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STATEMENT OF

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BEFORE THE SUBCOMMITTEE ON STRATEGIC FORCES

ARMED SERVICES COMMITTEE

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Chairman Allard, Senator Nelson and Members of the Subcommittee,

I'm honored to have the opportunity to address the subcommittee, and to join the leaders of our National Security Space team to address current space issues so vital to our nation and our military forces.

During my April 2002 testimony before the Senate Armed Services Committee, I noted that the barriers to competitive entry are falling as a result of new technologies made possible in the age of information. Nowhere is this truer than in space.

Now it is two years later, and transformation across the force is happening much faster than we expected when we announced the journey just 28 months ago. Not just a concept and not just action in the future, transformation is happening today. It's happening due in large part to the information and power derived from our vital space capabilities.

Our space capabilities are a prominent feature of the global advantage we currently enjoy. However, the space technology context is changing, making possible a movement to an additional business model and an expanded business base for space. Cost per kilogram on orbit is still a problem. But, capability per kilogram on orbit is soaring due to advances in information technology. This makes the alternative model feasible. The door for small, micro and nanosatellites is open, allowing us to redefine cost and mission criticality curves, increase transaction and learning rates and the ability to assume risk. As we move towards the age of the small, the fast and the many, it's time to start thinking about applying that movement to our model for space. Adopting this complementary and broader business model will help us ensure space superiority well into a future where space will be yet more responsive to our joint military forces. In short, it is within our capability to create options, a process which itself can be a competitive advantage.

Operationally Responsive Space is that new and complementary business model. At its core are (1) the defining of a joint military demand function and (2) the focus on providing joint military capabilities for our operational and tactical level commanders. Finally, the model incentivizes output rate and uses a co-evolutionary strategy of concept-technology pairing, providing for iterative advancement in operational capabilities.

Progress of Space Transformation

Our National Security Space team has made great strides in its short 45-year history. Rooted in the Cold War, the National Security Space program was viewed as a source of national power. There was a clear connection between space and our strategic deterrent forces. The nation capitalized on converted weapon systems to develop the ability to launch small payloads in low Earth orbit. Then we graduated to larger payloads in higher orbits vital for detecting the ballistic missile threat posed by the Soviet Union.

Thirty years later, the military value of space capabilities became apparent during Desert Storm, which many have deemed the first space war. In reality, our space forces, like our traditional military forces, used a robust Cold War force structure to defeat the Iraqi armed forces and expel them from Kuwait. Nevertheless, Desert Storm highlighted the importance of being able to distribute or operationalize these global space utilities to be operationally relevant in theater.

One need only compare Desert Storm with Operation Enduring Freedom or Operation Iraqi Freedom to see how successful we have been at operationalizing our global space forces. One of the key differences between Desert Storm and Operation Iraqi Freedom is the distribution of satellite-based wideband communications down to the tactical level. In Desert Storm our military forces numbered 542,000 and they had 99 megabits per second of bandwidth available. In OEF/OIF bandwidth rose to 3,200 megabits per second while our forces were reduced to 350,000. Satellite communications provided the backbone for Blue Force Tracking, shared situational awareness down to the individual level and allowed operational and tactical level commanders to exploit an unprecedented speed of command. The nation's space capabilities directly impacted speed of maneuver, the tempo of the fight, and the boldness and lethality of our forces.

Additionally, the advances made in missile warning were significant. In Desert Storm, using our Defense Support Program satellites designed to detect the Cold War ballistic missile threat, we were able to give rudimentary theater missile warning. However, in the 10 years since Desert Storm, advances in ground processing, on-orbit software, organizations, command and control and theater warning concept of operations made our warning capability dramatically more robust allowing for theater battlespace characterization.

Finally, it is obvious that, in the years leading up to Operation Iraqi Freedom, great advances were made in distributing the Global Positioning System signal to weapons. This has significantly increased our precision strike capability.

These examples of increased bandwidth, theater missile warning capability and precision, show just how important space capabilities are to transforming our force and how far we have come in operationalizing these capabilities. But all along the way, the operational and tactical benefits were what could be teased out of the larger National Security Space Systems.

The Link to Strategy

One may ask, why we need a new model; given the success of our existing force. From all indications our space forces are providing us with an asymmetric advantage that no adversary currently enjoys. Although that is clearly true, evidence suggests that our space supremacy is not guaranteed. An adversary might turn our asymmetric advantage into an asymmetric vulnerability if we cannot maintain space supremacy. The United States is the most heavily space dependent nation in the world and that holds true for our joint military forces — this will continue to hold true for the foreseeable future.

Alfred Thayer Mahan, a prominent naval historian and strategist, described the oceans as a Great Common. Today, space and cyberspace must be added to the list of commons that must be controlled. One of the recognized barriers to becoming a hegemonic power is the ability to operate in and control the commons. Therefore, we can expect nations with hegemonic aspirations to try to erode our ability to operate effectively in the commons and to achieve the ability to control the commons for their own use.

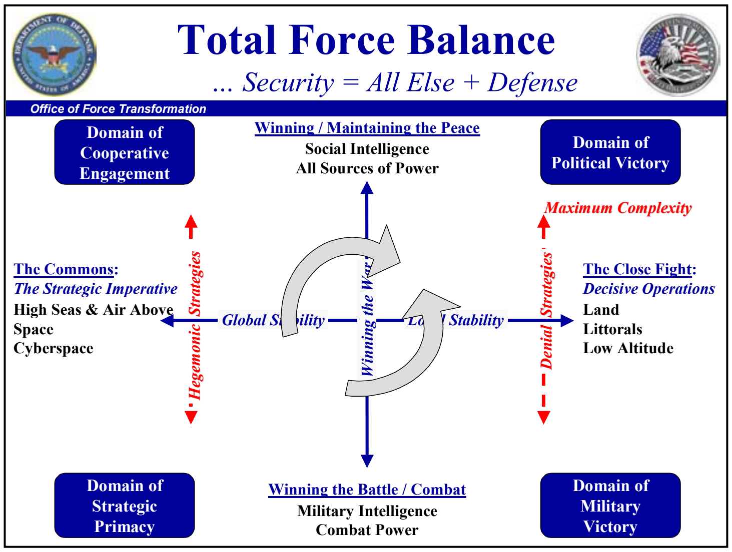

Figure 1

The barriers to entry into space, which were so high during the Cold War, have eroded. No longer is space reserved for great power nations alone. Space has become much more common, and today a nation needs not be a space power to employ space power. The commercial space communication and remote sensing industries that emerged in the 1990s, provide power derived from space, once reserved for the most powerful of nations, to weaker nations, organizations and even individuals. Additionally, the increasing capabilities of Small, Micro and Nano class satellites have moved them from a segment more suited for university backed experiments to a niche with potentially significant military utility. Today, nations can contract with universities to not only build microsats, but also to transfer the knowledge required to develop them. The United States, the leader in space, has taken a back seat to other nations in exploiting these smaller segments of the space industry. As we are at the threshold of transforming ourselves to a network centric military, using the coherent effects of distributed military forces and systems to achieve commander's intent, the newer smaller elements of space capability emerge as a toolset providing virtually unlimited potential.

In the past two years, other nations have launched 38 microsats while our contribution in this segment of the market is very modest. Furthermore, our Space Test Program as indicated by the number of satellites launched for test is in decline.

The Cold War attributes of our existing space program limit our ability to maintain space superiority required by today's rapidly changing strategic environment. Specifically, the mission criticality that grew out of the Cold War and the very high cost of our complex and highly capable space systems lead to a high consequence of failure. The required corresponding risk mitigation strategy incentivizes expensive, long lasting, heavy, multi-mission payloads. These same attributes also impact our ability to launch our satellites into orbit. They require larger, higher cost launch vehicles, with low launch rates and significant mission assurance oversight.

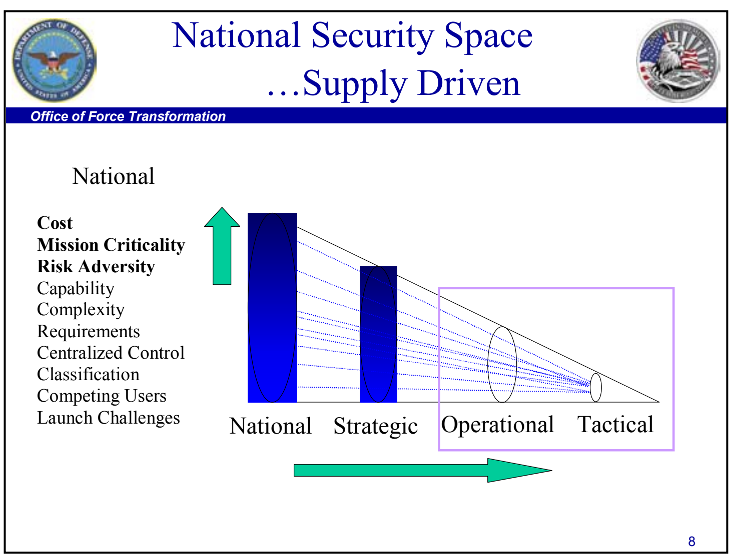

Figure 2

Attributes of Operationally Responsive Space

Operationally Responsive Space is a new approach. Rather than trying to operationalize national / global space utilities, this model designs military capabilities directly for the operational commander. The key attribute of the Operationally Responsive Space business model is that the field commanders drive the demand. That demand is the joint military capability required to meet operational and tactical level needs. Rather than treating our operational and tactical level commanders as lesser includeds, this business model designs a capability to meet their specific warfighting needs.

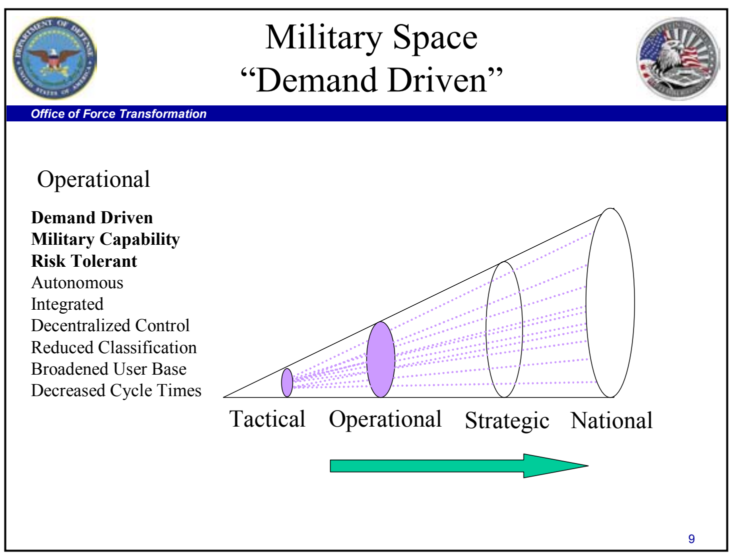

Figure 3

<u>Demand Function</u>. The operational level of war is a theater level of war and the operational commander is normally established only in a time of conflict. This definition helps put the demand function into context. The operational commander requires a theater capability to satisfy a joint warfighting need (vice a national intelligence need) that is available during joint war fighting planning timelines. This demand function changes the space calculus and the cost, risk

and mission criticality variables that incentivize lower cost, smaller, satellites and single mission, sub-optimized payloads with shorter life spans. The time function for responsiveness is then driven by adaptive contingency planning cycles rather than predictive futures or scripted acquisition periods. The objective is agility and dynamic fitness, not optimization.

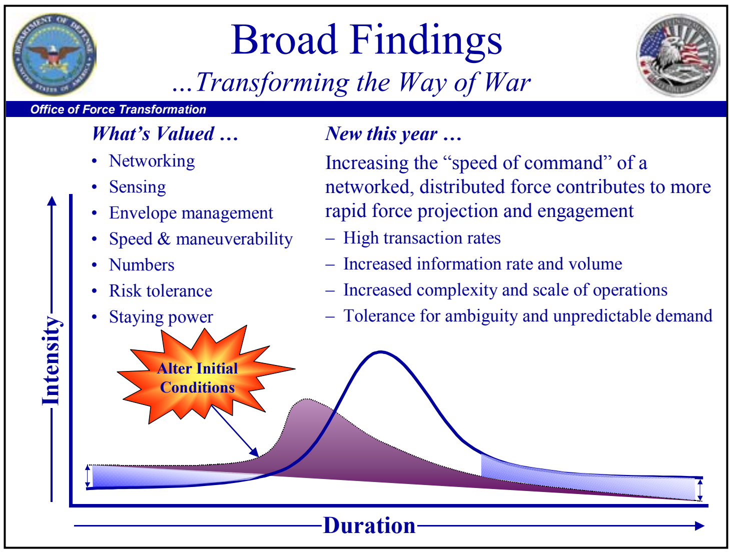

Figure 4

Military Capability. Today's joint force commander requires capabilities that are horizontally integrated, TCP/IP accessible, flexible, interoperable, joint down to the tactical level and are risk tolerant. Increasing the speed of command, which proved so vital in Operation Iraqi Freedom and Operation Enduring Freedom, requires high transaction rates, increased information rates and volume and a tolerance of ambiguity from unpredictable demand.

Autonomous. Operational Responsive Space capabilities necessitate the ability to launch and autonomously reach the required orbit without months of state-of-health checks, calibrations and configurations by large squadrons of satellite controllers.

Networked. When space is accessible to the tactical or operational users, it changes the manner in which relationships occur and the way that organizations behave. While micro or nano satellites may not offer technologies that are groundbreaking they can significantly alter the capabilities of a wider user base. The collective produces an understanding that is not replicated or deliverable by any single analyst or structured hierarchy. Leveraging space access by the entire defense establishment changes the methods and techniques that can be adopted by future users.

In a network centric force each satellite becomes a node within a tiered network of sensors such as larger space systems, UAVs, air and surface assets. A network centric approach uses the internet protocols throughout the entire lifecycle of the satellite. That means integrating the payload remotely and using the internet protocols for preflight testing, command and control, payload tasking and data dissemination. This will allow for increased fusion of data from multiple platforms while reducing lifecycle costs.

Broadened User Base. Parenthetically, there is no reason why this must be confined to Department of Defense needs. Rather, it could mean an organic space capability for the larger national security community. One of the objectives of Operationally Responsive Space is to make space assets and their capabilities available to operational and tactical users and an organic part of the Joint Task Force. One specific means to do this is for space to use the SIPRNET to task, receive and widely disseminate data. Because the SIPRNET has matured as a core U.S. warfighting command and control venue and evolved to be the de facto standard as a preferred data sharing service, the cost of gathering information has plummeted and the value of shared information content has soared. As a result both the richness of information improves and the reach of its content expands exponentially.

Complementing Big Space

Note that this complementary business model does not replace the larger space program. Today, small satellites cannot provide the capabilities required to meet all national intelligence needs. However, just as we have operationalized our larger space program to meet theater needs, these operationally designed theater capabilities will also enhance our national and strategic space capabilities. Specifically, these satellites will help reduce the burden we are currently placing on our national systems and the organizations that operate them, enhance the persistence of the national capabilities, assist in meeting the force structure requirements mandated by the current force planning construct, and help ensure that U.S. forces are adaptable to an uncertain future.

Another role that these systems could provide in the future is the ability to reconstitute our larger space capabilities if adversaries attempt to negate them. Although, it wouldn't be replenishment in kind, it could provide a subset of capabilities for our national and military leaders.

Test Bed For Big Space

As the pace of change in the information age is accelerating, so must the institutional transactions that create capabilities from "learning." Stagnation of institutional learning comes at the expense of creating future advantage. Today our space forces are at risk of becoming a strategically fixed target. The cost of sticking to slower generational turnover — a cycle that currently runs 15 to 25 years for U.S. forces — is likely to be technological surprise that works to our disadvantage in future conflicts.

Besides providing operationally relevant capabilities for the joint warfighter, this new business model would serve as a test bed for the larger space program by providing a clear vector for science and technology investments, enhancing the institutional and individual learning curves, and providing increased access to space for critical research and development payloads. Today, less than twenty-five percent of our space research and development payloads make it into orbit, and this is with a heavy reliance on the Space Shuttle.

Sound space science and technology stewardship requires that the sole superpower compete with itself to avoid stagnation. Getting new technologies into space earlier to understand the ramifications and inform our conceptual context builds a learning curve for big space and provides a look at alternative futures.

By reducing cost, increasing transaction rates and developing standardized buses and interfaces we change our risk mitigation strategy. This will allow the United States to lower the cost of placing payloads into Low Earth Orbit and simultaneously increase our ability to put research and development payloads into space. Additionally, these same attributes will allow sub optimized, simpler "wooden round" payloads to be launched into orbit.

However, the most important aspect of the test bed is the institutional and individual learning that will take place. As an institution, we will learn there are alternative methods and processes to conduct space operations that could not have been developed through our larger space program. Additionally, the smaller satellite programs will provide great venues to pair seasoned space expertise with new prospects, allowing them to "cut their teeth" in an area where failure is a data point.

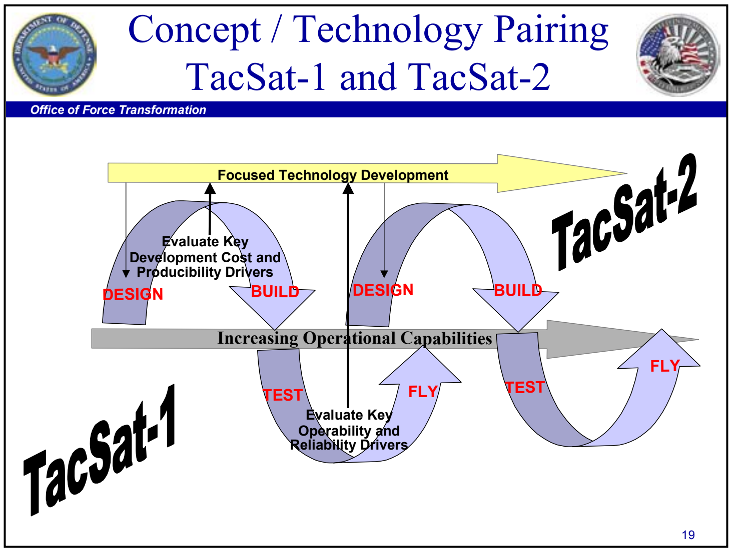

Figure 5

Finally, this business model uses a co-evolutionary process, pairing concepts and technologies in an effort to start influencing change immediately. The co evolutionary techniques guide the Operational Responsive Space approach to instantiating these capabilities. The techniques are used to stimulate disruptive innovation through the continuous development and refinement of operational concepts, processes, technologies and organizations. This approach should influence technology, policy, concepts of operations, acquisition processes and public/private partnerships.

Operationally Responsive Space provides the ability to conduct a strategy of generational science & technology and acquisition. This new business model brings the United States "back to the future." The Operationally Responsive Space model is similar to the space model of the 1960's and 1970s. All space systems started small and in low earth orbit and grew bigger and higher as technology and operational requirements matured.

Analysis of the development of the Global Positioning System satellite constellation provides some key attributes that are readopted in our model.

Creating leverage by targeting the investment of relatively small research and development dollars and the role of research laboratories.

The Global Positioning System grew out of work done by the Service laboratories. The Naval Research Laboratory and Air Force Research Laboratory were both targeting the investment of relatively small research and development dollars towards key technologies required to develop the system. When it became apparent that DoD could not continue to fund two unique systems, the two labs were directed to get together over a Labor Day weekend and come up with a single approach. The best attributes of both approaches were put together in the final system. It was determined that the Navy had the best clocks and orbits and the Air Force had the best signal structure. DoD directed the Air Force to take the lead in operationalizing the system and the Naval Research Laboratory was funded for continued research and development. In our Operationally Responsive Space business model we view the research labs as matched filters for technology concept pairing to address operational needs.

Affordable access to space

The successful development of the GPS constellation relied on testing clocks in space. The Naval Research Lab was able to get "free piggy back" rides to space using excess capacity on the Agena rocket. The cost, timelines and risk associated with getting piggyback research and development payloads to space today hinder our ability to advance space technologies.

Generational Approach

The Global Positioning System actually grew out of a series of lab sponsored experimental microsats. In all there were 15 navigational microsats and 8 research and development satellites. Combined, these satellites served as stepping-stones to the operational Global Positioning System. They provided intermediate capabilities to begin developing operational concepts directly impacting the final orbital parameters adopted for the operational system.

Our business model seeks to embed experimental capabilities into combatant commanders warfighting experiments. By doing so, we can mature the operational concepts in parallel with the technology. By increasing transaction rates, next generation technology and operational concepts can be embedded into future payloads, leading to increased capability for the warfighter.

Public / Private Partnerships

Another key attribute of the GPS acquisition program was the public / private partnership between the Services and Rockwell which won the contract to build the first block of operational satellites. For about a year, engineers from Rockwell worked with the Service laboratories to learn all the lessons to be learned prior to developing the operational system. This public / private team was crucial to the success of the acquisition program. Currently, our science and technology strategy falls short on several fronts. First, access to space does not afford a robust space science and technology and research and development program. Secondly, there is a gap in translating research and development into operational capabilities. The new business model and co evolutionary approach seek to bridge this gap.

The Way Ahead

Over the past year, the department has taken great steps in embracing this new business model. My office funded the TacSat-1 experiment with the goal of providing an operationally relevant capability to the warfigher in less than a year and for 15 million dollars. Although we expect to be right on the margins of both metrics with a planned early summer launch, a lot of progress has been made in our institutional processes.

The Air Force, under the leadership of Mr Teets, Gen Jumper and Gen Lord, has provided outstanding support to our operationally responsive experiment. They have crafted a customized mission assurance approach for the oversight of a new commercial launch vehicle consistent with the nature of the TacSat-1 experiment. Additionally, they have worked closely with the commercial launch provider to come up with innovative safety processes that will ensure public safety. At the same time, they have been willing to accept risk in operational suitability and effectiveness. This process is on going, and real organizational learning is happening in the Air Force and in the commercial launch company.

Our TacSat-1 experiment has set the baseline for a co-evolutionary concept / technology pairing process and has helped shape a stronger relationship between Service laboratories. The Air Force is following our TacSat-1 with a TacSat-2 that builds on the modest capabilities provided by our first instantiation. This is a realistic first step of generational science and technology efforts.

Critical to achieving the agility and flexibility demanded by an operational responsive space model we must develop standards for modular / scalable satellite buses. This must be a part of our future plans and will allow us to increase the utility margin of smaller satellites.

We have forged a healthy relationship with the Pacific Command to imbed these capabilities into their annual combatant commander exercises.

TacSat-1 has also served to strengthen interagency relationships. OFT has capitalized on NASA's and the Air Force and Army Space Battlelabs' work with the Virtual Mission Operations Center. This has allowed internet based payload tasking and data dissemination. Additionally, we have forged a partnership with the Federal Aviation Administration, the commercial space regulators, to ensure proper liability and indemnification levels.

Finally, taking a more macro view, DoD is stepping up to making operationally responsive space a near term capability. General Jumper, the Air Force Chief of Staff, recently announced the Air Force's Joint Warfighting Space concept. The Air Force is leading a joint team to investigate operationally responsive space technology vectors and STRATCOM is engaged to help define the corresponding vectors for operational concepts.

The leaders I am privileged to testify with today are taking the right steps to move this concept, currently in its infancy, into an operational warfighting capability.