Dr. Chris Scolese

Director, National Reconnaissance Office

32rd Annual INCOSE International Symposium

Keynote Presentation

Remarks as Prepared for Delivery

27 June 2022

Abstract: *Since its inception more than 60 years ago, the National Reconnaissance Office has worked to secure and expand the U.S. intelligence advantage by developing, acquiring, launching, and operating the world's best space-based intelligence, surveillance, and reconnaissance, or ISR, capabilities. That mission is unwavering. But the world in which we operate has changed. The pandemic showed that the global supply chain is fragile, and Russia's assault on Ukraine made it harder to access raw materials. Rather than bemoaning the fact that what worked in the past may not work in the future, we can embrace this changing world as an opportunity. This presentation will explore how the NRO aims to take advantage of new capabilities to be faster and more efficient, relying on systems engineers and their digital engineering tool box to mitigate risks and architect the future.*

Good morning and thanks so much for inviting me to join you. It's an honor to kick off this year's International Symposium. Thank you to Michael Vinarcik for the kind introduction. And thanks to the entire INCOSE team for hosting this week's event – especially President Marilee Wheaton, my neighbor over at Aerospace; and President-Elect Ralf Hartmann – we look forward to your leadership.

I know you have convened an impressive group of systems engineers – the brightest and most talented people on the planet (wink wink). Of course I say that only in a half joking way. Many of us started out as discipline engineers, in my case Electrical and Computer engineering, but very early on it became apparent that I was working on a system and needed to know how my component interacted with other components – not all of which were electrical or computers. Thus I think it becomes relatively clear regardless of our backgrounds in order to succeed we must become system engineers – in name or in practice.

So for the next few minutes I want to relate my observations and thoughts on the state of and if I can be presumptive the direction we must follow as we deal with the challenges to today to realize the opportunities of the future.

A little background. For those of you who are not familiar with the National Reconnaissance Office, we are part of both the Department of Defense and the Intelligence Community – the DoD and the IC. Our mission is to develop, acquire, launch, and operate the architecture that is

the foundation for America's advantage and strength in space. We have a diversified architecture of spacecraft—different sizes, different capabilities, different orbits—that we use to collect and deliver the world's best space-based intelligence, surveillance and reconnaissance, or ISR, information.

If you saw the new Top Gun movie… how did Maverick and the Navy know where to find that uranium enrichment plant in enemy territory? ISR. Both in the movies and in real life, ISR is critical to national security. Satellites and other space-based sensors collect data that provide important information to the DoD, IC, policymakers, and warfighters. NRO systems are often the only tools able to access hostile territory or rugged terrain, and we can collect critical information without risking human lives or infringing on other nations' territorial sovereignty.

We also serve more than 500,000 government users. We provide data and imagery to two dozen domestic agencies, including DHS, FEMA, and NOAA, that support civilian customers with things like environmental research and disaster relief. Scientists have used NRO imagery to create a global environmental database to help predict climate change, assess crop production, map habitats of endangered species, track oil spills, and study wetlands. NRO resources are also used to develop products that help depict and assess the devastation in areas affected by natural disasters like wildfires and earthquakes so that relief organizations can make decisions about where and what to deploy to be most helpful before they are even on the scene.

The NRO's vision is "see it, hear it, sense it" – we've done that since our inception at the dawn of the space age more than 60 years ago.

Yet I can tell you that right now is an unprecedented time both for the NRO and for the space domain.

The United States has never before been more reliant on our capabilities in space. Our national security and our modern way of life depend on it. Think of living without GPS as an example. At the same time, our world and our competitors are becoming more complex and posing unprecedented challenges. For 60 years, America's dominance in space was largely unchallenged. That's not the case anymore. Space has never been more congested, contested, or competitive. Satellites are being launched in record numbers. Our competitors, especially China and Russia, are developing tools both on the ground and in space that put our assets and our advantages at risk. They are dedicating money, manpower, and resources, including newer, better weapons and anti-satellite technology. Space has turned from peaceful to competitive, and has all the potential to become conflicted.

Just how congested has space become? This chart shows the number of satellites in orbit – from about 500 back in 1987, to nearly 5,000 now and still growing.

But it's not just space where we see challenges. Space and space systems are the areas I know best, However, like you I daily commute so I

know that we have similar challenges in the traffic area. And since the conference is held in Detroit this year it seems only appropriate to show that space is not unique with an automotive example.

Those of you in the auto industry are familiar with these challenges. Anyone who has sat in traffic in the last 30 years knows our roadways are more congested than ever. They're also more contested – just consider the spike in aggressive driving and road rage. And they are more competitive. There are new technologies like electric vehicles, new players like Tesla, and new phenomena like ride-sharing, autopilots, and the surge in e-commerce putting more vehicles on the road competing for the same amount of space.

In fact, research shows that congestion in major cities is up significantly. This research from the University of Austin, Texas, shows the number of hours drivers spent in rush-hour traffic more than doubled in some areas between 1987 and 2017. Washington, DC's metro area, for example, shows an increase from 49 hours in 1987 to 102 hours in 2017. As a DC commuter myself, I can't say I'm surprised!

It's imperative that we confront those challenges, stay a step ahead, and develop the tools and technologies that will improve the situation. As the world evolves, we must evolve along with it.

I'll talk for a minute about what we at the NRO are doing to address the challenges of today, then go into some detail about how we are relying

on systems engineers like you to architect the future. It's clear we need your expertise and your tool box to ensure we prioritize the right capabilities and take on the appropriate level of risk.

Earlier this year the NRO refreshed our strategic priorities, identifying five elements that are the engine behind our evolution. I want to highlight the shape – it is horizontal because all of these priorities are critical and interconnected, none more important than the others:

- WORKFORCE: We depend on every member of our team contributing to our success. We are investing heavily in recruiting, retaining, and educating a dynamic workforce that represents our country and empowering them with the resources they need.

- INNOVATION: Our competitors are smart and fast, so we have to be even smarter and faster. Innovation is built into the DNA of our agency and is part of everything we do. We are accelerating timelines, integrating disruptive technologies, incentivizing creativity, and investing in the technology of tomorrow. We're building a diversified architecture in space. On the ground, we are managing data faster than ever.

- RESPONSIVENESS AND AGILITY: We are applying advanced technologies and techniques to accelerate delivery of data to the user. We're enhancing overhead tasking, collection, and data

processing capabilities, and adding automation and multi-intelligence processes, among other things.

- RESILIENCY: From our spacecraft design, to our supply chains, to our information technology infrastructure, to our collection architecture, we are building resilience into all our systems. We are building a comprehensive, proliferated overhead architecture that can anticipate and adapt to current needs, emerging customer demands, and future threats. This will increase the survivability and strength of our systems by shoring up single points of failure and addressing vulnerabilities both on the ground and in orbit.

- PARTNERSHIPS: We know we cannot solve today's most difficult problems on our own. We depend on our relationships with other government agencies, other nations, academia and the private sector to identify new opportunities to optimize talent, tools, and effectiveness.

All of these priorities, from our workforce to our innovation to our partnerships, have one overall goal – developing reliable systems faster. We need new tools, new processes, new materials, and new people to get it done.

Of course, along with each of these new elements come new challenges.

Let's be clear – every generation pursuing every goal faces challenges. We've always had them, and always will. It's one of the few constants we can depend on in a changing world. This is what we're facing right now:

The pandemic showed that the global supply chain is fragile, and Russia's assault on Ukraine made it harder to access raw materials. But we still must meet our goals to deliver satellites, automobiles, airplanes, vaccines, and many other products. We are fortunate today to have new tools that allow us to gain insights faster and improve our decision making process. Coupled with new materials and processes we have great opportunities.
However, we often use our tools and processes to conduct what ifs in a virtual environment that delays decisions. So we have to be careful to use our tools, processes, and procedures to provide greater insight and enable our decision making, leading us to solutions and progress.

This is where systems engineering comes into play. We need to take advantage of the new capabilities, new systems, and new materials to ensure we are meeting the needs of the end user. This means prioritizing the delivery of capabilities. Digital engineering needs to accelerate our timelines so we can deliver needed products faster. And we have to be able to optimize our decision-making with risk management. Too often risk assessment is left until the end. We need to frame our decisions by asking what risks we are willing to take and what need mitigating.

Let's think about how we balance the risk. Built into any program are risks associated with schedules, costs, and technical issues. How much innovation is enough? Could there be too much? What is the right amount of resiliency? Can we right-size the schedule acceleration? And we have to ask ourselves, when does a system become too complex? We could spend hours on these 2 charts - suffice it to say that we can use our tools to make the process more efficient or not. I choose the former!

History shows we can do this – balancing innovation and risk by focusing on our needs, not our tools. In the 1960s, Americans got to the moon in less than nine years. We built the world's first atomic submarine in less than five years. And we developed a COVID vaccine in about one year. At the NRO, just recently we developed two experimental satellites and got them into orbit in less than two years – I can tell you that's a remarkable pace. In today's fast-changing world, we can't depend on incremental advancements that take decades to develop. We must continue asking "what if?" and pushing the boundaries of what's possible. We are depending on systems engineers to use the concept and tools of digital engineering to help us take advantage of new capabilities and to become faster and more efficient. To make our lives better.

We also need to focus on continuous improvement. Doing it faster doesn't mean doing it with more risk. We need to right-size the number of what-ifs… support decisions sooner… and find the right level of insight.

As we consider the future of digital engineering, it is important that we set goals in the areas of technology, innovation, and transformation and measure them in context of achieving reliable systems faster.

In 2020, the NRO developed a digital engineering strategy, modeled on the DoD's Digital Engineering strategy that included formalizing the use of models, building our digital engineering IT, and training our workforce. We have seen success in all of these areas, but the pandemic has required us to change rapidly – shifting from independent IT structures to a more integrated one, and moving from classroom training to developing shorter web-based training. None of this has been perfect. We're still figuring out our own abstraction layers across the enterprise to include our suppliers and partners, working the development of taxonomies and common models, and understanding what data we use in our decisions. Compounding the challenge is the nature of IT at the NRO, where the preferred tools of our engineers may not be available. Digital engineering is the future, however. As we adapt, we need to ensure the tough job of systems engineering still gets done.

I leave you with a call to action, based on what we see at the NRO. We see this as an opportunity for collaboration. Let's work together to develop processes that utilize new tools that enable our mission without adding unnecessary layers of review. Too often, we see "paralysis by analysis" – if we're too hesitant to make a decision, we get stuck and risk doing nothing. Some ideas to consider:

- We need multi-level security. How can we develop tools with security in mind – ones that will enable a simple sign-on, data centricity, and secure clouds?
- How can we expand systems engineering education, using models, data analysis, and software development?
- We need multiple pathways to mission success. How can we improve leadership, team-building, conflict resolution and stakeholder communications?
- How do we grow our standards and best practices?
- And how can we build a culture of excellence, sharing our successes and our lessons learned?

The tools and technologies we are developing should be widely applicable – relevant to satellites in space and autos on the ground and every industry in between.

I told you earlier that this is an unprecedented time for the NRO and for the space domain. It's also a critical time for systems engineering. We have a bright future if we use our advanced analytical capabilities, vibrant workforce, new materials, and new technologies to enable that future.

I'm happy to take your questions.

# # #