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The Journal of Military Electronics & Computing

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Serial FPDP Boards

JTRS AND SD RADIO BAND TOGETHER

PLUS:

Military Market Upbeat, Despite Uncertainties

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Features

January 2009 Volume 11 Number 1

Special Feature

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Serial FPDP Boards

COTS (kots), *n.* **1.** Commercial off-the-shelf. Terminology popularized in 1994 within U.S. DoD by SECDEF Wm. Perry's "Perry Memo" that changed military industry purchasing and design guidelines, making Mil-Specs acceptable only by waiver. COTS is generally defined for technology, goods and services as: a) using commercial business practices and specifications, b) not developed under government funding, c) offered for sale to the general market, d) still must meet the program ORD. 2. Commercial business practices include the accepted practice of customer-paid minor modification to standard COTS products to meet the customer's unique requirements.

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The Army has an upgrade program underway to remanufacture 300 of the current fleet of 425 CH-47D helicopters (upper right) to the CH-47F standard. The communications suite includes jam resistant HF and UHF radio systems. The upgraded cockpit will include a digital data bus that permits installation of enhanced communications and navigation equipment for improved situational awareness.

US Army Photo

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The Journal of Military Electronics & Computing

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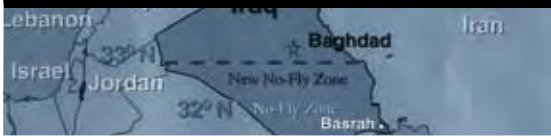
Publisher's Notebook



Auld Lang Syne...About Time!

Here it is 2009 and I never felt that 2008 got started. It sure ended with a crash. The media keeps focusing on doom and gloom to get ratings—just what we need to crawl out of this mess. They also can't decide if the Obama administration will be a warm wind that will blow all this away, or whether our current difficulties are so great not even the Obama administration can fix it in a reasonable time. I also noticed how that $10 billion per month for the war in Iraq has almost become insignificant. That brings us to our little corner of the world.

With a solid month behind us since the election, we now have many cabinet members selected for nomination along with their commentary regarding the future of the military and its mandate. It appears that the new administration is taking some heed from the missteps of the mid-nineties administration regarding dismantling of the military. That said, it also seems clear that they do see a need to streamline and tighten accountability with respect to military contracts. The issue becomes: Will the new administration have sufficient political capital and will to control the Congress?

The administration has selected the majority of the cabinet from experienced politicians. Bucking the trend of removing all cabinet members from the previous administration and keeping Gates on is a prudent decision. With the new President's support, this cabinet should have sufficient connections and political capital to get Congress in line. This now only leaves the military brass as the wild card. Over the years the brass has always been motivated by bigger, better and more costly—their contention being that they see their mission as preparing for peer-to-peer conflicts. That's a much more glamorous vision than limited military actions or anti-terrorist activities. Determining a balance in our nation's policy with respect to the different levels of threat we foresee, setting a direction for the military and selling that to the brass and the American people will not be easy.

Recently it was reported that the Government Electronics and Information Technology Association (GEIA) does not predict any major changes to military and its budget for the foreseeable future. They do predict that the usual shift of emphasis and money from one program to another will take place. Also, according to the report, between now and 2019 there will be a 7 percent decline with respect to the total defense budget in monies going to R&D and deliverable weapons systems. If the new administration does its job properly, that 7 percent can be found in waste, mismanagement of programs and unrealistic proposals.

What will the future of our little segment of the military electronics market be? The fact that we have such a wide range of suppliers of electronic products—from the larger GEs, Curtiss-Wrights and Kontrons to the smaller RGB Spectrums, CSPIs and GMSs—we never really see any major changes, only shifts. When the military money spigot is turned on we get a general increase. When the military money spigot is tightened there's less money for development of our type of product by the primes and then they need to come to our market. When new programs are delayed or cancelled, the military needs to increase the upgrades and retrofits of existing programs. And the military still has the drive to move out warfighers out of harm's way, replacing them with electronics and automation wherever possible.

As a result of all that, we're in a lot better position than the primes right now. Even though they've been recording record revenues and profits; there is every indication that there will be belt tightening. This definitely has to be on the minds of their shareholders. In the mid to late nineties there was a lot of consolidation and acquisition of different military companies to increase market share, and corporate growth was the light at the end of the tunnel. That's not the case today. With government pressure to limit wasteful funding and tighter control of where the money is going, primes will need to consider something that until today would bring the ire of their shareholders: diversify into commercial areas.

Something more personal: We at *COTS Journal* and the entire RTC Group hope you had a happy holiday and wish you a healthy and prosperous New Year. Don't let the self-serving, Chicken Little media terrorize you. Just use common sense and with any luck we will close out 2009 with greater promise than we closed out 2008. We look forward to your continuing support and comments. They keep us on our toes to provide what you want and need. ▮▮

Pete Yeatman, Publisher
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The Inside Track

Lockheed Martin and Saft Team to Develop Batteries for JASSM

Saft has collaborated with Lockheed Martin Missiles and Fire Control to design lithium-ion (Li-ion) batteries for the Joint Air-to-Surface Standoff Missile (JASSM) program. Designed as an autonomous, precision-standoff missile for the United States Air Force and Navy, the JASSM will rely on Saft's batteries to power two unique flight test systems; the missile's telemetry instrumentation kit (TIK) and a flight termination system. Saft will provide three separate batteries, made up of MP 144350 cells, to be loaded on each test missile. Together, the three batteries offer a complete, reliable power solution for the high-performance test missile.

The JASSM (Figure 1) enables pilots to strike high-value, heavily defended targets from well outside the range of enemy air defenses. The 2,250-pound missile has a range of more than 200 nautical miles and is designed to cruise in adverse weather, day or night. The missile's 1,000-pound multipurpose penetrator warhead and pinpoint accuracy make it highly effective against a wide range of enemy targets.

Figure 1

Airmen here prepare a JASSM to be loaded onto a B-1B Lancer. The JASSM, or AGM-158A, is an air-to-surface, single warhead self-propelled missile.

Lockheed Martin
Bethesda, MD.
(301) 897-6000.
[www.lockheedmartin.com].

Saft America
Cockeysville, MD.
(410) 771-3200.
[www.saftbatteries.com].

DRS Technologies to Produce More Vehicle Computing Systems for Army

DRS Technologies received an Indefinite Delivery Indefinite Quantity (IDIQ) $531 million contract ceiling extension to its current JV5 production contract, to provide JV-5 ultra-rugged vehicle computing and display systems for the U.S. Army's Force XXI Battle Command, Brigade and Below (FBCB2) program and Blue Force Tracking (BFT) and the United States Marine Corps (USMC) situational awareness requirements. This IDIQ contract provides for an indefinite quantity of JV-5 vehicle computing and display systems over the next five years, allowing the U.S. Army to place delivery orders against this contract for individual requirements. The ceiling extension was awarded to DRS by the U.S. Army's Communication-Electronics Life Cycle Management Command (CELCMC) in Fort Monmouth, New Jersey.

Figure 2

The JV-5 vehicle computing system includes new technologies such as multicore processors, increased memory, greater data storage and CompactPCI expansion capability.

The JV-5 vehicle computing system (Figure 2) includes new technologies such as multicore processors, increased memory, greater data storage and expansion capability to allow for future technology improve-

SNT Wins U.S. Army Contract to Evaluate On-the-Move Networks

The U.S. Army Communications-Electronics Life Cycle Management Command (CELCMC) has awarded Scalable Network Technologies a $349K basic research contract to develop a prototype analysis and simulation tool for evaluating cross-layer wireless network designs. The U.S. Army is studying cross-layer network designs as a potential solution to the interference, capacity and latency limitations of current-generation on-the-move communication networks.

A collaboration by SNT and Telcordia Technologies, the prototype of a cross-layer analysis and simulation system (CLASS) tool will be developed using analytical and simulation-based approaches for evaluation and validation of different cross-layer network architectures. Telcordia will participate as a subcontractor to SNT. The CE-LCMC CLASS prototype will include each of the analytical and simulation modules specified in the architecture of the CLASS tool and incorporate appropriate algorithms, operational scenarios and analytical optimization mechanisms.

Scalable Network Technologies
Los Angeles, CA.
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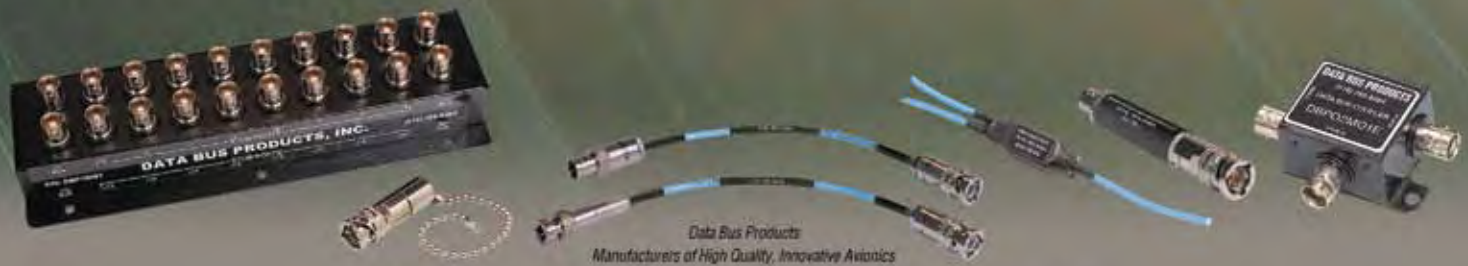

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ments. These enhancements provide the computer systems with better graphics processing, data handling and system networking capabilities. The company's DRS Tactical Systems unit in Melbourne, Florida will manufacture the systems and is scheduled to continue delivering them through 2012.

DRS Technologies
Parsippany, NJ.
(973) 898-1500.
[www.drs.com].

Northrop Grumman to Put Countermeasures Systems on Marine Corps Helicopters

Northrop Grumman Corporation has been awarded separate contracts to outfit U.S. Marine Corps CH-53D and CH-46E helicopters with the company's battle-proven Directional Infrared Countermeasures (DIRCM) system. Under the terms of these latest contracts, with a combined value of approximately $13.3 million, Northrop Grumman will integrate the DIRCM self-protection system onto the Marines' CH-53D (Figure 3) helicopter fleet, making the CH-53D the third Marine Corps rotary-wing platform to receive DIRCM protection from shoulder-launched, heat-seeking missile threats. In addition, numerous enhancements will be incorporated on the CH-46E helicopter fleet to streamline maintenance and handling of the system in the field. System deliveries will begin this year, with final deliveries in this year.

Figure 3

The DIRCM system on board the CH-53D Sea Stallion helicopter functions by automatically detecting a missile launch and activating a laser-based countermeasure system to defeat the missile.

The only such aircraft protection system currently in production, Northrop Grumman's DIRCM system is now installed or scheduled for installation on several hundred military aircraft to protect approximately 40 different large fixed-wing transports and small rotary-wing platforms from infrared missile attacks. The system functions by automatically detecting a missile launch, determining if it is a threat and activating a high-intensity laser-based countermeasure system to track and defeat the missile.

Northrop Grumman
Los Angeles, CA.
(310) 553-6262.
[www.northropgrumman.com].

DataPath to Retrofit U.S. Army JNN/WIN-T Terminals

The U.S. Army has awarded DataPath a contract to manufacture and integrate Ka band conversion kits and provide spares kits that will enable DataPath Satellite Transportable Terminals (STTs) and other systems on the battlefield to operate using the Wideband Global SATCOM (WGS) system. The satellite SATCOM terminals being converted were designed and built by DataPath and deployed by the U.S. Army for the Joint Network Node (JNN)/Warfighter Information Network-Tactical (WIN-T) program. With all options exercised over a base year and three option years, the agreement could total as much as $225 million for DataPath.

The WGS system, with its first satellite launched in October 2007, increases the high-bandwidth communications capacity available to support U.S. military operations worldwide by adding Ka and X band capacity to supplement limited military X band and commercial Ku band. This will be the first deployment of large numbers of WGS-capable, Ka band SATCOM terminals for the JNN/WIN-T program. Under this delivery order, DataPath will provide and install Ka band conversion kits on approximately 800 deployed DataPath STTs and 18 Unit Hub SATCOM Trucks (UHSTs). DataPath will also provide spares kits for the retrofitted terminals.

DataPath
Duluth, GA.
(678) 597-0300.
[www.datapath.com].

ThalesRaytheonSystems Inks Deal to Upgrade Army Firefinder Radar

ThalesRaytheonSystems has been awarded a $217 million U.S. Army firm-fixed-price contract to provide production modification kits and power amplifier modules as part of the Reliability Maintainability Improvement program for the AN/TPQ-37 Firefinder weapon locating radar. ThalesRaytheonSystems is an equally owned transatlantic joint venture between Raytheon Company and Thales Group.

The Firefinder RMI program enhancements include a modular, air-cooled transmitter and new common radar processors that will be applied to the Army's entire fleet of AN/TPQ-37 Firefinder radar systems as well as to the fleet of agile AN/TPQ-36 Firefinder radars. These upgrades will significantly reduce lifecycle costs and provide higher system availability, extending the expected life of the radar to year 2030. The RMI program could potentially save the U.S. Army more than $5 billion. The AN/TPQ-37 is the world's premier long-range weapon locating radar. It locates the position of hostile artillery, rockets and mortars so friendly forces can quickly and accurately return fire. ThalesRaytheonSystems will procure, build, integrate and test upgrade kits for the AN/TPQ-37 radar, which will then be delivered to and installed by the U.S. Army Depot at Tobyhanna, PA, as part of a planned upgrade program for AN/TPQ-37 radars in the U.S. Army's fleet.

Figure 4

The AN/TPQ-36 Weapon Locating Radar is an artillery, rocket and mortar locating system. Location of hostile artillery and mortars by the AN/TPQ-36 is completely automatic.

Raytheon Company
Waltham, MA.
(781) 522-3000.
[www.raytheon.com].

COTS Websites

www.geia.org

GEIA Web Site Provides Valuable Mil/Government Forecast Info

The GEIA (Government Electronics & Information Technology Association) is a group of several companies that provides the government with electronics and information technology (IT) solutions. In partnership with its members and their government customers, GEIA studies the market for IT solutions, enabling technologies and advanced electronics products and services for defense and civil government agencies. The GEIA then produces annually a 10-Year Defense Electronics Forecast and a 5-year Federal IT Forecast, as well as special market studies such as Services and Support, Net Centric Operations, and so on. This report can be purchased on the Web site. In short, the GEIA links industry to government through this unique forecasting process in which its members conduct hundreds of federal customer interviews.

GEIA is in constant touch with key government executives and representatives of civilian and defense agencies, as well as Congress. Via its Web site, GEIA provides information to industry on trends and opportunities, and facilitates doing business with government through market-forecast activities and other councils and committees. The GEIA also maintains an active standards development program. Configuration Management, Systems Engineering, Derating of Electronic Components and other key standards have been created and/or updated in recent years. These represent areas in which the association has become recognized nationally and internationally for its leadership and expertise.

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Arlington, VA.
(703) 284-5317.
[www.geia.org].

Special Feature

SDR/JTRS Technology Update

Software Radio and JTRS Making Steady Progress

Although challenges still lay ahead, Software Defined Radio and the JTRS program are moving steadily forward. As the pieces come together, JTRS and the broader SDR community's efforts are getting more in synch with one another.

Jeff Child
Editor-in-Chief

With its most troubled days well behind, the DoD's Joint Tactical Radio System (JTRS) remains one of the most sweeping and technically challenging programs ever conceived. The Joint Tactical Radio System program was initiated in early 1997 to improve and consolidate the DoD's Services Branches efforts in developing radios in a more coordinated way instead of each going on separate tracks. The JTRS program has evolved from separate radio replacement programs to an integrated effort to network multiple weapon system platforms and forward combat units.

At the heart of JTRS is the development of an open architecture radio waveform technology that allows multiple radio types—handheld, aircraft, maritime—to communicate with each other. With the goal of meeting diverse warfighter communications needs through software programmable radio technology, JTRS is central to the military's plan for Network Centric Operations using seamless real-time communications—both with and across the U.S. military services, and with coalition forces.

Figure 1

The Harris' Falcon III AN/PRC-152(C) handheld radio was the first JTRS-approved radio to be fully certified to the JTRS Software Communications Architecture (SCA).

Pieces Coming Together

The last twelve months have seen steady progress for the various elements of JTRS. While not the most dramatic year for the program, it has been productive. Filling in the puzzle pieces of the program, a number of contracts—large and small—were awarded over the past year. Among the most significant was the Airborne and Maritime/Fixed Stations (AMF) JTRS contract awarded to Lockheed Martin. The initial System Development and Demonstration (SDD) contract value was $766 million.

AMF JTRS will network and provide communications for more than 160 platform types including fixed and rotary wing aircraft, submarines and surface ships, and fixed stations worldwide. The

POSIX: A Perfect Fit for SCA

Paul Leroux, Technology Analyst
QNX Software Systems

SDR holds the key to dealing with evolving transmission standards. But for a time, SDR was itself in need of standards that could ensure software reusability and interoperability across various SDR products and platforms. To address the problem, the DoD's JTRS Joint Program Office (JPO) contracted a four-company consortium to develop the SCA, which is now mandated for use in all JTRS development projects.

When defining the SCA, the JTRS program had several goals in mind; among them, to reduce development costs, simplify software reuse, and ensure that software would port easily from one JTRS hardware platform to another. To achieve these goals, the JTRS program based the SCA on two existing standards: the CORBA middleware architecture and the POSIX application programming interface (API).

On the one hand, the choice of POSIX makes sense. The standard is clearly defined and documented, based on long-established practice and used by large numbers of programmers. But at the same time, POSIX has traditionally been associated with larger, general-purpose operating systems (OSs) such as UNIX and Linux, rather than the resource-efficient real-time operating systems (RTOSs) needed for many SDR-based products. Is POSIX, then, too large and unwieldy for military handheld radios and other resource-constrained SDR products?

The answer is no. To understand why, consider the underlying principles of the SCA. The JTRS program consciously avoided the temptation to define the SCA as a specific architecture. Rather, they defined it as an implementation-independent framework that ensures SDR systems achieve the objectives of reusability, portability and interoperability. The SCA places constraints on "interfaces and the structure of the software," but not on "the implementation of the functions performed."

This is why POSIX is such a good fit for SCA. Although POSIX is rooted in UNIX practice, the POSIX working groups explicitly defined the standard in terms of "interface, not implementation"—much like the SCA itself. As a result, a variety of operating system architectures can support POSIX APIs without adopting a large Unix-like kernel. A microkernel RTOS, for example, can implement the POSIX API, but in a form that can easily scale down for resource-constrained systems or scale up for systems with larger requirements and hardware resources.

Nonetheless, because POSIX doesn't specify an implementation, not all POSIX-conformant OSs bring the same benefits to the SDR table. For instance, some RTOSs support the POSIX PSE52 Realtime Controller 1003.13-2003 standard, the minimal POSIX profile required for SCA applications, but don't support the POSIX process model. This model is essential to preserving the key goals of the SCA, since it allows software components to run as memory-protected processes that can be debugged quickly, upgraded dynamically and reused across products with little or no modification.

Other OSs support the POSIX process model, but to varying degrees. Some, for example, allow only user applications to run as POSIX processes. Others extend the process model to include device drivers, networking stacks and file systems. As a result, these services can run as dynamically upgradeable processes, with full access to POSIX APIs.

QNX Software Systems
Ottawa, Ontario
Canada
(613) 591-0931.
[www.qnx.com].

Lockheed Martin team performed a successful Network Centric Operations Live Flight Demonstration at the end of the Pre-SDD Phase of the Program. The team includes BAE Systems, General Dynamics, Northrop Grumman and Raytheon.

Several Small Business Innovation Research (SBIR) contracts were also awarded by the JTRS JPEO (Joint Program Executive Office) in the past year for a variety of JTRS components. Among those awarded such contracts were Coherent Logix, Mayflower Communications, SCA Technica, MegaWave, Texas Research Institute and STI Electronics. Also of note was a support services contract overseen by the U.S. Navy's Space and Naval Warfare Systems Command (SPAWAR), with Scientific Research Corporation (SRC) as the prime contractor, to provide waveform portability support to the U.S. Navy's SDR systems. PrismTech was to work closely with SRC to provide the Navy with support and expertise related to the authentication of JTRS waveforms and Software Communications Architecture (SCA) compliance. PrismTech has provided SDR and JTRS product and services—under its Spectra2 product line—to numerous companies within the defense industry. PrismTech has also aided JTRS JPEO in defining waveform portability industry guidelines.

A couple years ago Harris' Falcon III AN/PRC-152(C) (Figure 1) handheld radio became the first JTRS-approved radio to be fully certified to the JTRS Software Communications Architecture (SCA). That certification represents an important milestone not just for Harris, but for software defined radio (SDR) in general. The use of the POSIX standard was an important element of that (see sidebar "POSIX: A Perfect Fit for SCA").

SDR Forum and JRTS Formalize Ties

The ongoing efforts of the Software Defined Radio Forum have always been very synergistic with JTRS. And last summer the relationship to that organization was formalized. The JPEO JTRS and SDR Forum signed a formal agreement to collaborate and share information. This teaming helped enable commercial industry participants to have greater visibility into DoD requirements, processes and science and technology needs for JTRS programs. In addition, the agreement provides a vehicle for forming partnerships among JPEO JTRS and SDRF members to explore

Figure 2

General Dynamics displayed and demonstrated its Rifleman radio at the MILCOM conference last fall. Jeff Child, Chief Editor of *COTS Journal*, is holding this small FPGA-based unit with casing removed, at General Dynamics' booth. The Rifleman radio mirrors the Small Form Fit-C (SFF-C) Version 1 of HMS with additional radio controls and its own power supply.

new technologies and processes currently at the forefront of the commercial wireless communications industry.

Like the JTRS program itself, the field of software defined radios has been technically challenging over the last decade as standards and digital hardware have evolved to meet the extraordinarily high demands of this application. Working together, standards and technical techniques are being developed that will meet stringent DoD security and reliability requirements while also enabling cost-effective SDR implementations for consumer and commercial products. This month the SDR Forum and the JPEO JTRS are sponsoring a joint SDR Forum technical meeting and JTRS Science and Technology Forum (JSTeF) in San Diego, CA. The JSTeF will focus on the DoD-specific aspects of wireless network systems by discussing JTRS processes, emerging science and technology opportunities and requirements, specifically in the areas of network security, secure radio architecture and software development standards.

JTRS WNW Demonstrated

At the MILCOM conference in San Diego last fall, General Dynamics C4 Systems demonstrated its JTRS technology. By embedding waveforms, like the Wideband Networking Waveform (WNW) and IEEE 802.16 or "WiMAX" wide-area networking, the company's Handheld, Manpack and Small Form Fit (HMS) Joint Tactical Radios provide the needed bandwidth and spectrum range to facilitate communication between tactical vehicles while they are moving. According to General Dynamics, the first HMS radios will be in warfighters' hands in early 2010.

Other HMS radios are currently in user tests to prove their effectiveness in close-combat tactical communication, including the Rifleman radio in use by the U.S. Army's Evaluation Task Force at Fort Bliss. The Rifleman radio (Figure 2) mirrors the Small Form Fit-C (SFF-C) Version 1 of HMS with additional radio controls and its own power supply. General Dynamics displayed and demonstrated these small, FPGA-based systems at MILCOM. ▮▮

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[www.gdc4s.com].

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Tech Recon

Military Market Update

Despite Mixed Signals, MIl Market Looks Encouraging

Even with all of the political and financial upheavals on many fronts—foreign and domestic, the military market is looking surprisingly good, especially for the embedded computing and electronics segment of the market.

Warren Andrews
Editorial Director

Several factors—including the new administration, the thought of winding down action in Iraq, picking up activity in Afghanistan, new hostility between Palestine and Israel, the potential eruption of hostility between Israel and Iran, saber rattling by the Russians, a continued threat of domestic terrorism, mayhem in the financial markets and growing domestic bail-outs—all conspire to make it difficult to forecast the short-range future of the military. Even the small subset of the military market we look at—the merchant market for embedded computers and electronics, less than $2 billion out of a budget of some $530 billion—is subject to the vagaries of political influence and global perspective.

This past year saw the merchant market for computers and electronics in the military grow some 7 to 8 percent to approximately $1.4 billion (see sidebar, "What We're Counting"). Some companies topped that, boasting growth in the double-digit range, while others staggered along with only about 5 percent growth.

Figure 1

There is currently a trend toward the commercial merchant market supplying more complete systems to the military including processor and storage, I/O, cooling technology and some level of software support wrapped up in a single package. The example shown is a rugged 5-slot compact chassis loaded with three PowerPC-based SBCs and three mezzanine cards that provide the 1553 and ARINC military communications interfaces and control the graphics display.

Overall, makers of military electronics fared slightly better than their commercial counterparts that experienced only a 4 percent annual growth. The growth was somewhat greater than predicted due to an increase in smaller form factor boards and subsystems and wider use of embedded computers in the military in general. To be fair, however, average selling prices (ASPs) in the commercial space have been steadily dropping for the past decade while military ASPs have not experienced the same price erosion.

Doing Something Right

A quick view of the market shows most areas in surprisingly robust health. A common refrain of many of the individuals interviewed for this report was "I don't know what we're doing right, but I sure hope it keeps happening." They're seeing a continued strength in the market—part from continued upgrade and technology insertion in conventional weapons, and part due to new programs that have received increasing attention.

At one end of the spectrum are older programs typified by the likes of the Abrams tank, where programs for upgrading and retrofitting are expected to extend through 2009 well into 2010. At the other end of the spectrum are new

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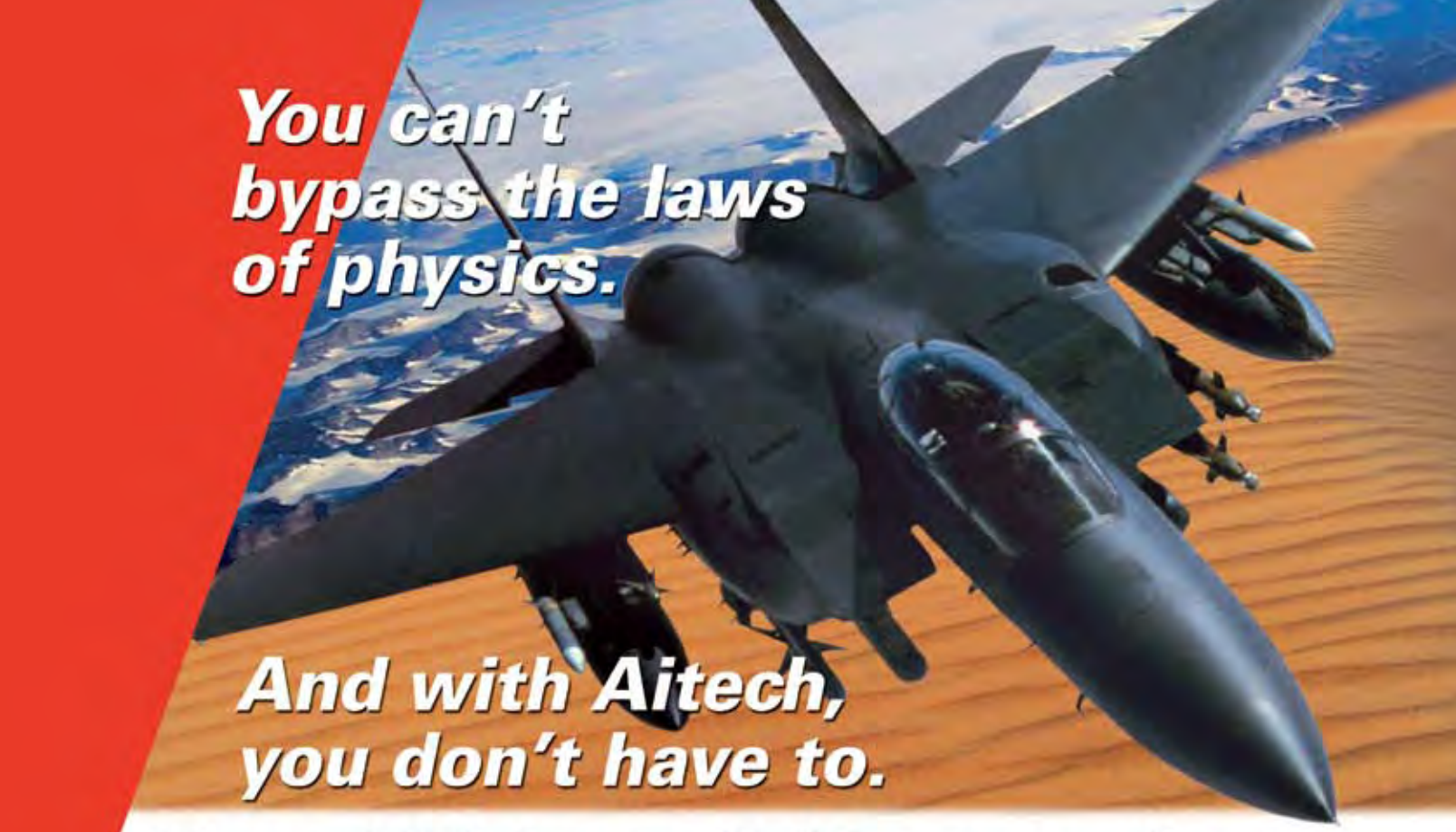

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and emerging UAVs that are expected to grow at an overall rate of about 30 percent to $3.25 billion, according to Frost & Sullivan's Senior Consultant, Lindsay Voss (*COTS Journal*, October 2008, p.20).

All that said, the overall growth may be a little deceiving as the computer and electronic component in those UAVs is expected to grow at a far greater rate as more and more capabilities are added. For example, hyperspectral imaging and laser radar are expected to augment conventional infrared and SAR currently in use. At the same time, this growing amount of information gathered is taxing the bandwidth of conventional systems to transmit to ground stations.

Boosting Compute Density

The result is that more and more intelligence and signal processing is being incorporated in the vehicles so that a lot of the information can be pre-processed, minimizing the bandwidth required to download. For example, an area can be scanned and examined for anomalies from previous scans and only the anomalies sent to the ground station. While this requires an astounding amount of signal-processing intelligence, vendors have come up to the task. Mercury Computer's PowerBlock 50, for example, packs 172 Gflops of processing power in addition to storage in its six-slot, seven-pound form factor.

As systems continue to get smaller and more powerful, the trend toward co-locating an increasing amount of signal-processing intelligence and storage up to the location of the sensors is increasing. The combined increase in both sensor electronics and processing and storage capability is boosting the electronic component value ahead of that of the transport vehicles. UAVs are not the only vehicles looking at such changes. Manned aircraft as well as satellites are using similar approaches to limit the amount of bandwidth required to download critical information and speed the process.

Though much of the merchant-market computers and electronics in the military continue to be based on stan-

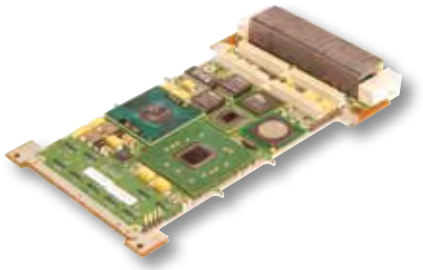

Figure 2

The latest technology coming from VITA is VPX (VITA 46), which many believe will ultimately displace legacy VME boards and systems. The approach uses serial switched fabric technology with state-of-the-art, gigabit connectors (3U version shown). The technology is expected to keep suppliers ahead of the technology curve for the lifetime of many military programs.

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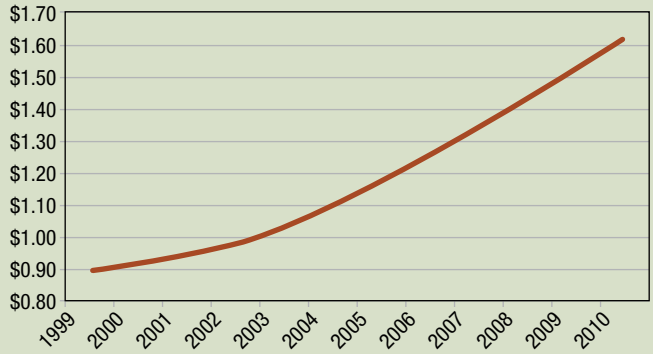
What We're Counting

There is often some confusion as we look at the military electronics market. Jane's Forecast Analyst team shows the total worldwide market for military electronics at a level of some $80+ billion, divided among many different technologies including Sonar, EOIR, Command & Control, Radar & RFEW and military communications (see *COTS Journal*, October 2008, p. 30).



The board, subsystem and system business is some subset of the entire amount and in small bits and pieces fits into each technology. Unfortunately, we can only guess at that amount since much of it is embedded in larger programs such as an aircraft, shipboard systems or combat communications and networking systems. These are generally managed by large prime contractors such as Boeing, Lockheed Martin, SAIC, Northrop Grumman and others who only release the electronic component of those systems in general terms.

The subset of the market that we look at is restricted to the merchant market (commercially available, not necessarily off-the-shelf, though that term is often applied) for specialized components, boards, boxes, subsystems and systems often, but not necessarily, based on industry standards. The merchant market is differentiated from what some in our industry call a gray market (gray primarily because it's in the shadows and can't be closely identified) in which prime contractors make basically the same products as the merchants, but they are used within the contractor's program directly bypassing the market.

In the past, the merchant market served as a fast way for prime contractors to prototype systems that were subsequently manufactured by the primes themselves for various reasons, primarily monetary. That trend, though still very much there, is slowly changing as prime contractors are deploying more "COTS" boards and systems to pare development costs, which military contracts are more careful to limit.

That merchant market has grown significantly over the past decade—actually beginning in 1994 when then Sectary of Defense, William Perry, made a ruling on military procurement to open the door for merchant-market goods. The Figure shows the growth of this market from 1999 through 2010 as close as we can measure it. Even as the total DoD budget may not increase over the next several years, the market for computers and electronics is expected to continue to increase as we move to more intelligent warfare, and technology continues to take the place of people in harm's way. Further, economies finally reaching the military are going to mandate further use of standard platforms from a competitive merchant market.

dards-based modular backplane systems such as VME, boxes such as Mercury's PowerBlock 50 and a wide variety of others are starting to make inroads into a variety of systems. Not only do prime and sub-prime contractors want "boxes" rather than "boards," they are looking for greater levels of integration including software. One major vendor in the military computers and electronics space reports that software development has had an impact to the overall budgeting process and is expected to have even more impact going forward.

One major trend has been small complete systems in a box often loosely

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based on 3U CompactPCI. These systems find themselves in a variety of applications from UAVs to the 360° situational awareness systems in the latest land vehicles. In addition, relatively "standard" compute-engine boxes are being applied to a variety of other military programs. Yet other approaches use smaller form factor boards to squeeze full avionic capability into a half-ATR box (Figure 1).

Military: VME's Strong Suit

VME continues to be a strong suit in the military, entrenched as it is in a lot of legacy applications. It's expected to lose some of its grip in coming years as older programs are phased out and newer ones—programs with higher-performance and smaller space and lower weight requirements—replace them. Venture Development Corp. (VDC) reports that it expects VME-based systems including VME41 and 46/48 to dominate the market with 75 percent share in 2009. It suggests that 18 percent will be held by CompactPCI, 3 percent by ATCA/MicroTCA and 4 percent by other architectures.

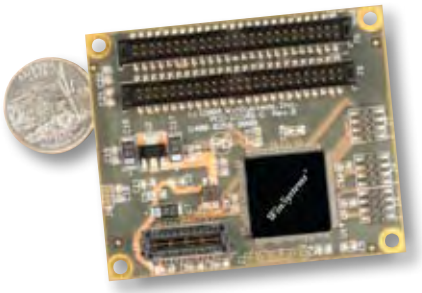

Figure 3

The latest standard effort from the Small Form factor Special Interest Group (SFF-SIG) is SUMIT (Stackable Unified Module Interconnect Technology), an electromechanical connector specification that integrates high- and low-speed serial and legacy expansion buses for next-generation, low-power embedded systems. Shown here is a Pico-I/O module from WinSystems that uses the SUMIT interface.

At the present time, it's difficult to see how the various VME (VITA) architectures are separated. Conventional VME (traditional VME, 2eSST and VXS) continue to make up the bulk of the business. VPX (VITA 46) (Figure 2) is the new guy on the block and the first to completely eschew the conventional VME architecture with no backward compatibility to older systems. But VME advocates are quick to point out that bridges exist to make hybrid systems of VME and VPX so users need not abandon legacy VME boards.

Over the past year, several companies have been out salting the market with VPX evaluation systems hoping to achieve some critical mass of customers and design wins. Many companies including industry leaders Curtiss-Wright and GE Fanuc Embedded Systems in addition to smaller firms such as start-up Extreme Engineering Solutions and others already have a lot of VPX products on the market. In addition, more than a

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handful of full-fledged design wins have been reported.

VPX— Investing in The Future

Although attractive, VPX still remains the "high-priced spread." There have been some instances where OEMs have looked at VPX then stepped back to 3U CompactPCI. In these cases, users reported that they didn't need the extra performance of VPX so their thought process went to the cheaper alternative—why pay the additional price. However, VPX advocates point out that performance is only one of the advantages of the newer architecture. Like VME, VPX offers users a longer useful life.

In contrast, CompactPCI is at, or near, the tail end of its lifecycle and there does not appear to be any mid-life kicker that will rejuvenate it. While CompactPCI Express is in the offing, there has been little commercial activity outside of a small handful of vendors. As conventional cPCI chips become obsolete, cPCI is unlikely to survive the typical life of long-lived military programs.

Therefore, VPX may be a more viable alternative. VPX advocates point out the long history of VME in military programs where many VME systems were designed in more than a decade ago and are still going strong. VPX uses the latest switched-fabric technology, current state-of-the-art connector technology and chips and chipsets that promise to provide a long set of legs for current programs.

MicroTCA and Other Choices

While many support VPX heartily, other approaches continue to make inroads. MicroTCA—the system-based version of the AMC mezzanine card—for example, is starting to show up in labs at a number of major prime contractors such as BAE Systems and Lockheed Martin. While there are still some "survivability" issues, there are at least two major efforts under way to provide a ruggedized MicroTCA. One looks to provide a cocoon-type approach, cradling the system in its own environment. Another approach looks to ruggedize the entire board, connector structure and backplane.

Then there are factions within each area, for example, communications applications require robust systems for cell towers that have to withstand temperature and humidity extremes, but are not subject to mechanical abuse beyond basic transportation. However, for deployed military systems, boards and systems must tolerate high g forces and survive shake-rattle-and-roll testing in addition to thermal resistance. At the present time, most MicroTCA systems are deployed in relatively benign environments not subject to severe mechanical shock. That may change as new standards evolve. Stay tuned.

Still other standard approaches have been gaining support in the military. There are several programs that now use ATCA as signal-processing blades. While these are not ruggedized, the applications are often fixed-portable and do not require high levels of mechanical survivability. Other form factors that are starting to make a showing in military applications are several of the small form factor approaches. In addition, IBM Blade Servers have shown up in a couple of applications.

In addition to the older EBX and PC/104 form factor cards, it's likely that the new breed of small form factor boards made possible by the latest low-power processors such as Intel's Atom family and Via's Nano, will be showing up in military programs. In addition, look for some of the newer approaches such as SUMIT (Stackable Unified Module Interconnect Technology) (Figure 3) sponsored by the SFF-SIG (Small Form factor Special Interest Group). In addition, mezzanine cards such as AMC and PMC still occupy a major place in a variety of systems populating a variety of platforms from ATCA to VME and motherboards.

The Past, Present and the Future

I have intentionally steered clear of projections of programs and various budgetary matters until some of the dust settles and we get a clearer understanding of where things are going. There is a great level of certainty that programs will continue and retrofits and technology upgrades will continue virtually unabated. The balance of the

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budget, state of various programs such as FCS, F-22, F35, Naval shipbuilding and so on—as well as a more thorough look at architectures, subsystems, technology futures and statistics, will be the subject of a separate document coming later this year.

While 2008 ended on a pretty dismal note economically, it was a time of several technology breakthroughs and innovations. Some were of greater impact than others, but all contributed to the overall technology treasury we continue to base our new systems on. Many of these have appeared in our sister publication *RTC* magazine's News, Views and Comment section over the past year.

Processors

One of the most significant technology boosts for 2008 might have been Intel's 45nm hafnium-based technology that has enabled the Atom, which in turn is pushing 32-bit embedded control into smaller places where issues of space, power consumption and heat had been previously prohibitive. What's ahead for Intel? CEO Paul Otellini envisions an x86-based processor in everything. Where's the technology future? "I guarantee you that Moore's Law will not end on my watch," he says. So expect to see Intel continue process development on a grand scale. Already the company has 32nm feature sizes in the works and on experimental die. That's about a 30% decrease.

Memory

Memory technology has also seen some significant development. While envisioned years ago, the latest comes from Hewlett-Packard in the form of a memory resistor, which it claims to have built. The theory of a memristor was postulated back in 1971, but it has taken until now to make a working version. H-P's claim is that it would be more energy efficient than flash or other technologies and can permanently store information. The prototype was made putting a film of titanium dioxide between electrodes and applying a charge. As the charge flows through it, the atomic structure actually changes. Not yet in production

But as we started out, it is but one of many approaches that have been announced and are just now being commercialized. One such is from Numonyx, a joint venture recently formed by Intel and STMicroelectronics, which is betting on a technology called phase-change memory, which takes advantage of certain materials' characteristics to change structure with the application of heat. The company claims it is now shipping 128 Mbit chips using the phase-change approach.

RF Power

In April this year, HVVi Semiconductor announced a new way to do RF Power Transistors that allows higher operating voltages (48V and more), thereby outperforming the dominant RF power transistor standard (Lateral Double-diffused metal Oxide Semiconductor (LDMOS)) that's been used for the past 15 years in radar systems.

Advanced Process

A Raytheon-led team has accomplished a key step in demonstrating that affordable, high-performance circuits for military applications can be produced by growing semiconductor compounds directly on silicon. According to Raytheon, selective placement of semiconductor compounds on silicon is an important achievement because it proves that optimal circuit performance can be produced through a heterogeneous, high-yield, monolithic integration process.

These are but a few of the many heady developments of the year from the semiconductor side of the fence. However, they have been enabling technologies and have made possible innovation in other areas, such as SUMIT (see above) and COMIT. Other developments on the module front include a MiniBlade spec for Solid-State Drives on small boards also by the SFF-SIG. And, lest we forget, we are firmly entrenched in the age of the multicore processor that has enabled countless new SBCs and powerful computing engines. ▮▮

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		CMA157886PX1400HR	CMX158886PX1400HR	CMD158886PX1400HR	CMX158886PX1400HR-BRG	CMD158886PX1400HR-BRG	CME146786CX650HR	CME147786CX400HR	CME147786CX650HR	CML147786CX400HR	CML147786CX650HR	CMX147786CX400HR	CMX147786CX650HR	CME136686LX500HR	CME137686LX500HR
Expansion Bus	PC/104 ISA Bus	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI-104 PCI Bus	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓
	PCI Bus Masters	4	4	4	4	4		4	4	4	4	4	4		4
	APIC (add'l PCI interrupts)	9	9	9	9	9	9	9	9	9	9	9	9		
CPU and BIOS	CPU Max Clock Rate (MHz)	1400	1400	1400	1400	1400	650	400	650	400	650	400	650	500	500
	L2 Cache (KB)	2048	2048	2048	2048	2048	256	256	256	256	256	256	256	128	128
	Intel SpeedStep Technology	✓	✓	✓	✓	✓									
	ACPI Power Mgmt	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0
	Max Onboard DRAM (MB)	512	1024	1024	1024	1024	512	512	512	512	512	512	512	512	512
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RTD Quick Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	ATA/IDE Disk Chip (MB)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
	Audio		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	Digital Video	LVDS	LVDS	LVDS	LVDS	LVDS				TTL	TTL	LVDS	LVDS	LVDS	
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	**RS-232/422/485 Ports**	4	4	2	4	2	2	2	2	2	2	2	2	2	2
	USB Ports	4	2	4	2	4	2	2	2	2	2	2	2	2	2
	10/100Base-T Ethernet	1	1	1	1	1	1	1	1	1	1	1	1	2	1
	ECP Parallel Port		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO (Advanced Digital I/O)	14	18	18	36	36	18	18	18	18	18	18	18	18	18
	multiPort (aDIO, ECP, FDC)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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Bus	Active Bus	PCI	PCI	ISA	ISA	PCI	PCI	PCI	PCIe	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
	Passthrough Bus	ISA				ISA	ISA		PCI				ISA		PCI	ISA
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
	McBSP Serial Ports	✓	✓			✓	✓	✓	✓							
Analog Input	Single-Ended Inputs	16	16	16	16	16	16	16	16							
	Differential Inputs	8	8	8	8	8	8	8	8							
	Max Throughput (KHz)	1250	1250	500	100	1250	500	500	500							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Input Ranges/Gains	3/7	3/7	3/4	1/4	3/6	3/3	3/3	3/3							
	Autonomous Calibration	✓	✓													
	Data Marker Inputs	3	3	3		3										
Conversions	Channel-Gain Table	1K	1K	1K	1K	1K	1K	1K	1K							
	Scan/Burst/Multi-Burst	✓	✓	✓	✓	✓	✓	✓	✓							
	A/D FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Sample Counter	✓	✓	✓	✓	✓	✓	✓	✓							
	SyncBus	✓	✓			✓	✓	✓	✓							
Digital I/O	Total Digital I/O	16	16	16	16	16	16	16	16	48	18/9	64	48	48	48	48
	Bit Programmable I/O	8	8	8	8	8	8	8	8	24	6/0		48	48	48	✓‡
	Advanced Interrupts	2	2	2	2	2	2	2	2	2			2	2	2	✓‡
	Input FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Versatile Memory Buffer												4M	4M	4M	8MB
	Opto-Isolated Inputs											48				
	Opto-Isolated Outputs											16				
	User Timer/Counters	3	3	2	2	3	3	3	3	3	3		10	10	10	6
	External Trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓‡
	Incr. Encoders/PWMs										3/9		4/8	4/8	4/8	✓‡
Analog Out	Analog Outputs	2	2	2	2	2	2	2	2							
	Max Throughput (KHz)	200	200	200	100	200	100	100	100							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Output Ranges	4	4	3	1	4	5	5	5							
	D/A FIFO Buffer	8K	8K			8K	8K	8K	8K							

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10GbE: Well Suited for Demanding New C4ISR Apps

High-bandwidth, "fat pipe" data processing is becoming a vital technology for COMINT, ELINT, situational awareness and other applications. 10 Gbit Ethernet has emerged as the interface solution of choice for those systems.

Rob Kraft, Vice President of Marketing
AdvancedIO Systems

Military application developers continue to hunger for ways to take advantage of improved communications and faster processing. They also are trying to coordinate information to create more automated, cohesive and mission-aware links between the various groups and devices. Today's battle communications gear is certainly a far cry from the days when surveillance consisted mainly of wireless voice relay of human visual observations. But today's system architects want to go to the next level and seek to fuse data from high-performance sensors, COMINT, ELINT, situational awareness and other C4ISR applications—a collection of technology that shares a common need for "fat data pipes."

Interconnecting high-bandwidth sensors or large numbers of lower-bandwidth sensors on airborne, ground vehicle, or stationary platforms represents a data plane domain where earlier generations of Ethernet were unable to compete against technologies such as Serial FPDP and Fibre Channel. But thanks to the arrival of the speedy 10 Gbit Ethernet standard, the universal nature of Ethernet promises defense programs new levels of portability and easier software maintenance throughout the application signal path.

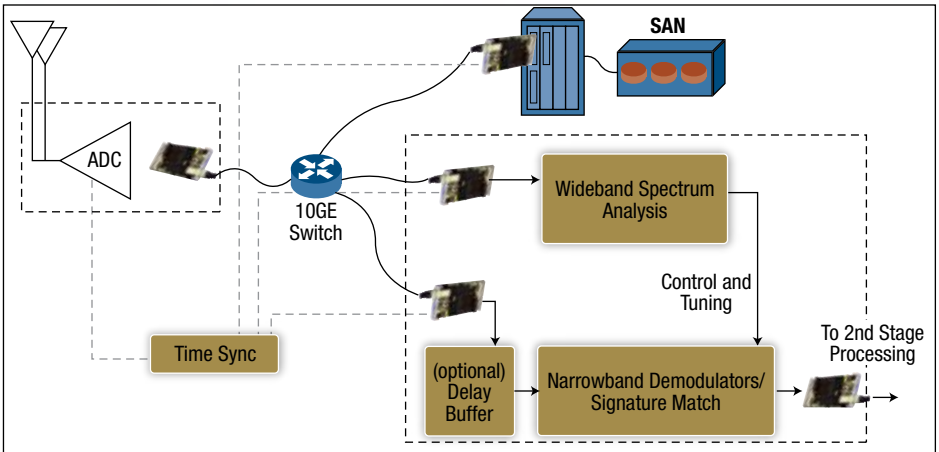

Figure 1

Shown here is a typical COMINT/ELINT wideband analysis application with real-time record and playback capability, enabled via 10 GigE interfaces. A key architectural problem in such applications, which 10 GigE can address, is how to send raw sensor data in parallel to storage and multiple processing streams.

Because of the heavy processing load of running Ethernet protocol stacks at 10 Gbit rates, most 10 GigE implementations use some form of a protocol offload coprocessor to achieve high-data-transfer-rate performance and minimize processor utilization. The offload coprocessor, typically an ASIC in the commercial world, performs the heavy lifting of the protocol, reducing the burden on the processor.

Figure 1 depicts a COMINT or ELINT wideband analysis application with real-time record and playback capability. Real-time C4ISR applications,

such as these, have a requirement to send raw sensor data in parallel to storage and multiple processing streams—a challenge that 10 GigE addresses handily. However, these applications also impose unique functional and performance requirements on the 10 GigE interface that differ significantly at the application and hardware level from the 10 GigE interfaces used in the large server-based markets. It's important to understand those unique requirements, the challenges they impose on the 10 GigE interface, and the architectures that solve them, pointing out where typical commercial solutions fall short.

Application-Level Challenges

A critical element in ISR (Intelligence Surveillance and Reconnaissance) systems, especially those dealing with multi-channel, direction finding and sensor fusion, is the ability to accurately time-tag the data with a sufficient level of accuracy. The tagging is used to enable the alignment of data arriving from the multiple sensors. It's also used if the data is recorded and used later for playback, to simulate the re-injection of data into the system with the same timing fidelity with which it was originally captured.

Performing the time tagging in the CPU is not a suitable solution for meeting the accuracy and precision requirements. By the time the packets reach this point, they have gone through several non-deterministic interfaces. Instead, tags should be applied as close to the 10G interface as possible. The ASICs designed for commodity 10 GigE NIC cards generally do not support hardware interfaces for packet time stamping or playback staging. This leaves access for tagging at the socket layer only, which is insufficiently accurate.

Keeping "Corrupt" Packets

Since ISR systems take in sampled and digitized representations of real-world signals, they flow the data through signal processing algorithms such as filtering, FFT, decoding, or other processing for detailed analysis. Some of these algorithms can correct or tolerate a number of scattered errors, but they are not amenable to a consecutive swath of missing data. A good analogy would be the idea of a few letters missing from a sentence versus having a whole paragraph go missing.

Ethernet protocol stacks are designed to discard packets if an error is detected in a checksum. This means discarding anywhere from a series of 1500 or 9000 (depending on the network's packet or MTU size) consecutive bytes, depending on the type and layer at which the error occurs. Ironically, the source of this error could be a small change in a packet's header, which does not affect the integrity of the data. While this behavior makes good sense in most network applications of Ethernet, where higher protocol or application layers deal with it, it can severely and unnecessarily hamper the performance of real-time sensor processing applications.

As a result, when it comes to using Ethernet in C4ISR systems, a solution with the capability to avoid dropping packets with errors is essential. Again, the requirement for this capability is unique to systems performing signal processing functions on digitized sensor data and does not apply to the vast majority of Ethernet networking applications in the commercial space.

Extended Duration Data Bursts

Capturing hard real-time sensor data differs fundamentally from typical commercial applications. Consider an airborne surveillance radar platform or a ground-based EW platform. During the application's "listening phase" the sensor is rapidly digitizing a stream of incoming signals. This is followed by a longer rest-period until the next outgoing pulse is transmitted. When Ethernet is used as the incoming

VITA 42.6 Standard Puts 10 GigE on XMC

VITA is working toward expanding the features of XMC technology by defining a standard for integrating into it two types of 4-lane 10 Gigabit Ethernet (10 GigE)—10G Attachment Unit Interface (XAUI) and 10GBASE-KX4. XAUI is a widely accepted switching interconnect technology for 10 GigE components. It has a low pin count and a self-clocking serial bus, and it enables low-cost and low-power 10 GigE chip-to-chip communication on board or over a backplane. 10GBASE-KX4, as specified in IEEE Std 802.3ap-2007 clause 71, is a similar 4-lane standard for running 10 GigE across backplanes.

The VITA 42.6 specification will define an open standard for supporting 10 GigE over either XAUI or 10GBASE-KX4 protocol on the XMC form factor. The XMC form factor is defined in VITA 42, which is a family of "dot specs." VITA 42.0, also known as the XMC base standard, defines the physical features that enable switched communications between a standard mezzanine card, known as a PMC card, and its carrier. These features include the addition of one or more high-speed connectors to the PMC form factor to carry the additional electrical signals necessary for such communications.

VITA 42.6 is a protocol layer standard that builds on the XMC base standard by describing how XMC carriers and XMC mezzanine cards may communicate in a standard way using the aforementioned 4-lane protocols. The standard aims to define the assignment of and provide guidelines for the use of the signals over the VITA 42.0 XMC connectors. The guidelines and design rules are intended to be consistent with the physical, transport and logical layers of the XAUI or 10GBASE-KX4 specifications, so that VITA 42.6 products will be interoperable with other hardware and software using those standards. The standard is currently undergoing the second ballot and is expected to be finalized by Q1 2009.

sensor fabric, the listening phase brings the prospect of receiving multiple consecutive packet bursts at full line rate without the option of controlling the flow by asking a sensor to pause its transmission.

Typically, a 10 GigE Ethernet interface card buffers incoming data by using host system memory, located external to the card and accessed over PCI-X or PCIe. However, there is often at least momentary contention for accessing system memory, which in the case of consecutive line-rate bursts, can result in dropped data. Therefore, a 10 GigE interface used for these applications must be designed with sufficient local data buffer.

Figure 2

AdvancedIO Systems's V1021 is an FPGA-based 10 GigE XMC/PMC module with SFP+ optical interface.

High-performance embedded real-time applications such as reconnaissance aircraft, FCS ISR drones or UAVs with SIGINT payloads, place unique real-time performance demands on the datapipe they use. To effectively address these demands, 10 GigE technology must implement features including interfaces for precision time-stamping, local memory to accommodate large full-rate inbound bursts and outbound data staging, and the ability to customize stack behavior for receiving real-time sensor data.

Generally, these performance requirements exceed what commodity NIC cards and the ASICs they are based on can do since these products are optimized for a different set of application requirements, and lack some or all of the required features. However, carefully designed 10 GigE products, such as AdvancedIO's V1021 board, facilitate the use of the latest incarnation of widespread Ethernet in high-performance real-time applications (Figure 2).The board has been deployed for that purpose already in such C4ISR systems. ■■

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Technology Focus

Serial FPDP Boards

Serial FPDP Finds Niche Handling High-Speed Sensor Data

Serial FPDP maintains the simplicity of parallel FPDP while overcoming its distance limits. That's smoothed the way for military system designers to implement fast, efficient sensor data input channels.

Jeff Child
Editor-in-Chief

Many kinds of high-performance embedded computing systems in the military market have an appetite for high-speed data from sensors. Often such input is presented as one or more channels of analog data, and, in some cases, the sensor data is provided directly to the processing system. However, in other cases, the sensor data is converted to digital data by a smaller system near the sensor itself and then sent over one or more fiber optic links to the processing system. For these applications, Serial Front Panel Data Port (FPDP), or ANSI/VITA 17.1-2003, provides a simple point-to-point protocol with low overhead, high throughput and minimum latency.

Serial FPDP overcomes a key limitation of parallel FPDP: its distance limitations. It does so by using a serial interface based on the Fibre Channel physical layer. Serial FPDP retains the frame format of the original standard thus simplifying the exchange of data between parallel and serial implementations. As a result, Serial FPDP makes it easy to exchange data from local chassis and legacy systems using parallel interfaces to remote chassis through a Serial FPDP connection.

When Serial FPDP was originally deployed, it was based on the fiber optic transceivers that were readily available at the time. The fastest version of Serial FPDP uses a bit rate of 2.5 Gbaud, providing of 247 Mbytes/s after 8B/10B encoding. As sensor technology improved, the sensor-to-processor interface often combined multiple Serial FPDP links to meet the ever increasing need for bandwidth. Although this approach provides the necessary throughput, it adds complexity at both ends of the link to manage splitting the data at the source and then aligning the resulting fiber optic streams at the destination. Because there is no standard method for doing this, link aggregation becomes an application-specific part of the problem.

The latest version of Serial FPDP, VITA 17.2, addresses these requirements in two ways. First, the choices for raw bit rates are expanded to include 3.125, 4.25, 5.0 and 6.25 Gbaud, allowing each link to operate up to 2.5x faster than before. Second, the standard now includes the capability to aggregate links in sets of 1x, 2x, 4x, 6x, 8x or 12x, allowing a single logical link to consist of multiple underlying physical links. The net result is that a stream of sensor data of up to 75 Gbaud (7.5 Gbytes/s) can now be considered a single Serial FPDP link.

Figure 1

Northrop Grumman's Airborne Laser Mine Detection System (ALMDS) depends on Serial FPDP and VXS to process high-speed sensor data. ALMDS is deployed on helicopters to allow the U.S. Navy to detect sea mines in shallow water areas.

An example of a program using Serial FPDP is Northrop Grumman's Airborne Laser Mine Detection System (ALMDS). The Central Electronics Chassis (CEC) system of the ALMDS combines FPGAs, Serial FPDP and VXS technologies to process sensor data and synchronize and manipulate that data for rapid decision making. ALMDS is deployed on helicopters (Figure 1) to allow the U.S. Navy to detect sea mines at or near the water's surface. Using an airborne light detection and ranging blue-green laser, the ALMDS system covers a large area of the ocean detecting, localizing and classifying mines. ▮▮

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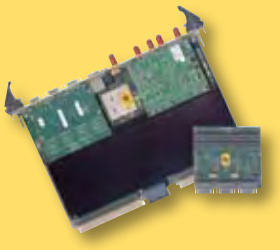
Technology Focus:
Serial FPDP Boards Roundup

24 Serial FPDP Channels Blend on VME Card

Using FPGAs in conjunction with the Serial FPDP (sFPDP) interconnect makes for a power combination. Such a solution has enormous benefits for radar, sonar, SIGINT, ELINT, digital signal processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing and other processing-intensive applications. Serving exactly that arena, Annapolis Micro Systems offers its FPGA-based WILDSTAR family that provides 24 sFPDP channels per VME slot. The Annapolis sFPDP Cards (UNI3 or UNI6) come with an easy-to-use Serial FPDP interface supporting up to 12 lanes of 2.5 Gbit Full Duplex data. Three frame types are supported: Normal Data Fiber Frame, Sync without Data Fiber Frame and Sync with Data Fiber Frame in Point-to-Point Mode. The card has three individually configurable, industry-standard 4X connectors, providing 4 lanes per connector, with dedicated signal conditioners to ensure clean communication. It supports up to 7.5 Gbytes/s full duplex per I/O card and a wide variety of readily available copper and fiber cables.



Up to two serial I/O cards and two LVDS I/O cards can reside on each WILDSTAR 4 or WILDSTAR 5 VME/VXS main board, with half that number for the PCIX or PCIe. The sFPDP card (UNI6) also supports Rocket I/O protocol at up to 75 Gbit Full Duplex per I/O card, three ports of 10G Full Duplex InfiniBand per I/O card or 10G Full Duplex Ethernet per I/O Card. No other FPGA board vendor can match the volume of data we can send straight into the heart of the processing elements and then straight back out again. WILDSTAR 4 for PCI boards starts at about $13,500 and UNI6 I/O Mezzanines start at about $4,500.

Annapolis Micro System.
Annapolis, MD.
(410) 841-2514.
[www.annapmicro.com].

Card Delivers 3.125 Gbits/s on Four Ports

It's not always possible to get data conversion gear close to where the analog data is acquired. Serial FPDP is rapidly becoming the interconnect of choice for streaming data capture systems because it is a protocol optimized for maximum data rates and minimum overhead. It efficiently accommodates many applications requiring great distances between the data input site and data processing stations. Along those lines, Conduant offers its StreamStor Serial FPDP Mezzanine Board for long-distance, high-speed, data capture from Serial FPDP or other optical fiber data protocols. When combined with Conduant's StreamStor Amazon SATA disk controller, real-time data input performance exceeds 500 Mbytes/s.

The StreamStor Serial FPDP Mezzanine Board features four independent optical fiber interface ports for simultaneous data input and output available on each port. With data rate and wavelength options, the board can support cable lengths up to 25 kilometers. The StreamStor Serial FPDP Mezzanine Board exceeds the ANSI/VITA 17.1-2003 specification with sustained rates of 300 Mbytes/s (3.125 Gbytes/s). Wavelength options include 850 nm (nanometers) and 1300 nm for distances up to 25 kilometers. Data rates range from 1.06-3.125 Gbits/s on each of the four ports. The mezzanine board supports multiport recording whether bonded or independent. It is field-upgradeable and features customizable hardware.

Conduant
Longmont, CO.
(303) 485-2721.
[www.conduant.com].

Serial FPDP Board Serves Up Quad Channels

The Serial Front Panel Data Port (sFPDP) interconnect has become the industry standard for high-speed serial communication in today's advanced sensor-to-DSP systems. For its latest sFPDP offering, Curtiss-Wright Controls Embedded Computing has introduced a new rugged, high-performance, quad channel Serial FPDP card that delivers sustained data rates up to 247 Mbytes/s on each of its four channels. The new FibreXtreme SL100/SL240 Serial FPDP card, based on Altera's Stratix II GX FPGAs, connects distributed devices through a highly specialized communications protocol (VITA 17.1-2003) optimized for maximum data throughput. The Stratix II GX FPGA is used to obtain full throughput rate on all four sFPDP channels while providing a full rate PCI Express host bus interface. The embedded transceivers in the FPGA support data rates in excess of 6 Gbits/s, enabling future performance enhancement.

The cards, available in both PCI and XMC mezzanine formats, are designed for use in applications that require high data rates such as digital signal processing, radar and sonar, medical imaging, range and telemetry systems. The sFPDP card off-loads the host processor, enabling data transfers to occur without the CPU overhead and non-deterministic latencies associated with many layers of complex software protocols. Availability of the FibreXtreme SL100/SL240 card is off-the-shelf in the first quarter this year.

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4Mb	512K x 8	3.3 OR 5.0	44
4Mb	1M x 4	3.3 OR 5.0	54
8Mb	512K x 16	3.3	54
8Mb	1M x 8	3.3	54
16Mb	512K x 32 (PLASTIC)	3.3	54
16Mb	1M x 16	3.3	54
16Mb	2M x 8	3.3	54

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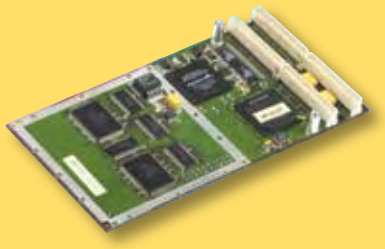
FPDP II Rides on Rugged PMC

Demand is on the rise for multichannel, high-rate sensor data transfer across a single backplane. Providing a solution, GE Fanuc Embedded Computing offers the ICS-8500, the first PMC to become available that delivers 400 Mbyte/s FPDP II—compared with 160 Mbytes/s for FPDP—in a rugged environment. The ICS-8500, which can be configured as either a transmitter or a receiver, also features 8 Mbytes of swing buffer memory, setting it apart from products that provide only limited FIFO capability.



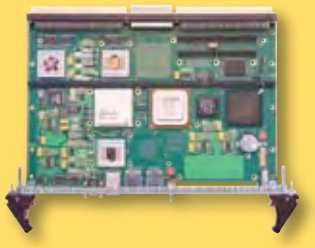
Available in convection- and conduction-cooled versions, the ICS-8500 offers similar functionality to the popular ICS-500-R and ICS-500-T PMC products, but is configurable under software control as either a receiver or transmitter. The 400 Mbyte/s FPDP II interface is provided via the P4 connector: when the ICS-8500 is communicating with a non-FPDP II device, it automatically reverts to ANSI/VITA 17 FPDP operation at 160 Mbytes/s.

In transmit mode, the board provides an FPDP/TM interface. In addition to a continuous data transmit capability, a Loop mode of operation is available in which a fixed length of data equal to the programmed buffer length is written to both banks of the swing buffer. When triggered, this data is repetitively generated and transmitted by the FPDP output interface. In receive mode, the board provides both Receive (FPDP/R) and Receive Master (FPDP/RM) capabilities. A key feature of the product is its ability to perform the corner turning function: this software-enabled feature reorders multichannel data from "channel ordering by time" to "time ordering by channel."

GE Fanuc Embedded Systems
Charlottesville, VA.
(800) 368-2738.
[www.gefanucembedded.com].

VME Blade Marries RapidIO and Serial FPDP

Intensive signal and data processing systems such as radar and imaging equipment place high demands on high-performance, low-latency throughput. Feeding such needs, Kontron offers its PowerNode5, the first dual 64-bit PowerPC970 VME blade server with backplane Serial RapidIO and Serial FPDP connectivity. The board is a rugged 6U VME PowerPC blade server featuring two 64-bit PPC970s running at 1.6 GHz. Its design is a clone of the IBM JS20 blade computer, providing the PowerNode5 with a very high level of performance and full binary compatibility with IBM JS20 blade servers, in a 6U form factor fully adapted to any of today's embedded systems requirements.



Thales' Serial RapidIO switch fabric is an original implementation with a distributed Serial RapidIO architecture: each PowerNode5 is equipped with a 4-port switch allowing a flexible, full-mesh interconnect of up to four PowerNode5s and scalable up to a 16-PowerNode5 machine. The PowerNode5 features triple x4 Serial RapidIO links available on an enhanced performance P0 connector, compliant with legacy VME64x backplanes. The PowerNode5 is also available with a twin Serial RapidIO link plus a single Serial FPDP link option. The current version of the PowerNode5 blade computing node is currently shipping with an entry-level unit price of $9,670.

Kontron America
Poway, CA.
(858) 677-0877.
[www.us.kontron.com].

Two Serial FPDP Channels Provided on XMC

Mercury Computer Systems' Sensor I/O XMC daughtercard provides a direct interface into the RapidIO switch fabric for sensor input, enabling low-latency processing of data streaming directly from sensors. The daughtercard implements the Serial Front Panel Data Port (Serial FPDP) protocol over fiber on two 2.5 Gbaud full-duplex channels.

Full system performance is enhanced because each channel can be programmed for data distribution without processor intervention. The interface can sense signals in the data stream that indicate sensor mode changes, and route data appropriately to different processors or endpoints on the RapidIO switch fabric. The board supports connections up to 150m and a real-time latency as low as 4 microseconds. All four FPDP data modes are supported, and it provides four DMA engines with chaining and branching. Support for Serial FPDP is as specified by VITA 17.1-2003 and is compatible with all products supporting any subset of the VITA 17.1-2003 protocol.

The Sensor I/O XMC is software-compatible with RACE++ Series RINOJ-F products, easing migration from the legacy I/O daughtercards while offering significant improvements in speed as well as configuration flexibility. The card draws approximately 6.5W of power (typical) and operates over temps of 0° to 40°C and at altitudes of 10,000 ft. A rugged version of the product is also available.

Mercury Computer Systems
Chelmsford, MA.
(978) 256-0052.
[www.mc.com].

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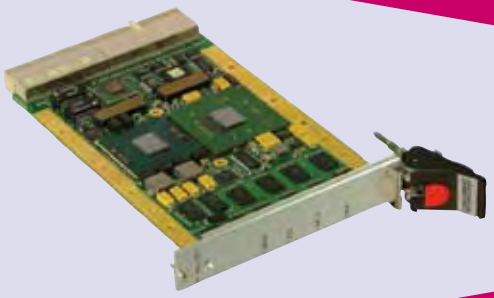

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Serial FPDP PMC/XMC Boasts 25.6 Gbit/s Throughput

Raw, full-out bandwidth is what FPDP is all about. With that in mind, TEK Microsystems' JazzFiber-V5 Serial Front Panel Data Port (FPDP) I/O module features high-performance streaming sensor I/O interfaces. The JazzFiber-V5 module provides single and multichannel ANSI/VITA 17.1-2003 Serial FPDP interfaces with the hardware, firmware and software features to support the emerging VITA 17.2 standard for Serial FPDP extensions.

The JazzFiber-V5 module is the first Serial FPDP I/O module to support four fiber optic interfaces at up to 6.4 Gbits/s for aggregate throughput of 25.6 Gbits/s. It uses the latest Virtex 5 FPGA technology, including FXT devices. The card does classic Serial FPDP plus draft VITA 17.2 extensions, including channel bonding, higher bit rates and protocol enhancements. The card sports 512 Mbytes of DDR3 memory with 6.4 Gbytes/s of onboard throughput. The module will support memory capacities of up to 2 Gbytes when higher density memory devices are available in 2009.

The PMC interface is a PCI-X 64-bit 133 MHz local bus. The XMC interface is PCI Express 1.0a x8 for 2 Gbyte/s full duplex throughput. Commercial, rugged air-cooled and rugged conduction-cooled options are available. The integrated firmware and software transparently support single Serial FPDP streams as well as logical streams using x2 and x4 channel bonding defined in VITA 17.2.

TEK Microsystems
Chelmsford, MA.
(978) 244-9200.
[www.tekmicro.com].

Quad Serial FPDP Provided on XMC/PMC

FPDP offers many advantages as a point-to-point data link, and Serial FPDP does the same only faster. VMETRO expanded its range of high-performance PMC/XMC modules with the SFM Quad Serial FPDP module. The SFM supports up to four simultaneous serial FPDP (VITA 17.1-2003) channels. Until now, Serial FPDP cards have typically had just one channel. This new four-channel interface card provides a higher level of functional density without creating a bottleneck getting the data to and from the baseboard. The functional density and high performance is especially important for high-performance data recorders, high-channel density sensor arrays and high-end DSP systems. The simplicity and wide support for Serial FPDP make it ideal for a wide range of real-time embedded computer solutions.

In order to achieve optimal performance, VMETRO implemented the SFM with separate DMA controllers for each channel. The SFM PMC module supports PCI-X data transfers at speeds up to 133 MHz. The SFM XMC module supports PCI Express via the XMC connectors and provides the full 2.5 Gbit/s data rate per channel. Using PCI-X and PCI Express this way enables more than one Serial FPDP transfer to happen simultaneously.

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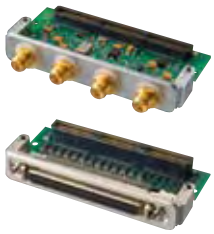

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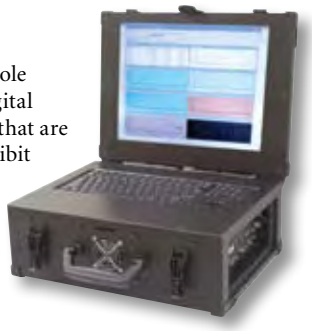

When you can integrate any technology down to a significantly smaller size and weight, sometimes that opens up a whole range of new mission capabilities. Along just those lines, GE Fanuc Intelligent Platforms has announced the DDR-300 digital data recorder (shown) and the DSC-300 signal conditioner. Both are specifically designed for use in harsh environments that are subject to extremes of heat, vibration and shock—the DDR-300 meets the MIL-STD-810F standard, conditions that prohibit the use of conventional rackmount units. The DDR-300 and DSC-300 are rugged, compact and lightweight, allowing them to be field-deployed in space-constrained and weight-constrained environments such as aircraft and tanks, and in dangerous testing environments that require the units to be nearby.

A complete, self-contained, ready-to-run field-deployable unit, the rugged DDR-300 32-channel or 64-channel digital data recorder includes an integral 15-inch XGA TFT display, USB keyboard and mouse, integrated stereo speakers and support for up to 2.5 Terabytes of high-speed (up to 100 Mbytes/second) 7200 rpm SATA disk storage, which may optionally be implemented in a RAID configuration. The rugged DSC-300 8-channel signal conditioning module weighs less than 5 lbs, and is capable of handling either analog or digital signals and either differential or single-ended inputs.

GE Fanuc Intelligent Platforms, Charlottesville, VA. (800) 368-2738. [www.gefanuc.com].

Matrix Routing Switcher Supports HD-SDI

The high-definition serial digital interface (HD-SDI) standard is gaining importance in the defense market as the DoD increases its reliance on sophisticated video and graphics information. Sensoray's Model 2444, HD SDI matrix routing switcher features remote capability and simple front panel operation. Sensoray announced the newest addition to their line of products, the 2444. The 2444 allows for remote capability and simple front panel operation. It features a built-in, customizable Web page that allows for remote operation while remaining operating system independent.

Model 2444 is capable of switching SMPTE 292M & SMPTE 259M from any of the four inputs to any of its four outputs. An automatic reclocking and equalization of the incoming signal is applied to HD SDI signals from as far away as 150m, and SD SDI signals from as far as 250m away. The unit is enclosed in a simple desktop case; custom packaging dependent upon the end user's needs can be arranged for OEM quantity orders. The 2444 is available with pricing starting at $226. OEM pricing and customization available.

Sensoray, Tigard, OR. (503) 684-8005. [www.sensoray.com].

Re-circulating ATR Enclosures Beat the Heat

The problem of cooling today's fast and hot running processors is only getting more difficult. Easing that burden, Carlo Gavazzi Computing Solutions has introduced its 715 Series of re-circulating air-cooled rugged ATR enclosures. Engineered for maximum protection of COTS cards deployed in caustic environments, the 715 Series is designed to withstand extremes in temperature, vibration, humidity and contaminants.

The 715 Series' re-circulating air-cooling system provides a contaminant-free environment for COTS convection-cooled cards. While functioning as a typical conduction-cooled system on the outside, the cooling system for the 715 Series uses a re-circulating fan on the inside to transfer circuit card heat energy to the conducting walls. The conducting walls are engineered thermal cores providing maximum heat transfer to the exterior surfaces of the system. For high dust environments, the 715 Series provides an advantage over conventional-cooling methods since it does not draw outside air in to cool the system. Featuring a rugged, brazed aluminum frame construction, the 715 Series is available with scalable power options and can be configured to custom form factor requirements for a variety of airborne and vetronics applications.

Carlo Gavazzi Computing Solutions, Brockton, MA. (800) 926-8722. [www.gavazzi-computing.com].

1U MicroTCA Chassis Offers Fail-Safe Capability

MicroTCA is rapidly infiltrating the mindshare of military system designers. The new VadaTech VT850 is a 1U MicroTCA chassis with twelve mid-height or six double width, mid-height slots for AMCs, accepting any AMC.1 (ports 4-7), AMC.2 (ports 0-1) and AMC.3 (ports 2-3 are routed to adjacent slots). The front panel of the VT850 has two I/O FRUs and eight AMC slots. The I/O interfaces with the chassis to provide out of band 10/100 Ethernet that interfaces to the shelf manager/MCMC directly, serial interface (R-232) to the shelf manager/MCMC, GbE link to the onboard GbE switch, serial interface to the power module, and GPS to the Telco clock.

With two hot-swappable 650/850W redundant power supplies that can function individually should one be removed and replaced, the design features two dual intelligent cooling units with cooling from right to left and a removable air filter on the front of the chassis to maintain fail-safe reliability. The 12 temperature sensors monitor the intake and output of air temperature throughout operation. Coated with Humiseal 1A33 Polyurethane and Humiseal 1B31 Acrylic, this design is capable of operating with up to 30Gs per axis. Vibrations can range from 0.5Gs RMS at 20-2000 Hz without failure. The VT850 can operate between 0° and 50°C, with storage temperatures ranging from -40° to +90°C.

VadaTech, Henderson, NV. (702) 896-3337. [www.vadatech.com].

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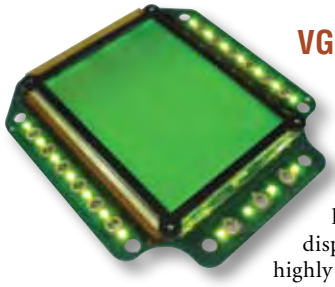

VGA Monochrome LCD Suited for Extreme Environments

The military's typical needs in the display area are a combination of harsh environmental capability mixed with high quality. Feeding such needs, DCI has designed and manufactured a LCD display called the mil.vga specifically for this highly critical market segment. The display is robust in design and designed for high brightness in extreme sunlight conditions and incorporates a low light Night Vision Imaging System (NVIS) utilizing a compliant LED backlighting system.

The display supports formats up to ¼ VGA or 320 X 240 in either portrait or landscape mode. The monochrome LCDs use FSTN LCD technology in the transflective mode for sunlight and NVIS viewing. Viewing angles of +\- 30° are supported in both horizontal and vertical directions, -20° to +40° in other directions. Contrast ratios are over 2:1 over the entire viewing angle and operation temperature. The storage temperature of the unit is -51° to 71°C, with operation temperatures of -40° to 70°C. The LCD is backlit with peak wavelength of 565NM (NVIS Green) Backlights that when dimmed are viewable under NVIS (Generation III) without degrading NVIS operation.

DCI, Olathe, KS. (913) 982-5672. [www.dciincorporated.com].

Isolated USB Data Acq Board Has 16-Bit Resolution

The adoption of PC technologies like USB has transformed the way military programs now craft their test and instrumentations systems. What used to require racks of boards can now be done with a collection of USB modules. Exemplifying that trend, Data Translation offers a USB data acquisition board aimed at embedded applications. Importantly, users do not need an external power supply since the module runs completely on USB power while at the same time offering ±500V galvanic isolation, a critical feature for industrial embedded systems. The DT9818 from Data Translation offers all the features of a high-performance data acquisition module without any limitations.

The DT9818 board provides 8 or 16 analog inputs, 2 analog outputs, 16 digital I/O lines, 2 counter timers and allows simultaneous operation of all subsystems at throughput rates up to 150 kHz. This board-only OEM version allows the user to embed data acquisition capability directly into their USB system. Many software choices are available for application development from ready-to-measure programs like Measurement Applets and quickDAQ, to full graphical programming with Measure Foundry rapid application development builder.

Data Translation, Marlboro, MA.
(508) 481-3700. [www.datx.com].

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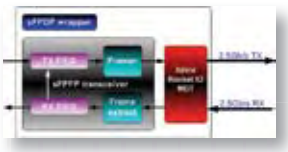

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Compact LAN Platforms Feature Integrated Processors

The military's push toward Net-Centric operations is fueling demand for networked processing platforms. Along those lines, WIN Enterprises has rolled out platforms that feature the Intel EP80579 Integrated Processor with Intel QuickAssist Technology. The EP80579 is the Intel system-on-chip (SoC) purpose-built for the embedded and communications market with highly integrated security features.

The PL-10540 and PL-10550 support 4GbE and 5GbE LAN capability, respectively. OEMs are offered a scalable selection of 600 MHz, 1.066 GHz or 1.2 GHz versions of the Intel EP80579 Integrated Processor. Support for Intel QuickAssist high-bandwidth and low-latency accelerator technology is available on select Intel EP80579 SoC processors. Integration of the CPU, North Bridge, Southbridge and security coprocessor on a single die optimizes packet processing and enables the reduced-footprint design of the new WIN Enterprises networking platforms. Linux, Windows Embedded XP and FreeBSD are supported. Pricing in OEM quantities begins at $425 per unit for the PL-10540 and $455 for the PL-10550.

WIN Enterprises, North Andover, MA.
(978) 688-2000. [www.win-ent.com].

High-Speed Data Board Boasts Deep Memory

A blend of speed, reconfigurable processing and very deep onboard memory, enables new data acquisition capabilities in SIGINT, surveillance, missile testing, RADAR and other defense applications. Along just those lines, Ultraview has announced an ultra-fast PCIe data acquisition board series allowing uninterrupted acquisition of two concurrent 3 Gsample/s 8-bit A/D channels. When installed in any x16 PCIe slot, the AD8-3000 can acquire data at an aggregate rate up to 6 Gbytes/s, optionally process it in the onboard Virtex-5TM FPGA, buffer it in the 8 Gbyte onboard DDR-II RAM, and continuously stream the data via 1.4 Gbyte/s PCIe x8 DMA transfers to host system RAM, for immediate use, graphical display, or storage to disk.

A selective recording feature allows acquisition to be dynamically stopped and started in response to a TTL input, increasing effective memory depth by storing only the needed data, for RADAR, burst communication, pulsed-spectroscopy and other applications. Multiple, concurrently triggered, AD8-3000 boards may be ganged to acquire multiple channels in lock step. The AD8-3000 supports external clocks of 500 MHz-1500 MHz (sampling rates of 1 to 3 Gsamples/s), and also has a 2 Gsample/s internal clock (other frequencies available). Pricing in quantity of 2-9 boards ranges from $9,895 to $12,195 depending on configuration and options.

Ultraview, Orinda, CA. (925) 253-2960. [www.ultraviewcorp.com].

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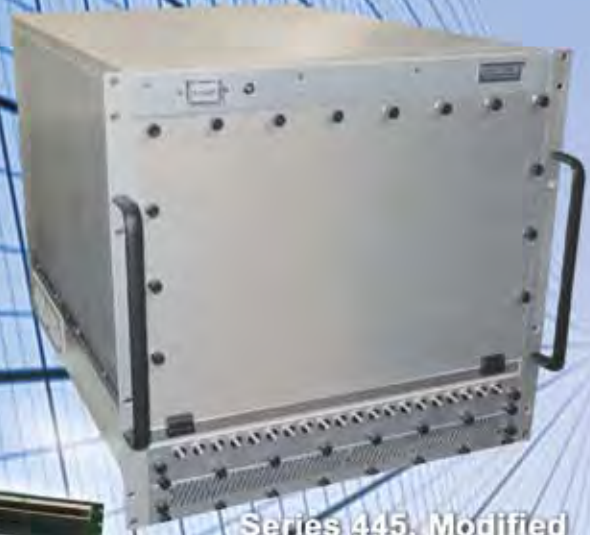

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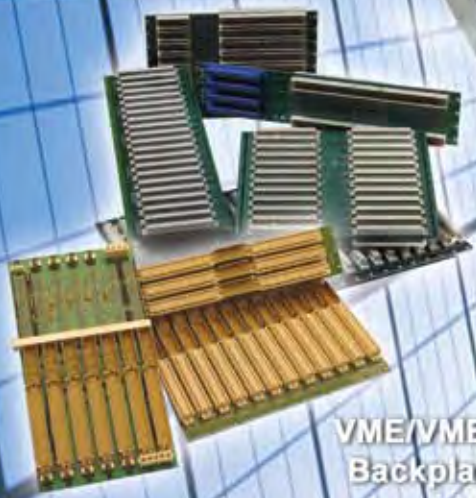

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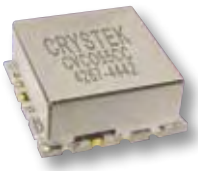
6U VPX SBC Serves up 45nm Core2 Duo CPU

The multicore processor trend fits neatly into the desires of today's military system designers who want to pack as much compute density into a slot as possible. A new rugged 6U VPX SBC from Curtiss-Wright is based on the Intel Core2 Duo processor T9400. The Intel Core2 Duo processor T9400 is validated with the Mobile Intel GM45 Express chipset, providing graphics core performance up to 533 MHz and up to 8 Gbytes of 800 MHz DDR3 system memory. This platform is suitable for a broad range of embedded applications such as interactive clients, embedded platforms and industrial automation equipment.

The VPX6-1952 is available with 4 Gbytes or 8 Gbytes of high-bandwidth SDRAM and comes with a complement of high-speed I/O, including dual Gigabit Ethernet, three serial ports, ten USB 2.0 ports, and an XMC site with 20 differential and two single-ended signal pairs mapped to the backplane. The board's integral high-speed SERDES Gigabit Ethernet and XMC mezzanine module connectivity enable high-bandwidth data flows. Data can also flow from the VPX backplane to the XMC site to support demanding high-bandwidth applications. Pricing for the VPX6-1952 starts at $13,500.

Curtiss-Wright Controls Embedded Computing, Leesburg, VA. (613) 254-5112. [www.cwcembedded.com].

4442 MHz VCO Targets Digital Radio, SatCom



Applications ranging from military digital radios to satellite communications continue to hunger for advances in oscillator technology. The model CVCO55CC-4267-4442 from Crystek is a Voltage Controlled Oscillator (VCO) that operates from 4267 MHz to 4442 MHz with a control voltage range of 0.1V~16V. This VCO features a typical phase noise of -104 dBc/Hz at 10 KHz offset and has excellent linearity.

Output power is typically +5.0 dBm. The device is packaged in the industry-standard 0.5-in. x 0.5-in. SMD package. Input voltage is 8V, with a max current consumption of 40 mA. Pulling and Pushing are minimized to 3.00 MHz and 0.50 MHz/V, respectively. Second harmonic suppression is -20 dBc typical. The CVCO55CC-4267-4442 is targeted for use in applications such as digital radio equipment. Pricing will start at $18.46 each in volume.

Crystek, Ft. Meyers, FL.
(239) 561-3311. [www.crystek.com].

Atom-Based Module Boasts Credit-Card Size

The new Qseven form factor was specially developed with an eye on the latest low-power processor technology and demand for small physical size—a requirement that ranks high in many defense applications. With a typical power consumption of under 5W, mechanical dimensions that are scarcely bigger than a credit card, integrated battery management and ACPI 3.0 power management functions, the conga-QA is the first module to use that Qseven form factor. The conga-QA is fitted with the latest Intel Atom Z5xx range of processors and the Intel US15W system controller hub.

The new module provides fast, serial differential interfaces such as PCI Express and SATA, although it consistently avoids old "legacy" interfaces such as EIDE and PCI to ensure that future generations of CPUs and chipsets can also be used without problems. It provides 8x USB 2.0, 1x SATA, 1x SDIO, 1x PCIe, LPC bus, I²C bus as well as Gbit Ethernet and high-definition audio. The new module further offers up to 4 Gbytes onboard flash storage as an option for robust mass storage. The flexible SDIO interface means that SD cards can also be used as easy and robust mass storage. The conga-QA will be available from April 2009.

Congatec, Cardiff-by-the-Sea, CA.
(760) 635-2600. [www.congatec.us].

FPGA AMC Board Sports Optical Transceivers

The AMC form factor has steadily won its way into the minds of systems designers, and that's given the military reason to consider it. A new AMC module from BittWare features four small form factor pluggable-plus (SFP/SFP+) transceivers that enable support of virtually any serial communication standard. The four SFP/SFP+ SerDes channels are connected directly to the onboard Altera Stratix II GX FPGA, which handles the higher level communications protocols. The SF/GXAM enables BittWare's customers to meet their increased bandwidth needs while also maintaining a small board footprint and low power consumption.

The SF/GXAM is a full-size, single wide AdvancedMC that can be attached to AdvancedTCA carriers or other cards equipped with AMC bays, and also used in MicroTCA systems. The four-cage SFP/SFP+ connector on the front panel with each transceiver provides support for virtually any serial communication standard, including: Fibre Channel, Gbit Ethernet, SONET, CPRI and OBSAI. The four SerDes channels are connected directly to the Stratix II GX FPGA. In addition, the SF/GXAM provides BittWare's Atlantis framework implemented in the FPGA, a front panel I/O interface, a control plane interface via BittWare's FINe interface bridge, an IPMI system management interface, and a configurable 11x SerDes AMC interface supporting a variety of protocols. It also provides 10/100 Ethernet, Gbit Ethernet, two banks of DDR2 SDRAM, one bank of QDR2 SRAM and flash memory for booting the FPGA and FINe. The SF/GXAM is priced under $4,000 in OEM quantities.

BittWare, Concord, NH. (603) 226-0404. [www.bittware.com].

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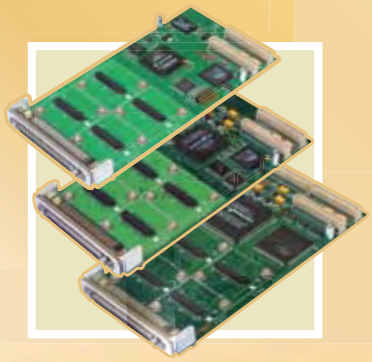
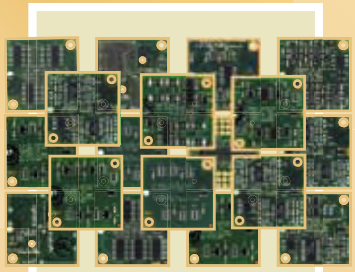
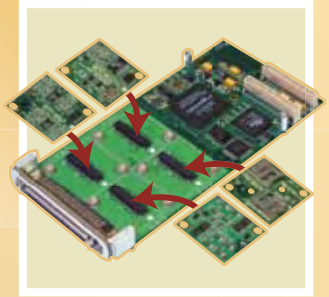


2 Choose I/O Conversion Modules



3 Assemble with IP Core and ECM Code



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www.technobox.com/mmsintro-fp.htm

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Micro Mezzanine System

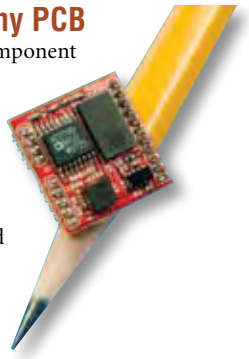
PXI Card Blends Boundary Scan and Dynamic Functional Test

System developers can now get more bang for their buck when it comes to test instrumentation gear. That's because multiple functions are now available on a single board. Goepel Electronic has launched a new series of JTAG Digital I/O PXI modules named PXI 5396-x. The PXI 5396-x modules offer 96 individually configurable single-ended channels and support the structural JTAG/ Boundary Scan test as well as dynamic I/O operation up to 100 MHz to execute functional tests.

PXI 5396-x are 1-slot 3U modules, which differ in onboard memory depth of 72 Mbytes (PXI 5396-X) and 144 Mbytes (PXI 5396-XM). All modules offer 96 single-ended channels configurable as input, output and tri-state, which allow simultaneous driving, measuring and real-time comparison. While the signals are processed to test bus operations completely synchronous in the JTAG mode, the dynamic I/O mode enables functional testing with freely programmable clock frequencies from 500 Hz to maximum 100 MHz. That's why first structural Boundary Scan tests and afterward functional tests can be executed with the same instrument.

Goepel Electronic, Jena, Germany.
+49 03641 6896-739. [www.goepel.com].

Electronic Compass Resides on Tiny PCB



Electronic compass technology is a critical component in a variety of mobile systems. A new addition to their low-cost line of tilt-compensated OEM digital compasses for embedded applications that is ultra-small and highly accurate is being introduced by OceanServer Technology. The OS4000-T Nano Compass features 3-Axis magnetic sensors with 3-Axis accelerometers and provides nominal accuracy of 0.5 degrees, 0.1 degree resolution, ±180 degree roll, ±90 degree tilt and includes electronically gimbaled tilt compensation. Offered in a 0.6-inch square through-hole package, weighing only 1 gm, this ultra-small device is designed for mounting on a system board and talking via a TTL interface for a wide range of applications.

Available with a carrier board, serial and USB drivers, evaluation software and schematics to assist with applications/integration, the OS4000-T Nano Compass includes an ASCII interface, hard- and soft-iron calibration and user-configurable data formatting. Providing up to a 40 Hz data update rate, a 50 MIPS processor supporting IEEE floating point math, a 24-bit A/D converter and a programmable com rate from 4,800 to 115,000 baud are included. OS4000-T Nano Compasses are priced at $249 each or $89.74 (500s); with larger quantity discounts offered. Developer's kits are $399.

OceanServer Technology, Fall River, MA.
(508) 67-0550. [www.ocean-server.com].

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Coming Next Month

COTS JOURNAL

- *Special Feature: Slot-Card Board Consolidation in Large UAVs*. "Mission autonomy" is the watchphrase in today's large UAV system designs. Next-generation UAVs are replacing the multiprocessing of big, power-hungry boards based on general-purpose processors like the PowerPC-based boards, with more integrated boards sporting FPGAs. The original Global Hawk, for example, embedded around 40 processor boards. Today's payloads replaced around 30 of those boards with just a couple of FPGA-based cards—and that trend is continuing. This section looks at how this system consolidation is impacting the radar, imaging processing and communications capabilities of next-gen large UAVs.
- *Tech Recon: Power Supply/Power Conversion Trade-Offs*. At one time they were an afterthought in the system design process. But today power supplies and power conversion electronics rank as a make or break technical choice in embedded military computer systems. With more and more computing stuffed into smaller spaces, power has direct implications on the size, cooling and mobility of a system. Articles in this section examine technology trends affecting DC/DC converters, power supply module bricks and slot-card power supplies (VME, cPCI and others).
- *System Development: SATCOM On-the-Move Architectures*. When the Army issued the directive to armor all tactical vehicles to protect our soldiers from weapons such as Rocket Propelled Grenades (RPGs) and Improvised Explosive Devices (IEDs), pressure was on to reduce the weight budget left over for the electronics aboard vehicles. For SATCOM On-the-Move systems, that means systems integrated into a much smaller volume, compared to the current-generation systems. System designers are consolidating their architectures relying heavily on server computer blades and subsystems in 1U form factors and/or CompactPCI. This section examines the efforts underway to accomplish mobile satellite comms in half the space, and considerably less weight.
- *Tech Focus: Conduction-cooled Compact PCI*. Now well into its second decade of existence, the CompactPCI embedded form factor has achieved the maturity and broad product range that military system designers so crave. The 3U flavor of cPCI is particularly attractive to space/weight-constrained applications like avionics. This Tech Focus section updates readers on cPCI trends and provides a product album of representative conduction-cooled 6U and 3U cPCI boards.


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COTS

Editorial

Jeff Child, Editor-in-Chief

UAVs Take Front Row Seat

The start of the year is a good time to take the pulse of the industry—and with a mood of uncertainty in the air, this is no ordinary January. To kick off the year, I recently called as many of the technology suppliers as I could to get a sense of how they predict their piece of the defense market panning out in the coming months and how their focus may change—or not—depending on where they think things are going. Among these are makers of embedded computers, power supplies and any defense-oriented electronics supplier of that ilk. Many expressed an uncomfortable sense of uncertainty about the future. But, despite a dim overall economic picture in the general economy, the impression I got is that things aren't too bad for anyone who does a majority of their business in the military market.

Some see a bit less growth than expected, or delayed growth, but the overall picture is certainly positive. This is consistent with the trend over the past ten years of the electronics and embedded computer component of the overall DoD budget ramping up dramatically, even when the total DoD budget sees a dip. Part of that is driven by an emphasis on defense programs that require increasing amounts of compute-density—stuff ranging from sophisticated radar upgrades to advanced UAV payloads that provide more mission autonomy.

The UAV area looks particularly promising. According to a November GOA report on UAVs, the DoD plans to spend more than $17 billion from 2008 to 2013 for UAV systems with expanded and new capabilities. In fiscal year 2009 the DoD requested around $3.5 billion for UAV system procurement and R&D, an increase of $1 billion more than the department's fiscal year 2008 request.

The roadmaps of all branches of the DoD include heavy investment in UAVs—both large and small. And board-level embedded computing is critical in most all of them. Larger UAVs use backplanes crammed with VME and CompactPCI boards—the Global Hawk and Predator, for example. Meanwhile small UAVs, although many don't use standard boards yet, are looking to form factors like PC/104, COM Express and others. Complete stand-alone rugged box-level subsystems—often designed for a special payload function—are also having an impact in the UAV market space.

If UAV development efforts within the DoD become more standardized, it's also possible that the idea of standard form factor embedded computing will gain an even greater stake in this market segment. Things are slowly moving in that direction. As with any fast growing technology area, there's an inherent danger in a lot of duplication of effort as different military branches each pursue their own UAV platforms. And a lot of that's happened. There's been a series of reports to Congress by the Government Accountability Office (GAO) over the past couple years raising the issue of standards and collaboration issues in UAV development. There have been attempts to leverage common aspects of UAV programs across the Service Branches—some successful and some less so. Last year the Army and Air Force inked an agreement to establish an acquisition partnership for the development and acquisition of the combined Sky Warrior and Predator acquisition program. The idea was to reduce total acquisition costs and facilitate increased interoperability between the platforms.

The Army and Marine Corps meanwhile have crafted a common set of UAV programs to support land operations. For example, the Marines began fielding the Shadow tactical UAV in 2007 as the replacement system for its legacy Pioneer UAV. The Shadow is the tactical UAS fielded by the Army's brigade combat teams. For their part, the Navy and Marine Corps have also combined some separate UAV acquisition programs. The Navy combined two separate programs—the Navy's Small Tactical UAS and the Marine Corps' Tier II UAS—into a single acquisition program.

Despite those successful examples of collaboration between the Service Branches, there ought to be more according to the most recent GAO report on UAVs in November. The GOA and the DoD don't entirely agree on how best to achieve that goal. The report advises the DoD to establish a single entity to do executive management of the department's UAV development efforts and programs. The DoD, in contrast, believed such management is best handled by the strategy of Joint Capability Portfolio Management and by the UAS Task Force. Joint Capability Portfolio Management is a strategy of developing and managing capabilities across the entire department—rather than by military service or individual program. The idea is to think in terms of collaboration from the ground up rather than trying to integrate many separate programs from each of the Service Branches after systems have been designed and developed. ▮▮

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