Enabling Radical Innovation through Joint Capability Technology Demonstrations (JCTD): The Case of the Internet Routing in Space (IRIS) JCTD

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This paper analyzes the case of the Internet Routing in Space (IRIS) Joint Capability Technology Demonstration (JCTD) as a potential model for disruptive innovation in the government space sector. It finds that technologies like IRIS – characterized by a promising yet unproven relatively mature concept, which faces substantial barriers to implementation, but which could benefit from the stability associated with a government patron, creates a strong argument for leveraging the government's position as a relatively coherent, high volume customer, to catalyze disruptive change. The JCTD model, by creating an opportunity to demonstrate the service-oriented utility of the innovation prior to wide-spread deployment, addresses the common disconnect between technology change and perceived service improvement directly. However, it fails to adequately mitigate the significant administrative overhead (both financial and bureaucratic) of collaborating with the government. Key areas where expectations may need to be adjusted in the future are highlighted through the case.

I. Introduction

FOUR years ago, in 2005, during conversations between Gen. James Cartwright of STRATCOM and Cisco, a new strategy for tackling the growing military communication challenges was laid out. Faced with ever increasing bandwidth demands in the battlespace and an undefined lag before the gap would be filled by the next generation of military communication satellites, Gen. Cartwright sought a near-term capacity gap fill. Incidentally, there was a small team at Cisco whose mission was to bring internet routing to space. Following a series of technical successes in satellite on-board processing and regenerative capabilities[1-3]; and building on many years of teamwork and experimentation between the DoD and the private sector, which culminated in the successful demonstration and evaluation of the Cisco Router in Low Earth Orbit (CLEO)[‡] in 2003;[4] they were ready for a large-scale proof-of-concept. Gen. Cartwright's interest was just the catalyst they needed. What resulted from that timely meeting was the essential structure of the Internet Routing in Space (IRIS) Joint Capability Technology Demonstration (JCTD) being exercised today.

Like its conception, the structure of the IRIS JCTD is somewhat unorthodox. Where JCTDs typically take the form of a monetary contract for a specific product or service to be developed for the DoD, the IRIS JCTD might better be described as collaborative concept exploration. Cisco will provide the IRIS payload which will be "hosted" aboard an Intelsat General commercial, geostationary satellite for a fee. The DoD commitment under the JCTD is to fund its own project management team during the 3 year development and conduct 3 months of operational testing culminating in a Military Utility Assessment (MUA). If successful, the Services *may* acquire the IRIS capability as a formal program of record, however are under no obligation to do so.

The IRIS JCTD has brought together an unlikely partnership. Cisco Systems (Cisco), fundamentally an Internet Protocol (IP)-based network provider, is looking to radically change the way satellite communications are done and extend the benefit of networking into space, but realizes that early adoption by the military will vastly smooth the

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[‡] The CLEO initiative - which paired an industry consortium with the U.S. Army Space Missile Defense Command's (SMDC) Future Warfare Center along with the Air Force Space Command's Space Battle Lab and NASAs Glenn Research Center – successfully placed a router on board a small remote sensing satellite.

transition. Intelsat General Corporation (IGC), wholly owned subsidiary of the pioneering International Communication Satellite Consortium (Intelsat), sees an opportunity to expand their "hosted payload" experience while keeping an eye on a potential future of their business. The US DoD, facing a near term satellite communication shortfall and long term acquisition issues, views IRIS as an experiment; a promising, but unfamiliar, way to generate new capabilities.

With the first launch scheduled for July 2009, any comment on the success of the technology demonstration would be premature. However, as a case study in novel partnerships between commercial and government interests to generate potentially disruptive innovation, fertile examples of the challenges and successes have already come and passed. Much can be learned from these experiences. As a result, this paper will focus on the management and economic aspects of the IRIS JCTD endeavor. It will examine the nature of the IRIS JCTD and assess this partnership as a model for government industry partnership for innovation generation going forward.

II. JCTDs as an Innovation Enabler within the DoD Acquisition System

Generating radical innovation is challenging, and characteristics of the space acquisition context, with its monopsony-oligopoly market (one buyer, few sellers) and extremely complex, robust products, make it harder still. Addressing these challenges has preoccupied innovation scholars for many years. Starting from Schumpeter's (1934) basic supposition that long term economic growth can only be sustained through the entry of innovative entrepreneurs and the necessary value destruction of established (monopolistic) companies [5], much of the business literature on innovation, developed over the subsequent eighty years, has addressed the question of why successful firms fail to traverse the discontinuity imposed by radical innovations. There are three complimentary ideas. One school of thought, epitomized by the Teece profit model,[6] argues that innovation happens most effectively when the innovator profits from his efforts. It follows that established firms – who continue to profit from previous innovations if the status quo is maintained - will use their market power to resist competence destroying change.[7] Another perspective is that incumbent firms don't fail to traverse discontinuous change because of a lack of capability; rather, it is because they remain focused on the needs of their core/mainstream customer until it is too late.[8] Further, even when a firm does recognize the need to address a new market base, there are multiple types of competence that can be destroyed even by seemingly small changes.[9] Finally, as articulated by Schumpeter, and supported by later empirical work,[10] the cycle of establishment and destruction is natural in a healthy market, and should be harnessed but not interfered with.

In the government acquisition context, however, the relative lack of competition and extremely high barriers to entry effectively eliminates the potential for natural "disruptive" market corrections.[11] Thus in order to ensure that new technology continues to be developed, the DoD employs a two-tier organizational structure focused on (1) research and development and (2) formal acquisition programs. Technological innovation in the DoD is conducted by the Service Laboratories (e.g., Air Force Research Laboratory, Naval Research Laboratory, Army Research Laboratory) and several science and technology (S&T) organizations such as the Air Force Office of Scientific Research, the Office of Naval Research, and the Defense Advanced Research Projects Agency. These latter S&T organizations are focused primarily on a research-level investigation of basic physics and phenomenology. As these S&T organizations demonstrate concept feasibility, technologies are transferred to the Service Laboratories for further development, maturation, and demonstration of capability.

In theory, once these innovation organizations mature concepts to the point where they can be realistically assessed for cost, schedule, and performance contributions to a given set of program requirements, they may be considered as part of the Joint Capabilities and Integration Development System (JCIDS) process. JCIDS constitutes the formal DoD procedure for the establishment of acquisition requirements and evaluation criteria for future defense programs and assesses all available alternatives for meeting a validated warfighting need. Created to replace service-specific requirements generation systems, JCIDS is driven by the needs of US Combatant Commanders with an emphasis on interoperability. JCIDS integrates the preferences of multiple stakeholders in the defense establishment by examining (perceived) capability shortfalls or gaps of the Combatant Commanders or Secretary of Defense.[12]

However in practice, the need for a third type of technology development was observed; one which emphasized the need to mature promising concepts into implementable capabilities. To this end, the Joint Capabilities Technology Demonstrations (JCTD) office was stood-up in 2006[§] explicitly to provide emerging technologies and innovative concepts to the warfighter as quickly as possible. JCTDs focus on resolving joint needs within a one-to-three year timeline, by creating opportunities for technology and operational demonstrations of mature

[§] Replacing the Advanced Concepts Technology Development Program, which began in 1995 technology/solutions (TRL 5-7). The funding for JCTDs is relatively modest – $2 to $3 million – and short term – typically three years, at the end of which successful demonstrations are actively transitioned into programs of record.

III. The IRIS JCTD

A. The IRIS Product

The goal of IRIS is to extend the Internet Protocol (IP) capabilities which have become ubiquitous in terrestrial networks into space.[4] Where communication satellites have traditionally followed a "bent-pipe" strategy (the on-orbit asset merely amplifies the signal and bounces it back to a compatible source, effectively unchanged), IRIS equipped satellites will perform both regeneration and processing on-orbit (allowing the use of smaller ground stations and cross-beam, cross-frequency communication among any node in the network). For the purposes of the JCTD, the IRIS payload will be "hosted" aboard the Intelsat 14 satellite, and be connected to three of its 36 MHz transponders (2 Ku- and 1 C-band). The payload itself consists of a programmable satellite IP modem, an IP router and up- and down-converts to and from 70 MHz and C- and Ku-band transponders and will fully support cross-band and cross-beam connectivity within and between coverage areas. That means that Ku-band users will be able to communicate directly with C-band users, and the need for routing via ground-based teleports will be minimized.[13]

This is a radical innovation in the communication satellite market because it represents a fundamental change in how capacity is conceived and can be allocated. Instead of leasing transponders and apportioning use of the "pipe" as is done today, if IRIS is successful, information transfer will be path agnostic making more efficient use of the overall network capacity. The analogy has been made to transporting cargo on railway tracks (bent-pipe) versus highways (networked).[14] The first case can be extremely efficient and secure if there is a track serving the desired trajectory and there are no blockages. However, if anything goes wrong or there is insufficient volume along the available routes to warrant their up-keep, the highway option, with its inherent flexibility, will be superior. This is particularly true when different track gauges (or, communication protocols) make interoperability challenging.

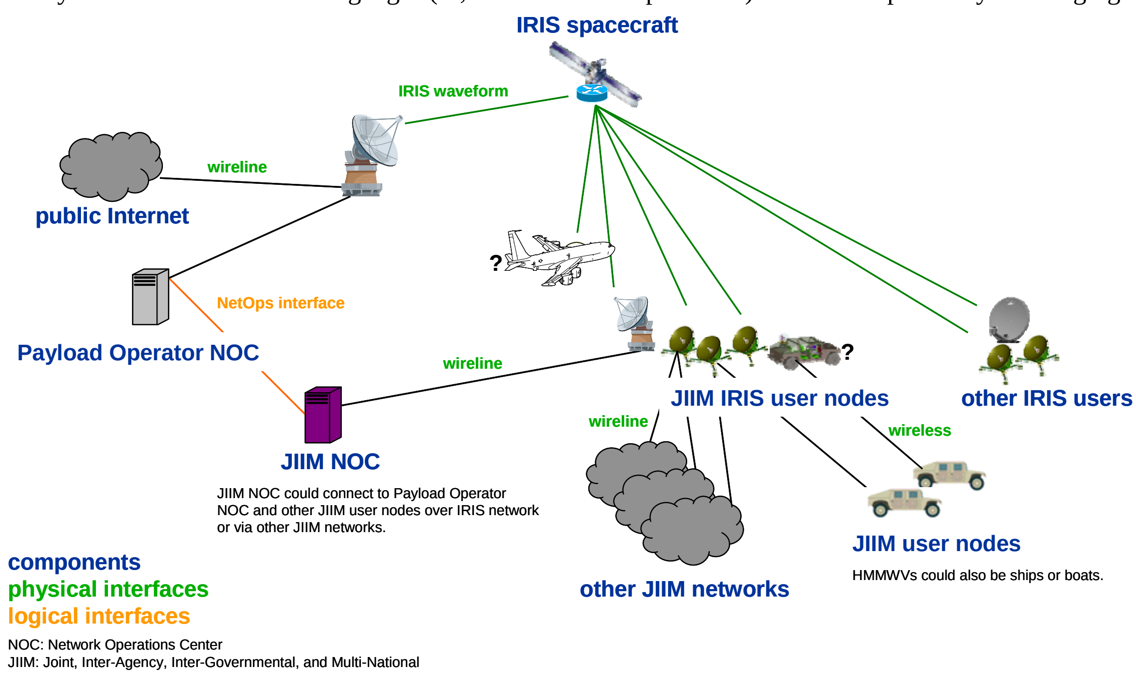

Figure 1 – Artist's Rendering of an IRIS enabled Network[15]

As with most radical innovations, the IRIS technology faces several significant barriers to implementation. Firstly, there are legitimate technical concerns which are often used to justify maintaining the bent-pipe approach. In the space industry in general, and the communications sector in particular, fighting obsolescence is a major issue. Long satellite lives – on the order of 15 years – are required to justify the enormous upfront launch costs; and once on orbit, servicing and upgrading of physical components is effectively impossible.. This creates a strong incentive to minimize the "high-technology" of the space component. In practice this means that everything but the essential repeater function of the satellite link is offloaded to the ground stations.

This strategy has proven effective over the 50 year history of satellite communications. The capacity supported per dollar of investment has increased exponentially, service providers are consistently turning a profit and demand is currently being satisfied. However, there is a physical limit to how much capacity can be achieved along this technological path (s-curve). Spectrum is a finite resource that will eventually become saturated. Once this point is reached – and with the military trend towards network centric warfare and real-time intelligence, coupled with satellite TV and video communications, it may be less than 10 years off – demand will exceed supply, eventually forcing a divergence from the bent-pipe approach. When this happens, IRIS-like approaches to improving overall network efficiency, which employ software modems that are on-orbit upgradeable, will become extremely appealing. However, until that time, there will remain a strong tendency to maintain the status quo.

This resistance to change on the part of satellite service provider incumbents embodies a natural reluctance to deviate from a profitable status quo. While resistance to change is certainly not unique to the satellite sector, a history of limited competition and high barriers to entry compounds the industry's inertia. More relevant to the present discussion though, is the way in which the IRIS innovation will impact the incumbent business models. The bent-pipe paradigm lent itself to the following value chain: manufacturer sells a satellite to the satellite operator, who leases transponders (i.e., spectrum) to the service provider, who either uses the resource themselves (in the case of the military), or parcels voice channels or TV signals etc. (e.g., HBO) and sells their use to the end-user. Market power, in this value chain, is concentrated among the service providers and manufacturers, while the IRIS advantages of flexibility and system level efficiency disproportionately benefit the service providers and end-users in the current market structure.

Certainly if IRIS succeeds in increasing spectrum efficiency and flexibility – a marketable commodity – that value could, in principle, be captured through a modified business model that markets origin-destination (OD) communication rather than leases transponder time. Similarly, the interoperability afforded by on-board processing may lead to a new commercial market for bundled satellite services (i.e., internet, phone, TV, on one bill, but now available anywhere anytime) leading to more capturable value. However, given the current profitability of the market for leased transponders, these "ifs" and "maybes" do not create a compelling case for incumbents to take on significant business risk. While the strategic question of whether or not to "bet the business" on a potentially disruptive innovation is common to incumbents across multiple industries, the stakes in the satellite sector are somewhat different. The sheer magnitude of the costs associated with updating the infrastructure are extremely high and dependant on network effects, while at the same time, the risk of new entrants (i.e., someone else doing it if you don't) is quite low because of the aforementioned high barriers to entry.

Particularly in the DoD context of a top-down acquisition system and monopsonist buyer, resistance to change among industrial firms can be overcome if the need is strong enough. However, "needs" are defined in terms of desired effects (in the theater of operations) that cannot be met with current capabilities. And IRIS will not create a new effect *per se,* rather it significantly improves the efficiency of existing operations at the system level (something the acquisition process has trouble valuing). For example, with the current DoD infrastructure, space-, air-, sea- and ground-based assets cannot communicate directly with one another. The practical work-around involves "multiple hop" transmissions, and while perhaps effective in some circumstances, it is also inefficient and sometimes infeasible in others. IRIS – with its any-to-any capability – will solve the fundamental interoperability issue, but since the new capability will have negligible impact at the individual end-user level, it is not something that would be asked for by the warfighter. As a result, the burden falls to the developer to demonstrate the network level improvements to strategic decision makers before the system will ever be adopted.

B. The IRIS JCTD Team

Told from an innovation perspective, the story of the IRIS JCTD is one of an entrant firm (Cisco) - with long term profit-oriented objectives - leveraging a government procurement mechanism (JCTD) and the experience of an industry incumbent (Intelsat) to mitigate the risks associated with championing a disruptive technology. This section describes each of the key stakeholders and their goals with respect to the JCTD.

1. DoD Team

As the first space capability JCTD, IRIS is unorthodox in two key respects. Firstly, where DoD acquisitions are nominally driven by a validated warfighter need, IRIS is a speculative innovation that has not been requested directly. Second, where the DoD is accustomed to procuring specific products or services, at the end of the IRIS JCTD, the DoD won't own anything; the industry team of Cisco and Intelsat General will own the payload and spacecraft they develop. The DoD is involved in the development only as advisors and to liaise with potential DoD customers if suitably impressed. The DoD IRIS JCTD management team has three main components, each with different functions and perspectives.

First, technical management (TM) was appointed through the USAF Space and Missile Systems Center (SMC). The TM is responsible for planning and coordinating the interface between the government and industry during system engineering and development efforts.[15] Second, the operations manager (OM) was appointed through the US Army Space and Missile Defense Command's (SMDC) Battle Lab, housed in the JCTD office. The OM is responsible for planning, coordinating and directing all activities related to the IRIS JCTD. The OM will coordinate user participants, equipment, and facilities for demonstrations; develop the Concept of Operations (CONOPS), mission scenarios and demonstration plans; conduct the military utility assessment; and develop Tactics, Techniques, and Procedures (TTPs) for successful technology.[15] Since the Battle Lab is traditionally focused on bringing innovative technologies to the warfighter, the OM is most comfortable with the push nature of the endeavor (i.e., undefined application *a priori*).

Third, the transition manager (XM) was appointed by the Defense Information System Agency (DISA). The XM is responsible for providing the Department of Defense user community a contractual means to obtain IRIS service to support user communication requirements. The XM also prepares the supporting IRIS JCTD Transition Plan.[15] Responsibility for the JCTD shifts from TM to OM to XM over the course of the three year contract. As a result, at the time of the interviews, the XM team was only just becoming familiar with the project. They were hesitant to make a premature assessment of the technology before a formal evaluation has been completed. However, from a DISA point of view (with a primary responsibility for distributing satellite service across the combatant commands) the fact that the IRIS JCTD does not explicitly address a validated warfighter need, makes it particularly important to ensure that the concept has clear military utility and is not just a "cool new technology."

The DoD's goals for the IRIS JCTD are fourfold:

1) Use the JCTD to assess the operational utility of space-based IP routing for Joint, Interagency, Intergovernmental, and Multinational (JIIM) users;
2) Provide a test bed upon which to examine network operations and develop a Concept of Operations (CONOPS) for space-based routing;
3) Demonstrate the ability to leverage commercial acquisition process to rapidly deploy new, space-based communications capability; and
4) Develop a post-JCTD mechanism for JIIM users to obtain IRIS services if the operational utility assessment is successful.[15]

2. Intelsat General Corporation (IGC)

The International Communication Satellite Consortium (INTELSAT) is as old as the communication satellite industry. INTELSAT launched the first commercial communication satellite – Early Bird in 1965 – and completed the first geosynchronous network with the launch of INTELSAT III in 1969. When Apollo 11 landed on the moon, the INTELSAT satellite network transmitted the television signal to 500 million viewers around the world. In 2001, after 37 years as an intergovernmental organization, Intelsat Ltd. was incorporated as a private company. Following a 2006 merger with PanAmSat, Intelsat became the largest provider of fixed satellite services (FSS) worldwide to each of the media, network services/telecom and government markets. As space sector *incumbents* go, INTELSAT defines the term, but it has managed to maintain its industry leadership by keeping a close eye on emerging trends.

Intelsat General Corporation (IGC) is Intelsat's government sales arm. IGC was incorporated in Washington DC (as opposed to Intelsat's Bermuda) in order to capture the business generated by the US government's growing civil and military reliance on commercial satellite services. In fact, at points during recent oversees military engagements in Iraq and Afghanistan, commercial operators were supplying more than 80 percent of the DoD's satellite communications.[16] IGC believes that, following Bush's directive to the government to use commercial services to the "maximum practical extent," commercial service providers and government customers must find new mutually beneficial arrangements.

One such arrangement is embodied in the concept of "hosted payloads." The idea is that since power production degrades over a satellite's lifetime, in order to guarantee that engineering margins are maintained at end-of-life, extra power must be available initially. This extra power (i.e., the area under the degradation curve but above the required margin) could be sold to payloads that would a) operate for a sufficiently shorter life than the host satellite; and b) not interfere with the host's operations. Technology demonstrations or tests fit the bill because they are typically short-lived, making this a relatively inexpensive and quick[**] way to "burn-down" TRL (technology readiness levels). IRIS, in its JCTD test form, is an ideal hosted payload candidate.

Thus, IGC's interest in the IRIS JCTD is two-fold. First it provides another opportunity to explore the feasibility of the hosted payload concept. Second, it effectively provides them a risk-free front row seat to Cisco's experimentation with a potentially revolutionary change to the way they do business. Although, unlike Cisco, IGC does not believe that the industry has reached its inflection point.

3. Cisco Systems Ltd.

Founded in 1984 by a group of computer scientists from Stanford University, Cisco has grown into a multinational corporation of nearly 70,000 employees worldwide. With IP-based networking at the core of its business, Cisco has worked to maintain an entrepreneurial spirit as it transitions into the role of "established firm." Continuously on the look-out for new market opportunities, for Cisco, space is the logical next node in the expansion of the *human network*.

Cisco is no stranger to the unique characteristics of government contracting. However, although the Global Government Services Group (GGSG), staffed by about 1000, has decades of experience providing IP solutions and services to a government customer, their focus has remained fiercely commercial. Staying away from highly customized build-to-order contracts, GGSG has shown the wide applicability of commercial off-the-shelf (COTS) technologies to government needs.

While internet routing may be the future of space-based communications and the next logical node in Cisco's expansion of the human network, significant challenges exist. Recognizing these challenges and the risks associated with enacting disruptive change in the highly conservative and capital-intensive space sector, a wise firm would want some insurance before taking the proverbial leap. The JCTD is just that insurance. It represents a formal demonstration of interest on the part of the government and an opportunity to prove the feasibility of the concept. If the DoD does choose to pursue the capability entailed in IRIS, the sheer magnitude of the military's capacity needs may be sufficient to catalyze a move industry-wide to space-based IP, thus expanding the potential market even further.

IV. JCTD as an Innovation Mechanism: Advantages of and Challenges Associated with Government Involvement

The characteristics described above, of a promising yet unproven relatively mature concept, which faces substantial barriers to implementation, but which could benefit from the stability associated with a government patron, creates a strong argument for leveraging the government's position as a relatively coherent, high volume customer, to catalyze disruptive change. The IRIS JCTD model does just that, creating an opportunity to demonstrate the service-oriented utility of the innovation prior to wide-spread deployment. In so doing, the JCTD addresses the disconnect between technology change and perceived service improvement directly. However, while the case for collaboration between established and new players in the government space market is enticing, the enabling aspects come at the cost of significant administrative overhead. This section elucidates some of the core trade-offs.

1. Advantages of Government Involvement

From a commercial point of view, programmatic risk mitigation is the major advantage of government involvement in enabling radical innovation. This risk mitigation takes two main forms. Both are captured in the idea of the government as an "anchor tenant." The concept of "anchor tenant" is borrowed from the vocabulary of shopping centre space allocation. The anchor tenant is usually the first, and leading, tenant in the shopping center; through their prestige and size they attract other ancillary tenants and guarantee the stability of the project. Applied to DoD involvement in IRIS technology, the hope is that initial buy-in from the government – with its sufficient clout - will prove out the utility of the concept and subsequently attract commercial interest. This strategy is particularly important when the full spectrum benefits are unclear a priori, as is the case with IRIS. For example, while interoperability across space- air- and ground-assets is of central importance to the DoD and would remedy a recognized limitation, the impact that such a capability will have on bundled services for commercial users is less clear. However, the tests that have been part of the JCTD process have generated momentum for the commercial offering as well.

From a government point of view, industry partnerships provide an opportunity to leverage the paper-to-orbit efficiency that commercial service providers have perfected, but which is unmatched in the government sphere.

[**] Compare Intelsat's average 3 year development time to the DoD's 15-20 years

In addition, they give the government an opportunity to influence the path and priorities of technology innovation in industry to suit its needs. However, each of these advantages has a converse challenge associated with them.

2. Additional Challenges associated with Government Involvement

Partnerships with government players come at a cost – both financial and bureaucratic. Firstly, business in the government and industry contexts operate on fundamentally different "clock cycles" with implications for expectations and procedures. In the DoD context, acquisitions often take as many as 3 years to generate requirements and 15-20 years to complete the product development. During that time, it is not uncommon for needs and operating conditions to change; and since DoD project managers are accustomed to operating in a flexible cost environment, where achieving performance trumps the cost of scope changes, project requirements are often adjusted to suit the changing environment. However, in the commercial world, where profit is the primary metric, costly mid-course corrections are not taken lightly. This difference in operating culture has been a source of tension in the IRIS JCTD arrangement, as highlighted by the discussions concerning wave form selection.

For example, IRIS was developed in part to address a near-term communication capacity shortfall in the U.S. Central Command. With an Intelsat satellite already scheduled to be inserted into an appropriate orbital slot for Middle East (CENTCOM) coverage three years later; and since most of the ground terminals in that geographical region operated using one particular communication protocol, the IRIS test wave form was chosen accordingly. Cisco began development work immediately to ensure the tight schedule would be met. However, because of delays in finalizing the JCTD contract, the demonstration timeline was delayed by over a year. This delay meant the IRIS payload could no longer make the launch schedule to be hosted on the satellite over the Middle East, and would have to be hosted on a different Intelsat satellite in a different orbital location launching at a later time. As a result, instead of servicing the Middle East, the IRIS JCTD tests will now be conducted over South America where there are very few IRIS wave form compatible ground stations presently installed.

If this were a solely DoD-controlled project, one of two actions would have been taken. Either the launch of the original satellite would have been delayed to accommodate the new schedule of the IRIS payload, or the wave-form would have been re-developed to be suitable for the new orbital slot. However, with the bulk of the financial investment coming from the industrial team, the DoD role is advisory. And, from a commercial perspective, it would be unthinkable for IGC to modify a carefully planned, pre-sold, replacement cycle to accommodate an (already discounted) hosted payload. Similarly, Cisco could not, in good conscience, write off 18 months of development work on a 3 year technology demonstration. As a result, IRIS will be launched with the CENTCOM-compatible wave-form in the South American orbital slot.

For testing purposes, it doesn't really matter that IRIS will be launched in the "wrong slot" from a wave form perspective; minor modifications are being made and the concept will be demonstrated as fully as it might otherwise have been. Nonetheless, this example illustrates a systemic challenge for commercial firms working in government/military spheres. The bureaucratic nature of large organizations slows the decision making process. When the government is funding the effort, additional money can restore most missed opportunities, but this is not the case when commercial entrants take on equal partnerships. However, it is unlikely that this fundamental element of the government acquisition culture will change in the near future. As a result, entrant firms must recognize that bureaucratic decisions come with the territory and plan accordingly. Alternatively, in order to leverage the cost and schedule advantages of more commercial-like acquisitions, the government may have to get into the practice of fixing decisions early and sticking to them.

The logistical challenges faced by a firm unaccustomed to government contracting are not limited to the bureaucratic nature of its decision making. As a government organization, responsible for allocating significant funds for the public good, the US military is subject to a long list of regulations and standards. Simply put, working with the government is administratively complicated and often costly. In the past, Cisco has avoided some of these challenges (e.g., cost accounting standards and federal acquisition regulations) by subcontracting with government primes (subcontractors are not individually subject to these regulations). However, the rules for space hardware create additional burdens that cannot be avoided. As a result, Cisco has, for example, had to develop a whole new set of internal procedures in order to become ITAR (International Traffic in Arms Regulations)[††]-compliant.

In large organizations for which government space contracts represent a large part of their business, being ITAR-compliant is a normal part of the business culture and ITAR compliance is spread across the whole firm. However, for entrant firms, becoming ITAR-compliant is not only a huge undertaking, but it can also run counter to their

[††] ITAR is a US unilateral export control designed to regulate the amount and type of military-related information and materials transferred outside the US or to non-US citizens living in the states. The list of controlled goods is non-specific and has been interpreted to include all technology used on satellites. In order to ensure ITAR-compliance many defense contractors separate government and non-government divisions completely and only employ US citizens in the former.

corporate culture. For example, Cisco, like many other high-tech multi-national corporations, derives its competitive advantage, in part, from having access to top talent from the far corners of the world. Such companies pride themselves on an open culture of collaboration. Until recently, any Cisco employee, anywhere in the world, could access any aspect of the Cisco intranet. Now, for the first time, a series of firewalls have been built around the IRIS online workspace and the IRIS team has received ITAR training to clarify with whom and what technical information they are allowed to share and what they cannot. In effect, the open, idea-sharing culture, that begot the innovative IRIS concept, must be altered in a fundamental way if the project is to get implemented with government involvement. Without entering into the ongoing debate regarding the merits of ITAR, the challenges it presents for entrant firms – both financially and culturally -- cannot be underemphasized.

V. Conclusion

It takes more than a great idea to change the fundamentals of an industry, particularly one with a high degree of government involvement such as the space sector. If disruptive change is to be achieved though, getting government buy-in early is sufficiently important to merit weathering the challenges that government partnerships entail. That being said, if the JCTD joint venture model is going to work long term, all of the government, new entrants and incumbents will have to find a more solid middle ground in which to cooperate. The current partnership structure of the IRIS JCTD is working because of overlapping objectives built into the program – and shear persistence of many of the key stakeholders – rather than a sustainable long-term alignment of interests. Most entrants will neither have the economic stability to fund, nor the commitment to pursue, an IRIS-like innovation to the extent that Cisco has. Given that most radical changes come from outside, it is in the government's interest to make the infusion task more manageable. In the future, whether JCTDs will become an attractive platform for this technology infusion to take place for space-based capabilities may depend in large part on the outcomes of the IRIS partnership experiment.

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