CASE STUDY

Small Form Factor Mission Systems
Driving Forward the Development of Next Generation UUVs

CURTISS-WRIGHT

DEFENSE SOLUTIONS

Challenge

- Implement high TRL, SWaP-optimized processor and network switch for UUV operations
- Integrate Network Attached Storage (NAS) device with government approved encryption
- Deploy MIL-STD-compliant rugged COTS solutions at no NRE cost

Solution

- Modified COTS mission processors pre-integrated with I/O expansion cards and Wind River® VxWorks Real-Time Operating System (RTOS)
- Rugged NAS appliance with COTS encryption that meets NSA guidelines
- Ultra-small form factor Gigabit Ethernet switch with IEEE-1588 support

Results

- Turnkey and cost-competitive mission systems
- ITAR-free systems delivered with short lead time and no developmental expense
- Rugged COTS systems meet UUV platform environmental requirements

Challenge

Development of Unmanned Underwater Vehicle (UUV) platforms is on the rise due to emerging mission requirements from global defense forces and the availability of Commercial Off The Shelf (COTS) technologies already proven in unmanned aerial platform deployments.

Looking to develop a common reference system architecture for a new family of Larger Diameter UUVs (LDUUV), one system developer sought out Small Form Factor (SFF) mission processors, network switches, and Network Attached Storage (NAS) Line Replacement Units (LRU) for use in the development and production phases of their program. While the larger displacement design of this new class of UUV would enable more sensors and extend mission duration over its smaller predecessors, the demands of integrating a much larger overall electronics payload meant that hardware selection would be heavily influenced by their Size, Weight and Power (SWaP) footprint.

To support the various control, monitoring, and network functions of the platform architecture, the developer specified robust technical requirements for the mission computer and switch LRUs. The processor systems required low-power multi-core Intel® CPU architectures with a large number of Ethernet, serial, and digital I/O interfaces together with a VxWorks RTOS. The managed Ethernet switches, used to network the computers with onboard sensors and storage devices, required advanced Quality of Service (QoS) traffic

DuraNET® 20-11 Ethernet Switch, DTS3 Network Attached Storage and DuraCOR® 311 Mission Computer

prioritization and IEEE-1588 Precision Timing Protocol (PTP) support to enable time stamping with nanosecond accuracy.

To mitigate the risk of on-board mission data from the unattended UUV falling into unfriendly hands, the platform developer required a NAS device that could encrypt Data-At-Rest (DAR) to meet NSA guidelines. Moreover, the NAS device would need to support netbooting of network clients to reduce SWaP and maintenance.

The UUV design team sought to accelerate program integration and reduce overall risk by leveraging solutions previously tested and qualified to the extreme demands of MIL-STD-810G, MIL-STD-461, MIL-STD-704 and/or RTCA/DO-160G standards for environmental, power, and EMI compliance.

Solution

The UUV developer selected multiple Curtiss-Wright SFF COTS-based systems in order to meet the program's technical, cost, and schedule requirements. The specified LRUs included two Parvus DuraCOR® 311 mission processors, a Parvus DuraNET® 20-11 Ethernet switch, and a DTS3 NAS device.

The rugged DuraCOR 311 mission computer is one of the smallest rugged mission processors on the market. This unit's modularity delivered an ideal solution for both the UUV's "vehicle controller" and "casualty monitoring system and power distribution assembly controller". With its low-power Intel "Bay Trail" Atom™ quad-core CPU, the LRU provided the necessary processing performance and compatibility for the VxWorks OS. Its multiple open-architecture expansion slots for Mini-PCIe (mPCIe) cards allowed additional asynchronous serial ports and specialized digital I/O outputs to be pre-integrated through Curtiss-Wright's Modified COTS (MCOTS) services with no NRE expense. In fact, Curtiss-Wright worked with third-party I/O module suppliers for the add-on modules to ensure that the VxWorks OS worked seamlessly, all at no cost to the customer.

The miniature DuraNET 20-11 8-port GbE switch more than satisfied the UUV developer's managed network switch and SWaP requirements. This "pocket sized" fully managed 10/100/1000Base-T switch provides carrier-grade network management together with IEEE-1588v2 precision timing capabilities. The mission computer and switch were pre-qualified to a very comprehensive range of MIL-STD-810, DO- 160, MIL-STD-704, and MIL-STD-461 tests.

Curtiss-Wright's Data Transport System 3 (DTS3) was selected as the platform's NAS device. This 3-slot solution enables Ethernet-based mission storage from DuraCOR 311 clients and other devices. The DTS3 is equipped with four 1 GbE ports and supports Network File System (NFS), Common Internet File System (CIFS), File Transfer Protocol (FTP), iSCSI, and HTTP. The DTS3 also supports PXE Booting, a form of netbooting, enabling X86 network clients to boot directly from the DTS3 instead of each individual LRU. Using PXE Boot, the customer can centrally manage and update multiple network clients from a single location. To meet the program's encryption requirements, the DTS3 protects data using Two-Layered Encryption™. An AES-256 bit FIPS-certified ASIC encryptor provides the first layer in the form of hardware full disk encryption, while a FIPS certified AES-256 bit algorithm provides software full disk encryption for the second layer.

Result

The selection of these highly reliable and readily available LRUs enabled the platform designer to successfully implement a highly robust, low-SWaP solution for their newly architected large displacement UUV. These COTS systems provided the CPU performance needed for vehicle control and data processing, along with the fast networking and specialized I/O interfaces needed to support the LDUUV's current ISR mission. The LRUs' modular, open architecture design also eases the integration of expanded mission payloads as more sensors are integrated in the future. All three LRUs were delivered within a short lead-time at zero NRE including the modified DuraCOR 311 systems with purpose-built VxWorks BSP software. Complying with the requisite ruggedness and environmental qualifications, these Curtiss-Wright's SFF systems provided the system integrator with ITAR-free, COTS-based solutions.

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