

THE NORAD EXPERIENCE:

*Implications for
International Space Surveillance Data Sharing*

Full Report

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1. Summary

The purpose of this project is to examine the experience of bi-national collaboration in North American Aerospace Defense Command (NORAD) as a source of lessons learned for the present-day problem of creating a workable international collaborative system for space situational awareness (SSA). SSA in general includes a variety of elements to support military, civil and commercial activities, including space object tracking, characterization, prediction, and space weather. For the foreseeable future, such collaboration would be focused on data sharing among space operators and national or joint multinational SSA sensing systems (such as that being discussed among European nations), and primarily to support safety and civil uses. NORAD today is a customer of certain SSA products produced by other U.S. military entities, which are used to support its primary responsibility of providing an aerospace warning of attacks on North America. Under past organizational structures, it was more directly involved in SSA analysis, and its experiences, particularly in incidents such as the uncontrolled entry of the Soviet COSMOS-954 nuclear-powered reconnaissance satellite, are worth examining.

Discussion in space circles of the need for better, more generally accessible SSA solutions have grown since the early 2000s. A series of incidents in the past few years, most notably the Chinese anti-satellite (ASAT) system test of January 11, 2007, and the collision on February 10, 2009 between the defunct Russian reconnaissance satellite COSMOS-2251 and the operational communications satellite Iridium 33, have served as a series of wake-up calls in this area. NORAD's role as a bi-national organization, particularly one historically involved in SSA functions, suggests that its experiences could be an important source of lessons learned that can be applied to the evolution of an international solution. NORAD's bi-national nature offers the possibility that at least *some* of the issues that will be faced in an international organization have been faced and resolved in NORAD's history.

Several important distinctions must be drawn at the beginning of any such discussion. One is to distinguish between SSA data sharing in general, in which distinct systems share or trade the data they acquire with each other, resulting in a mutual improvement, and the concept of a widely-inclusive international organization that operates its own data acquisition and analysis center. The former is done today on a very limited basis: the U.S. and Russian militaries trade their catalogues of space objects annually, and some information in the catalogues is withheld out of security concerns. There is no serious proposal under consideration at present for the latter. What is being discussed today is an ongoing, perhaps real-time interchange among many international players that could provide the initial steps towards a widely-inclusive system.

Two other sets of distinctions should be kept in mind. The first is the difference between SSA data for military use and SSA data for civil use, which is analogous to the distinction between the data civil air traffic control systems need and use, and that which military warning systems need and use. All that is required in the way of data for civil SSA is a database of object locations, a point of contact for each, and information about the space environment (weather, atmosphere, etc). Military SSA requires that you not only know where an object is but also what it does, as

well as its strengths and weaknesses, capabilities and intent.

The second major distinction is that of military versus civil space objects. Gaining assent to share SSA data on highly sensitive military or intelligence payloads will be difficult to obtain, and is likely to pose a major roadblock to SSA data sharing. This is further complicated because nations with strong SSA sensing and analysis capabilities may find important allies requesting they not release data on those allies' sensitive systems ("black payloads"); this already is the case with the United States' release of its catalogue. However, there is no compelling need to require the sharing of information on sensitive objects for civil SSA, and similar situations have been successfully dealt with in the context of NORAD. States which choose to operate sensitive satellites and not share data on their location are free to do so, but assume the implicit responsibility to ensure that those satellites do not collide with or pose a threat to other satellites. Thus, it is probable that international SSA data sharing will be confined to voluntary sharing of data on non-sensitive civil and commercial systems for the foreseeable future. There is a great deal of low-hanging fruit in civil international SSA data sharing to be gained, and attempting to expand the scope of discussions beyond that area seems likely to jeopardize the tangible and readily realizable benefits thereof.

Finally, it must be noted that "NORAD" is often used in non-expert discussion to denote the entire U.S.-Canada air warning and defense system and space warning system, or even the entire U.S.-Canadian joint military relationship. This is inaccurate. NORAD is specifically only a bi-national headquarters and command in which U.S. and Canadian forces participate. While supporting the NORAD mission, the actual combatant, operational, tactical, and administrative command and control of sensor and air defense assets is exercised by other commands, such as Air Force Space Command. When this analysis uses the term "NORAD," it refers only to the command organization; when the term "the NORAD system" is used, it refers to that headquarters and also the larger set of U.S. and Canadian set of capabilities that support it functionally for air warning and defense of the continent, and those space analytical functions performed under NORAD's auspices. This term also is used retroactively (and thus somewhat anachronistically) to refer to the system when it was under construction, before NORAD per se was formed and named in 1957. The ballistic missile defense capabilities currently deployed in Alaska and California, are run solely by the United States and are not a NORAD responsibility.¹

For the purposes of this analysis, there are three areas of NORAD's history deserving particular attention. The first is the **pre-formation period**, from the time of the initial Air Interceptor and Air Warning Plan of 1946 (issued by the Military Cooperation Committee of the U.S.-Canada Permanent Joint Board on Defense) through the start of NORAD operations in 1957 and the signing of the NORAD Agreement in 1958. It is possible to construct parallels between this period and the present in terms of the formation of an international SSA system. As in that era,

¹ The complete U.S. doctrine regard joint operations can be found in Joint Publication 1-0 "*Personnel Support to Joint Operations*", Joint Chiefs of Staff, 16 Oct 2006, online at http://www.dtic.mil/doctrine/new_pubs/jp1_0.pdf

there are proposals in circulation that may form part of a workable and desirable solution, but the political paths to achieving it are not clear, and the will to implement it has not yet been summoned. As was brought out in the history of NORAD's formation² there is a consistent impression that planning far outran the political will and motivation for actual implementation, and that action only followed specific precipitating incidents that had the effect of motivating consensus and commitment of resources. This may well turn out to be the case in SSA as well.

The second set of issues focus on the **operational history of NORAD**. Two main points stood out as relevant . The first was the degree to which the underlying charter of NORAD was particularly minimalist, and the consequent freedom of operation and adaptation which NORAD has seemed to have enjoyed. As Jockel points out³ this was partly due to the fact that the on-the-ground cooperation of the United States Air Force (USAF) and Royal Canadian Air Force (RCAF) far outran the civil authorities of both countries, and particularly the diplomatic functions. Persons unaware of the detailed history of NORAD often are surprised at the sparseness of the paper trail it left, not just at founding, but continuing to the present day. For example, one Canadian officer interviewed as part of this project (See Appendix A, Summary of Interviews) is currently working on a catalogue of the Memoranda of Understanding underlying current and recent NORAD operations, and discovered that even today, many areas are still dealt with primarily by handshake understandings, and that written MOUs lag far behind. This situation has been altered to some extent by the ending of the previous triple-hatting of the NORAD and U.S.-national commands, as previously, many operational "understandings" were essentially negotiated "by the CINC with himself", as one interviewee characterized the process.

The perception of NORAD's mission and function has changed several times from its founding through today. An organization conceived of to address attacks by reciprocating-engine Tu-4s had to evolve to deal with ICBMs coming over the Pole, come back to Earth to deal with stealthy Air-Launched Cruise Missiles (ALCMs) and today deal with air-related anti-terrorist missions. The flexibility (not to mention the imprecision) of its charter seems to have been particularly useful in enabling NORAD to adapt and survive. This would argue for a similarly minimalist charter for an international SSA data sharing arrangement that focuses on broad issues and solutions and not solely to prevent specific events from occurring again. For example, although any arrangement formed today would be focused on improving our ability to deal with incidents such as the Iridium-Cosmos collision, it is highly likely that ten or twenty years down the road other contingencies -- possibly entirely unanticipated -- will arise that cannot be tackled by a narrow solution. An international arrangement may need to deal with it. NORAD's history suggests that if an international SSA data sharing arrangement is in place, and has been considered successful, it will be looked to as the departure-point for a capability to deal with

² Jockel, Joseph T. *No Boundaries Upstairs: Canada, the United States, and the Origins of North American Air Defence 1945-1958* University of British Columbia Press, Vancouver, 1987 (Hereafter ""NBU")

³ Jockel, Joseph T. *Canada in NORAD 1957-2007: A History* McGill - Queen's University Press, Montreal & Kingston, 2007 (Hereafter "CiN")

such a contingency. *Mission creep* is the inevitable companion of success. In such circumstances, a loosely-drawn charter that permits such repurposing without extended negotiations among its parties will be a considerable advantage.

The second relevant point is that almost all the political controversy and tension between the US and Canada in NORAD's history has arisen over issues about what to do once data has been sensed and analyzed. Shortly after its inception, it became more evident that nuclear-tipped anti-aircraft weapons – BOMARC and GENIE – would be needed to give the system even a minimal chance of stopping enough bombers to render it worthwhile. The fact that such weapons would have to be based on Canadian soil created a government-toppling crisis in Canadian politics. Three different instances in which the US deployed or planned to deploy anti-missile defenses (Nike-Zeus/Sprint in the 1960s; the Strategic Defense Initiative in the 1980s; and the current BMD deployments in this decade) similarly created substantial political friction in Canada and tension between the NORAD partners. There seem to have been hardly any issues about the *need* to achieve situational awareness of airspace, or even the appropriate means for doing so. Disagreement on the sensing side of the problem primarily centered on issues over location, financing, and manning of particular stations, which although important to the participants at the time, were resolved through give-and-take bargaining typical of a partnership negotiation process.

The relevance of this for SSA data sharing is that it will be much easier to achieve a functioning international SSA data sharing arrangement if its charter, although minimalist in regard to means, firmly restricts it to a sensing and analysis function, and leaves response to individual participants. It is worth stressing that this distinction allows for very substantial latitude in sensing and analysis activities. For example, the arrangement might consist solely of arrangements and protocols for exchanging sensed data and space-object self-reported data among parties. Or, to give one example, it might provide for a physical facility staffed on an international basis where personnel from member parties work side-by-side in creating and maintaining a shared catalogue. This could include personnel from parties with no space objects and no sensing capabilities, to give such parties a stake in a worldwide problem. What it would not seek to do at the time of its founding is create a means for dealing with space objects once a problem has been identified and brought to the attention of the system's participants. Such actions – effectively, enforcement of a space traffic management system -- would either require a separate organization, or a negotiated follow-on at a later time to add such functions to a data sharing arrangement. The trust built up in working together on a data sharing arrangement would help pave the way for such a subsequent step.

The third area is broadly that of the **organizational culture and experience of a bi-national organization**. This project's activities included a series of interviews with officers having done NORAD duty, mostly but not entirely Canadian, and a workshop held at the Space Policy Institute on July 25, 2009, including a variety of participants in SSA policy. The interviews strongly reinforced the starting assumption that NORAD has evolved a strong organizational

culture in which the bi-national nature of the organization has been a particular point of pride and distinguishing characteristic. There has been a particular value, in the estimation of both the interviewees and the author, in U.S. and Canadian personnel serving side by side and in mixed reporting relationships, so that people become accustomed to reporting to and supervising the other nationality. Some points that were made repeatedly in the interviews stressed that, to the actual NORAD personnel, bi-national operation has been far more of an asset than a liability. The differences between U.S. and Canadian forces practices and organizational cultures have largely been complementary. In one example cited by several sources, divergent U.S. and Canadian promotion and posting practices, and the different scale of the two nations' forces, have resulted in the U.S. forces often having more intensely trained and knowledgeable personnel in NORAD, but on shorter tours. Canadians often are longer in any given rank and post, and have the opportunity to learn from several such U.S. specialists, and provide an otherwise-absent source of organization knowledge continuity to the combined operation. Another point made was that personnel come to view themselves as advocates for NORAD back to their national governments, rather than agents of the government in the organization.

Another observation made by several interviewees, both Canadian and American, was that during the period following the creation of NORTHCOM and CANADACOM shortly after the events of September 11, 2001, this bi-national transparency has been altered to some extent, because the particular structure has the effect of polarizing more differences of opinion along national lines, something which was rarely the case in past structures. This appears to be an unintended effect of the change in structures, and is all the more noteworthy. It was also observed that some of the changes noted were an unintended artifact of the change from the historical system of triple-hatting NORAD and U.S. national commanders⁴, which, by ending the situation of the commander "negotiating with himself," created a lag time of some years while paperwork was put in place to cover, for instance, the presence of Canadians in the Joint Space Operations Center (JSpOC) performing the SSA and space superiority mission. Thus the system is gradually re-establishing its bi-national nature. Bi-national, and in future, international cooperation is achieved by experience and effort, and can be degraded unintentionally by relatively minor changes. This suggests that if an international system were to have at least some operational center in which personnel from the various nations worked together for relatively extended tours of duty, it would create mutual familiarity and a network of personal ties that could have value in and of themselves in future situations.

⁴ By tradition, from 1985 through 2002, U.S. appointed NORAD commanders were formerly designated as commanders of three different entities: NORAD, U.S. Space Command (USSPACECOM), and Air Force Space Command (AFSPC). USSPACECOM is a US combatant command and its commander exercises *combatant*, *operational*, and *tactical* command and control of US joint (Army, Navy, Marine, and Air Force) forces. A combatant command such as USSPACECOM or U.S. Northern Command (USNORTHCOM) performs missions in support of NORAD as directed by the U.S. President and Secretary of Defense. AFSPC exercises Title 10 *administrative* organize, train, and equip control functions. AFSPC contributes forces to US combatant commands such as the former USSPACECOM as directed by the U.S. President and Secretary of Defense. Combatant command and control and administrative control functions are distinct. Double and triple hatting the commander in this way means that while the decision making may be unified, separate staff structures in the various organizations are needed to carry out decisions which impact more than one entity.

2. History of NORAD

Author's Note on Nomenclature. During the time periods covered in this section, the air services of the United States and Canada and their structures of governance each went through organizational changes. The air services of the United States (excluding naval and Marine aviation) were organized as a part of the U.S. Army and known as the Army Air Corps through 1941, at which time they became the U.S. Army Air Forces. In 1947, The USAAF became an independent service known as the U.S. Air Force, as it remains today. Prior to 1947 the Army was under the authority of the Cabinet-level Secretary of War. In 1947, the War Department and the Navy Department were combined into the Department of Defense, and three subcabinet Secretaries, of the Army, Navy, and Air Force, were established to administer their respective services. In Canada, the Royal Canadian Air Force was established in 1924. In 1968, the three Canadian armed services were combined into a unified Canadian Forces, administered by the already-existing Department of National Defence (DND), reporting to the Cabinet-level Minister for National Defence. The air forces now serve under an Air Command within the Canadian Forces. The forces under Air Command are sometimes referred to informally as the "Canadian air force".

This analysis will refer to each service by its historically correct name when it is discussed at a specific point in time. When referred to in the context of the entire time span of the study, the terms "U.S. air services" and "Canadian air services" are used to refer to the respective services regardless of the particular name or form they took in any given period. The U.S. air forces have consistently used Army-style ranks ("colonel", "general", etc.) throughout their history. The RCAF used the distinct rank structure ("group captain", "air marshal") created by the Royal Air Force. Upon unification, the Canadian air service adopted Army-style ranks. This study, when referring to historical Canadian personnel, will use the rank system that prevailed through the larger part of any individual's career, e.g., "Air Marshal C. Roy Slemon."

2.1. The Airspace Situational Awareness Problem in the Mid-20th Century

2.1.1. The Formational Influences of NORAD's Founders

The formation and structure of NORAD must be understood in the context of its environment. This includes the experiences and history of those who made the critical initiatives and decisions that led to the emergence of NORAD in its bi-national form. These founders dealt with a unique combination of new phenomena:

- The creation and use of radar-enabled airspace situational awareness capabilities on a continental scale across national borders, including the creation of sensor networks in operationally challenging Arctic environments;
- Binational cooperation between the U.S. and Canada, having had only recently

undertaken to collaborate deeply on continental defense, overcoming a long history of antagonism;

- The advent of the Cold War and the need for rearmament and almost complete upgrade of air forces;
- The use of nuclear, and then thermonuclear weapons in war, which radically changed expectations and needs regarding warning time, defensive strategies, defensive weapons, and the definition of success in defense.

Their task was one of integrating these disparate elements into a workable overall solution under the pressure of extraordinary events. Additionally, having solved all of these matters in the course of founding NORAD, the principals in rapid succession had to cope with the advent of intercontinental ballistic missiles and create the first modern, comprehensive system of space situational awareness. The principals also had to simultaneously reconfigure the surveillance system to deal with even newer threats, such as low-observable cruise missiles and air-enabled terrorism, while subsequently having to adapt the system to deal with even newer threats.

Given the success with which NORAD has met and matched its initial challenges, there is a certain amount of hindsight triumphalism that takes those successes for granted and minimizes the scale or nature of the challenges that were overcome. Whatever the challenges facing the creation of an effective international space situational awareness system, it is important to see the creation of the bi-national NORAD system as proof that air and space awareness can be achieved on more than a national basis and under challenging conditions. In particular, it is important to understand that prior to the creation of NORAD and its technical capabilities, it was not generally accepted that effective airspace situational awareness was desirable, achievable, or affordable, or that it could be done effectively as a genuinely bi-national project.

2.1.2. Airspace Situational Awareness Before and in World War II

The emergence of radar as an operational, rather than experimental technology did not occur until the late 1930s. As war became more and more conceivable, defense planners particularly in Britain began considering the possibility of an integrated, national-scale air defense warning and control system that would incorporate radar, and possibly make it the primary tool for detection and ground control. Research and development in radar was undertaken in other nations as well, particularly Germany, but it was not as great a priority, partly because German planners did not envision a prolonged war against powers with substantial offensive strategic air capabilities. German blitzkrieg doctrine discouraged large investments in defensive technology. Consequently, German radar development, although technologically proficient, was pioneered by its Navy, which understood that its role, other than in submarine warfare, was primarily defensive. German and British radar development took place independently; neither side was even certain that the other had any radar capability.

In Britain, however, the question of whether defense against strategic air attack was even

possible or desirable, as well as what if any measures would be cost-effective, was widely debated. The “strategic airpower” theories⁵ of Giulio Douhet, Hugh Trenchard, and William “Billy” Mitchell were well known in military and policy circles in developed nations, and debated widely in newspapers and magazines. British Prime Minister Stanley Baldwin's 1932 Parliamentary speech introduced the catchphrase "the bomber will always get through", which became a familiar encapsulation of this logic. The Royal Air Force (RAF) resolved the debate in favor of a substantial air defense establishment, combined with substantial investments in air command and strategic attack. The air defense investment included a hardened (by contemporary standards) integrated warning and command system, and a radar warning system designated CHAIN HOME, which used an simple but effective approach to radar, thus enabling the system to acquire approaching aircraft accurately as far out as 120 miles and sometimes even further. Unlike RAF, German radars used rotating antennas in UHF and VHF bands, which became the standard approach subsequently. CHAIN HOME used fixed tower antennas in HF bands, an idiosyncratic choice that had the advantage of not being recognizable as radar at all by German intelligence. German intelligence experts flew signal-intelligence flights in Zeppelins off the British coast during the spring and summer of 1939 to try to determine what the mysterious tall towers might be; encountering strong noise in the HF bands, they concluded that their equipment was malfunctioning.

Given the location of German bases used in the Battle of Britain, CHAIN HOME operators often acquired the German aircraft as they assembled after takeoff from their own bases, and monitored them continuously. CHAIN HOME was largely operational by the outbreak of war in September 1939, although the RAF continued to expand and improve it continuously thereafter. At its peak, CHAIN HOME provided effective warning around the perimeter of the entire United Kingdom.

Royal Canadian Air Force personnel were closely involved in the key phases of the Battle of Britain, working seamlessly with the Royal Air Force. The air defense elements of the RCAF were intimately familiar with CHAIN HOME and its capabilities, and were well aware of its critical contribution to the Battle of Britain. Key RCAF players in the formation of NORAD, particularly Air Marshal C. Roy Slemmon, who was Air Chief of Staff during the NORAD formational period and first Deputy CINC NORAD, valued a proactive air defense and a robust situational awareness capability due to their extensive experience in the military. The prewar air defense debate, and with it the CHAIN HOME debate, foreshadowed the subsequent debates regarding the need for airspace situational awareness following World War II in many particulars. The debate on the futility of defense, even passive civil defense, in light of the probability of the use for weapons of mass destruction was present, in the form of the assumption that strategic bombing would certainly include the use of chemical weapons. The actual case was that chemical weapons were made ready, but never used because of effective mutual

⁵ See for example *The Prophets: Advocates of Strategic Bombing* (http://www.centennialofflight.gov/essay/Air_Power/Prophets/AP11.htm)

deterrence and was dismissed as unlikely by many in the debate. This debate had real outcomes, in the sense that it affected the allocation of resources in the critical prewar period such that, had the decision been made to invest primarily or entirely in offensive strategic airpower and CHAIN HOME had never been built, the outcome of the Battle of Britain would have been much different. This lesson was widely appreciated within the RCAF.

The United States Army Air Forces (USAAF) watched the strategic airpower debate at a bit more of a distance than the RCAF, but with equal or greater attention. Unlike the RCAF, the USAAF had a very proactive strategic airpower element in the prewar years and a strong tradition of advocacy through voices such as Mitchell and later Curtis Lemay. Still assuming invulnerability to major air attack through the insulation of oceanic distances, the USAAF placed air defense at a substantially lower priority than did the RAF. However, the Battle of Britain was too obvious of an example not to serve as a lesson learned. The other lesson learned -- a very searing one -- was the disastrous lack of effective air warning and defense at Pearl Harbor and the Philippines on 7/8 December 1941. The lesson was compounded by the fact that radar sensing capability was in fact present at Pearl Harbor, in use (albeit experimentally) at the time of the inbound attack, did acquire the attacking aircraft, but failed to identify the attackers correctly, failed to relay effective warning to the local command authorities, and failed to remain in operation to maintain contact with the incoming aircraft. Furthermore, these problems were compounded by the fact that the national command authority was aware of the likelihood of an imminent state of war. It furthermore knew that the enemy customarily began its wars with an immediate strike against opposing naval assets. Despite this knowledge, the national command authority was unable to send a timely alert or order to upgrade readiness states because the only available communications channels were an unsecure single-string military radio channel which was down at the time, and a commercial single-string radio channel with no ability to take priority measures to accelerate transmission or delivery.

All of these challenges are worth stressing because from the time of proactive air warning planning onward in North America, remedies to these problems -- including secure, redundant, 24/7 operational channels of communication between sensor, assessment capability, defense command and control, and national command authorities - have been part of the basic requirements of any air or space situational awareness and response capability. The early planners of air defense were only too well aware of both the historical cases in which these capabilities were not available, and the case in which they had been made available, with drastically different outcomes.⁶

Throughout World War II, CHAIN HOME and a proliferating variety of radar and other sensor

⁶ Although no example of a direct comparison has come to the author's attention, it would have been instructive to have overlaid the coverage footprint of CHAIN HOME on the Hawaiian Islands -- by doing so, the launch point of Admiral Yamamoto's aviators would have been within the marginal extreme range of CHAIN HOME. If the operators had not detected the actual takeoff of the attack squadrons over the Japanese fleet, they would certainly have detected them shortly afterwards.

applications continued to improve the capabilities of air defense. The use of on-board radar in night interceptors was a major innovation. British and other Allied forces increased their margin in this area, due in part to German Air Minister Hermann Goering's technological conservatism.⁷ All-weather night interception capabilities became yet another standard part of the capabilities mix, further increasing the cost and complexity of a modern integrated air defense system, but also increasing the abilities of air defense.

Although the British achievement of CHAIN HOME became an essential contribution to a decisive victory in the Battle of Britain, and thus instrumental to the outcome of the war, the Germans ultimately developed a sophisticated airspace awareness, radar-guided anti-aircraft and ground control interception system covering Germany and much of occupied Western Europe. This system caused heavy losses to Allied strategic forces. However, unlike CHAIN HOME, it did not deter its opponent's strategic bombing, which only grew heavier and more effective through the course of the war. Thus it too served as a lesson learned to the Allied air services of the critical role of airspace situational awareness.

The other significant accomplishment of CHAIN HOME came in response to the introduction of short-range ballistic missiles by Germany in 1944. The operational advent of the V-2 in September 1944, led to the rapid adoption of countermeasures by the Allies. One such response was Operation BIG BEN, which included adaptation of the CHAIN HOME system to detect incoming V-2s, backtrack the trajectories to the launch location, and vector air attacks to the launch sites, as well as give warning to emergency responders in the target area.⁸ CHAIN HOME proved to be readily adaptable to detection and assessment of SRBMs. Although research has not encountered any specific documentation of this point, it may be the case that awareness of the BIG BEN operational history may have contributed to the confidence with which NORAD responded to the expansion of its responsibilities to include ballistic missile early warning in the ICBM era. The CHAIN HOME experience may also be worth further study, in that the V-2 campaign was the largest data base to date of objects launched into space and returned on ballistic arcs to earth targets. As such, the BIG BEN application of CHAIN HOME is the largest historical data base on space situational awareness, warning, and response in real-world situations.

The greatest impact of the World War II experience on the foundation of NORAD may have been simply that the value of air defense and the need to address the balance of defense investment between defensive and offensive capabilities was taken deeply to heart by both American and Canadian air force personnel. The Americans had seen their war open with a catastrophic failure of airspace situational awareness and response. The need not to be again

⁷ Göring's technological conservatism was illustrated by his response to a proposed German cockpit radar system: "My pilots have no need of cinemas in their airplanes". This would be neither the first nor the last example of the weakness of totalitarian intolerance for open debate in decision-making.

⁸ Cabell, Craig, and Thomas, Graham A. *Operation BIG BEN: The Anti-V2 Spitfire Missions 1944-45*, Spellmount, 2004

taken by surprise was a lesson every professional military person had internalized. The Canadians had been intimately involved in one of the war's most brilliant and critical successes -- the Battle of Britain was almost certainly the highest-profile success of air situational awareness and air defense in history. Churchill's verdict -- "Never before have so many owed so much to so few" -- could also be taken as a scathing critique of pre-war underinvestment in air defense. If so many had staked so much, why on earth had they come to depend on so few? Alongside "Remember Pearl Harbor", Churchill's words served to buttress every argument for greater investment and a greater weighting of the scales to defense in the subsequent half-century of debates. Ironically, that ongoing debate ends up being, in essence, a contest between opposed quotes from two British Prime Ministers: Baldwin's "The bomber (today read, *missile*, or *terrorist*) will always get through" versus the implication of Churchill's epigram. Strategic attack, weapons of mass destruction, mutual deterrence, new-technology sensors, defense countermeasures, attack response and damage mitigation -- all of these issues have merely replayed themselves with new actors and new levels of technology since then.

2.2. The Postwar Period in the North American Context

2.2.1. A Clean Sheet of Paper: The Military Cooperation Committee and the Air Interceptor and Warning Plan of 1946

The end of military operations in 1945 created two great conflicting movements within the defense establishments of the United States and other Allied nations. The first movement was the massive demobilization of the military and defense capabilities created to fight the war in conjunction with the pent-up desire to shift spending from military to civilian goals, and enable postwar relief and reconstruction efforts on an enormous scale. The second movement was the fervent desire of the military and defense professionals never to go back to the state of unpreparedness and lack of situational awareness that characterized the opening days of the war, a state that, in the firm belief of all parties, had served as an invitation to the totalitarian powers to unleash their aggression in the first place. If you had asked any such professional to describe the lesson learned from World War II, he would have been able to do no better than quote the old Roman motto *si quaeris pacem, pares bello* (if you wish peace, prepare for war).

The political establishments of the Allied nations experienced a parallel split in motivations and sentiments. As is typical of politicians in democracies, they made an imperfect compromise, which led to a small but non-trivial investment in planning and forecasting, while investing only the minimum in expenditure for actual research and development in new capabilities. The United States' services had inherited a stupendous amount of war materiel, and with conscription still in force, could maintain a sizable military fairly cheaply for some years. Few saw any active opponent on the horizon; many still saw the USSR as a recent ally with whom any differences could probably be resolved by good will and negotiation. Less optimistic people in that regard could still see that the USSR had been utterly ravaged by the war and would probably be preoccupied with reconstruction for the foreseeable future. Finally, the possession of a

monopoly of nuclear weapons by the United States was likewise thought to be a guarantee of peace for the foreseeable future; certainly an impoverished and ravaged nation of peasants (as the USSR was generally supposed to be) was hardly going to produce atomic weapons or bombers that could reach America any time in the near future.

One of the things that the United States could do within available resources was to build on its wartime alliance structures and undertake comprehensive planning. The United States had entered World War II with very little experience in creating and managing alliance structures. During World War I, it had joined and participated in existing Allied structures as a new and junior partner, and had only just started to gain enough experience in inter-allied affairs and combined operations to be effective when the war ended. The United States had entered World War II as a junior partner to the British, both in resources and experience; most historians now believe that the balance changed overall during 1943, and the United States from that point on became the senior partner. One of the first allied mechanisms set up by American initiative was the Permanent Joint Board on Defense (PJBD) established by President Roosevelt and Canadian Prime Minister William Lyon Mackenzie King in 1940, which still meets today. As its name implied, it was intended from the start to be a standing body and outlast the war, which the United States had not yet entered at that point. As such, it was one of a rather few allied bodies that was specifically permanent. In 1946, as part of a general effort in U.S. forward-looking defense planning, the PJBD established the subsidiary Military Cooperation Committee (MCC) to undertake a general plan for the defense of North America in any future conflict.⁹

The subsequent Air Interceptor and Warning Plan of 1946, produced at Hanscomb Field, Massachusetts, envisioned a comprehensive radar sensing capability provided by several layers of radar warning stations, including an outer perimeter with a chain of stations around the northern eastern, and western periphery of the North American continent, including U.S., Canadian, and Newfoundland national territory. Newfoundland was a separate Dominion that had been administered by a joint British-Newfoundland appointed commission from 1933 until it unified with Canada in 1949; the Plan envisioned most of the radar stations in Newfoundland being established on the U.S. bases obtained under the U.S.-British Destroyers-for-Bases Agreement of 2 September 1940.

The Plan further specified that an inner perimeter be built to form a ring around the industrial core of the northeastern United States and Canada — presumed to be the primary target for any attack. The Plan also envisioned a bi-national command center receiving and assessing sensor input, and controlling U.S. and Canadian interceptors. Given some relatively minor changes, the 1946 Plan is very much like the final NORAD plan as adopted in 1957. This is not surprising; any planner working with the constraints of radar technology as it existed in that era, examining the experience base with CHAIN HOME and other wartime systems, and given the mandate to

⁹ Jockel, Joseph T., and Sokolsky, Joel, eds. *The Road from Ogdensburg: Fifty Years of US-Canada Defense Cooperation* The Edward Mellen Press, Lewiston/Queenston/Lampeter 1992 pp. 9-25 (Hereafter "RFO")

defend the whole continent, would likely have come up with something close to the architecture defined in 1946.

It is of interest, however, that the Plan emphasized the need to defend the continent at the perimeter, and that defense should be actively bi-national, rather than merely allied or cooperative, from the start. The geography of North America, and the placement of the U.S.-Canada border, relative to the centers of population and industry, is such that it is simply not realistic to defend it against nuclear-armed air attack, especially from the USSR, on anything but a fully bi-national basis. The subsequent history of NORAD's formation confirmed this preliminary assumption, as the two nations' forces experimented with lesser measures, and continually found them inadequate. The Plan assumed that the USSR was at least a potential enemy. It assumed that it would get bombers capable of at least one-way missions from Soviet territory in the foreseeable future, and it assumed that it would have nuclear weapons at some point in the future, although its assumptions about the likely time scale tended to be overly optimistic.

Given these assumptions, it was desirable to detect and assess any such attack as early as possible, in order to:

- Mobilize the maximum defense resources to attempt to intercept the attack force;
- Permit the maximum in civil defense countermeasures;
- Give retaliatory forces the maximum possible time to sortie and move toward their targets;
- Engage the enemy as far north as possible.

All four of these goals would remain on the NORAD agenda throughout its existence, although different goals would receive different weighting in different decades, and the U.S. and Canadian governments would assign in some instances different weightings within those decades, which, as will be discussed, became a source of tension between the two partners.

In particular, the problem of defense of North America against a Soviet air attack emphasized moving the battlespace as far north as possible, for somewhat different reasons for each nation. Assuming that the Soviet forces would eventually carry nuclear weapons, as they eventually did, stopping as large a number of bombers as possible became much more important than in World War II air defense. Given the very limited capabilities of air defense in the immediate postwar era, especially the primitive guidance, it then became essential to use nuclear air defense weapons, in order to get the highest possible percentage of kills and to make the kills as likely as possible. The best way to assure this was to place a nuclear warhead as close as possible to enemy bomber formations and explode them. Ultimately, two such weapons became main air defense weapons: the MB-2 GENIE and the CIM-10 BOMARC. The former was an early air-launched, short-range, nuclear-armed missile; the latter was an air-breathing surface-to-air

missile, also with a nuclear warhead.

For both Americans and Canadians, detecting and engaging the Soviet forces as early as possible was desirable. However, this was even more important to the Canadians due to use of nuclear weapons: even a successful engagement with attacking bombers could be catastrophic for Canada if the interception took place within the first hundred miles or so of the border, over or near Canada's main population and industrial centers. To accomplish this northward movement of the battle space, however, was a challenge of a daunting magnitude for the airpower capabilities of those days, or in fact any day. In order to permit this detection and engagement to take place far enough north that such harm was minimized, a massive network of radar detection stations of an unprecedented scale, would have to be financed, built, and manned on Canadian (and pre-1949, Newfoundland) soil. A substantial chain of air interceptor bases and surface-to-air missile sites, again on an unprecedented scale, would have to be financed, built, and manned on Canadian soil, and many squadrons of advanced all-weather jet interceptor aircraft acquired, crews trained at a high level of aviation skill, and manned and maintained on what is now termed "24/7" ready alert status, for the indefinite future. Worse yet, much of the radar system would have to be built, manned, and maintained in the sub-Arctic and Arctic regions of Canada, where little or no infrastructure of any kind existed, transport was problematic even in the mildest seasons, and the sole population was native peoples still living a mostly-traditional lifestyle.

Most problematic of all, the nature of the defense weapons required that nuclear weapons be maintained on Canadian soil ready for use at any moment. Neither of the two options for accomplishing this -- leaving them in the hands of U.S. forces stationed on Canadian soil, or arming and training Canadian forces to operate such weapon -- was viewed as acceptable by substantial sectors of Canada's public policy commentariat and political system. This triggered an ongoing series of internal political battles within Canada, and awkward periods in U.S.-Canada relations, that were never adequately resolved throughout the entire period in which nuclear-armed defense weapons were operational. This issue built on top of a long history of contentious U.S.-Canadian relations, which will be discussed in the following section. Suffice it to say that the presence of substantial numbers of U.S. uniformed personnel and weapons, particularly nuclear weapons, on Canadian soil in peacetime was unprecedented and not universally accepted. The alternative of arming Canadian forces with nuclear weapons and in essence making Canada a (limited and conditional) nuclear power also created qualms in Canadian circles given Canada's historical aversion to nuclear programs of any sort, civilian or military.

The 1949 union of Newfoundland with Canada also complicated the situation. Canada was reluctant to admit the principle of stationing U.S. forces on its soil in peacetime. Yet the union with Newfoundland resolved that issue in that Canada effectively inherited the U.S. bases already existing there. The presence of those bases was a consequence of an international agreement for which the United States had fulfilled its obligations in full, while the reciprocal obligation of hosting the bases continued through 2039. The union with Newfoundland meant

that Canada had assumed those obligations, including an unusually broad status-of-forces agreement that gave the United States jurisdiction over even host-nation nationals on the base premises. Nor could Canada have readily demanded the termination of base agreements at the time of union, since the bases had become a mainstay of the depressed Newfoundland economy. Union had only passed by a narrow margin of 7,000 votes, and it certainly would have failed had the Canadian government publicly admitted that they wished to close down Newfoundland's primary hard-currency earner.

The United States did not admit that the bases had been, or were to be used for, storage or transit of nuclear weapons, but given the fact that the bases at Gander and Goose Bay were normal refueling stops for aircraft of that era on trans-Atlantic flights, and that US Navy vessels routinely docked in Newfoundland, it is not unlikely that nuclear weapons had at a minimum transited through Newfoundland without specific disclosure to host-nation authorities either before or after Union. Furthermore, since the Dominion of Newfoundland was effectively under British administration from the inception of the basing agreement in 1940 through Union in 1949, it is likely that British authorities, if they were consulted, would not have had the sensitivities about nuclear weapons that Canada had, given that the United Kingdom had a robust nuclear weapons program of its own and was at that time in the process of developing its own nuclear strike force. In fact, had the Newfoundland referendum on union gone the other way, which given the closeness of the question was certainly possible, the future of NORAD might have been quite different, possibly being a tri-national organization from the start, and one in which the questions of nuclear weapons on Newfoundland soil would have been a non-issue, and one whose resolution would have colored the question in regard to Canada. Pursuing the counterfactual in this regard might be an interesting exercise, but one that is beyond the scope of this paper.

Viewing NORAD and the continental air and space defense system it coordinated in hindsight, it is easy to take for granted its achievement. Yet understanding the starting-point from which it was built, and the unprecedented nature of the physical, technological, and political challenges that were faced and overcome, it is hard not to be impressed with the vision, persistence, and dedication of the many Americans and Canadians who worked for over half a century to safeguard North American skies and space. It also stands as a lesson and existence proof for those contemplating the challenges of a broader international system for space situational awareness data sharing, that cooperation can be gained, and obstacles, whether political or technological, can be overcome.

2.2.2. Legacies of Suspicion: Overcoming Historical Barriers to Close U.S.-Canada Cooperation

The preceding paragraphs alluded to the effects of lingering historical frictions in dealing with sensitive issues such as presence of U.S. military personnel on Canadian soil in peacetime, and especially the issue of nuclear weapon storage, control, and use on Canadian soil. On issues such as the use of the NORAD system's assets for ballistic missile defense, these past issues can

still overhang debate in contemporary Canadian political life. It is important to understand the depth and breadth of historical U.S.-Canadian antagonisms to fully appreciate the magnitude of the achievement represented by NORAD's history of successful bi-national operation. It would be tempting for skeptical commentators to discount the value of the NORAD precedent in international collaborative work on the grounds that the U.S. and Canada have so much in common, in language, national culture, and shared history, that cooperation was automatic and free of the sorts of national antagonisms that might be encountered in bringing other partners into an international system.

The reality has been substantially more complex. It is true that the United States and Canada share a large amount in common, particularly when viewed from a global perspective. In fact, there has been over the countries' history a substantial interchange of population, making Canada the only nation to have been the destination of a substantial number of emigrants from the United States. (And these common things have in fact been useful in constructing the framework of U.S.-Canadian defense cooperation during and since World War II.) However, these commonalities should not lead to ignorance of the fact that the United States and Canada are separate states with distinctly different situations, concerns, and state agendas. These differences have in the past led to armed conflict and periods of mutual antagonism. Although this legacy is very much a background today, and in many ways far more strongly overshadowed by the history of joint effort by the United States and Canada in and since the Second World War, it nevertheless remains as a factor that can arise whenever any U.S.-Canadian policy disagreements are debated in Canada.

It is easy for Americans to forget, or never to have known, that the ancestors of a key founding element of Canada were refugees driven out of the United States at the conclusion of its Revolution, a group larger as a percentage of population than the French refugees from the Reign of Terror; that the United States has invaded Canada with the stated goal of annexation in two wars, burning Canada's capital the second time; repeatedly annexed by force, threat of force, or diplomatic pressure, territory reasonably claimed by Canada, most recently in 1903; acted as a safe haven for terrorists openly planning, and carrying out, raids into Canada in the 1880s; and sheltered draft dodgers from the Canadian military at the start of both World Wars. In short, the United States has done to Canada at some point in the past two centuries most of the aggressive things one state can do to another. Even when they are aware of them, these events may seem like ancient history to Americans. However, in considering the critical founding era of NORAD, one must remember that the key elements of the Canadian government experienced the latter part of these negative events in their formative years. Consider the following quotes by two representative figures:

"The Americans have apparently walked in [to Northwest Canada, in the construction of the Alcan Highway] and taken possession in many cases as if Canada were unclaimed territory inhabited by a docile race of aborigines...Canada has been too preoccupied by her own war effort to cope with the Americans who unfortunately under

the cover of the needs of the war are acting in the Northwest as if they own the country." Vincent Massey, High Commissioner of Canada to the United Kingdom, 1943¹⁰

"There is already an increasing and in some manifestations an unhealthy preoccupation with the strategic aspects of the North [of Canada]; the staking of claims, the establishment of bases, the calculation of risks. For no country have these faint stirrings of unhallowed but all too familiar fears a greater or more sinister significance than for Canada." Lester Pearson, Canadian Ambassador to the United States, 1946, writing in *Foreign Affairs*.¹¹

To contemporary eyes, the idea that the United States was in 1943 acting with any serious intent to annex or control Canadian territory during or after World War II seems close to paranoia. The fact that both quotes are from former Ambassadors to the United States, one a future Governor-General and the other a future Prime Minister, suggests that such thinking -- the *all too familiar fears* alluded to by Pearson -- was widespread in high Canadian political circles at the time. It is worth considering, however, that Massey (1887-1967) was sixteen at the time of the Alaska boundary dispute of 1903, which was then a major issue for Canada, especially when the British member of the arbitration panel voted for a result considered far too favorable to the United States. In Canadian eyes, this was yet one more instance of the United States grabbing Canadian territory and Britain backing down from defending the claim under American pressure. It was perhaps not incredible that, writing forty years later, he might fear that the United States could turn its presence in the Yukon Territory into another territorial claim.

Pearson (1897-1972), born a decade after Massey, seems equally paranoid, making it clear that "for no country...than for Canada" did the U.S.'s interest have "more sinister significance". Considering this statement is from Canada's Ambassador to the United States, and a future Prime Minister who actually won election by taking a more pro-American position on nuclear weaponry than the opposition, the undertones of suspicion are telling. This is America's *friend* speaking. Yet this mindset, still widespread at the end of the war in higher circles, was dwindling in the face of the experience of U.S.-Canadian comradeship in arms during the war. A new generation of Canadians was rising to leadership positions in the military and eventually in civil government, for whom the issues of 1903 were past history, but the memories of wartime cooperation were recent and vivid. The Americans who had worked with them were equally matter-of-fact about the reality of cooperation to defeat a far more alien and far more threatening power. Their lessons learned were those of the need for preparedness, the need for cooperation among allies, and the need for pragmatic measures administered pragmatically as the need was foreseen.

¹⁰ NBU, p. 2

¹¹ NBU

If Massey represented the old generation still fundamentally formed by prewar attitudes, and Pearson was a swing generation aware of the legacy of suspicion but convinced by events of the need to cooperate, the new postwar generation was well represented by C. Roy Slemon, (1904-1992) a lifelong airman and eventually Air Marshal and the first deputy commander in chief (DCINC) of NORAD. Slemon was a Western Canadian, born in Winnipeg, who, unlike Massey and Pearson, did not come from the small, closely-knit Eastern Canadian elite. He joined the Canadian air service in 1924, soon after its formation, and rose through the officer corps, spending many years flying aerial photography missions in western and northern Canada (which made him intimately familiar with the terrain over which the NORAD system would have to operate) and eventually serving in staff and high-level command positions in Europe during World War II. His generation had a pragmatic approach to cooperation with allied forces, whether British or American, and took the air defense task for North America with utmost seriousness. This pragmatism clashed with the older generation of political leadership. As Chief of Air Staff, RCAF, from 1953 through 1956, he had made what he had thought were off-the-record comments at a function to the effect that a continental (i.e., bi-national U.S.-Canadian) air defense command was "inevitable". This caused a minor political crisis, forcing the government to claim that no such thing was being planned. This of course merely predicted NORAD as it became the following year. One can suspect, although there is no certain documentation of it, that Slemon's indiscretion was primarily the result of this clash of basic assumptions between the upper political levels and the pragmatists of the war-influenced military. The formation of the former was still fundamentally prewar, and in some senses still marked by the colonial/anti-colonial opposition viewed through the lens of that generation's political task -- to be able to place Canada's interests ahead of Britain's when they were in conflict, and to prevent Canada from merely passing from British influence to American. Slemon's generation took Canadian self-government and national interest for granted, and concentrated on using the tools of national self-determination to pursue national interests.

In their own ways, Massey, Pearson, and Slemon were each pioneers of Canadian self-government and self-determination. Massey was the first Canadian ambassador to any position -- Canada had previously been represented entirely by the British Foreign Service. He became, eventually, the first Canadian Governor-General. Pearson was the first Canadian ambassador to the United Nations, and pioneered the strategy of using Canada's membership and participation in international organizations to leverage Canada's role in foreign affairs. This strategy was exemplified by his initiative in creating the international peace-keeping force as part of the resolution of the Suez crisis of 1956, for which role he received the Nobel Peace Prize. Slemon was a member of the first generation of Canadian pilot-officers trained by the RCAF, as opposed to those who had served in the British air arms during World War I, and thus of the first generation of Canadian airmen to grow up with a Canadian institution, in which pursuit of wholly Canadian objectives was assumed as a matter of course. In his service in the Allied effort in the Second World War, his relation with British and American services was one of formal equality and close cooperation. This was due to the sharp reaction in Canada and other Dominions to their treatment in World War I, in which Canadian forces were assigned as the

British high command saw fit; in World War II, the Canadians sought to have their forces remain distinct, although still under overall Allied command. Slemon capped his career as Deputy Commander-in-Chief (DCINC) NORAD-- an entity of which he was essentially a co-founder -- and in which role he pioneered a new advance for Canadians, in sharing command of a bi-national defense organization in which Canada was a formally equal partner.

These three pioneers thus exemplified threads of Canadian thought and sentiment that, in various combinations, continue to determine Canadian reactions to cooperation with the United States. Constructing the NORAD system, and maintaining its operations through multiple substantial evolutions of technology, strategic doctrine, and successive U.S. and Canadian governments and their needs in a manner that satisfied these multiple and conflicting demands, was an accomplishment of no little political skill and will on both sides of the border. As such, it serves both as an existence proof of the ability to place old disputes and historical sensitivities in perspective when driven by need, and a forewarning that construction of any international system for data sharing in space situational awareness will likely have equal or greater obstacles and will require equal or greater persistence by its advocates. Perhaps the most obvious lesson is that perception of need is the strongest incentive for cooperation. In the case of the NORAD system, the prospect of suffering attack with nuclear weapons did wonders in focusing the mind of its eventual architects. Today's advocates of international SSA data sharing would do well to focus on a clear and pragmatic presentation of the particular problems to which SSA data sharing is a solution. NORAD's founders discovered, as will be discussed subsequently, that it was necessary initially to attempt less-than-global global solutions to their problems. As these solutions were tried, one by one, each would prove inadequate. It was this experience that convinced national decision-makers that no solution short of the full NORAD framework would be adequate. At the same time, in the real world, legislatures did not make authorizations or appropriate funds until a crisis was on hand. They had to continue to make their case and have plans ready for the moment at which national authorities were finally ready to act. It is likely that current international SSA data sharing will follow the same course of action.

Ultimately, the creation of NORAD satisfied, or was at least acceptable to, all three strands of Canadian sentiment. As will be seen, the technical demands of the NORAD task were relentless and gave no quarter to political sensitivities. So, in the end, Canada simply did not have enough trained personnel to meet the specialized needs of the radar stations needed for the NORAD warning system, nor was Canadian industry able to provide all the technical equipment for the first generation of radar stations. Thus Canada was reluctantly forced to agree to the use of American personnel in manning many of the early radar stations until adequate Canadian personnel could be trained to do so. But due to the concerns that preoccupied Massey's generation, and as can be seen were not absent from Pearson's, care was taken to assert Canadian sovereignty in regard to the stations and the American personnel present. Canadians were not treated as "a docile race of aborigines", to use Massey's phrase.

Likewise, Pearson and other Canadian internationalists were able, with the aid of the creative use

of ambiguity, to weave the NORAD thread into the fabric of the Canadian narrative. Specifically, Pearson, both as Ambassador to the United States and later as Minister for External Affairs during NATO's formational period, had maximalist ambitions for NATO, perhaps the most ambitious of any of the national founders. He had pushed hard for an "economic dimension" (8, 9) to NATO -- essentially, a North Atlantic free trade area -- in parallel to its military and parliamentary dimension. The economic dimension of NATO is an idea that had its predecessors in the advocacy of "Atlantic federalists" such as Clarence Streit¹² and would show up again during Pearson's premiership in the form of the proposed U.S.-UK-Canada North Atlantic Free Trade Area negotiated, but never implemented, between Lyndon Johnson, Harold Wilson, and Pearson in the late 1960s. It is a persistent idea and has reappeared in the past decade - now dubbed the Trans-Atlantic Free Trade Area or TAFTA -- often from somewhat surprising sources such as former French foreign minister Hubert Védrine, previously a strident critic of globalization.

Although frustrated in his ambitions for the economic side of NATO, Pearson had reason to be gratified with Canada's role as a founder and credible player within NATO. That role is in fact a conspicuous success of the Canadian "place at the table" strategy, rather more so than Canada's participation in United Nations affairs. Canada maintained permanent combat units in Europe until the end of the Warsaw Pact, an extraordinary state of affairs given its size and historical isolationist sentiments. In the early 1960s, it went so far as to consider acquisition of tactical nuclear weapons for its NATO forces. Given the importance of Canada's NATO role -- one supported strongly by both major parties by 1958 -- it is not surprising that linking NORAD to NATO in some fashion became a persistent theme in Canadian politics. This had the effect of creating an ongoing confusion, as will be discussed further, as the US side -- most particularly the Joint Chiefs of Staff (JCS) -- was adamantly opposed to linking NATO and NORAD. The JCS was concerned both about the possibility of subjecting the defense of North America to NATO control, and also with any possibility of being forced to share secure NORAD information with NATO members, not all of which were fully trusted with secure information. The Diefenbaker government chose to represent NORAD as a NATO function in arguing the case before the Canadian parliament, yet there was - and is - nothing in any of the NORAD agreements that links the two organizations. It is true that NATO's enabling agreement, the Treaty of Brussels, formally binds its signatories, including the United States and Canada, to a mutual defense obligation, and thus the NORAD agreement can be represented as an arrangement for fulfilling that obligation, but that is not the same as placing NORAD within a NATO complex. In the end, the issue was dealt with by further obscuring the point.

NORAD is also a particularly good example of the strand of pragmatic cooperation between Canada and the United States. Since cross-border cooperation to an unusually high degree

¹² Streit, Clarence K. *Union Now: A Proposal for an Atlantic Federal Union of the Free*, Harper & Row, New York, 1939

among neighbor nations has been typical of the US-Canada relationship, even during the periods in which official relationships have been strained, what is noteworthy is the pragmatic aspect of the relationship. Abstract intellectual constructs have played little or no role in U.S.-Canada collaboration, and have had little purchase on the imagination of either popular or elite levels in either country. On the contrary, America has more typically been devoted to a vision of American exceptionalism that inherently downplays U.S.-Canadian commonalities; in earlier eras, Anglophobic sentiments were often political crowd-pleasers, and Canada was treated conceptually as a part of the British empire long after it had evolved to effective self-determination. On the Canadian side, most idealistic constructs of identity and attachment have been consciously non-American or anti-American: the Tory tradition has stressed the Loyalist heritage and the sacrifices of exile in the American War of Independence, the Crown's role in Canadian constitutionalism, and the connections of Empire and Commonwealth; the Liberal tradition came to stress Canada's involvement in international organizations abroad and its binational and multicultural nature at home.

In no case has there been a "North Americanism" or "Continentalism" equivalent to the Europeanism of the European Union. The few trial balloons for the concept of a North American Union on the EU model have drawn fainthearted flickers of interest from the ivory tower and violent rhetorical opposition from conspiratorial-minded websites on both sides of the 49th Parallel. This lack of an overarching theory of connectedness has been to some degree an advantage: it has required each cooperative step to defend itself in terms of relevance to an immediate need, and thus has added clarity and focus to such efforts. The contrast between U.S.-Canada cooperation stands out in particular in comparison to the joint defense projects of the European Union, which tend to be driven by an politically-generated desire to display cooperation whether or not there is a clearly-defined need or focus. This is particularly true because those areas of joint European defense in which cooperation makes clear and obvious sense have tended to already have been addressed through joint NATO programs in which U.S. and Canadian capabilities play an important part.

The degree to which there have been problems between the political levels of the United States and Canada over NORAD has usually reflected the tensions within the Canadian political system among these strands and U.S. reaction thereto. There have been three main areas of contention:

1) The fact that the maximal Canadian expectation in 1958, following the conclusion of the initial NORAD Agreement, was full pre-consultation with the United States on continental defense issues, including responses to events taking place beyond North America that had continental defense implications. These expectations were allowed to arise in part because the actual text of the Agreement was ambiguous, and in fact did not represent any explicit consensus between the negotiating parties. The obligation to mutual consultation was inserted at the last minute at Canadian request, and was then used by the government in justification of the agreement. Subsequently, the sequence of events around the Cuban Missile Crisis established that mutual consultation would not be the case: the U.S. government made its decisions without

consultation with Canada; Kennedy called Diefenbaker only to inform him of the decisions made. NORAD was intended to be purely a military arrangement for the efficient conduct of air defense operations. Contrary to the interpretation implied by the Canadian government's statements at the time of the NORAD Agreement, it was not a "continental NATO", in the sense of a general U.S.-Canada partnership on defense. Even today, many Americans and Canadians alike continue to share this misconception; for example, most are not aware that while NATO is established by treaty, NORAD is sanctioned only by an exchange of notes, or are aware of the differences that this implies. Differing understandings of NORAD have given rise to friction between the American and Canadian political systems regularly over the history of the relationship. Partnership and the "place at the table" -- the Canadian voice -- is a key element of modern Canadian political identity. Realism dictates that Canada -- with a tenth of the resources of the United States, and a lower percentage of GDP dedicated to defense -- cannot reasonably expect to have a veto over American actions. However, it is important to the Canadian system that it be able to show that it was listened to. Americans tend to undervalue this and focus on actual exercise of power. Thus, they often fail to see much value in a consultation that is not a veto, thereby assuming that the Canadian quest for an advisory role is a disguised demand for a veto.

2) Command and control of nuclear warheads in Canada was a problem throughout the period in which effective air defense required the use of such. As discussed previously, the initial design of the North American air defense system assumed a war of subsonic jet fighters scrambling to intercept 350-knot piston bombers carrying 20-kiloton nuclear bombs. In such a war, sufficient attrition of attackers to provide effective defense was imaginable if and only if the defenders could launch nuclear-tipped missiles into the formations of approaching bombers. Guidance systems were far too primitive in that era to permit effective non-nuclear defense weapons. Thus, both American and Canadian forces understood that defense must be nuclear. Since geography required (and weapons effects strongly advised) that the engagement be performed as far north as possible -- i.e., primarily over Canada and Alaska -- either the interceptors would have to be Americans armed with nuclear weapons, similarly-armed Canadians, or a mixture of both. Since Canada as a practical matter could not field sufficient interceptors to support an adequate defense, in practice American interceptors with nuclear weapons would have to be permanently based on Canadian soil, and Canadian interceptors would have to be armed with nuclear weapons that Canada did not possess. The United States volunteered to provide Canada with the MB-2 GENIE air-to-air missile, armed with a 1.5 kiloton warhead, and the CIM-10 BOMARC anti-aircraft missile, armed with a warhead in the 7 to 10 kiloton range.

Both the question of whether Canadian forces would accept U.S.-provided nuclear warheads -- the point on which the Diefenbaker government fell -- and the question of whether the US would be permitted to maintain nuclear forces on Canadian soil created tensions on all three grounds. Canadian self-determination found the presence of U.S. nuclear weapons hard to swallow. Canadian multilateralism and internationalism became conflicted between three elements: the

multilateralist desire to do their duty to NORAD and (in the related question of nuclear weapons for Canadian forces in Europe) NATO; the desire for Canada to play a leading role in nuclear arms control, which was rendered more difficult by their possession of nuclear weapons; and the pragmatist case for cooperation with the United States, led by the military, which saw the unarguable need for nuclear weapons in an active air defense. Canadian politics became whipsawed between the various strains: the Diefenbaker government came down on the side of sovereignty and refused the BOMARC warheads, and promptly fell; the Pearson government defeated them with an appeal to upholding Canadian international obligations, and the pragmatic case for the defense of Canada; and the subsequent Trudeau government -- of the same party as Pearson -- deactivating the BOMARCs as part of a broader internationalist push toward international nuclear arms control.

3) Differences in perception of nuclear strategy between partners caused problems when events highlighted unresolved differences. This was aggravated by the habit of dealing with unresolved points by burying the difference in vagueness, permitting each side to take away the interpretation it chose. This strategy of ambiguity had worked well for Canada in intra-Commonwealth relations, where the entire period between the invention of Dominion status in 1867 and the assumption of effective independence by the Statute of Westminster in 1931 was marked by a tacit agreement on all sides to leave the precise relationships vague and untested whenever possible. This worked less well with U.S.-Canada relations, where the structure and pace of events made clear decisions unavoidable. As discussed previously, the initial strategy in the 1949-55 era was predicated on relatively small numbers of piston bombers, low-yield nuclear bombs, and a combination of retaliation-based deterrence and active air defense. The goal was to insure that the Soviets would be sufficiently uncertain of doing adequate damage to North America, while being certain of sustaining unacceptable damage, so that they would not initiate war. As delivery systems proliferated and increased in effectiveness, bombs went from low-yield nuclear to high-yield thermonuclear, and finally ICBMs gave an attack option that allowed no effective defense, so strategy necessarily changed. Retaliation and deterrence went from being part of the strategy to being the center of the strategy, and active air defense went from being a goal in and of itself to being primarily valued for its contribution to assured retaliation. Its function was now to degrade the air-breathing portion of the attack and insure adequate warning time for the retaliation force. NORAD's primary function ceased to be its ability to detect incoming bombers and vector interceptors and missiles against them; rather, the heart of NORAD became the BMEWS anti-ICBM detection and assessment system, as a means of assuring retaliation against a missile strike and thus preserving deterrence.

The United States and Canada agreed on these elements, but the proportion of emphasis began to differ. The U.S. forces, particularly the war-fighting Strategic Air Command, continued to pursue a strategy that assumed victory in the event of war, even in the face of massive damage to North America from nuclear weapons. The Canadian governments, particularly under Trudeau, became more and more committed to the concept of mutual assured destruction as a spur to international arms control and de-escalation of conflict. Thus the American view perceived any

enhancement of war fighting capabilities as adding to deterrence and as making the outcome of any conflict even less appealing to the Soviet side. The Canadian view perceived any enhancement of capabilities as destabilizing of mutual deterrence and injurious to the prospect of arms control. Therefore, the American view saw ballistic missile defense as a positive step, whereas the Canadian saw it as destabilizing. This also had consequences for NORAD's air-defense capabilities. The Trudeau government had disliked the nuclear-armed BOMARC missiles they inherited from the Pearson government, but it was the shift in strategic realities that permitted them to stand down the BOMARCs in the early 1970s on the grounds that active air defense was no longer the best use of resources.

Given that BMEWS did not use Canadian territory, once the main threat had shifted to ballistic missiles, the entire concept of a bi-national U.S.-Canadian command had only a secondary role, and some discussion arose on both sides of the border about terminating NORAD. However, as the organization had acquired a symbolic and practical value in its own right, such talk never reached the point of action. Subsequently, the advent of stealthy air-launched cruise missiles in the 1980s revived the relevance of NORAD for all scenarios, as one of the fears was that such missiles might permit a "decapitation" strike on American command and control facilities. Once again, even the Canadian view of mutual assured destruction (which stressed the "mutual" aspect) required a strong NORAD to prevent destabilization. Even the end of the Cold War did not render NORAD obsolete, although it went through an additional period of trying to understand how its capabilities might best be used for new challenges. The terrorist strikes of September 11, 2001, suddenly renewed the relevance of air situational awareness, this time in the context of domestic terrorist hijackings. This constituted a return to NORAD's original roots, as the task of following a hijacked aircraft across the busy and convoluted U.S.-Canada border benefited from a bi-national command every bit as much as did the original task of vectoring an interceptor across the border.

As the previous discussions highlight, the U.S.-Canada partnership has inherent tensions. The disparity of population, economic resources, and military capabilities between Canada and the United States -- generally speaking, Canada has 10% of the potential resources of the United States -- guarantees that the relationship will have built-in asymmetries. On the other hand, Canada's sovereignty requires that in some aspects at least, the two partners must deal on a basis of formal equality. Canada's experiences within the Commonwealth relationship with Britain had already given Canadian service and political personnel useful experience in asymmetrical yet formally equal working relationships. The time during which the North American air defense system, and thus NORAD, was formed was unusual in that Canada's geographical contribution was critical to the task, and thus, atypically, Canada had a roughly equal bargaining position. Additionally, the period in which acquisition of Canadian territory was a significant national goal for certain elements of the American political system had long since come to an end; America was far more invested in the broad Cold War struggle. Canadian concerns in this regard had been made obsolete by the course of history. Therefore, the U.S. had come to the table with a propensity to deal generously with Canada in order to get the air defense job done, and this

willingness permitted the inherent tensions to be overcome, particularly in the matters of staffing and finance of the sensing and interception assets on Canadian soil. Despite tensions over nuclear weapons and differing interpretations of nuclear strategy, NORAD set in motion a series of processes including technological and economic cooperation, and the creation of a network of U.S. and Canadian service personnel, that has woven a much denser network of permanent threads between the two countries.

2.3. Response to Crisis: From Air Warning Plan to NORAD

2.3.1. From Theoretical to Perceived Threat: LASHUP and PERMANENT

After the iteration of the Air Interceptor and Air Warning Plan, as discussed previously, no action was taken toward its implementation. The United States and Canada were preoccupied with postwar transition, and no immediate enemy was generally perceived. Although the Air Warning Plan was clearly intended to deal with the Soviet Union as a potential enemy, it was not called out specifically. Most important, the Soviets had neither a means of attack against North America nor nuclear weapons to deliver, while the U.S. was able to threaten Russia with both. Various estimates of Soviet potential tended to see it develop nuclear weapons and delivery systems more in the 1950-1955 timeframe.

Thus, the first perception of crisis, bringing at least one of these capabilities imminent, was the unveiling of the Tu-4 (NATO designation "Bull") bomber, a copy of the American B-29s which had force-landed and been interned in Siberia during the Second World War, at the Kremlin May Day parade in 1947. The Tu-4 was capable of round-trip missions from the nearest Soviet bases to the northwestern United States and western Canada, and further inland on a one-way basis. In response, the U.S. Army Air Forces Air Defense Command generated Plan Supremacy (1947), closely resembling the Air Warning Plan. No action was taken in response to the plan.

The known existence of the Tu-4 sparked the next set of events with the advent of the Berlin Airlift, and the consequent possibility of U.S.-USSR hostilities in 1948. The U.S. government and armed forces had to examine possibility of war with the USSR. As the Tu-4 had given the Soviets the ability to strike at the continental United States, the problem of how to anticipate and defend against such attacks had to be considered. Looking at the two-way range of the Tu-4, concern arose over the possibility of a conventional strike at the Hanford, Washington nuclear facilities. Given that the prevailing winds are from the west to the east, such a strike had the potential to spread radioactive debris from the facilities across the United States. This potential drove home the fact that the United States had no in-place, reliable ability to detect or intercept such an attack. This, in turn, drove home fears of a new Pearl Harbor with nuclear consequences. As always, the armed forces responded with what capability they did have: Alaskan radars were activated and placed on a round-the-clock basis; interceptors in Alaska were placed on alert. However, attempts to place mobile radar units in the Pacific Northwest to

protect Hanford and other targets "collapsed after a week of operations".¹³

In response to this alarming situation, plans were drawn up to create an interim U.S. radar network, designated LASHUP. It called for 44 stations around key U.S. target areas, to provide short-range warning while permanent measures were designed and implemented. LASHUP became fully operational in April 1949. The permanent system was designated, unoriginally, PERMANENT. It included radar stations, interceptor squadrons, and ground control centers around the periphery of continental US and Alaska. PERMANENT's funding was authorized but not appropriated in March 1949. Again, an immediate crisis driver was required to move from theoretical awareness of a threat to actual commitment to remedies. In this case, the driver was the revelation of the successful test of a Soviet nuclear bomb in September 1949, well ahead of the predictions upon which U.S. planners had been relying. Funds for PERMANENT were appropriated in October 1949.

Although the period from the Berlin Airlift crisis through 1950 was one of an increasing awareness of a possibility of a major war, and a consequent broad rearmament, the air defense projects that began in this era still had to fight for quite limited defense resources that struggled for priority along with a host of postwar needs. This battle over resources included a strong opposition from the Strategic Air Command, which advanced the argument that the best -- and in effect, the only -- defense was as strong an offense as possible, and that all available resources should be placed into strengthening the strategic bomber force. It was essentially the same debate as that in Britain prior to 1939, with the addition of nuclear weapons to argue that even a few bombers getting through would be a catastrophe.

It was the outbreak of the Korean War in June 1950 that actually created the perception that general war might be imminent and whereby rearmament projects switched from being primarily resource-constrained to primarily time-constrained. Viewed in retrospect from today, the Korean War tends to be remembered primarily as a regional conflict fought with a small part of the U.S.'s military potential. From the contemporary perspective, however, it was seen as possibly, or even probably, merely the first theatre of a new world war, and one in which the bulk of U.S. forces had to be kept in reserve to deal with what would probably be the main theatre, Western Europe. What is generally not appreciated is the degree to which, after 1950, the U.S. went on a wartime footing in many ways equivalent to the opening phases of World War II, especially financially. Although most of the classic Cold War programs -- the B-52 bomber, the Atlas missile -- had already been in process, suddenly resource constraints were lifted and schedules were accelerated as much as possible.

The wartime status helped in other ways: the Air Reserves were called up, and the Air National Guard was federalized, which rapidly augmented the number of interceptor squadrons available. Canada similarly rearmed. Canada's internationalist position led them to place a high priority on supporting the United Nations, which had overall command of the forces in Korea, including

¹³ NBU, p. 32

Canadian units. The same motivations prioritized support of the newly-created NATO, which was to see the return of Canadian combat forces to Europe. Canadian rearmament was in a way even more accelerated than America's, given that Canada had demobilized much more thoroughly in 1945, and done very little to rebuild its base in the first few years after the war. In fact, for the first two years after the war, the Canadian air force consisted only of a training cadre and a handful of reservists flying surplus P-51 Mustangs on weekends.¹⁴ (11)

2.3.2. The Canadian Gap

As the PERMANENT system was coming on line in the United States, the lack of Canadian warning and/or interception capabilities became a glaring weakness in problem of defense against attack from the most likely direction -- the north. U.S. defense plans called for a preferred six hours warning to permit the assured launch of retaliatory forces, the mobilization of the maximum possible interceptor force, and the evacuation of potential target cities. The fact that so many key U.S. industrial targets were located on the U.S.-Canada border (e.g., Detroit and Buffalo) or within an hour or two's flight (most of the industrial Midwest and Northeast) made the resultant lack of warning problematic. Radars on the border itself would provide less than an hour's warning. This was unacceptable to prudent defense planning.

Canadian military and political authorities realized that the U.S. would intercept and engage attackers in Canadian airspace with or without permission in a wartime situation. Furthermore, it was clear that the Soviet war plans would hardly discriminate between American and Canadian targets in wartime. Canada was a NATO member and pledged to fight in the event of any Soviet incursion into the NATO area in Europe. Soviet doctrine emphasized industrial capacity as a key target in wartime, and the separate U.S. and Canadian states were seen as "bourgeois superstructure" overlaying a single infrastructure of production. It was reasonable to assume that any Soviet attack would be a general attack with nuclear weapons against all military, industrial, and infrastructure targets in North America without discrimination. This assumption was validated when Soviet attack plans became known after the end of the Soviet Union; such a plan was in fact the only extant Soviet operational plan. They had never so much as drawn up a plan for attacking the United States without attacking Canada as well.

Thus, Canada by 1950 had come to the realization that it had to join in general rearmament; and that defense of Canada's national territory, its NATO obligations, and the pragmatic needs of cooperation with the United States (the three threads of Canadian politics, as previously described) all pointed to a jointly-planned continental air defense warning and interception capability on a scale much greater than previously planned. The problem was handed to the existing, successful means of cooperation, the Permanent Joint Board on Defense (PJBD). The PJBD examined the problem in June 1950; the resultant joint USAF-RCAF planning group empowered to study the problem produced the "Plan for the Extension of the Permanent Radar

¹⁴ NBU p. 32

Net of the Continental Air Defense System."¹⁵

That Plan called for 39 radar stations across southern Canada, including Newfoundland. The stations in Newfoundland, to be built at the US's existing bases there, were to be manned by US, the rest, by Canada. A cost-sharing formula for the construction and operation of the stations was proposed. This formula took into account the fact that a continental system required a more extensive and thorough system than Canada could readily afford. Since the development of the system needed to be paced by continental needs, not Canadian means, it was reasonable to the U.S. to assist with the costs.

Consequently, in February 1951, the PJBD issued Recommendation 51/1, calling for the development of the radar tracking system described in the Plan. The United States and Canada agreed on this system, now designated PINETREE. The system was essentially an extension of PERMANENT into southern Canada, using the same technology; the name was chosen both for its alliterative reference to PERMANENT, and because the line was sufficiently far south in Canada that it was still in the forested zone. PINETREE locations were chosen roughly along the 50th parallel in Canada as existing roads and rail lines (or in Newfoundland and Labrador, coastal shipping capabilities) provided usable logistical support in each meridian, giving a relatively even line across lower Canada that could be constructed quickly without extraordinary logistical challenges. Even so, the need to locate the operational centers of each station on the highest available point in the area created substantial civil engineering challenges. The cost of the system was estimated at US\$191 million (approximately US\$1.5 billion in today's dollars). PINETREE raised issues of control, staffing, financing, reporting, coordination that have characterized U.S.-Canada continental defense ever since. The ultimate outcome was arrived at through extensive negotiation, resulting in some stations (primarily in Newfoundland and Labrador) paid for and manned by USAF personnel, some paid for by the U.S. and staffed by RCAF, and some paid for and staffed by RCAF.

The commitment to construct and deploy the PINETREE system then brought to the fore the issues of interception subsequent to detection and identification. As Canada did not have the ability to deploy enough interceptors to engage an attacking force successfully in the most desirable area -- Canada north of its populated area -- it was a given that U.S. interceptors would have to be based in Canada and/or cross the border to engage the attackers in Canadian airspace. Additionally, the most effective manner of conducting the defense would be for American and Canadian interceptors in any given region to be under the control of the same ground interceptor control station. Given the convoluted topography of the border region, especially in the industrial Great Lakes area and the Pacific Northwest, American and Canadian interceptors would be crossing each other's airspace constantly. The timescale of nuclear war, even with the relatively slow-moving piston bombers, make traditional methods, such as an exchange of notes

¹⁵ NBU, p. 44

or even a phone call between heads of government, dangerously inadequate. A President or Prime Minister out of reach for an afternoon's fishing might not be reachable between the time of an identified attack and the bombing of a major city. In August 1950, the U.S., anticipating the possible outbreak of a general war in the near future, requested the right to intercept potentially hostile aircraft in Canadian airspace, even in the absence of declared war. This was granted, after debate, and thus began a process of step-by-step authorizations for greater freedom of action for Canadian and American air defense forces. To the military planners, however, each step was an inadequate substitute for the solution identified in 1946, but never considered politically discussable -- a bi-national air command controlling all U.S. and Canadian air defense forces between the Rio Grande and the North Pole. In, the 1951 Canadian Chiefs of Staff committee proposed a joint air defense command, but it was premature in the political context of the day. Half-measures such as the 1952 agreement providing for joint training on local notice continued to characterize the process.

2.3.3. Extending Awareness - The Mid-Canada Line and the Distant Early Warning Line

Meanwhile, the success of the PINETREE Line allowed the air defense planners to turn to the next step in the realization of a comprehensive North American warning and interception system. Between 1950 and 1956, the United States and Canada took successive steps to move warning and interception further north, and to close gap in existing warning, especially in the Prairie Provinces. As Soviet bombs grew more powerful -- particularly with the revelation of Soviet thermonuclear capability in 1953 -- and Soviet delivery systems grew faster and more capable, it became clear that the scenarios for which PERMANENT and PINETREE had been planned were obsolete. More warning time was critical, and moving the battlespace further north became a more and more pressing concern. In parallel, as warning improved, the issues of command and control only accelerated, and continued to drive the search for a comprehensive solution.

The incoming Eisenhower administration moved quickly to review the situation and propose a comprehensive, long-term plan. In June 1953, at Eisenhower's request, the National Security Committee formed the Continental Defense Committee of its Planning Board and appointed Lt. General Harold R. Bull, a wartime associate of the President, to review the air defense portion of the problem. In July 1953, the Bull Committee recommended the construction of a Distant Early Warning line of radar stations in the Arctic, and an intermediate Southern Canada Line at 54 degrees North latitude. The DEW line would fulfill the requirement for comprehensive peripheral radar coverage identified in the Air Warning Plan of 1946. The August 1953 detonation of a Soviet thermonuclear device increased the sense of urgency over the Bull Committee's recommendation. In September 1953, the National Security Council and the Military Study Group of the PJBD endorsed the Bull Committee's recommendations.

This new air-defense initiative must be viewed in the larger context of the rapid change in the perception of the strategic environment and the search for a politically and economically sustainable long-term strategy. It is not sufficiently appreciated to what extent the strategic assumptions regarding the potential for world war changed radically and rapidly, not once, but

several times between 1945 and 1965. The immediate postwar period was one of war-weariness and hope in the prospect that the United Nations would prevent new wars and channel disagreements with the Soviet Union into manageable diplomatic processes. Planning for future wars was comprehensive and implicitly oriented to the Soviets as the principal potential adversary, but that was more from lack of other potential opponents than a genuine concern over any immediate threat. Deteriorating events in Europe and the installation of puppet regimes in Eastern Europe changed this perception. Between 1947 and 1949, the advent of the Tu-4 bomber, the Berlin airlift crisis, and the Soviet nuclear bomb transformed a hypothetical future opponent into an imminent threat, and one that the U.S. had no immediate means of forestalling save for the threat of retaliation. The following year, the outbreak of shooting war in Korea led defense planners to be concerned that they were seeing not, as we now understand it to be, a limited regional war, but the opening stages of the next world war, one which might start with a surprise attack on the North American homeland within a matter of months, not years.

In this first period of threatened nuclear world war, planners -- who still tended to view war in the context of their vivid 1939-45 experiences and assumptions -- tended to see the prospective combat as a larger, more accelerated, and more dangerous version of the previous war. A nuclear-weapons strike -- understood in the context of Hiroshima-scale 20 kiloton bombs -- was seen as the equivalent in damage of one large-scale WWII conventional bombing raid. In short, the conventional bombing was perceived as catastrophic and costly, but something that a nation could suffer, recover from, and continue on to fight a war, as Britain, Germany, and Japan had all done. Air defense and civil defense measures were seen as worthy of pursuit, as well as things that could make a difference and substantially mitigate damages.

A great many of the preparations for war made in the 1950s -- fallout shelters, evacuation of cities using the new Interstate Highway System, a massive interceptor and anti-aircraft missile capability -- made sense in the context of this sort of non-nuclear war. However, the advent of Eisenhower, who understood the realities of a massive war effort far better than had Truman, drove a new examination of the strategic situation of the U.S. and its allies. As the new administration strove to make sense of their situation in 1953, the situation was about to change radically.

As discussed previously, the 1953 test of a deliverable Soviet thermonuclear weapon upped the ante in air defense drastically. The test of the Soviet thermonuclear weapon was both delivered earlier than originally predicted and before the development of a deliverable American H-bomb. In 1952, the Soviets had begun flight tests of their Tu-20 (NATO designation "Bear") turboprop intercontinental bomber, with speeds of up to 500 knots and sufficient range to place all of North America at risk. Suddenly the prospective nuclear war was not merely a matter of compressing a massive WWII air raid into a single strike, which was bad enough, or of one bomb wiping out a medium-sized city, but of a situation in which one bomb could destroy a major metropolitan area. At the same time, the rapidly escalating costs of rearmament began to worry Eisenhower. He could see that even if a war could be avoided, the cost of preparing simultaneously for a

WWII- style land war, and the sort of thermonuclear exchange that the next decade promised, could ruin the national economy without a shot being fired.

As a result, in October 1953, Eisenhower approved National Security Council Directive 162, initiating the so-called “New Look” defense policy. This shifted American (and effectively, NATO) policy toward primary reliance on nuclear deterrence. Sufficient land forces would be maintained in Europe to deter a land attack by the Soviets, but the U.S. would no longer plan on maintaining a World War II-scale conventional force day-to-day. Nuclear weapons, once they and their production facilities had been developed, were much cheaper to produce and maintain than a WWII-scale conventional military. Thus, a nuclear deterrent force based on bombers and eventually missiles would be the first line of defense. Consequently, the survivability of the deterrence force against a first strike became the critical mission of the U.S. armed forces. Air awareness and defense became even more critical, since the issue of what percentage of an attacking force could be destroyed was no longer the most relevant issue. That was replaced by how to provide the maximum possible warning period in order to guarantee the launch of the retaliatory force. The Distant Early Warning (DEW) Line at 69 degrees North and the intermediate warning line at 55 degrees North in Canada (now termed the Mid-Canada Line) became critical elements of maximizing the warning period and guaranteeing the credibility of deterrence.

Given the September 1953 NSC and PJBD endorsements of these warning lines, events moved quickly. In October 1953, Canada announced it would build the Mid-Canada Line at approximately 55 degrees N latitude, using a unique Canadian technology that had been developed at McGill University in Montreal. This technology, which gave the line its alternate name of the McGill Fence, was an early form of Doppler radar. This was useful because it provided an alternative technology that gave the possibility of detecting aircraft that escaped the different technologies used in the DEW and PINETREE lines. From October 1953 through May 1955, these systems, which had existed only in outline plan and experimental technology demonstrators, moved from concept to implementation. Both lines were to be built for the large part beyond any conventional transportation infrastructure. The Mid-Canada Line's eight continuously manned control stations were mostly located on existing roads or harbors, but its sixty intermittently-tended automated stations were for the most part located on rugged terrain only accessible by helicopter or tractor train. The DEW Line, although located in the harsher climate of the Arctic, was in some ways more accessible than the Mid-Canada Line, since its stations could be accessed by sea during the short (four to six week) window of navigability during the summer. The systems engineering and sheer physical construction challenges of these two lines were a major task, especially for the Canadians who had not worked on this scale under such harsh conditions.

However, working under Cold War pressures and priorities, the work advanced quickly. In May 1955, Canada and the U.S. exchanged notes assenting to U.S. construction of DEW Line in Arctic. In keeping with the various threads of Canadian policy, extensive measures protecting

Canadian sovereignty were included in the agreements. This was the last step before DEW Line construction could begin in earnest. Construction started on the Mid-Canada Line in 1956 and proceeded quickly. By April 1957, the eastern half was operational, and the line was declared fully operational on New Year's Day of 1958. Construction on the DEW Line was essentially parallel, taking place in 1957 and becoming operational by the end of that year.

2.3.4. The Obstacle of Divided Command

With the advent of the PINETREE Line, the operational issues of a continental defense system run by two separate national commands became more and more evident. In any scenario involving attack from the north, the need for U.S. and Canadian interceptors to freely cross national borders, to be directed at any moment by whichever ground control, U.S. or Canadian, made sense, and above all, for all available forces to be allocated by a single commander as need dictated was the only efficient solution. In 1954, the USAF-RCAF Joint Planning Group report on the topic identified the lack of a single commander for continental air defense as the single biggest obstacle to overcome, now that a comprehensive solution to the air warning problem had been agreed upon.

Once more, the solution identified in 1946 -- a bi-national command with a single commander -- was so obviously desirable that it was hard to avoid the conclusion, yet the political systems of both countries shied away from it. The U.S. replied to RCAF inquiries to discuss the topic by deferring it until the more immediate problem of creating a single commander for all U.S. air defense efforts had been accomplished. In many ways this proved to be more difficult than the bi-national command problem. The USAF had authority over aircraft, including interceptors; the Army had authority over anti-aircraft artillery, and -- as it argued -- by extension, over anti-aircraft missiles. The Navy also played a role as the operator of the offshore radar picket vessels and airborne radar aircraft that provided warning against bombers coming straight in across the Atlantic or Pacific. In 1954, the Joint Chiefs of Staff addressed this problem by creating CONAD as tri-service joint air defense command in Colorado Springs. Thus, a single commander for U.S. air defenses was created.

Here it is important to keep in mind the distinction between a service command, which is an organizational division within a single service, such as the Air Force, and a joint or unified command, such as the previously-described CONAD, and includes units of more than one armed service. Such joint commands are now termed Unified Combatant Commands, or UCCs. This can be confusing, particularly when the service command and the unified command bear the same name, and often the same commander. This was the case, for example, during the period where the U.S. Air Force had a Space Command (which still exists), and a unified U.S. Space Command (which no longer exists) that typically had as its commander the commander of Air Force Space Command -- a practice known as "dual-hatting". When U.S. Space Command was the U.S. national component of NORAD, its commander was also the commander of NORAD, so in essence he was "triple-hatted". Thus, whenever he took any particular action, it was always important to maintain awareness of which hat he was wearing at the time. Understanding these

distinctions are essential in understanding why the creation of CONAD was a step forward in North American air defense, and why it made it possible to conceive of a NORAD structure.

Although this paved the way for a bi-national command, the JCS was reluctant to create a formal U.S.-Canada structure. Several interlinked concerns drove this hesitance. Primarily, the JCS preferred the flexibility of local agreements between U.S. and Canadian military personnel, which could be struck informally or with minimal paperwork, and which would often be concluded without attracting the attention of the national political systems. They believed, with some justification, that a formal structure would elevate all disagreements to national political levels, whereas U.S. and Canadian airmen, working informally, had more latitude for compromise.

Particularly, the JCS were concerned that Canada would view a joint command as a NATO jurisdiction. It was also averse to bringing North American activities under the NATO umbrella, both because they were inherently reluctant to raise what was at worst a need for bilateral consensus to a multilateral level, which in their experience dragged out decision-making and reduced the range of available solutions to the lowest-common-denominator options. Additionally, they considered the Canadian forces trustworthy in terms of security, whereas they considered -- not without some justification -- several of the Continental partners to be poor custodians of sensitive information.

Despite these objections, the pragmatists in USAF, and RCAF air defense commands continued to push for a bi-national continental command. In particular, RCAF Chief of Staff A/M C. Roy Slemon and CINCONAD Gen. Earle Partridge each served as strong advocates in their own countries. Meanwhile, the interagency process continued to work the solution through the bureaucracies step by step. In February 1955, the USAF-RCAF Joint Planning Group on air defense presented a plan for a bi-national command plan to the Military Study Group (MSG). The MSG agreed to take it to higher levels. Subsequently, the Canadian Chiefs of Staff endorsed the plan. In December of 1955 the JCS likewise approved the proposal for a bi-national command.

With these endorsements in hand, in January 1956, U.S. Secretary of Defense Charles Wilson approached the Canadian Chiefs of Staff Committee. As a result of that outreach, a new joint USAF-RCAF study group was created, and essentially repeated the former work of the 1955 Joint Planning Group, but with more emphasis on specific implementation steps. The new plan took what was probably the path of least resistance: it essentially included the RCAF on equal basis as the fourth service along with the USAF's Air Defense Command, the Army's Anti-Aircraft Command, and the U.S. Navy CONAD. Thus, a new layer, NORAD, was erected with Commander-in-Chief CONAD dual-hatting as Commander-in-Chief NORAD, with a Canadian Deputy Commander-in-Chief NORAD. This dual structure proved to be a robust mechanism as it preserved the ability of the U.S. to step aside from NORAD and act on a national-only basis when consensus with Canada was not readily forthcoming. It is likely that this ability to act bi-nationally or nationally depending on the circumstances saved the existence of NORAD on a

number of occasions where the only other alternative would have been to dissolve it.

The December 1956 Joint Study Group plan presented a concept for a combined commander, called, somewhat clumsily, the Commander-in-Chief Air Defense Canada-U.S. ("CINCADCANUS"). This plan was endorsed by both the Canadian and U.S. executives. However, as the plan neared the formal approval steps, in June 1957, a snap Canadian election unexpectedly changed government. The Liberal Party government of Louis St-Laurent was replaced by a minority Conservative Party government under John Diefenbaker. The advocates of the Plan within the Canadian military and civil service pressed the new Prime Minister to approve the Plan, representing it as having essentially been agreed to by the former government. Any hesitation now would, they argued, represent a show of bad faith by Canada to its most important partner. Diefenbaker was thus under pressure to approve it, and did not want to create a major issue at the very beginning of his leadership within a precarious minority government. His Cabinet Committee thus approved Air Marshal Slemon's appointment as DCINC NORAD, implicitly approving Canada's participation in NORAD, but no formal measures to approve the bi-national arrangement were taken.

NORAD began operation in September 1957 on the basis of an inter-services agreement. Only afterwards were questions raised in Parliament as to why such a major commitment on Canada's part was taken on such an informal basis. To satisfy this concern, diplomatic notes were exchanged after the fact in 1958, and were characterized as the NORAD Agreement. NORAD's existence is usually dated from the signing of the Agreement in 1958, but a functioning bi-national command of that name, fully able to commit U.S. and Canadian forces across the continent, was operational from September of the previous year.

2.4. Formational History of NORAD: Lessons Learned

The history of the conception and formation of a bi-national air and space defense command in North America is a segment of a longer historical arc that begins with the strategic airpower/air defense debate of the 1930s, particularly as experienced in inter-war Britain. This debate, conducted in English, was readily available to and widely followed by American, British, and Canadian airmen. The British debate foreshadowed the later North American debate: given the distances involved between likely aggressors and defenders, and the then-current ranges and payload capabilities of the expected aircraft (taking into account the potential for chemical and biological weapon delivery), the problem more closely approximated the post-1947 balance between North American and Soviet ranges and capabilities than it did the pre-1939 North America vs. Germany problem.

The British debate and the Second World War experience of defending Britain influenced the expectations of postwar North American defense planners, particularly in that:

- The integrated radar detection/assessment/ground control system designated CHAIN HOME performed to and above the maximal prewar expectations of air defense

advocates, and was instrumental in permitting Britain to continue fighting in 1940

- The probability of effective mutual WMD deterrence had been seriously underestimated by defense planners prior to 1939, when in fact both German and Allied armed forces continued to refrain from using their plentiful chemical and biological weapon stockpiles even through the final, apocalyptic phases of the war in 1945
- The RCAF in particular, by participating in the Battle of Britain, had a strong cultural disposition to the importance of air defense, reinforced by the post-1945 decision to forego strategic bombing capabilities in the postwar RCAF.

The U.S. air services after 1945, which became the USAF in 1947, were internally divided between Strategic Air Command advocacy of a primary or even exclusive focus on strategic bombing versus the Air Defense Command's advocacy of strong continental air defense. The Canadian service had a much weaker debate, which was primarily a spat between allocating resources for tactical air support by Canada's NATO contingent in Europe versus NORAD interceptor forces and the sensor networks. The disparity in focus is illustrated by the fact that Air Marshal Slemon, the principal Canadian advocate for NORAD, was, prior to the command's formation, Chief of Air Staff for the entire RCAF, while the principal American advocate, General Partridge, was merely Commander-in-Chief of CONAD, the air defense command.

Overall, however, the primary lesson was that the air defense problem for North America, seen in the light of the World War II experience and the reality of nuclear weaponry and intercontinental bombers, was readily comprehensible even in the immediate postwar period. The form and nature of the solution -- the sensor networks, the interceptor capabilities, and the integrated bi-national command to control them -- were laid out in 1946 in substantially the same form in which they ultimately appeared in 1957. What stands out from the chronicle of the intervening years is the process of procrastination, denial, painful adoption of quickly-superseded half-measures, and hurried (and costly) catch-up triggered by imminent crises, aggravated by chronic intelligence failures underestimating the timeliness and scope of the problem. Each step in the process followed the same pattern in miniature -- proposal, inaction, crisis, and hasty implementation of the original blueprint.

The lessons of the problem of airspace situational awareness that led to the formation have direct, albeit inexact, parallels to the problems of space situational awareness. The events of concern in space situational awareness (SSA) have many of the same characteristics as the outcomes against which NORAD was created to guard. They are potentially catastrophic: an asteroid impact could potentially be as catastrophic in outcome as a major nuclear exchange, taking into account likely atmospheric follow-on effects. However, the asteroid threat is not readily predictable or assessable, except in terms of statistical analysis that the voting public (and many political decision-makers) cannot readily follow or comprehend. Thus, it is likely that every measure to improve international space situational awareness, and sharing of data therein, will languish in proposal form until some immediate crisis motivates political decision-makers to adopt them and fund them. Measures requiring international cooperation will take a substantially

higher level of motivation than merely national solutions. The NORAD history also suggests that a focused entity within a smaller nation may be able to stimulate the process if it can strongly advocate a clear option and volunteer to do its own part. Recent events such as the Chinese anti-satellite test and the Iridium-Cosmos collision may serve as part of the build-up to such a period of challenge and response, which suggests that efforts to create a consensus for the SSA data sharing equivalent of the Air Interceptor and Air Warning Plan of 1946 may indeed be well-timed.

3. The Operational Experience of NORAD

3.1. NORAD Adapts

Reviewing the NORAD experience from 1957 through the present day, what stands out in particular is the way in which its structure has proven robust through major changes in the organization's objectives and assumptions. Some of these major transitions have included:

3.1.1. The Shift from Bomber to Missile Attack as Primary Threat

The addition of its missile warning role, the creation of the Ballistic Missile Early Warning System (BMEWS), and the de-emphasis on the intercontinental bomber threat in turn led to the consequent reduced need for Canada's unique geographic contributions and its substantial interceptor capabilities. The original overwhelming driver for the creation of NORAD and Canada's unique partnership status was the inescapable need for advanced early warning and thus sensor stations on Canadian soil were essential, and the difficulties of attempting to deploy and control interceptor forces across a convoluted industrial border region. BMEWS required sensor stations as well, but not interceptor squadrons. The U.S. had some choice in the locations for missile warning sensors; hence, neither Denmark, as host for the Greenland BMEWS station, nor the United Kingdom, as host to (and operator of) the Fylingdales sensor station, were offered membership in a distinct defense organization for that purpose. Nevertheless, even though bomber attacks fell to the level of a secondary threat and the primary driver for cooperation with Canada was diminished, NORAD remained in existence and Canadian personnel remained working side-by-side with Americans. Canadians serving in NORAD also added space surveillance and assessment to their roles even though Canada was not involved in the sensor aspect of space warning. Involving Canadians had become a habit for the U.S. Air Force by that point.

As discussed previously, the North American air defense system had been conceived and developed as a defense against a specific concept of war -- of relatively low-speed intercontinental bombers delivering relatively low-yield, Hiroshima-sized nuclear weapons. Many of the measures that current observers, looking back on civil defense programs of the 1950s and 1960s, deride as pointless or absurd -- fallout shelters, or duck-and-cover drills in schools -- made perfect sense as precautionary measures against nuclear war, and were in fact derived from careful analysis of the aftermath of the Hiroshima and Nagasaki bombings. However, the rapid improvement in the destructive power of and delivery mechanisms for nuclear weapons meant that the initial civil defense lessons from Hiroshima and Nagasaki quickly became irrelevant. The advent of the Tu-20 higher-speed, longer-range bomber in the early 1950s (first test flight, 1952) drove the construction of the Mid-Canada Line and DEW Line to increase the warning times for evacuation and defense. Most importantly, the advent of the Soviet thermonuclear bomb in 1953 led to a radical rethinking of the nature of war and the value of air defense. The very high casualty estimates for thermonuclear war that began to

emerge in the 1950s created even more urgency for active air defense. However, as a more full understanding of likely thermonuclear war scenarios began to sink in, pessimism over the ability to achieve high enough attrition rates among attacking bombers led to a new emphasis on mutual deterrence. In the early 1960s some Canadian political voices questioned the value of active air defense -- particularly some members of the Canadian Liberal Party. These liberal members proposed that NORAD confine its interception activities to verification that an attack was in progress, which would lead to the launch of the retaliation force. This approach was sarcastically dubbed "Birdwatching" by Canadian Conservatives, and was never accepted as an official doctrine in Canada or the United States.¹⁶

A related consequence of the shift from air-breathing nuclear delivery vehicles to ICBMs was the elevation in importance of space activity in NORAD, which led to the growth of a formal SSA role, and the acquisition of substantial SSA analytical capabilities within NORAD. The actual sensors were under command of other organizations; NORAD was a customer for their inputs.

3.1.2. Differences Between the United States and Canada in Concepts of Deterrence

These differing views of deterrence, as discussed previously, were especially aggravated during the several periods of time in which the United States actively launched anti-ballistic missile or ballistic missile defense initiatives. These programs had advocates and opponents on both sides of the 49th Parallel. Typically, the advocates tended to be centered more in the militaries of both countries, and some strategic analysts. Opposition was more likely to be found in the diplomatic services, particularly those dedicated to the international arms control processes. Canada, because of its stronger emphasis on international organizations and processes, and because of the way mutual deterrence was understood by the Pearson and Trudeau governments, tended to oppose ABM/MBD programs because they feared the destabilization of deterrence. These concerns arose again in the 1980s and 2000s, with the related issue of "weaponization of space", expressed as a concern in some Canadian circles as an avoidable extension of an arms race and one that could add to the destabilization of deterrence.

These disagreements over ABM/BMD, the various anti-satellite (ASAT) programs of the US, and particularly the potential role of NORAD as a targeting, command and control center for such programs, proved the value of the separate national command structures that the parallel existence of the American national command (under its various names over the years, initially ADCOM, today NORTHCOM) and NORAD provided. This allowed the US to operate programs through national command structures without Canadian participation. Thus it permitted the retention of a bi-national role in air defense and SSA analysis even when ASAT and ABM/BMD programs were operated on a U.S.-only basis.

Of course, this recourse to national-only solutions for areas in which Canada chose not to

¹⁶ CIN p. 53

participate created strains in the system, such as the exclusion of Canadian personnel from certain space mission areas. However, the choices as these issues arose were to:

- Either give Canada an effective veto over certain aspects of U.S. defense policy, a measure which was rejected in 1946 and every subsequent occasion in which the possibility has arisen
- To disband NORAD and conduct all operations on a national basis,
- To continue bi-national consensus on the whole, while segmenting off areas on which consensus was not possible.

The choice of the latter option, although less than optimal, at least preserved the NORAD structure and maintains the experience of bi-national operation, and permits the re-expansion of bi-national operations if policy changes, as for instance it did when the Sprint ABM system or the two different ASAT systems the U.S. developed were stood down.

It is also worth noting that the differences of opinion between the Canadian and U.S. political systems over ABM/BMD roles and programs has never been absolute. Some parties on both sides of the 49th Parallel find it useful to promote narratives that variously stereotype Americans as, variously, "warmongers" or "realists", while Canadians are portrayed as "pacifists" or "peace-loving". In actual fact, most decisions on either side of the border were made on the unemotional basis of options, resources, and consequences, and often the final decisions were close calls that could easily have gone the other way. On the several occasions in which Canada was invited to take a formal role in ABM/BMD research, development, or deployment programs, Canada debated the issue internally in a vigorous manner, and even when it declined a formal, intergovernmental participation, it has permitted (and quietly encouraged) private Canadian entities to participate in research.

Although the United States and Canada have many commonalities, they are distinct and separate states. It is inevitable that they will make different policy choices from time to time. NORAD has been able to ride out the difficulties created by such divergent choices and adapt to new circumstances. Any new system for international SSA data sharing will likely contain members with much greater divergences in policy and difficulties are likely to arise more frequently than in U.S.-Canada relations. Such a system would be well advised to build substantial internal flexibility to be able to survive such divergences.

3.1.3. NORAD's Space Role and Canadian Concerns

Canadians were initially reluctant to change NORAD's name from "Air" Defense to "Aerospace" due to concerns over the implication that a North American Aerospace Defense Command could be construed as official Canadian involvement in space-related military programs such as ABM/BMD or ASAT. The issue was resolved in 1981 in favor of the change, as reflecting the reality that NORAD as an organization had a significant role in SSA regardless of its relation to ABM/BMD, ASAT, or other programs of potential concern. The timing of this change in

attitude is not coincidental. In fact, the name of NORAD, and the lack of the word "space" in the title, became talking points in the controversy over NORAD's handling of the de-orbiting of the Soviet nuclear-powered satellite Cosmos 954 in January 1978. This incident is discussed in greater detail below at II.b. At the heart of the issue was whether NORAD had had an obligation to report the impact predictions to the Canadian government, whether it did in fact carry out that warning function appropriately and in a timely manner, and whether the Canadian government had acted properly on the warnings received from NORAD. At one point during the debate, Trudeau incorrectly argued that NORAD had no formal space role or obligations, and pointed to the lack of the word "space" or "aerospace" in its title.¹⁷ Partly in response to this highly visible reminder of NORAD's SSA role, the subsequent renewal of the NORAD Agreement in 1981 included the change of its name to "Aerospace" defense command with no Canadian objections. As Jockel comments, referring to Trudeau's misstatements on the matter, "Canadian officials probably also came to the conclusion that when a name confuses the Prime Minister, it is time to change it."¹⁸

3.1.4. Advent of Stealthy Cruise Missiles

The advent of ICBMs as the primary threat against North America in the early 1960s had served to relegate NORAD's extensive air defense system -- and Canada's unique geographical contribution -- to a secondary importance. In the early 1980s, the advent of stealthy air-launched cruise missiles renewed the "air-breathing" threat and, with this possibility of an undetectable Soviet decapitation strike, disrupted the balance of deterrence that was particularly important to Canadian strategic concepts. Thus, renewing and modernizing the NORAD sensor system to guard against such destabilizing strikes was a task that the Canadian and American governments could embrace with equal enthusiasm. This threat retuned radar networks and interceptor capability to a higher priority. The warning systems erected in the 1950s -- the PINETREE, Mid-Canada, and DEW Lines -- had been allowed to run down or, as in the case of the Mid-Canada Line, had been entirely eliminated. As a result, the DEW Line was upgraded into the North Warning System, covering the same territory with fewer but more effective radar systems. The interceptor capability was addressed by the creation of Forward Operating Locations (FOLs), which would allow interceptors to be pre-positioned in the far north in times of increased alert. Detection and interception of ALCMs as far north as possible was even more important than with the bomber threat, as the bombers carrying the ALCMs were far easier to detect than the missiles themselves. Therefore, it was highly desirable to be able to detect and intercept the carrier aircraft before they launched the ALCMs. These measures augmented operational potential cost-effectively.

¹⁷ CIN p. 106

¹⁸ CIN, p. 108

3.1.5. Changes in U.S. Command Structures

One of the most disruptive experiences for NORAD has been the several shifts, over time, of the command structure of the American side of NORAD. The first of these major shifts was the 1985 transition from the Aerospace Defense Command to USSPACECOM as the U.S. National Command. The USSPACECOM commander was then dual-hatted as the commander of NORAD. Note again the discussion of "dual-hatting" and service vs. unified command and control or "UCC" structures in Section 1, previously. For the first time in NORAD's history, the U.S. side was a command that was not exclusively dedicated to air and space defense. A separate arrangement (also headed by the USSPACECOM commander) was made for the strictly air-defense U.S. operations of NORAD (termed the "U.S. Element of NORAD") to permit national action in air defense by the US on occasion. This was disruptive partly because the new command had a broader focus and often was preoccupied with issues in which the Canadians were not involved at all. Partly, it was disruptive because a new group of U.S. officers came into Colorado Springs with no bi-national experience and no understanding of why the Canadians were there or how they worked. The period of education in these matters was lengthy, and complicated by the short duty tours of American personnel: no sooner than one group of officers became familiar with the NORAD bi-national culture than they were rotated out and replaced with another group requiring education.

The advent of a Space Command occurred at a time when the U.S. was entering a new period of research on both ABM/BMD (the Strategic Defense Initiative) and anti-satellite missiles, including one designed to be launched from fighter aircraft that could be based in northern Canadian forward operating locations. The implementation of a Strategic Defense Initiative renewed suspicions within the segment of Canadian politics opposed to missile defense as well as raised concerns that NORAD could be a Trojan horse to re-involve Canada. Again, the flexibility of NORAD's structure (in this case, allowing the creation of the U.S. Element, NORAD to permit U.S.-only air defense activities at Colorado Springs) and the commitment of the Canadian political system to the NORAD link permitted NORAD to ride out the storm. The robust commitment to, and appreciation of, the NORAD bi-national culture meant that the NORAD personnel at Colorado Springs, American and Canadian alike, persisted as patient advocates of the bi-national system, educating the USSPACECOM personnel and re-establishing the equilibrium.

3.1.6. The Anti-Terrorist/Homeland Security Role

The September 11, 2001, terrorist attacks using hijacked aircraft as weapons highlighted the degree to which NORAD's capabilities had been tightly focused on the traditional external attack role. One NORAD officer interviewed recalled, on that day, being able to watch Russian aircraft taxiing on their bases in real time, but being unable to contact an FAA regional center to determine what was going on in internal U.S. airspace. Yet NORAD was, once again, the most logical basis from which to build a homeland air defense for North America. The same convoluted U.S.-Canada border that had made it essential to command U.S. and Canadian air

defenses bi-nationally similarly required a bi-national solution to defense against terrorist incidents. For example, anti-terrorist planning for the 2010 Vancouver Olympics was headed by the RCMP in conjunction with CANADACOM. However, NORAD will bear the responsibility for air-related issues. An unidentified aircraft over Point Roberts, Washington, only minutes from downtown Vancouver, can no more be dealt with by standard government-to-government communications than could a posited Soviet bomber over Windsor, Ontario in 1956 -- a bi-national system seamlessly tracking threats regardless of borders is the only feasible solution. As General Charles Foulkes, Chairman of the Canadian Chiefs of Staff said in 1958, contemplating the problem then, there are "no boundaries upstairs."¹⁹

The wide-ranging review of the U.S. defense structure following the September 11th attacks resulted in what has been the largest and most consequential change in NORAD's system since its founding. The U.S. had evolved a system of unified commands (formally, "Unified Combatant Commands"), all-service commands with either geographical area (e.g., European Command, Pacific Command) or functional (e.g., Transportation Command) responsibilities. However, by 2000, no area command covered the U.S. itself, or Canada. To remedy this, a unified command, U.S. Northern Command (USNORTHCOM) was created in 2002, with responsibility for the defense of North America and surrounding areas. USSPACECOM was terminated and its space functions merged into USSTRATCOM, the successor to the Strategic Air Command. Thus NORAD found itself dealing with STRATCOM without the traditional convenience of its commander being dual-hatted. Previously, the space functions that NORAD had used had been under USSPACECOM, whose commander was dual-hatted with NORAD, and triple-hatted with Air Force Space Command (AFSPC). Therefore, it was an even more radical change in NORAD organizational culture than the shift to USSPACECOM in 1985. NORAD and USNORTHCOM were both customers for various kinds of SSA information provided by USSTRATCOM.

Without the dual-hatting of NORAD and space commanders, suddenly the Canadians found themselves barred from aspects of space situational awareness that they had been participating in freely for decades, because USSTRATCOM commanders did not have paper in place authorizing their presence in space-related facilities such as the Space Control Center (SCC), which later became the Joint Space Operations Center (JSpOC), and creating such paperwork was a low priority in a newly-reorganized command.²⁰ This tendency was further aggravated by the revival of missile defense in the US and the stand-up of active BMD sites in Alaska and California. The decision of the Chrétien government in Canada to decline participation in this

¹⁹ NBU, p. 4

²⁰ The SCC was not part of NORAD or USNORTHCOM – it was under administrative command of AFSPC and 14th Air Force. It did, however, provide critical data to NORAD which was used for the aerospace warning mission. Thus, NORAD did exercise some operational control over certain aspects of SCC operations, such as sensor downtime and configuration, which impacted the aerospace warning mission. The JSpOC is a joint entity under USSTRATCOM, with 14th Air Force as the primary force provider, and currently provides certain space warning data to NORAD and USNORTHCOM.

system, which was made on a closer decision than is generally assumed, meant that, once again, the U.S. would have to conduct substantial parts of its activities without Canadians present. Here again the dual national/bi-national nature of NORAD's structure proved essential to being able to preserve bi-national action.

In addition to these strains, there were organizational-cultural issues brought up by the changes in structure. USNORTHCOM included many Army officers who, even more than the Air Force space officers at the creation of USSPACECOM, had no experience with or feeling for bi-national operation, and who were entirely unused to comingling American and Canadian officers in reporting relationships. Just as in the days of NORAD's founding, the U.S. and Canadian air arms probably shared more organizational-cultural affinities than did the U.S. Army and U.S. Air Force. Subsequently, in January 2006, Canada stood up Canada Command as a functional equivalent to Northern Command. Although given the formation of USNORTHCOM, this was a logical consequence and it further encouraged the tendency for internal disagreements regarding the conduct of operations within NORAD to become polarized along national lines, an outcome that had been rare prior to the USNORTHCOM/CANADACOM structure.

However, NORAD flexibility and the dedication of NORAD personnel, American and Canadian, to the bi-national mission appear to once again be working to resolve problems. The paperwork to cover the presence of Canadian personnel in USSTRATCOM functions and facilities was eventually put in place in 2007, returning Canadians to some of the places from which they had been excluded. And American officers unfamiliar with NORAD's bi-national ways of operations gradually came to understand NORAD's unique culture. Several of the officers interviewed as part of this research believed that this transition was being weathered in the same manner as previous transitions have been in the past.

3.2. COSMOS 954: Preview of Future SSA Issues?

Within the history of NORAD, the most directly applicable experience in international data sharing in space situational awareness (SSA) is unquestionably the set of events around the de-orbiting of the Soviet satellite designated COSMOS-954 in January 1978. In this incident, many of the issues that arose may well arise again in any proposed future SSA data sharing system. Thus a more detailed examination of this incident, with particular attention to the cross-border data sharing and notification aspects, is warranted. It is also noted that substantial matters in relation to this incident remain open and unresolved in the open record yet today, thereby requiring a more detailed examination as a useful follow-on to the present study. This point will be discussed in more detail in the Conclusions and Recommendations section of this paper. A brief chronology of the incident demonstrates the relevance of the history to the issues at hand in this work.

In November 1977, the U.S. Defense Space and Missile Activity Center (DEFSMAC) informed the Canadian Department of National Defence (DND) of the possible de-orbit of COSMOS 954,

a Soviet reconnaissance satellite with a nuclear radio-thermal generator (RTG) on board; its impact was estimated for April 1978. Subsequently, in December 1977, Prime Minister Pierre Trudeau was personally briefed on the matter during a visit to NORAD headquarters in Colorado Springs. On January 11, 1978, DEFSMAC changed its impact date estimate to January 23, and the DND was informed. At that point, the Canadian federal government began major preparations for its response effort. However, it did not at that time inform provincial or local officials, or the general public. When this lack of disclosure was subsequently criticized, some Canadian federal officials claimed that U.S. officials had asked them not to disclose the information due to intelligence security concerns. This claim was never substantiated, but it is the case that COSMOS 954 was a reconnaissance satellite, and the U.S. has always been reluctant to disclose anything that indicated how much or little it might know about foreign military capabilities.

The case is further complicated because the existence of the technical means by which the U.S. had obtained the information -- the Defense Support Program (DSP) satellite system -- was at the time highly classified. This is illustrative of a generic issue in SSA data sharing, whether international or merely between national military and civil or commercial programs. The primary mission of the SSA capabilities of the United States (and other States, in general) is to protect its most valuable space assets, which are usually classified military and intelligence satellites, and collect military intelligence information on the space assets of potential adversaries. These same SSA capabilities could also be used to detect and collect intelligence on those classified or sensitive national satellites. Thus, a large portion of SSA information is closely guarded. In NORAD, its Canadian personnel, who generally have broad access to air and space surveillance information, are not permitted to access much of this information, and none in regard to classified U.S. space systems. Any international SSA data sharing system will have to accept that for the foreseeable future, information on such systems (not only the U.S.'s, but those of other powers) will not be shared and the system will have to be designed to take those concerns into account. Even some peripheral information that could aid analysts' ability to infer information about such systems may be withheld.

The re-entry of COSMOS 954 in fact occurred on January 24, 1978, in the Northwest Territories of Canada. President Carter personally informed Trudeau shortly afterwards; likewise, National Security Advisor Zbigniew Brzezinski informed his Canadian opposite, Ivan Head. NORAD formally informed DND shortly after that. DND phone logs also suggest that other U.S. agencies may have called prior to the NORAD notification, but this situation is not clearly documented.²¹ Subsequently, the question of the manner in which the direct flow of information from NORAD to Canadian command authorities was accomplished, and how decisions were made within Canada after receipt of re-entry warning information, became a public issue in Canada. The actual information flows in this episode are still not clear in the open literature.

²¹ Interview with Prof. Joseph Jockel

Any international SSA system can expect that the handling of information in episodes like that of COSMOS 954 may become an issue, unless all information in the system is always publicly available. Full public disclosure in real time would avoid decisions on who gets to see what data when, and under what restrictions. However, full public disclosure would create its own issues, beginning with the fact that such disclosure would likely limit substantially the amount of data any operator would voluntarily contribute. Beyond that, it is the case that reported information will be incomplete and not necessarily accurate, even assuming all participants have no incentive to hide or misrepresent the data they report. Any action taken on the basis of incomplete information will have consequences, some of which will impose costs on at least some parties. Information that overstates the likelihood of space-to-space collisions will impose fuel and vehicle lifespan costs on the operator should unneeded collision-avoidance maneuvers be made.

Space-to-earth warnings have the potential to cause substantial costs in the form of disruption, evacuation costs, and other preparation costs. A series of evacuations as a precaution against events that did not come to pass will quickly create skepticism about such warnings among the general public and degrade willingness to comply with subsequent warnings. Moreover, warnings of space-to-earth face the same issues as severe weather warnings and other uncertain predictions with large downsides. Some level of negligence or disregard in unfulfilled predictions may become actionable, and liability claims may arise. An evacuation order may have been reasonable in terms of actual costs versus potential costs of non-evacuation times probability of incident, but the general public tends to disregard such calculation, and considers that any precaution that did not actually turn out to be needed is self-evidently a mistake. This is a generic problem with probability-based precautionary actions, and will continue to apply to space-to-earth incident prediction for the foreseeable future. An actual incident resulting in substantial loss or life and/or damage may invert the perception of risks versus precautionary costs for some period of time, however. In such a case, authorities can expect to come under criticism for being too reluctant to order evacuations.

The COSMOS 954 incident, and particularly the cross-border data handling and sharing issues therein, are a good candidate for further research. As discussed previously, its problems are directly relevant to current discussion on SSA international data handling and sharing. It is also a good time to undertake new research: relevant public records in the U.S. and Canada are becoming declassified. At the same time, many of the principals in the incident are still alive and may be available for interviews.

4. The Bi-national Factor

4.1. Two Relevant Points from Operational Experience

The operational experience of NORAD suggests two main points relevant to designers of future international SSA data sharing system: the advantages of a minimalist charter and a focus on data collection and analysis and not actions taken as a result of data.

4.1.1. The Advantages of a Minimalist Charter

The Charter of NORAD was particularly minimalist, thus enabling freedom of operation which particularly aided its ability to adapt to a succession of major changes in its mission, environment, and circumstances. These have included changes in the perception of NORAD's mission and function from era to era. Over that time, threats have evolved from Tu-4s through ICBMs through stealthy ALCMs through air-enabled terrorist missions. The flexibility, perhaps even deliberate vagueness, of its charter was useful in enabling NORAD to adapt and survive. The on-the-ground cooperation of the American and Canadian air services outran in a number of instances the formal arrangements between the civil authorities of both countries, and particularly the diplomatic functions. This is not unique to NORAD, of course. The U.S. military maintains military-to-military relationships and agreements with many allies. It is particularly true of U.S.-Canada relationships. The U.S. military's relationship with its Canadian counterparts -- its oldest formal continuous military-to-military relationship -- was launched in 1940 by the "Ogdensburg Agreement", which was, officially, never more than a pair of press releases issued by President Roosevelt and Prime Minister Mackenzie King. This pattern has been characteristic of NORAD operations to this day; many areas still dealt with mostly by handshake understandings as written MOUs lag behind. This situation has been altered somewhat by end of dual-hatting of NORAD and USSPACECOM. As discussed previously, many operational "understandings" were effectively negotiated "by the commander with himself", in the words of one NORAD officer interviewed. Consequently, the new relationship between STRATCOM and NORAD has resulted in the creation of paper trails in some areas that had been traditionally dealt with informally.

Thus, in regard to SSA data sharing, the NORAD experience suggests that, so long as the actual entities involved in any future international SSA data sharing system have a comfortable working relationship, the charter may benefit from being written in such a way as to give the partners room to evolve and adapt as circumstances demand.

4.1.2. Focus on data collection and analysis, not actions based on data

Controversy and tension between U.S. and Canada over the course of NORAD's history has arisen almost entirely over issues about action after data was sensed and analyzed, e.g.: arguments over the use, possession, and storage of nuclear anti-aircraft weapons, such as

BOMARC and GENIE, or the long, problematic series of ABM/BMD issues from Nike-Zeus through current BMD deployments. There have hardly ever been any fundamental disputes about the need to achieve situational awareness, or appropriate means for doing so. The disagreements on the sensing side primarily centered on location, financing, and manning of radar stations. Although these issues were contentious at the time, they were resolvable through give-and-take bargaining typical of partnership negotiation. This history suggests that an international SSA data sharing organization, which will have sufficient issues over sensing and data handling to resolve in the course of development, would be well advised to limit its functions by charter to sharing of sensed data, and avoid at least for the initial period of development, any consideration of actions in response to sensing and identification.

4.2. Notes on the Organizational Culture and Experience of a bi-national Organization

The activities of this project included a series of interviews with officers having done NORAD duty. Six officers between the ranks of captain and general were interviewed. In order to insure frank discussion, the interviewees are not identified, and records of the sessions were confined to written notes. Additionally, Prof. Joseph Jockel of St. Lawrence University, generally considered to be the primary academic expert on the history of NORAD, granted a lengthy and detailed interview. The results of the interviews are summarized as follows:

Interviews validated the following points unanimously:

- NORAD has evolved a strong, distinct organizational culture as a result of its unique bi-national operational practices;
- The bi-national nature of the organization is a particular point of pride and distinguishing characteristic, that participants feel sets them apart within both the U.S. and Canadian militaries;
- There is agreement that there is particular value in the operational practice of U.S. and Canadian personnel serving side by side, in mixed reporting relationships: individuals are assigned positions on the basis of experience and competence, not nationality;
- Thus, personnel have become accustomed to reporting to and supervising the other nationality.

Interviewees have stressed that bi-national operation is far more of an asset than a liability. Differences between U.S., Canadian forces practices and organizational cultures have largely been complementary. For example, divergent U.S. and Canadian promotion and posting practices, and the different scale of the two nations' forces, have resulted in U.S. forces often having more intensely trained and knowledgeable personnel, but on shorter tours. Canadians often remain longer in any given rank and post, and thus have the opportunity to learn from

several such U.S. specialists. Thus, Canadians' longer tours of duty providing an otherwise-absent source of organization knowledge for, and continuity to combined operations. Another advantage mentioned by several interviewees: personnel have come to view themselves as advocates for NORAD back to national governments.

Following creation of USNORTHCOM and CANADACOM, the situation altered to some extent: interviewees consistently reported that the new structure has had the effect of polarizing more differences of opinion along national lines. As noted above, this was rarely the case in past structures. This appears to be an unintended effect of the change in structures. Some changes noted were the unintended result of the change from the historical NORAD practice of dual-hatting NORAD and USSPACECOM (and previous national aerospace/air defense command) commanders. This change ended the historical NORAD practice of the commander "negotiating with himself" in dealing with the status of NORAD personnel in facilities and roles operated prior to 2002 by USSPACECOM and its predecessors. The effects of this shift created a lag time of some years while paperwork was put in place to cover situations previously handled by dual-hatting. For one example, the presence of Canadians in the Joint Space Operations Center () at Vandenberg Air Force Base, a USSTRATCOM facility, could not resume until paperwork was put in place to permit their presence, and executing such paperwork had not initially been a high priority at USSTRATCOM. Canadians are now returning, joining (somewhat ironically) British and Australian personnel already serving there.

These experiences support the argument that bi-national cooperation is achieved by experience and effort, and like all human constructs, is subject to disruption by unintended effects of changes introduced for other purposes. For example, NORAD's bi-national functionality degraded unintentionally by relatively minor changes in organizational structure and changes in the threat. This sensitivity to unintended effects will likely be as or more characteristic of international efforts as well.

The bi-national nature of NORAD, and the flexibility of its enabling Agreement added stability through its multiple evolutions. The long process of its formation made both U.S. and Canadian politicians and military reluctant to abandon NORAD once it was formed. NORAD's existence had only been made possible by a unique set of circumstances which will probably never be duplicated again. Once formed, NORAD's practical and symbolic significance was such that nobody wanted to dismantle it even after the specific rationales for its existence had disappeared. The re-emergence of an air-breathing threat in the 1980s also underscored the point that the relatively small costs of retaining NORAD had been cheap insurance against the possibility that it might once again be a critical capability, as it turned out to be. The experience of working together created a dedication to the bi-national concept among both Americans and Canadians. As this experience grew, NORAD personnel became increasingly dedicated to bi-national efforts and subsequently strong advocates for its continuation.

As the history discussed previously demonstrates, NORAD was always able to adapt to new circumstances. Even in periods in which Canada's geographical contribution was less important,

such as the later 1960s and 1970s, the Canadian human resources contribution was valued by NORAD and both governments. The choice of Canada is a historical accident in some ways. Had the U.S. sought in, say, the mid-1960s to choose one ally to contribute personnel to a bi-national space warning and assessment capability, it is not clear that it would have chosen Canada. The United Kingdom, for example, with its larger pool of service personnel and its direct contribution to ballistic missile warning via the radar installation at RAF Fylingdales, might have been the more logical candidate. But Canadians were already in Colorado Springs performing the analogous work in air defense, the political and administrative systems were in place to accommodate them, and it was thus an easy step to add the space tasks to NORAD's agenda. This was aided by the fact that historically Canadian personnel assigned to Colorado Springs have been considered to be high quality. NORAD is a choice assignment in the Canadian Forces and competition for the slots is strong. This competition insures high quality and highly motivated personnel. This in turn has made the U.S. Air Force happy to continue the NORAD relationship even during the periods in which the original rationale for Canadian participation had weakened. The various commands inside the Air Force are in constant competition for limited resources both in funding and in quality personnel. The Canadian human resources were in effect a protected pool of capability that other commands couldn't touch, which became a useful characteristic. Had the Canadian element of NORAD been a drain rather than an asset, there were numerous moments in history in which the command could have been dismantled with little protest.

The interviews, in general, validated this study's initial assumptions regarding bi-national experience, but also brought to light some under-appreciated points. As previously discussed, the interviews without exception highlighted the strong sense of mission apparent in NORAD personnel. NORAD's bi-national nature was, again without exception, a key part of this sense of mission. This is not to say the achievement of a successful bi-national system was a given, or was accomplished without effort. There are substantial differences between U.S. and Canadian Forces policies and practices in some areas, which create a requirement for learning and understanding by personnel unfamiliar with the other nation's system. One example cited frequently is the slower Canadian promotion practices, and the Canadian Forces' lack of the "up or out" policy as practiced in the U.S. armed forces. Canadian personnel policy tends to permit an officer to remain in a particular rank and position so long as he or she is doing a good job. Promotion requires a positive indication that the candidate is well-suited to the expanded roles of the higher rank.

This practice has resulted in the presence of personnel in the middle ranks who are lower-ranking for their age than their U.S. equivalents. U.S. personnel unfamiliar with Canadian practices may assume that this slow promotion is an indication of poor performance or other negative reasons. As one senior Canadian officer remarked in an interview, "You may have a fellow who is a captain and a transport pilot. You know he'll never make major, but he can be one hell of an airplane driver. Why not leave him there as long as he's doing a good job?" As the comment indicates, these practices, plus the longer Canadian tours of duty, mean that personnel often

accumulate more experience and more seasoned judgment in particular positions. U.S. personnel may have more specialized training in a particular job, but the Canadian will have learned from several such well-trained Americans. The longer Canadian tours of duty also mean that Canadians at NORAD tend to become the custodians of organizational memory. Similarly, there are aspects of U.S. practices that Canadians have come to appreciate. For example, the Canadians interviewed for this project concurred that the ability to bring back skilled ex-military personnel as civilian contractors is an aspect of the U.S. system that Canada might wish to imitate.

Another attribute remarked upon by an interviewee was that the Canadian Forces tend to reorganize less frequently than the US. One observation by a senior Canadian officer was that U.S. commanders like to demonstrate achievement, but often have little scope, due to resource and/or policy constraints, to innovate. Reorganization is an achievement attainable without competing for resources; therefore, reorganization for its own sake, with little final improvement in outcomes, is not uncommon. Yet reorganization imposes costs in disruptions, and it is particularly a strain on bi-national organization, as partners have to adjust. As can be seen from the example of the ADC transition to USSPACECOM, and again in the example of the USSPACECOM transition to USNORTHCOM and CANADACOM, each transition required an extended period of learning in regard to bi-national organization, and other adjustments, before functionality returned to normal.

5. Lessons Learned Applicable To International SSA Data Sharing

5.1. What Can Be Learned from the NORAD Experience

At a minimum, episodes in NORAD's history stand to serve as an existence proof that SSA data sharing can be performed on a bi-national basis. As exemplified by NORAD, a bi-national organization obtained certain elements of SSA information, assessed it, and passed the results along to both nations. The actual work was performed by nationals of the two partners working together in a combined work environment with, generally speaking, no distinction of nationality in assignments except for the Commander and Deputy. The big exception, and a significant one in terms of future SSA data sharing approaches, has been the limitations on Canadian knowledge of U.S. classified military or national-security systems. With this significant caveat, NORAD demonstrated that bi-national operation is possible in the SSA task on an ongoing basis. The NORAD experience also suggests that if undertaken with the right background and approach, bi-national operation can be an asset rather than a liability.

The NORAD history also suggests that international structures can be proposed and debated, but implementation will probably only happen following the perception of an imminent crisis, or the occurrence of an actual disaster. Organizational champions and individual leaders in each country must push for international solutions. In the NORAD case, what is immediately apparent is that the role of the respective USAF and RCAF champions of air defense and the bi-national solution -- Partridge and Slemon -- were critical to NORAD's formation.

Radical measures such as bi- or multinational organizations will probably not gain support until less radical measures are considered and found wanting. The basic form of North American air defense was well-understood from 1946 onward, yet no single measure recommended by the Air Warning and Air Interceptor Plan in that year was adopted in that form. In every case, intermediate solutions had to be tried and found wanting before a commitment could be gained for the full solution. It is likely that an international SSA data sharing system will experience the same pattern. Regarding this, it is worth emphasizing that the world is not at the beginning of this process in regard to SSA. The de-orbiting of Skylab, COSMOS 954, and Salyut were well-publicized incidents in the past. However, since none of them resulted in loss of life or extensive damage, general public opinion has treated them as isolated incidents, rather than -- as they are -- initial examples of an accelerating need for better SSA data collection and sharing.

The commercial satellite industry, however, has in recent years begun to move from a position of passive acceptance of collision risks and post-accident reaction to a realization that proactive measures need to be taken. As always, the insurance industry, serving as a mechanism for anticipating future losses, has served as a spur to this realization. In particular, recent incidents include the Chinese anti-satellite test of January 11, 2007, which generated the largest trackable debris cloud from a single event in the history of space activity, and the collision on February 10, 2009, between Iridium 33 and COSMOS-2251. The collision not only destroyed an active

commercial satellite, but also created a significant amount of debris that permanently increases the collision risk to the rest of the Iridium constellation and other satellites in that orbital region. To date, the growing perception of a problem in this area has not spread beyond the active space community and the policy levels directly dealing with its issues. However, another event on the scale of COSMOS-954, or any event in which a de-orbited space object impacted a populated area and/or caused loss of life would likely elevate the issue into general view.

In assessing the political climate in nations that might be prospective members of an international SSA data sharing effort, it is worth bearing in mind the formative events and "lessons learned" that influence the key stakeholder organizations. This was a critical factor in the sequence of events that led to the formation of NORAD and the incorporation of the RCAF as a player into a previously all-U.S. unified command. NORAD's formation reflected the strong USAF and RCAF organizational belief in the lessons learned from the Battle of Britain and Pearl Harbor. In planning an international SSA data sharing effort, a similarly critical step will be the identification of prospective players and specific organizational champions in those nations. In searching to identify such champions, players who have benefited from close international cooperative roles, who have a strong ethos of identifying and proactively meeting future challenges or who have been affected by the consequences of a lack of proactive measures in the past, might be particular targets for cultivation.

One particular lesson from the foundation of NORAD has tended to be overlooked in recent years precisely because of NORAD's success. This is the degree to which historical legacies of suspicion and tension between the U.S. and Canadian governments still influenced attitudes and political will at the time of NORAD's founding. In the U.S.-Canada case, these negative legacies were overcome with mutual effort and a gradual process of trust-building. In the NORAD case, several positive elements were also available to counteract the negative legacies, starting with the reality that even in the times of greatest conflict and suspicion, a very broad-based network of human, commercial, institutional, and infrastructure ties connected the United States and Canada far more intimately than most neighbor countries.

More important in NORAD's case, generational change was on NORAD's side. The senior levels of Canadian politics and institutions in the 1945-1958 time frame had formed their political consciousness during the period of the 1903 Alaska-Canada border dispute and still saw the U.S. as a potential threat to Canadian territorial sovereignty. However, the younger generation rising in politics and the military had been influenced much more by the U.S.-Canadian cooperation and combined operations of the Second World War. In addition, all generations were realistic about the fact that Canada's landmass stood directly on the route between the Soviet Union and the United States, and to do anything other than be as active as possible in the defense of the continent, was to risk becoming the "Belgium of the Nuclear

Age”.²²

There are several available models for international SSA data sharing; any or all of these in some combination may become the template for future action. No two nations have perfectly harmonious relationships, nor can they ever be expected to. Any implementation of these models may result in two or more partner nations to overcome past legacies of mistrust and suspicion. The NORAD experience offers lesson for data sharing templates to deal with such issues.

The impact of generational change within the U.S. military on the subject of SSA data sharing cannot be understated. An entire generation of military leaders has experienced the frustration of existing barriers in attempting to share information in coalition operations: most notably, the International Security Assistance Force (ISAF) in Afghanistan, as highlighted in a recent report by a NATO think tank.²³ Additionally, after years of insistence on unilateral space operations, the U.S. military has recently concluded that there is a strong need for data sharing between allies and commercial partners, as evidenced by the 2009 Schriever War Game, which will be discussed in greater detail below.

5.1.1. Where NORAD's Lessons Are Not Directly Transferable

As discussed previously, there are a number of possible models for international SSA data sharing structures that might be considered. In some such models, the NORAD experiences are broadly applicable, while in others, there are fewer directly applicable lessons to be derived. In all cases, it is important to bear in mind that NORAD was and is an explicitly military organization performing a classic military task. It is commanded by a military general officer and is part of the regular military hierarchy, although it has specific direct routes of communication to the national command authorities of both member nations. It is funded as a military activity from military appropriations in both countries. Its initial product, airspace situational data, was intended for military use and not normally used by the relevant civilian air regulatory authorities, the FAA and Transport Canada, who have their own dedicated radar networks. In space, the SSA product (now a USSTRATCOM product, for which NORAD is only one of many users) is primarily used for military applications but increasingly also for civilian uses, including protection of NASA's civil government space assets, and is a primary regulatory input for the FAA's space regulatory authority, the AST. However, the latter situation is an unintended anomaly (since military systems are not typically given a civil regulatory role) and the U.S.'s SSA function is still a primarily military function. As an initial step toward

²² This is in reference to the role that Belgium played in both World Wars. Although officially neutral and protected by treaty in both instances, Belgium was invaded by Germany in 1914 and 1940 largely so the Germans could avoid or bypass the military fortifications and presence in northeastern France. Thus, although Belgium was not the primary target nor did it provoke war, it nonetheless became a casualty of war simply due to its geographic location.

²³ JAPCC report at <http://www.japcc.de/108.html>

resolving this anomaly, the U.S. military created the Commercial and Foreign Entities (CFE) system as a means of serving customers other than the military, which has since evolved into the SSA Sharing Program. This anomalous military role and its implications are a subject for further discussion elsewhere.

An international SSA data sharing system may ultimately be all military in nature, mixed military and non-military, or entirely non-military, and may even have non-governmental actors as direct participants. The more the model becomes non-military, the weaker certain parallels to NORAD become. However, even if the data sharing is done on a non-military basis, the information gained is almost certain to be applicable to security matters and thus used by militaries. Although the concerns of the Integrated Threat Warning/Attack Assessment (ITW/AA) requirements for insuring the integrity of data will prevent such data from merely being fed into the data sharing systems. (See the discussion of ITW/AA at C. below.) Additionally, NORAD only encompasses two nations as full members, although, for example, United Kingdom forces are effectively integrated into NORAD operations and SSA data sharing through the participation of UK forces operating the BMEWS station at RAF Fylingdales. Likewise, Norway has a minor existing role in SSA data sharing through their GLOBUS II sensor which also provides SSA data to the U.S. military.²⁴ An international SSA data sharing organization would almost certainly be multi-national or international in nature, and thus the politics of its development and operation will by nature be more complex than in NORAD's bi-national case.

Another instance in which the NORAD experience may be of limited relevance is in the models in which some participants in international SSA data sharing may not be allies. In fact, in some models, participants may be strategic rivals or even nations that are considered hostile to each other. NORAD, as established, only works because of the extremely high trust that has been created between the United States and Canada. Airspace sensing data has been shared fully between the United States and Canada in all instances. In cases related to ABM/BMD activities, Canada was given the same opportunity to participate on a substantially (but not symmetrically) bi-national basis, which did not happen because of political decisions taken by Canada. Some models of international SSA data sharing would involve very selected data being shared by national participants. In such models, the NORAD model would not apply, and there would likely be no single physical space in which personnel from the various participants would work side to side. Thus, some of the mechanisms that have resulted in close and effective cooperation would not be available.

Another area in which the NORAD experience is not directly transferable is in the nature of the motivation and the perception of the threat. NORAD was created as a means of avoiding a mass nuclear attack on the United States and Canada, a potential attack which was considered to be credible by people who had, only a few years before, seen the consequences of underestimating a

²⁴ GLOBUS II Sourcebook <http://www.fas.org/spp/military/program/track/globusII.pdf>

threat of attack. Obviously, the prospect of a mass nuclear attack, with deaths counted in tens to hundreds of millions, was a very strong motivator for both the military and civilian authorities who had to make the decisions. The threat and probability profile upon which the need for international SSA data sharing is based is quite different.

Considering SSA data sharing, the probabilities of further space-to-space collisions essentially approach unity. Debris models show conclusively that they will happen again, and will happen at an accelerated pace unless significant measures are taken to control the space debris population. The probabilities of space-to-earth impacts are also extremely high; the main areas of uncertainty lie in the size of the impacting object, the population density of the impact area, and the likelihood of nuclear or chemical materials on board capable of magnifying the casualties and costs of cleanup. As densely populated areas are still concentrated in a relatively small percentage of the planet's surface, it is possible that quite some time may pass without a sizable impact in a densely populated area. Or it could happen this year, in which case the political outcry for effective SSA data sharing, and charges of neglect for having failed to create it in the past, would be highly audible. And, although Earth-approaching cosmic objects are not at present a major focus of SSA data sharing, it is now understood that the frequency of space-to-earth impacts of cosmic objects is rather more frequent than previously assumed. Again, one incident could quickly change the perception of risk and the willingness to devote resources to it. As it happens, an international SSA data sharing system designed primarily to improve prediction of and avoidance measures against space-to-space collisions would be in and of itself a framework that could quickly be augmented to deal with the other less-easily-calculated threats. In designing the former system, consideration should be given to not precluding such expansion.

5.2. Some Approaches to International SSA Data sharing and Relevant Issues

For the purposes of this discussion, possible architectures for ISSA data sharing should be envisioned as falling into a design space bounded by two dissimilar models. The first is what may be called the "CSSI Model", after the proposal offered for discussion by the Center for Space Standards and Innovation in Colorado Springs, Colorado.²⁵ The CSSI model proposes a structure modeled on the historically successful Internet Committee for the Assignment of Names and Numbers (ICANN), which regulates and manages assignment of Internet domain names. ICANN is of interest in that it is voluntary, international, and encompasses a wide variety of users, including governments and non-governmental entities, both non-profit and for-profit. It has no compliance mechanism aside from mutual recognition, yet it is highly successful. The CSSI model for ISSA data sharing would be, at a minimum, an organization for

²⁵ Buckwalter, Bjorn; Chan, Joseph; Kelso, T.S.; Vallado, David A. *Improved Conjunction Analysis via Collaborative Space Situational Awareness* 3rd IAASS, Rome, 2008 Oct 21-23

voluntary, mutual sharing of limited data sets by space object operators -- essentially, a mutual self-reporting system with a common, standardized format. The system could also be expanded if participants were willing to contribute sensed data on debris and other objects beyond self-reporting by operators; at present, this would encounter policy barriers in the US and elsewhere.

The virtue of the CSSI model is that all space operators have something to gain in participating and reporting. The U.S. would acquire data it otherwise might not have. The system would in general generate better positional data than the two-line element sets (TLEs) most commonly used today and also provide improved collision avoidance capabilities. Unlike other models, since it would be an open participation model, it would be a means of permitting participation by countries such as Russia and China, who are substantial space operators, and without whose participation a system would not have data on a large fraction of active satellites. A fully open system, of course, increases the possibility of participation by States such as Iran or North Korea, which could raise yet other issues.

Issues arising from the CSSI model center on the problem of knowledge inherent in a self-reporting system of players with national agendas. Since NORAD's awareness of space objects must be treated as part of their overall mission of threat warning and attack assessment, they have evolved stringent standards on reliability of data sources. The question follows, specifically, "How does NORAD and other national threat warning/attack assessment capabilities, such as those of Russia or China, evaluate the likelihood of the veracity of self-reported data?" This is the issue known in military terminology as ITW/AA: "Integrated Threat Warning/Attack Assessment" and it is precisely the function that had failed so dramatically at Pearl Harbor, and failed because it had not been treated as an integrated requirement. ITW/AA seeks to create a seamless flow of information, and increasing improvement of the quality of that information, from the sensors to the analysts to the decision-makers. A familiar and constant problem of military command is that in which decision-makers must choose from among several mutually-exclusive sets of information, each with plausible evidence of validity. The German invasion of France in 1940 and the Allied invasion of Normandy in 1944 each were such cases; in both instances, the true attack location was known. The defenders instead chose, fatally, to believe credible-seeming, but false information indicating a different location. These were assessment failures.

Current ITW/AA procedures seek to reduce this uncertainty through strict rules and procedures designed to screen out false, misleading, or merely unproven information. One NORAD officer, in discussing the CSSI model, made the point that he was, in essence, not permitted to act on data unless NORAD had sensed the object directly. This is, once again, an ITW/AA issue. The CSSI model might improve the ability to identify objects for further analysis and sensing, although it also raises the possibility that a participant might choose to spoof the system through deliberately misleading reporting, particularly if some potential players were admitted to the system. Here, it is worth considering that such spoofing becomes less of a problem the more players are involved. It becomes a crowd-sourcing paradigm, where the crowd can weed out a

single bad actor or single errors, as long as more than one party has independent access to the data source.

The following points are also worth considering. In a model such as that used for CSSI, any system for prediction of potential adverse outcomes must recognize that predictions by their nature are less than perfect. Such predictions often serve as a basis for anticipatory measures that will impose costs, often substantial. Such costs must be imposed on the basis of incomplete and imperfect knowledge. This will always create dilemmas for public officials. The question of when and on what basis to trigger an evacuation of a city on the basis of severe weather warnings is an example of such a problem. Ordering evasive action by a satellite whose finite lifespan and economic utility is primarily determined by remaining station keeping fuel is a similar example, although lives are usually not at stake. As one of the participants in the workshop in this project pointed out, "false alarm" is a misleading term as a decision to take such evasive action represents a choice between actions based on two imperfect estimates of risk. In the event, that a collision warning motivated evasive action, imposed costs, and then was shown to have been made on the basis of flawed analysis with avoidable errors has the potential to generate liability claims. Weather forecasters may motivate civil authorities to evacuate urban areas; such evacuations not infrequently generate accidents that cost lives or damage, and some evacuations turn out to be unneeded. Sovereign immunity typically prevents litigation against forecasters; what would the liability issues be in a space collision avoidance situation? This is an unresolved issue.

The other point made in regard to the CSSI model is that it only covers space objects under active control, which is only a small fraction – less than five percent - of all trackable objects. Dead satellites and fragmentary debris are still a major problem. (This would be improved substantially if the U.S. Government and other States were willing to share the SSA data gathered on such objects. However, many governments currently do not share SSA data, and therefore the CSSI model must be assessed on the basis of current policy. A change in policy would obviously affect that assessment. Even without this data, the CSSI model is worth considering -- its benefits are real. It would be an argument against relying on such a system as the sole means of gaining SSA, a policy which nobody, including CSSI, is advocating. What it does suggest is that an ISSA data sharing system may be a combination of various types of systems, with various mixes of players and capabilities. The question then becomes one of what other system may be envisioned as part of the ISSA data sharing solution. If the CSSI type of system represents one boundary of the solution space, what might be the other?

An alternative model -- although one that is potentially complementary to the CSSI model -- is termed here the "Circles of Trust" model. It is one that explicitly builds on, and expands from, the successful NORAD historical experience in bi-national SSA. Essentially, it would take the SSA function currently performed by USSPACECOM and used by NORAD and other entities, and the gradual addition of other national participants. This is not a detailed proposal for such a system, merely an iteration of the basic principles upon which it might be founded. A system

built on this Circles of Trust model could be built within NORAD, it might be a new adjunct to NORAD, or it could be an entirely new organization. The disadvantage of a NORAD-based system is that NORAD is involved only peripherally in SSA at present, and that situation would have to be reversed. On the other hand, NORAD is a successful template for bi-national action, and it might be easier, organizationally and diplomatically, to augment NORAD's role in SSA and add additional players, than to create a new international organization. Evolution tends to be more successful than revolution in governmental and international organizations.

Unlike the CSSI model, the Circles of Trust model would specifically require the ability to produce actionable, trustable SSA data to the relevant U.S. military entity, whichever it might be, under its existing rules. If it is an adjunct to NORAD rather than an evolution from it, it might be an exclusively military organization, it might include uniformed, armed services that are not primarily warfighting forces (perhaps along the lines of a "Space Guard based on the Coast Guard model), or it might include civilian agencies, presumably ones able to deal with highly classified data. These are questions for further study.

The Circle of Trust model has a number of inherent advantages. It builds on existing relationships that are already involved as SSA partners with the U.S. in varying degrees. The close integration of the RAF element operating the BMEWS facility at RAF Fylingdales into NORAD, and the current UK and Australian presence in the JSpOC at Vandenberg AFB, would make both of those nations relatively easy additions to the system. The approach of gradually adding trusted partners reduces the trust and validation problems inherent in other approaches. The institutional and human dynamics of such a system would probably closely follow the dynamics of the existing bi-national organization in Colorado Springs.

The idea of a quadripartite cooperation in defense space activities, including the United States, the United Kingdom, Canada, and Australia has emerged a number of times recently from multiple sources. A recent issue of High Frontier Journal reported on the outcome of the U.S. Air Force's Schriever V space wargame, in which the three allies were permitted to participate in a significant manner for the first time. This participation was so successful that authors Rouge and Danielson, writing in that issue, called for a permanent structure providing for space operations among the four partners as well as key commercial partners.²⁶ This is interesting from the standpoint that many of the factors enabling close cooperation between the US and Canadian forces also facilitate such cooperation with the UK and Australia as well. However, it is important to distinguish Rouge and Danielson's proposal from a Circles of Trust ISSA proposal. The latter is *not* necessarily a multinational space operations center, but rather a concept for handling SSA data among a relatively small set of partners, which would be capable of handling more sensitive levels of data than a more open system based on the CSSI model. A system passed on the Circles of Trust model would still seek to generate SSA products of use to

²⁶ Danielson, Dennis L., and Rouge, Joseph D., Coalition Space Operations: Lessons Learned from Schriever V Wargame, in High Frontier, The Journal for Space and Missile Professionals, Vol. 5, No. 4, August 2009

civil and military users alike.

Also of interest in the discussion of the Schriever V wargames was the exploration of data restrictions. Because the wargames were an exercise, it was possible to share data and link computer systems in a way that current U.S. policy does not permit in the real world. If the Rouge-Danielson proposal were to be considered seriously, it would require a re-examination of such policies in regard to close allied access to information. Any such changes would also have possible consequences for ISSA, and might make a Circle of Trust approach more feasible. ISSA advocates would do well to monitor such discussions.

Furthermore, some current developments make the present time a propitious moment to contemplate such an enlargement of the existing data sharing systems. The progress made on development of the Canadian Sapphire radar satellite system and its follow-ons give Canada a specific contribution to SSA of a nature and scale it has never had before. Canada had some sensor contribution in the past, through the Baker-Nunn telescopes, but that is nearly two decades in the past, and Sapphire stands to be a significantly greater contribution. The 2009 Australian Defense White Paper²⁷ signaled an emerging Australian interest in both SSA and radar-imaging satellites, suggesting possible contributions by Australia beyond human resources and geography.. The Defense Paper also indicated the viability and reality of Australia as an important geographical asset for SSA. Another suggested partner for such a system might be Norway, whose intelligence agency operates a U.S. sensor that is an important link in the Space Sensor Network.

Possible issues for consideration for a Circles of Trust model include the fact that such a system would grow gradually, and might take a long time to build as a truly international system. Additionally, the politics of who to invite might become contentious -- would excluded nations be resentful, or suspicious? It is certainly the case that other sets of nations would seek to create their own "Circle of Trust" systems. This is to be expected and is not an argument against the U.S. pursuing of such a course. It is likely that international SSA data sharing will take place in an environment characterized by nations and sets of nations operating closed, primarily military systems for military purposes, with some stripped subset of their sensed data released to wider circles. Some such multinational systems, though, may be more open. The European discussions on a multinational European system may produce such a capability. At the same time an open, primarily civil international SSA data sharing arrangement, perhaps along the lines of the CSSI proposal, could share more limited sets of data more widely and openly. This open, civil system might or might not have an international analytical center in which analysts from multiple nations and organizations work together to improve analysis. Such a center could be useful in creating buy-in options for nations that currently have no such analytical capabilities – thus possibly building wider support for ISSA proposals. As discussions on ISSA data sharing move

²⁷ Defending Australia in the Asia Pacific Century: Force 2030 Defence White Paper 2009 Australian Government - Department of Defence, Para 9.101

forward, a useful early focus may well be on achieving an agreement on common standards and formats for SSA data, and other protocols seeking to insure that when and where nations decide to share SSA data, or expand the degree of sharing, they might do so readily.

5.3. Topics for Further Investigation

1. In terms of the historical aspect of this study, a closer look at the Operation BIG BEN history, and the Strategic Airpower vs. Air Defense debate in pre-1939 Britain as an influence on Cold War assumptions would expand the historical understanding of Cold War thinking and motivations. The question of the specific influence of these issues on the NORAD formational period, and specifically the idea of the RCAF as a direct link between the two periods, has been described as "academically new ground" and may be a candidate for further work.
2. On the history of ISSA and data sharing across national borders, a closer look at the handling of COSMOS 954 as a model of an ISSA data sharing problem would be a genuine addition to the historical literature. As has been suggested, this moment in time is particularly useful for such study, as it is possible to examine newly declassified documents as well as interview principals involved in the situation, many of whom are still living.
3. Further investigation in the airspace side of NORAD's functions may provide useful parallels to the ISSA data sharing task. For example, highly classified aviation activities are conducted by the United States at locations such as Groom Lake in Nevada. Some data from these activities may exist in the airspace warning system, information that the United States would not automatically choose to share with Canada without specific consideration. To the extent possible in an unclassified study, it may be useful to examine the way the need for segregation of such data is handled.
4. On the practical matter of paths to a future SSA system, a more detailed look at both the CSSI and Circle of Trust models, as well as other models for ISSA data sharing that may emerge, would be timely. Particularly useful would be laying out the parameters of a wider system of common standards and data formats in which the CSSI and Circles of Trust models might work in parallel. It would be particularly useful to identify the pros and cons of all proposed systems more clearly.
5. Several particular practical questions emerged in the course of research on this project, all of which may merit more detailed study. One issue is defining what should NORAD's future should be in bi-national and International SSA data sharing. Within that, it may be useful to revisit the efficacy of existing and possible future command structures. One issue that arose in several conversations with interviewees was the fact that USSPACECOM had been merged into USSTRATCOM primarily because of an arbitrary dictum that no more than ten unified

commands exist in the table of organization.²⁸ This may not be a sufficient reason for maintaining the current structure; some arguments exist for "walking the cat back" once more and reviving USSPACECOM. Such a minimalist solution, of course, still does not address the issues of adequate institutional means for developing doctrine and tactics specifically suited to the space environment.

6. A separate question meriting further, more detailed study is who should be the U.S. interlocutor for ISSA data sharing? Should the USAF continue in this role? Should a civilian agency be considered? NASA, FAA/AST, DOC, or a new entity could all be candidates. A new uniformed, armed service on the Coast Guard model -- a "Space Guard" -- has also been suggested for various tasks.²⁹ Its characteristics might also be appropriate for the ISSA data sharing participant role. At the workshop, a non-U.S. diplomatic participant strongly favored such a model when described and thought it would be preferred by a number of international partners.

²⁸ Jockel interview op. cit.

²⁹ McKinley, Cynthia A.S. The Guardians of Space: Organizing America's Space Assets for the Twenty-First Century, in *Aerospace Power Journal* Spring 2000

Appendix

The Culture of a bi-national Organization: Summary of Interviews with NORAD Personnel

An integral part of this research was the series of interviews carried out with current, and former, serving NORAD officers to examine from personal experience the organizational culture and experiences of NORAD over the past twenty-five years. Interviewees were guaranteed anonymity to insure a free and frank discussion. All interviewees were serving officers with the exception of one recently retired senior officer. One interviewee was still on duty at NORAD in Colorado Springs; all others were at new assignments. Ranks of the interviewees ranged from Captain to Lieutenant-General. Time of assignment at NORAD ranged from two to eight years; one interviewee served two turns separated by eleven years.

1. Similarities in Interviewee Viewpoints

The general conclusions from the interview process, relevant to the main issues of the report, have been summarized at Section III, Part 1 of the Report. Some representative quotes from individual interview notes, provide further elaboration of points include, by subject area, the following:

1.1. Regarding the question of whether internal differences polarized on national or by other (e.g., service, command, etc.) lines:

“Primary orientation has been to command, historically little friction between Canadians and Americans per se. Creation of Northern Command (U.S.) and Canada Command (Canada) has introduced national polarization because commands are now polarized along national lines; intra-command disagreement now acquires national overtones. Moving the SSA functions [from Colorado Springs] to the Joint Space Operations Center (JSpOC) [at Vandenberg Air Force Base in California] has hampered ease of communication with Canadians. Most Canadians wish to be involved in space warning again.” (Major, CF)

“Historically, NORAD was very effective in fostering a NORAD organizational culture distinct from either the USAF or Canadian forces: ‘People forgot they were Canadian or U.S.: they were NORAD’. In practice, personnel were often “layered” -- an American would report to a Canadian, who would report to a Canadian, etc. This did not seem to be done in accordance with any particular requirement, but was a result of assigning [the] best person to [a] job with no regard for nationality. “Rather than

representing national interests to NORAD, NORAD personnel felt that they were advocates for NORAD and the NORAD mission back to the national commands and governments.’ ” (Major, CF)

"Historically, NORAD vs. all other commands was the most significant division, because NORAD was not entirely parallel to other commands in status or structure. There has also been a division between personnel stationed at Colorado Springs and outlying units. Even units ultimately under operational command of NORAD did not always understand the genuinely bi-national nature of NORAD and how it worked. An anecdote was reported of a visit by the Deputy Commander NORAD and his staff, who on that visit were primarily Canadians, to a radar installation outside of Washington being manned by Alabama National Guard personnel. The Guardsmen at first did not understand why the visitors were interested in the installation, assuming it was perhaps a courtesy tour for allied visitors. They were surprised to be informed that the Canadian personnel were above them in their chain of command."

It was also noted by multiple interviewees that other situations where U.S. and Canadian personnel routinely worked together, cooperation would create common interests and perceptions that would cut across national lines. The example was given of P-3 crews where the US and Canadian crews stationed on the East Coast found they worked together more easily than they did with the P-3 crews stationed on the West Coast, regardless of nationality.

Interviewees felt that recent changes in command structures -- NORTHCOM and CANADACOM --- had broken down the NORAD cohesion to some extent and tended to polarize issues more on national lines.

1.2. Regarding differences between U.S. and Canadian personnel

“Canadians are typically assigned to 4-year tours, U.S. to 2 [year tours]. Canadian promotions are slower, so that in any job slot, typically the Canadian is older, more mature, more experienced, and has had more time to learn the job. Also, NORAD is a prize assignment in CF -- one of the relatively rare out-of-Canada slots that are helpful to promotion. Therefore, there is competition for the slots and intense screening of personnel, so the quality of personnel tends to be higher.”

Major differences are result of different US and Canadian policies and attitudes on personnel. Canada does not have an "up-or-out" policy; competent personnel are permitted, and to some extent encouraged, to remain in particular jobs at which they do well for the majority of their careers. A series of proficiency steps within each rank enable personnel to receive pay raises without promotion; there are twelve such steps within the grade of captain. The result may be officers who are much older for their rank than their American equivalents. The example was given of an officer who did his first tour of duty in Colorado Springs at the rank of captain, and

who returned ten years later, still at the same rank, but reporting to a much younger American major who had been a lieutenant during his first tour.

This can cause misunderstanding and friction as Americans not familiar with the Canadian system ‘will sometimes assume the Canadian must be stupid or incompetent’ to be so junior in rank at such an age. Americans often are very well-trained or skilled at their particular job, because the larger scale and greater resources of the US military permitted specialization and intense training; Canadians tend to be more generalist, but personnel who have been in particular jobs for long periods of time (pilots were a given example) often accumulated long practical experience and judgment that made them valuable. The combination of US and Canadian approaches can be synergistic if experience working together permits them to develop mutual respect and communication.

1.3. Regarding lessons learned for possible international SSA data sharing organizations.

The interviewees focused primarily on the “Circle of Trust” model:

“Binational and (presumably) international cooperation depends on trust built up through working together on an interpersonal basis, layered command structures in which reporting relationships ignored national lines. personnel of both (all) nations working side by side on a daily basis, and (in military cases) commands not divided along national lines. Sense of identity to the organization, dedication to the mission of the organization, and, for smaller nations, an awareness of the national benefits of participation in such a mission. Canadians, and especially Canadians in the military, attach a great symbolic importance to NORAD as a symbol of Canada's importance, unique bilateral relationship with the U.S., and important player in international structures. An international SSA organization could bring similar benefits to its members. "Circle of Trust" model could work well in expanding NORAD's functions to Australian, UK, Japanese, and other allies -- UK, Australian participation already in existence.”

“Working side by side, dedication to shared task, wearing the same uniform (all personnel typically wore US flight suits with national insignia), reporting to opposite nationality, created strong esprit de corps and NORAD identity. Canadians and Americans alike were proud of their bi-national, NORAD identity. felt others outside NORAD failed to understand or appreciate uniqueness. SSA organization might try to foster organizational identity transcending national identities through similar measures where appropriate.”

2. Differences in Interviewee Viewpoint

It is also relevant to note some of the differences in viewpoint between mid-level and senior officers, and between senior officers. For example, all mid-level officers (captain and major) viewed the disruptions caused by the shift from USSPACECOM to USNORTHCOM, and the consequent demise of the dual-hatting of USSAPCECOM and NORAD commanders, as both injurious and ongoing, if not permanent. The senior officers (colonel and general) saw it as equally undesirable, but viewed it more as a transitional issue that was in course of resolution.

An example of a difference of perspective between senior officers came on the question of transition from “need-to-know” as a criterion of data sharing within the services to “need-to-share”. One officer was a strong advocate of such a policy, and gave several examples of situations on or subsequent to September 11th, 2001 in which the need to pre-emptively reach out and involve other agencies or services in situations. Another officer commented that such policies may have arguments in their favor, but that he “had not yet been given a get-out-of-jail free card”. In other words, “need-to-know” has been policy for so long within the services that an elaborate structure or policy and regulation have been constructed in which that criterion had been an essential assumption. Implementing a “need-to-share” mandate would require a substantial revision of the entire structure, and until that had been done, any officer would be in danger of being penalized for unintended consequences of trying to implement a need-to-share policy.

The interviewee's experience of the shift from USSPACECOM to USNORTHCOM, and the consequent issues with presence of Canadians in the JSpOC and other sensitive areas prior to the execution of paperwork permitting that presence, is a parallel case. The underlying change was executed with no intention of changing the policy of permitting Canadian access, yet that change was an unintended consequence, and required additional changes to remedy the consequence. Implementing “need-to-share” would likely require a similar review to avoid unintended negative consequences.

This difference of opinion on “need to share” might merely reflect individual judgment, or it might reflect the fact that one officer was retired and could take a higher-level viewpoint, while the other was immersed in the details of implementation of policy in a working environment.

A similar difference of perspective may also arise in future as discussions about models for international SSA data sharing deal with sensitive topics such as US ITW/AA considerations. Discussions on data sharing with a former USAF officer with NORAD experience, at the rank of captain, viewed current ITW/AA policies as potential roadblocks to full US participation in such systems. The same topic came up in an interview with a Canadian colonel with current NORAD responsibilities, whose concern was the fact that ITW/AA criteria apply to data used in the space warning role for valid reasons, and that it would be genuinely difficult to use data acquired from an international data sharing system in the same manner as data acquired from sensors within the bi-national system. “I need to be able to see (the sensed object) myself”. At the same time it

was obvious to the Captain that a mutual international data sharing system would generate data that could not be gained readily, or at all, through existing means.

3. General Conclusion from the Interviews

The interviews suggest that the challenge for data sharing advocates is to design a system that permits the U.S.'s military SSA system to appropriately use the data products of an international sharing arrangement, contributing the maximum amount of data from the U.S. system consistent with bona-fide security considerations.

Two steps would seem useful:

- 1) Advocates of international data sharing should to acknowledge from the start that ITW/AA procedures were generated in response to valid considerations and are the distillation of lessons learned, often catastrophically
- 2) An international SSA data sharing system, properly designed, could enhance, rather than compromise, the US's space warning and SSA mission.

About Secure World Foundation

Secure World Foundation is a private operating foundation dedicated to maintaining the secure and sustainable use of space for the benefit of Earth and all its peoples.



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