MILSPACE 2009
Building Future Space Partnerships

Karyn Hayes-Ryan
Associate Chief Operating Officer

Thank you for the opportunity to speak to such an esteemed international audience. It is truly a pleasure to be here today. Thank you, SMI and all the participants for your collaborative conversations yesterday.

This conference fills an important role for the space community. It's a great opportunity to develop partnerships, share ideas, and gives us an opportunity to work together to strengthen the spirit of enterprise, innovation, and technological advancement that characterizes the world of space.

That being said, the theme of this year's conference, "building future space partnerships", strikes at the heart of what we as a community must do in order to stay with or ahead of the burgeoning global requirements for space capabilities. Individual nations, individual corporations and people can not hope to address future needs without an understanding of and cooperation with the rest of the space community. This includes U.S. and coalition intelligence, military and commercial organizations, corporations, and alliances.

To foster these partnerships, we need to understand the varying needs of our respective customers and find a common ground that will allow us to share and leverage technology, strategy, and capabilities in ways that will benefit all players on this international stage. Last year, General Chilton, the Director of U.S. Strategic Command, talked about the International Space Station and how it is truly a shining example of international partnership. It is worth taking time to study the lessons learned from that international collaboration, and apply them to our efforts today.

Many of us in this audience come from military and intelligence organizations around the globe. When you spend your entire career in that environment, you are focused on responding to the specific direction and requirements of your leadership. It is easy to lose sight of the needs and desires of nations other than your own.

Over twenty years ago, in the 1980s I began my career in this arena. The US Military and Intel Community were focused on the Cold War, and our space industry was focused on the same problems.

We at the NRO were very protective of our technology. In fact, we kept the information on our space technology predominantly within the NRO. As you can logically interpret from my biography, I have serve the US Intelligence Community in several capacities – using the data collected from space to do intelligence analysis; tasking and scheduling satellite surveillance collection, operating and maintaining U.S. intelligence spacecraft, and developing imagery payloads and acquiring satellites.

Until 4 or 5 years ago, I relied exclusively on internal U.S. government – developed technologies.

That is no longer the case. It is neither economically feasible nor technologically astute. Today I am senior official assigned to the National Reconnaissance Office. I manage all NGA personnel and resources assigned to the NRO. I am the NRO's Associate Chief Operating Officer, responsible for the acquisition and operations of the overhead reconnaissance systems that meet the needs of the United States Intelligence Community and the Department of Defense.

In order to do my job and to serve my country, it is incumbent upon me to understand the big picture of space acquisition – and that unquestionably includes gaining perspective on the existing and future needs and capabilities of the international space community. I believe everyone in this room today has a similar responsibility, not just to each individual's respective leadership, but to our coalition and to the world. It goes without saying that now more than ever in history, the actions of one nation in space will affect the actions of others.

The satellites in orbit today are the lifeblood of contemporary communications, spinning the webs that bring television, radio, weather data, and many of the other services we all rely on to carry out our daily activities. These webs that send signals around the world are intricately intertwined, connecting individuals and nations in ways that were never even dreamed of twenty years ago.

This is one of the main reasons we need to build relationships and strengthen our partnerships. The very nature of satellite communications

pre-supposes global cooperation. Global cooperation, however, is not always an easy task. It takes a common understanding of the needs and requirements of all users, the ability to prioritize those requirements, and a commitment to work together to ensure the best solution for the greatest number of people. That takes ingenuity, innovation, and a willingness to adapt to a rapidly changing world. It may drive policy changes for many nations – and often policy is more difficult than technology.

As the senior Intelligence Community official, I am obligated to marshal all the resources at my command to provide the best guidance possible to the organization. My background across the spectrum of space serves as an advantage. I have learned a few important lessons along the way that influence the way I approach my work:

The old way is not necessarily the best way

Less than 10 years ago, we in the U.S. Intelligence Community restricted data based upon a documented "need to know" – you had to prove "need to know" to receive data. Events of September 11th, 2001 challenged that premise. The NGA began partnerships to share imagery and imagery data across our coalition partners.

For our partners to take full advantage of the imagery data, we need to address compatibility and interoperability standards. Further they need information on how we collected the data, and the technology and techniques used. We are incorporating data from other country's space assets into our U.S. architecture. We are learning, perhaps a bit slowly

that by sharing information, we gain a lot. The advice, experience, and the council of our counterparts who have been partnering for decades have been invaluable.

The younger members of our workforce do this with more ease and fluidity than those of us with many years under the “need to know” mindset.

It occurred to me that time, distance and nationality mean nothing to this new generation, and that while we spend a lot of time talking about teamwork and learning to collaborate, younger people are living that life. They aren’t talking about teamwork and collaboration. Every aspect of their lives is informed by those interconnecting webs – and it’s enhancing their education and growth, increasing their exposure to information and ideas. In turn they apply their experience to the scientific and social problems of the day, bringing a fresh, informed perspective to the table and coming up with exciting, collaborative solutions. This younger generation views change and adaptation as a way of life, not a challenge to tackle.

For industry, a leading cause of failure is the inability to adapt, and a leading cause of sustained success is the ability to adapt to change.

Rather than focus on the negative, let me illustrate how a company, once at the top of the technology game, was faced with the prospect of losing their business and found a niche in a changing market that turned the company around. In 1987, a popular computer company made an executive decision that resulted in the loss of a significant portion of their

market share. As technology advanced and the company tried to recover from what many consider to be one of the worst business decisions in recent history, the rest of Silicon Valley raced ahead, implementing new business models and development processes that more closely resembled Montessori schools than the traditional hierarchical corporate structures of prior generations.

The company, recognizing their business decision was based on outdated assumptions and technology, leveraged the collective brilliance of their staff to develop a new set of tools for innovation. In one quietly developed, brilliantly executed gesture, apple computers launched the iPOD on the 23rd of October, 2001 and swiftly reversed their fate. By realizing that in order to continue as a viable business, they had to understand and adapt to a changing world, Apple was able to return to its lofty position as a leading innovator in the industry.

In this economic and political climate, we must use our collective brains to solve the complex challenges of today. We need to stay open to new ideas, and remember to look for opportunities to incorporate innovation in all aspects of our business. In this rapidly evolving high-tech environment we live in, unless we are able to keep pace with technology, we will be unable to address the requirements of the future.

The shifting world landscape, along with the fiscal uncertainty that characterizes this day and age is forcing us to look at alternatives, to become more efficient and more effective. We no longer have the budgets, nor do we have the time, to discover new technology, new

phenomenologies, new techniques and capabilities exclusively on our own. This does not just pertain to how we use our capabilities today, but most importantly in the way we conduct research and development and establish our future. We must to do more with less, and to optimize the tools and technologies already in place to help us innovate and overcome the challenges of tomorrow – and we need to do this together.

We wouldn't be here today if it weren't for the vision, innovation, and willingness to explore new ideas that first led man to reach for the stars. In much the same way the founders of space exploration looked beyond traditional propulsion principles, and our first space reconnaissance visionaries applied new techniques to existing technologies (think about the crazy concept of taking pictures in space, then dumping them in a bucket to be caught by a plane in flight!), today's engineers must look beyond today's technologies to address the needs of tomorrow.

As it has been from the beginning, the need to adapt to a rapidly changing world is driving much of the satellite development underway around the globe today at a pace that exceeds our traditional acquisition methods and our research and development structures.

A few examples of evolving requirements that are driving current research and development are the need to protect against cyber threats, space situational awareness, the need for monitoring and predicting weather, and the growing demand for increased bandwidth capacity. These challenges have been instrumental in changing the way the NRO approaches some of the most costly R&D experiments.

From the vantage point of the Chief Operating Office at the National Reconnaissance Office, charged with managing the National Technical Means of the United States, I see every day how rapidly evolving technology is applied to the hard problems we face. We are a leading provider of remote sensing capabilities, and as a prominent space acquisition organization, we must continually look for ways to become more effective. Today more than ever we need to collaborate on our R&D efforts with our coalition partners.

If we look at the history of the development of aircraft since the Wright brothers, we can identify dramatic advances that have shaped the nature and significance of flight in our daily lives. We now fly sophisticated airplanes that whisk us from Washington DC to Paris France in comfort and style. When Burt Rutan and the Spaceship One aircraft that actually reached the lower perimeter of space came along, a whole new paradigm for air travel was born.

Similarly, since Sputnik first amazed the world, space technologies have experienced equally exciting developments. Every aspect of our modern lives is touched by sophisticated spacecraft of one type or another. As a disruptive technology, Spaceship 1 promoted a new view on travel. What will be the next transforming innovation in space development?

The NRO is looking closely at using small satellites we call CubeSats, to reduce the cost and delivery time to provide improved capabilities to our users. By taking advantage of the relatively low cost to build and launch small satellites, we can conduct CubeSat experiments that will allow us

to mature satellite technologies and develop our scientists and engineers, as well as fly new experiments in space.

The CubeSat technologies allow us to conduct low cost research and development at a very rapid pace, and help us advance a broad spectrum of new technologies. In the past, the length of time to determine the feasibility of new ideas was dependent on the program schedule to launch full-scale system acquisitions, which could take ten years. Using CubeSats to determine concept feasibility will make that process much faster. There is no question that the time, cost, and innovation benefits exceed traditional development methods.

We have made a significant commitment to the CubeSat approach.Today we have 12 satellites in build.

The relatively low cost of these systems also allows us to accept higher levels of risk as we test new capabilities and new components, and fosters a culture of creativity in our laboratories. This creates a healthy environment where trial and error is encouraged, with the understanding that we learn faster by trying and failing and then trying again. In the long run, an environment that promotes innovation and makes room for experimentation saves us time and money – and the results often exceed our expectations.

Small satellites allow rapid innovation and novel applications. For example, the “innovation cycle” that characterized the development of the IPOD can be applied to satellites. In the commercial world, technologies refresh every 6 months. Using CubeSats as a vital element of our research and development, we are able test out new applications

in timelines significantly shorter than if those same applications were "space qualified" on full-scale reconnaissance satellites.

Another exciting aspect of small satellites is the rapidly expanding community. There is an emerging, open development community consisting of dozens of Industry participants along with 90-plus Universities worldwide. These non-traditional developers bring new ideas and new enthusiasm to the market, providing much needed competition. Just like collaboration, competition can also help us discover great technical and cost-effective solutions. With many minds working on the same problems, great solutions are possible.

We are supporting non-traditional satellite builders and universities through efforts such as our recent Innovative Experiments Initiative (IEI) and our significant investment in U.S. academic endeavors. Last year's IEI focused on advancing CubeSat subsystem technologies. The results of the CubeSat initiative were promising, and have prompted the pursuit of some exciting new concepts at the NRO's Advanced Science and Technology directorate. These investments stimulate a great deal of research and development.

There are companies selling CubeSat kits online that can be purchased by anyone with a credit card. These companies are building partnerships with other small companies that produce specialized components for these versatile small satellites.

Some of our British counterparts have already been flying smallsats for over 25 years, and have demonstrated the utility of this technology for a wide variety of uses.

As members of this exclusive international space community, we are all benefiting from the advances of our partners and we all lead in different areas. It is important that we continue to leverage the lessons learned and benefit from the synergy that smart minds across the world can bring to the table when focused on a common vision.

One of the most important aspects of small satellites is the ability to keep pace with Moore's Law. When satellites take 10 years to build, technology lags behind. When satellites stay on orbit for decades, technologies find few opportunities to prove themselves. It is much more difficult to upgrade an on-orbit spacecraft – and it's also difficult to persuade the oversight organizations that control our budgets that we need new capabilities when older vehicles remain on orbit. With small satellites that can be built in less than 6 months, technology can stay at the leading edge and we can keep pace with evolving requirements.

Small satellites leverage commercial technologies in a much more exciting way than traditional programs. The best ideas from rapidly advancing innovations in electronics, computers, and even video games can be brought into the satellite world. For example, the batteries that are the primary power source for several CubeSats on orbit are exactly the same as the batteries used in IPODs today. Leveraging these quickly evolving technologies in a large, complex satellite program is inconceivable due to the time and risk involved in incorporating new, non-space qualified parts.

Our CubeSats are allowing new technology to gain flight heritage that might take years to earn on traditional satellite programs. In turn these

technologies can be transitioned to larger platforms much faster than in the past. This will, in turn, accelerate the pace at which we can launch the larger exquisite reconnaissance programs for which we are known.

The NRO is pursuing several near term research and development activities centered around small satellites. Technologies such as solar cells, batteries, commercial processors and radios are being integrated as CubeSat payloads and will be demonstrated on-orbit.

Small satellites can accelerate these development activities by providing rapid feedback to developers, allowing them to refine their processes. The mature, proven technologies can then be transitioned to larger platforms, allowing us to keep pace with national needs.

Two such technologies are the Gravity-gradient boom and the Plug and Play attitude control system.

The NRO is developing a lightweight boom with integrated solar cells to greatly increase available power. The boom will also provide low cost, completely passive gravity-gradient attitude stabilization for a two-segment CubeSat spacecraft. This added capability will increase system power by a factor of 5 and will enable higher power payloads to be demonstrated on orbit. This approach uses passive strain energy for deployment, which could also be adapted to larger spacecraft systems.

Another example is a low cost precision pointing Control Moment Gyro (CMG) system. This attitude control system, based on a redundant four gimbal CMG configuration, will enable future CubeSat systems to actively maintain peak tracking and sensor positioning for more

demanding demonstrations. The “black-box” plug-n-play architecture enables the system to be easily retrofitted within the CubeSat framework. The larger satellite developers can take advantage of this lesson learned and apply it to large-scale acquisitions.

Small satellites allow a wonderful opportunity for our space professional work force development. This is an extremely critical issue in the U.S. at the moment. Building a complete satellite in less than six months allows new space professionals to see a satellite complete lifecycle, and helps them develop the program management skills that will help them succeed in the future. This valuable experience will pay dividends on larger and more complex satellites.

The new generation of space professional is accustomed to fast-paced technology adoption, and expects rapid results. Small satellites provide avenues for the new generation to apply that technological enthusiasm in a way that benefits the entire community.

The NRO is actively working with universities to train the next generation of space professionals. The NRO is currently providing CubeSats to universities to augment academic programs and inspire enthusiasm for future space development. These projects provide an opportunity for students to develop key engineering skills as well as hands-on experience. Participating universities build coursework around these CubeSats, which can be built within a 1 year academic program. We are also working with high schools to generate enthusiasm for aerospace engineering before they head off to the universities.

The NRO will be conducting several flight experiments with small satellites over the next several years. Space environmental sensing is one of the areas being studied. The need for monitoring and predicting the effects of solar flares and the effects of radiation is an important international and commercial issue, and is critical to safe operation in orbit. The NRO is currently exploring space environmental monitoring and the development predictive models that will help us understand system anomalies.

Another program involves building CubeSats to fly new technologies. These “TechSats” will be flying some exciting new solar cells, structures, and battery technologies.

Small satellites give us the opportunity to make big advances because they function as low-cost test-beds that allow us to mature technologies rapidly for larger platforms, help develop the future workforce, are far more risk tolerant than traditional research and development approaches, and perhaps most importantly, are opening up new ways of conducting business in space with new opportunities for international partnership.

On the international front, we are working with members of the global space community to define and establish standards for CubeSats and deployment mechanisms. For example, we are active members of the aeronautics, space and defense not-for-profit organization CANEUS (Canada, Europe, United States) International, which fosters

coordinated, international development of micro and nano technologies for aerospace applications. At their annual meeting last year, one of the main discussions addressed the development of standards to ensure international interoperability for small satellites. It is critical that we work as a community to address the issue early on to avoid the kinds of expensive and sometimes dangerous problems we deal with every day in other technology sectors such as motion imagery.

The NRO is working with the domestic space community to increase launch capacities. These expanded capabilities will open the door to new technologies and in the future may lead to new partnerships.

In addition to reduced timelines, reduced risk, and enhanced capabilities, the phenomenon of small satellites is introducing a much needed shot in the arm to the space industrial base, and the workforce that makes it possible for the world to benefit from satellite technology. While these small-scale systems are not the answer to every satellite requirement, they play an important role in solving many of the challenging technological questions we in the space community must answer today if we expect to be able to fulfill the requirements of the future.

We must determine how to improve our technologies, and deliver better value to our customers. CubeSats open new opportunities to innovate, expand, and improve capabilities and aren't constrained by international boundaries. If we work together to develop and share the new concepts and technologies that will characterize the space domain for the years to come, we can all succeed. We have evolved from our "need to know"

mentality and are approaching a “need to share”. We look forward to our expanding partnership. Thank you.