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USE OF COMMERCIAL SPACE ASSETS BY THE JOINT FORCE COMMANDER

By

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A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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15. Abstract: The commercial space industry has surpassed the military with more satellites on orbit. In the coming decade, it is projected that 1000 more commercial satellites will be launched. The United States Government is relaxing trade restrictions to stimulate private-sector investment in commercial space systems. With more capital being funded into the commercial sector, the industry is at the start of a new evolution of space technologies available to private citizens and foreign governments alike.

The evolution of technologies will bring smaller, lighter and more capable satellites for less money. The launch cost involved will also decrease and allow more entities to place systems in space. The United States military is already augmented to varying degrees with commercial systems. The commercialization of space will change the way the military is enhanced by space systems. As these new technologies become available to the market, the Joint Force Commander will need to continually assess their military utility in order to prevent the enemy from gaining an edge.

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ABSTRACT

The commercial space industry has surpassed the military with more satellites on orbit. In the coming decade, it is projected that 1000 more commercial satellites will be launched. The United States Government is relaxing trade restrictions to stimulate private-sector investment in commercial space systems. With more capital being funded into the commercial sector, the industry is at the start of a new evolution of space technologies available to private citizens and foreign governments alike.

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INTRODUCTION

"Space, the final frontier" is now "space, the hottest business venture on earth." The business world took space by storm in 1998 with more commercial space launches than military. In May of 1998, there were more commercial satellites on orbit than military for the first time in space history.[1]

Today, the number of commercially owned and operated satellites in orbit total over 200. This is double the number from one year ago.[2] There is projected to be 1000 more commercial satellites launched in the coming decade.[3] Global space revenues are projected to increase from 77 billion U.S. dollars in 1996 to over 120 billion U.S. dollars in the year 2000.[4]

Contributing to this expansion are former defense contractors who, because of decreased defense spending and relaxed government regulations, are entering the commercial market with their technologies. One of these contractors, Raytheon, wants to take its defense technologies into the commercial marketplace. Raytheon understands the need to master the marketplace as well as master the technology to be successful in the commercial market place.[5] On January seventh of this year, Lockheed Martin announced the formation of a new commercial space systems unit. This unit will build

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[1] Tom Riebe and Matt Schweitzer, "Space Operations and Support," *Aerospace America*, December 1998, 83.
[2] U.S. Space Command, "Satellite Boxscore," 13 January 1999, <http://www.spacecom.af.mil/usspace/boxscore.htm> (23 January 1999).
[3] Ben Iannotta, "Rockets Take Aim at Booming Market," *Aerospace America*, February 1998, 34.
[4] Craig Covault, "Global Commercial Space Business Sought for ISS," *Aviation Week & Space Technology*, 11 May 1998, 26.
[5] Anthony L. Velocci, Jr., "Raytheon Chief Sets New Course," *Aviation Week & Space Technology*, 5 October 1998, 26.

communication satellites and remote sensing spacecraft for commercial customers as well as international governments.[6]

With the blessing and support of the United States Government, the commercial space industry is ready for vigorous new growth. Issued in September of 1996, President Clinton's new National Space Policy will commit the nation to a strong and stable program in space. Among the key provisions:

> In the commercial sector, the policy seeks to stimulate private-sector investment by committing the US government to purchase commercially available goods and services, and by offering stable and predictable access to federal space-related hardware, facilities, and data. The policy also lays the groundwork for moving away from international launch quotas toward an international commercial environment characterized by free and fair trade in commercial launch services.
>
> For national security, the policy directs closer coordination between Department of Defense and intelligence to improve the nation's ability to support military operations worldwide, to monitor and respond to strategic military threats, and to monitor arms control and nonproliferation agreements and activities.[7]

There has also been a fundamental shift in the Air Force's involvement in the space business. In keeping with service wide initiatives to use private services, the Air Force will buy launch services vice launch vehicles. Speaking at the Commercial Space Industry Leaders' Conference in Colorado in December of 1998, acting secretary of the U.S. Air Force, Whit Peters said, "we need to make sure those portions of the space business that can be commercialized are commercialized."[8]

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[6] Defence Systems Daily, "Space Articles," 7 January 1999,<http://defence-data.com/archive/page3530.htm>

[7] The White House, Office of the Press Secretary, "President Clinton Issues New National Space Policy," <http://www.whitehouse.gov/WH/EOP/OSTP/html/spacepol-press.html> (15 January 1999).

[8] Defence Systems Daily, "Space Articles," 18 December 1998, <http://defence-data.com/curent/page/3450.htm

Commercialization will bring many benefits to space. We will see a decrease in the cost per pound for manned and unmanned flights. Launch on demand will eventually become a reality, thereby reducing the lead-time to put a satellite into orbit. The amount of venture capital being raised on Wall Street will accelerate the production of new systems that are smaller, lighter and more technologically advanced.

With these advances by the commercial space industry and the commitment of the U.S. government to use these systems, what will be the implications for the Joint Force Commander? Will this change of direction in space to a commercially dominated area be a benefit to the operational commander? Will these perceived force multipliers really be additional tools in the commander's toolbox or will they be millstones around his neck that are exploited by the very adversaries he is sent to defeat?

This revolution will only add to the already phenomenol array of capabilities at the commander's command. As we leave the industrial age, with its dependence on oil, we enter the information age that will be dependent upon space to fuel its progress. The commercialization of space is the next step in the evolution of the information age, and it is necessary for us, the United States military, to be at the forefront, so that we can have control of how it evolves.[9] The commercialization of space will only benefit the operational commander in the long run, and the sooner we realize this and prepare for it, the better.

[9] General Howell M. Estes III, USAF, "Space as an Area of Vital Interest," 3 November 1997 <http://www.spacecom.af.mil/usspace/speech7.htm>

BACKGROUND

The United States military has been operating in space since the beginning of space exploration over four decades ago. Since 1959, with the launch of a Transit, the first U.S. navigational satellite, the Navy has operated in space. Satellites verified the presence and subsequent removal of missiles from Cuba. Soviet merchant ships left their holds open for inspection and verification of removal by the satellites overhead. Although the military has employed space-based assets for over forty years, it was not until Desert Storm that our first 'space war' occurred.

Desert Storm was the first widespread use of space-based systems by all members of the armed forces. The military use of space greatly enhanced coalition effectiveness. Military and commercial satellites carried over 90 percent of inter/intra-theater communications.[10] During Desert Storm, it was necessary for at least eight coalition civilian satellites to augment U.S. systems.[11] The reliance on space-based systems for the next contingency will only increase, and to meet that demand, we will have to depend on more commercial systems. Even today, during peacetime, operational commanders in theater use commercial space systems. The carrier group staff onboard the USS Carl Vinson, presently in the Arabian Gulf, has access to two separate commercial systems for each of the following: weather, communication, and imagery.[12] How often and how much these systems are used compared to their military counterparts is dependent upon the preferences and needs of the commander.

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[10] CDR Dale R. Hamon and LTC Walter G. Green III, "Space and Power Projection," *Military Review* 74, no.11 (November 1994): 64.
[11] Jeffery L. Caton, "Joint Warfare and Military Dependence on Space," *Joint Force Quarterly*, Winter 1995-96, 49.
[12] Commander Ashby, N2 Commander Carrier Group Three, E-mail with author, Newport, RI, 3 February 1999.

The space mission of force enhancement is to provide space support to regional commanders and is accomplished by the roles of navigation, weather, surveillance and reconnaissance, and communication.[13] It is necessary for the commander to understand the capabilities of the commercial space systems even if they are not being employed because more than likely his adversary is taking full advantage of these systems.

NAVIGATION

The pinpoint accuracy of the Navstar Global Positioning System (GPS) was highlighted during Desert Storm, with coalition forces operating flawlessly in the featureless desert. The military advantage of precisely determining your position anywhere on earth is self-explained. The civilian advantages of such an accurate navigation system are still being developed. We already have options available on automobiles to tell you where your car is and to communicate your position to authorities if your airbag deploys.

A new multibillion-dollar market with over 160 manufacturers is developing GPS-based systems. You can now purchase a handheld receiver for less than 100 dollars. Civil aviation is also embracing GPS navigation. Using only GPS navigation, a Gulfstream airplane flew a flawless approach to Washington's National airport last year, demonstrating the capabilities of the navigation system.[14]

The increased dependence of the civilian community on this system has caused some changes to be made in national policy. In his 1996 "US Global Positioning System Policy", President Clinton promoted his commitment to the commercial exploitation of

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[13] GEN Howell M. Estes III, USAF, "Space and Joint Space Doctrine," *Joint Force Quarterly*, Winter 1996-97, 61.
[14] The Whitehouse Homepage, "Steering by the Satellites," <http://www.whitehouse.gov/WH/EOP/OSTP/Science/html/satellite.html

the GPS system. One of the policy guidelines was the discontinuation of the GPS selective availability within a decade. During this time, the Department of Defense needs to prepare our military forces for operations without the selective availability option. The Department of Defense will also be responsible for retaining a military advantage without disrupting or degrading civilian uses.[15]

The United States is not the only country with a global navigation system. Russia has the Russian Global Navigation Satellite System (GLONASS). Europe is developing the European Geostationary Navigation Overlay Service (EGNOS), an augmentation system to work with GPS and GLONASS.[16] The Europeans envision a future Global Navigation Satellite System that must be certifiable for public safety and developed and controlled on an international civilian basis. Japan is also developing a GPS-compatible augmentation system and will not develop a new civil only system.[17]

A readily available and accurate GPS signal to the opposing force of the Joint Force Commander does not appear on the surface to be acceptable. If, however, we look closer at the situation, we will see the advantages for the United States to have control of the system making it available to all users. Technology has advanced so that today it is relatively inexpensive for a nation to deploy a GPS system. As long as the U.S. system is available and free, we deter the design development and deployment of competing systems and retain control of the one system used by many. For an adversary, having an

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[15] Whitehouse GPS Factsheet, "US Global Positioning System Policy,"<http://www.whitehouse.gov/WH/EOP/OSTP/html/gps-factsheet.html

[16] An augmentation system takes a known geographical reference point and determines the difference, if any, from the received signal then applies this differential to its own receivers for an extremely accurate position.

[17] Richard J. H. Barnes and Roy Gibson, "An International Look at Global Navigation Satellite Systems," *Space Policy* 14 (1998): 189-192.

accurate navigation capability is not a substitute for state of the art equipment, training, experience, and good morale.

WEATHER

Exploiting the natural environment in military operations is as eternal as is the wisdom of Sun Tzu, who states "If you know Heaven and know Earth, you may make your victory complete."[18] From the forecast of the weather off the beaches of Normandy on D-Day, to the determination of the composition of the sand for General Schwarzkopf's "left hook" during Desert Storm, the ability for determining and exploiting the weather has been an advantage for the operational commander.

During Desert Storm, commanders throughout the theater received weather forecasts four times per day, including pictures of cloud cover. Initially, data was downlinked to ground-station vans, but by the end of the war, two prototype units, able to fit into a small Army vehicle, were being utilized.[19]

The National Oceanic and Atmospheric Administration will soon be launching the next generation weather satellites. These satellites will improve the quality of the space-based data provided to meteorologists. Europe's Eumetsat spacecraft scheduled for launch in 2003 will provide further improvements to weather data.[20] The capabilities of these satellites are a great improvement over present systems.

The ideal goal in exploiting the weather is not simply to operate in optimum weather. The goal is to have weather in which you are still able to operate, but the

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[18] Sun Tzu, *The Art of War*, ed. James Clavell (New York: Delacorte Press, 1983), 20.
[19] LTC Steven J. Bruger, USAF, "Not Ready for the First Space War," *Naval War College Review,* Winter 1995, 77.
[20] Joseph C. Anselmo, "New Weather Satellite to Improve Forecasts," *Aviation Week & Space Technology,* 11May 1998, 80.

enemy's ability to defend himself is degraded. With the combination of improved data collection and dissemination as evidenced above, the possibility exists that with a portable terminal to receive downlinked information, a tactical commander would be able to pick the optimum moment for action.

IMAGERY

It used to be that when you thought of satellite imagery, the first things that came into your mind were the reconnaissance birds made famous during the Cold War. Today, when you mention satellite imagery, one ponders the many uses from the tracking of forest fires to the monitoring of agricultural crops, to the real estate agents who help clients evaluate properties, and even one day to helping the Center for Disease Control track disease and epidemic factors.[21]

Commercial imagery and remote sensing systems are blossoming. As a result of the decline in the cost to operate the ground support function of a high-resolution digital camera imagery operation, several partnerships have formed to provide imagery to the open market.[22] By opening this market, the operators hope to generate a large enough revenue stream to develop and maintain a space imaging system. Although promising commercially, this becomes a threat to the imaging dominance of the United States and Russian governments. Theoretically, a news organization could obtain imagery to cover a conflict and give away positions of opposing forces on the evening news. Presidential Decision Directive 23 (PDD-23), issued in 1994, is intended to prevent this from happening. The directive allows companies to develop one-meter resolution satellites for

[21] Stephen Williams, "Space-age Disease Detectives," *Newsweek,* 4 May 1998, 84.
[22] Bill Sweetman, "Spy Satellites: the Next Leap Forward," *Jane's International Defense Review,* 1/1991, 28.

commercial use, provided that the government can block out coverage for national security if necessary.[23] Although this may seem defensive in nature, it actually allows U.S. companies, experienced in satellite imagery, to set the mark for excellence and control the market. Perhaps the best measure of commercial imaging capability is the recent U.S. congressional direction to limit imagery resolution to no better than three meters over Israel, much to the dismay of the commercial providers.[24]

Some companies are not interested in one-meter resolution; their markets are in larger resolution imagery and would risk profits by transitioning to a smaller resolution. Just like the need for different scaled maps, there is a need for different sized resolutions in imagery.

The U.S. military uses commercial resolution to fill gaps in tactical mission planning and battle damage assessment. The expanding market of imaging orbiters with the promise of one-meter resolution offers the U.S. military the ability to meet the needs of the warfighter for imagery and to free up national reconnaissance assets for critical needs during a conflict. This would be similar to the use of commercial satellite communications for non-tactical use during times of conflict.[25]

COMMUNICATIONS

The space based communications industry is enjoying phenomenal growth. With a majority of the public believing that they have to have a cell phone to survive in today's world, having a phone that is not bounded by cell areas or that is not unusable in certain locations is a must have. Thus, we enter the world of satellite communications for the

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[23] Ibid., 30.
[24] Tom Riebe and Matt Schweitzer, "Space Operations and Support." *Aerospace America*, December 1998, 83.
[25] Robert K. Ackerman, "Air Force Planners Exploit Commercial Space Imagery," *Signal*, June 1995, 15.

average consumer. The new personal communications satellite systems are intended to incorporate the advantages of both satellite and cellular systems into a single global network. Initially designed for the business traveler or for people in remote areas, this new system, where the satellites act like orbiting cellular base stations, is attracting a lot of attention and anticipation of its use.[26]

The use of commercial communications satellites to augment military communications satellites will continue to increase in the future. This will allow the U.S. military to capitalize on the exploding commercial marketplace. The next decade will give the Department of Defense the opportunity to explore for national security purposes the potential of two new types of communication services. The first is the launch of several constellations of commercial communications satellites in low earth orbit, and the second is the availability of more capable commercial satellites in geosynchronous orbit. While it is not clear how and which systems will be used, it is abundantly clear that the Department of Defense plans to leverage the commercial markets more and more to support the operational need of the warfighters.[27]

On first glance, the expanded uses of commercial space-based systems seem to be a win-win situation. Not only will it benefit the military and help the economy to continue to prosper, but it also matches Network-Centric Warfare's bottom line, which is that no node can be worth more than the connectivity it provides.[28] After closer

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[26] John V. Evans, "New Satellites for Personal Communications," *Scientific American*, April 1998, 72.
[27] Gil I. Klinger and Theodore R. Simpson, "Military Space Activities the Next Decade," *Aerospace America*, January 1998, 49.
[28] Thomas P. M. Barnett, "The Seven Deadly Sins of Network-Centric Warfare," *U.S. Naval Institute Proceedings*, Jan 1999, 37.

inspection, one can make several cases for threats that could cause the operational commander problems.

Threats to these systems come not only from terrestrial sources but also from the space environment itself. For example, geomagnetic storms can increase satellite drag, causing orbital changes that affect sensor performance, satellite control, and space object tracking. If the United States is to rely increasingly on space-based assets for force enhancement, it must remain aware of its own vulnerabilities to the space environment, as well as those of its adversary.[29]

Terrestrial threats could include attacks on the satellites themselves, either from land based or space-based weapons. Attacks could also be made on connecting nodes or other supporting facilities of the systems. If we could design a system that was truly attack proof, it would take a long time to develop, with a large budget and it would probably be technologically outdated by the time it was produced. This brings us to the question, "is any system truly bullet proof?" We have yet to design a ship or airplane that is invincible; why should we expect a space system to be?

A benefit of the commercialization of space is the advancement of technologies because of the infusion of capital. With advancing technology, the equipment packages that go on satellites, whether communication, imagery, navigation or weather, are being built smaller lighter and more capable. Moreover the launch technology for satellites is improving by becoming cheaper and faster to get the payload on orbit. I believe that it is the advancement of these technologies that hold the answer to the question of the vulnerability of the operational commander's space systems. One answer to the question

[29] Bruger, 79.

of how to replace a destroyed satellite or to get one on orbit where you need it would be to use launch on demand technology, which will be a by-product of the advances made by the commercialization of space.

Another answer to the overflight/security of satellites is the use of High Altitude Endurance-Unmanned Aerial Vehicles (HAE-UAV) that give the operational commander more control. Originally built for battlefield surveillance, the HAE-UAV could also be packaged with a communications suite to supply force communications.[30] An even better option would be the High Altitude Long Endurance-Unmanned Aerial Vehicles (HALE-UAV).

To explore the outer edges of the atmosphere, NASA is building a remote controlled, solar powered aircraft called the Centurion. This HALE-UAV would reach 100,000 feet in altitude with a 100-pound payload, and with back up batteries, its on station time would exceed 24 hours.[31] There are also other HALE-UAVs being developed for the communications business, where they would be used over major metropolitan areas instead of a constellation of satellites on orbit. These could be dirigibles or winged craft, powered by solar or fuel cells, with piston or jet engines. While the fuel burners would only have a few days on station time, the others could last weeks.[32]

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[30] Michael L. McDaniel, "High-Altitude UAVs Should be Naval Players," *US Naval Institute Proceedings*, February 1999, 72.
[31] Warren E. Leary, "The Dream of Eternal Flight Begins to Take Wing," *The New York Times*, 12 January 1999, sec D, p. 1.
[32] Joseph N. Pelton, "Telecommunications for the 21st Century," *Scientific American*, April 1998, 85.

CONCLUSIONS

These emerging technologies give the operational commander a wide variety of options as to how he will deploy his forces. There are drawbacks, but everything has its disadvantages. As with any system, the prudent commander would not deploy without the benefit of a back-up or alternate system in case of failure. This holds true with the commercial space systems that he is able to utilize.

In future conflicts, significant support may come from civil and commercial systems. A joint force commander must coordinate and orchestrate the activities of these supporting space forces in conjunction with his own forces. The number of nations and commercial firms that have or are developing space-based systems is growing. This makes the availability of information with military utility commonplace.

The use of commercial satellite systems will prove to be an effective and efficient means of relaying military traffic. The changing military doctrine, of reduced force-structure and a CONUS based force, requires rapid global response to crisis. Satellite communications provide the ability to quickly establish a communications infrastructure and connect numerous users. Commercial satellites should be employed to provide surge capacity for military satellite systems already in existence. If the military systems are operating at capacity, commercial satellites should be employed to take over all non-tactical traffic requirements.

What effect will this revolution in space have on the Joint Task Force and the way it executes its mission? The commercialization of space will only benefit the operational commander. We need to prepare now to fully utilize the advantages brought by these systems.

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