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Defensive Electronic System Seeks Updated Direct Attach Storage

Challenge	Solution	Result
Replace exactly the existing memory board	Designed a special board to exactly replace the existing board	No software changes in the existing system
Address future obsolescence issues	Followed design approach of COTS XMC-554C board	On time and on schedule
Allow for future additional memory	Provided 512GB capacity mSATA-based board	Expandable memory capacity

Challenge

Defensive electronics are used by the military to protect transports and other large, slower flying aircraft. With their slow flight and predictable path, these aircraft are highly susceptible to shoulder-fired, surface-to-air missiles.

A large aerospace company had an existing electronic countermeasure system which was fielded on several aircraft. However, they were faced with obsolescence issues with the solid-state memory, computers, and other equipment in the system. They urgently needed a replacement for the memory (and board) that was going end of life.

The new memory board had to use current storage technology with wide industry support and future longevity. Most importantly, the new memory board had to replace the existing memory board exactly – form, fit, and function (FFF[i]).
No changes to the software or firmware could be tolerated. Any changes to other electronics would require further testing and would increase technical and schedule risk for the upgrade program. Initial memory requirements were only for 512GB, but future expansion of the electronic countermeasure system may require more memory. So, it was highly desirable that the new memory board be designed to leverage increasing memory.

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Since these systems were used on larger, fixed-wing aircraft, it was determined that size, weight, and power (SWaP) were not nearly as important as the issue of exact replacement. The existing memory board used Serial AT Attachment (SATA) memory. So, the new replacement memory board had to use SATA as well, but with a newer approach. SATA memory is widely used in commercial, industrial, and military applications.

The system designer searched for solutions to these unique requirements and turned to Curtiss-Wright. With many years of experience developing commercial off the shelf (COTS) data storage products, the company asked Curtiss-Wright to propose a custom design memory replacement using the experience and knowledge gained during the internal research and development (IRAD) for their COTS storage products. The program had to remain on schedule with minimal technical and schedule risk.

Solution

Using its own IRAD funds, Curtiss-Wright had already designed a small mezzanine memory board that fit onto larger computing boards. See Figure 1[ii] . The XMC-554C was designed to the ANSI/VITA 42 standard[iii]. The XMC-554C memory board used mSATA memory cards. The mSATA industry-standard devices are inserted into a connector and are replaceable as new memory capacities become available. Memory sizes are doubling about every 18 months or so.

Curtiss-Wright had designed the XMC-554C mezzanine card for use in single-board computers (SBC) and digital signal processor (DSP). SBCs and DSPs with the XMC-554C are used in rugged, deployed applications.

Curtiss-Wright proposed to use the same mSATA approach on the special design memory board replacement. With knowledge and experience with mSATA in a fielded product, Curtiss-Wright followed a proven approach that reduced the technical risk for the new memory board and, at the same time, allowed for future expansion of memory capacity.

After the contract award, Curtiss-Wright held a series of design review meetings with the customer. The proposed solution was discussed, iterated, and finalized with a mutually acceptable approach. Design proceeded with no significant issues. The printed circuit board was laid out and prototypes built. After designing a test fixture, the new prototype boards were tested at Curtiss-Wright against an agreed upon set of parameters. Example software was given to Curtiss-Wright for exercising the board. Curtiss-Wright also used its own specially developed memory test software during the verification process. Environmental tests were also performed including temperature, shock, and vibration.

After successful testing at Curtiss-Wright, the new prototype memory boards were taken to the customer. The boards were installed into the customers' existing system with existing software. After successfully completing those tests, the go-ahead was given for full production and subsequent deployment.

Figure 1: Curtiss-Wright XMC-554C COTS Mezzanine Memory Board

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Result

Both at Curtiss-Wright and the developer's, the new storage board proved to be an exact FFF replacement. The developer did not have to change the existing system software. The existing system with the new memory board worked exactly like the system with the old memory board. This result reduced development time for the customer.

Without the need for new software, the developer could move very quickly through the test phase and into the re-deployment stage. The program remained on the tight schedule given.

The successful operation with the existing software also reduced the overall program risk. The existing system software had been developed, tested, refined, and re-tested over several years, making modifications and adjustments along the way. As with many complex systems, issues were discovered only after numerous deployments. So, re-using the existing software reduced the overall program risk.

The choice of mSATA drives resulted in wide industry support and options for capacity. The memory board was delivered with 512GB of total storage initially. However, the memory capacity could be increased even now to 1TB or beyond. With memory capacities doubling every 18 months or so, the new memory board allows for future growth with minimal effort.

As might be expected, the mean time between failures (MTBF) calculations with solid-state memory were very high. For anyone familiar with solid-state memory, this fact should be no surprise.

With no software changes, reduced technical risk, on-time delivery, and high MTBF, the new memory board development was a great success for Curtiss-Wright and the customer.

Figure 2: Countermeasures in action

References

> [i] Form, fit, and function may be known by the acronyms FFF, 3F, or F3.

> [ii] Rugged XMC SATA Solid State Drive | XMC-554C

> [iii] VITA - Standards

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