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CompactPCI Powering the *Next-Generation Wireless Network*

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CompactPCI Comes of Age

It seems not long ago at all that CompactPCI® was just an innovative idea to ruggedize the existing PCI specification. Back in 1994 when this new standard was beginning to form substance both on the drawing board and in design committee, it was well understood that the communications markets were the major opportunity of the future. It was no surprise that over the last few years CompactPCI has made its way into the labs and product plans of most, if not all of the world's major telecommunications companies. As we begin this new millennium, CompactPCI will come of age as many of these development projects head through production into deployment within the telecommunications infrastructure. CompactPCI is rolling out in a big way and helping to effect change across many segments, none so fast moving and pervasive as the world of wireless communications.

The Changing Face of the Wireless Industry:

The wireless telecommunications industry is rapidly changing. Deregulation, advancements in both communication and computer technology, and customer demands for faster and more flexible services are fueling these changes. Network operators and service providers need to quickly create and deliver new, reasonably-priced Internet Protocol (IP)-based voice, data and video services to customers if they want to remain competitive and differentiate themselves in this ever-changing market.

While the industry is eager to deliver these advances, until now, wireless technology has been limited in the types of services and devices it can support. This is due to two factors: 1) the proprietary nature of the technology and 2) the expense involved in customizing this technology to meet the rapidly changing industry needs.

Today, network operators and service providers are demanding a new, more flexible approach that will remove the barriers to innovation. They require distributed, open-standard IP digital networks that provide new feature-rich, affordable, easy-to-access and value-added services. This

new approach must also provide unprecedented connectivity, reliability, availability, scalability and serviceability. The ultimate benefit of this new approach is to enable network operators and service providers to deliver consumers wire line quality in a wireless world.

The Solution:

Over the years, Motorola, like many telecommunications companies, has acquired reliable computer platforms to host its telecommunications applications. These have included internally designed redundant and distributed systems, as well as commercial fault tolerant computers, typically unique to a given group's requirements.

Committed to driving even more dramatic levels of reliability and availability, in 1997 Motorola launched a critical corporate-wide initiative known as "5NINES." Motorola's goal is to increase the system availability of all of their products, especially those used in the telecommunications infrastructure market, to achieve 99.999% system or service availability and beyond. This equates to 5 minutes or less of downtime per year, both planned and unplanned.

In 1998, representatives of Motorola's equipment groups, led by Motorola's Network Solutions Sector (NSS), formed a committee to develop a next-generation, open-system wireless telecommunications architecture using as many industry standard components as possible. This architecture would be designed to deliver unprecedented new levels of wireless network availability or "infinite dialtone" comparable to that which only wire line telephony could deliver until now. In addition, Motorola's vision was to enable and facilitate the development and deployment of next-generation telecommunications technologies and services. The committee divided the telecommunications network infrastructure into a three-tiered hierarchy to simplify the platform selection process. These tiers ranged from real-time control systems at the lower end to large servers at the high end.

	Typical Platforms
Tier 3	• OAM&P • HLR, VLR • Feature Server
Tier 2	• Base Station Controller • Gateways • Call Control

Tier 1	• Base Transceiver Station

Once the architecture was defined, the next question became what would be the best technology on which to base the backbone for this digital wireless network of the future?
After extensively analyzing a host of potential products and partners , Motorola NSS first determined that CompactPCI was the ideal choice as a technology standard. Then, after serious peer vendor review NSS went on to choose Motorola Computer Group (as their CompactPCI supplier). It was crucial that the chosen platform meet their reliability and availability goals and MCG was able to do this by providing an industry-leading hardware solution with its advanced and award-winning CompactPCI high-availability embedded computing platforms.

Why CompactPCI?
In posing the question why CompactPCI, there are two components: the business component and the technological one.

From a business perspective, CompactPCI's position as an open standard holds the key. Today the pace of innovation of new network technologies and services is driven by software. While the hardware is still important an operator will make infrastructure decisions based on the feature sets delivered by a particular solution as well as the costs involved to set-up and run a network. The fact that an XYZ chip or bus architecture may be powering the Base Station is of little consequence, they want to know how quick they can bring services online and start billing customers.

When designing equipment that will power the next generation networks, the engineering resources need to focus heavily on the software added value and not on home grown hardware platforms. The advantages of an open standard such as CompactPCI are many.

- A wealth of easily added communications adapters and peripherals.
- Products may be purchased from many sources, alleviating single source issues.
- Open standards encourage vendor competition, which reduces prices and speeds innovation
- Competition also ensures upgrade paths to the latest chipsets and technologies.
- Industry standard operating environments and software become readily available.

- Utilizing standard hardware and software, the training burden is reduced as staffing becomes easier due to an increased knowledge pool.

The technological benefits of CompactPCI are now well recognized. Growing out of the mainstream PCI community the foundation is a solid one, based on tried and tested chipsets. The physical limitations of PCI slot cards made them impossible to safely be included within designs requiring high levels of availability and reliability. Coupling the PCI electrical specification with the IEEE 1101 mechanical standards gives CompactPCI the robustness required for carrier grade infrastructure deployment. One of the ultimate "killer benefits" provided by CompactPCI is its intrinsic ability to provide the hardware fundamentals required for high availability architectures. This is due in no small part to the Hot Swap specification which defines 3 models, Basic, Full and High Availability. The high availability model, while inheriting the attributes of the others (physical hotswap and software control) adds the ability for the application to control the system at a slot-by-slot level. This creates an environment where the software can have ultimate control of the hardware, literally "turning off" a slot that may have a failing component. This type of isolation is vital for the fault management functions required of a high availability solution aiming for the 5NINES goal. At this time, Motorola Computer Group's CPX8000 range of CompactPCI platforms is possibly the only CompactPCI solution proving capable of delivering these levels of availability.

CompactPCI at the Heart of the Reliable Platform

CompactPCI is the only standard bus architecture that has - its sights set on open high availability since its inception. Features such as hotswap and high availability models were designed into the standard at an early stage and PICMG® (PCI Industrial Computer Manufacturers Group) committees are still adding to and enhancing the specifications. So is this enough to build a platform for the new digital wireless networks?

Not in itself, to build a truly highly available solution, it requires a holistic approach, it is not one component that makes the whole but the combining of many. There are 3 major building blocks that must all be in harmony to create a high availability solution--the hardware, the operating environment and ultimately the application itself.

At the heart of the Motorola NSS wireless solution, for example at tier 2 of the architecture, is MCG's CPX8216 PowerPC® high availability platform—named "product of the year" by *Computer Telephony* magazine. The software environment in this particular case is Chorus, although MCG has the widest range of options available including, LynxOS®, VxWorks®, Linux® & Windows2000®.

MCG's customizable and high-availability CPX8216 is a major reason Motorola NSS chose MCG to develop the hardware platform of its new wireless architecture. The CPX8216 will help enable NSS to build high-availability wireless telecommunications applications that meet or exceed the "5NINES" availability goal of Motorola's corporate-wide initiative. The 5 minutes or less of downtime that 99.999% system or service availability equates to includes both planned and unplanned interruptions. This means that hardware or software upgrades also count as potential downtime, this needs to be handled by features such as "hot software upgrade". The CPX8216 open-architecture platform enables any active module, including system CPUs, to be exchanged for repair or upgrade while the system continues to operate.

MCG's Open-Architecture Approach:

This use of CompactPCI as a platform for next generation wireless infrastructure is an excellent example of MCG's open-architecture approach, which leverages best-of-breed hardware,

software and expertise to ensure optimum technology solutions for its OEM customers. As mentioned previously, choice and flexibility are at the core of open systems environments such as CompactPCI. The range of hardware and software solutions that MCG offers its OEM partners helps enable them to choose the right combination of products to suit their particular needs. The added flexibility arising from MCG's ability to customize products makes MCG the best choice as an embedded telecommunications outsourcing partner.

The CPX8000 family of CompactPCI systems, announced in October 1998, an industry first and the only commercially available Solution, allowing dual-redundant CompactPCI CPU boards to operate in hot-standby configuration, which was previously reserved for proprietary solutions costing significantly more.

CPX8216 Feature Summary:

CPX 8216 Features	Benefits
All primary system components, including power supplies, fans, disk drives, I/O boards and even the system CPU, can be configured with a redundant standby.	A single point of failure does not cause the whole system to fail. In addition, the ability to upgrade software on the standby CPU and then bring it into service can eliminate software maintenance from impacting system availability.
All active components—CompactPCI cards, power supplies, fans, alarm panels and disk drives—are hot-swappable, including system CPU.	Failed components can be replaced without removing power, so the system can continue to operate.
All active components— CompactPCI cards, power supplies, fans, alarm panels and disk drives—are field replaceable units (FRUs), replaceable in under 5 minutes.	Maintenance can be accomplished at the application site. No need to return the entire system to the factory. Maintenance time is minimal and predictable.
Network Equipment Building System (NEBS) and European Telecom Standard Institute (ETSI) compliant	Meeting the mandatory U.S. and European telecom equipment standards enables our customers to provide solutions for the telecom network infrastructure - the heart of the business. It enables them to sell to the carriers (AT&T, Sprint, MCI etc.)
Targeted at switching applications and deployment within unattended sites	Applications are typically running around the clock and around the world. The ability to monitor the operation and perform remote diagnostics and repairs of the equipment from centralized locations can result in significant cost savings and efficient operational overhead
Individual card and system-level alarming	The operational state of each primary component can be individually monitored, allowing precise fault detection and even preventative maintenance.

This collaboration, which leverages best-in-class technology from two industry leaders, will result in a series of next-generation, high-availability platforms that will be used by Motorola

NSS to build wireless infrastructures, as well as across all Motorola equipment groups that design and manufacture network infrastructures for satellite, paging, two-way radio and Internet networking customers.

As we have seen CompactPCI is providing the reliable platform powering the next generation of wireless networks. This along with the huge number of projects going into full-scale production during 2000 shows how CompactPCI has truly become a mainstream technology. With all the benefits of open systems, telecom equipment manufacturers are taking advantage of CompactPCI and companies such as Motorola Computer Group to speed new products to market while concentrating on their own distinctive value add. This trend is increasing all the time and expected to continue long into the future.