

TRANSFORMING SPACE SURVEILLANCE TO MEET TODAY'S SPACE SUPERIORITY NEEDS*

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Transformation of national defense is more than just the buzz word of the day. With the fall of the Soviet Union, the rise of a more distributed threat that we fight in the Global War on Terrorism and the advances of technology, it is imperative that our operations and the capabilities that they employ meet these changing needs. This is no less true in the military space domain. With our dependence on space assets and capability higher than ever and still on the rise, the need for enhanced Space Situation Awareness (SSA) and the means to act swiftly and effectively on that SSA has become a predominant concern.

In times past, space surveillance was almost synonymous with SSA in the minds of many. Doctrine now holds that SSA is comprised of Intelligence, Surveillance, Reconnaissance, Environment and Command & Control. Space surveillance still plays a strong role, but what and how it must contribute to SSA has significantly changed.

In this paper, the author will review the Cold War approach to space surveillance that served us in the past (and strives to continue doing so) and the required changes in that approach to meet today's SSA needs. The review will characterize the constraints and factors leading to the current state of space surveillance, driving functions for change, and progress that must occur to bring us up to date.

INTRODUCTION

Vision and planning documents outlining major transformation needs in the DoD existed prior to the 9/11 attack on the U.S. The impact of that event on transformation plans has been to increase the urgency of implementing some changes and of developing some new capabilities, though some aspects of transformation have also been delayed by the Global War on Terrorism (GWOT).

In the space domain, a key planning document was US Space Command's Long Range Plan (LRP). Signed out in March of 1998 by then CINCSPACE General Howell

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M. Estes III, the LRP captured both a vision of where we needed to be in the year 2020 and a roadmap of how to get there. While dismissed as “just another document” by many since then, the LRP continues to track well with goals, programs and activities in space mission areas.

In the area of space surveillance (referred in the document as Surveillance of Space, a component of “Control of Space”), the key tasks (Figure 1) and goals for 2020 were quite ambitious. Real time characterization of High Interest Objects (HIOs) would need to go from 0% capability in 1998 to 100% capability by 2020 (50% by some time between 2005 and 2012). Capability for precise detection and tracking of 30cm-sized objects at LEO and GEO in 1998 would need to become 10cm and 20cm respectively between 2005 and 2012, improving to 1cm and 10cm by 2020. Locations would need to be determined to within 500cm at LEO and 2km at GEO in the mid-term, moving to 10m and 100m respectively by 2020. Timely surveillance of HIOs would go from days and hours in 1998 to Near Real Time (NRT) by 2020. Catalog and monitoring functions would move from predictive to NRT in the same time period.¹

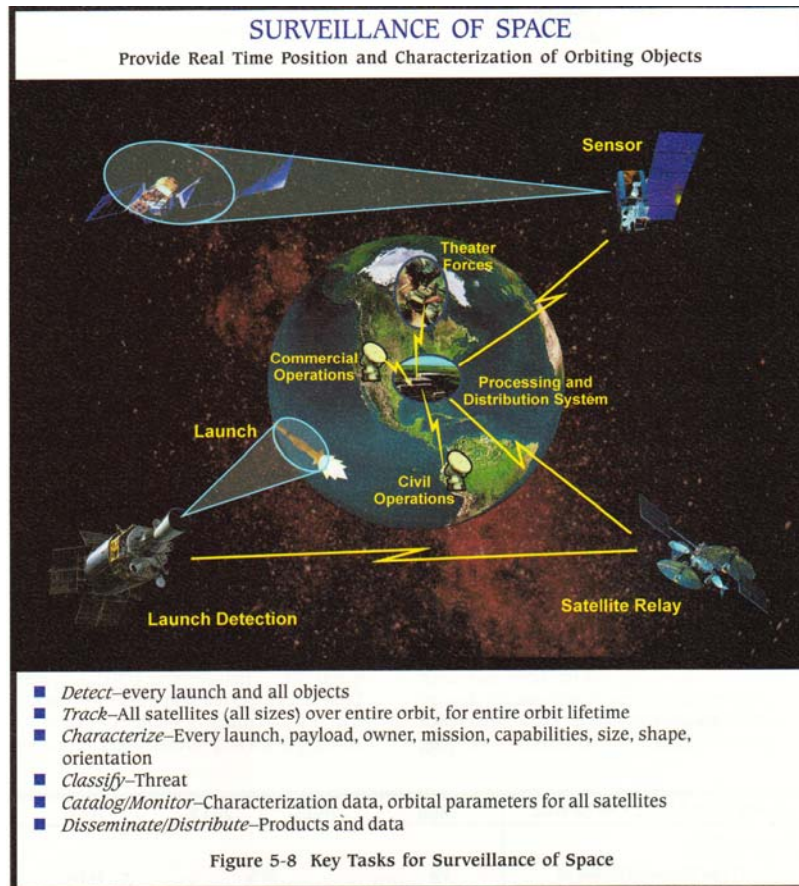


Figure 1: Key Tasks for Surveillance of Space (Source: US Space Command Long Range Plan, March 1998)

The importance of citing these performance goals is to set the stage for understanding why we need to change the way space surveillance capability development and deployment progresses in order to meet such goals and timelines.

In concert with the LRP, subsequent Air Force Space Command (AFSPC) Strategic Master Plans (SMPs) have included programmatic planning for meeting desired capabilities to include enhancing our performance in space surveillance.

On January 11, 2001, the “Report of the Commission to Assess United States National Security Space Management and Organization”² was released. Led by Donald Rumsfeld from its inception until December of 2000 when he was nominated as Secretary of Defense (SECDEF), the Commission assessed the current state of U.S. space and outlined the required role, objectives, organization and management of National Security Space. Rumsfeld’s confirmation as SECDEF established this “Space Commission Report” as a fundamental reference for the transformation of space. Regarding space surveillance, the report reaffirmed the goals of the LRP, stating the following:

“...the U.S. must be able to identify and track much smaller objects in space than it can track today...An improved space surveillance network is needed to reduce the chance of collision between satellites, the Space Shuttle or the International Space Station and the thousands of pieces of space debris orbiting the earth. It will also have to track objects deeper in space, such as asteroids or spacecraft. And to reduce the possibility of surprise by hostile actors, it will have to monitor space activity.”

Eight months later, to the day, the U.S. was attacked, making transformation of National Defense and National Security Space at once more urgent and more difficult.

Throughout all of this time Counterspace Operations, considered the ways and means to Space Superiority, would gain in importance and prominence. Space doctrine³ currently holds that Counterspace Operations is comprised of Defensive Counterspace (DCS), Offensive Counterspace, and Space Situation Awareness (SSA). While many details of these components are worked independently, the three are necessarily connected and dependent on each other, and SSA is understood to be a critical enabler of DCS and OCS. SSA is further broken down into the following components: Intelligence, Surveillance, Reconnaissance, Environmental Monitoring and Command and Control (C2).

In times past, space surveillance was almost synonymous with SSA in the minds of many. This made sense, as much of what we knew about space objects and their activity came from space surveillance assets. Space surveillance still plays a strong role, but what and how it must contribute to SSA have significantly changed.

The key changes imperative for this domain are the methods for developing and

implementing capabilities, policy, and the required “ops tempo” (rate) of progress. These will be covered in the body of this paper, beginning with the author’s perspective on how space surveillance has evolved to date and ending with recommendations to aid in the transformation of space surveillance to meet current and future Space Superiority needs.

AUTHOR’S CAVEAT TO COMMENTS THAT FOLLOW

It is important to note that there are many who command a far better knowledge of the history and details of space surveillance than does this author. At the same time, the author has had the benefit of hearing many first-hand accounts from past and current builders and operators of space surveillance capabilities. Moreover, the author has had a number of years of intense involvement in innovative exploitation of space systems and information, to include those related to space surveillance. The author has also played a significant role in evolving policy related to the use of space surveillance data.

Sensitivities run high among those in the space surveillance community. It is expected that some may object to the characterizations offered in this paper, as such has been the response for many who challenge the methods, approach and progress made by developers in the space surveillance community.

Finally, the perspectives offered in this paper are those of the author and do not necessarily reflect official positions of the U.S. Government or any other entity.

SPACE SURVEILLANCE DEVELOPMENT TO DATE

The threat of ICBMs carrying nuclear warheads set as a priority the need to detect inbound missiles to alert us and to enable a defensive and offensive response. Ground-based radar systems were built that have, in large part, filled that role for decades now. As the need for space surveillance grew, these assets were turned to the task of monitoring space launch, on-orbit and de-orbit activities. As computing and other technologies improved, hardware systems and C2 connectivity were upgraded as well. Algorithms and methods for exploitation of data from these space surveillance assets also evolved, though there is widely varying opinion today on qualitatively how much progress has been made. Those involved in the rehosting of software on each successive system upgrade contend that improvements have been continuous. At the same time, there are those involved in system upgrades who maintain that, in some ways, we’ve lost operational capability with each upgrade.

Some key forcing functions guided the development environment of these previous systems, as well as our operational capability today. First, due to the dire nature of the nuclear threat, missile warning and associated systems were strictly controlled under Integrated Tactical Warning / Attack Assessment (ITW/AA) standards of operation and development. The capability needed to be in a hardened location, so Cheyenne Mountain became the central operating location for such operations and the fusion point of space surveillance data collection and dissemination. Stove-piped, classified C2 systems used to collect and transmit missile warning information provided a ready means for similar

activities in space surveillance. For practical reasons, (programmatic, funding, technical, etc.) space surveillance became housed with other ITW/AA capabilities and was subjected to the same constraints.

This early alignment of the space surveillance mission with ground-based radar sites, coupled with the “closed architecture” of an ITW/AA system, allowed for the formation of a strong bond among the radar site personnel and those developing the capabilities in use. This appears to have served space surveillance needs adequately throughout the Cold War.

With the advent and increasing use of more sophisticated space-based capabilities, to include national space assets, the space surveillance community, operations and capability development efforts became increasingly influenced by national intelligence needs.

PROBLEMS IN SPACE SURVEILLANCE

It is the observation of many, to include this author, that the environment described above has allowed too few outside contributors to aid in the advancement of space surveillance capabilities, to the detriment of SSA and national defense. Stated another way, too few have had too much control over the development and operational integration of space surveillance capabilities. At first blush this would not appear to be the case. There are many, many uniformed officers and enlisted members, contractors and civil servants involved in the operations, programmed upgrades and policy making related to space surveillance. When one considers the technical knowledge required to master the space surveillance domain (exploitation techniques, physics, hardware limitations and capabilities, scenario variables, etc.), the field drastically drops to a relative few experts in various aspects of the domain.

Needs and requirements, at a certain level, have not escaped military visionaries and leaders, as evidenced by the documents cited in the introduction of this paper. The “art of the possible”, however, is known to far fewer people in the domain. For many years now, military personnel charged with the responsibility of updating requirements and fulfilling them have relied on the closed group of advisors and developers for improvements in space surveillance. Given their relatively short tours of 3 years or less, military personnel of all ranks charged with the responsibility of moving space surveillance forward have been (unknowingly) at the mercy of this small, controlling group.

At the same time, for many years, there have been several innovators from many sectors who have demonstrated what could be done to improve and further exploit existing space surveillance systems and data. Regardless of the magnitude of fidelity or improvement demonstrated, if the capability was not aligned with the interests of those controlling development, it would not make its way into operational use. While this might seem incredibly difficult to believe, it has been a relatively easy task to dismiss outside innovation using contracting, ITW/AA, information classification, funding, and a

host of other excuses to justify preserving the status quo path of development.

Over time and the successive turn-over of many military personnel, purveyors of the status quo in space surveillance have been able to entrench their agenda in policies and procedures to control access to data and to direct the use of only certain “mil-spec” software which they develop.

While few uniformed personnel would find the above characterization concerning space surveillance believable, if they have anything to do with advancing SSA and Space Superiority, they know that we need more capability than we have and they have a sense that we should be able to do more with what we’ve got. This sense is heightened when exercises and real world events highlight inadequacies in our current capabilities. Unfortunately, concern is typically short-lived and deficiencies are explained away, forgotten with time, or identified as work in progress. Pragmatists that are aware of the arduous nature of upgrading space surveillance capabilities attempt to use the same methods and pathways that have, for years, yielded incremental improvement. They argue that we are making steady progress toward meeting formal requirements, though to many it appears that our needs (which may or may not have been articulated in formal requirements) are fast outpacing our improvements in this domain.

With the backdrop of other major transformational efforts underway (Global Information Grid (GIG), net-centric system integration efforts, data fusion, autonomous exploitation, etc.), past practices in the space surveillance domain and the ops tempo for improvement must change substantially. It is not enough to simply rehost the same, suboptimal (even if incrementally better than previous) software routines on new, GIG-oriented (i.e., the Combatant Commander’s Integrated C2 System (CCIC2S), or other) systems. It is time to embrace and exploit the innovation and good work, largely marginalized and excluded to date, of a number of innovators to truly enhance our SSA posture.

A TIME FOR CHANGE

Common themes in the current transformation of national defense include:

1. Enhanced sharing of information and data with a net-centric means of doing so.
2. The means for a rapid infusion of effects-based capability to ensure adaptability to a continuously morphing threat.
3. A prevailing need to more broadly engage and unleash human potential to meet a significantly increased ops tempo in this wholesale transformation

It was essential to embrace these themes in the rapid formation and operational stand-up of the Department of Homeland Security (DHS). While there may be many things yet to fix or address in this new office, rapid and positive progress on many fronts could not have occurred without this new philosophy. This was the message conveyed by DHS representatives at the Armed Forces Communications and Electronics’ (AFCEA’s) SpaceComm 2004, which was subtitled: “The Need to Share”. The conference highlighted a major shift in philosophy on how we develop, build and integrate and share

systems and information to improve our national defense posture.

The 9/11 Commission's report⁴ also identified a strong need for moving from predominantly a "need to know" to a "need to share" when it comes to our national defense. The Commission strongly criticized the over classification and stove-piping of information that, if more broadly shared, might have helped us to more effectively address a growing terrorist threat that led to that tragic event.

The Commission's assessment and recommendations, shown in Figure 2, could not have greater applicability than in the domain of space surveillance. In fact, the direction that

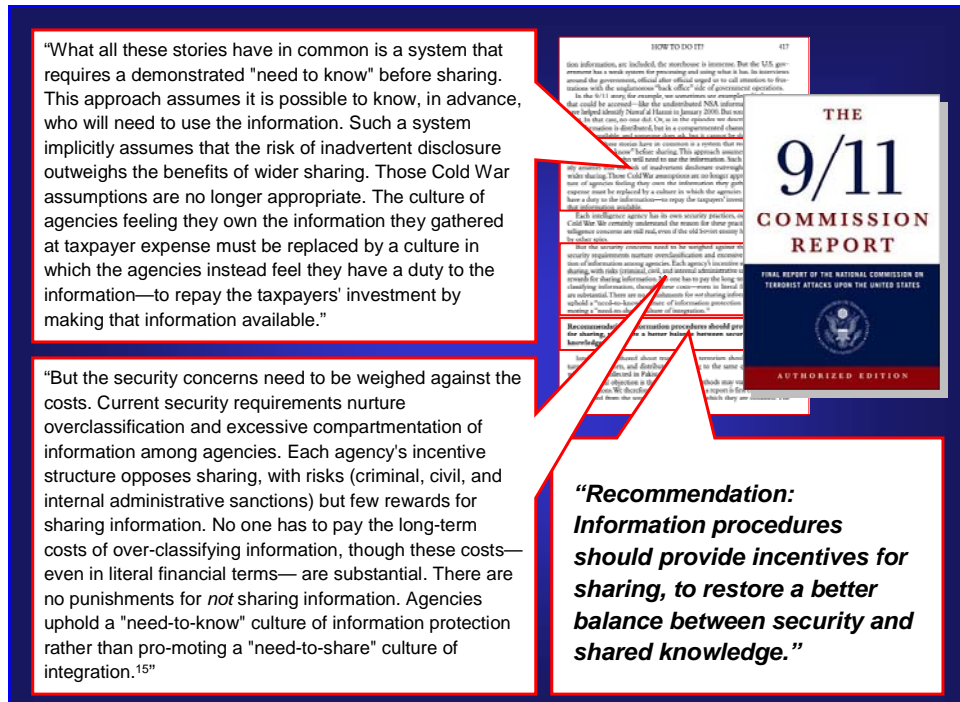


Figure 2: Excerpts from the 9/11 Commission Report, page 417, addressing the need to more broadly share information.

space surveillance has gone in recent years with sharing information and data appear to be in exact opposition to these recommendations for change. Dismissing the need to make such a change, regardless of the domain, invites a repetition of failure and the inability to effectively contribute in this new and emerging paradigm. Embracing the referenced "lessons learned" from 9/11 for space surveillance would, the author anticipates, significantly move us ahead in exploiting the systems and data that we already have and render more effects-based capabilities sooner. We would still need the means for rapid integration into operations. That leads to the second theme in transformation.

It is time to abandon the locked-down development environment that has long impeded advances in space surveillance, especially when national defense is moving toward a

much more agile C2 posture through net-centric operations. Merits of an approach must be assessed based on the ability to reliably deliver the desired effect, not simply promise it. The contracting structure must not reward incremental improvement over long time periods and at great cost, but rather should demand and encourage identifying and leveraging known successes with common, modern standards for easy, net-centric integration. Just as the concept of Tactical Satellites (TACSATs) aims to provide a mechanism for adaptable deployment of space-based capabilities, so should and can our ground-based C2 systems allow for modular plug-ins of emerging space surveillance exploitation capabilities. Employing commonly known and accepted commercial standards, rather than government-imposed mil-specs, will facilitate such an environment. We can no longer afford to repeat the “Ada versus C” and similar mistakes of the past.

Requirements, acquisitions, and contracting personnel, while admitting that we must do better, will likely react to the above statements with frustration, suggesting that such things are simply not practical or invite unacceptable risk. It’s important to understand that those who seek parity with the U.S. in space superiority, explicitly in space surveillance, will take and are taking such risks. Moreover, daily successes and far less technical and programmatic execution risk are being exhibited in other domains, military and otherwise. Even if we maintain an edge in space surveillance through our current approach, we are settling for far less than we could have, and far less than we may need, whether formal requirements track those needs or not. For optimal SSA contributing to the best-possible and a sustained space superiority lead, significant changes in our development environment and approach, such as those suggested, must occur.

Finally, to truly engage and unleash human potential, the collaboration and development base for space surveillance must be significantly expanded. For the worst of reasons, many who have contributed and continue to contribute meaningfully toward enhancing space surveillance capabilities have been willfully marginalized and excluded from development and advisory roles for the government. Unknown to and unrecognized by most in uniform, the small, closely-knit body of advisors, developers, validators and implementers have controlled space surveillance policy and technical advances for many years. This cannot continue. Moreover, it is likely that it will not.

As SSA efforts continue to compress operational timelines and increase integrated information sharing, responsible agents for assessing and improving SSA are realizing that we’re not getting enough from our space surveillance component. They are compelled and willing to discover problem areas and work through them. The key to their success will be whether or not they recognize that it is not sufficient to continue turning to their long-standing set of technical and policy advisors, developers and implementers.

CONCLUSION

Transformation of National Defense is evolving non-uniformly. Some areas are compelled to seek and embrace needed change and are doing quite well. In the area of

Space Superiority, SSA has emerged as an essential enabler and is rightfully under tremendous scrutiny and is evolving rapidly. While new C2 systems are facilitating a new look and some improved capability for space surveillance contributions to SSA, too much of the old trappings of the domain are inhibiting development. Collaborative development, data sharing and the means to assess and rapidly incorporate effective capabilities must all be significantly broadened if vision, goals and necessity for more effective space surveillance is to become a reality.

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