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## **BROAD AREA MARITIME SURVEILLANCE: AN UNMANNED SOLUTION FOR THE ROYAL CANADIAN AIR FORCE**

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**JCSP 45**

**Service Paper**

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## **BROAD AREA MARITIME SURVEILLANCE: AN UNMANNED SOLUTION FOR THE ROYAL CANADIAN AIR FORCE**

### **AIM**

1. The aim of this service paper is to examine and recommend a practical option for the use of unmanned aircraft systems (UAS) in support of Royal Canadian Air Force (RCAF) missions. The paper will highlight several RCAF defence and non-defence mission sets that can be conducted more effectively or efficiently by a UAS in comparison to conventional platforms.

### **INTRODUCTION**

2. Unmanned aircraft systems have experienced extraordinary growth in the past three decades, particularly in the defence and security sectors.<sup>1</sup> The overarching mission sets that have driven contemporary defence UAS innovation include those that are predominantly “dull, dirty and dangerous”<sup>2</sup> and pose untenable risk to manned platforms. Today the military UAS continuum ranges from specialized tactical micro-UAS platforms to semi-autonomous, high-altitude long-endurance (HALE) vehicles that are fitted with sophisticated sensor and communications suites and are capable of projecting airpower globally. While Canada led the industry in early UAS research and development activities in the 1960s and demonstrated modest engagement in operational UAS applications during the war in Afghanistan, the CAF and more specifically the RCAF have since fallen significantly behind their alliance partners in practical UAS skills and experience.<sup>3</sup>

3. This paper will identify several operational areas where the RCAF could, in conjunction with existing CAF frameworks, leverage a single emerging UAS concept to achieve synergistic effects in the joint operating environment. In the interests of clarity, the following examination will be delivered through the lens of the United States Navy’s (USN) Broad Area Maritime Surveillance (BAMS) initiative and how it could be employed to great effect in support of a variety of RCAF missions. Despite the perspective from which it is examined, it is crucial that BAMS be viewed not as a specific platform, but rather as a conceptual UAS capability, and that any future or derivative analysis remain impartial and informed only by legitimate CAF operational requirements.

### **DISCUSSION**

4. The overarching defence priority established by the government of Canada and CAF strategic leadership is *strong at home*, which includes the detection, deterrence and defence against threats to or attacks on Canada.<sup>4</sup> Having the longest coastline of any other nation in the world, the defence of Canada’s maritime approaches, including the arctic, is of utmost

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<sup>1</sup> Gary Schaub Jr., “JUSTAS for all? Innovation and UAVs in the Canadian Forces,” *Defence Studies* 15, no. 2, (June 2015): 124.

<sup>2</sup> P. W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (New York: Penguin Press, 2009), 54.

<sup>3</sup> Danny Garrett-Rempel, “Will JUSTAS Prevail? Procuring a UAS Capability for Canada,” *Royal Canadian Air Force Journal* 4, no.1, (Winter 2015): 20.

<sup>4</sup> Department of National Defence, *Strong Secure Engaged - Canada’s Defence Policy*, (Ottawa: DND Canada, 2017), 14.

importance in the future operating environment. Arctic sovereignty is particularly challenging given the harsh climate, vast geography, sparse population density and austere infrastructure. In spite of the factors that serve to otherwise restrict CAF presence in the arctic, the effects of climate change and economic globalization converge to make the arctic increasingly accessible and enticing to potential security threats.<sup>5</sup> If it is to fulfill its core mandate, the CAF must develop innovative means of conducting persistent intelligence, surveillance and reconnaissance (ISR) operations across the continuum of domestic maritime operating environments, including the arctic.

5. The current CAF initiative to field an RCAF operated UAS is the Remotely Piloted Aircraft Systems (RPAS) project, a derivative of its predecessor, the Joint Unmanned Surveillance Target Acquisition System (JUSTAS). As a major capital procurement project, the objectives of RPAS are intrinsically linked to the strategic objectives and investment initiatives outlined in *Strong, Secure, Engaged*.<sup>6</sup> Characterized as a medium-altitude long-endurance (MALE) UAS, the ultimate aim of RPAS is to deliver:

...an integrated persistent long-range, intelligence, surveillance, target acquisition and reconnaissance capability...capable of providing near-real time information to tactical, operational and strategic commanders to support both domestic and deployed operations, and when required, provide a precision strike capability to support operations.<sup>7</sup>

It is envisioned that RPAS will act as a force multiplier and not a replacement to any extant capability. Still in the project definition phase, the forecast RPAS completion horizon is 2030 and the current maximum budget allocation is \$4.99B (CAD).<sup>8</sup>

6. Intelligence, surveillance and reconnaissance (ISR) is a framework by which integrated collection, exploitation and processing activities are planned and executed in a synchronized manner and the resulting intelligence products are disseminated in direct support of operations.<sup>9</sup> In practical terms, the aim of ISR is to build situational awareness and facilitate decision superiority, essential elements of any effective military operation. Although ISR is an inherently joint activity, airpower's core attributes of speed, reach, precision and elevation make the RCAF a principle stakeholder in the ISR enterprise. Furthermore, UAS platforms are "ideally suited for collection missions that are long and tedious (dull), hazardous to humans (dangerous) or are

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<sup>5</sup> Levon Bond, "JUSTAS and Project Epsilon: Integrated Intelligence, Surveillance, and Reconnaissance of the Canadian Arctic," *Canadian Military Journal* 11, no. 4 (Autumn 2011): 24.

<sup>6</sup> Department of National Defence, *Strong Secure Engaged - Canada's Defence Policy*, (Ottawa: DND Canada, 2017), 39.

<sup>7</sup> Royal Canadian Air Force, "Update and New Name for the Joint Unmanned Surveillance Target Acquisition System (JUSTAS) Project," last modified 06 July 2018, <http://www.rcaf-arc.forces.gc.ca/en/article-template-standard.page?doc=update-and-new-name-for-the-joint-unmanned-surveillance-target-acquisition-system-justas-project/j9u7rzyf>.

<sup>8</sup> Defence Capabilities Blueprint, Remotely Piloted Aircraft Systems (RPAS) Project, last modified 30 May 2018, <http://dgpapp.forces.gc.ca/en/defence-capabilities-blueprint/project-details.asp?id=977>.

<sup>9</sup> Department of National Defence, B-GA-401-002/FP-001, *Royal Canadian Air Force Doctrine - Intelligence, Surveillance and Reconnaissance* (Ottawa: Royal Canadian Air Force, 2017), 5.

carried out in undesirable conditions (dirty)”,<sup>10</sup> attributes that are the epitome of maritime and arctic ISR operations.

7. An emergent UAS paradigm that is well positioned to address the specific challenges of Canada’s maritime and arctic security mandate is the BAMS concept. Recently developed by the United States Navy (USN) and provisionally adopted by Australia and Germany, BAMS was driven by the unique operational requirements of maritime ISR and the inherent challenges that otherwise limit or preclude the employment of extant UAS fleets in the maritime domain. BAMS has not yet achieved full operational capability and it is still undergoing implementation.<sup>11</sup>

8. The BAMS platform, known as the RQ-4C Triton, is based on an enlarged version of the Northrup-Grumman RQ-4 Global Hawk with several distinct improvements that enable maritime and arctic operations.<sup>12</sup> The BAMS UAS concept offers a persistent beyond-line-of-sight (BLOS) maritime ISR platform that embodies both the MALE and HALE concepts of operations. BAMS’ inherent strengths lie in its reach, endurance, ability to operate in austere conditions and versatile suite of maritime-centric sensors. Although it does not fully replicate conventional maritime capabilities, BAMS augments them by providing a fused recognized maritime picture that allows conventional manned platforms to focus on localized kinetic activities; a complimentary capability closely aligned with the core tenets of RPAS.

9. The BAMS air vehicle is fitted with anti-ice capability, lightning protection and a reinforced fuselage for hail, bird and load gust protection. These features allow BAMS to safely transition from a benign HALE operating envelope (50,000ft and higher),<sup>13</sup> through cloud and volatile maritime weather, down to low levels where specific target prosecution can occur. The robust features of BAMS facilitate this tactical agility with minimal risk to the vehicle, attributes that lend itself well to operations in the harsh Canadian maritime domain.

10. BAMS features a 360-degree array of active and passive sensors that are task-tailored for maritime operations. With a >400nm sweep width, BAMS’ multi-function active sensor (MFAS) maritime radar is adept at scanning the wide swaths of ocean or shore-line typified by Canada’s expansive maritime approaches. MFAS is equally capable of interrogating specific targets and generating a detailed radar image of a contact for the purposes of automated target recognition, a task that is the essence of maritime security operations.

11. BAMS is fitted with an auto-tracking, multi-spectral electro-optic/infra-red (EO/IR) targeting system sensor that produces and transmits high fidelity imagery and full motion video (FMV) of targets or areas of interest. BAMS also features an absolutely essential element of any

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<sup>10</sup> Ibid., 17.

<sup>11</sup> Jane’s 360, “Navy League 2018: MQ-4C Triton nears Operational Capability, Garners International Interest,” last modified 09 April 2018, <https://www.janes.com/article/79127/navy-league-2018-mq-4c-triton-nears-operational-capability-garners-international-interest>.

<sup>12</sup> Northrup Grumman, “MQ-4C Triton - Making the World’s Oceans Smaller,” last accessed 12 October 2018, <http://www.northropgrumman.com/Capabilities/Triton/Pages/default.aspx>.

<sup>13</sup> The Simons Foundation - Arctic Security Briefing Papers, “Canada, the Arctic and the Expanding World of Drones,” last accessed 12 October 2018, [http://www.thesimonsfoundation.ca/sites/default/files/Canada%20the%20Arctic%20and%20the%20expanding%20world%20of%20drones%20-%20Arctic%20Security%20Briefing%20Paper%20October%2027%202017\\_0.pdf](http://www.thesimonsfoundation.ca/sites/default/files/Canada%20the%20Arctic%20and%20the%20expanding%20world%20of%20drones%20-%20Arctic%20Security%20Briefing%20Paper%20October%2027%202017_0.pdf).

maritime ISR platform; an Automatic Identification System (AIS) receiver. AIS interrogates ship-based AIS transponders transmitting vital information such as name, type, position, size, registration, speed, track, ports of call etc. When employed as a corroborative tool in conjunction with other sensors, AIS is vital in identifying suspect maritime tracks requiring further investigation or interdiction.<sup>14</sup>

12. Essential to persistent UAS maritime security operations, particularly in the vastness of Canada's northern maritime approaches, are the elements of coverage and endurance. BAMS is capable of remaining aloft for over 24hrs, has an operating range of over 8000nm and can cover more than 2.7 million square miles in a single mission.<sup>15</sup> In a Canadian context, BAMS can survey an area that equates to 2/3 the size of Canada's landmass or the entirety of Canada's Exclusive Economic Zone from Yarmouth to the northern tip of Ellesmere Island to Vancouver Island in a single sortie.

13. In comparison to its conventional manned maritime ISR counterparts, namely the CP140 Aurora, BAMS is far superior at conducting long-range detection, deterrence and defence in the Canadian maritime domain. BAMS is operated with less than half the crew of the Aurora (4 versus 10), has twice the endurance, twice the range and a superior ISR sensor payload.<sup>16</sup> BAMS is also the platform of choice to conduct the *dirty, dull and dangerous* mission sets. Maritime surveillance missions, particularly in Canada's northern reaches often face adverse meteorological and environmental conditions (dirty), protracted and risky periods of tedium (dull) and few viable alternates should an emergency occur (dangerous). Executing these missions using an unmanned platform, with no corresponding degradation in capability, diminishes the effects of external mission stressors, increases the tolerance for risk and affords the RCAF greater operational flexibility.

14. While BAMS is specifically designed to fulfill a maritime surveillance role, it could readily be employed in an expeditionary ISR capacity to support Canada's *engaged abroad* mandate such as that experienced Libya.<sup>17</sup> In addition to the payload specifications discussed above which are compatible with virtually any expeditionary mission, BAMS possesses a sophisticated electronic support measures (ESM) suite that acts as a force multiplier in the delivery of theatre-wide operational effect. Organic ESM allows BAMS to passively detect, classify and localize electromagnetic radiation in the battlespace, build the electronic order of battle and enable decision superiority.

15. BAMS is also a capable network relay and data fusion center, a synergistic joint effect delivered by the CP140 in Libya during OP MOBILE.<sup>18</sup> Not only can BAMS act as a theater

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<sup>14</sup> Captain Daniel Arsenault and Captain Josh Christianson, "Punching Above Its Weight: The CP140 Aurora Experience within Task Force Libeccio and Operation MOBILE," *Royal Canadian Air Force Journal* 1, no.3, (Summer 2012): 29.

<sup>15</sup> Jane's Navy International, "US Navy Officially Inducts Triton UAV into Service," last modified 04 June 2018, [https://janes.ihs.com/Janes/Display/FG\\_950316-JNI](https://janes.ihs.com/Janes/Display/FG_950316-JNI).

<sup>16</sup> Royal Canadian Air Force, "CP-140 Aurora – Technical Specifications," last modified 28 November 2017, <http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cp-140.page>.

<sup>17</sup> Captain Daniel Arsenault and Captain Josh Christianson, "Punching Above Its Weight: The CP140 Aurora Experience within Task Force Libeccio and Operation MOBILE," *Royal Canadian Air Force Journal* 1, no.3, (Summer 2012): 31.

<sup>18</sup> *Ibid.*, 30.

communications relay platform facilitating communications between elements that are not within line-of-sight of one another, it can also fuse sensor inputs from deployed friendly forces and rebroadcast the common operating picture via data link. This capability would allow the RCAF to “drastically increase interoperability, situational awareness, targeting efficiency and sensor picture clarity of the total force while also providing a resilient alternative to vulnerable satellite communications systems.”<sup>19</sup> While the CP140 has proven itself capable in these domains, unlike the Aurora, BAMS can maintain station much closer to the battlefield, above the engagement zones of man-portable weapons systems.

16. BAMS also possesses significant potential in Canada’s non-defence role of national search and rescue (SAR). Canada’s SAR regions extend from the mid-Atlantic ocean, to the geographic North Pole, to approximately 600 miles west of Vancouver Island. SAR events that occur at the outermost boundaries of these areas are extremely demanding for conventional SAR assets, particularly when a protracted search is required and on-station time is severely limited by extended transit requirements. BAMS’ extraordinary agility, reach and endurance combined with a sensor payload that closely rivals modern fixed-wing SAR platforms such as Canada’s Airbus CC-295, make it a perfect complement to the national SAR enterprise.

17. One of the many possible SAR scenarios invoking BAMS engagement involves a vast search area in the mid-Atlantic resulting from a missing aircraft or sailing vessel. In this instance, BAMS could be deployed to the scene in advance of the manned SAR assets, operating in a MALE/HALE configuration to quickly sanitize the search area using the full suite of onboard sensors. Upon detecting and classifying possible SAR targets from the aloft position, it could then descend through cloud into an identification configuration so as to ascertain each target’s identity and relevance via EO/IR. Whether the outcome of this process is the positive location of the SAR target or simply the elimination of hundreds of irrelevant targets, BAMS could substantially reduce search-phase pressure on conventional manned SAR assets and allow them to focus on the human-centric aspects of the rescue operation.

18. The RCAF is also routinely engaged in humanitarian response and disaster relief (HADR) missions in the wake of global catastrophes such as earthquakes, hurricanes, fires and floods. Often the first task of any HADR response is area reconnaissance. A deliberate and detailed survey of the affected area provides a clear operational picture to enable the effective allocation of HADR resources. With its ability to provide sustained, real time multi-spectral imagery over a wide area of operations, conceivably in advance of the deployed force’s arrival, BAMS constitutes a highly effective post-disaster reconnaissance platform that would enhance Canada’s while-of-government commitment to HADR missions both domestically and abroad.

19. From a cost perspective, a modest BAMS fleet capable of fulfilling core *Strong, Secure, Engaged* requirements is tenable under the current RPAS procurement framework. Based on existing foreign military sales data, the approximate per unit cost of BAMS including control,

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<sup>19</sup> Foxtrot Alpha, “The Navy Has the Ultimate MH370 Search Tool, It’s Just Not Operational,” last modified 18 March 2014, <https://foxtrotalpha.jalopnik.com/why-mq-4c-triton-the-ultimate-mh370-search-tool-isnt-1545912657>.

support and training systems is conservatively estimated at \$500-\$800M (CAN),<sup>20</sup> making the BAMS concept a feasible option to satisfy the CAF's future UAS operational requirements.

20. Despite its versatility and robust design, BAMS does possess some inherent limitations. Perhaps foremost among these is BAMS' lack of precision strike capability, an attribute that makes it non-compliant with RPAS' defined requirements. However, public opposition to the concept of armed UAS operations is one of the factors that have been cited as key impediments to recent UAS procurement initiatives in Canada.<sup>21</sup> If the public debate over the ethical and moral aspects of armed UAS operations continues to remain unresolved in Canada, a deliberate rationalization of the RPAS precision strike requirements may be in order and any demonstrable compromise in this area could serve to streamline the program.

21. Another noteworthy barrier to the CAF's implementation of a strategic UAS asset such as BAMS is the inevitable and costly requirement for reliable multi-band satellite communication (SATCOM) accessibility to support BLOS UAS operations.<sup>22</sup> Canada's limited access to existing SATCOM architecture is an immutable truth and is a capability gap that it must bridge in close synchronization with any BLOS UAS procurement initiative. Several nascent Canadian SATCOM projects have been initiated to enhance CAF's limited capabilities in this domain,<sup>23</sup> however significant investment effort will be required to ensure unencumbered SATCOM accessibility and the full exploitation of MALE/HALE UAS capabilities, particularly in the arctic.

## CONCLUSION

22. The preceding text examined the strengths and weaknesses of the BAMS concept in the context of CAF strategic vision, existing defence frameworks and various RCAF missions. While the analysis was conducted through the lens of the specific BAMS platform, it was intended to illustrate that a collection of sophisticated capabilities under one conceptual umbrella could be employed with synergistic effect across the joint operational domain.

23. Despite its limitations, BAMS is potentially an ideal candidate to fulfill the strategic objectives of the RPAS program from both a cost and operational effectiveness perspective. Conceptually it offers the appropriate mix of specialized maritime-centric features while remaining versatile in its potential scope of force employment activities both domestically and abroad. If decisively applied, the BAMS concept would improve RCAF efficiency, effectiveness and interoperability while simultaneously allowing the CAF to re-establish its footing and credibility in a defense sector that will become increasingly prevalent in the modern battlespace.

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<sup>20</sup> Aviation International News Online, "Australia Confirms MQ-4C Triton Buy," last modified 28 June 2018, <https://www.ainonline.com/aviation-news/defense/2018-06-28/australia-confirms-mq-4c-triton-buy>.

<sup>21</sup> CBC News, "Liberals Drone Shopping Exercise Sets Stage for Debate over Lethal Force," last modified 28 February 2016, <https://www.cbc.ca/news/canada/ottawa/liberals-drone-shopping-security-1.3468269>; Michael Byers and Kelsey Franks, "Unmanned and Unnecessary: Canada's Proposed Procurement of UAVs," *Canada Foreign Policy Journal* 20, no. 3, (December 2014): 285.

<sup>22</sup> Conrad Edward Orr, "Can Unmanned Aircraft Systems Meet Canadian Air Power Needs?," *Royal Canadian Air Force Journal* 5, no.3, (Summer 2016): 19.

<sup>23</sup> Defence Capabilities Blueprint, "Space Systems," last modified 30 May 2018, <http://dgpaapp.forces.gc.ca/en/defence-capabilities-blueprint/project-kic.asp?id=5>. CAF SATCOM projects include Enhanced Satellite Communication – Polar, Mercury Global and Tactical Narrowband SATCOM Geosynchronous.



## RECOMMENDATIONS

24. In light of the examination and conclusions, the following recommendations are provided for Chief of Force Development consideration and engagement with CAF/Department of National Defence (DND) stakeholders as applicable:

- a. Recommend the establishment of a CAF / Defence Research and Development Canada (DRDC) consortium to conduct a detailed study of the operational merits of the BAMS concept, in whole or in part, in the context of CAF doctrine, operational requirements and overarching government strategic direction. The analysis should also include requisite fleet size along with possible basing and mission control center options.
- b. Recommend the scope of RPAS be expanded to include consideration of a hybridized MALE/HALE UAS that is capable of global, all-weather operations.
- c. Recommend RPAS' precision strike requirement be rationalized to ensure compatibility with government and international policy, CAF operational requirements and potential barriers it might impose on timely RPAS program implementation. If possible, consideration should be given to deferring the precision strike capability to a future MALE project.
- d. Recommend a rationalization of existing CAF SATCOM procurement initiatives to ensure compatibility and synchronization with possible RPAS C2 support requirements.

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