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Unmanned vehicles push wireless, but lack in multicore

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Military electronics is going through a mobile boom in drones—a rise in unmanned planes, trucks and ships—that is just beginning.

In some ways, military mobile systems are less sophisticated than the smartphones, e-readers and tablets that are their civilian counterparts. The military mobiles have not yet adopted multicore processors or robust virtualization software, and they are just starting to establish open application platforms. But they are pushing the envelope in the use of software-defined radios and sensors.

According to an October 2010 report to Congress, the U.S. military uses more than 10 types of unmanned aircraft. Various military branches logged more than 450,000 flight hours in at least 6,000 unmanned aircraft during 2009 alone, the report said.

By 2015, the U.S. Department of Defense projects it will have 197 groups with unmanned vehicles at 105 locations in the United States alone, up 35 percent from the number of groups last year. That does not even count the adoption of drones by non-military government agencies such as the Federal Aviation Administration, NASA, Homeland Security and others, all of which are just starting what is expected to be a broad adoption of drones for a variety of uses.

Further out on the horizon, intelligent transportation systems that guide consumer cars along smart highways have been on the drawing board for years.

Google's recent work on a self-driving car is the latest wrinkle in bringing automated transport to the average garage.

One report pegged the 2009-2013 budget for military drones at $15 billion. The New York Times, however, reported that the Navy alone plans to spend $12 billion on Global Hawk unmanned surveillance planes, which are estimated to cost as much as $218 million each. That's great news for companies such as

General Atomics, Northrop Grumman Corp., Raytheon Co. and others that make drones. (The companies declined interviews for this report, citing the sensitive nature of military drone programs.)

The vehicles are often loaded with a variety of sophisticated sensors and the intelligence to process data in real-time, minimizing the need for communications with ground stations.

“The processing demands have gone up dramatically as more and more sensors get put on these vehicles,” said Glenn Beck, an aerospace and defense segment marketing manager at Freescale Semiconductor Inc. “They are not using multicore, and it’s predominantly 32-bit chips. But they definitely will use multicore and 64-bit chips in the future.”

The start of virtualization

First-generation software enabling a rudimentary level of virtualization in aircraft is just starting to emerge based on the 653 Project, a landmark effort to consolidate separate Boeing 777 systems. The aircraft information management (AIM) system Honeywell Inc. delivered for the Boeing project was defined as an open system. It allowed as many as 17 competing vendors to share time-sliced segments on a single host processor from Freescale, consolidating multiple boxes into one—an unprecedented move in avionics.

The AIM system is seen as a huge design win for Honeywell. The concept is expected to proliferate across commercial aircraft.

The 653 effort “could save Boeing billions in maintenance costs because they won’t need to revamp separate hardware boxes and retest all their platforms every time there is a change,” said Chip Downing, senior director of Wind River’s aerospace and defense business. The Wind River VxWorks 653 Platform provides a basic level of task isolation.

Military electronics planners are applying lessons of the 653 project across a range of efforts to create open military platforms for drones. One objective is to allow more vendors to participate in creating hardware modules or software applications for unmanned vehicles.

Another objective is to create a universal portable ground station that can control many types of drones, reducing cost and complexity. Initial versions that might fit in trailers or even backpacks could eventually be miniaturized to the size of tablets or smartphones.

The Unmanned Control Segment Working Group, a joint standards effort sponsored by the Office of the Secretary of Defense, has released version 1.0 of its software platform for such universal control stations and is expected to make version 2.0

available to defense contractors soon. Northrop Grumman won a $3.3 million contract from the Navy in February to participate in the program.

Adoption of open platforms also leads to adoption of more levels of security.“We do a lot of work creating trusted systems inside our processors using secure boot, domain separation and tamper detection,” said Beck. “These are features primarily from networking and telecom sectors, but they have use in the mil-aero sector.”

Wind River code ensures apps only get access to the processor according to set time-shared schedules. “That makes systems more secure because no app can take over whole system; it’s a kind of early military virtualization,” said Downing.

On the wireless horizon

The military is out in front in the development of wireless technologies.

It pioneered ultrawideband’s use more than a decade ago. Today, drone designers are in the vanguard of cognitive- and software-defined radios that survey available spectrum and smartly use open gaps to avoid detection and jamming.

“They are deploying [such radio technology] at different levels for different purposes, such as achieving more reliable connections between aerial vehicles and ground stations,” said Rodger Hosking, a vice president at embedded board maker Pentek Inc., which supplies computer boards to a number of military contractors.

The smart radios are typically implemented in high-performance FPGAs assisted with a supervisory microprocessor.

Analog components such as 12-bit, 3.6-GHz A/D converters and 16-bit, 1.25-GHz D/A converters are also typical, Hosking noted. “We are constantly being pressured for faster ADCs and DACs for faster comms paths and more bandwidth,” Hosking said.

Jon Adams, a wireless business development manager for Freescale who has worked for both Boeing and Raytheon, said he knew of “some drones that operate at frequencies of 3.1 to 10.6 GHz,” adding that “military systems are not bound by FCC rules, so they generally use a lot of spectrum.”

Drones also helped pioneer 60-GHz networking, which only recently came to consumer markets. The phase array radars in the nose of some aircraft form multiple beams to create secure, broadband links to other friendly aircraft, Adams explained.

The military produced a long-term road map to coordinate its efforts on drones. It suggests a broad range of projects will attempt to break new ground in areas such as intelligent voice control, energy harvesting and alternative power sources such as

biomass fuels, cloaking and object-avoidance capabilities, and extreme weather tolerance.

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