DOES COMMERCIAL SATELLITE BROADBAND HAVE THE DOD AIMING BEHIND THE TECHNOLOGY TARGET

Mr. Richard (Ric) VanderMeulen
ViaSat Inc., ric.vandermeulen@viasat.com

ABSTRACT

The Department of Defense has 13 purpose-built communication satellites providing 21 Gbps of warfighter capacity including three MUOS satellites with 120 Mbps, three AEHF satellites with 5.4 Gbps, and seven WGS satellites with 16.2 Gbps of capacity. The Department leases about 10 GHz of bandwidth creating an additional pool of 15 Gbps. Together these satellite communications (satcom) systems enable the Department to deliver over 36 Gbps at any giving moment or busy-hour.

Today's commercial High Capacity Satellite (HCS) broadband systems are delivering four times this capacity from a single satellite with the promise of 30 times this capacity on a single satellite by 2019. HCS systems are being deployed by essentially every satellite provider and are offering services to new commercial broadband markets that demand higher speed delivery and significantly reduced cost relative to the Department's systems. These new commercial technologies and services are becoming globally available, are being offered directly to the public, and as such even potential adversaries, and are outperforming the Department's technology.

These commercial HCS broadband services, widely known as "new space" are providing ten to even one hundred times the improvement in performance and cost to the commercial broadband market and potentially offer significant advantages to the warfighter and taxpayer.

The new commercial HCS business success are creating multiple communication systems globally optimizing the economics of two-way broadband communication and providing multi-path redundancy for the Department to leverage for significantly better warfighter capabilities without the need of RDT&E investments.

The wisdom of the Department's satcom acquisitions and the National Defense Authorization Acts (NDAA) to trial or pilot these new generations of commercial HCS services are aligned to enable the Department to determine how best to leverage these advances as part of its resilience efforts.

DOES COMMERCIAL SATELLITE BROADBAND HAVE THE DOD AIMING BEHIND THE TECHNOLOGY TARGET

A lot has been published of late on how Department of Defense satcom services are acquired and most often claim that the Department doesn't do this wisely. A better view would be, what the Department does, they do wisely! Let's look at this from two perspectives:

First, for the Department's purpose-built satellite satcom services, the Department typically competes these satellites using full-and-open competition and procures multiple satellites to be delivered over a decade in order to get the best pricing per satellite with competitive and volume production forces at play. The wisdom in this is that it reduces per-satellite costs and establishes a global uniform capability enabling warfighter terminal interoperability wherever the mission takes them.

What would make this practice unwise is if the industry was in a period of rapid technology advancement. In the past eight years, the Department put its first Wideband Global Satcom (WGS) satellite in use and has placed a total of seven of them into orbit, all with essentially the same capability. While in the same timeframe, the commercial HCS industry has reduced the cost of capacity, meaning what a bit costs to deliver, by nearly three orders-of-magnitude and increased the capacity on their satellites by nearly three orders of magnitude. This transition has moved capacity from 3.5 Gbps per satellite to over 1000 Gbps per satellite and even if the cost of the satellites and satellite launches where the same, the cost per delivered bit would clearly be less due to higher capacity.

The fortunate part of the Department's approach is achieving global coverage first; the unfortunate part is falling behind commercial HCS industry innovation, which is rapidly improving capacity and capacity economics.

Secondly, for the Department's leased Ku-band services, the Department typically acquires these on an annual lease basis again to get competitive pricing forces in play. Though much has been said about the savings that would come from multi—year leases the data shown in Exhibit 1, comparing the satellite service provider's average revenue per Transponder from all their customers to that the Department actually pays shows that the Department is remarkably on target in average price. When considering that the average revenue also includes multi-year purchases, this data shows the wisdom of the Department's competitive annual lease purchases.

Ku-band FSS Provider	2015 Average On-Orbit Transponders	2015 Average Fill	2015 In use Transponders	2015 Revenue
Intelsat	2,175 TPEs	75%	1,631 TPEs	$2,165M
SES	1,506 TPEs	72%	1,086 TPEs	$1,514M
Eutelsat	1,175 TPEs	78%	915 TPEs	$1,213M
total	4,827 TPEs	75%	3,632 TPEs	$4,892M
				$1.4M / TPE / Year

Exhibit 1: Average Revenue per 36 MHz Transponder Equivalents – based on the earning releases of the Ku-band industry leaders, the Department's annual Ku-band leasing is in line with the average market price.

In addition, much of the market-talk has been on the above mentioned improvements in both the cost of capacity and capacity per satellite and the pricing pressure these are creating on these Ku-band leases.[i] So, again the wisdom of these single year leases allows the Department to benefit from this market pricing pressure and enables the Department to upgrade to higher value capabilities as soon as they are available. The Department is in a position to pilot or trail these new services immediately. With the commercial HCS industry in a race to provide the Department, and other customers, with greater value for service revenue, the Department can easily trial or simply subscribe to these new services as they become available, establishing the knowledge and know-how to wisely and affordable procure these services on an ongoing basis.

Maybe expressed differently, in an era when the cost of a barrel of oil is declining, the analogy to the cost of capacity declining, would it be wise to be hedging on oil and gas futures? No.

LAST 10-YEARS IN SATCOM

"Service providers around the world share concerns about running out of bandwidth. Business challenges surrounding continued bandwidth growth, linked to video, mobility, and cloud applications, are significant. Service providers also report declining revenue from a cost-per-bit perspective, so not only does the network need to grow, it also needs to grow more cost effectively."[ii]

This is the market-driven dilemma that is driving terrestrial and satellite broadband providers alike. Connecting the unconnected is really an economic problem. The satcom industry has clearly proven that it can communicate from anywhere to anywhere, the problem for satellite broadband becomes how to give customers the amount of data and speeds that they need today and then how do you do it again tomorrow, when they will need more. To succeed as a global broadband internet service provider and technology company, ensuring consumers, businesses, governments and warfighters have communications access - anywhere - whether on the ground or in-flight, requires technology innovations in designing HCS to deliver a best-available network that extends the reach and accessibility of broadband internet service globally.

Commercial HCS are specifically designed to optimize the capacity economics of two-way broadband communication, meaning that they maximize the amount of user speed and capacity, or pool of bits, that are generated for a given total end-to-end investment including satellite, launch, insurance, ground segment, and operations. To understand the progress these HCS systems are making in the past 10-years, we can look back at two important metrics for comparing the Department's purpose-built and leased Ku-band to these new space solutions.

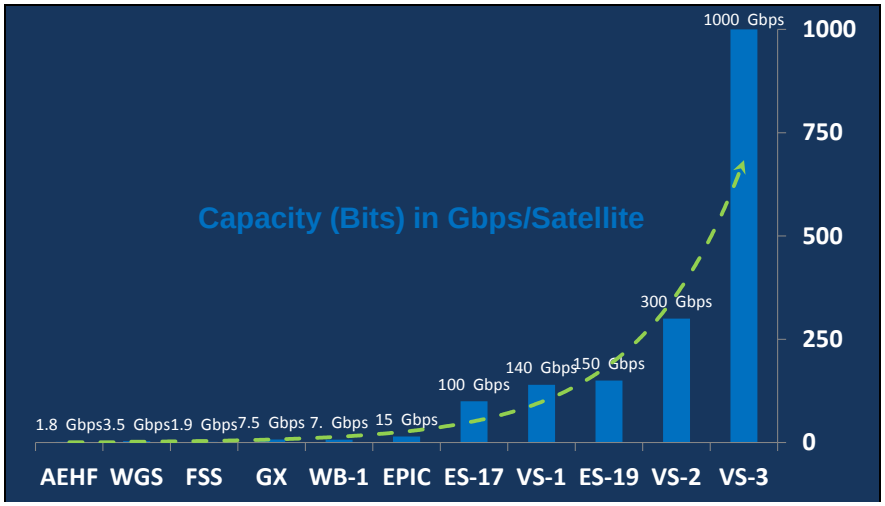

Exhibit 2: Capacity per Satellite – During the past 10-years, the capacity, or number of bits, that a given satellite can provide to customers or end-users has steadily risen providing the promise for increased speeds and performance

Exhibit 2 shows that the capacity or the number of bits that a given satellite can deliver to its customers and thus the utility or mission capability that can be provided has steadily risen from 1-2 Gbps per satellite to over 1000 Gbps per satellite. This increase in available bits or capacity enables these "new space" commercial HCS broadband systems to offer significant increases in end-user speeds.

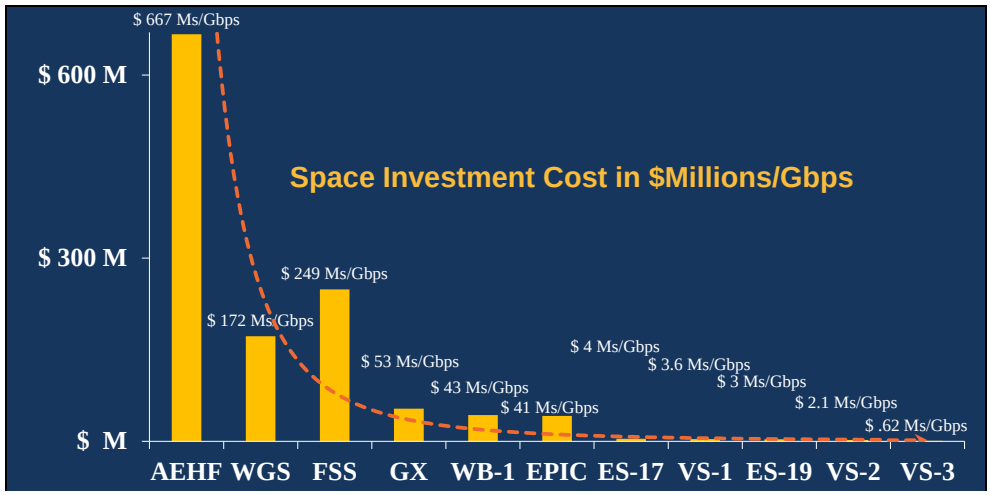

Exhibit 3: Space Investment Cost of Capacity – During the same 10-years, the investment cost to deliver these bits to customers or end-users has also steadily decreased providing the promise for better affordability.

Exhibit 3 shows how the investment cost in the space segment needed to generate this capacity has also decreased. In this case from over $600M per delivered Gbps to under $1M per delivered Gbps, achieving a clear reduction on the cost of capacity for affordability. This cost data is based on the cost of the satellite on-orbit including satellite, launch, and insurance if applicable.

Since the launch of the first WGS satellite in October 2007 the industry has created these new space HCS with ever improving cost-per-bit economics, availability, resilience, and end-user speeds and performance for broadband. When using the Department's purpose-built and leased Ku-band capacity, the satcom planning becomes one of apportionment driven by the historically high-cost, limited supply, and degraded threat environment performance of the Department's satcom capacity. Transition to these new space commercial HCS market-driven technologies would allow the Department to rapidly solve the limited supply and historical high-cost issues.

The capacity and cost metrics are undeniable and are the reason why the new space participants, or the right-side of these graphs, are excited about the volumes of capacity that can be delivered in the form of speed, data plans, and resilience and the resulting affordability that can unlock markets that had been closed. The resistance to adoption of these new space systems is basically the installed base, which will eventually need to change.

COMMERCIAL HCS REVENUE IN 2015

The Department should anticipate that these commercial HCS services will provide reduced rates on a delivered-bit basis and will also provide a corresponding increase/improvement in mission performance in terms of end-user speeds and network resilience. The Department should recognize that to take advantage of improvements in satellite technology and reap the significant return-on-investment of leveraging commercially-available satellite technology they will need to upgrade their installed base of terminals when the timing is appropriate.

Referring to Exhibit 1, the average annual revenue of Ku-band leases in 2015 was $1.4M/TPE. So comparing that to these commercial HCS service providers, we should anticipate that the HCS revenue on an equivalent TPE basis should be less. This would be logical since the new space focus is on opening up new markets and revenue sources by creating capacity and capacity economics that enable new use-cases, like consumer broadband or even commercial airline passenger live streaming, and their pricing needs to target these new markets.

As shown in Exhibit 4, this appears to be the case, with the HCS revenue in 2015 estimated to be $0.33M/TPE. This data is based on the leading North American HCS providers, EchoStar and ViaSat, and estimates their equivalent transponder or (TPEs) by assuming 1.5bps/Hz. So again, the Department's wisdom of using single year leases will allow them to transition to these new space HCS service as they become globally available and as they upgrade their installed base of terminals to serve either new or upgrade missions.

Satellite Broadband	2015 On-Orbit Gbps (TPEs at 1.5 Bits/Hz)	2015 Revenue
North America HCS Providers	262 Gbps **(4852 TPEs)**	$1,581M **$0.33M /TPE / Year**

Exhibit 4: Average Revenue per 36 MHz Transponder Equivalent –based on the earnings releases of the HCS industry leaders, the HCS customers are paying over 4-fold less than Ku-band customers.

The commercial HCS industry is market-driven to continue investing in and increasing the value of satellite broadband to serve new market elements that haven't been served with prior satellite systems, like direct-to-home consumer broadband and commercial airline passenger broadband to the seat. These new markets are in turn funding these investments.

So, the Department can leverage these investments by just subscribing. They don't need to invest RDT&E monies and they don't need to invest in traditional O&M activities, they just need to subscribe. Eventually, the Department may want to invest in specialized capabilities, but they can immediately start to offset their historically high-cost, limited supply, and degraded threat environment capacity performance by choosing to buy the service.

SUMMARY

These new commercial HCS systems, employing spot beam and frequency reuse technologies and techniques, are enabling broadband communications; targeting new levels of end-user service including global coverage with flexible capacity allocation based on changing demand; providing simple deployable and mobile roaming terminals for ease-of-us; providing adaptive and active protection mechanisms for high availability operations in the threat environment; and enabling end-to-end based security and end-user provisioning to support a variety of joint missions.

The Department is entering yet another Analysis-of-Alternatives (AoA), this time focusing on is Wideband satcom. The data shown in Exhibits 2 and 3 show significant improvements in Wideband capacity and also show that these improvements are coming from multiple industry participants, which brings competitive options as well as resilience options. But these systems also bring the same improved speeds, costs, and resilience to the commercial market, meaning to both the public and potential adversaries. Timely completion of the AoA and piloting of these new space HCS services is important.

Our vision is focused on providing customer-relevant, meaning terrestrial-equivalent, broadband speeds to our end-users. We focus on achieving the network capacity to fulfill these broadband speeds and end-user growth in the busy-hours and not do that through over-subscription or apportionment. Connecting the unconnected is really an economic problem, so for the commercial HCS industry that means striving to achieve capacity economics that can match terrestrial broadband delivery. Exhibit 5 shows our airborne version of this focus, essentially focusing on providing customer-relevant, meaning terrestrial-equivalent, services to every seat on every airplane.

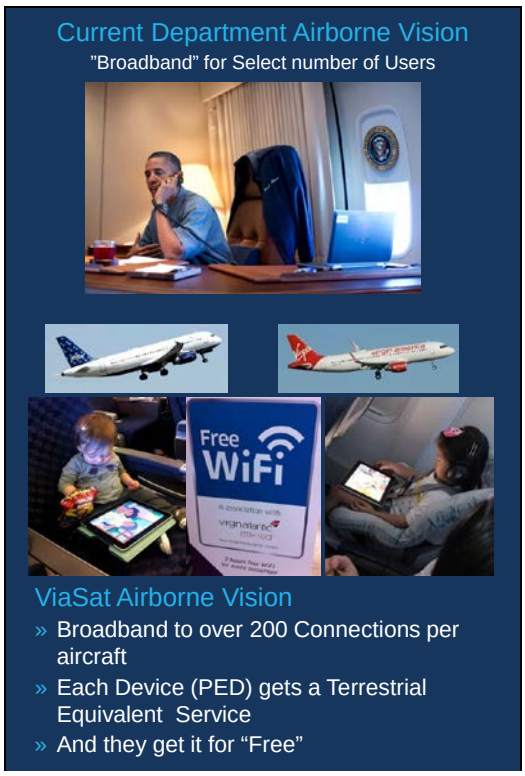

Exhibit 5: Airborne Vision – use Capacity and Capacity Economics to achieve customer-relevant services where terrestrial broadband can't economically reach

It has been just over 10 years, since the first High Throughput Satellite (HTS) went into service, when Thaicom initiated operations on IPSTAR.[iii] Since that time, almost every satellite service provider and every satellite manufacturer has engaged in some element of HTS.

Companies like EchoStar/Hughes and ViaSat are preparing to launch their third generation of High Capacity Satellites (HCS) with Echostar-19 and ViaSat-2. Each of these generations has improving end-user speeds and capacities, availability and resilience, interference rejection, anti-jam performance, and bandwidth economics from a cost-per-bit perspective. In addition, ViaSat has announced that it has started it fourth generation, ViaSat-3 satellites, that will each provide more capacity than the combined capacity of the entire 400 satellites on orbit today.

In closing, HCS provide dramatic cost-effective improvements in providing communications to warfighters, civilians, and emergency responders. These systems are available and in use today and would provide significant mission performance and cost-effective improvements over current practices, ensuring long-term business success. In the case of the Department, it should use the Pilot Program funding from the National Defense Authorization Act (NDAA) to develop an operational performance assessment comparing empirical performance metrics for anti-jam, network resilience, end-to-end speed, end-to-end cost, network capacity, and military effectiveness of new commercial HCS services to the Department's purpose-built and leased Ku-Band capacity.

This operational performance assessment will generate empirical results that will build upon prior and ongoing studies and include an evaluation of the necessary end-user terminal (e.g., airborne, shipborne, and ground fixed, transportable, and mobile) acquisition, platform integration, training and support required to operate with these new commercial satellite services and other systems. With this level of information, the Department will have a solid foundation from which to make future acquisition-related decisions on communication capabilities.

[i] http://www.nsr.com/news-resources/the-bottom-line/cannibalization-or-growing-the-pie/
[ii] Cisco, Connect-World, the information and communication technology (ICT) decision makers' magazine, 18 Jan 2015
[iii] http://www.satnews.com/story.php?number=913062521

