By land, by sea, by air: rugged computers are everywhere

Military and aerospace organizations around the world tap novel rugged mobile computers for mission-critical applications.

BY COURTNEY E. HOWARD

A large majority of professionals today require fast, reliable computing platforms—be they desktop, laptop, or handheld computers, servers, or similar devices—to get the job done. In the military, however, a soldier’s computer can mean the difference between mission success and failure, and even life and death. A great deal is at stake, and so military leaders make a point to buy the optimal computers for each aerospace and defense application.

“Warfighters have mission-critical requirements and they deserve rugged mobile computers that they can rely on,” says Bill Guyan, vice president of programs & strategy for DRS Tactical Systems Inc. in Melbourne, Fla. “That means ultra-rugged systems that are designed from the start to meet the most demanding operational conditions.

“On an increasingly networked battlefield, the reliability of a soldier or vehicle computer has a direct impact on combat effectiveness,” Guyan continues. “It is no help to a warfighter to have an inexpensive solution that meets a commercial off-the-shelf (COTS) specification, but fails on the battlefield. Battlefield computers and displays, like any battlefield system—a weapon, a vehicle, and a radio—need to be selected for its ability to perform in the worst-case scenarios.”

A system’s ruggedness and reliability may top the list of requirements for mission-critical computers, but they are followed closely by size, weight, power, and cost (SWaP-C).

SWaP-C has always played an important role in soldier systems, Guyan explains. “Soldiers already carry heavy loads and they have limited space for carrying large systems or many sets of replacement batteries. Soldier systems also have the potential for fielding in high numbers, so small unit cost differences can matter a great deal.”

Size and security

“Size is really important,” acknowledges Fed de Gastyne, federal business development manager at Panasonic Computer Solutions Co. in Secaucus, N.J. Mil-aero users increasingly require ultra-mobile personal computers (PCs), he says. As a result, Panasonic’s Toughbook U1 and Toughbook H1 are designed to combine ease portability and small size with the features, performance, connectivity, and operating system of a laptop.

Soldiers can “walk around an entire day with a Toughbook U1 or H1,” de Gastyne adds. The compact PCs were crafted with wearability in mind: whether held in the hand, placed in a pack, or used with a harness or sling offered by Panasonic. The U.S. Navy and Air Force need hands-free, he says, to climb on and off aircraft.

“If I’m a tech and climbing on an airframe all day long, it’s nice to have a hand free,” de Gastyne notes. “Using the Toughbook U1, you might not have to climb down on your entire shift.” The U1 uses a rugged, solid-state drive able to withstand the vibration of a helicopter. It is employed by the U.S. Navy in aircraft maintenance and airborne applications, such as acquiring and recording forward-looking infrared (FLIR) data, supplementing avionics, and other functions of military aircraft.

“The Navy doesn’t want the fastest computer,” de Gastyne observes. “Speed and storage are always going to be important, but if you have the latest and greatest computer and you drop it one foot.... They would rather have it rugged, and know that the hard drive and the display are OK and the data is secure.”

U.S. Air Force personnel use the larger Toughbook 52 rugged laptop for mission planning. In the future, de Gastyne anticipates military personnel will “take it from mission planning to mission accomplishment—taking our devices into the field and into the fight, not only the barracks.”
The U.S. Air Force also employs the Toughbook H1 mobile clinical assistant, designed to be durable and lightweight. "We found they like that form factor and can carry them on C-130s and use them for technical orders," de Gastyne explains. "Technicians can stay up on the air frame all day long and go from one technical order to the next," saving time and money.

More important than size, de Gastyne admits, is reliability. "If you were to talk to warfighters, and I have talked to a lot, they'll say 'It's heavy,' but then they'll say 'It saved my life.'" In fact, Panasonic personnel such as de Gastyne pride themselves on a low first-year failure rate of 2.4 percent across the entire line of Toughbook computers, compared to that of competitors at roughly 25 percent. "If you're out in the theater and you're maintaining a helicopter, what happens if yours is one of the 25 failures?"

**Aircraft aid**

U.S. Air Force personnel also take advantage of rugged laptops from General Dynamics Itronix in Sunrise, Fla. "As the U.S. Air Force builds new and replaces older infrastructure in and around flight lines, they are looking for technology that will enable faster response time and reduce the cost of their operations," explains Amy Tupler, product manager at General Dynamics Itronix.

"Imagine an airman on the flight line has an order to replace a part in a C-5," Tupler says. "Rather than get into a vehicle and go to the hangar or maintenance depot, locate the right maintenance manual and instructions, and return to the aircraft, the airman fires up the notebook either inside or outside of the airframe or in a secure area, searches for the right digitized maintenance manuals, identifies the needed repair instructions, and finishes the job in far less time. He could even order a new part. The embedded radio technology in the GD8000 saves time and reduces the cost of a maintenance job, in this example."

The General Dynamics Itronix GD8000 is a fully rugged notebook computer designed for the rugged user and tested to military extremes. General Dynamics Itronix product managers, such as Tupler, focus design efforts on communications, in addition to SWaP and rugged characteristics. In mil-aero environments, "we're talking about having a GD8000 on a belt or on a ladder, and crawling through a plane or falling from a cart," Tupler says. "Users want to be able to maintain the integrity of the signal and hard drives."

For this and other reasons, engineers stay current with standards and design notebook computers with shock-mounted hard drives, ensure that the flip assembly between the display and keyboard survive any shock and vibe, and make sure the radio architecture is mounted throughout a fall and the casing around antennae continues to protect the componentry to maintain communication throughout a job or mission despite a traumatic event.

Mil-aero professionals "fully appreciate a rugged device—not just for rugged's sake, but a purposefully rugged device," Tupler mentions. "About 10 years ago, Itronix saw a need for an intelligent radio that uses software and related technologies to enable emerging wireless communications." Embedded radio technology in the GD8000 enables users to connect to essential communications and information networks, even in the most remote locations—such as on an Air Force base or somewhere else where users are far apart. "The radio technology we use is considered high-power, up to 300 milliwatts. Itronix has also opted to embed what we call an intelligent radio into the PC. By intelligent I mean that we have integrated radio technology into the PC that enables more than two-way communications. It allows for high-bandwidth, extreme conditions, and long-distance communications that increase productivity, while providing the latest security requirements that the military need. It's also modular, so users can swap radio devices without returning them to the factory."

**Road-worthy ruggedness**

"In the past several years," Guyan says, "SWAP-C has become equally important to the vehicle system. Increased electronic systems and increased vehicle armor have really placed space, weight, and power requirements at a premium."

Many technology companies are working to put reliable, high-performance computing power in the hands of soldiers in ground combat vehicles. Guyan explains that DRS is addressing vetronics design constraints by developing and fielding new multifunction platform rugged computers and displays, expanding the functionality of already fielded systems, and developing new embedded on-board vehicle power solutions.

"New systems like Joint Battle Command-Platform (JBC-P) and Ground Combat Vehicle (GCV) require new thinking from industry, so we are hard at work to
ensure that we have the latest solutions available to meet the emerging requirements,” Guyan states. “The warfighting customers’ vision for Unified Battle Command (UBC) and Victory Architecture certainly serve to guide our innovation efforts.”

DRS Tactical won a contract from Comtech Mobile Datacom for more than 25,000 Military Rugged Tablet (MRT) computers for the U.S. Army Movement Tracking System (MTS) program. U.S. Army personnel will use the Joint Platform Tablet MRT as its next-generation computing system for new and deployed MTS systems.

According to the $217 million contract, the DRS Tactical Systems business unit is designing and manufacturing rugged computing systems, including Joint Platform Tablet MRT computers, keyboards, docking stations, interface cables, and base plates.

“This important order provides a proven ultra-rugged computing system to our soldiers, with leading-edge dual core computing capability that can be relied upon for this mission-critical application,” says Mike Sarrica, vice president and general manager of DRS Tactical. “Additionally, it provides hardware commonality with other Joint programs, and enables planned Army transformation to Joint Battle Command–Platform.”

The Joint Platform Tablet MRT is designed with expanded capacity, enabling upgrades as increased capabilities and future requirements emerge. MRT capabilities include increased processing speed, a removable hard disk drive, an emergency alert button that can signal an urgent situation back to the command-and-control center, and a night-vision imaging system-capable, 10.4-inch display. Internal MIL-STD 1275 power filtering eliminates the need for external power adapters, whereas the modular docking station ensures fast computer dismounting.

“We are delivering approximately 2,000 systems per month right now for the U.S. Army MTS program,” Guyan says. “This rugged, dismountable tablet computer is in use by the U.S. Army, U.S. Marine Corps, and the U.S. Air Force. It features best-in-class, ultra-rugged performance, a rugged sunlight-readable touch screen, multicore processing, up to 128-gigabyte, solid-state, removable hard drives, and hot-swappable batteries.”

**MRTs and mortar**

DRS Technologies also won a $3.4 million contract from Elbit Systems of America in Fort Worth, Texas, to provide MRT systems for the U.S. Army Mortar’s FireCon program at Picatinny Arsenal, N.J.

U.S. Army soldiers will use the MRT as the centralized controller device and computer for the Mortars FireCon system, which links mortar fires capability with the digital battlefield.

Deliveries from the DRS Tactical Systems
business unit will continue through 2014.

Guyan describes strong international interest in the system, which he attributes to its compact size, proven performance, and vehicle-mounted or dismounted flexibility. “It is ideal for battle management systems, vehicle and asset tracking, remote systems command and control, close air support, and indirect effects targeting,” he says. “It can also serve as a multipurpose vehicle or command post user terminal operating multiple applications and operating systems.”

Computing in combat

“The key today is providing the highest embedded computing performance, coupled with the lowest cost and SWaP,” says Doug Patterson, vice president of worldwide sales and marketing at Aitech Rugged Group Inc. in Chatsworth, Calif. It is with these characteristics in mind that engineers developed the Aitech NightHawk RCU (Rugged Computer Unit), he says.

The NightHawk RCU is designed to deliver small size and weight combined with natural convection/radiation cooling for a variety of military, aerospace, and rugged commercial environments, including manned and unmanned, ground or airborne vehicles, as well as low SWaP remote interface unit (RIU) and data concentrator unit (DCU) applications. The self-contained PC, housed in a mil-spec enclosure with power drawn directly from the vehicle’s power bus, is based on the low-power Intel Atom processor and provides up to 2 gigabytes of DDR SDRAM (double data rate synchronous dynamic random access memory), 8 gigabytes of SSD (solid-state disk) memory, an optional 250-gigabyte SSD for application data storage, and the I/O needed for a remote networked subsystem.

A HMMWV-mounted, chemical and improvised explosive device (IED) detection system—currently under evaluation for immediate use and rapid deployment in Iraq and Afghanistan—employs an Aitech NightHawk RCU embedded computer as the RIU/DCU. This rugged application incorporates extreme temperature swings, in addition to high shock, vibration, and sand/dust contaminant levels, Patterson describes.

“Because of the super-fine particulates and sand in this area of the world, and the location of the unit in the vehicle, the NightHawk RCU utilizes conduction-cooling for all internal electronics and the stand-alone RIU/DCU is free-air (radiation and convection-cooled) without the use of fans or blowers for assisted cooling to meet the system’s requirements,” Patterson explains. “The NightHawk RCU easily meets the low heat dissipation and low power requirements, as well as the data throughput needed for the application without burdening the vehicle’s electrical generator or adding any appreciable heat to the cab’s crew compartment. Low heat and low power means higher reliability and a longer lifecycle.”

Required ruggedization

“SWaP is the main issue the military is dealing with, whether in a soldier-borne or vehicle-borne system,” notes Michael Macpherson, director of embedded systems at Curtiss-Wright Controls Embedded Computing (CWCEC) in San Diego. As more and more digital data is required on the battlefield, an ever-increasing amount of electronics is finding its way into combat vehicles. “It is important to move heat away from electronics and keep it out of the...
cabin air or off the soldier’s body. Reducing the thermal load has become paramount in the battlefield.”

Curtiss-Wright rugged computing systems have been used on a variety of mobile ground programs, both new programs and upgrades to older platforms, at the embedded computing level, including applications such as the Marine Corps’s Ground/Air Task-Oriented Radar (G/ATOR) where CWCEC’s VPX COTS modules and packaging provide performance density, and the TARDEC Unmanned Ground Vehicle, an example of the increased use of COTS in unmanned systems.

Macpherson has seen greater demand for complete systems solutions and integrating electronics in battlefield scenarios.

“We’re seeing increased demand for standards-based, COTS products at the subsystem level, not just the board level,” says Macpherson. A more deliberate technology-insertion roadmap, to mitigate obsolescence, is evident.

Macpherson sees increased demand from prime contractors pursuing unmanned opportunities for the company’s architecture, perhaps for its SWaP, rapid time to market, and flexibility. He also notes more demand for intelligent surveillance and reconnaissance, including signal intelligence and radar signal processing applications. In general, the industry is working to meet demand for more capability in a system with a smaller footprint that can be put together rapidly. “We are all working to upgrade platforms and bring new capabilities to the battlefield within the next year. Not 10 years, but one year. We have the technology to enable customers to meet demands now.”

“Given the way the military is fighting current wars, we need to bring new capabilities into that battlefield daily,” agrees Chris Wiltsey, vice president of embedded systems at Curtiss-Wright in San Diego. “It is no longer about planning five to 10 years out, and long development periods. We are best at having rugged technology available to deploy into the battlefield now. Whether for a wheeled vehicle, tracked vehicle, or aircraft—whatever ruggedization is required—we have off-the-shelf subsystems.”

According to Wiltsey, Curtiss-Wright has gained contracts as a result of prime contractors realizing the product’s performance and ruggedization, going right into the vehicle with it, and deploying within weeks of a first test. “Our focus is rugged deployed military—everything else takes a second seat as we create system products,” he says.

**Radar requirements**

A large prime contractor working on a defense contract to deliver mobile, ground-based radar systems required rugged and robust computers for a major radar program upgrade. Engineers selected a rugged 6U Open VPX solution from Mercury Computer Systems in Chelmsford, Mass.

“The customer was making a ground-based radar system for a combination tracker/interceptor/launcher mobile application with high compute-intensive and rugged requirements,” describes Anne Mascarin, product marketing manager at Mercury Computer Systems.

The rugged computer system needed to withstand a lot of ground movement in arid, dry environments, Mascarin continues. It also had to be capable of rapid, intense computations on the move, to locate and track hundreds of targets each minute. “What suited their needs best was OpenVPX technology,” she says. “Mercury is one of the chief contributors to the OpenVPX rugged interoperability standard.”

Mercury Computer Systems officials initiated the formation of the OpenVPX Industry Working Group, the primary goal of which is to develop a comprehensive OpenVPX System Design Guide covering VPX systems for 3U and 6U form factors. A portion of the Design Guide defines VPX Profiles, sets of specifications, and practices, which, when followed, shall result in truly interoperable system components, describes a representative.

The prime contractor required fast delivery of the rugged computing system, due to QRC (quick reaction capability) requirements of the contract. Mercury Computer Systems accelerated the schedule, approximately from 24 months to 12 months. “The OpenVPX rugged interoperable standard, and our Services and System Integration team, which works with the customer to accelerate system development for QRC programs, were both big parts of our [contract award] win,” Mascarin concludes.

**Seafaring servers**

Electronics upgrades are not limited to ground-based combat vehicles and aircraft alone. Ocean-faring vessels are also the subject of modernization efforts. The U.S. Navy undertook a mission to upgrade its afloat and airborne command-and-control systems, to achieve greater flexibility, better performance, and a reduced cost of ownership, explains William Kehret, president and chief executive officer at Themis Computer in Fremont, Calif.

The original program, called Common Enterprise Display Consoles, is now abbreviated CDS. “The General Dynamics-AIS team won this competition, using a Themis designed and supplied common electronics module,” Kehret says. The Module is a 3RU variant of the company’s CoolShell technology, with all front-accessible, front-cabled field replaceable units.

“The CoolShell COTS motherboard—
based, bladed systems have the advantage of bladed system cable management, scalability, RAS, and cost of ownership,” Kehret explains. Themis is also delivering new payload systems designed for unmanned aerial vehicle applications, and bringing lower cost of ownership, improved scalability, and shorter down time during spiral refresh to high-end UAV platforms, he continues.

Themis Computer’s “Rugged Enterprise Servers (RES motherboard-based servers) are widely used for the Canadian Navy’s Halifax Cruiser program,” Kehret adds.

“The Navy, for its afloat computing platforms, is migrating away from distributed bus-and-board architectures, to the use of more aggregated server-based services,” Kehret explains. “A full range of compute servers—from stacks of one-rack-unit boxes, to blade servers with 8 to 12 multi-socket processor blades—are being deployed on everything from submarines to big-deck ships. These are truly enterprise-level solutions, at sea.

“At the next level,” Kehret adds, “battle groups have more in common with today’s distributed enterprises, than with earlier stove-piped, application-specific computing systems. Themis is bringing a new level of integration to these enterprise computing environments, with our bladed CoolShell servers.” The company also offers Rugged Enterprise Servers for these defense platforms, and is addressing the modernization of bus-and-board applications ranging from ground vehicles to airborne applications.

Crystal Group’s devices have also been selected for common afloat network applications for shipboard networking. “These applications have required the latest 5500 series Intel Micro architecture, as well as a solution to the shock and vibration problems characterized by Navy environments,” Ghylin says. “This environment tends to be tougher than you might expect; there is constant vibration, swings in temperature, and shock from normal fleet operations.

“Space and power are, of course, huge issues,” Ghylin adds, “which is why we see virtualization making such a big play in the Navy. We are on the leading-edge of the virtualization wave, which is being driven in the Navy for cost and size reduction, but will soon be carried into the Army, Air Force, Marine Corps, and Coast Guard for size and weight reduction as the benefits become more and more apparent.

“We are working on mobile applications where rugged servers are replacing rugged laptops,” Ghylin mentions. “Laptops are great when you need to pick up a computer and go, but if the computers are fixed-mounted, a rugged rackmount server is much more appropriate. In a similar amount of rack space as a rugged laptop, a user can install a 1U RS112 server and have access to 8-16 CPU cores at 2.53 GHz, 48 gigabytes of RAM (random access memory), 4 terabytes of storage, and a PCI-Express expansion slot or a high-end graphics card for manipulating digital maps. This is 5 to 10 times the capability that a rugged laptop can provide, but it comes in at a similar price point and similar size profile when rack-mounted.

A further benefit of using a rugged server, Ghylin continues, is that it can be virtualized to replace up to 16 clients. “This means that one server can replace up to 16 laptops through the use of virtualization software. This approach not only saves cost, but more importantly for mobile applications, saves substantial size, weight, and complexity.”

Rugged COTS

“Size, weight, and power consumption are key drivers for the mil-aero market,” describes Nancy Pantone, director of product management, systems, and modules at Kontron in Poway, Calif. “We will continue
to see smaller, lighter and less power hungry products being developed to meet the needs of warfighters in the field.”

Kontron works with customers to make sure that Kontron COTS systems are highly reliable, easy and quick to repair in the field, if needed, and that usage is intuitive, Pantone continues. “Military personnel don’t have the time to read thick user manuals and troubleshoot system problems day after day. They depend on their equipment and need high MTBF (mean time between failures), hot-swappable components, and logical designs.”

Many defense programs, in the U.S. and abroad, have adopted Kontron rugged computing systems and components. One of the most current applications is the P-8 Poseidon, a maritime patrol aircraft for the U.S. Navy; another aircraft program includes the Australian Airborne Early Warning & Control or “Wedgetail” program. Pantone says, “Common among these and other military and aerospace programs is the use of a wide variety of form factors from Kontron.”

Engineers at Azimuth Inc., a government contractor in Morgantown, W.Va., turned to Kontron when building an ultra-rugged, distributed embedded system for the Department of Defense’s Stiletto program. The onboard computer aids the Stiletto crew in its fight against drug traffickers, enabling personnel to manage all integrated systems, including situational-awareness sensors and navigation, communications and networking, craft control, and integrated video capabilities.

The embedded computing system needed to withstand the rigors of high-speed pursuits in rough seas, perform reliably within the carbon-fiber material used in Stiletto’s hull, and offer flexibility and scalability. Azimuth engineers selected the Kontron CP602, a COTS, 6U, CompactPCI-based CPU board with an Intel Core Duo processor for the Stiletto boat implementation.

“As many government programs will see budget cuts due to the current economic climate, it is crucial for contractors to provide technology that can satisfy many missions and multiple roles,” says a Kontron representative. “From naval exercises to the possibility of networking between a Special Forces team and an unmanned aerial vehicle (UAV) the Stiletto can use its powerful computing capabilities to provide critical reconnaissance information or real-time images.”

Kontron officials see a growing need for mil-aero computing platforms that span sizes from rack-mounted to wearable, with performance and power consumption tuned to meet the application. “We are seeing needs for smaller rack-mounted industrial PCs and have responded by offering ‘short’ rack-mount configurable COTS systems suitable for compressed space requirements,” Pantone says. “We also see increasing demand for COTS Atom-based Box PCs, like our new Microsopc MPCX28, an in-vehicle PC which can support increased video and communications needs, intralogistics, video surveillance, vehicle tracking, GPS, and control of automated vehicles at environmental temperatures from -25 to 70 degrees Celsius.”

Unleashing the unmanned
SWaP is a concern in virtually all mil-aero platforms, but none more so than unmanned vehicles. Engineers at Getac, a manufacturer of mobile, rugged computers that meet the demands of field-based applications in Lake Forest, Calif., understand well the rugged computing needs of warfighters in the field UAVs.

“Weight and mobility are huge concerns,” John Lamb, director of marketing at Getac, explains. The environmental conditions for warfighters roughly nine months out of the year require lightweight, rugged systems with a long battery life and sunlight-readable screens, he says. “Where they are today are perhaps the brightest spots on the planet.”

U.S. Air Force (USAF) officials selected Getac rugged notebook computers as part of the organization’s Quarterly Enterprise Buy (QEB) program. NCS Technologies, maker of mission-specific computers in Manassas, Va., manufactures and delivers Getac’s B300 rugged notebook and V100 rugged convertible computers to the USAF. Quality, performance, endurance, and overall cost savings factored into the decision to select Getac products for the program. The Getac B300 and V100 rugged computers will be included in the QEB program through the first half of 2010.

Rugged computers from Getac are employed in the control of unmanned drones and other unmanned vehicles on the battlefield. “It is an increasingly popular use for our systems,” Lamb says. “In a lot of cases, we are customizing our laptops with satellite antennae on the sides.”
In fact, Getac provides several options for customizing a rugged computer for a specific mil-aero environment and application. The company can outfit its rugged devices with: an expandable battery for up to 24 hours of battery life, external communication equipment, military connectors, GPS, and even a Web camera for video conferencing and two-way communication in the battlefield. Moreover, Getac has infused its complete line of rugged notebook and tablet PCs with Microsoft Windows 7 compatibility. “Much progress has been made in the field of unmanned aircraft systems (UASs),” says Themis’s Kehret. “Large, high-altitude, long-endurance USAF (U.S. Air Force) tier II+ UAS, such as Global Hawk, have significant on-board compute and DSP capability.”

Themis is seizing the opportunity to add as much computing power as possible to smaller, more widely deployed medium-altitude, long-endurance (MALE) USAF tier II UAS platforms. “Whole new architectures and levels of SWaP optimization will be required to ‘unleash’ tier I UAS,” Kehret predicts.

**Future functionality**

Battles today are fought and won not as much with bullets and bombs, as with information. Soldiers’ lives and mission successes rely on the availability of mission-critical data, delivered via rugged, mobile computers. “The rugged computer is becoming an increasingly essential element of every warfighter’s daily mission,” DRS Tactical Systems’ Guyan admits. “As computers and displays migrate from platforms and command posts to soldiers, we will see increased form-factor variation to include distributed wearable systems,” Guyan adds. “The commercial market continues to drive down the cost of ever-improving technologies. We will continue to see smaller, faster, and cheaper multi-core processors.”

“The future holds a number of developments for rugged computing,” Crystal Group’s Ghylin predicts. “It is no longer acceptable for the military to use decades-old technology or a hodge-podge of COTS equipment. Our warfighters deserve and demand the best technology available.”