At What Cost?

Leveraging emerging small satellite constellations

By Maj. Bradley Townsend

Recent news coverage is full of reports of plans for commercial satellite communications (COMSATCOM) capabilities that will revolutionize the industry. Many of these plans rely on using constellations of Low Earth Orbit satellites that leverage recent breakthroughs in small satellites combined with advances in the launch industry that are making possible the idea of having hundreds or even thousands of small satellites aloft.

The potential impact on military operations of these new constellations is sizable. They may offer easy mobile access to reliable, low-latency and high-bandwidth communications.

The challenge for the U.S. military space community will be in overcoming its traditional reliance on military satellite communications (MILSATCOM) and a troubled history with COMSATCOM acquisition. It is worth looking back at this history to judge how successful the military may be in maximizing opportunities presented by emerging developments in the commercial market.

The only existing smallsat constellation is owned by mobile satellite communications company Iridium which has long supplied the U.S. military, but even with an updated constellation of satellites it offers only a hint at the capabilities that may be available in the near future.

Early Bird

The first commercial communications satellite, Early Bird, was launched in April 1965 by the International Telecommunications Satellite Consortium (INTELSAT).[1] INTELSAT emerged from the Communications Satellite Corp. (COMSAT) which was established by Congress in the Communications Satellite Act in August 1962.[2]

At the time, the Department of Defense was attempting to build its own satellite communications constellation. Called Advent, this program was a joint project where the Army would manage the payload while the Air Force "flew" the satellite itself, the origin of the 53rd Signal Battalion's current role.[3] In a foreshadowing of many future military space programs, the Advent program was significantly over budget and behind schedule when then-Secretary of Defense Robert McNamara cancelled it.

McNamara saw the creation of COMSAT Corp. as an opportunity and opened discussions with the newly formed company to lease bandwidth from it at lower cost than Advent. This was an ambitious goal. COMSAT had not yet founded INTELSAT or launched its first satellite.

The DOD and COMSAT could not agree on costs or the need for dedicated military transponders aboard COMSAT's satellites. In July 1964 McNamara ended negotiations with COMSAT and opted for development of a new dedicated military satellite constellation under the direction of the Air Force, the Initial Defense Communications Satellite Program.[4]

From that point until the first Gulf War in 1991, military satellite communications needs largely were fulfilled by the MILSATCOM constellation. That MILSATCOM could do this was primarily the result of timing.

The Vietnam War ended before the U.S. military had a significant dependence on satellite-communications capabilities. Peacetime usage did not stress the available bandwidth to a point that required the purchase of commercial bandwidth. This changed with Operation Desert Storm, when demand spiked and satellites carried more than 80 percent of all communications.[5] This percentage was achieved despite demand exceeding supply in both bandwidth and satellite ground equipment.

Gulf War Growth

Commercial SATCOM played a substantial role in the communications architecture of the Gulf War. Just prior to the start of the conflict the total bandwidth usage in the U.S. Central Command area of operations was 4.54 Mbps.[6] This was entirely provided by MILSATCOM.

Within the first month all MILSATCOM bandwidth available in the theater was consumed, and the DOD was forced to transfer satellites from other global locations and adopt other extreme measures to support the growth. At the height of the conflict, demand increased to 67.65 Mbps carried over MILSATCOM and 31.39 Mbps on COMSATCOM for a total of 99.04 Mbps.[7]

Commercial SATCOM, provided entirely by INTELSAT, carried 31.6 percent of military satellite traffic and nearly 20 percent of all traffic in the entire theater. Interestingly, the military relied on COMSAT-founded INTELSAT to carry the majority of data transmitted to the continental United States because INTELSAT had both the constellation of satellites and the ground-transfer stations to support the effort, whereas the military did not.

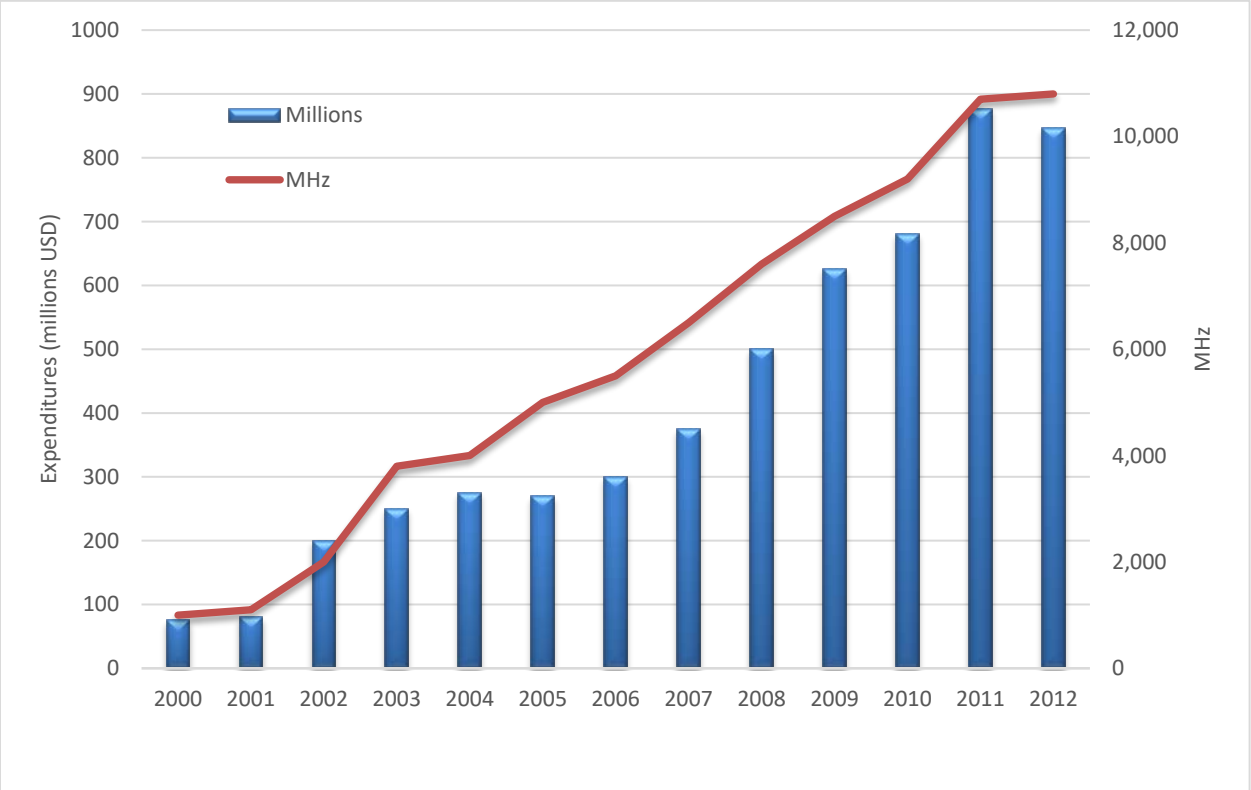
Air Force Space Command, in a review of lessons learned from the conflict, identified that communications plans had underestimated the level of demand and recommended that DOD acquire more satellites to support future operations.[8] Nowhere in the lessons-learned document was using COMSATCOM as a backup mentioned as an alternative.

Desert Storm set a benchmark for SATCOM usage, averaging 140 bps per deployed soldier.[9] Future conflicts saw further growth. In Kosovo in 1999 average usage was 3,000 bps per soldier. It reached 8,300 bps per soldier in the opening days of Operation Enduring Freedom in Afghanistan and a further 13,800 bps per soldier by 2004 in Operation Iraqi Freedom.[10] Total bandwidth used in 2003 during the invasion of Iraq was 3.2 Gbps compared to the 99 Mbps used for a force more than twice as large in Desert Storm.[11]

Free-for-All

This exponential growth in SATCOM usage came at a cost to the U.S. government and drove an evolution in how COMSATCOM was acquired (see table 1 for growth in COMSATCOM demand since 2000).

Table 1: DOD Fixed Satellite Service Bandwidth Cost and Usage

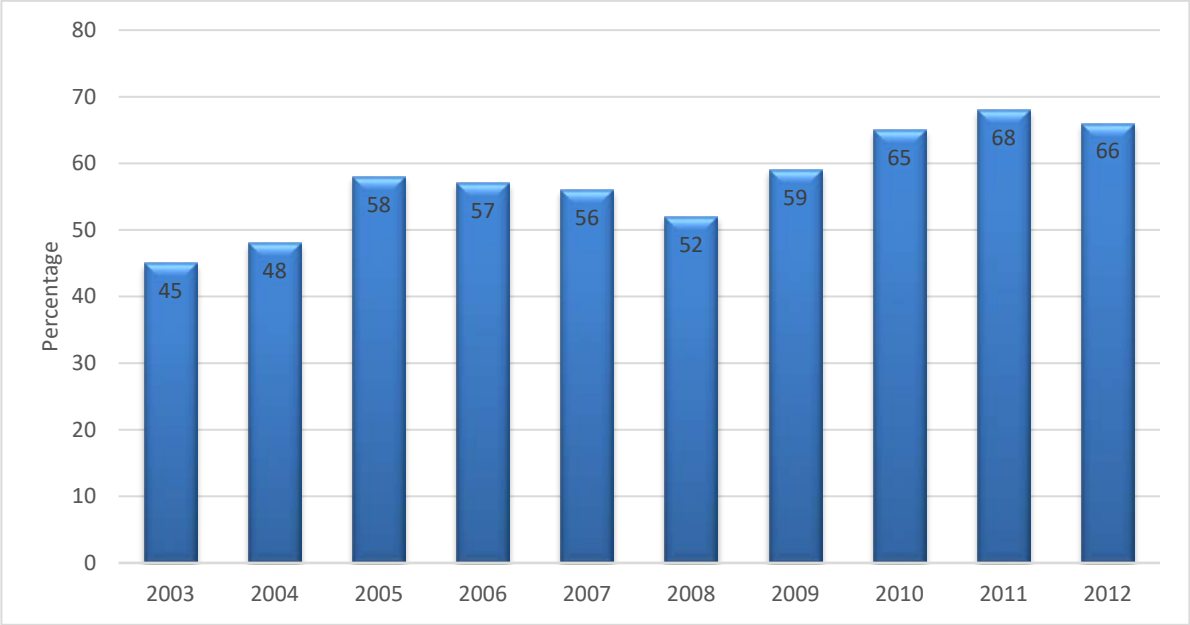


Source: Department of Defense, "*Satellite Communications Strategy Report" in Response to Senate Report 113-44 to Accompany S.1197 National Defense Authorization Act for Fiscal Year 2014* (Washington: Office of the Chief Information Officer, Aug. 14, 2014).

The sudden increase in the operations tempo and associated demand for satellite bandwidth created a free-for-all in acquiring COMSATCOM bandwidth to meet the surge. After Desert Storm ended, DOD mandated that the Defense Information Systems Agency (DISA) would manage acquisition for commercial bandwidth.[12]

DISA did so in accordance with federal regulations and standards, but the process was slow and demand was immediate. Users of DOD commercial-satellite services were dissatisfied with DISA, claiming that it was too slow for military operations and too expensive.[13] Many users circumvented DISA. The General Accounting Office (GAO) in 2003 estimated that at least 20 percent of DOD's purchased bandwidth was acquired without going through DISA.[14] A 2015 GAO report raised this estimate to 55 percent.[15]

Table 2: Percentage of DOD Fixed Satellite Services Acquired by DISA, 2003-12



Source: United States Government Accountability Office, *Defense Satellite Communications: DOD Needs Additional Information to Improve Procurements* (Washington: GAO-15-459, July 2015).

DISA has refined COMSATCOM acquisition procedures over the last 20 years in an effort to lower costs, improve contract usage rates and meet growing demand. Today the DOD acquires most of its COMSATCOM from DISA primarily using the Future Commercial Satellite Communications Services Acquisition (FCSA) contract model and its subcontracts, Custom SATCOM Solutions 2 (CS2) and CS3.

The CS2 contract was valued at $3.4 billion and had a three-year base period with two one-year options. Its successor contract, CS3, extends the base period to five years with one-year options for five more years and a $2.5 billion ceiling for that extended window.[16] A successful bidder on CS3 must "provide the COMSATCOM system engineering design, configuration, installation, implementation, training, and on-going maintenance and operational support necessary to deliver a COMSATCOM complex solution."[17]

The General Services Administration, in its request for proposals, allowed the solution to possibly include a combination of fixed and mobile services and components. This flexibility may allow future small satellite data providers to compete successfully with a hybrid solution. The adoption of emerging technology, however, may be limited by the success that the GSA and DISA have had under FCSA in extending contracting authority for longer base periods in order to lower cost.

CS2 was limited to a maximum five-year period as a result of Pentagon and congressional pressure. Since indefinite delivery/indefinite quantity contracts under FCSA do not allow for new providers during the base period, and the Pentagon did not want to miss opportunities to adopt new technology at the five-year mark, it limited CS2 to a maximum of five years.[18]

The 10-year period of performance under CS3 allows for reduced costs but will preclude the acquisition of any emerging technologies during this period. Since this timeframe likely covers the initial launch and adoption of many proposed small satellite constellations, the CS3 contract represents a savings on existing COMSATCOM but is an obstacle to the adoption of new technology.

Emerging Technologies

The partial centralization of COMSATCOM purchases within DISA and GSA will harm the adoption of emerging technologies because much of the cost savings achieved is through discounts based on volume and length of contract. The CS3 contract length of 10 years, when options are included, is a deliberate tradeoff by the DOD for cost savings in exchange for the ability to adopt new technologies.

Because the CS3 contract includes options for complex solutions using a hybrid of mobile satellite services and fixed satellite services, it will tie up budget resources that could be applied to new small satellite data constellations as they will likely be treated more as mobile than fixed type services.[19]

The inability of the CS3 contract vehicle to provide an avenue for the adoption of emerging technologies during the contract period will prevent the DOD from being an early adopter of small satellite data constellations. DISA attempted to develop a method for adding new providers to the contract during the development of the CS2 contract vehicle but found no way to do it under the indefinite model of CS2. These limitations likely will not change for CS3.[20]

Limited services were included under IT Schedule 70 in the CS2 contract, which does allow for the addition of new capabilities during a contract lifecycle, but it is typically limited to purchases of less than $550,000.[21] For example, a representative contract between GSA and COMSAT Corp. includes a maximum purchase limit of $500,000 for various COMSAT hardware.[22]

This schedule will allow experimentation with new hardware as it is introduced if the providers of these capabilities choose to apply to the schedule process, or third parties operating outside the DISA/GSA process acquire their services directly. These limited opportunities will be the only option during the CS3 contract period for demonstrations of the new emerging data constellations' usefulness.

Technological Obstacles

Beyond contracting issues there are technological obstacles to the adoption of emerging satellite technologies. In a 2014 report, the DOD identified three conditions under which commercial services are acquired: when military bandwidth was unavailable; when user demand exceeded military capability; or when user ground terminals were incompatible with MILSATCOM.[23]

The technology aspects of this problem are interrelated. Incompatible ground terminals are the result of the DOD's resistance to adopting technology compatible with commercial standards. Therefore, when users need SATCOM bandwidth for immediate operational purposes, they also are forced to acquire a compatible ground system at substantial cost which encourages the user to remain on commercial bandwidth, both to recoup the investment in ground hardware and to ensure against future MILSATCOM bandwidth availability limitations. This creats a self-

reinforcing cycle where large bandwidth users, such as unmanned aerial vehicle systems, have to rely on COMSATCOM in order to ensure availability of the necessary SATCOM.

The challenges associated with moving between MILSATCOM and COMSATCOM is something the Air Force Space and Missile Systems Center is addressing. SMC released a request for information in 2016 as part of a congressionally mandated Pathfinder program to develop a ground terminal with the ability to adapt to existing providers' needs.[24]

This universal ground terminal would blur the lines between COMSATCOM and MILSATCOM, allowing the differences to be immaterial to the user, possibly solving the user-driven technical separation between the two. A universal ground terminal represents a significant technical challenge and one that the DOD also will have to address if it ever hopes to resolve the issues associated with U.S. military reliance on COMSATCOM.

Dependence on COMSATCOM is a fact within the Department of Defense. DOD will never again be able to rely solely on MILSATCOM to meet its needs. Despite this, a history of troubled acquisition policies and chaotic decentralized purchasing does not bode well for the military's ability to fully leverage emerging COMSATCOM capabilities.

With CS3, DISA has achieved cost savings at the expense of flexibility. The ability to leverage the additional capabilities provided by emerging technologies in the commercial sector represents a flexible strategic reserve that should be fully embraced by DOD, DISA and the acquisition enterprise.

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