

A TRANSFORMATIONAL ERA: COMMERCIAL SATELLITE INNOVATIONS BRING “ANYTIME/ANYWHERE” SATCOM FOR TODAY’S GOVERNMENT USER

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ABSTRACT

In the modern era of worldwide conflicts and catastrophes, global events emerge swiftly and unpredictably, which means government/military users providing support must stand ready to deploy “anytime/anywhere.” In doing so, they rely upon satellite communications (SATCOM) that goes where they go – as fast as they get there.

However, budget challenges are combining with a dysfunctional, piecemeal and antiquated military SATCOM procurement model to prevent this, especially when it comes to augmenting legacy government systems with the very best that commercial SATCOM has to offer. Fortunately, federal agency leaders and lawmakers are increasingly acknowledging the situation, voicing greater support for an entirely integrated SATCOM architecture in the interest of rapid and cost-effective innovation relevant to government needs. In conducting the analysis of alternatives for wideband communications, for example, the National Defense Authorization Act for Fiscal Year 2017 calls for the Secretary of Defense to develop study guidance that requires such analysis to include the full range of military and commercial satellite communications capabilities, acquisition processes and service delivery models to achieve an order-of-magnitude improvement in SATCOM capabilities.¹

As leadership moves forward with studies on alternatives, we already see tangible evidence of commercially available end-to-end capability to include ground, terminal and space segments, at a much more affordable cost and faster rate than the current acquisition model allows. Additionally, innovations in commercial SATCOM capabilities have demonstrated solutions and capabilities that challenge the aptness of parsing SATCOM into the archaic bins of “narrowband,” “wideband” and “protected.” In this paper, you will find examples of the recent innovations in Ka- and L-band that are portable and globally available on demand, to enhance communications and mission support in an affordable manner.

Between the commercial technological innovations solving real operational challenges and the opportunity to inculcate new business models, we are truly entering a transformational era.

OBSTACLES STAND IN THE WAY OF EFFECTIVE SATCOM CAPABILITES

In the modern era of global conflicts and in the face of an ever-changing threat environment, events emerge swiftly and unpredictably, which means national security users providing support must stand ready to deploy “anytime/anywhere.” In doing so, they rely upon SATCOM that goes where they go – as fast as they get there. Department of Defense (DoD) users need immediate access to resilient, robust and secure SATCOM around the globe, across the full spectrum of engagement.

At the end of the day, troops depend upon mobile, data-intensive apps on a global basis. It does not matter to them who “owns” SATCOM. They simply want results, in the form of superior capability, portability, flexibility and resilience. Imagine the day when satellite communications, and the technologies that support the function, are considered integral to the entirety of telecommunication architecture required for government-networked operation – a network that is truly transformational.

Commercial satellite communications (COMSATCOM) are essential for military users to achieve these objectives. Strong COMSATCOM companies persistently invest in innovations to extensively expand capabilities in

advance of need, therefore, staying ahead of the demand in order to solve real operational challenges. They build systems from the ground up with U.S. government customers in mind, thereby, augmenting military satellite communications (MILSATCOM) cost-effectively, wherever and whenever needed. Trusted industry partners understand and respect the military requirements, budget restrictions and the cultural challenges. They recognize and strive to develop solutions that seamlessly integrate with legacy MILSATCOM to provide even higher throughput and performance for optimal redundancy, diversity, protection, scalability and global portability – the ideal resilient, force-multiplying approach.

Thanks to advancements from the private sector, COMSATCOM can be integrated into baseline DoD architectures to “ease the pain” of agencies facing the ongoing challenges of overstretched budgets and constrained MILSATCOM access. Expanding such integration would improve operational flexibility and enhance industry’s relationship with government, elevating it to that of a fully realized partnership. This partnership would support seamless connectivity and functionality, allowing users to operate anywhere the mission takes them at any time.

However, due to DoD budget pressures combined with a piecemeal and antiquated SATCOM procurement model and cultural challenges that present additional obstacles, the government is not yet capitalizing on the very best that industry has to offer. The government still primarily pays for COMSATCOM through Overseas Contingency Operations (OCO) funding – regardless of private industry’s proven track record in supporting mission-critical operations such as Airborne Intelligence, Surveillance and Reconnaissance (AISR), Very Important Persons Special Airlift Missions (VIPSAM), Blue Force Tracking (BFT) and emergency response/public safety for nearly a generation. For global mobile users, the traditional model of acquiring broadcast-centric fixed transponder leases is outdated and inefficient. It requires pre-commitment from agencies to acquire large amounts of fixed bandwidth in a piecemeal approach that forces them to “guess” how much they may need and over which region. This is ineffective and costly in an era when new flexible and affordable business models, such as the managed service model are available that greatly enhance efficiencies and responsiveness to meet the DoD requirements.

Further complicating matters, key SATCOM responsibilities are distributed in a fragmented pattern across the Joint Staff, U.S. Strategic Command (USSTRATCOM) and each of military service entities. Subsequently, agencies acquire terminals through military services and embed them into programs of record with no direct correlation to their respective communication information requirements nor the supporting space system timelines. This asynchronicity of programs and disconnectedness of terminal and space segment timelines lead to a series of stove-piped efforts and the lack of a cohesive operational capability.

With world events and an evolving operational and threat environment driving modern military responses that depend upon highly dynamic, mobile and asymmetrical engagement, we simply must do better.

POSITIVE MOMENTUM BUILDING FOR INDUSTRY/GOVERNMENT PARTNERSHIP

The future of DoD SATCOM modernization depends upon industrial partnerships. A strong government/industry partnership will enable the DoD to field-integrate SATCOM capabilities while ensuring resilience in space, with seamless, satellite-driven mobility, connectivity and functionality. It will pave the way toward rapid evolving and cost-effective innovation that is relevant to end users’ needs – i.e., built to government’s requirements, affordably and reliably. Viewing SATCOM as a solution to an operational need – a capability that supports the mission execution, rather than a stand-alone product or an isolated satellite hardware acquisition program – represents a significant shift in culture required to transition toward a more responsive

SATCOM as a Service model tailored to the demands of today and the future for modern national security demands.

Fortunately, senior government leaders and lawmakers are increasingly acknowledging the need to rely upon commercial operators for the adoption of an enterprise-level, completely integrated architecture and strategy. The following are just a few developments from the recent past that have significantly contributed to the positive momentum:

- The National Defense Authorization Act (NDAA) for Fiscal Year 2017 stands as a means to consolidate, streamline and improve SATCOM acquisitions. It calls for the Secretary of Defense to develop study guidance for an analysis of alternatives (AoA) for a follow-on wideband communications system to the Wideband Global SATCOM (WGS) system, which includes space, air and ground layer communication capabilities. The study guidance would include the full range of military and commercial satellite communications capabilities, acquisition processes and service delivery models.¹ Such assessment is focused upon the achievement of order-of-magnitude improvements in SATCOM capabilities. The U.S. Air Force has expressed a keen interest in bringing commercial operators into the analysis to determine the right way forward, rather than simply buying more DoD-owned satellite assets. As part of its analysis, the U.S. Air Force is also exploring alternative business relationships with SATCOM suppliers rather than the historical and dated transponder leasing megahertz, which has been noted repeatedly to be less than efficient. This is a significant recognition of what the private sector brings to the military's operational picture. Frank Kendall, Under Secretary of Defense for Acquisition, Technology and Logistics, signed off on the AoA in December 2016 and the analysis is underway.
- The U.S. Air Force announced that it plans to formalize the permanent creation of a commercial presence within the Joint Space Operations Center (JSpOC)². This follows the launch of the Commercial Integration Cell (CIC) pilot program with JSpOC in June of 2015, one through which Inmarsat and five other satellite services companies – DigitalGlobe, Inc.; Eutelsat America Corp; Intelsat General; Iridium Communications; and SES Government Solutions – have shared technology, operational coordination and information with the government on a no-cost basis. After signing six Cooperative Research and Development Agreements (CRADAs), which enable industry and the government to share technology and information on a collaborative basis, we have been working with the JSpOC to increase the degree of integration and space situational awareness while enhancing the command and control capacity of the Joint Functional Component Command for Space (JFCC Space) under the U.S. Strategic Command (USSTRATCOM). The CIC has focused on the development of processes and commercial/government integration in conducting conjunction (or debris) assessments and addressing electromagnetic interference and resolution. In addition, the CIC supported U.S. Strategic Command (USSTRATCOM) with satellite communications and imagery representatives for the Global Thunder and Global Lightning exercise engagements. Through the recent 2017 Global Lightning exercise, the government again recognized the operational imperative and utility of commercial partnerships: "As a fully embedded mission partner the CIC greatly enhances our capabilities and improves the speed and efficacy of our cooperative efforts across industry," said Lt. Gen. David Buck, JFCC Space Commander.³
- Rep. Jim Bridenstine (R-Okla.) has formally introduced his proposed American Space Renaissance Act, described as a "Sputnik moment" intended to advance the "incentivizing (of) industry to innovate and thrive here in the United States."⁴ The act, several components of which are not instantiated in bills, would encourage agencies to acquire more services – such as communications, remote sensing and

weather data – from private satellite operators. Bridenstine said, in introducing the bill: “There doesn’t seem to be one national space enterprise. What we’re trying to do is to bring a lot of elements together and make sure that in the end, the technologies being advanced are relevant to all the different enterprises that exist.”⁵ Lawmakers have already incorporated some of the bill’s language into the NDAA, including the implementation of preliminary steps that would transfer space situational awareness oversight from the DoD to the Federal Aviation Administration (FAA), as part of a broader plan to eventually hand over space traffic management duties to the FAA.

- General John Hyten, Commander USSTRATCOM, U.S. Air Force, has repeatedly demonstrated genuine commitment to space resilience and protection, emerging as advocate for commercial satellite communications as essential to military satellite architecture. Per General Hyten’s latest remarks, “Safety in space and deterrence to stop a war will also require the Air Force to work closely with industry partners It pertains to us in two ways ... It creates an economic environment that the U.S. military will have to defend at some point, and it creates an opportunity for us to take advantage of a commercial sector” that can provide launch, remote sensing and other services.⁶
- Lastly, President Trump and his team have made forward-looking statements about space programs, emphasizing these programs as one of the administration’s key interests. President Trump “made space policy a major part of his final campaign message and Vice President Pence has been very enthusiastic about the role he would assume as head of the new National Space Council,” said former Pennsylvania Republican Congressman Robert Walker, a senior advisor to the Trump campaign and a former Chairman of the U.S. House Science, Space and Technology Committee. “The council would help keep space issues front and center during the Trump Administration ... Its space policy puts a priority on reducing the vulnerability of our military space assets through use of multi-satellite constellations and new technology for (the) servicing and refueling (of) those constellations.”⁷ According to The Wall Street Journal, the President Trump administration’s evolving space policy is expected to foster private investment.⁸

These forward-thinking leaders combined with industry technology advancements provide the opportunity to establish an integrated architecture where the DoD considers COMSATCOM right alongside MILSATCOM. This new architecture may include legacy and a perhaps a small amount of purpose-built military-unique capability combined as a complementary, holistic model for the most critical communications-supported missions. As leadership moves forward and evaluates future architectural and acquisition models, we have already seen tangible innovative solutions that are readily available commercially -- end-to-end capabilities built to meet government requirements. To cite just a few examples, the following services deliver increased interoperability among space, terminal and ground segments, at a much more affordable value than the current inefficient and often lowest price, technically acceptable (LPTA) acquisition models allow and at much higher speed to market than MILSATCOM programs. The military depends heavily upon satellites for global navigation and timing, communications and imagery, among other operations. Troops must have access to resilient, robust and secure SATCOM wherever they are, at a moment’s notice across the full spectrum of engagement. Strengthening the resilience of SATCOM architectures is an essential way to address the increasingly challenging space environment. Given this reality, the defense of our space assets remains a top objective of government leadership, with a focus on agility, cost-effectiveness and enhanced combat readiness. These positions were recently reiterated by General David Goldfein, Air Force Chief of Staff at a recent Mitchell Institute Space Power Breakfast, where he stated that “Only when we think about and talk about space in the same way we talk about operations in the air, on land, at sea or in cyber will we move in the direction of truly integrating space across all warfighting domains.”⁹

This speaks to the urgency for optimal resilience in space, through **diversity, distribution and protection**.¹⁰ To achieve **diversity**, the DoD can and should leverage industry partnership to access a wide range of constellations, frequency bands and functions, addressing different needs throughout different attributes and creating a robust, resilient environment in space *and* on the ground. Consequently, U.S. forces can deploy legacy systems from the military while gaining more capabilities – such as global mobility – from commercial operators. **Distribution** refers to the need to separate missions with distinctive purposes, so users are not entirely dependent upon a single satellite for everything – surveillance, communications and other mission-critical capabilities. Available commercial resources lend assistance here too, as satellite companies can quickly integrate capabilities to support a range of tactical functions. Traffic is distributed within all commercial and military resources, so the mission proceeds regardless of which satellites are jeopardized by degradation or a threat. Another advantage: because companies serve both public and private customers, they “muddle the targeting picture” for adversaries, reducing the incentive and opportunity to compromise systems.

Private industry is setting standards for protection too, increasing the hardening of space assets not only for government customers but also for their users from banking and finance; commercial aviation; oil and gas; and other industries. To maintain those customers’ trust, satellite companies are devoted to improved waveforms, command encryption and a vigilant mission assurance posture. They are highly incentivized to defend satellites with the latest in proven anti-jamming mechanisms and a strong cyber posture. Some also pursue the proliferation of our space assets to boost redundancy – in the event that an adversary or other non-nefarious event would compromise one asset, they may employ others that are nearby, interoperable and readily available on the orbital belt. Thus, the DoD mission endures without interruption, even if military assets are compromised.

Terminal Adaptability

Many commercial terminals are designed to work in multiple bands as well as across the contiguous military and commercial satellite spectrum, leveraging disparate networks in a homogenous architecture. With this, government users supplement their capacity via COMSATCOM while still deploying existing WGS-certified and multi-band terminals. In addition, agencies save considerably on taxpayers’ dollars while better supporting end users by filling gaps where MILSATCOM coverage is limited, not as flexible or otherwise not available.

Secure Diverse Networks

Benefiting from COMSATCOM, some government users are able to access and control wideband capacity as part of their own independent network, in the same frequency band and WGS system, complemented by global commercial SATCOM as a Service. These users have the option of connecting their military terminals through any DoD-certified waveform to the same destined Point of Presence, or through industry-provided secure enclaves. Either way, users are assured of authenticated Point of Presence in trusted locations, with vigilant network protection mitigating risk while safeguarding the enterprise. In the process, industry obtains revealing insights into the types of responses available inside of government operations, along with a deeper understanding of national security implications. In some cases, satellite companies adjust design elements and business strategies accordingly, paving the way for tactics, techniques and procedures (TTP) to function more effectively and safely in this diverse environment.

The satellite industry and government partnership has never had greater potential to support the ever-growing government need for flexible, reliable and effective innovation in telecommunication technologies and service delivery. The partnership however will be even greater enhanced with the commitment to SATCOM as a Service. This end-to-end managed service enables access on demand to reliable satellite capability worldwide. It reduces the inefficient and costly broadcast-centric transponder leasing issues, because agencies no longer have to

estimate and pre-order bandwidth in advance of a mission, doing away with costly “guesswork.” With no infrastructure charges or R&D investment on their part, customers are able to relocate from one location to another and simply “plug in” to get the connectivity they need, when they need it. While recognizing this is not an insignificant cultural shift, the advantages of embracing a new business model cannot be understated. This allows users to leverage COMSATCOM for core functions, while seamlessly integrating with MILSATCOM to address remaining gaps for combined and outstanding redundancy, diversity, protection, scalability and global portability – again, the ideal resilience approach. It frees up military members from the administration of disparate networks so they can focus on their critical warfighting and military-unique missions.

With SATCOM as a Service, information flows instantly from Point A to Point B using commercial capacity alongside the military, as users employ their existing WGS-certified terminals to affordably attain a superior state of efficiency and functionality. A uniform distribution of power leads to frequency of use and a consistent, uninterrupted experience for users. When world events trigger usage spikes, they readily access increased capacity, benefitting from the ensuing flexibility and affordability.

INNOVATION DELIVERS GREATER RESILIENCE AND FREQUENCY DIVERSITY

Financially strong and innovative COMSATCOM companies are regularly deploying new technologies to significantly expand and improve DOD capabilities, across a wide range of frequencies and constellations. These innovations are available globally and on demand, enhancing mission critical mobile communications in an affordable manner. These operationally relevant solutions blur the historical demarcations of “narrow” or “wideband” and offer enhanced non-nuclear hardened protection.

For example, Inmarsat’s fifth-generation (Inmarsat-5 or I-5) satellite system –Global Xpress – is the first ever commercial Ka-band satellite network that brings the benefits of seamless, consistent, wideband access to the U.S. government to meet mobile, interoperable communication needs, at an affordable price worldwide.¹¹ It is a system that has ushered in an era of expanded, MILSATCOM-compatible communication capabilities and solutions. Global Xpress design was guided by a careful assessment of user requirements and technical possibilities, with the primary objectives of global coverage, wideband connectivity and applications for on-the-move users, with the highest of service standards. The spot beam architecture allows for a continuous, consistent service anywhere in the world – on land, at sea and in the air – handling traffic seamlessly across each spot beam. And when there are demand surges, Global Xpress directs its spot beams to provide additional capacity. The mobility feature that results from this design allows government to adopt a more affordable and efficient approach to buying COMSATCOM. That is, users no longer have to lease prepositioned capacity by guessing where the next conflict will be, or compete on the spot market. Rather, government users access the Global Xpress service on a subscription basis. These subscriptions are underpinned by powerful industry-leading service level agreements (SLAs) with committed information rates (CIR) to ensure expectations and needs are met on-demand when and where required. This business model is not dissimilar to terrestrial or wireless telecommunication infrastructure that employs managed end-to-end networks. This managed service approach for Global Xpress therefore provides the complete end-to-end mobility solution from a single operator supporting mission critical communications and applications on a global basis.

Global Xpress has been in government operation since July 2014 and today is deployed on multiple platforms in support of airborne, expeditionary and maritime missions worldwide. And Inmarsat continues to invest in the continuing advancement of the Global Xpress platform to meet the ever-escalating bandwidth demands of its mobile users. Recent over-the-air tests achieved a forward channel throughput rate of 330 Mbps over Inmarsat-5 satellite in orbit.¹² The company is committed to the pioneering of the most advanced L-band and Ka-band

services, and is fully funding its next-generation Inmarsat-6 (I-6) as its first dual-frequency satellites. A single I-6 will carry more processing power than the entire Inmarsat-4 (I-4) fleet (excluding Alphasat), and the Ka-band payload on each I-6 will deliverer per beam speeds up to three times that of the current Global Xpress fleet. I-6 will fully integrate into Inmarsat's existing constellations, providing full-backwards compatibility and the most technologically advanced capabilities to enhance support to military and commercial customers well into the next generation

Commercial providers also deliver effective, custom-built innovations designed to augment legacy and stressed military narrowband resources: Inmarsat's L-Band Tactical Satellite (L-TAC) is a highly resilient, Ultra High Frequency (UHF) and Very High Frequency (VHF)-like tactical narrowband capability that provides robust, low-cost, beyond-line-of-sight (BLOS) mobile communications to DoD and Allies, safety and other government Push-to-Talk users on land, at sea and in the air.¹³ Using I-4, satellite-based BLOS is provided across a global footprint. L-TAC enables users to connect tactical voice and data circuits using their existing terminals; their standard waveforms, as well as the same crypto. Using only a small applique L-TAC then provides access to the highly reliable and always-on Inmarsat network. This service is implemented using a single hop through an I-4 satellite providing users with the same experience as if operating on UHF/VHF SATCOM yet with the resilience and diversity of the Inmarsat constellation to complement military SATCOM when congested or otherwise unavailable. This is a transformative capability for agencies requiring fast-reaction deployment worldwide with optimal portability and security. Users obtain a superior level of secured satellite throughput with small, lightweight antennas supporting highly mobile asymmetric missions, such as patrols from Forward Operating Bases and AISR. The L-TAC service is currently active in operations for several U.S. and Allied nations' armed forces throughout the world. A civilian variant has been launched for police and emergency services or for other non-military federal users.

Inmarsat's enhanced aeronautical services support critical U.S. government Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) operations. One such example uses Inmarsat's reliable, worldwide L-band satellite and ground network accessed through micro-antennas as small as 5 inches, users benefit from record-breaking data rates as high as 10Mbps x 10Mbps.¹⁴ High-order modulation schemes efficiencies up to 4.5 bits per hertz result in cost-efficient bandwidth utilization. Available production terminals are ultra-compact and ideal for manned and unmanned aeronautical platforms. Terminal solutions leverage existing installed antennas, including mechanically steered antennas as well as advanced low profile, phased array antennas. These solutions provide users unparalleled coverage and performance for their aeronautical connectivity needs, while retaining the ease of use, reliability and low cost of ownership provided by Inmarsat's global network. Today, government aeronautical users benefit from Inmarsat's unique, globally available L-band constellation on multiple platforms and missions to operate wherever that mission takes them.

These type of technological and now-operational innovations blur the lines between narrow and wideband, certainly challenging the efficacy of these archaic system differentiators.

CONCLUSION

With the criticality of military and national security missions and their dependence on SATCOM for success compounded by an evolving and dynamic operational environment, now is the time to truly evaluate the full spectrum of options to establish the integrated SATCOM architecture for tomorrow.

Technological advancements in space segment capabilities, terminal flexibilities, ground infrastructure and responsive service delivery offer the government optimum flexibility to operate through a contested environment by leveraging trusted solution from commercial SATCOM industry partners. By breaking down yesterday's artificial

distinctions of narrow and wideband and looking at mission requirements and the capabilities required to meet them, the stove-piped and closed solutions of yesterday will be replaced with more adaptive and responsive solutions that leverage technology advancements and the asymptotic rate of change in industry to the greatest advantage. And then by revamping the business model approach toward an acquisition of services approach, an integrated SATCOM architecture emerges as an enabler for mission success rather than an unsynchronized series of disconnected, unrelated hardware purchases using dated designs and old business processes. Between the commercial technological innovations solving real operational challenges and the opportunity to inculcate new business models, we are truly entering a transformational era.

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⁵ <http://spacenews.com/bridenstine-introduces-american-space-renaissance-act/>

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¹¹ <http://www.inmarsat.com/global-xpress-us-government/>

¹² <http://www.inmarsat.com/news/inmarsat-vt-idirect-advance-global-xpress-capabilities/>

¹³ <http://www.inmarsat.com/press-release/inmarsat-announces-new-scalable-l-tac-service-for-defence-market/>

¹⁴ <http://www.inmarsat.com/press-release/inmarsat-l-band-service-wins-mobile-satellite-users-association-2017-mobility-innovation-award/>