SOLUTIONS BRIEF

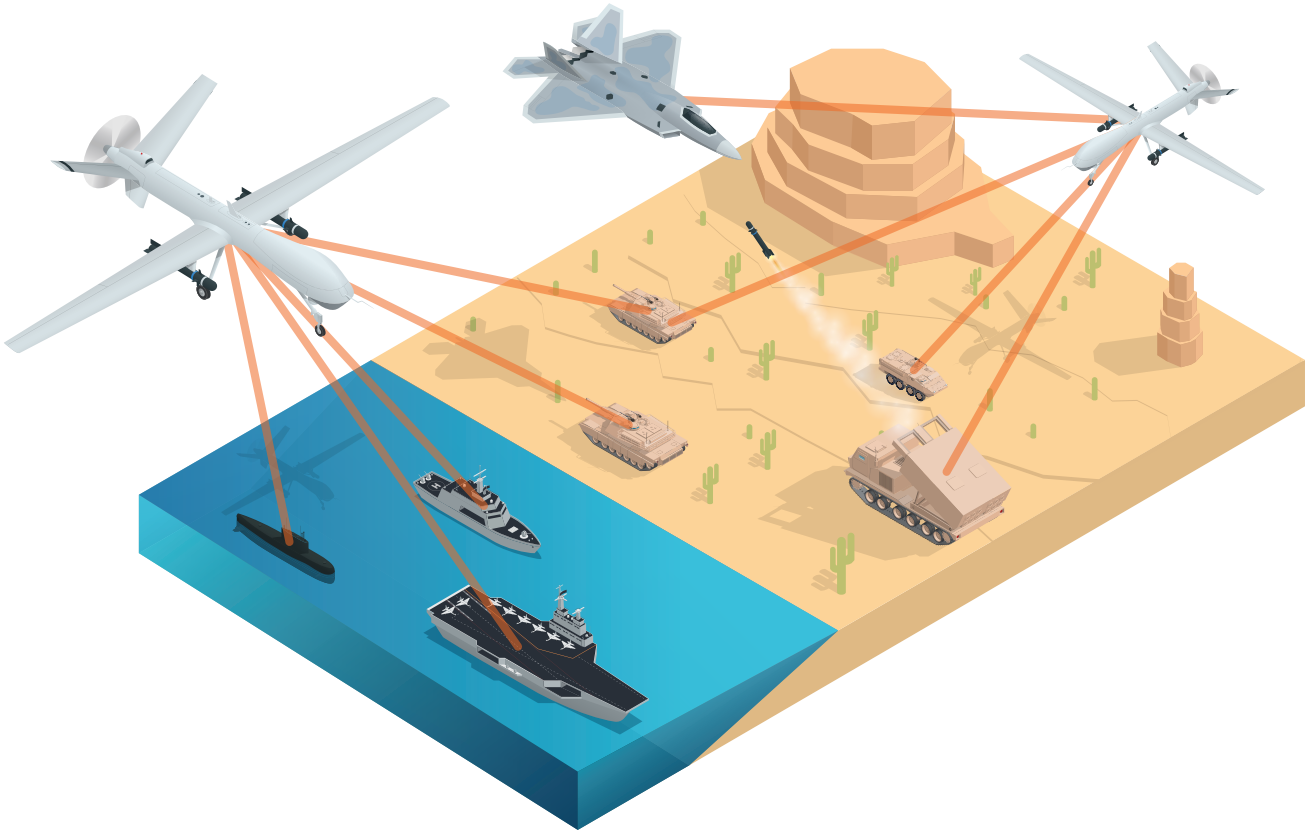
Electronic warfare sensor processing in a SWaP-constrained environment

abaco SYSTEMS

Electronic warfare sensor processing in a SWaP-constrained environment

Introduction

How a major technology company turned to Abaco to help develop its planned unmanned aircraft systems UAS platforms with sophisticated sensor subsystems – and the alternatives to its solutions that are enabled by new technologies.



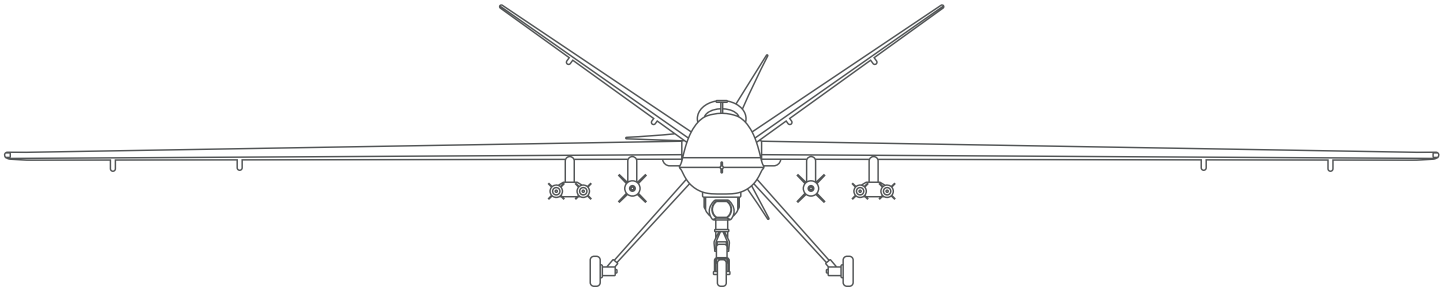
Electronic warfare relies extensively on sensors across the electromagnetic spectrum – signals such as radio, infrared or radar – to provide 360-degree situational awareness and advanced signals intelligence while denying the enemy the opportunity to do the same or to prevent the enemy from disrupting friendly use of the spectrum.

Across air, land, sea and space, thousands of sensors onboard manned and unmanned tactical platforms are collecting huge amounts of data. Early generation UAS and C4ISR systems are now being upgraded with a focus on simplifying ingestion of complex data gathered from multiple sensors, transforming data into knowledge, and turning that knowledge into actionable intelligence – enhancing situational awareness, lethality and survivability in dynamic operational environments.

Historically a means of providing situational awareness to directly-involved combat forces, sensor ingest and processing is increasingly being deployed in unmanned platforms. Few platforms exemplify the computing challenges faced by the military better than Unmanned Aircraft Systems (UAS).

A confined space into which the maximum payload can be deployed; the need to conserve power for maximum performance and mission duration; a potentially harsh environment; and the need to deploy the maximum possible processing capability. The requirement for solutions with optimal size, weight, power, cost, cooling, compliance (SWaP-C3) capabilities, built to exacting standards of ruggedization and leveraging state of the art technologies – such as RFSoC, FPGA, DSP and GPU platforms - is accelerating.

Electronic warfare sensor processing in a SWaP-constrained environment



Radar, Electronic Warfare and Signals Intelligence: A Multi-Function Problem Set

The intensified movement in radar and EW systems away from fixed analog systems towards fully digitally programmable systems has allowed for an increase in operational frequency ranges, using frequency agility and advanced modulation techniques. For radar systems, these techniques mean that they are harder to detect - but also harder to jam or spoof. As radars leverage wider bandwidths, jamming and interference technologies are also required to increase their operational frequency ranges. The net result is a processing power and bandwidth escalation race, one that is becoming increasingly fast-paced. Traditionally, radar and EW systems have used countermeasures based on a static threat library. There were a number of known threats that the system had been thoroughly tested against - and a proper set of procedures and methods for getting around them.

If an unknown threat was detected, some generic countermeasures could be employed – but, in general, information was gathered on the new threat for post-mission analysis. Further analysis was then conducted over time until an update to the static threat library could be performed and tested. The process could take months, or even years. This methodology was acceptable when the upgrade process for the threats followed a similar timetable; however, modern digital technology allows threats to quickly employ new techniques. This requires countermeasures to do the same.

Cognitive RF, EW

These new methodologies, often described as cognitive RF and cognitive EW, rely on reconfigurable hardware and software that can detect, learn about, and adapt to new threats in the field during a mission. To enable this, the learn-and-adapt process for the threat library becomes a feedback loop, enabling new countermeasures to be developed on the fly. This requires a significant processing performance leap, one that must be accomplished without a significant increase in size, weight, and power.

A key feature of any prospective cognitive processor is reconfigurability. Algorithms will continue to evolve over time and the best processor architecture for any particular task may change over time. As a result, a multi-processor architecture gives the most flexibility in overcoming evolving threats.

Merely employing a single processor architecture allows some adaptive techniques to be used - but possibly not all. For example, some of the techniques employed may require low latency implementation in FPGA devices while others, such as deep learning based classification, are currently best performed on technologies such as GPUs

.

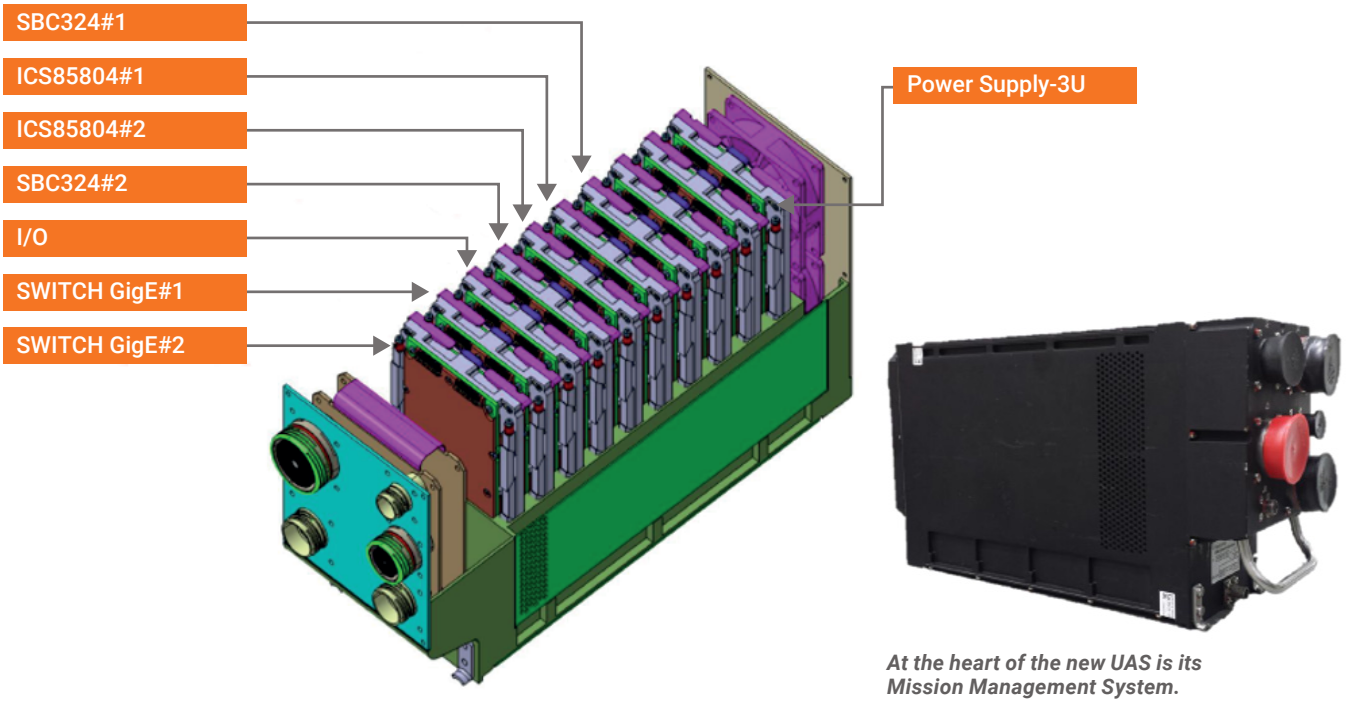
State of the art UAS

To enable a response to these significant challenges, a major technology company turned to Abaco to help develop solutions for its planned UAS platforms. The company was looking to design a new, state of the art UAS for Intelligence, Surveillance and Reconnaissance (ISR) missions that would deliver a combination of performance and operational characteristics that would place it at the very top end of the UAS MALE (medium-altitude long-endurance) category.

At the heart of the new UAS is its Mission Management System (MMS), a leading edge multi-mission integrated sensor system. Its service-oriented architecture allows easy system reconfiguration and the introduction of a range of sensor suites to match a wide range of military, paramilitary and civil requirements. This MMS architecture provides a scalable and modular approach, allowing for additional mission capabilities as the EW & SIGINT threat environment evolves.

Its advanced multi-platform data fusion algorithms act as a system capability multiplier, providing a truly integrated sensing solution. The MMS incorporates user-selectable levels of

Electronic warfare sensor processing in a SWaP-constrained environment



At the heart of the new UAS is its Mission Management System.

autonomy that are designed to deliver the appropriate information to the user at the right time, reducing operator workload.

The MMS's processing unit is a rugged 3U VPX computer equipped with two Abaco ICS-8580 video acquisition boards, two SBC324 single board computers two GBX410 Ethernet switches and a custom I/O board.

The ICS-8580 is a 2-channel high-definition or 4-channel standard definition H.264 video encoder/decoder rugged XMC module hosted by a 3U VPX carrier. The SBC324 rugged single board computer features the high performance, highly integrated Core i7 processor from Intel. The GBX410 is a fully managed multilayer Gigabit Ethernet switch, managed by Abaco's unique OpenWare switch management environment.

Powerful yet flexible

With the Abaco-enabled MMS at its heart, the company was able to develop and deliver a solution combining wide operational speeds, a fast climb gradient, high operational ceiling and a variety of payloads, providing end users with a powerful yet flexible system that outperforms other MALE platforms across a wide range of mission sets, including aerial, land, coastal, maritime and offshore security, COMINT/ELINT, EW/SIGINT among other roles.

Some 30 of these UAS platforms have been manufactured to date, and the company expects the platform to find a significant international market. Cognitive processing and the constant need for more bandwidth are significantly driving up the performance requirements of radar and EW processing subsystems, while the availability of size, weight, and power is being driven down.

Advanced technologies

It is clear that the future will see the requirements of minimum SWaP-C3 and maximum performance being successfully addressed through the use of advanced technologies such as multi-core processors, GPUs, and Xilinx's RFSoC, Zynq MPSoC and traditional FPGAs, allowing developers to focus on radar prototyping of suitable cognitive and digital processing algorithms.

For next generation cognitive radar and EW systems, Abaco's VP430 and similar products will provide the necessary edge over adversaries with superior end-to-end latency and system performance while delivering minimal SWaP. EW/SIGINT solutions leveraging the VP430's extraordinary capabilities will enable massive on-board DSP and multi-channel processing on aircraft at the tactical edge and be at the heart of next generation EW and SIGINT solutions.

WE INNOVATE. WE DELIVER. YOU SUCCEED.

Americas: 866-OK-ABACO or +1-866-652-2226

Europe, Africa, Middle East, & Asia Pacific: +44 (0) 1327-359444

Locate an Abaco Systems Sales Representative visit: **abaco.com/products/sales**

abaco.com