Opportunities to Improve **Fixed Wing SAR** Capabilities

by Mark Aruja

THE CANADIAN PRESS\MONCTON TIMES

Mk 1 eyeball at work – how effective at 4am?

In 2005, when the air force developed its Statement of Requirements for the Fixed Wing SAR (FWSAR) program, the defence environment, and the issues facing the air force were significantly different than they are today. The substantial challenges facing the Air Force back then were the overall deterioration of the C-130 Hercules fleet, concerns about strategic lift capability in general, and the need for tactical lift in deployed operations.

In its 2004 budget, the government of the day had announced the FWSAR project as a top priority, however, the relative shortfalls in military airlift created a disconnect by placing the FWSAR requirement in a higher priority than many defence analysts, and many inside DND would have deemed appropriate. Since that time, the C17 project was initiated and the first aircraft are operational, the C130J project was initiated, and appears well underway to fruition, and the Medium-to Heavy-Lift Helicopter project was conceived and is in rapid maturation.

These efforts resulted in the FWSAR project being put in abeyance while the arguably more significant priorities of airlift capacity in general were being resolved at a pace not seen in defence procurement perhaps since WWII. As a result, many of the substantial capability deficiencies existing at the time of the writing of the FWSAR Statement of Requirements have now substantively changed.

Bolstered by unprecedented gains being made in new rotary and fixed wing tactical and strategic airlift capabilities, a new and refreshed look at Search and Rescue Capability requirements is in order.

With over 15 million square kilometres of SAR responsibility, of which 9 M sq.km. are overland (with dramatic variations in topography and climate), addressing search capability is the overarching priority.

One of the most significant advances in global SAR capabilities was declared operational in 1985 with SARSAT, a satellite-based means of forwarding timely and accurate distress beacon information, to remote rescue co-ordination centres. Canada was a founding player in this endeavour, which continues to prove itself on a daily basis. However, SARSAT cannot help in cases where there is no distress beacon, or in the case of malfunction. In those instances, it is necessary to address airborne search in each of the two very different cases of overwater and overland.

Overwater SAR is relatively simple; the physics of the environment are well understood and there are a plethora of electronic sensing systems available. However, in Canada these sensing systems, electro-optic, electronic intercept and radar, are exclusively maritime surveillance assets developed for warfighting purposes.

Today's air force SAR fleet, including the C130, Buffalo and Cormorant have no viable search tool other than the "Mk 1 eyeball." Whereas the human brain and vision will continue to be a mainstay of airborne search capability, today's technology suggests that much more needs to be accomplished than simply procuring a means to move these eyeballs. If this were the case, it would be arguably much more cost effective to expand the Civilian CASARA network to leverage the thousands of aviators spread across the country who have aircraft, and local area knowledge to conduct visual searches, and then call in rescue assets, both air and ground.

And what of future overland capability? The immediate answer would see the Cormorant helicopter retrofit without delay with one of a number of proven, reliable sensing systems currently in use around the world. Further, all future primary SAR aircraft, both fixed and rotary wing, should incorporate the same technology to bring our SAR capability up to international standards. That leaves us with the need, and the opportunity, to provide Canada with a leadership role in the development of overland sensor technology.

Obviously, DND should ensure that future SAR aircraft have the open architecture required to allow requisite spiral development of these and other new technologies.

Arguably, among agencies in Canada that are involved in Search and Rescue, DND has the sole capacity, both financially and technologically to leverage electronic sensing technologies.

The DRDC-led AIMS Technology Demonstration Project is one example where the potential of Canadian-developed gated laser technology is being explored. Electro-optic sensors, which are inherently limited by a narrow field of view, can be complemented by software techniques now available to "stitch" together these individual small images to provide a panoramic view to improve area search coverage. Nascent, but ever-evolving automated tools to assist operators in detecting and identifying targets, need to focus on search capability as a dedicated endeavour, not just for combat tasks.

Infra-red detectors continue to improve, providing a night-time capability that is dramatically superior to visual searches, and also complements daylight sensors. In addition to the sensors themselves, defining effective operator-machine interfaces, and providing tools to conduct search planning need to be addressed to ensure that the sensor capability can be managed.

Another deficiency is the lack of any capability to develop overland search plans to optimize search flight paths – taking into concurrent consideration the variables of aircraft performance, sensor performance, meteorological environment and topography. Today's avionics provide linear estimates which are only satisfactory for overwater or high altitude overland searches; these were developed a century ago.

Although powerful electro-optic sensors are readily available today, their use is often characterized as "looking through a soda straw." If you have thousands of kilometres to search, how should that straw be best utilized to ensure that the area is covered to an acceptable probability of target detection? Air Force crews presently have no tools available to make such a determination, even though technologies to do this, such as Digital Terrain Elevation Data, are now available.

The increase in global knowledge is derived from the power of the network – *Metcalfe's Law*, rather than *Moore's Law*.*

This has led to an explosion in capability developments, and there can be direct translations of these concepts to addressing Search capabilities. Canada's existing SAR planes, for instance, have no means to collate information for what would be called Situational Awareness, and provide limited to no command and control capability.

If there are dramatic improvements in developing search planning tools, can they be coordinated with other ground and air assets to yield a higher level of "system" performance? Solutions exist. Satellite systems such as Iridium and Globalstar offer global communication coverage at affordable rates, and off-the-shelf, inexpensive software for information sharing can range from e-mail with attachments, to sophisticated imagery-on-demand capabilities, the latter being largely driven by advancements in unmanned airborne systems.

UAVs can generate copious volumes of data (much of it with questionable utility) over communication paths which may be limited, not pre-defined, and to multiple users with different requirements – a direct parallel between military ISTAR and the civil search mission.

Sensing technologies can dramatically improve target detection. Coupled with effective planning tools for shared situational awareness, they can provide the foundation to resolve the remaining capability deficiency, namely airborne command and control of on-scene assets for Search and Rescue operations.

A renewed Statement of Requirements to address airborne Search and Rescue capabilities provides a unique opportunity to exponentially upgrade search capability by addressing the availability of existing electronic sensing technologies, and their purposeful integration with yet undeveloped technologies to dramatically improve upon the ubiquitous Mk1 eyeball.

A specific focus on the overland search mission offers the potential for the greatest capability improvement, and the most cost-effective means to utilize relatively expensive aircraft for SAR missions, which the air force continues to conduct with distinction for the benefit of all Canadians. SAR

Mark Aruja is the Air Programs Business Development Manager at Thales Canada's Systems division. During his air force career he accumulated over 3000 rotary and fixed wing hours as a tactical navigator in maritime surveillance and search and rescue operations. For students of ancient history, he was the Operational Requirements Manager for the New Shipborne Aircraft project from 1986-90.

* In 1965 Intel Corporation co-founder Gordon Moore predicted transistor, and subsequently integrated circuit capacity would double every two years. Known as **Moore's Law**, this has borne out to be generally true since then. **Metcalfe's Law**, however, states that the value of a telecommunications network is proportional to the square of the number of users of the system.