High-flying computer processing

"Unmanned aerial vehicles (UAVs) will play a major role in the increasingly dynamic battle control that will evolve in the 21st century... the decisions made now will lay the foundation for how far and how fast these advances are implemented. Only our imagination will limit the potential of UAVs in the 21st century." **United States Office of the Secretary of Defense**

The Air Force Research Laboratory (AFRL) has been working on unmanned flight for decades. But successful operation of unmanned air vehicles (UAVs) presents many unique challenges. Not the least of which is computer processing. Processors on board today's UAVs are only capable of processing about 10 percent of the data acquired by onboard sensors. As sensors become more sophisticated, more compute-intensive data processing is needed.

A unique role

UAVs are powered aerial vehicles that have been used in reconnaissance and intelligence-gathering roles since the 1950s, and are growing in popularity because of their successful combat performance, great versatility and relatively low cost. The hope is that, in about a decade, unmanned aircraft will be ready to take on more highly dangerous missions now performed by manned aircraft.

To further this aim, the AFRL Sensors Directorate has enlisted the help of SRC Computers Inc. SRC has been awarded a development contract to create a miniaturized computer system for use onboard UAVs. The system is based on SRC's IMPLICIT + EXPLICIT ARCHITECTURE and reconfigurable MAP processor. The resulting mobile computer is expected to perform 96 Gflops with more than 6 Gbytes/s of direct sensor I/O bandwidth in a single computer weighing as little as 10 pounds. The system will initially be used to support a variety of UAVs and other Air Force sensor applications.

Seeing/hearing sensors

The AFRL Sensors Directorate mission is "to lead the discovery, development, and integration of affordable sensor and countermeasure technologies for our warfighters". In other words, the Sensors Directorate is tasked with providing the eyes and ears of the warfighter, focusing on surveillance, attack and self-defense systems.

Because locating and identifying targets requires enhanced sensor capabilities on vehicles with restricted real estate, sensors are one of the key areas of development for UAVs. But, increasingly sophisticated sensors necessitate more intensive data processing.

According to Tim Kemerley, Chief of Aerospace Components Division, Sensors Directorate, AFRL at Wright-Patterson Air Force Base, the SRC program will have real results in this area: "The object of this program is to accelerate the development and transition of a new onboard RF and EO/IR sensor signal processor that will increase the capability per unit volume and power by a factor of 500 to 1000."

AFRL sources explain that "electro-optical (EO) sensors operate in the visible and infrared (IR) portions of spectrum these specialized sensors detect and recognize concealed targets and environmental conditions. Radio frequency (RF) sensors in airborne and space-based radars are used for target detection and tracking, and electronic warfare systems."


Jon Huppenthal

HST spoke to **Jon Huppenthal**, President and CEO of SRC Computers, about the challenges of designing for UAVs

HST. In the AFRL's search for an appropriate processor, what were its primary concerns?
JH. AFRL actually has several application areas of interest but they all share common selection factors. In general AFRL wanted to achieve orders of magnitude increases in processing capability per unit volume and per unit power. In addition, they needed a processor that is easy to program and port existing applications.

HST. MAP is extremely mobile, light and compact. How important is this for use in UAVs?
JH. As with any airframe application, these are all very important factors. In the case of UAVs, it is even more critical because they are generally smaller. In addition, because they are unmanned, UAVs have many more sensors that must be dealt with automatically, which increases the computational requirement.

HST. What other major considerations are there when designing a system for UAVs?
JH. As always, having an adequate thermal and power solution is important. However, in the case of UAVs there is another factor that can have a big impact on these systems. Because there is no pilot, the UAV is capable of operating in a much higher G-force envelope. In this environment, even a small heatsink or moderately sized power component may need a very large retention system to hold it in place. To eliminate this problem, in addition to air-cooled systems, SRC also offers MAP with a SprayCool cooling system. This phase change cooling solution eliminates the need for all heatsinks and increases the efficiency of power supplies by keeping them cooler. It also has the ability to preheat the system when used in an environment requiring a cold start.

HST. Sensors and imaging applications are of key importance in UAVs. What benefits does MAP provide in this area?
JH. MAP has two significant benefits for both these types of applications. The first is very high external bandwidth. Each MAP has two general purpose input output (GPIO) ports that each sustain 3 Gbytes/s and can be directly connected to user-defined sensors. This is in addition to the 3 Gbytes/s of sustained payload bandwidth that MAP has to interconnect to the rest of the SRC system. Each of the GPIO ports is 96 bits wide to allow the user to physically partition its bandwidth across a variety of sensors simultaneously.

The second benefit that MAP offers to this family of applications is extreme processing parallelism. Each MAP can simultaneously execute 96 billion floating point operations per second. Since most sensor and image processing applications are integer operations, MAP supports even higher numbers of parallel operations. This means that the number of sensors a single MAP can support will be higher and the time to solution for an image processing application will be shorter than any other processing solution.

HST. How can MAP benefit other homeland security applications?
JH. MAP-based systems are being used for a variety of homeland security applications such as biometric facial recognition, cryptology, target recognition and geospatial mapping. It has also shown superior performance for applications related to muzzle flash detection and classification. Of course, this is in addition to its use in general purpose computation applications.

HST. What further development do you plan in this sector?
JH. We already have hardware and software efforts underway that will continue to increase system performance, such as GPIO bandwidth, and add additional features such as expanded software libraries. In the embedded space, we will be offering additional form factors. Of course, as with all of our systems today, we will maintain software compatibility across our entire product line. ■

SRC Computers, Inc. is a privately owned company, established in 1996 in Colorado Springs, Colorado by Seymour Cray. For more information please visit **www.srccomputers.com**.