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for the U.S. House of Representatives,

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"Commercial Remote Sensing: Facilitating Innovation and Leadership"

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Mr. Chairman and Members of the Subcommittee, thank you for providing an opportunity to discuss the strategically important topic of US commercial remote sensing, and how we can facilitate innovation and US leadership in this sector through our policy and decision-making processes.

Professional Experience and Context

The views that I express here are my own, and based on nearly 25 years of experience in the remote sensing industry. My Bachelor's degree is in Physics and Engineering Science (double major) from Seattle Pacific University, and my Masters Degree is in Optics from the University of Rochester. Since the start of my career in 1992, I have been involved in remote sensing.

While still in graduate school, I was recruited to work in industry on a government program initializing satellite payloads, working anomaly resolution, and optimizing image processing and image products. Throughout the next decade, I worked with multiple sensor types and helped to create new products for use by analysts, decision makers, and warfighters. In addition, I focused on providing analysts and engineers better access to data, information, and expertise, by creating a distributed architecture and utilizing the Internet and World Wide Web. Pre-9/11/2001, I collaborated with colleagues across the national security community to promote information sharing across intelligence disciplines to better enable situational awareness. Furthermore, I participated in various military exercises focused on how to provide critical information in a timely manner to enable decision making -- what those in the national security business would call "actionable intelligence." What is foundational to all of this intelligence is geospatial information, for it provides critical context.

Post-9/11/2001, I was recruited from industry into government to lead innovation and organizational transformation, and served as a senior executive in both Defense and Intelligence. Initially, I served as the Deputy Technical Executive of the National-Geospatial Intelligence Agency (NGA), focused on multi-INT integration, to include better collaboration between NGA and the National Security Agency (NSA) -- America's Eyes and Ears -- from tasking and collection all the way to analysis and production. This required significant cultural changes and a paradigm shift in order to combine these resources to provide a more holistic view of what was occurring at any given time in any area of the world, in order to aid in policy development and decision making. In every case, geospatial information served as the foundation layer, and provided critical context to enhance situational awareness. During my visits "down range" to the combat zones in Iraq and Afghanistan, I saw first hand the value of providing integrated products in a timely manner to better inform combatant commanders and special operations forces, and the importance of having that data at a level that could be shared with Commonwealth (5-eyes) and

Coalition partners. While in Afghanistan, I worked with one of the commercial imagery providers, Digital Globe, to provide commercial imagery data directly from their archive within minutes of time over target, which proved to be invaluable for both mission planning and operations. National Technical Means (NTM) imagery can provide great insight to the analysts in the intelligence cell, but the operators cannot take NTM imagery with them on a mission because it is classified. Upon my return to the Washington DC Metro area, I used this insight and those mission imperatives to affect necessary change.

When the new Director of National Intelligence was established, I was asked to serve the first Deputy Chief Information Officer for the Intelligence Community. There I applied my technical expertise and operational experience to affect changes in policy to better enable modern operations, as much of the policy we were dealing with was over 50 years old, written for a different era, and crafted long before the advent of modern technology and the Internet. In addition, I served on the Special Access Program (SAP) review board, where we assessed all programs that were SAP or wished to be SAP, and either granted or denied approval. Following that assignment, I went "back to my roots" and served as the Chief Technology Officer of the National Reconnaissance Office (NRO), helping to lead one of the biggest transformations the agency had seen in over 15 years, with a focus on creating an integrated ground architecture that enabled the processing of data from various sources (classified and unclassified) and afforded timely access to that information to intelligence analysts around the world. In my last government assignment, I served as the DNI's senior representative to the Secretary of Defense's Intelligence Surveillance and Reconnaissance (ISR) Task Force, focused on stability operations in Afghanistan and around the globe. One of the most critical aspects of successful stability operations is information sharing for shared situational awareness -- not only with traditional partners, but also with "non-traditional" partners. For the US government, non-traditional partners are those who are not in established coalitions (e.g. NATO), but those who comprise "the coalition of the day." Members of such coalitions can include local citizens, private volunteers, and humanitarian organizations.

This experience compelled me to make a move to one of the most innovative companies on the planet -- one whose founders' mantra is to have a "healthy disregard for the impossible." It is an amazing experience to be surrounded by fellow innovators in an environment that liberates and empowers people to create, innovate, and affect positive change. After spending nearly two decades in the national security community, I was impressed with Google's "default to share" model, while employing a security team that is second to none. It reinforced an intrinsic belief I have had that there is a difference between classified and secure, and most people do not really want classifed information -- they want secure information sharing. Commercial industry can provide a high level of security for sensitive data, and liberate non-classified data from the increasingly complex national security apparatus. This means that the government too can harness the power of

commercial data combined with the commercial cloud to take its business to a whole new level, be more efficient and effective, and provide secure access to data, information, and expertise in a timely manner around the world.

Last year, I founded Sunesis Nexus LLC, and am consulting with a broad range of both US and International customers on various topics to include remote sensing. In addition, I co-founded Global Nexus Alliance, a nonprofit organization that seeks to apply open source technologies such as commercial remote sensing in the humanitarian sector to support their operations.

Since 2012, I have been a member of the Advisory Committee on Commercial Remote Sensing (ACCRES), which was created by the Secretary of Commerce to advise NOAA on matters related to the US commercial remote sensing industry, including regulatory responsibilities.

Personal Perspective

"The only constant is change." - Heraclitus
That statement was true in 500 B.C. and is even more true today. The speed of change in the remote sensing industry is unprecedented. To use an analogy, the US Government must strive to make itself the "Deleware" of the international remote sensing industry, by attracting the top innovators and creating an environment in which they can flourish and be competitive in the global markets, and thereby enable the US to maintain a leadership role in this sector.

We must be careful what we label as "intelligence," because once something is labeled "intelligence," we limit the users and the uses.
In the 20th century, the primary source of remote sensing information was government or military assets. That is not the case today. In the 21st century, we have companies building a wide range of remote sensing assets, from the traditional large satellite "bus in the sky" to microsat "box in the sky." Because the national security community was first in this arena, their default posture often seems to be to view commercial remote sensing innovation as a threat, and to consider any new capability as classified, or at least the aggregate of capabilities as classified. At this point, we must remember that unclassified or non-classified information in the aggregate, while it may be sensitive, is still unclassified. The national security community has a tendency to classify any open source information of interest and to label it as intelligence, when in fact, it is not. This has huge ramifications for people with boots on the ground conducting operations. In too many instances, information that comes from a Commonwealth (5-eyes) source, when brought into the national security apparatus gets labeled NOFORN, and then cannot not be shared with the very Commonwealth partner that provided the information. In other instances, information that

is gathered in an open environment is loaded on JWICS, because that is the default system for the analysts, and immediately gets labeled TS/SCI, even though the source is not classified and the data is not classified. This mindset and procedural issue is affecting the perspective of the national security community with regard to commercial assets. It also limits the data and information that can be used in operations around the world. This is the reason why Central Command (CENTCOM), during Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), sought to change policy and analyst practices and get them to default to writing reports at the lowest level possible, and only then move to higher systems to provide additional context from classified sources. This paradigm and procedural shift was necessary to enable reporting to get into the hands of people who needed it, most of whom did not have access to classified systems.

If we don't share together, we risk dying together.
Commercial imagery, being open and free of classification, can be freely shared. National Technical Means (NTM) data, having come from a classified source, is labeled as classified and, as such, cannot be freely shared. It is rare these days that we would do a U.S.-only operation. More often than not, we find we must work with partners that we have not previously worked with before. We do not have classified data sharing arrangements with these partners, and we do not necessarily have the level of trust we would require in order to share classified data. Yet, we are embarking on an endeavor with these partners where shared situational awareness is not only key to the success of the mission, but critical to the safety of all involved.

For example, Counter-Terrorism operations, and Humanitarian Assistance and Disaster Response (HADR) operations, require the ability to share timely information with the "coalition of the day," which often includes "non-traditional" partners. By sharing this information in a geospatial context, we enable what I call "Unity of Effort without Unity of Command." Imagery from commercial remote sensing assets is critical to these operations, whether in Afghanistan or Haiti or the United States. Furthermore, commercial remote sensing assets can tip and cue NTM assets.

It's not just about pixels; it's about information services derived from the data.
If you talk to most any of the big names in Silicon Valley to include Google, Amazon, and Facebook, they are not as interested in the pixels from the imagery as they are with the data that can be derived from it and the information services that it enables. They use the data to constantly refresh base maps, update roads, enable more precise geolocation and navigation services (e.g., GPS, Google Maps), etc. They understand the need to continually improve in order to stay on the leading edge. Given the volume of data collected from commercial sources each day, the government could be perpetually updating their base maps and digital terrain maps, rather than scheduling the updates every so many years. Furthermore, with the underlying base imagery and elevation data being constantly

updated, a customer could create a tailored map product at any time from the commercially sourced data, and share it as needed -- whether they are engaged in a battle against enemy forces, or are in a race for time to find and aid survivors following a natural disaster. A combatant commander should never again have to fight a war "at the intersection of 4 different map points." In addition, georeferenced social media and news sources can provide valuable insight and additional context in a HADR scenario, as we saw following the 2010 Haiti earthquake. Once again, commercial imagery provides critical, sharable context.

Utilizing commercial remote sensing assets and automated processing can be a huge competitive advantage. We collect mass amounts of data every day, but just because we collected it, does not mean we are any smarter. You cannot do intelligence by osmosis. Someone has to look at the data, and there are not enough humans to do it, so we need machines to do it and then tip the humans as to what to look at on any given day at any given time. Once again, data derived from commercial remote sensing sources, continually processed and analyzed, can provide critical insight not otherwise seen if you are only imaging at 10am and 2pm every day.

If we don't take intelligent risks, we risk becoming irrelevant.
In my experience, the biggest barriers to innovation are culture, policy, and technology. By far, the biggest challenge is most always cultural. In case of remote sensing, the government used to be the only game in town. Over time, others have entered the field. Some have chosen to essentially replicate the government business model. Others have entered with radically new and innovative business models. There is no way for the government to predict what could come next or to keep pace, or to accurately judge the validity of a commercial business model. Creating an overly burdensome regulatory environment and oversight policy that holds commercial innovation back until such time that the government can catch up or get comfortable with it is not a reasonable or responsible use of authorities, and can have devastating consequences for the industrial base. The burden of proof should always be on the government to make the case for "why not." The burden should not be put on industry to make the case for "why." What has made this country great is our industrial base, and intelligent risk taking -- not being limited by how things are today, but imagining how they could be and making it so. There are so many things that someone outside of government dreamed up and made a reality that we now consider indispensable parts of our lives today. There are completely new fields being invented, and we do not tend to see the same level of government regulation and oversight in those arenas as we have observed in the commercial remote sensing arena, yet some of the capabilities have become just as critical to our national security and our way of life. Is it perhaps because the government was not there first, and therefore is not clinging to its perceived leadership role, using its authorities to keep all of the other "new comers" to the field in check?

Government should empower, not compete with, industry.
As was the case when I was in government, we are dealing with limited resources. Our national debt is a tremendous risk to our national security and we cannot increase spending, so we must focus the resources the government does have on things that are unique to its mission and are uniquely governmental, and leave the rest to industry. In the case of remote sensing satellites, there was a time when the government was the only source, but that is far from the case today. If commercial industry or academia can do it, let them, and then focus limited government resources on capabilities that the government needs that are not already found elsewhere. Before embarking on a new program, the government should first look at what is available in commercial industry, and then determine what complementary capabilities it needs that are presently lacking in the commercial space. By doing so, they can save the taxpayers money, while also enjoying a more robust capability by utilizing what others have already built. A great example of this is In-Q-Tel, which funded a technology called Keyhole that became Google Earth.

The government should explore alternatives to the government owned / government operated (GOGO) model. For example, the government could establish service level agreements (SLAs) with other providers, and give some thought to using its funding for other missions and not replicate what is already available by other means.

Take for example LANDSAT and the European Space Agency (ESA) Copernicus Program Sentinel Satellites. The ESA Sentinel constellation over satisfies the majority of the Landsat Data Continuity Requirements. The US government could work a data exchange agreement between the EU and US to provide Sentinel-2 capabilities to the LANDSAT Community. By utilizing the ESA capabilities, such as Sentinel-2, NASA could focus its limited resources on capabilities it needs that are presently not a part of the ESA's constellation, e.g., Thermal IR.

Consider high resolution electro-optical imagery. Two producers of high resolution imagery are DigitalGlobe and Airbus Defense and Space. Together, they have more than 2 billion square kilometers (sqkm) of coverage capacity per year, with 0.5m GSD panchromatic and up to 8 bands of 2.0m GSD visible and near-infrared. That is a vast amount of data that the US government can utilize to fulfill its mission and provide resiliency.

The potential loss of our industrial base is a national security issue.
US policy articulates a very supportive environment for commercial satellite industry. In reality, historical regulations and oversight have not supported the intent of that policy. Artificially constraining what US commercial industry can build and/or sell handicaps them in the international marketplace, which is quickly being flooded with others who want to play in this space and face less restriction to do so.

Over-regulation has led to the demise of US commercial satellite ventures in the past. For example, prior to October 2015, US licensing policy applied more stringent controls on operation and dissemination of synthetic aperture radar (SAR) systems and data than on optical systems. US Policy is particularly stringent on the handling of "phase history data," which is the raw data collected by the satellite and is most valuable for the advanced interpretation of image data. These restrictive data dissemination policies are a major reason why no US firm has been able to effectively enter the global SAR market to date.

One of the key goals articulated in the 2006 National Space Policy is to, "Enable a dynamic, globally competitive domestic commercial space sector in order to promote innovation, strengthen US leadership, and protect national, homeland and economic security." Sadly, the US is not leading with regard to space-based commercial radar imaging systems, due to over-regulation. Although the US government granted a 1 meter resolution radar-imaging license in 1998, the licensee was not authorized to sell better than 5 meter resolution imagery. Then in 2000, the US government granted another 1 meter resolution radar-imaging license, but the licensee was not authorized to sell better than 3 meter resolution imagery. The reality both faced is that the utility of 5m and 3m SAR imagery is limited, which restricts the commercial viability of this arrangement. Meanwhile, non-US commercial SAR providers significantly improved their capabilities and, in 2007, both Germany and Italy launched SAR satellites with better than 1 meter capability. It is safe to assume that other, less transparent, governments may do the same in the future.

History of US Commercial SAR Policy (timeline)

- 1997: Former Sen. Dennis DeConcini noted, "No U.S. Company has been licensed to sell high resolution radar imagery." Noting that 12 U.S. companies had been granted licenses since 1992, but none for radar, he argued, "if Commerce does not license a radar satellite system, then a foreign owned radar system, with a one meter or less capability, will enter the market leaving the U.S. government with no effective control in this area."
- 1997: DoD opposes commercial sale of radar satellite imagery better than 5-meter resolution, due to national security.
- May 1998: Former Sen. Tom Daschle wrote to the Pentagon noting, "If currently proposed restrictions on U.S. commercial remote sensing satellites are not revised, the capabilities of foreign SAR systems will quickly exceed those of the United States."
- June-November 1998: A U.S. company (Space Radar Corporation) obtains a license to operate a 1-meter resolution commercial radar satellite, but data sold could not be better than 5-meters.

- November 2000: A second U.S. company (Ball Aerospace and Technologies) obtains a license to operate a commercial radar satellite, but resolution restrictions apply. Three-meter resolution imagery eventually is allowed for sale.
- 2004-2005: The Government considers, but does not issue a 1-meter commercial radar satellite license.
- June-December 2007: Germany's TerraSAR-X and Italy's COSMO-Skymed 1 are launched with better than 1-meter capability.
- October 2009: Department of Commerce authorizes commercial sale of 1-meter resolution radar imagery to Northrop Grumman.
- October 2015: XpressSAR, Inc. receives the only license for sub-meter resolution to date.

  [reference: http://apogeospatial.com/commercial-sar-comes-to-the-u-s-finally/]

Leadership has set the vision. Now we must implement it.
National Security Presidential Directive (NSPD) 27 [dated 2003] states that it is the policy of the United States to advance and protect national security interests by maintaining leadership in remote sensing and sustaining the US remote sensing industry.

Presidential Policy Directive (PDD) 4 [dated 2010] states that the United States is committed to growth of a US commercial space sector.

The 2011 National Security Space Strategy states that the United States should rely upon proven commercial capabilities to the maximum extent practicable.

These documents create the framework for a less restrictive regulatory environment that would better support US innovation and leadership in the remote sensing sector.

Conclusion

In summary, we cannot lose sight of the characteristics that have made the US a global leader in so many aspects, and those include courage, intelligent risk taking, and innovation. We see things not as they are, but as they could be, and make them so. We dare to try things no one else has tried, and go places that no one else has gone before. To quote President Kennedy in the race to the Moon, "We choose to… do [these and] other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone." Our world is changing at an unprecedented pace. Our industries must keep pace, and remain agile and adaptive. Our regulatory environment must enable them to do so, and not thwart the very characteristics that have made us great and enabled the US to enjoy a global leadership position.