

GAO

Report to the Subcommittee on  
Strategic Forces, Committee on Armed  
Services, U.S. Senate

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July 2008

# DEFENSE SPACE ACTIVITIES

DOD Needs to Further  
Clarify the  
Operationally  
Responsive Space  
Concept and Plan to  
Integrate and Support  
Future Satellites





Highlights of [GAO-08-831](#), a report to the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate

## Why GAO Did This Study

The Department of Defense's (DOD) operational dependence on space has placed new and increasing demands on current space systems to meet commanders' needs. DOD's Operationally Responsive Space (ORS) concept is designed to more rapidly satisfy commanders' needs for information and intelligence during ongoing operations. Given the potential for ORS to change how DOD acquires and fields space capabilities to support the warfighter, this report discusses to what extent DOD (1) is developing ORS to support warfighter requirements and (2) has a plan that integrates ORS into existing DOD and intelligence community processes and architecture. GAO reviewed and analyzed ORS planning documents, the ORS concept of operations, and processes for meeting warfighter needs and also interviewed defense and intelligence community officials who are involved with the ORS concept.

## What GAO Recommends

GAO recommends that (1) DOD define ORS key terms, how timely satisfaction of a need is evaluated, and what Joint Force Commander needs the ORS concept is trying to satisfy; (2) establish an ongoing communications and outreach approach for ORS; and (3) identify the steps necessary to ensure the integration of the ORS concept into existing DOD and intelligence community processes and architecture. DOD partially concurred with our recommendations.

To view the full product, including the scope and methodology, click on [GAO-08-831](#). For more information, contact Davi M. D'Agostino at (202) 512-5431 or [dagostinod@gao.gov](mailto:dagostinod@gao.gov).

## DEFENSE SPACE ACTIVITIES

### DOD Needs to Further Clarify the Operationally Responsive Space Concept and Plan to Integrate and Support Future Satellites

#### What GAO Found

DOD is making some progress in developing the ORS concept, but whether it will meet warfighter requirements is unclear, principally because the concept is in the early stages of development and not commonly understood by all members of the warfighter and national security space communities. Our prior work examining successful organizational transformations shows the need to communicate to stakeholders often and early and to clearly define specific objectives. Since the Joint ORS Office was established in May 2007, it has developed a process for converting warfighter needs into formal requirements and identifying potential ORS solutions. Moreover, DOD issued the ORS Implementation Plan in April 2008 and is also developing new ORS guidance documents. However, GAO found disparity in stakeholder understanding of the ORS concept within the warfighter and national security space communities. This disparity exists because DOD has not clearly defined key elements of the ORS concept and has not effectively communicated the concept with key stakeholders. For example, initial ORS planning documents are broad and lack the specificity needed to guide the ORS concept, according to some members of the warfighter and national security space communities. Moreover, officials from the intelligence community were concerned about DOD's lack of consultation and communication with them regarding the ORS concept. Without having a well-defined and commonly understood concept, DOD's ability to fully meet warfighter needs may be hampered.

DOD has acknowledged the need to integrate ORS into existing DOD and intelligence community processes and architecture, but it has not fully addressed how it will achieve this integration. The 1999 DOD Space Policy states that an integrated national security space architecture that addresses defense and intelligence missions shall be developed to the maximum extent feasible in order to minimize unnecessary duplication of missions. DOD plans to begin integrating any new ORS processes or systems that are developed for ORS sometime between 2010 and 2015. However, integrating national security space systems can be a complex activity, involving many entities within DOD and the intelligence community. GAO previously reported that DOD's existing intelligence, surveillance, and reconnaissance (ISR) processes activities already face significant integration challenges, and adding new ORS systems into the existing ISR enterprise will increase the challenges of an already complex and challenging environment. Given the concept's immaturity, members of the national security space community have raised concerns about how the ORS concept will be integrated with existing DOD and intelligence processes and architecture, and voiced concerns about being burdened by an additional new requirements process specific to ORS. Nonetheless, as GAO described earlier, DOD is developing a process unique to ORS for submitting ORS warfighter requirements. The complexity of the national security space environment calls for DOD to begin to adequately plan integration of the ORS concept now to help ensure that DOD avoids the risk of duplicative efforts and wasted resources.

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## **Abbreviations**

DNI	Director of National Intelligence
DOD	Department of Defense
ISR	intelligence, surveillance, and reconnaissance
JCIDS	Joint Capabilities Integration Development System
JROC	Joint Requirements Oversight Council
ORS	Operationally Responsive Space

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United States Government Accountability Office  
Washington, DC 20548

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July 11, 2008

The Honorable Bill Nelson  
Chairman  
The Honorable Jeff Sessions  
Ranking Member  
Subcommittee on Strategic Forces  
Committee on Armed Services  
United States Senate

The Department of Defense (DOD) depends on space assets to support a wide range of military missions to include intelligence collection; battlefield surveillance and management; global command, control, and communications; and navigation assistance. This operational dependence on space has placed new and increasing demands on current space systems and organizations to meet Joint Force Commanders' needs. Moreover, the potential for emerging threats could affect the United States' and other countries' access to the free use of space.

The Director of Space Policy in the Office of the Undersecretary of Defense for Policy explained that the 2004 U.S. Space Transportation Policy calls for demonstrating an initial capability for operationally responsive access to and use of space to support national security requirements before 2010. This includes demonstrating the capacity to respond to unexpected loss or degradation of selected capabilities or providing timely availability of tailored or new capabilities or both. In that regard, the Secretary of Defense, in coordination with the Director of Central Intelligence, shall develop the requirements and concept of operations for launch vehicles, infrastructure, and spacecraft to provide operationally responsive access to and use of space to support national security.<sup>1</sup> DOD designated Operationally Responsive Space (ORS) as the concept to implement one of the policy goals contained in the U.S. Space Transportation Policy. DOD defines ORS as assured space power focused on timely satisfaction of Joint Force Commanders' needs.

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<sup>1</sup>With the creation of the Director of National Intelligence (DNI) in 2005, the Secretary of Defense now coordinates such activities with the DNI.

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In the conference report accompanying the John Warner National Defense Authorization Act for Fiscal Year 2007, Congress made a finding that access to and use of space are critical to preserving and protecting U.S. national security. The Act required the Secretary of Defense to establish an Operationally Responsive Space Program Office within DOD whose mission is (1) to contribute to the development of low-cost, rapid-reaction payloads, buses,<sup>2</sup> spacelift, and launch-control capabilities in order to fulfill joint military operational requirements for on-demand space support and reconstitution and (2) to coordinate and execute operationally responsive space efforts across DOD with respect to planning, acquisition, and operations.<sup>3</sup> The Joint ORS Office, located at Kirtland Air Force Base, New Mexico, was officially activated in May 2007.

In the warfighter and national security space communities,<sup>4</sup> U.S. Strategic Command is responsible for establishing overall operational requirements while the services are responsible for meeting those requirements. The Air Force is DOD's primary procurer and operator of space systems. The Army controls a defense satellite communications system and operates ground mobile terminals. The Navy procures DOD narrowband satellite communications capability and operates several space systems that contribute to surveillance, meteorology, and warning. The National Reconnaissance Office designs, procures, and operates space systems dedicated to intelligence activities. The National Security Space Office facilitates the integration and coordination of defense, intelligence, civil, and commercial space activities. The Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics is responsible for various DOD initiatives to improve the department's acquisition processes and management of investments. The Office of the Under Secretary of Defense for Intelligence exercises policy and strategic oversight over all defense intelligence, counterintelligence, and security plans and programs, including intelligence, surveillance, and reconnaissance (ISR).

We reviewed aspects of the ORS concept in 2006 and determined that DOD needed a departmentwide strategy for pursuing low cost, responsive

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<sup>2</sup>A satellite bus can be thought of as the spacecraft vehicle. It provides the physical and electrical architecture to support the payload. The satellite payload is the sensor or experiment being carried by the bus.

<sup>3</sup>Pub. L. No. 109-364, § 913(b).

<sup>4</sup>The national security space community is composed of DOD and intelligence community members that are involved in U.S. national security space activities.

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tactical capabilities—both satellite and launch—for the warfighter, and to identify corresponding funding.<sup>5</sup> Subsequently, the John Warner National Defense Authorization Act for Fiscal Year 2007 directed DOD to submit a report that sets forth a plan for DOD acquisition of ORS capabilities to support military users and military operations. This plan was submitted to Congress in April 2007. We also reviewed DOD’s development of a higher-level strategy to guide the ORS concept, as well as other future space efforts, and issued a report regarding the need for the Secretary of Defense and the Director of National Intelligence to identify and resolve any remaining differences of opinion and issue a National Security Space Strategy.<sup>6</sup> Moreover, we recently reported on the status of DOD’s progress to date in implementing the ORS concept and assessing associated challenges.<sup>7</sup> In that report, we recommended that the Secretary of the Air Force develop an investment plan to guide the Joint ORS Office as it works to meet urgent needs and develops a technological foundation to meet future needs. Given the potential for ORS to change how DOD acquires and fields space capabilities to support the warfighter, for this report, we determined to what extent DOD (1) is developing ORS to support warfighter requirements, and (2) has a plan that integrates ORS into existing DOD and intelligence community processes and architecture.

To determine whether ORS is being developed to support warfighter needs and the extent to which DOD has a plan that integrates ORS into existing DOD and intelligence community processes and architecture, we reviewed and analyzed ORS planning documents, the ORS concept of operations and processes for meeting warfighter needs. We also interviewed defense and intelligence community officials that are involved with the ORS concept, including the Undersecretaries of Defense for Policy and Intelligence, the National Security Space Office, U.S. Strategic Command, the Joint ORS Office, the National Reconnaissance Office, the Office of the Director of National Intelligence, the National Security Agency, and the National Geospatial-Intelligence Agency.

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<sup>5</sup>GAO, *Space Acquisitions: DOD Needs a Departmentwide Strategy for Pursuing Low-Cost, Responsive Tactical Space Capabilities*, [GAO-06-449](#) (Washington, D.C.: Mar. 14, 2006).

<sup>6</sup>GAO, *Defense Space Activities: National Security Space Strategy Needed to Guide Future DOD Space Efforts*, [GAO-08-431R](#) (Washington, D.C.: Mar. 27, 2008).

<sup>7</sup>GAO, *Space Acquisitions: DOD Is Making Progress to Rapidly Deliver Low Cost Space Capabilities, but Challenges Remain*, [GAO-08-516](#) (Washington, D.C.: Apr. 25, 2008).

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We have conducted our performance audit from June 2007 through July 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. More detailed information on our scope and methodology is provided in appendix I.

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## Results in Brief

DOD is making some progress in developing the ORS concept, but whether it will meet warfighter requirements is unclear, principally because the concept is in the early stages of development and not commonly understood by all members of the warfighter and national security space communities. Our prior work examining successful organizational transformations shows the need to communicate to stakeholders often and early and to clearly define specific objectives. Since the Joint ORS Office was established in May 2007, it has developed a process for converting warfighter needs into formal requirements and identifying potential ORS solutions. Moreover, DOD issued the ORS Implementation Plan in April 2008 and is also developing new ORS guidance documents. However, we found disparity in stakeholder understanding of the ORS concept within the warfighter and national security space communities. This disparity exists because DOD has not clearly defined key elements of the ORS concept and has not effectively communicated the concept with key stakeholders. For example, initial ORS planning documents are broad and lack the specificity needed to guide the ORS concept, according to some members of the warfighter and national security space communities. An official from one geographic combatant command said that the Initial Concept of Operations for ORS was not well-defined and officials from another combatant command told us that it was really more of a vision statement. Moreover, officials from the intelligence community were concerned about DOD's lack of consultation and communication with them regarding the ORS concept. Without having a well-defined and commonly understood concept, DOD's ability to fully meet warfighter needs may be hampered. We are recommending that DOD clearly define all aspects of the ORS concept and establish an ongoing communications and outreach approach to communicate this definition and to foster the understanding and acceptance of the ORS concept among stakeholders.

DOD has acknowledged the need to integrate ORS into existing DOD and intelligence community processes and architecture, but it has not fully



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addressed how it will achieve this integration. The 1999 DOD Space Policy states that an integrated national security space architecture that addresses defense and intelligence missions shall be developed to the maximum extent feasible in order to eliminate programs operating in isolation of one another and minimize unnecessary duplication of missions and functions and to achieve efficiencies. DOD plans to begin integrating any new processes or systems that are developed for ORS sometime between 2010 and 2015. However, integrating national security space systems can be a complex activity, involving many entities within DOD and the intelligence community and may take longer than anticipated. Senior ORS officials told us that they cannot determine exactly how to integrate the ORS concept at this time until they know more about the nature of ORS capabilities that will be developed. Given the concept's immaturity, members of the warfighter and national security space communities have already raised concerns about how the ORS concept will be integrated with existing DOD and intelligence processes and architecture. However, at the same time, combatant command officials have voiced concerns about being burdened by an additional new requirements process specific to ORS. Nonetheless, as we described earlier, DOD is developing a process unique to ORS for submitting ORS warfighter requirements. In addition, the intelligence community has expressed concern that the ORS concept has not been integrated into existing ISR analysis processes. We recently reported that DOD's ISR activities already face significant integration challenges, and adding new ORS systems into the existing ISR enterprise will increase the challenges of an already complex and challenging environment. If DOD does not begin to adequately plan integration of the ORS concept now, DOD may not meet its time frames for integrating the ORS concept. Also, the concept could result in duplicative efforts and wasted resources, or it could jeopardize the concept's ability to fully meet warfighter needs. Therefore, we are recommending that the DOD Executive Agent for Space, working with stakeholders such as the Under Secretary of Defense for Intelligence, identify the steps necessary to integrate ORS as integration issues arise and take steps to ensure these and future integration issues are addressed in the long-term planning of the Joint ORS Office.

In written comments on a draft of this report, DOD partially concurred with our recommendations. DOD's comments are reprinted in appendix II.

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## Background

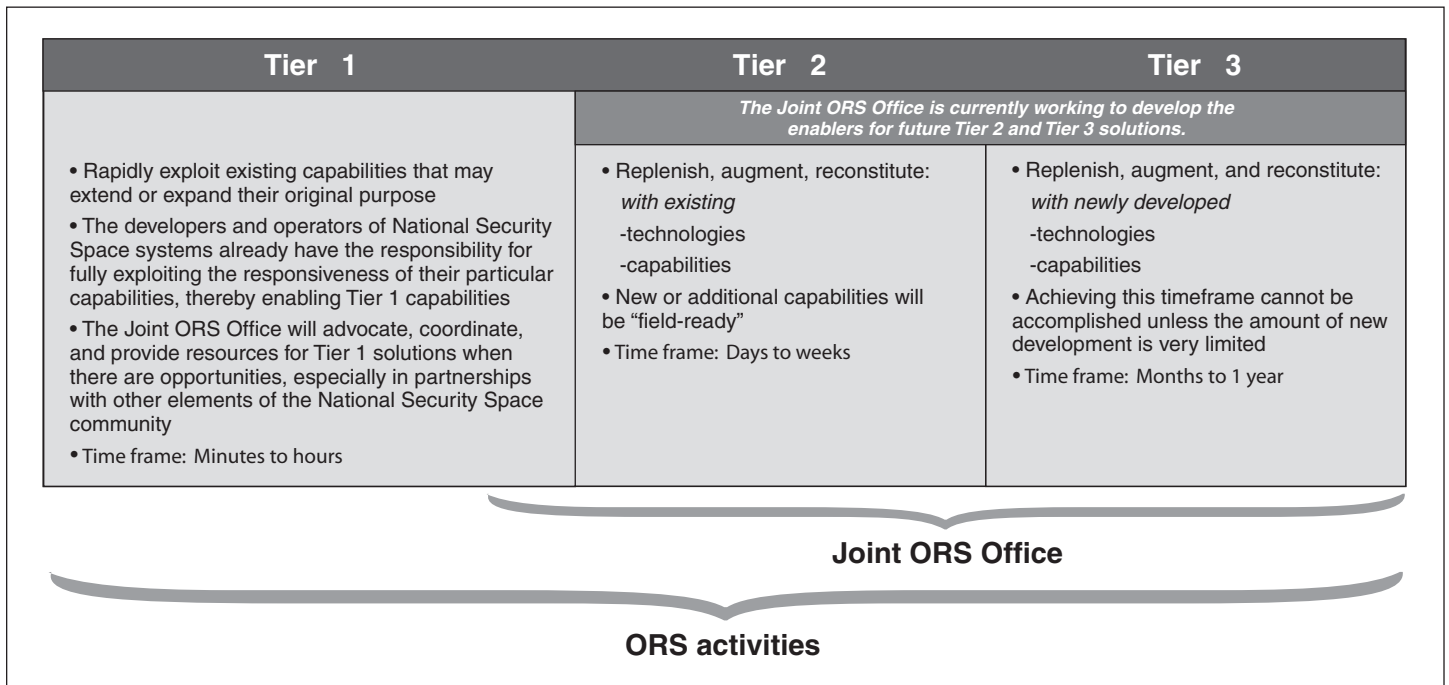
Challenges in global political affairs have placed increasing demands on the way the United States uses space capabilities to achieve national security objectives. DOD's space network is expected to play an

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increasingly important role in military operations. Yet in each major conflict over the past decade, senior military commanders have reported shortfalls in tactical space capabilities, such as those intended to provide communications and imagery data to the warfighter. To provide short-term tactical capabilities as well as identify and implement long-term solutions to developing low-cost satellites, DOD initiated the ORS concept. The ORS concept aims to quickly deliver low-cost, short-term tactical capabilities to address unmet needs of the warfighter. Unlike traditional large satellite programs, the ORS concept is intended to address only a small number of unmet tactical needs—one or two—with each delivery of capabilities. It is not designed to replace current satellite capabilities or major space programs in development. Rather, the ORS concept has long-term goals of reducing the cost of space development by fostering low cost launch methods as well as common design and interface methods.

The ORS concept is based on three tiers, as shown in figure 1, that are distinguished by the means to achieve the effects as well as the length of time required to deliver ORS capabilities. According to DOD, the timelines may not be possible at the outset, but will remain an important goal as the ORS program matures. The Joint ORS Office plans to focus on fielding Tier 2 and 3 space capabilities and when directed, support the achievement of Tier 1 response times in coordination with other members of the warfighter and national security space communities. ORS solutions can be derived from ORS activities from more than one tier.

**Figure 1: The ORS Tiered Approach to Enhance Responsiveness of Space Capabilities**



Source: GAO analysis of the ORS tiered approach.

The Joint ORS Office has intentionally been limited in size, and therefore it will rely on existing space organizations for specific ORS support and execution activities. Capabilities developed under the ORS concept will be complementary to other fielded space capabilities. With a focus on augmenting, reconstituting, and filling unanticipated gaps in U.S. space capabilities, ORS aims to provide a critical capability for the United States to maintain the asymmetric advantage it has derived from its space-based capabilities over potential adversaries.

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**DOD Is Making Progress in Developing the ORS Concept to Meet Warfighter Needs, but the Concept Is in the Early Stages of Development and Not Commonly Understood**

DOD has taken several steps to develop the ORS concept to meet warfighter needs; however, the concept is still in the early stages of its development and not commonly understood by all members of the warfighter and national security space communities. DOD has developed a process for converting warfighter needs into formal requirements and identifying potential ORS solutions. In April 2008, DOD issued an Implementation Plan and continues to draft instructions and guidance to further clarify ORS and how it can meet warfighter needs. In spite of this progress, common understanding of the ORS concept is lacking because DOD has not clearly defined key elements of the ORS concept and has not effectively communicated the concept to key stakeholders.

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**DOD Has Made Some Progress in Developing the ORS Concept**

DOD has made some progress in developing the ORS concept. Since the Joint ORS Office was established in May 2007, it has developed a process that converts warfighter needs into formal requirements and potential ORS solutions. DOD also issued an Implementation Plan in April 2008 and continues to develop further ORS guidance.

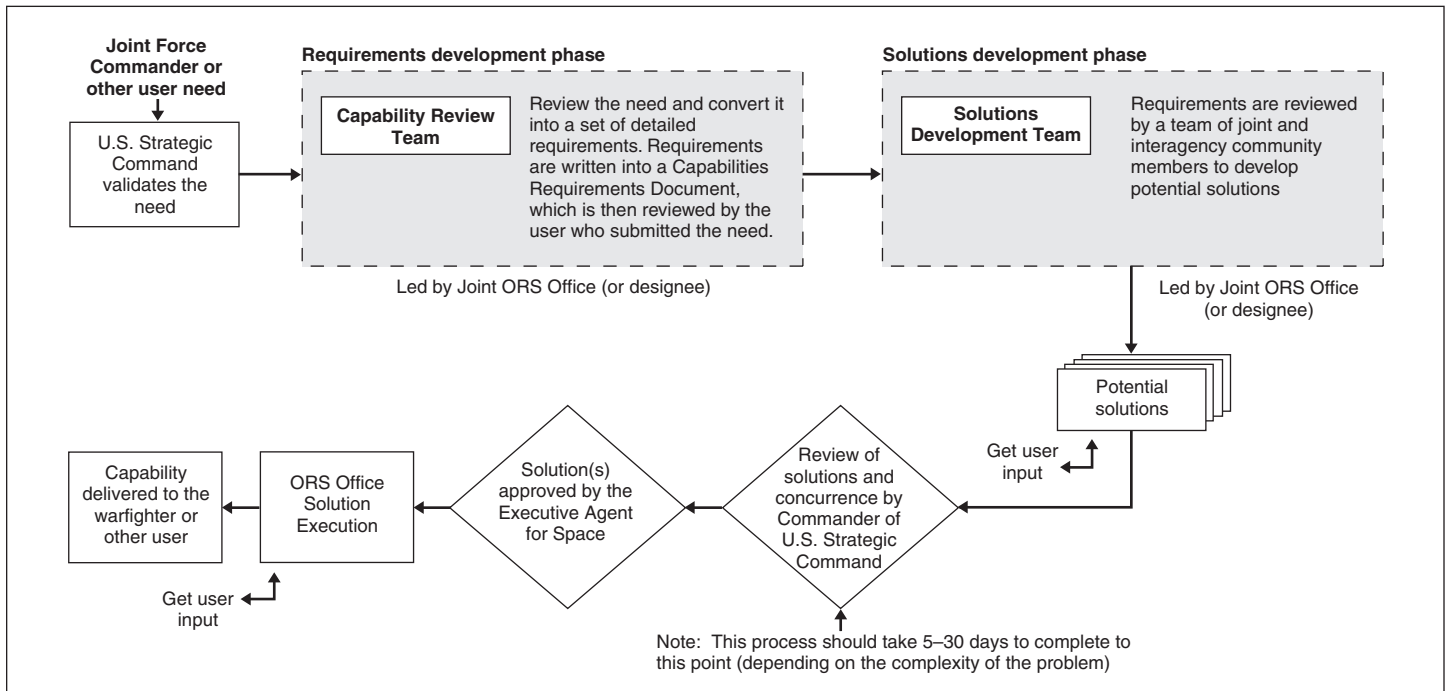
**Process to Identify ORS Solutions Has Been Developed**

DOD has established a process that converts a warfighter need into formal requirements and identifies potential ORS solutions for those requirements.<sup>8</sup> As shown in figure 2, the ORS Requirements and Solutions Generation process begins when a Joint Force Commander or other user submits a capability need to U.S. Strategic Command.

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<sup>8</sup>According to the ORS Initial Concept of Operations, ORS needs and requirements development will operate within the Joint Capabilities Integration and Development System (JCIDS) framework to the maximum extent possible. Tier-1 solutions, using existing systems, should not normally require JCIDS activity. Since Tier-2 and Tier-3 solutions will be within the Force Enhancement and Space Control mission areas (such as ISR, communications, and space situational awareness), Joint Requirements Oversight Council (JROC) validated requirements most likely exist for the requested capability.

**Figure 2: The ORS Requirements and Solutions Generation Process**



Source: GAO analysis of the ORS Requirements and Solutions Generation process.

During the requirements development phase and the solutions development phase, teams are assembled from across the warfighter and national security space communities by the designated lead for the respective phases. At this time, the Joint ORS Office has asked Air Force Space Command<sup>9</sup> to facilitate the requirements development phase and has asked the Air Force Space and Missile Systems Center<sup>10</sup> to facilitate the solutions development phase. The solutions development phase can begin before the formal Capability Requirements Document is delivered. The Joint Force Commander or other user who submitted the need has multiple opportunities to provide input throughout the ORS Requirements

<sup>9</sup>Air Force Space Command delivers space and missile capabilities to the warfighting commands.

<sup>10</sup>The Air Force Space and Missile Systems Center develops, demonstrates, acquires, fields, and sustains space and missile capabilities for the joint warfighter.

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and Solutions Generation process to ensure that the solutions being considered will actually fit the need.

At the time of this report, one warfighter need has completed the ORS Requirements and Solutions Generation process and two other warfighter needs are in process. The need that has completed the process was a request to augment global ultra-high-frequency communications. The Joint ORS Office received the need from U.S. Strategic Command on September 14, 2007, and the initial solutions were presented to the Commander of U.S. Strategic Command on October 17, 2007. The second need is a classified space situational awareness need. Possible solutions for the second need have also been presented to the Commander of U.S. Strategic Command and the DOD Executive Agent for Space for approval. According to the Deputy Director of the Joint ORS Office, after completing the process, there was some question whether a space-based capability was the best way to meet the need. He said that the DOD Executive Agent for Space has asked for more information and the potential solutions are now in senior leadership review. A third need for an ISR capability has begun the ORS Requirements and Solutions Generation process. As of the end of May 2008, this need has completed the requirements development phase of the ORS Requirements and Solutions Generation process.

**The ORS Implementation Plan Has Been Released and Additional Guidance Documents Are Currently Being Developed**

In July 2007, the Deputy Secretary of Defense tasked the DOD Executive Agent for Space to develop by October 15, 2007, an ORS Implementation Plan to guide ORS activities. The DOD Executive Agent for Space did not meet this deadline, but the plan was issued April 28, 2008. The ORS Implementation Plan identifies the DOD processes and staffing resources required to meet ORS needs, and outlines the elements necessary to implement the ORS concept as well as serving as the initial charter for the Joint ORS Office. Additionally, the Deputy Secretary of Defense required the military departments to assign personnel to fully staff the Joint ORS Office no later than August 1, 2008, and to establish dedicated funding for ORS beginning in fiscal year 2010.

In addition to issuing the implementation plan, three ORS guidance documents are currently being drafted, but no timeline has been established for their completion. First, U.S. Strategic Command is drafting an update to its Initial ORS Concept of Operations that is intended to make the initial concept of operations shorter and more concise, to clarify the services' roles and responsibilities, and to provide more information on ORS capabilities, including who will be able to operate them. Second, DOD is drafting an instruction to assign responsibilities and to prescribe procedures for Joint Force Commanders to submit urgent operational

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needs for a possible ORS solution. Third, U.S. Strategic Command is drafting an instruction that is designed to assign responsibilities for ORS within U.S. Strategic Command and its supporting Joint Functional Component Commands.<sup>11</sup> According to U.S. Strategic Command officials, this instruction will implement and expand upon the guidance found in the DOD instruction mentioned above. U.S. Strategic Command's instruction will also detail the procedures the command will use to prioritize warfighter needs. According to a U.S. Strategic Command document, factors that will be taken into consideration for prioritization include: (1) the operational relevance of the need, (2) the degree of urgency of the need and how soon the need must be satisfied, (3) whether the need has a potential space solution, (4) the technical feasibility of the need, (5) whether ORS resources can address the need, and (6) whether ORS is the best choice of all possible means to address the need.

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## The ORS Concept Is in the Early Stages of Development

Most ORS efforts are in their initial phases and thus it is too early to judge their success. According to the ORS Implementation Plan, the Joint ORS Office will accomplish its objectives over time in a “crawl, walk, and run,” approach. At this time, the ORS concept is still in the “crawl” phase which means that the warfighter is getting involved with the ORS concept and the focus of ORS efforts is on demonstrating building blocks for later efforts, conducting experiments, and determining what can be accomplished with current assets. “Walking” would be characterized as the evolution of the ORS concept into a warfighter-driven concept with selected capabilities tied to gaps and integrated within the existing architecture. The ORS Implementation Plan states that this phase would not begin until approximately 2010. A “run” would involve a full range of space effects delivered when and where needed and is expected to begin in approximately 2015. The former Deputy Commander of U.S. Strategic Command told us that he expects the current tactical satellites to propel the ORS concept to somewhere between a walk and a run.

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<sup>11</sup>Joint Functional Component Commands are responsible for the day-to-day planning and execution of U.S. Strategic Command's primary mission areas: space; global strike and integration; ISR; network warfare; integrated missile defense; and combating weapons of mass destruction.

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## A Common Understanding of the ORS Concept Is Lacking

Key stakeholders do not share a common understanding of the ORS concept for two primary reasons—the ORS concept is not clearly defined in its initial guidance documents and DOD has not adequately communicated the concept to key stakeholders. As a result, stakeholders throughout the warfighter and national security space communities do not share a common understanding of the ORS concept.

## DOD Has Not Clearly Defined the ORS Concept

DOD has not documented a clear definition of the ORS concept and as a result key stakeholders in the warfighter and national security space communities do not share a common understanding of the concept. Our prior work examining successful organizational transformations shows the necessity to communicate clearly defined goals and specific objectives to key stakeholders. Initial ORS planning documents—the Plan for ORS<sup>12</sup> and the Initial Concept of Operations<sup>13</sup>—are broad and lack the specificity needed to guide the ORS concept, according to some members of the warfighter and national security space communities. For example, the associate director of the National Security Space Office said that the Plan for ORS addressed the eight areas required by the National Defense Authorization Act for Fiscal Year 2007 in only a broad sense. Moreover, an official from one combatant command said that the Initial Concept of Operations was not well-defined, and officials from another combatant command told us that the concept of operations was really more of a vision statement.

We found several examples of a lack of clarity within these initial documents. First, the Initial ORS Concept of Operations states that ORS is focused on the timely satisfaction of the urgent needs of the Joint Force Commanders, but it does not adequately define what constitutes “urgent.” Additionally, the approach presented in the April 2007 Plan for ORS for enhancing the responsiveness of space systems is to implement ORS to develop more affordable, small systems that can be deployed in operationally relevant time frames, but does not clarify what is meant by “operationally relevant time frames.” According to the Plan for ORS and

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<sup>12</sup>The 2007 National Defense Authorization Act required DOD to submit a Plan for Operationally Responsive Space within 120 days of the enactment of the act. DOD provided the plan to Congress in April 2007, and the plan identified a general approach for establishing the ORS concept.

<sup>13</sup>The Initial Concept of Operations was written by U.S. Strategic Command and approved in May 2007. According to U.S. Strategic Command officials, the concept of operations was written to help define and scope the ORS concept in response to those in the community who were asking for initial guidance on ORS.



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the Initial Concept of Operations, some ORS solutions could take up to 1 year to execute. Officials in the Office of the Undersecretary of Defense for Policy questioned whether these time frames could really meet an urgent need. Additionally, officials from one combatant command told us that a time frame of 1 year to get a need met would not be considered responsive enough for them unless a satellite was already in orbit so that they could task it directly. Based on these examples, key stakeholders are not operating under a common understanding regarding the time frames for ORS. Moreover, key stakeholders in the intelligence community have said that they are not sure which operational needs or urgent needs the ORS concept is to satisfy.

Additionally, at the time of our review, other guidance documents needed to clarify the ORS concept had not yet been developed. The August 2007 memorandum from the DOD Executive Agent for Space directed the Joint ORS Office to develop an ORS Strategy, an ORS Road Map, and an ORS Program Plan in addition to the ORS Implementation Plan. The Deputy Director of the ORS Office said that they decided to complete the ORS Implementation Plan before writing the other documents so that it could guide the development of the other required documents. Now that the ORS Implementation Plan has been released, he said that they will need to get more guidance from the DOD Executive Agent for Space regarding what specific information should be included in the remaining documents.

#### DOD Has Not Communicated Effectively with Key Stakeholders

DOD has not effectively communicated with key stakeholders or engaged them regarding the ORS concept. Our prior work examining successful organizational transformations shows the need to adopt a communication strategy that provides a common framework for conducting consistent and coordinated outreach within and outside its organization often and early and seeks to genuinely engage all stakeholders in the organization's transformation. However, DOD did not initially involve the geographic combatant commands in the development of the ORS concept. For example, officials from one geographic combatant command told us that they did not have any input into the development of the Initial Concept of Operations for ORS and were not involved in any of the ORS working groups. These officials were concerned that failing to involve the geographic combatant commands in the ORS concept development would lead to new capabilities that drive warfighter requirements instead of warfighter requirements determining how to develop ORS capabilities. Additionally, officials from a functional combatant command told us that key ORS meetings took place in August 2007 but they were not invited to participate and neither were the geographic combatant commands. These officials were concerned that failing to invite these combatant commands

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to the meetings might result in the development of requirements that really do not benefit the warfighter.

The first extensive outreach to the combatant commands was in preparation for the November 2007 ORS Senior Warfighters Forum, which took place 6 months after the standup of the Joint ORS Office. A senior space planner, who is the lead for ORS for one combatant command, told us that during preparatory briefings for the ORS Senior Warfighters Forum, participants were told that the purpose of the forum would be to learn what space capabilities the combatant commands needed that ORS might be able to address. However, after a couple of briefings, he learned that the purpose of the ORS Senior Warfighters Forum had shifted to that of educating the combatant commands on the ORS process and how to get an ORS capability. The senior space planner explained that rather than asking the warfighter what they need, the focus was now on placing their needs into a process that had already been developed. This same combatant command official told us that no clear answers were provided to questions asked at the ORS Senior Warfighters Forum regarding the submission of warfighter needs or how these needs would be prioritized and, as of the end of February 2008, they had received no updates from U.S. Strategic Command on any of the issues discussed at the forum. Similarly, an intelligence agency official told us that no consensus was reached during the forum and very little concrete information was relayed regarding how ORS will be used in the future.

Officials from various commands called for better communication strategies to enhance their understanding of the ORS concept. Various geographic combatant command officials we spoke with generally said that U.S. Strategic Command should increase its ORS outreach activities (e.g., visits, briefings, and education) to reach more staff throughout the commands and services. The Chief of Staff at the U.S. Strategic Command Joint Functional Component Command for Space acknowledged that outreach activities need to be completed with the combatant commands so that they can better understand how future ORS capabilities can benefit their area of operation. Officials from U.S. Strategic Command acknowledged that they had not done a good job of educating the combatant commands on the ORS concept in its early days. However, the Deputy Director of the ORS Office told us that one of the responsibilities of one of the division chiefs who arrived in March 2008 at the Joint ORS Office will be to reach out to the combatant commands and engage the warfighter on the ORS concept.

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Additionally, DOD has not communicated well with the intelligence community regarding the ORS concept. Officials from the National Security Agency said that they are very concerned about the lack of consultation that has been done with the intelligence community regarding the ORS concept. Officials from the National Geospatial-Intelligence Agency also said that they believe that communication with the intelligence community regarding the ORS concept has been insufficient. However, both agencies acknowledged that communication between DOD and the intelligence community has improved since they started working together on tactical satellites, but their concerns regarding communication remain.

While the U.S. Strategic Command and the Joint ORS Office have taken some steps to promote the ORS concept such as the November 2007 ORS Senior Warfighters Forum, directing one of the Joint ORS Office division chiefs to reach out to the combatant commands, and engaging the intelligence community on the tactical satellites, they have not developed a consistent and comprehensive outreach strategy. The lack of a clearly defined ORS concept and effective outreach to the stakeholders has affected the acceptance and understanding of the ORS concept throughout the warfighter and national security space communities. Without a complete and clearly articulated concept that is well communicated with key stakeholders, DOD could encounter difficulties in fully implementing the ORS concept and may miss opportunities to meet warfighter needs.

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## DOD Plans to Integrate ORS into Existing DOD and Intelligence Processes and Architecture, but Has Not Identified How It Will Accomplish This

DOD has recognized the need to integrate the ORS concept into the warfighter and national security space communities' processes and architecture, but it has not yet determined specific steps for achieving integration. DOD does not plan to begin integrating the ORS concept in accordance with the 1999 DOD Space Policy until between 2010 and 2015. However, integrating space systems is a complex activity that involves many entities inside DOD and the intelligence community and may take more time to accomplish than expected. Therefore, taking incremental steps as the ORS concept matures may help the Joint ORS Office to achieve timely integration and help assure that warfighter requirements will be met. Senior ORS officials have told us that the ORS concept is still too new to begin its integration, but combatant command and intelligence community officials are concerned about how the ORS concept will be integrated into their existing processes for submitting warfighter needs and processing ISR data.

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According to the 1999 DOD Space Policy,<sup>14</sup> an integrated national security space architecture that addresses defense and intelligence missions shall be developed to the maximum extent feasible in order to eliminate programs operating in isolation of one another and minimize unnecessary duplication of missions and functions and to achieve efficiencies. This policy also directs the Secretaries of the Military Departments and Combatant Commanders to integrate space capabilities and applications into their plans, strategies, and operations. In order to be consistent with DOD Space Policy, new processes or systems developed under the ORS concept should be integrated into all facets of DOD's strategy, doctrine, education, training, exercises and operations. DOD has acknowledged that the ORS concept needs to be integrated and one of the goals in the ORS Implementation Plan is to integrate the ORS concept into the existing space architecture between 2010 and 2015.

Given the complex environment of the warfighter and national security space communities, changes that affect one organization can have an effect on integrating national security space systems, and may take longer than anticipated. We previously reported that DOD is often presented with different and sometimes competing organizational cultures and funding arrangements, and separate requirements processes among the agencies involved in the defense and national space communities. This complex environment has prevented DOD from reaching some of its past integration goals. For example, in 2005, changes at the National Reconnaissance Office resulted in the removal of National Reconnaissance Office personnel and funding from the National Security Space Office, and restricted the National Security Space Office's access to a classified information-sharing network, thereby inhibiting efforts to further integrate defense and national space activities—including ISR activities—that had been recommended by the Space Commission.<sup>15</sup> If the Joint ORS Office does not successfully integrate the ORS concept into the existing space architecture within established time frames, this may result in a lack of coordination among various members of the warfighter and national security space communities.

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<sup>14</sup>Department of Defense Directive 3100.10, Space Policy (July 9, 1999).

<sup>15</sup>The Space Commission is a congressionally chartered commission that reviewed the management and organization of national security space activities. The Space Commission issued a report in January 2001 that made recommendations to DOD to improve coordination, execution, and oversight of the department's space activities.

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Officials from the Joint ORS Office and U.S. Strategic Command acknowledged that they have not yet determined how any future ORS processes and systems will be integrated into existing national security space processes and systems, because the concept is still too new for them to determine the best way to achieve integration. Furthermore, the ORS Implementation Plan states that the Joint ORS Office will be working with the military departments and appropriate agencies to prepare for a smooth transition of systems when they are developed and acquired by the Joint ORS Office. However, the Joint ORS Office does not yet have any new space capabilities to be transitioned. Senior ORS officials told us that they cannot develop a comprehensive plan for the integration of ORS processes into existing DOD and intelligence community processes and architecture until they know more about the nature of ORS capabilities that they will be able to develop.

Moreover, U.S. Strategic Command officials said that integration of new systems will have to take place on a case-by-case basis depending on the type of capability that is developed. They also said that it is conceivable that in certain situations, integrating some ORS solutions might not be the most cost-effective and efficient way to provide an urgent capability to a warfighter. For example, some of the architecture for addressing ISR needs requires high levels of data classification. If a warfighter had a need that could be met at a lower classification level than a particular ISR system would allow, it might be faster and less expensive to not integrate that particular ORS capability in order to preserve a lower classification of the data obtained and avoid the expense and complications associated with processing data with higher classifications.

For these reasons, DOD has not laid out any specific steps toward the longer-term goal of integrating the ORS concept into the existing space architecture, which has raised some concern within the warfighter and national security space communities about the possible creation of unnecessary duplicative processes. For example, combatant command officials told us that they are already burdened by multiple processes for submitting their warfighter requirements. They emphasized that any processes developed for submitting ORS requirements should be integrated into existing requirements submission processes so as not to require a new process for them to learn to use and manage. However, the Deputy Director of the ORS Office said that the process of submitting ORS requirements currently under development is a separate and parallel process to existing methods of submitting warfighter needs and he does not yet know how it will be integrated. He explained that the ORS concept has only been tested with two warfighter needs so it is too soon for them

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to determine how particular ORS processes—such as the requirements submission process—will be integrated into existing warfighter requirements processes. U.S. Strategic Command officials told us that in the future, they envision receiving ORS requirements from multiple existing processes already in place, but time is needed to allow the concept to mature and develop before integration can be fully addressed.

Intelligence community officials also raised concerns about the importance of using their current processes and architecture so as not to create unnecessary duplicative processes to get data to the warfighter. Furthermore, officials from the National Geospatial-Intelligence Agency told us that their analysts cannot keep up with the data being collected from existing space assets, and they do not know who will process information from any new assets that might be developed under ORS.

DOD officials have acknowledged the need to integrate ORS into the existing ISR enterprise; however, accomplishing this goal will be especially challenging. We recently reported that DOD's existing roadmap for integrating current ISR capabilities does not provide DOD with a long-term comprehensive vision of the desired end state of the ISR enterprise. We also reported that DOD has not been able to ensure that ISR capabilities developed through existing processes are really the best solutions to minimize inefficiency and redundancy. Therefore, it will be difficult for the Joint ORS Office to reduce inefficiency by integrating its processes and systems into the current ISR enterprise, which already faces numerous integration challenges. The Deputy Director of the Joint ORS Office said that the office has not yet determined how data collected by any new ORS solutions developed for ISR needs will be integrated into existing intelligence community back-end processes for analyzing and distributing data collected from space assets.

Integrating the ORS concept will involve many agencies across the warfighter and national security space communities and may take more time than anticipated. If the integration of the ORS concept is not adequately planned, DOD may not meet its time frames for integrating the ORS concept. If the ORS concept is not integrated into the existing space architecture as integration issues arise, the ORS concept could create duplicative efforts resulting in wasted resources and inhibiting the ORS concept's ability to fully meet warfighter needs.

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## Conclusions

While DOD has taken a number of steps to advance the ORS concept and to develop a process for providing ORS capabilities to the warfighter, its

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ability to implement the concept will be limited until it more clearly defines key aspects of the ORS concept and increases its outreach and communication activities. Without a complete and clearly articulated concept that is well communicated and practiced among key stakeholders, DOD could encounter difficulties in fully implementing the ORS concept and building the relationships necessary to ensure ORS's success. Furthermore, even though it may be too early to develop a comprehensive plan for integrating ORS processes and systems into the existing national security space architecture, DOD can identify the steps necessary to achieve integration as the concept matures. Integrating the ORS concept will be very challenging, especially as it pertains to ISR activities that will have to be coordinated among many agencies across DOD and intelligence community agencies. Identifying the incremental steps toward integration could help DOD meet its time frames for integrating the ORS concept, prevent the ORS concept from creating duplicative efforts, ensure that the ORS concept meets warfighter needs, and ensure its future satellites are adequately supported.

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## Recommendations for Executive Action

We recommend the DOD Executive Agent for Space take the following three actions:

- Direct the Joint ORS Office, in consultation with U.S. Strategic Command, to define ORS key terms including what qualifies as an urgent need, how timely satisfaction of a need is evaluated, and what Joint Force Commander needs the ORS concept is trying to satisfy.
- Direct the Joint ORS Office, in consultation with U.S. Strategic Command, to establish an ongoing communications and outreach approach for ORS to help guide DOD's efforts to promote, educate, and foster acceptance among the combatant commands, military services, intelligence community, and other DOD organizations.
- In consultation with the Undersecretary of Defense for Acquisition, Technology, and Logistics and the Undersecretary of Defense for Intelligence, and in cooperation with the military services, identify the steps necessary to ensure the integration of the ORS concept into existing DOD and intelligence community processes and architecture as the Joint ORS Office continues its long-term planning of the ORS concept.

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## Agency Comments and Our Evaluation

In written comments on a draft of this report, DOD partially concurred with our recommendations. DOD's comments are reprinted in appendix II. The National Reconnaissance Office also provided technical comments, which we incorporated as appropriate.

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DOD partially concurred with our recommendation to define ORS key terms including what qualifies as an urgent need, how timely satisfaction of a need is evaluated, and what Joint Force Commander needs the ORS concept is trying to satisfy. In its comments, DOD stated that it codified the definition of ORS on July 9, 2007, and U.S. Strategic Command developed an Initial Concept of Operations containing additional terms intended to further define and clarify ORS activities. However, our work showed that the warfighter and intelligence community believe that key ORS terms need to be better defined and clearer. As we stated in our report, the initial guidance documents—such as the Plan for ORS and the Initial Concept of Operations—are considered broad by users and lack the specificity needed to guide the ORS concept. Based on our work, this has led to a lack of a common understanding of the concept among the warfighter and national security space communities. DOD also stated that responsibility for providing overarching definitions and policy guidance will remain with the Office of the Under Secretary of Defense for Policy, and U.S. Strategic Command will continue to validate ORS requirements and provide additional clarification, definition, and direction to the ORS Office as the capability matures. However, our recommendation focuses on the need for better-defined and clear ORS terms. Therefore, we continue to believe that DOD should take additional steps now to define and clarify ORS and provide more definition of key terms.

DOD partially concurred with our recommendation to establish an ongoing communications and outreach approach for ORS to help guide DOD's efforts to promote, educate, and foster acceptance among the combatant commands, military services, intelligence community, and other DOD organizations. In its comments, DOD stated that communicating a clear, concise message was vitally important to the success of ORS and it is currently conducting outreach efforts in numerous forums. We acknowledged DOD's efforts to promote the ORS concept in our report; however, despite these efforts, confusion regarding the ORS concept persists. As stated in our report, the lack of a clear definition combined with the lack of a consistent and comprehensive outreach strategy has affected the acceptance and understanding of the ORS concept throughout the warfighter and national security space communities. DOD's comments also stated that the burden of outreach should not be placed solely upon the ORS Office and that all ORS stakeholders will continue to play an active role in promoting and fostering acceptance of the ORS concept. Apart from who is designated to develop and implement it, our work showed that a comprehensive communication and outreach approach or strategy that reflects agreed-upon definitions and direction for the ORS concept is needed or DOD



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could encounter difficulties in fully implementing the ORS concept and may miss opportunities to meet warfighter needs.

DOD partially concurred with our recommendation to identify the steps necessary to ensure the integration of the ORS concept into existing DOD and intelligence community processes and architecture as the Joint ORS Office continues its long-term planning of the ORS concept. In its comments, DOD stated that integration of ORS capabilities into current processes and architecture will depend upon the value provided by the current processes and architectures and that integration into existing systems will be considered by the ORS Office as a matter of course. DOD also stated that personnel assigned to the ORS Office from across DOD and the intelligence community bring knowledge and experience that will help to identify ways to selectively integrate ORS capabilities into current systems, when appropriate, in order to streamline delivery of products to the customers. However, based on our work, if integration of the ORS concept is not timely and adequately planned, DOD may not meet its time frames for integrating the ORS concept into the existing space architecture between 2010 and 2015. Moreover, if the ORS concept is not developed and integrated well in advance of launching future satellites, the ORS concept could create duplicative efforts resulting in wasted resources and inhibiting the ORS concept's ability to fully meet warfighter needs. Therefore, we believe our recommendation to take a more proactive approach to integrating the ORS concept, once better defined and communicated with the warfighter and national security space community, continues to have merit.

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We are sending copies of this report to the Secretaries of Defense, the Army, the Navy, and the Air Force. Copies will be made available to others upon request. In addition, this report will be available at no charge on our Web site at <http://www.gao.gov/>.

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If you or your staff have any questions about this report, please contact me at (202) 512-5431 or [dagostinod@gao.gov](mailto:dagostinod@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.

A handwritten signature in black ink, appearing to read "Davi M. D'Agostino". The signature is fluid and cursive, with the first name "Davi" being the most prominent.

Davi M. D'Agostino  
Director, Defense Capabilities and Management

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# Appendix I: Scope and Methodology

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To determine whether the Operationally Responsive Space (ORS) concept is being developed to support warfighter needs and the extent to which DOD has a plan that integrates ORS into existing DOD and intelligence community processes and architecture, we reviewed and analyzed ORS planning documents, the ORS concept of operations, and ORS processes for meeting warfighter needs. We also reviewed relevant legislation, policies, and prior GAO reports. We interviewed officials at the U.S. Strategic Command including the Joint Force Component Command for Intelligence, Surveillance and Reconnaissance and the Joint Force Component Command for Space as well as officials from the Joint ORS Office to discuss the progress of developing the ORS concept, the initial ORS planning documents, outreach regarding the ORS concept, and plans to integrate the ORS concept into the existing space architecture. We also interviewed officials at Air Force Space Command and the Air Force Space and Missile Systems Center to discuss the new process developed for converting warfighter needs into formal requirements and potential ORS solutions. In addition, we interviewed officials from the U.S. Central Command, U.S. European Command, U.S. Pacific Command, U.S. Southern Command, and U.S. Special Operations Command regarding warfighter involvement in the creation of the ORS concept, the ability of the ORS concept to meet warfighter needs, the degree of outreach received regarding the ORS concept, and the integration of the ORS concept into current processes for submitting warfighter needs. To discuss issues regarding ORS capabilities that may address warfighter ISR needs and the integration of these capabilities into current intelligence community processes and systems, we interviewed officials from the Office of the Director of National Intelligence, the National Geospatial-Intelligence Agency, the National Reconnaissance Office, and the National Security Agency. Furthermore, we interviewed officials from the Office of the Undersecretary of Defense for Policy, the Office of the Undersecretary of Defense for Intelligence, and the National Security Space Office to discuss policy issues related to ORS. Finally, we interviewed officials from U.S. Air Force Headquarters, U.S. Army Space Branch, the Air Force Research Lab, and the Naval Research Lab to discuss service involvement with the ORS concept and the tactical satellite experiments.

# Appendix II: Comments from the Department of Defense



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& INTERDEPENDENT  
CAPABILITIES

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Ms. Davi M. D'Agostino  
Director, Defense Capabilities and Management  
United States Government Accountability Office  
441 G Street, NW  
Washington, DC 20548

Dear Ms. D'Agostino,

This letter is the Department of Defense (DoD) response to the GAO draft report, GAO-08-831 "*DEFENSE SPACE ACTIVITIES: DoD Needs to Further Clarify the Operationally Responsive Space Concept and Plan to Integrate and Support Future Satellites*," dated June 6, 2008 (GAO Code 351053).

In general, DoD agrees with the assessment and recommendations contained in the draft report, although we differ on the responsibilities for implementing the recommendations (please see the attached Comments to the Recommendations for specifics). It is important to note that the research conducted by the GAO Team took place within the first year of the Operationally Responsive Space (ORS) Office's existence. While the GAO recommends improvement in selected areas, the ORS Office has accomplished much during this short period of time.

As the ORS Office matures and additional personnel are assigned, relationships and responsibilities will continue to evolve and many of the issues highlighted in the report will be addressed as a matter of course. Linkages to the National Security community, including the Intelligence Community, continue to improve. The new US Strategic Command Concept of Operations will further clarify ORS timelines and the requirements validation process.

Thank you for the opportunity to review and comment on this draft report. Questions should be directed to DoD's primary action officer, COL Patrick Frakes, Director, Space Policy & Information Operations, (703) 697-6364.

Sincerely,

A handwritten signature in black ink, appearing to read "Brian Green".

Brian Green

Deputy Assistant Secretary of Defense  
for Strategic Capabilities

Enclosure:  
As stated



GAO DRAFT REPORT – DATED June 6, 2008  
GAO CODE 351053 /GAO-08-831

"DEFENSE SPACE ACTIVITIES: DoD Needs to Further Clarify the Operationally  
Responsive Space Concept and Plan to Integrate and Support Future Satellites"

DEPARTMENT OF DEFENSE COMMENTS  
TO THE RECOMMENDATIONS

**RECOMMENDATION 1:** The GAO recommends that the DoD Executive Agent for Space direct the Joint Operationally Responsive Space (ORS) Office, in consultation with the U.S. Strategic Command, to define ORS key terms including: what qualifies as an urgent need, how timely satisfaction of a need is evaluated, and what Joint Force Commander needs the ORS concept is trying to satisfy.

**DOD RESPONSE:** Partially Concur. Defining the key terms, metrics, and requirements is vital to achieving mission success. The Deputy Secretary of Defense codified the Department's definition of Operationally Responsive Space (ORS) on July 9, 2007. This definition provided focus for the intended purpose of ORS and differentiated ORS from other space activities. Subsequently, United States Strategic Command developed an initial Concept of Operations containing additional terms intended to further define and clarify ORS activities. While we agree with the substance of the GAO recommendation, responsibilities for providing overarching definitions and policy guidance will remain with the Office of the Under Secretary of Defense for Policy; United States Strategic Command will continue to validate ORS requirements in accordance with public law, and provide additional clarification, definition, and direction to the ORS Office as we further mature this capability.

**RECOMMENDATION 2:** The GAO recommends that the DoD Executive Agent for Space direct the Joint Operationally Responsive Space (ORS) Office, in consultation with the U.S. Strategic Command, to establish an ongoing communications and outreach approach for ORS to help guide DoD's efforts to promote, educate, and foster acceptance among the Combatant Commands, Military Services, intelligence community, and other DoD organizations.

**DOD RESPONSE:** Partially Concur. Communicating a clear, concise message to the Combatant Commands, Military Services, intelligence community and others is vitally important to the success of ORS. Numerous forums, including the ORS Executive Committee and Senior Warfighter Forums, as well as other outreach efforts, including ORS personnel participation in exercises and conferences, are currently underway. We agree that outreach is important, but that burden should not be placed solely upon the ORS Office. All ORS stakeholders will continue to play an active role in promoting and fostering acceptance of the ORS initiative.

**RECOMMENDATION 3:** The GAO recommends that the DoD Executive Agent for Space, in consultation with the Under Secretary of Defense for Acquisition, Technology and Logistics and the Under Secretary of Defense for Intelligence, and in cooperation with the Military Services,

identify the steps necessary to ensure the integration of the Operationally Responsive Space (ORS) concept into existing DoD and intelligence community processes and architecture as the Joint ORS Office continues its long-term planning of the ORS concept.

**DOD RESPONSE:** Partially Concur. Integration of ORS capabilities into current processes and architectures will depend upon the value provided by the current processes and architectures. In many cases, it may be the current systems that preclude responsive support to the Joint Force Commanders. ORS is intended to use and exploit existing processes and architectures if they can meet the Joint Force Commanders' needs. Integration into existing systems will be considered by the ORS Office as a matter of course in the solutions development phase. Personnel assigned to the ORS Office come from organizations across the Department of Defense and intelligence community; these individuals bring a wealth of knowledge and experience which will help to identify ways to selectively integrate ORS capabilities into current systems, when appropriate, in order to streamline delivery of products to the customers.

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# Appendix III: GAO Contact and Staff Acknowledgments

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## GAO Contact

Davi M. D'Agostino, (202) 512-5431 or dagostinod@gao.gov

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## Acknowledgments

In addition to the contact named above, Lorelei St James, Assistant Director; Grace Coleman; Jane Ervin; Amy Higgins; Enemencio Sanchez; Kimberly Seay; Jay Spaan; Matthew Tabbert; Karen Thornton; and Amy Ward-Meier made key contributions to this report.

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