another possibility. But, this will have to wait for the arrival of new silicon that dramatically reduces the cost of bridging TDM to IP or Ethernet. Such silicon is on its way, as there is an enormous market for interconnection legacy TDM circuits with newer packet-based transport. However, for now, bridging H.110 over Ethernet remains rather expensive.

Finally, there is a proposal from StarGen Technology and Lucent Microelectronics to bridge H.110 over StarGen's high-speed switched serial interconnection fabric. This is very interesting, as StarGen is also introducing software-compatible PCI bridges for scaling PCI systems.

Beyond PCI

Today's PCI bus is limited to about 1 Gbps peak, at least at 33 MHz and 32 bits. Doubling the speed and/or the width gives a corresponding upside. And the PCI architecture includes PCI-to-PCI bridging, so there is some ability to increase system capacity by keeping traffic that is local to one bus segment on that bus segment (and thus off of other bus segments).

Several schemes have emerged to further scale PCI and carry it over longer distances – for example, between adjacent shelves in a rack. Last year, PLX acquired high-speed ring technology when they bought Sebring Networks. Using this technology, they introduced Gigabridge™, a bridge between PCI and their high-speed ring. And StarGen has announced PCI bridging over the StarGen high-speed fabric of switched serial links. Potential advantages of the StarGen approach are that, like Infiniband, it's a serially interconnected switch fabric that can scale indefinitely (at least in theory). In addition, with Lucent providing H.110 bridges for the same serial fabric, a single interconnection fabric potentially serves both PCI and H.110.

If PCI becomes highly scalable, then Ziatech's CompactNet, i.e., IP-over-PCI as it's being defined by PICMG 2.14, becomes much more interesting. IP-over-PCI provides the potential to run packets between boards in a CompactPCI system using only a software layer and the existing PCI interface.

Putting it together

Our goal should be to extend CompactPCI so it addresses a larger proportion of the telecommunications market. Two principals are important. The first is compatibility with existing systems and the second is leveraging mass-market technology. And two paths have emerged. The first is to extend existing PCI and H.100, perhaps with the StarGen technology, eventually bridging or migrating to Infiniband when Infiniband becomes widespread. The second is to add Ethernet connectivity to the existing CompactPCI backplane, first with the PICMG 2.16 proposal, and then with additional connectivity.

The real issue for the CompactPCI community is to find a single architecture that supports both paths with an absolute minimum set of variants. There should be no more than 2–3 front card configurations, i.e. standard slot definitions. Backplane variations are more easily supported, as one expects to see different combinations of standard slots, but it would be best if 4–5 standard backplanes covered the majority of the market. The challenge for 2001 is to agree on that common architecture and to resist the temptation to go off in a half dozen different directions.

Looking to the future

CompactPCI has found a sweet spot in telecom, serving a variety of needs for TDM systems of less than a thousand channels or so. Even with no further standards, the CompactPCI market will grow to at least $2B by 2004. But with common agreement on a minimum set of CompactPCI extensions, the market could really boom.

Inside this section:

Manufacturing

National Instruments
By Dr. James Truchard, President and CEO
www.ni.com

National Instruments is meeting demanding measurement automation applications in many areas such as manufacturing and manufacturing test with 3U PXI and measurement software platforms such as LabVIEW, Measurement Studio, and TestStand. The open PXI standard brings high throughput, integrated timing and triggering technologies, and like CompactPCI, industry-standard PC software for environments such as Windows 2000/NT/Me/9x at a relatively low cost.

Today's competitive landscape moves at Internet speed and the pressure to manufacture products at high yields as fast as possible has never been greater. With product cycles moving at speeds obeying Moore's Law, companies are having to design, manufacture, and test consumer products in record time. While traditional instrument control, such as RS-232 and GPIB, have been and still are trustworthy paradigms for measurement automation, the need for faster and higher throughput of measurements is getting stronger. This is where 3U PXI comes in with the fast PCI bus. PXI-based measurements are realized at data transfer rates approaching 60 to 100 Mbytes/sec with standard operating systems. This is a substantial increase in throughput compared to serial and GPIB data transfer rates. When you have to test your products by the thousands, shaving off a few seconds in an automated test sequence amounts to a significant increase in productivity and the bottom line.

The exploding telecom and information technology markets are driving the need for ever-shrinking products. Today, engineers are integrating multiple functions on a single chip (SoC) that were once implemented on multi-chip boards. Mixed signal measurement tests of SoC chips require tight synchronization of your instrumentation. 3U PXI fills this need greatly with its integrated timing and triggering technologies. Multiple devices can be programmed to deliver the synchronized measurements that are needed for today's test requirements. PXI is transforming Test and Measurement from loosely coupled and often incompatible stand-alone instruments, to tightly integrated, high-performance measurement systems.

For the past twenty years the computer has been the core of virtual instrumentation. Virtual instrumentation allows the user to define the functionality of the measurement hardware through software. Virtual instrumentation has essentially made it possible for anyone, regardless of their computer expertise, to develop sophisticated instrumentation systems. The combination of flexible PXI measurement hardware and National Instruments software platforms is allowing for enormous development productivity gains. The PXI platform is only half the story for powerful measurement systems. The development environments of LabVIEW, Measurement Studio, and test executive TestStand provide the keys to the other half.

The relentless pace of Moore's Law keeps driving the cost and size lower in computing technologies such as Microsoft software platforms and Intel's x86 hardware platforms, as well as with measurement components such as analog to digital converters (ADC) and digital to analog converters (DAC). These benefits are directly leading to a new compact measurement automation standard, 3U PXI, which addresses the need for conservation of precious floor space. Large rack and stack systems such as 6U PXI, VXI, and stand-alone instrumentation, can be dramatically downsized today. 3U PXI is perfectly positioned to capitalize on these trends to deliver the measurement automation solutions for today and tomorrow's manufacturing test.

Testing

ZTEC
By Christopher Ziomek, CEO
www.ztec-inc.com

ZTEC has identified a general trend in the test and measurement industry as moving towards the CompactPCI platform to take advantage of the modularity, portability, and low price-to-performance ratio. Consequently, ZTEC is implementing all future products as CompactPCI instruments.

ZTEC is offering two new CompactPCI products in Q1 2001: a high-speed digitizer and an RF pulse analyzer. Look to ZTEC for additional CompactPCI products in 2001 that implement conventional high-end instrumentation functions.

ZTEC is specifically targeting its products for testing in the Telecom and Digital Networking markets. These are fast-growing segments of the test and measurement market, due to the increased activity in wireless communications and high-speed digital networks.

ZTEC's new CompactPCI products in 2001 will address high-speed data acquisition, RF and microwave testing, and digital network testing. ZTEC's high-speed digitizer products provide precision signal acquisition and operate as digital receivers. Within RF and microwave testing, ZTEC will add vector synthesizer, spectrum analyzer, network analyzer, and modulation analyzer products. Within digital network testing, ZTEC shall offer Gbit Ethernet and Fibre Channel test sets.

ZTEC is focusing on the demands of 2001 and our new CompactPCI instruments will directly meet the demands of the Telecom, Testing, Military, and Digital Networking industries.

GEOTEST

By Loofie Gutterman, President
www.geotestinc.com

As testing and factory automation requirements become more complex and with the growing demand for better, smaller, portable, and rugged testing solutions, companies need to focus their efforts on new technologies that meet these requirements.

An emerging new technology that can accommodate all these requirements and demands is the PXI bus. The innovative PXI bus has been adopted as an industry standard in August of 1997. PXI stands for Pci eXtension for Instruments (just like VXI stands for Vme eXtension for Instruments) and is a high-performance, low-cost alternative to VXI (and some even say the successor to VXI).

The PXI bus has been developed in response to the needs of test systems developers and users who required a new platform that was high-performance, functional, and reliable, yet easy to integrate and use. PXI leverages existing industry standards such as PCI and CompactPCI to benefit from high component availability at lower costs. Further, since the PXI is a PC-based platform, it maintains software compatibility with industry-standard personal computers, as well as all PC-based operating systems, software tools, and instrument drivers.

PXI provides full interoperability of CompactPCI and PXI instruments (3U and 6U) as well as all PC based software platforms and applications, creating a robust solution for any automation and control application requiring compact size, high performance, and rugged platforms.

Geotest is focusing its R&D energy on the PXI platform. Numerous new products, including a 6U, 20-slot PXI chassis, high-speed digital I/O, digital multimeters, counters, switching modules, power supplies, and many more will be introduced in 2001. The wide range of PXI products, both 3U and 6U provide for a critical mass necessary to make this new PXI bus the platform of choice for any test and automation application.

Today, over 50 companies produce hundreds of PXI products based on the standard. Additionally, as PXI is based on the CompactPCI standard, a PXI chassis can accommodate any CompactPCI card, providing an additional selection of thousands of CompactPCI products. To ensure full compatibility and interoperability of all PXI products, the PXI Systems Alliance (pxisa.org) maintains the PXI bus specifications. National Instruments, GenRad, Geotest, and many other Test and Measurement leaders such as LeCroy, Rohde and Schwarz, Marconi, and Racal Instruments are members of the PXI Systems Alliance and are supporting the PXI bus and PXI products.

ADLINK

By Jim Liu, CEO

www.adlinktechnology.com

Adlink Technology Inc., founded in 1995, has since been developing PC-based products for test and measurement, applied computing, and automation industries. In the last few years, we have acquired extensive knowledge in the application of standard PC technology to many industrial applications. With the know-how and expertise gained, we have designed and produced a comprehensive range of state-of-the-art products to solutions to meet various demanding industrial applications. We are constantly working towards providing superior quality and cost effective solutions for our customers around the world.

Our PC-based automation products are deployed in many different environments – supervisory control and data acquisition (SCADA), test and measurement, telecommunication, process control, machine automation, medical appliances, instrumentation, research Laboratories, intelligent transportation system (ITS), and production facilities. Our acquired extensive knowledge in PC-based industrial applications has enabled us to provide professional consulting services to our partners.

Perhaps a few examples can help you understand ADLINK better. In 1996, we released the first PCI-based DAQ card in Asia, PCI-9112. PCI-9112 series DAQ cards use state-of-the-art technology to make this card ideal for data acquisition and signal analysis applications in test and measurement as well as process control. In 1998, ADLINK envisaged CompactPCI would become the standard for the next generation platform of industrial PCs. For that, we established a CompactPCI R&D center devoted to the development of CompactPCI products. Shortly after our launch of cPCIS-2000, a 3U CompactPCI system, in 1999, it was awarded the highly prestigious, Symbol of Excellence Award, presented by CETRA (China External Trade Development Council), an affiliate of the Ministry of Economic Affairs of the Republic of China.

The cPCIS-2000 series is just another result of ADLINK's commitment and continuous effort in offering highly practical and versatile products for demanding applications. From data acquisition, motion control, industrial communications, to computer telephony, ADLINK can now provide total solutions for our customers. Furthermore, a wide range of software development support is available, from low-level drivers to high-level software components. All ADLINK software products function seamlessly with well-known software packages and users can benefit from these easy-to-use tool kits. We take pride in being able to release Windows 2000 drivers simultaneously at the same time Microsoft officially announced its Windows 2000. Also, we were Linux-ready by July 2000, and are currently developing drivers for VxWorks scheduled to release in 2001.

In the coming century, my challenge is to continuously strive to design and market new cutting edge products benefiting both our partners and all intended industrial users. Our new line of products geared for the year 2001 and beyond will be a showcase of our commitment to be in the forefront of Industrial Computing, Data Acquisition, Test and Measurement, Automation and Control technologies. By constantly keeping pace with advancements in PC technologies, and by our underlying principles of openness, speed, and innovation, I ensure that all future generation products not only meet the most demanding industrial applications, but also surpass the expectations of our users.

VIRGINIA PANEL

By Jeff Stowers, Executive Vice President

www.vpc.com

There are new trends and standards emerging, which bring the functionality of higher end testing systems into the price range of lower cost testing systems. The challenge of the ATE Industry will be to define the technology standard. Virginia Panel Corporation is meeting this industry challenge by focusing our energy to insure we provide mass interconnect solutions for the emerging standards.

Our company is structured as a solution-based team. We have integrated flexible manufacturing utilizing state of the art technology with the brightest engineering, marketing and sales talent in the industry creating a customer centric environment.

We were pioneers in bringing the power of the Internet into our company. This has allowed us to provide a number of innovative tools to both customers and sales partners reducing development time of new products dramatically. We will introduce an additional number of new Internet based tools in 2001 that continue to speed the product development cycle.

The incorporation of these elements has enabled the ability to develop a number of new technologies focused on meeting the market demand for new testing solutions. Great examples of this focus are solutions we offer for the emerging PXI Architecture Systems, our patented Fiber Optic, and Click Mass Interconnect Solutions. We have been and will continue to introduce innovative products to the market quickly with our continual focus on addressing and meeting specific customer requirements in a timely manner.

This is why we see the year 2001 as an exciting year in the Automatic Test Equipment Industry. Virginia Panel Corporation is a leader in Mass Interconnect System, creating order out of mass chaos.

MEKTRON SYSTEMS LIMITED AND MILTRON SYSTEMS INC

MEKTRON® SYSTEMS LIMITED
Turnkey System Enclosures & Integration

MILTRON® SYSTEMS INC.
Turnkey System Enclosures & Integration

By Bob Amos, CEO

www.mektron.co.uk/back-pins
www.miltron.com/back-pins

Unintentionally but surprisingly frequently, system enclosure design, operability, and maintainability do not figure highly in the minds of design engineers at the inception or even intermediate stages of a system's design/development cycle. Instead attention tends to be centered on the perceptively more technically challenging areas like architectural, hardware, and software issues.

This recognized but excusable phenomenon goes a long way in explaining why a fundamental and somewhat glaringly obvious and most important aspect of CompactPCI gets consistently overlooked. To the extent that when eventually highlighted it can hit like a bolt out of the blue! We are of course talking "genders."

Unlike the majority of other high performance open bus architectures, CompactPCI breaks with convention, rightly or wrongly, in that the male connector resides on the backplane instead of on the daughter card. At first glance it is perhaps difficult to discern anything overly worrying with respect to this arguably unwanted feature, until that nine-letter word "logistics" ultimately raises its head.

Mektron Systems Limited and our USA subsidiary company **Miltron Systems Inc.** specialize in the design and manufacture of high-end system enclosures for commercial through to military COTS applications. Moreover, apart from the standard developmental range of CompactPCI enclosure products that we offer, our customers typically present us with their more challenging high-availability and military COTS enclosure requirements. Not surprisingly therefore, such applications mandate an inherently high level of maintainability.

It is usually, therefore, at this later stage in the proceedings that the backplane's male connector "feature" comes under the spotlight as a problem to behold. But why should this be the case?

Firstly, it is perhaps worth remembering that hitherto CompactPCI, the backplane has generally been regarded, rightly so, as an inherently reliable system component both electrically and mechanically. What's more, particularly with female DIN 41612 connector based bus backplanes such as VME and Multibus II, users have acclimatized themselves to expect a high level of mechanical robustness during daughter card insertion and extraction. Should physical damage occur for some reason, it is invariably going to be limited to the male daughter-card connector. In maintainability terms this is simply fixed by replacing the daughter-card. Accordingly, apart from a few exceptional situations, ease of backplane removal and replacement as an LRU (Line Replaceable Item) has not been viewed as necessary.

CompactPCI's connector gender convention coupled with its particularly vulnerable high density 2 mm pin pitch, accounting for xxx pins per 6U slot, has on the other hand, started to flag up some serious system enclosure design considerations, which prior to now has really not been an issue.

Over and above enclosure manufacturers providing a high degree of due diligence with respect to backplane/cardcage alignment and users exercising a greater degree of care caution when extracting and inserting daughter boards, there appears to be no magical answer inherent within the CompactPCI backplane/IEEE mechanical make-up.

One route would be to treat the backplane as an LRU, but generally speaking even with innovative enclosure design techniques this can be far from straight forward and in any event would possibly in most circumstances take a longer than acceptable period to replace. Another obvious solution, which runs the risk of turning into a full-time pursuit is to replace damaged or broken pins on a pin-by-pin basis.

A couple of interesting and somewhat alternative approaches deployed by Mektron to help overcome this problem may be found on the Mektron Web site.

PEP

By Hugh W. Nevin, Jr. President of North American operation

Modular Computers®
A Kontron Company

www.PEP.com

Military computing is extremely diverse and requires a unique approach to match technology with demanding application requirements. For the past twenty-five years **PEP** has served as an experienced vendor providing VMEbus boards and solutions for military and ruggedized industry. Our success resulted from products featuring low power consumption, extended temperature support, small form factor, and ruggedized construction. PEP has incorporated these design concepts for use as building blocks of our CompactPCI portfolio.

PEP has experienced a growing requirement from the military in 2000 for CompactPCI solutions offering minimal power consumption and maximum x86 performance. In the past this has been a design criterion that involved sacrificing one element for the other. However, Intel has embraced the Embedded market and is now offering low power Pentium processors that are starting to converge with Motorola's PowerPC power/performance ratio. The key, however, is designing products around the optimal package, since Intel offers a broad selection of embedded building blocks.

PEP is committed to selecting components and packages that reduce aggregate power consumption for Single Board Computer (SBC) and I/O peripherals. This strategy is underlined with the existing product portfolio and is a fundamental starting point for new product design. Significantly, new SBC solutions have concurrent requirements for high performance and minimal power consumption. For example, in March 2000, PEP introduced a 3U single board 400 MHz Pentium III processor (CP302) offering typical power consumption around 13.5 watts. This innovative product was possible using Intel's Mobile Pentium III "Coppermine" 495-pin BGA2 package. This "flavor" of the Coppermine, with a core voltage of 1.35 volts, offers the lowest power and highest performance solution for Mobile Pentium on 3U CompactPCI.

The fastest processors from Intel are insufficient to keep pace with compute-intensive military requirements. CompactPCI offers a flexible bus architecture to implement sophisticated multi-processing configurations. To support multiprocessing solutions, PEP offers a multi-Operating System (OS) protocol stack (Racknet) using TCP/IP over the backplane.

A limiting factor with 3U CompactPCI has been the absence of extended temperature support for high performance systems. Many x86-based SBCs do not meet the standard temperature range (0 to 70 degrees C). However, the CP302's Pentium processor supports a case temperature up to 100 degrees C. PEP currently provides 400 MHz Mobile Pentium III in E2 (-40 to +85 degrees C), which is unmatched by any 3U CompactPCI vendor in the industry. PEP also complements the x86 architecture with a Motorola 8240 (MPC603e core) 3U CompactPCI SBC that also is compliant with E2.

To satisfy increasing demand for ruggedized mobile ground based systems, PEP plans in 2001 to concentrate on introducing leading edge 3U CompactPCI technology. PEP will continue optimizing board tolerance for shock and vibration. For example, while other vendors implement system DRAM only with DIMM or SODIMM, PEP utilizes shock-tolerant soldered SDRAM. Additionally, by utilizing BGA packaging (especially for the CPU), the board footprint is significantly reduced, which offers complete SBC solutions in a single width (4HP) form factor.

Today's vendors must provide broad OS support. PEP specializes in providing Board Support Packages for VxWorks, QNX, Windows NT/Embedded, and Linux.

PEP recently joined the Kontron family of companies, which includes Teknor Applicom, Inc. PEP is excited with the tremendous product and technology synergies within the growing family and anticipates a very successful 2001.

CARLO GAVAZZI

By Jeffrey Russell, CEO

CARLO GAVAZZI

www.carlogavzzi.com

Carlo Gavazzi Mupac has enjoyed a leadership position as a supplier of COTS (Commercial Off The Shelf), ROTS (Rugged Off The Shelf) and MOTS (Military Off The Shelf) hardware for over ten years, and is committed to maintaining this position in the future.

Currently, we are one of the largest suppliers of VME and CompactPCI Rugged Enclosures to the military both directly and through our extensive OEM customer base. Our enclosures are designed to accept COTS single board computers (those designed and manufactured by CG Mupac as well as those provided by other manufacturers) and perform reliably in tough military environments such as submarines, army vehicles, and surface ships.

An example CG Mupac's commitment can be found in our engineers' recent redesign of the U.S. Navy's next-generation Submarine Low Frequency/Very Low Frequency VMEbus Receiver (SLVR) chassis to meet the standard (MIL-S-901D) for the near-miss shock requirements.

The SLVR design uses an open-bus system architecture based on VME and VXI COTS components, thereby reducing system development time and cost. It uses a "militarized" chassis designed and manufactured by CG Mupac to protect the internal COTS components.

This new system needed to replace four much bulkier systems that were

currently in use, and will be installed on all classes of submarines as well as associated tender and shore installations.

The VME COTS design and industry standard interfaces provide the Navy with a small, lightweight system that requires less power and uses the pre-existing software. In addition to meeting MIL-S-901D Shock, the SLVR chassis are designed to meet other military standards for vibration, operating temperatures, relative humidity, altitude, fungus, ship motion up to 60% incline, electromagnetic compatibility, DC magnetic fields, airborne/structure-borne noise, thermal requirements, and Mean-Time-Between-Failure. In short, the new SLVR system designed by CG Mupac provides the Navy with expandability options as well as double the capability of its predecessor, all within the same space.

CG Mupac has also introduced a similar system using the CompactPCI architecture in anticipation of the coming trend of migration from VME designs to CompactPCI in the military. This design includes redundant power options, power and temperature sensors, and the ability to use our new 16-Slot Monolithic CPC Backplane. This system accepts Single Board Computers designed and manufactured by CG Mupac, and other peripheral hardware.

Our commitment to design and manufacture the highest quality enclosures and systems for the military is ongoing. Our capabilities are augmented by connected multi-factory design centers (Brockton, MA, Sparks, NV, and Garland, TX) that allow us to meet requirements with standard and custom product wherever the customer is located. This market represents a significant portion of our business focus, and we intend to maintain our leadership position in it.

Manufacturing Automation

MEN MIKRO

By Udo Fuchs, President

www.men.de

In the year ahead, we at **MEN Mikro** believe that more and more system designers in the manufacturing automation, test and other industrial/ruggedized markets will continue their migration to the 3U CompactPCI form factor. To maintain our position as a key supplier to these industries, MEN will continue to provide designers with flexibility in terms of a wide range of CompactPCI based solutions. This year MEN customers will have more options than ever before.

MEN will continue to support its traditional VMEbus customer base. But with demand for CompactPCI solutions in the industrial market building, MEN will focus on developing industrial strength compute platforms that can be leveraged across both markets. For example, MEN is introducing a variety of compute platforms that straddle the VME and CompactPCI worlds. One of our newest 3U VMEbus PowerPC SBCs, the MEN B11, is based on a very successful 3U CompactPCI PowerPC SBC, the MEN F1. The two boards share similar internal architectures, but the B11 includes a high-speed PCI-to-VMEbus interface developed by MEN.

We believe that the industrial embedded market will continue to move away from its dependence on Intel processors and will employ other processors with improved price/performance, such as the PowerPC, the ST-PC system-on-a-chip from ST Microelectronics and others. Solutions from MEN will continue to feature what we are known for – high quality industrial range performance in the harshest of conditions, including extreme temperatures, shock and vibration. And for those applications that require a Windows/Intel (WinTel) compatible architecture, MEN will continue to offer innovative CompactPCI Super Socket 7 and the Socket 370 compute platforms.

Beyond our unique processor alternatives, embedded industrial applications also demand a wealth of software and input-output (I/O) choices. For applications that require a Microsoft operating system, MEN's systems will continue to support compatibility with the WinTel architecture. And we are also expanding our support for users of real-time OSs like VxWorks and OS9, because these will continue to be in high demand in 2001. We also see increased requests to support the deployment of Linux on industrial platforms. MEN is addressing this by partnering with Monta Vista to supply a best-of-class Linux implementation.

I/O is always a concern for industrial embedded system designers and MEN will address I/O needs in the year ahead by offering two varieties of modular I/O. First, the M-Module mezzanine card has proven that it offers the flexibility and versatility designers need for real-world I/O requirements. Second, MEN will satisfy the need for high-bandwidth computer I/O with PCI-based PC•MIP mezzanine modules. MEN, Motorola, Schroff, and SBS have all collaborated on the development of the PC•MIP specification. This single mezzanine specification for high bandwidth computer I/O is good for the industry and we will aggressively support it next year.

In summary, MEN Mikro will focus its energies in the year ahead on meeting the many needs of industrial embedded designers because the demands placed on these systems require a broader range of capabilities and functionality than ever before.

TRACEWELL

By Larry Tracewell, President and CEO

www.tracewellsystems.com

I founded **Tracewell Systems** in 1973 to provide electronic packaging solutions for the electronics industry. In the years following, we received many patents for innovative products, such as the T-Frame, a development tool. In 1996, Tracewell Systems acquired the engineering and manufacturing operations of CompuServe. This acquisition expanded our capability to provide network hardware and support services. Today, the company specializes in the design and manufacture of system packaging, backplanes, bridging products, power supplies, and monitoring systems. We supply everything from off-the-shelf standard products to fully customized COTS ruggedized units and integrated rack systems for VME, VXI, PXI, CompactPCI, and proprietary bus systems. Tracewell Power, an affiliated company, was founded in 1995 to provide 200 to 2000 watt power supplies to the computer systems industry. We have received patents for power and cooling technology and manufacture products such as the PCI 350, CompactPCI power supply.

The industry's biggest challenge today is lack and availability of qualified people in our field. The electronic industry in general, suffers from an inadequate supply of skilled engineers; consequently companies that do not have in-house experience readily available face the challenge of continued dynamic growth. An electronic packaging company's foremost objective is to provide their customers with quality resources and in-house individuals that possess a diverse technical knowledge. The markets of 2001 and beyond will continue to demand vertically integrated companies that can provide them with a complete "one-stop-shop" for their projects.

Tracewell Systems is vertically integrated with a full range of engineering disciplines that allows us to supply complete design, software and manufacturing services to our customers. This includes system engineering, PCB assembly, metal fabrication, final test, wiring, and system integration. The main problems our customers face are power supply issues, backplane issues, and time-to-market issues. We believe in the systems approach to design and do not view any of these issues as an afterthought. We utilize our proprietary Smart Solutions™ process to solve complex design problems.

Our power supplies are customer specific with a number of unique designs and patented features. We designed and manufactured the 6U 350-watt CompactPCI power supply.

Our custom specific backplanes focus on telecommunication design particularly in the fields of ADSL, HDSL, SDH, and ATM. We have a great deal of experience with high layer count backplanes, up to 40 layers, with complex routing strategies, demanding conformance requirements, and high frequencies up to 2.5 GHz.

By using the Tracewell T-Frame, a developer has full test access to the component side of installed boards. Moreover, this unique system provides comprehensive monitoring functions such as voltage, current, temperature, and dual power for hot-swap testing. By solving measurement, control, and board accessibility problems during development, T-Frame reduces design cycles and time to market.

Tracewell Systems, Inc. strives to be the supplier of choice to equipment manufactures for the Telecom/Datacom, Manufacturing Automation, Testing, and Military/Ruggedized industries. Tracewell Systems, Inc. can take your project from concept to full production providing you with a system chassis with better performance, fewer components, and novel features that save you money. As many Smarter Solutions™ have found their way into top development labs in America and abroad, providing Tracewell Systems with a reputation of quality, innovation and value.

RTSOFT

By Olga Sinenko, President and CEO

www.rtsoft.ru/english

Being a software service provider always demands the ability to find the right solution for customer needs. It requires not only investments, but also forecasting the demand according to market trends. At **RTSoft**, this is not just a marketing cliché, but the core foundation of our business. Meanwhile, the new year will certainly bring several new challenges and drive us to set new goals.

One such challenge is the impact of network-centric architecture as it rapidly changes the landscape of dedicated systems. Today, connectability to the Internet is simply a must. It demands the presence of WEB enabling components, like browsers and Java VM, combined with basic TCP/IP stack. At the same time, every device must be customized to fit into a specific market niche. The goal of RTSoft is to provide a full range of integrated support, ranging from firmware to database connection. For OEM's this means a significantly shorter time to market, which is a synonym for success in 2001.

Another challenge is presented by a new generation of network-oriented chips, like the Motorola PowerQUICC™ II or the IDT RC323xx RISController™, which require much more firmware and software support. Even the learning curve for such chips can last several weeks before entering the design phase. Accumulating the extensive experience in this specific area requires a significant investment for the service provider, yet at the same time creates unique opportunities and advantages for the client – primarily, the ability to start a work on a new project immediately.

The rapidly expanding dedicated systems market also creates the need for numerous hardware platforms, tailored to specific tasks, to provide a maximum cost-effective solution for OEM's. This in turn creates a great challenge for hardware manufacturers in providing adequate software support, ranging from board-support packages to porting operating systems (OS's) to selected platforms. Turning to service providers such as RTSoft allows companies to direct their focus on core competencies, and thus provides more benefits to the end user. RTSoft accepts the responsibility to provide extensive software development and support services, both to the manufacturer and the OEM as needed.

Almost every device today is seeing an increase in software content, and this creates yet another challenge both for the manufacturer/OEM and the service provider. The quality of software and firmware must be paramount. It is no longer possible to merely assign a few engineers for this task. The better solution is to create a dedicated, professional and experienced team that addresses development as a business process, not just as "writing code." For many companies, regardless of size, a dedicated in-house support team will consume valuable company resources, thus slowing down the development. So it is often difficult to create such dedicated in-house engineering teams. At this point it becomes a natural and logical decision to outsource the entire project. However, while contracting a service provider for support issues (normally combined with development tasks) may greatly simplify the client's life, it can also put tremendous pressure on the service provider. Such assignments present a challenge for the software provider, and at the same time demand strict conformance to quality standards to be successful.

The proliferation of the open source-programming model started by LINUX opens the way for many advantages, but it creates global challenges as well. Using such a model demands providing extensive and professional support for clients.

BITTWARE

By Jeff Milrod, CEO
www.bittware.com

Most embedded DSP board vendors have redirected to become more vertically oriented. That is, they make their products more focused at solving the needs of a particular application (application-specific boards or ASBs, I call them). Contrary to this trend, **BittWare** is committed to providing excellence in general purpose DSP boards.

A common business axiom is that companies must change with the times. For technology providers this is certainly true. The question is what should change? I believe that board vendors should adapt their technical intellectual property (IP) to the needs of the customers but not go so far as to limit the customer's ability to add value or innovation.

Our customers need horizontal enabling technologies that they can use as system "building blocks." Allow me to make a somewhat unusual analogy. Much like the ubiquitous LEGO toy does for kids, an embedded board vendor's job is to provide system/product engineers the pieces they need to creatively and innovatively implement their applications. Also like LEGO, it is important that the vendors provide some special purpose pieces such as wheels, windows, etc; however, I feel it is a mistake for LEGO and embedded board vendors alike to make the pieces so special so as to limit the imagination of the user to little more than the assembly of a pre-designed model.

BittWare's unique value-add to this situation is not in knowing how to do telecomm better than our telecomm customers or instrumentation better than our instrumentation customers. Rather, it is leveraging our great wealth of DSP expertise and experience (over a decade) to build better and more flexible DSP "building blocks" that can be easily used by the true application experts, our customers.

To that end, BittWare is focusing its efforts on developing a broad range of balanced products that maximize (rather than minimize) flexibility and applicability. At a fundamental level, the DSP needs of telecomm applications are not that different from those of industrial controls – they use the same "building blocks," It's just that the telecomm application typically will need to use many more, and bigger ones.

All of our DSP board products feature an architecture that provides scalable DSP performance, memory, and modular I/O implemented on a variety of PCI formats: Plug-in, PC/104+, PMC, 3U and 6U CompactPCI. The balance of the architecture varies from product to product, some maximized for memory and others for processing density or I/O, but all BittWare products are balanced. Product pricing ranges from under $500 in quantity to over $10,000.

Key to any DSP application is the ability to interface processing to signals. Not only do our products facilitate modular I/O, we also provide specialized I/O "building blocks" (wheels and windows, not models) that are common to the implementation of DSP such as high-speed A/D, digital drop receivers (DDRs), high performance audio, and programmable digital interfaces.

For 2001, BittWare's energies will be directed toward producing better, faster, and cheaper DSP building blocks that allow our customers to be innovative and creative.

RADISYS

By Stuart Cohen, Vice President, Worldwide Sales and Marketing

www.radisys.com

At **RadiSys**, our strategy is simple: focus on building blocks for next generation Internet and communications systems; partner with Intel® Corp. wherever possible; and implement our "virtual division" concept with each of our customers in order to establish an intimate, high trust relationship. By doing this, RadiSys can offer a broad range of "best-in-class" solutions that combines the capabilities to meet today's needs with the flexibility for tomorrow's demands.

RadiSys provides more than simple component-level solutions. RadiSys offers a complete range of integrated "best-in-class" building blocks. Why building blocks? By offering a "one-stop-shop" of solutions and integrated application-ready systems, we are able to deliver more and more of what the customer needs. This will free up more of their critical resources to focus on their core competencies, which should lead to faster time to market products.

Since our building blocks have already been configured to work together in a subsystem, there is a reduction in the interoperability issues. This saves the OEMs time and money.

Our building blocks include Intel-based embedded solutions, DSP modules, network interface modules and system platforms – all designed in the PCI, CompactPCI and custom form factors. We also offer a growing family of Intel-based motherboards.

Our success rests on over a decade-long relationship with Intel Corp. Our experience with over 100 board designs crosses every Intel platform including the families of Intel Celeron™, Intel Pentium®, Intel Internet Exchange™ (IX) and Intel StrongArm® solutions. Additionally, RadiSys offers a comprehensive line of DSP solutions for voice/data convergence and a wide array of SS7, Frame Relay, HDLC, Serial and x.25 protocols based on open architecture standards.

At RadiSys, we see our customers as our partners – and we act as a "virtual division" of their company. With this kind of relationship, our customers can off-load their embedded work and focus on their own core competencies – application development, branding and selling. By collaborating with our customers as a virtual division, we create unique, Intel-based solutions based on their exact specifications.

For the last 13 years, Intel architecture has been at the heart of RadiSys' embedded solutions. As a member of the Intel® Applied Computing Platform Provider (ACPP) program, RadiSys has met Intel's strict criteria for quality assurance, manufacturing capacity, design capability, tools, and support. As an Intel ACPP, RadiSys is a reliable source for Intel architecture-based solutions, from board-level products to complete systems.

As a RadiSys investor, Intel also has a long history of collaboration with RadiSys on engineering efforts. Our relationship extends from design services and covers every step in between. We work closely with Intel throughout the development process from engineering, manufacturing and testing to marketing and sales. This is the key to creating our building blocks offerings. Our latest collaborative development project based on Intel IX architecture, is just one example. Our newest embedded processor products are a response to today's customer demand for scaleable performance and upgradeable networks built upon the IX cornerstone of programmable silicon.

Over the years, we have used our relationship with Intel to better serve our OEM customers. We work closely with Intel to ensure their latest technology is made available to the applied computing market in a timely manner. This allows our customers to speed up their design process, which lets them focus on adding value and differentiation to their products.

The end result? RadiSys delivers best-in-class building blocks for your specific applications – and that allows you to design products more quickly and with a longer life.

SPECTRUM SIGNAL PROCESSING

By Pascal Spothelfer, President and CEO

www.spectrumsignal.com

As various convergence technologies and standards mature, 2001 will be a year for accelerating deployments and technology development. 2001 will see the widespread rollout of various voices over broadband technologies in access networks, including Voice over DSL (VoDSL) and Voice over Cable (VoCable). 3G wireless development and trials will ramp, requiring new packet-voice processing technologies. The deployment of "softswitch" networks in the telecom infrastructure will begin to pick up steam, requiring robust media gateways and media gateway controllers. This growth in the Voice over Packet market is also reflected in upwardly revised market forecasts from Frost and Sullivan.

The accelerating deployments of such converged packet networks require breakthrough technologies for processing massive numbers of voice packets in a relatively small physical space, and with minimal power consumption. **Spectrum** is developing various core technologies to deliver massive voice processing and packet processing at the industry's highest-density and lowest price-per-port. Spectrum's aXs™ family of packet-voice processing board-level solutions integrate these technologies to enable services such as VoIP, VoA™, VoDSL, VoCable, VoWLL, Echo Cancellation, and 3G transcoding. aXs solutions are voice processing modules that ship pre-programmed and are optimized for rapid integration into infrastructure equipment, thereby reducing the equipment manufacturer's development risk and time to market, and accelerating the roll-out of these revolutionary services.

In the commercial wireless realm, Software-Defined Radio (SDR) will receive continued attention as the solution to the lack of a harmonized worldwide air interface standard. SDR enables seamless communication by enabling radio systems to be reconfigured via software so that they can adapt to different air interface protocols. SDR will enable service providers to offer support and roaming to mobile users using different protocols, such as IS-95 and IS-2000, and providers will be able to upgrade their equipment to support new standards without having to replace hardware. Spectrum's *flex*Comm™ product line of baseband processing engines and digital radio I/O offers the flexibility and modularity to support most software-defined radio architectures.

2001 will indeed be an exciting year for packet-voice and SDR, and Spectrum is committed to contributing key technologies and products to improve and accelerate service deployments in these markets.

FORCE

By Ajay Shah, CEO

www.forcecomputers.com

There's an ongoing technological revolution happening with the Internet, especially in the wireless arena, that's driving new aspects of Force's business. Our customers' market requirements are changing overnight. Established OEMs are being challenged by the sheer speed of change, startups are on extremely fast tracks. Moreover, this rapid technological evolution is fast-forwarding market requirements. The Telecom industry is demanding more integrated levels of outsourcing at all levels. This all translates into greater business opportunities for companies such as Force.

Speaking for **Force**, we've been successful managing the quick changes with positive customer and vendor relationships. Strong, long-standing relationships with our Telecom customers (we don't compete with them) have allowed us special insight to their customers' needs. From our vendor relationships we receive the earliest possible access to new technical developments and trends.

There is more to it than relationships. In a nutshell, we focus our specialized Telecom know-how to offer speed and flexibility – a fast time-to-market with multiple platform options. At Force, we have positioned ourselves in a unique space. We have developed the broadest range of solutions using open, standards-based products, CompactPCI platforms, and a full range of custom and standard designs. Our reputation is to provide the highest quality quick-turn systems customization with standard building blocks. Our dedicated design centers are *worldwide*, running 24x7, producing solutions for VxWorks, Solaris, Windows NT/2000, and Linux platforms – essentially leaving no Telecom customer's needs unmet. We also easily accommodate growing production demands and sudden manufacturing requirements in conjunction with our parent company Solectron.

There is still more to it – our employees. More than 50% of our employees work in Engineering, Applications Engineering, or Technical Marketing. That gives us a wide range of technical capabilities. This simple fact is very important to our customers. So, combine our technical capabilities with close customer relationships and we get excellent account and strategic planning abilities. Then, combine the technical capabilities of our staff with a complete product and services range, and we can anticipate, plan for, and deliver future technology and feature changes. It's a wining combination that works for Force and for our customers!

BROOKTROUT

By Eric Giler, President

www.brooktrout.com

Brooktrout provides both the telecommunication and data communication expertise necessary to build out the New Network. Brooktrout's businesses are focused on two areas, the first being the infrastructure and the second the applications that run on the infrastructure. We support the infrastructure as well as the applications by providing hardware and software, which is sold primarily to other companies that embed this technology into their products and services to build out the New Network.

The two messages that I would like to get across about Brooktrout is that we are New Network focused and that we are customer focused. We refer to our customers as partners because the word partner implies someone that you are inextricably linked to for your success or failure, and we make sure that we understand the needs of our partners so that we can meet them. Brooktrout puts a special emphasis on being a true partner with our customers in creating innovative solutions for the new global communications network. Accelerating a customer's time to market and helping them expand into new markets is not just about working together at an engineering level. Every aspect of the customer relationship is important to the whole process and affects the success of the customer and ultimately the success of Brooktrout.

Our technology accelerates the time to market for our customer's applications and in most cases, the technology that we provide is integral to the success of the companies that we serve. Our customers come to us because we specialize in the areas including Internet telephony, voice over DSL and wireless. In fact, our largest customer is Lucent Technologies, which as an aside owns Bell Laboratories, and therefore has the ability to develop any technology they need should they choose to put their money and resources behind it. Yet they choose to come to us for certain pieces of the technology because we specialize in it and therefore can get it done more quickly than they can with their own internal resources, which allows them to get to market quicker. However, we cannot rest for a moment and have to keep pushing ourselves to keep getting smarter and smarter, which we do by investing money to create and develop the products that our customers are asking for.

JUNGO

By Ofer Vilensky, President
www.jungo.com

The Telecom industry today is faced with a growing demand for High-Availability hardware infrastructure, in order to supply customers with top quality service. This translates into what is known as the "5 nines," meaning systems that are available 99.999% of the time. The need is for systems that not only handle failures with a minimum loss of system uptime, but that are also capable of "in flight" hardware upgrade and maintenance.

An essential building block in achieving this goal is hot swap capabilities, which could be achieved on CompactPCI systems, if it weren't for two problems.

First, a substantial amount of additional software is required at the operating system level, but currently, mass-market operating systems such as Windows Solaris (until version 8), Linux, and VxWorks, lack such additional software.

Second, the Hot Swap Standard itself is a bit cloudy in some areas. As a result, CompactPCI hardware vendors need to develop a different driver for each different CompactPCI system board, and companies using CompactPCI systems are forced either to give up utilization of hot swap capabilities, or to develop/buy proprietary solutions.

We at **Jungo** have addressed this pressing issue, by developing GO-HotSwap, an operating system extension that adds the necessary software layers required to support CompactPCI hot swap under all major operating systems, and on all available system boards.

We believe that a hot swap solution must also include several additional elements:

1) Be a generic solution that supports all CompactPCI devices, at all hot swap capability levels.
2) Multi platform capabilities – the solution should support all major operating systems.
3) Support legacy PCI drivers – the solution should support devices that use drivers that do not support hot swap.
4) Hot-swappable driver development tools – the solution should not only include the infrastructure to support hot-swappable drivers, but also include the tools to develop them.

GO-HotSwap provides a solution that answers these criteria.

Using *GO-HotSwap* players in the telecomm/datacomm markets can immediately implement CompactPCI hot swap capabilities under Windows 9x\2000\ NT\ CE \ NT- Embedded, Linux, Solaris and VxWorks, where these capabilities are not natively available. *GO-HotSwap* also includes a powerful driver development tool kit, which enables development of fully hot-swappable device drivers from scratch. The resulting code generated by the *GO-HotSwap* development toolkit is cross platform, and can be re-compiled and executed on any of the major operating systems supported, without rewriting it.

GO-HotSwap is also a generic solution; i.e., it is not dependent on the hardware configuration on which it is running, or the host PCI controller it is using. The same drivers written by the hardware vendor using the *GO-HotSwap* solution will compile and run on all supported operating systems, and on all CompactPCI systems. Moreover, an additional module in *GO-HotSwap* may be configured to enable legacy PCI drivers to be hot swappable.

GO-HotSwap is an ideal solution for hardware vendors, as well as for system integrators, operating system vendors/ distributors, or anyone else who would like to gain true hot-swap capabilities.

ENEA

By Lars Österberg, President and CEO

www.enea.com

Born out of the telecommunications industry, **Enea OSE Systems** has supported the telecom market for over 15 years. The OSE realtime operating system (RTOS) is one of the most widely accepted commercial operating systems for telecommunications systems worldwide today, and the company has been growing at a rate of over 100% for the last few years.

Massive technological changes are ongoing in the communications arena. Our telecom customers are using OSE to build infrastructures for 3G mobile systems. Soon consumers will be able to use their mobile phones for everything from paying for a soda at a vending machine to participating in a videoconference. In Sweden you can pay your train fare on your WAP phone and then use it instead of a ticket.

With such advances on the horizon, Enea OSE Systems understands the need to accelerate telecom application efficiency and functionality. To prepare for the 2001 telecom year, we are extending our outreach and strengthening our services in an effort to support our customers, vendors, and suppliers in their quest for a larger share of the telecom arena.

Having grown rapidly throughout Europe and North America over the last years, Enea OSE Systems is now expanding into Asia and will continue that expansion during 2001. Our new Tokyo office will be able to offer local engineers and sales support staff to meet the needs and demands of our Japanese telecom customers.

We know that our telecom customers need more than just a powerful product line, they also need product support. Throughout 2001, we will establish OSE Services all over the world. In the Nordic countries we are currently working together with our parent company Enea Data, who has a proven record of providing top-of-the-line consultancy services to telecom customers such as Ericsson and Nokia. In the US we launched our OSE Services with the opening of the first OSE Design Center, located in Phoenix, Arizona. Launched in collaboration with TekSci, the OSE Design Center offers developers working with the OSE RTOS access to genuine OSE competence and additional resources to get projects started, completed, or developed from start to finish. The OSE Design Center is an example of a growing trend in our industry: the need for RTOS vendors to supply expertise above and beyond best-of-breed products.

In 2001, we will continue to dedicate ourselves to providing the best products and solutions to base the next generation wireless and networking infrastructure and consumer applications on. Our mission is to understand and prepare for future standards and technology breakthroughs before they happen. By working closely with our partners, we are participating in the development of new and hot technologies, such as Bluetooth and WAP applications, as well as providing the base for the 3G mobile infrastructure systems.

Through our extensive product and service offering to developers of embedded systems, we have earned our reputation for offering reliable, high-performance and compact solutions for communications applications. 2001 will certainly present more challenges and opportunities: next-generation wireless applications, infrastructure changes, and millions of new devices across the globe. Our job will be to continue to look into the future, and make sure our customers are prepared to meet it head on.

ADVANTECH

By David Dan, Managing Director

www.Advantech.com

The new Telecom industry is booming. Every day new technologies and applications are emerging. For **Advantech's** CT and Network Computing Division the key for growth in this new market is based on the 2 key factors: Standardization and success of integration. In 2001, I believe you will see many leading technology suppliers developing partnerships to bridge these key factors and move Telecom into the next generation.

Advantech entered the Telecom Industry as a "hardware platform provider." We offered a full range of Industrial Computers, CompactPCI Platforms, CT Servers, and Thin Servers to meet the industry demands. However, after years of operation and service in this market, we see that customers are now looking for the total "solution." Since customers are requiring more than just hardware platforms, Advantech is evolving into an application ready platform provider for the communication infrastructure. We have developed partnerships with major technology vendors, including voice technology vendors such as Dialogic, Brooktrout, NMS, and operating system vendors such as VxWorks, and Windows NT. In 2001, we will continue to expand our partnerships by moving into vertical markets. We plan to work with application service providers (ASPs) and application software developers specializing in specific Telecom markets such as VoIP, Unified Messaging Centers, CRM, and Call Centers. The development of these partnerships, along with Advantech's commitment to quality products will move Advantech into position for the next generation of Telecom. In 2001 and beyond, you can expect to see Advantech's CT and Network Computing Division offering total system integration of Telecom solutions to meet the specific requirements of customers.

MOTOROLA COMPUTER GROUP

By Wayne Sennett, Senior Vice President and General Manager

www.mcg.mot.com

Driven by the never ending need to compress time to market and time to volume, Original Equipment Manufacturers are looking to outsource larger portions of their system solutions every day. While the figures for outsourcing in the embedded solutions market topped $3 billion in 2000, analysts believe this accounts for less than 30% of the total potential market.

What is driving this insatiable appetite for outsourced solutions? Time, money, resources, and ultimately, success in the marketplace. By capitalizing on outsourced design and manufacturing capabilities, OEMs can cut their time to market in half. They not only gain access to next generation technologies without having to expend their own engineering resources, but also realize increased cost efficiencies as well.

To address these growing OEM concerns, **Motorola Computer Group** builds upon its existing design, manufacturing and supply chain expertise to deliver customized, standards-based, carrier-grade platforms packaged and configured for telecom applications. We provide as much or as little of a solution as the OEM desires – everything from integration of third party hardware and software to writing technical documentation; from design and customization, prototyping and assembly, to regulatory compliance certification testing, labeling and shipping. On a product level, the "everything" includes flexible platforms typically based on CompactPCI technologies that provide choices of processor family, operating system, voice and data transport, packaging, and integrated third party I/O, communication and multimedia products.

While downtime may be acceptable in the home computing or small business environment, these seemingly small inconveniences can translate to millions of dollars lost on an annual basis in critical telecom applications. Providing the utmost in customer choice and flexibility, Motorola Computer Group helps to provide telecom solutions that businesses can count on every minute of every day and night. By offering access to standard high availability system platforms based on rules and policies originally developed for fault-tolerant platforms, we simplify the work for developers to easily make their systems highly available and enable network architects to benefit from software standardization and reuse across platforms.

The Motorola Computer Group Infinite Infrastructures Solutions approach will take our customers a step further as we address the ultimate goal in an outsourcing model – having the platform provider offer as complete a system solution as possible. Motorola Computer Group will offer standards-based application-enabled platform solutions as the building blocks upon which telecom OEMs can quickly and cost effectively incorporate their own customized functionality. With these foundation technologies readily available to them, OEMs are able to accelerate product time to market and life cycle profitability, while recapturing engineering resources and refocusing all efforts on their own competitive advantages and market niches.

The crunch is on. In a world where our customer's ultimate success in the marketplace is largely defined by the speed with which they get products to market, Motorola Computer Group will continually architect powerful new system-level solutions that pace the market, while ensuring these offerings can be customized and integrated easily for OEMs. In simplest terms, Motorola Computer Group will become a virtual extension of an OEM's in-house design and engineering capabilities – a partner in the truest sense of the word.

SBS TECHNOLOGIES COMMUNICATION GROUP

By Robbie Dhillon, Executive Vice President of Technology and Business Development
www.sbs.com

The challenges facing key players in today's OEM telecommunications marketplace span from meeting the constantly shrinking product release cycles to satisfying the performance demands of leading edge technology based products. As a leading provider of OEM telecommunications platforms and subsystems, **SBS Technologies** is well positioned and committed to developing innovative product solutions designed to address the unique requirements of our OEM customers' specific applications and technologies.

While SBS currently offers a wide breadth of telecommunications products, we have and will continue to develop and introduce state-of-the-art products in anticipation of evolving industry needs. Positioned as an extension of your engineering team, SBS prides itself on recognizing and addressing the many issues with which OEM telecom developers often struggle, including time to market, make vs. buy, software requirements and price/performance tradeoffs. Most recently, we have focused on advanced technology for high availability (HA) systems, CPUs, and intelligent I/O controllers.

In June 2000, SBS introduced the Cascade™ Series of HA CompactPCI systems designed for demanding mission critical OEM telecom and networking applications. In designing this series of HA systems, SBS developed a unique design approach that satisfies the hardware functionality required for HA. As is often the case, the integration and testing of hardware functions within operating systems (OS) and device drivers poses another significant challenge in the product development cycle. In the case of the Cascade system, we were able to overcome the HA-related software implementation issues by working closely with our OS vendors and OEM customers.

While software support creates a primary obstacle in HA system development, density and performance prove to be common challenges within the CPUs and intelligent I/O controllers' arena. A typical OEM application for our CompactPCI systems is a DSL Multiplexer (DSLAM) or Broadband Integrated Access Device (BIAD) that provides aggregation of multiple T1/E1 or DSL links onto an OC-3 or OC-12 ATM uplink. The challenges in such applications are to meet time-to-market, density and performance demands required to assure reliability and high-link utilization of WAN uplinks such as OC-3, OC-12, and OC-48.

In order to meet the performance requirements of a standards-based platform such as CompactPCI, hardware design must support the fastest components and bus standards (e.g. Full DMA, 64/66 MHz). In addition, subsystems have to be full-load tested to ensure that target design goals are met. These factors were among the many that prompted the implementation of SBS' open architecture model.

Open Architecture Approach Implementing a modular, flexible architecture in product development allows for the use of existing designs and hardware modules. The open-standard nature of this approach offers high-performance, efficient, and cost-effective solutions that can reduce time to market, facilitate customization, and enable greater flexibility to integrate/replace existing technologies.

The highest risk in new product design often occurs with the implementation of key hardware and software components that are in the early stages of development. To combat the risks associated with introducing new hardware components based on emerging technologies, SBS is focused on conducting thorough and disciplined research, followed by precise prototyping and detailed simulation. Once SBS has qualified and committed to a new design, we perform a rigorous quality assurance (QA) screening process, including hardware/software functionality and system integration testing. Dedicated to providing OEM customers with leading edge telecommunications products, SBS strives for product excellence by setting rigorous standards for product performance, testing, and reliability while forward pricing our products to maximize value for our OEM customers.

SBS is a leading provider of high-performance OEM telecommunications platforms and subsystems, including CPUs, WAN I/O, and enabling software.

ONE-STOP

By Steve Cooper, President and CEO

www.onestopsystems.com

CompactPCI provides an excellent basis for many new and advanced telephony applications. I believe 2001 will be another tremendous year for telephony applications being designed based on the CompactPCI architecture.

Over the past few years, the availability of modules needed to build systems has steadily increased. Yet there are several holes in the available product spectrum, particularly relating to telecom applications.

One Stop Systems' challenge for 2001 is to identify and fill these missing product holes, enabling telecom equipment OEMs to get their systems to market quickly.

For many new telecom and datacom applications, the key is small size and low cost. One Stop Systems has developed the industry's first 1U tall 2-slot CompactPCI enclosures, priced at only $350 (OEM quantities). These new enclosures, with or without rear I/O, are ideal for many embedded applications based on a single-slot CPU board plus one I/O board.

For high-end telecom applications, reduced total system size, true fault-tolerance, and remote system monitoring capabilities are required. One Stop Systems has recently announced a family of products that address many of the high-end system needs:

- 8U enclosures providing the functionality previously requiring 12U of rack space, plus fully fault tolerant cooling system. If a fan or blower fails, the system continues to run with plenty of cooling airflow.
- n+1 power supplies, n+1 fans and blowers, 16-slot CompactPCI backplane and full Internet system monitoring all in an 8U enclosure
- 16-slot backplanes with H.110
- CPU plus 14 available I/O slots enables maximum functionality
- Partitioned backplanes allow dual systems in one enclosure (clustering)
- Dual CPU backplanes allow multiple CPU boards to control a single bus (redundancy)
- System Monitoring Board and Internet Monitoring Software; CompactPCI form-factor, hot-swappable system monitoring capability (eliminates monitoring board hard mounted inside the enclosure). System administrators can monitor their system's vital signs remotely, and remotely reset the system if needed.
- Systems become Internet appliances

These new products continue One Stop Systems' commitment to providing the best and most complete line of CompactPCI modules and system solutions for telecom equipment OEMs.

The telephony equipment marketplace is one of the most dynamic markets in the world. New technologies, new companies, and new attitudes within established companies are all contributing to a tremendous rate of change within the equipment markets. In this marketplace, the time-to-market advantage gained by designing systems based on readily available CompactPCI modules can be a key strategic advantage.

By providing a broad line of ready available modules and systems, many specifically tailored to the needs of telephony equipment, One Stop Systems intends to help revolutionize this marketplace in 2001 and for many years to come.

RITTAL

By Hans Wagner, President and CEO

www.rittal-corp.com

With the CompactPCI roadmap fostering further success, Rittal Ripac has made a decisive move toward the support and development of this bus architecture and all the components required for the continued development. To explain, there are two major reasons why Telecom applications are looking closely at IEEE1101.10 and IEEE1101. 11 Packaging Products.

The first reason is the adoption of CompactPCI and VME64x into the Advanced Intelligent Network (AIN) market and its broad availability of software, combined with the rugged IEEE1101.1 mechanical packaging concept.

The second reason is that the IEEE Standards are turning many of the mechanical features into off-the-shelf availability products, such as an EMC gasket solutions, ESD protection, safety ground solutions, PCB keying concept, and protective solder side covers. A more important additional feature is a circuit pack injector/extractor metal handle solution that deals with high pin count insertion forces well above 185 lbs./force.

Rittal Corporation has developed a wide range of products that are not only fully compatible to these IEEE Standards but have numerous additional features as well, including built-in ESD clips and slot keying designs. For instance, Rittal has designed two versions of the injector/extractor handles; both are in compliance with the IEEE1101.10 standard. The new metal Type IVx handle version follows the need for maximum I/O capability on the front panel, typical for applications where much of the I/O exits the front panel.

The other slim line "Telecom Handle" Type VII, available in metal or plastic versions, is designed for little or no front panel I/O. This is typical for telecom applications where most or all I/O exits are on the rear of a typical 12 inch installation, and space is at a premium (NEBS). The slim line "Telecom" injector/extractor handle has all the features as required by IEEE1101.10 and proposed by IEEE draft P1101.11, including keying, ESD, safety ground alignment pin, self locking, labeling, as well as optional embedded microswitch for live insertion applications. In addition it also permits the PCB to be moved offset by 0.1 inch (2.54 mm) to the right, increasing the component side (also known as solder side) for Surface Mount Devices (SMD).

The guide rails are designed to accept PCB thickness of 0.062 inch (1.6 mm) up to 0.098 inch (2.5 mm) self-adjusting by molded-in pressure points. All guide rails are UL approved plastic material, as metal guide rails have become a menace when using sensitive components on the PCB.

In addition to these component level products, Rittal has also developed the innovative Compact-I low cost sheet steel CompactPCI subrack system and the RiBox unit. The RiBox, recently awarded the Best of Show award at CTE, is designed for those low slot count, low profile requirements associated with server applications.

Rittal continues to take a leading role in not only defining and executing industry standards but applying them to our comprehensive line of electronic packaging products. Rittal therefore continues to strive to be the market leader in technologically advanced product offerings for the CompactPCI and telephony industry.

PLX

By Mike Salameh, founder and president

www.plxtech.com

PLX Technology is focusing its energy on being the leading supplier of high-speed interconnect silicon and software to the networking and communications industries, with a great deal of our emphasis on the rapidly growing telecommunications segment. We provide these industries with high-performance silicon, software for managing data throughout the PCI/CompactPCI bus, and reference design tools that minimize design risk. Additionally, PLX supports third-party development tools through the PLX Partner Program which aligns several development tool suppliers with our own reference design kits (RDKs) and software development kits (SDKs) to address telecommunication systems requirements. This full complement of hardware and software solutions enables telecommunications equipment makers to maximize system I/O, lower development costs, minimize system design risk, and provide faster time to market.

Telecommunications equipment makers are demanding for 2001 and beyond solutions that enable a range of improvements: better performance, greater scalability, higher availability, and preservation of hardware and software investments. Those demands include faster line speeds, more powerful processors, ease of expansion, higher bandwidth, and carrier-class reliability. PLX has applied considerable resources toward satisfying those demands, developing PCI I/O Accelerator chips and I/O Processor devices designed into a wide variety of embedded PCI telecommunication systems, such as switches, routers, media gateways, remote access concentrators, and base stations. Additionally, PLX's recently introduced adaptive switch fabric architecture – a fully PCI-compatible architecture for edge-access equipment – delivers the

performance, scalability and high-availability the telecommunications sector is demanding.

Among PLX's telecommunications customers utilizing these solutions are 3Com, Alcatel, Cisco Systems, Compaq, Ericsson, Hewlett-Packard, Intel, IBM, Lucent, Marconi, Nortel, and Siemens.

PLX plays an active role in industry standards-setting bodies, both by participating in and contributing to strategic organizations such as the PCI Special Interest Group, PCI Industrial Computer Manufacturers Group, and CompactPCI and RapidIO trade associations. Additionally, PLX maintains active development and cross-marketing partnerships with several major hardware and software vendors.

The telecommunications industry is in the midst of a major shift away from proprietary designs and towards industry-standard system architectures and component silicon. This shift has created a diverse, multi-billion dollar market for silicon and software based on PCI, the industry's most widely adopted bus architecture and the basis of virtually all PLX products. PCI provides the basic interconnect to a broad spectrum of telecommunications equipment that comprises the Internet and corporate network infrastructure.

We're also channeling resources toward streamlining the product-design process for hardware manufacturers and software developers with RDKs and SDKs that help bring new and updated designs to production quickly. These tools enable manufacturers to dedicate more of their resources to product designs, instead of the actual PCI implementation.

The software development effort for a telecommunications system often is significantly greater than that of the system's hardware development. Our development tools, therefore, are designed to significantly reduce the time and effort software engineers must apply to their projects. And by offering software compatibility across successive generations of PLX semiconductor devices, telecommunications system designers and software developers are able to extend the useful life of their software investment.

PLX Technology will continue to meet the demands of telecommunications systems by offering high performance, high availability, scalability, compatibility, and faster time to market through complete I/O interconnect solutions.

STARGEN

By Tracy Richardson,
President and CEO

www.stargen.com

In 2001 and beyond, an overriding challenge for companies in the Telecom industry will be to meet growing customer demand for their products in an increasingly competitive market.

Persistent and growing demand for services in voice, data, and video in the business and consumer markets is rippling back through the to the telecommunications equipment vendors at a rate that is challenging long held assumptions about how to design and build product.

A key barrier to meeting time-to-market demand is the need to design custom components. In areas such as system interconnect there is an emerging trend toward using standard platform building blocks like CompactPCI to avoid custom designs. Unfortunately, often the standard-based approach does not deliver the performance and functionality system designers need to meet the next generation requirements of their customers.

In 2001, **StarGen** is dedicated to solving this problem by delivering standard-based switch fabric technology that telecommunications vendors can use to both meet their time to market requirements as well as deliver the functionality their customers' demand. In 2001, StarGen will play an important and growing role in providing "off-the-shelf" next generation solutions for these vendors.

Another key challenge for telecom companies in 2001 is meeting the exceedingly high expectations for scalability and reliability in the products they produce. StarGen's switch fabric technology will allow them to design next generation voice, data and video communication equipment with high scalability, Quality of Service, high reliability, and serviceability. StarGen's universal switch fabric supports industry standards like PCI with 100% backwards compatibility bringing the benefits of investment protection, low total cost of ownership, increased flexibility, and ease of adoption.

In telecommunications, the market never stands still and the market for these systems is broadening every day as major innovations in processing and transmission continue to change the rules of the marketplace. The buzzword today is "convergence," but the research and development work to meet the demands of convergence is very real and well under way at StarGen. StarGen switch fabric is designed to optimize the transport of the three convergent media types (voice, data, and video) that are aggregated to and from equipment such as remote access concentrators, DSLAMs, edge routers, Voice over Network Gateways, and wireless access concentrators that connect to the network core.

StarGen intends to grow in 2001 by leveraging the demand for open standards in the communications equipment industry to take a leadership position in the switch fabric market. It is important to note that success in this market will not be achieved by "going it alone." Our initial successes have come from working very closely with both the design teams at well respected communications equipment vendors and with key industry standards bodies to deliver product that will be widely adopted in the industry.

In 2001, all of us at StarGen are dedicated to making a positive impact by building great chips that become part of great telecommunications products.

ACULAB

By Alan Pound, Managing Director

www.aculab.com

"In pursuit of satisfying the future demands of customers in the coming year, **Aculab's** roadmap places energy into six key areas:

1. Delivering and enhancing scalable middleware solutions, incorporating an ECTF compliant server. Targeted at both the Enterprise and the emerging telephony ASP markets such technology will serve to meet the demands of corporate end users looking to enhance the portfolio of communication tools available to them coupled with enhanced management capabilities.
2. Broadening the support for our products on the CompactPCI platform, for Telco and other mission-critical applications. As competition intensifies it becomes increasingly important for LECs and CLECs to be able to offer feature rich, resilient, reliable and scalable, high density solutions that can utilize a range of protocols including SS7.
3. Increasing support for third party advanced speech technologies on the Prosody platform, such as Nuance and Phillips SpeechPearl. Being able to place choice in the hands of the developer is paramount to Aculab, in this high growth sector it is imperative that developers have the best mix of speech tools to hand, to allow them to capitalize on the growing opportunities.
4. Providing extended support for Voice over IP and other packet-based speech solutions. In essence making convergence of communication over a single network a reality.
5. Pursuing flexibility and scalability; defining and developing architectures for future product generations. Building on Aculab's "single slot solution" philosophy will see the continued development of high density, compact solutions that will enable a more cost effective means for application developers and system integrators to tap into the converging marketplace.
6. Determining additional ways to deliver value to customers through training and cooperative ventures, through to early adopter incentives, and partner conferences. There is more to a product than just the hardware or software itself!

Hence, Aculab wish to offer customers a complete product experience from pre sales service through to customer satisfaction." Visit www.aculab.com for more information on how Aculab can meet your needs in the coming year.

PIKA

By Jim Pinard, President and CTO

www.pikatech.com

The next twelve months will undoubtedly pose some significant challenges for the telecommunications industry. Deregulation will continue to spawn new competitive forces. Market pressures as well will dictate the need for even more service differentiation and increasingly shorter times to market for new applications. Added to these ongoing trends will be a need to host and deliver new classes of applications generated by the rapid uptake of last mile technologies such as xDSL, cable and wireless. This will reach a critical demand mass by 2002, helping generate even greater requirements for highly scalable, robust and reliable application development platforms.

Is there help on the way? The answer is both yes and no. Traditional approaches and non-focused equipment vendors will do little to turn these challenges into new opportunities. What are needed are some visionary development efforts. To be successful, these efforts need to leverage a wealth of market leading telephony experience into innovative next generation solutions. We, at **Pika Technologies**, will be focusing our energies on several fronts to meet these requirements in 2001. The end result will be massively scalable CompactPCI systems developed with industry standard multimedia building blocks in a highly cost effective, integrated, and flexible way.

Pika will address scalability requirements for central office environments in three ways throughout 2001: On a per-slot, per-chassis, and multi-chassis basis. Pika's PrimeNet MM CompactPCI family of multimedia resource cards will offer industry leading octal span T1/E1/ISDN Primary Rate Interface (PRI) network connections for up to 240 digital telephony channels, fully provisioned with a large array of media-processing DSPs (3600 Mips). Pika is also investing substantial resources throughout 2001 to develop enabling technologies that allow quick and easy creation of multi-chassis networks capable of scaling to tens-of-thousands of ports without the need to perform complex systems integration on a case-by-case basis. Pika's pre-engineered system architecture will substantially reduce configuration and maintenance issues.

Pika's commitment to standards-based solutions will help to substantially reduce time to market for our telecom customers, while increasing their range of application choices throughout 2001. Our move to packet-based technology will empower the development of feature-rich IP-based applications and services over the coming months and years. In particular, Pika will implement the full suite of fax-over-IP standards throughout 2001, as well as the full range of voice-over-IP codec standards and emerging communications protocols.

While many of these enabling technologies will benefit large and small telecom companies alike, Pika will also focus its energies throughout 2001 in exploring new opportunities to further address the needs of CLECs by providing next generation telephony building blocks to the soft-switch market. This will help our customers define a new future for IP-based networks that includes providing easily accessible voice service and standard connections to the public telephone network.

Scalability, flexibility, and a strong market focus: All will be critical to meeting the needs of telecommunication companies in 2001. The need to future proof telecommunications platforms will also be critical.

MAPLETREE

By Sean Aruda, President and CEO

www.mapletree.com

The evolution of the next generation network from the traditional circuit switched network to one with packet based elements will require telecom vendors to develop solutions that deliver advanced technologies at a low cost and rapid time to market. Fueled by deregulation, competition, and the demand for new services, network device requirements include high-port density and low power consumption to promote the actualization of next-generation network convergence. The industry is crying for solutions that enable the rapid market delivery of high-density, multi-service network equipment that bridge the gap between the PSTN and emerging packet networks. Building on our heritage as an innovator for next-generation convergence solutions, in 2001, **Mapletree Networks** will deliver the functionality and scalability for next-generation access devices that are unmatched in flexibility, scalability, cost, and form-factor.

Packet based networks will provide greater efficiencies, greater manageability, greater flexibility and a platform for delivering new services to business and consumer users. Emerging applications will require voice over broadband access gateways at the network edge and trunk gateways inside the network core. Wireless infrastructure equipment and enterprise class access gateways will require ultra-high port density, functionality, scalability and power dissipation. Mapletree will lead the development of solutions that take port-density and system integration to the next level, seamlessly integrating with network and bus physical layers and reducing OEM product design cycles.

Understanding that a significant goal for the industry is to improve voice quality over the IP network, Mapletree will continue its development of solutions that resolve issues surrounding network delay and echo. In addition to maintaining voice quality, Mapletree's patent pending processes for jitter buffer management and echo cancellation strategically match the demand for high-density solutions. Mapletree's adaptive jitter buffer management dynamically adapts to packet network behavior to establish optimal buffer lengths and minimized latency. Focusing DSP resources on canceling only echo, and not the delay, maximizes port density. Access solutions must meet the demands of flexible and high port-density while improving functionality for new and emerging applications.

Will 2001 be the year of convergence? Perhaps. New technologies and standards will continue to drive the demand for better, more efficient, cost-effective access solutions. Mapletree will continue to develop solutions that integrate platform level requirements with application-specific functionality for new services.

SBE, INC.

By William B. Heye, Jr., President and CEO

www.sbei.com

At **SBE**, we consider ourselves technology leaders in network applications processing for the telecommunications industry. Telecom carriers, switching equipment vendors, platform providers, and software developers look to us to provide the connectivity that allows network application developers to design innovative and cost-effective telecom solutions.

The telecommunications industry is undergoing a dramatic transformation. With the proliferation of the Internet, Intranet, and wireless communications, an enormous opportunity for telecom providers has presented itself, but not without challenge. To keep up with the growing demand of these converging technologies, existing circuit-switched voice systems must be migrated to digital packet-switched systems (or Internet protocol), capable of handling large volumes of voice and data traffic simultaneously. However, incumbent telecom carriers cannot totally replace their legacy systems.

The migration to Internet protocol (IP) is complicated by the different architectures and platforms now deployed in the public switched telephone network (PSTN). The solution to these Internetworking challenges is called a signaling gateway. These gateways will serve as a bridge between the circuit-switched PSTN and the new packet-based networks, paving the way for voice over IP (VoIP) and other Internet-based services that will be offered over high-speed backbones at a fraction of current costs.

SBE's product offerings of communications controllers are positioned to play a pivotal role in signaling gateways, media gateway controllers, and Softswitch systems, which are critical network elements in the converging PSTN/IP network platforms.

Our telecom solutions include a variety of products based on CompactPCI, PCI, PMC, and VME bus standards. These solutions are incorporated within mission-critical systems, major signaling, switching and routing networks. SBE products include SS7/AIN controllers for switch manufacturers, WAN interface adapters for routers and servers, and high-speed communications controllers for wireless and data messaging applications.

SBE offers four families of communications products. The HighWire products provide leading edge technology that enables the convergence of voice, video, and data; the wanPMC and wanXL product series that expands the power of Web servers with specialized communications processing; the LMC Series of WAN Adapters provides high-performance connectivity, and the VME product line, well recognized for its reliability, with more than half a million ports in operation worldwide.

As an enhancement to our flagship product line, the HighWire family, SBE has recently introduced the HW400 Software Developers Kit (SDK). This sophisticated developers' tool jumpstarts product development by combining a VxWorks board support package with high-performance VxWorks device drivers for all major hardware components on the HW400 platform. The familiar VxWorks driver interface eliminates the time-consuming complexities of chip-level programming. At the same time, developers can take full advantage of the HW400's rich feature set: full network switching, H.100/H.110 CT bus connectivity, selectable line interface, powerful layer one processing, fast Ethernet access, and onboard DMA. The HW400 SDK maintains a common API across the entire HW400 family, with solutions for PCI, CompactPCI, front panel I/O, and PMC carrier applications. Products developed with the HW400 SDK can be quickly ported between popular form factors for maximum flexibility with minimum effort.

Rapidly changing applications and requirements challenge the telecom market. SBE's efforts are focused to meet these challenges and to provide the solutions that will power tomorrow's telecom networks.

ZIATECH, an Intel company

By Robert L. Tillman, General Manager

www.ziatech.com

As a supplier of systems, platforms, and processors to the telecommunications industry, **Ziatech**, an Intel company, recognizes the challenges of providing faster and higher performing products that address the evolutionary needs of a converging marketplace. The telecommunications equipment manufacturers require unprecedented flexibility from their suppliers and the solutions they are acquiring. How to accommodate the unpredictable flow of voice, video, fax, and data through an infrastructure that is still under development requires an uncanny agility. And how better to meet that challenge at the edge of the network and within than with the CompactPCI bus architecture!

Demand spawned by the burgeoning e-business market continues to propel the telecommunications sector. But the widely reported crunch on capital among the telcos large and small requires that suppliers such as Ziatech help their customers address the essential time-to-money equation. In an era when every service from benefits to accounting to purchasing is a candidate for outsourcing, certainly the engineering, design and manufacture of the underlying platform, the computing core of next-generation telecommunication innovations, offers equipment manufacturers efficiencies of time and money, streamlining the process of bringing new products to market.

The beauty of CompactPCI in this telecommunications arena is its widely accepted architecture, based on open standards that offer high levels of reliability and scalability. Through ongoing

work to enhance the basic design offered by Ziatech in 1995, TEMs may now choose from off-the-shelf development systems that will fast-track their latest applications for voice over IP, automated billing or any of the seemingly unlimited functions that drive the Internet, wireless, and cabled distribution and receipt of data. The needs are varied, but CompactPCI provides the requisite flexibility in power supply, performance, and speed. We've developed, through PICMG, new standards for high availability, multicomputing, and hot swap all based on a ruggedness attained through robust mechanical and electrical systems. So when we turn the platform or system over to the telecommunications developers, they can focus on adding value through their proprietary software and applications with every confidence in the underlying computer control.

In 2001, we at Ziatech will be rolling out new products that will help the telecommunications equipment manufacturers meet their growth goals. Revolutionary products? No, that's not what the industry is asking for at this stage. Rather, we will provide building block alternatives tailored for telco applications: higher performance, lower power, and faster processing, for example. At the same time, we are increasing our commitment to support and service to enable stronger partnerships for tackling an increasingly competitive marketplace. This is possible in part through our new relationship as an Intel company, offering an expanded sales team as well as renowned engineering and design capabilities and state-of-the-art manufacturing facilities and processes that we can tap to enhance Ziatech's in-house expertise and experience. This new positioning can be particularly advantageous to telecommunications equipment manufacturers as they move from rapid start-up projects to being high volume infrastructure suppliers.

As the telecommunications industry forges ahead in 2001, Ziatech, an Intel company, will continue to be there, inside the infrastructure.

VOICEBOARD

By Mr. Greg Peacock, CEO

www.voiceboard.com

Our OEM customers in the carrier and service provider market sectors have three major objectives:

- Improving time to market for new products
- Simplifying the development of innovative new applications based upon convergent technologies
- Adapting to all of the new protocol standards

At **Voiceboard**, we have been focusing our efforts towards meeting these objectives by developing board-level solutions integrated with an extensive complement of embedded software. For 2001, we are focusing particularly on integrating our embedded high performance processors with recently developed signaling protocol and interworking software. We expect the resulting products will meet the Telecom industry demands for 2001 by:

- Reducing system development time and costs while also simplifying operational field configuration of systems
- Offering greater system scalability
- Requiring less engineering expertise for application implementation

Our experience has shown us that, although the challenges faced by OEMs differ widely, in fact, several common root problems are shared by all. The real source of most developer "headaches" is the perceived necessity of running real-time and protocol stack management software within the limited performance confines of the host CPU. At Voiceboard, our MediaPro® architecture eliminates this requirement. By completely offloading the real-time and low-level tasks from the host, system developers can realize exactly those key benefits they are most concerned about achieving.

System design, development, test, and deployment cycles are improved. Our customers have reported to us reductions in their product development and time-to-market cycles of 50% or greater. They can bring new Telecom products to market more quickly than ever before by using commercial off-the-shelf software modules, embedded at board level, instead of having to develop their own customized versions running in the host CPU. This enables our customers to focus efforts within their own core competency and value-add areas rather than on the minutia of protocol standards or stack management.

Another focus of the Telecom industry is to reduce the complexity and cost of developing application software. By using standard off-the-shelf software modules to perform tasks that previously were executed by the application, the developers' job is tremendously simplified. For example, it is not necessary to spend development and test time to integrate lower layer protocol stack management software into the higher application layer. Instead, all lower layers can be embedded into board-level, stand-alone gateways. The host application complexity is greatly simplified and development and test activities may be completed quickly.

An ancillary result of this change is that it becomes much easier for the system-level designer to keep pace with fast-changing communication protocol standards. That job can be left to other companies whose own primary focus is on the continued development of fully compliant software. Virtually unlimited scalability can also easily be achieved since adding spans, links, or additional boards to a system requires little, if any, additional host CPU support. The result is scalable system with little or no performance impact on the host CPU and application.

In summary, Voiceboard's focus for the year 2001 will be to further find ways to offload the host and add new embedded functionality to our MediaPro® products. This enables our Telecom customers to meet the challenge of providing users with reliable, high performance, scalable telephony solutions.

KAPAREL

By Ben Robitaille, President and CEO
www.kaparel.com

The ongoing double-digit growth in the converging communications market has and created problems for OEM's. One problem of interest to **Kaparel**, is that the growth has outpaced the internal abilities of many OEM's and created the need for them to outsource some, or all, of their design and production. This in turn has created a new set of problems for OEM's. Outsourcing presents a situation wherein the end customer's needs and requirements may not be well communicated and/or understood. This may be caused by several factors including but not limited to, the need for rapid time to market, constant technology changes, and differences between the corporate cultures of OEM's and those of their suppliers.

In 2001, with the telecom OEM's being somewhat shaken up in the recent stock market adjustment, it will be important that they bring products to market in record time to meet the needs of end user applications. Kaparel sees added pressure on our organization to be able to keep pace with the technology and turn product in the time necessary to address the market demands. This pressure comes from the need of OEM's to start converting applications into revenues more quickly, as their falling stock prices have eroded both available cash and investor confidence.

As an early innovator in CompactPCI backplane solutions for telecom suppliers, Kaparel created a business model early in our development to address this issue. The model is to offer a range of off-the-shelf products that can fulfill rapid prototyping to verify the application and then utilize the designs in our library to quickly spin a custom design for production of the product. In essence Kaparel becomes a "virtual backplane department" resource for our customers and not just a supplier of backplanes. We participate from the initial concept stages of the system design, right through to the implementation of theapplication. Kaparel sees more and more applications heading towards this custom solution with off-the-shelf timeframes format. In addition, the introduction of new bus architectures like Firewire and Infiniband and the incorporation of Ethernet in backplane designs require us to also have resources focused on these new advances so they can be incorporated into upcoming designs.

This "virtual" model means that Kaparel recognizes the need to partner with OEMs early in the design process. Partnership activities will range from product specification reviews, to joining in discussions with the OEM to discuss the end user's application. This approach allows Kaparel to provide input into the system design, thereby offering possible cost savings and shortcuts in the system design for faster time-to-market. We see this as a key success factor in 2001 and beyond and have made it an integral part of all of our ongoing growth plans. Kaparel is committed to truly partnering with our customers and ensuring we remain aware of their stated needs and requirements to provide them with the right solutions the first time!

INTERPHASE CORP.

By Greg Kalush, CEO
www.iphase.com

Interphase continuously addresses the challenges and demands of wireless and optical telecommunication providers by creating carrier-class solutions. Because service providers are expected to transmit voice, video, and data, performance and quality of service have become hot topics in the industry. Bottlenecks have developed at the core of the carrier network as bandwidth has expanded. On-board protocol processing, the sharing of communications across the backplane and high availability requirements for mission critical services are driving telecom companies to deploy services on CompactPCI platforms. The industry still faces the fact that the speed of traffic is only as fast as the slowest link in the chain. Interphase is addressing the entry point to the wide area network, striving to improve the onboard capabilities of I/O, to allow more distributed processing, larger amounts of bandwidth transmission and better overall system performance.

Another challenge for communication traffic is the ability to maintain sound quality of service. As Internet traffic expands, networks must expand to accommodate larger and more diverse amounts of bandwidth by prioritizing the types of traffic. In addition, we know that users have built strong networks and can deploy a tremendous amount of bandwidth from the carrier perspective, but problems arise because existing equipment isn't designed to move the voice, video, and data communications as fast as bandwidth now allows. Interphase is leveraging its experience with ATM and broadband to introduce communications controllers that provide a direct optical interconnect with the core. This increases quality of service by bringing intelligence through distributed I/O. With the development of Interphase's 4532 ATM CompactPCI controller, I/O is no longer passive, allowing I/O to control functions independently and use shared system resources. The 4532 controller permits core carriers of wireless services and existing optical infrastructures to provide faster networking systems with higher capacity and efficiency for advanced voice, video and data convergence. With the 4532 controller, processing capabilities that were traditionally done by the system CPU are being distributed down to every slot of that system, thereby permitting more bandwidth to be translated and more performance output from one system. Vital transactions remain on the system CPU, but distributed architecture has taken a lot of the processing requirements and pulled them down to the slot level. By having functions happen simultaneously across different slots, the bottleneck created on the system CPU is freed and providers are capable of moving more traffic faster.

Another problem occurs as bottlenecks arise when Quality of Service (QoS) guarantees are lost and too much information is funneled through one "pipe." Translating traffic repeatedly from one point in the network to another causes a loss in QoS, resulting in compromised network performance. Interphase's 4532 mezzanine card offers intelligent processing for an ATM interconnect on a CompactPCI system and allows transmissions to flow directly to SONET networks, preserving QoS guarantees inherent to ATM protocols and many broadband services, such as ADSL.

CONTINUOUS COMPUTING

By Ken Kalb, CEO

www.ccpu.com

Currently, one of the greatest challenges facing any company in the telecom industry is how to meet the market demand for highly reliable applications. Never has there been a need to create products more quickly, with fewer resources, while fulfilling industry standards for bulletproof reliability.

Continuous Computing addresses this challenge and opportunity by providing a leading platform for building voice over packet applications in the telecom industry. At CCPU, we empower application developers with a robust suite of products and services that speed their VoIP technologies to market quickly and very cost effectively. CCPU offers seven major platform products that include: media gateways, media gateway controllers, OAM&P, billing, signaling and enhanced IP servers for announcements, conferencing, and unified messaging.

Utilizing CCPU's award winning upSuite™ middleware and Hi-5™ architecture, virtually any VoIP telco application can be crafted into a central office grade system with 99.999 percent availability. CCPU provides a series of rapidly configurable hardware and software modules that form the basis of a single SKU platform level solution. The platform is then used by application developers with little or no modification, to create highly scalable and reliable products.

CCPU designs, builds and integrates all of the essential building block elements for VoIP applications. Systems include everything from hardware processors, DSP resources and gigabit Ethernet switches to operating systems, protocol stacks, and high availability middleware. In particular, upSuite, CCPU's patent pending HA middleware, has proven to be an invaluable tool. At its core, this product provides IP disk mirroring at wire-line speeds. Information that is created on an active processor and written to its local disk is simultaneously written across a TCP/IP network to a distributed redundant processor and its local disk. In short, application developers are shielded from implementing low level code for I/O devices while simultaneously controlling system resources to provision for power outages, scheduled and unscheduled maintenance and the like.

However, there is more to empowering customers' time-to-market requirements than offering an ideal product for their application. CCPU compliments its Hi-5 product line with custom hardware and software development services as well as rapid product realization for revision control, documentation, and all agency testing. These services, which function as an engineering resource to our clients, turn stand-alone applications into production grade revenue generating products in weeks instead of a year.

Testament to the business model and its implementation is the fact that CCPU has been soaring profitably at an 800 percent compounded annual growth rate while satisfying virtually every major blue-chip telecom equipment manufacturer including Cisco, Lucent, Ericsson, Alcatel, Nokia, Motorola and many others since inception nearly three years ago.

The challenge of providing time-to-market VoIP solutions for telecom equipment manufacturers is being met by Continuous Computing.

PENTAIR

By John Abbot, President

www.pentair.com

Because **Pentair Electronic Packaging** is a leading supplier of custom electronic packaging solutions, the telecommunications marketplace has become a key driver of our company's growth. We provide a wide array of custom and standard product platforms for both indoor and outdoor environments and applications for key telecom companies that want to partner with global suppliers like ourselves. Some of the issues we are focusing on in 2001 and beyond to serve our customers' needs are system integration, quick time to market design and development, flexible manufacturing capabilities, and global reach.

We continue to increase our capabilities for fabrication and system integration services by expanding our North American plant facilities in such strategic locations as Warwick, RI, Chicago, IL, and Pensauken, NJ. This includes now being able to offer UL approved level 5 integration (fully powered and tested systems plus logistics) for many of our telecom customers and developing supply management tools for helping build true partnerships. In fact, our company mission has become "Integration focus with a sheet metal expertise."

Time to market and product life cycles continue to shorten in the telecom market. On account of this, Pentair has a new Prototyping Center in Warwick, RI dedicated to enclosure and chassis systems. Services include design support, fabrication, welding, assembly, and integration. In addition, we offer pretested platform products for both indoor and outdoor applications that help save time and costs. This is especially true with our Schroff brand CompactPCI

enclosure products (subracks, backplanes, handles, systems) that can be modified to a customer's requirements. Collaborative Web-based design tools (software) also help with new product efforts so decisions are made quickly.

The combination of these initiatives can result in a quicker time to market (2-6 months) and significant savings on development costs.

There is constant cost pressure on the telecom industry to provide cutting edge technology but at an affordable level. This is why Pentair is constantly investing in new high technology fabrication equipment and software to reduce labor time and increase output for our customers. We pride ourselves on establishing manufacturing centers of excellence for aluminum and steel. We also continually leverage our best-of-class supply chain efforts over the entire enterprise to maximize volume discounts for materials, outsourcing and delivery.

With the high growth of telecom happening overseas as well as in North America, enclosure suppliers such as Pentair need to have global reach to serve the different markets involved. Besides having a strong presence in Europe, Pentair now has manufacturing facilities in Brazil and China to serve our top-tier telecom equipment providers.

The dramatic growth taking place in the telecom industry can also contribute to increased volatility. From quick spikes to abbreviated production stops, a supplier needs to be flexible enough to ramp up fast for high production requirements, and be prepared for sudden slow-downs. After a design or prototype has been approved, it is not uncommon for a telecom customer to establish an aggressive production schedule with us that may include the manufacturing of the enclosure as well as providing the complete integration and testing services, and often in a short time period. This is where Pentair with multiple manufacturing options and core competencies can maximize resources for accommodating these types of orders.

What survey respondents want from CompactPCI vendors...

When we compare the remarks of the CEOs and the results of our recent CompactPCI Systems Magazine survey, we have noted some interesting parallels. In the survey we asked, "Which new CompactPCI products or technologies do you need to make your business successful?" Here are a few of the more relevant entries:

- CompactPCI Hot Swap hard disk drives
- Gbit Ethernet
- Hot pull, redundant system slot, Solaris
- CompactPCI boards need to move to 220 mm deep for more space
- Telecom products
- VoIP

From the remaining responses to our survey question, one recurring concern is also the growing need for High Availability in telecommunications as the following requests demonstrate:

- HA software
- HA, G4, IP Backplane
- High Availability chassis backplane with Dual System controller slots
- High Availability Ethernet Switches
- High Availability CompactPCI Systems with T1 Interfaces
- Software Transparent HA Standards

We also asked more specifically, "How important is High Availability to you?" Here is the breakdown of how those in telecommunications responded.

It is evident that there remain significant challenges for CompactPCI in 2001 in the area of High Availability. Ofer Vilensky of Jungo summed it up this way, "The Telecom industry today is faced with a growing demand for High Availability hardware infrastructure, in order to supply customers with top quality service."