

# trajectory

THE OFFICIAL MAGAZINE

OF THE UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION

## Future Framework

The **Next NGA West** will usher the Intelligence Community into an era of open-source information and mobility.

- > The Internet of Things
- > Precision Agriculture
- > New Q&A section: Perspective





Analysts in today's world are expected to have the right information at their fingertips to answer urgent questions at a moment's notice. **Jagwire™** allows analysts to spend less time searching for the right data and more time providing answers for time-critical operations.

[harrisgeospatial.com/trajecory](https://harrisgeospatial.com/trajecory)



Jagwire™



# contents

2017 ISSUE 1

## 26 AUTONOMOUS AGRONOMY

Precision agriculture applies technology to improve crop yields and reduce costs as well as to provide early warning signs about food insecurity and regional conflict.

*By Melanie D.G. Kaplan*

*With software tools like John Deere Operations Center, farmers can easily compare their production data. They can view field maps side-by-side to evaluate yield impact and make quick decisions throughout the growing cycle.*

PHOTO COURTESY OF JOHN DEERE

## FEATURES

### 12 FUTURE FRAMEWORK

The Next NGA West will usher the IC into an era of open-source information and mobility.

*by Kristin Quinn*

### 18 SMART STUFF

The Internet of Things offers convenience, efficiency, and intelligence value, but also new risks to networks and data security.

*by Matt Alderton*

### 02 | VANTAGE POINT

In a period of great external change, USGIF is more agile than ever.

### 04 | INTSIDER

NGA leaders discuss the agency's future; NOAA's GOES-16 satellite sends first images; USGIF hosts second small satellite workshop; Tech Showcase West.

### 32 | MEMBERSHIP PULSE

General Dynamics Mission Systems; S2 Analytical Solutions; Tina Patterson, Jade Solutions.

### 35 | HORIZONS

Reading List, Peer Intel, USGIF Events Calendar.

### 36 | PERSPECTIVE

Dr. Peggy Agouris is dean of the College of Science, director of the Center for Earth Observing and Space Research, and professor of spatial informatics at George Mason University.



## TRAJECTORYMAGAZINE.COM

### WEB EXCLUSIVE

Learn how precision agriculture can predict civil unrest.

### TRADECRAFT

Download The State and Future of GEOINT 2017 report.

### ON THE COVER:

This custom illustration commissioned by *trajectory* is an artist's rendering meant to evoke the open, collaborative environment of the Next NGA West. Rendering by Stephanie Bower

### CORRECTION:

The 2016 Issue 4 article "Modern Slavery" incorrectly referred to a source as Aaron Rubenstein. His name is Aaron Snow. We apologize for the error.

# A Time of Transition

“Now, in a period of great external change, we must be more agile than ever.”



USGIF's first Machine Learning and Artificial Intelligence Workshop in January attracted nearly 300 attendees.

We at USGIF are proud of our status as a nonprofit educational foundation. Not all nonprofits are the same, and the various designations are not trivial, with different categories denoting specific organizational constructs.

Given our 501c3 status, USGIF is committed to supporting education, training, and professional development. The Foundation doesn't lobby Congress nor generally carry the torch for any specific topic. As I like to say, USGIF was founded with the idea that a rising tide would truly raise all boats—that Building the Community, Advancing the Tradecraft, and Accelerating Innovation would benefit all stakeholders across industry, academia, and government.

USGIF is unwavering in our educational mission, and we too must continue to learn both organizationally and personally. Now, in a period of great external change, we must be more agile than ever. USGIF's GEOINT Community Week has grown significantly over time since its beginning as a modest tech showcase. In 2016, our event in St. Louis expanded in an exciting way as the Foundation collaborated with innovation hubs in the city. We continue to develop special programs

based on Community interest and need, such as our Machine Learning and Artificial Intelligence Workshop in January. The GEOINT Symposium is a constantly evolving process as we seek to actualize attendee feedback, showcase emerging capabilities, and meet industry best practices.

The USGIF team comprises avid learners, with many of the staff holding multiple professional certifications in their respective fields. Our two journalists, Jordan Fuhr and Kristin Quinn, have tremendous educational and professional backgrounds.

Kristin recently led an effort to refresh *trajectory* magazine. We're intensely proud of our award-winning

publication and confident the updates to the content and design will help *trajectory* maintain its reputation for superb coverage of relevant topics. Reader feedback was particularly helpful in shaping our approach, and I encourage you to share your thoughts on the new look. Along with the print refresh, we will soon launch a newly designed *trajectory* website that will be fully responsive to individual devices and operating systems. Our intent is for the new site to deliver a consistently comfortable experience from smartphones, tablets, and desktops.

In this issue, we look ahead to the Next NGA West campus in St. Louis and NGA's plans for an unclassified, collaborative environment and a mobile-friendly workplace. This issue also includes features on the ever-expanding Internet of Things and the advent of GEOINT-enabled precision agriculture. On the final page, we introduce a new department called “Perspective,” in which we will interview various visionaries from across the GEOINT Community.

While “transition” is the current hot topic here in the D.C. area, USGIF remains an agile, learning organization in perpetual transition as we strive to meet the needs of our extended GEOINT Community now and into the future. I look forward to seeing you in our hallways and conference rooms as well as at our events and programs in the coming weeks and months. And of course in June at the GEOINT 2017 Symposium, which returns to San Antonio and its newly renovated convention center. Thank you for your ongoing support of and confidence in USGIF.

KEITH J. MASBACK | CEO, USGIF  
@geointer

## trajectory

USGIF CHAIRMAN OF THE BOARD  
The Honorable Jeffrey K. Harris

USGIF CEO AND PUBLISHER  
Keith J. Masback

EXECUTIVE EDITOR  
Jordan Fuhr  
[jordan.fuhr@usgif.org](mailto:jordan.fuhr@usgif.org)

MANAGING EDITOR  
Kristin Quinn  
[kristin.quinn@usgif.org](mailto:kristin.quinn@usgif.org)

EDITOR  
Brad Causey  
[bcausey@glcdelivers.com](mailto:bcausey@glcdelivers.com)

ART DIRECTOR  
Gretchen Kirchner Rund  
[grund@glcdelivers.com](mailto:grund@glcdelivers.com)

ASSISTANT EDITOR  
Lindsay Tilton Mitchell  
[lindsay.mitchell@usgif.org](mailto:lindsay.mitchell@usgif.org)

AD SALES  
Erik Henson  
[ehenson@naylor.com](mailto:ehenson@naylor.com)



*Trajectory* is the official magazine of the United States Geospatial Intelligence Foundation (USGIF).

### HOW TO REACH US

LETTERS AND COMMENTS  
For comments on *trajectory*, contact  
[trajectory@usgif.org](mailto:trajectory@usgif.org).

SUBSCRIPTIONS  
For information on subscribing to *trajectory*, sign up for free at  
[trajectorymagazine.com](http://trajectorymagazine.com).

USGIF MEMBERSHIP  
For more information on USGIF or becoming a USGIF member, contact 888-MY-USGIF (888-698-7443).

TWITTER  
[@trajectorymag](https://twitter.com/trajectorymag)

PUBLICATION MANAGEMENT



847-205-3000 | [GLCDELIVERS.COM](http://GLCDELIVERS.COM)



See a better world.™

DigitalGlobe

# More capable. More capabilities.

The Radiant Group has joined DigitalGlobe. Combining our people, data, and technology will accelerate our shared vision of becoming the indispensable source of information about our changing planet to better serve your mission needs.

**A world of insights.**

Learn more at [radiantacquisition.digitalglobe.com](http://radiantacquisition.digitalglobe.com)



# INTsider

COMMUNITY NEWS,  
EVENTS, AND EDUCATION

 COMMERCIAL SPACE

■ USGIF NEWS  
■ GEOINT COMMUNITY NEWS  
■ EDUCATION  
■ APPLICATIONS  
■ CIVIL

NGA Director Robert Cardillo gave the opening keynote at USGIF's Small Satellite Workshop in November. Among other topics, Cardillo spoke about the contract NGA awarded Planet to provide the agency with a near global imagery refresh every 15 days.

PHOTO BY ERICA KNIGHT, NGA

## USGIF Hosts Second Annual Small Satellite Workshop

More than  
**250**  
attendees  
participated  
in USGIF's  
Small  
Satellite  
Workshop  
during 2016  
GEOINT  
Community  
Week.

The need for commercial space initiatives and in particular the information yielded by small satellites will remain steady throughout the new presidential administration, according to experts speaking at USGIF's Small Satellite Workshop.

USGIF hosted its second Small Satellite Workshop at the National Geospatial-Intelligence Agency (NGA) in Springfield, Va., Nov. 14 and 15, as part of the Foundation's 2016 GEOINT Community Week. The first day was unclassified and the second day was held at a classified level.

NGA Director Robert Cardillo provided the opening keynote at the unclassified session. He discussed the \$20 million contract NGA awarded in September to small sat operator Planet, which will provide the agency with a near global imagery refresh every 15 days.

Cardillo said although the agency is further along in building its relationship with Planet, it is "ready and willing to jump in with both feet with

more commercial companies"—in particular those that are Amazon C2S compliant.

Dr. Fred Kennedy III, senior policy advisor for The White House Office of Science and Technology Policy, also gave a keynote address, and claimed we are witnessing a "perfect storm" in space access.

"This is the new space renaissance," Kennedy said. "We just need to figure out how to feed it and keep it moving forward."

The unclassified agenda also featured panel discussions on turning pixels into answers, how the launch industry will support the market, and where policy changes might be needed to ensure the industry isn't stifled.

During the panel on turning pixels into insight, John Charles, NGA's national GEOINT officer for commercial imagery, said machine learning and cognitive analytics would be key to making sense of commercial data generated by small sats.

"NGA is serious about leveraging these new capabilities," Charles said, nodding to the recent Planet contract. "The

From **2014** to **2015**, investment in precision agriculture nearly doubled to **\$4.6B.**

— EXCERPT FROM "AUTONOMOUS AGRONOMY." SEE PAGE 26 FOR THE FULL STORY.

challenge is finding the right mix of imagery and analytics to acquire."

The unclassified portion of the Small Satellite Workshop concluded with a presentation on the Joint NGA and National Reconnaissance Office (NRO) Commercial GEOINT Activity (CGA).

Michael Foster and Peter Muend, NGA and NRO's Commercial GEOINT leads, respectively, outlined how CGA will serve as the focal point for the Intelligence Community's engagement with the commercial imagery industry; orchestrate assessments of emerging commercial capabilities; and recommend how NGA and NRO can shape U.S. remote sensing policy.

## GEOINTERACTION TUESDAY

### Two NGA Leaders Discuss Future of Agency



USGIF FILE PHOTO

NGA's Maj. Gen. Linda Urrutia-Varhall (left) and Heidi Smith (right) discussed a variety of agency initiatives at USGIF's November GEOINTeraction Tuesday event.

Maj. Gen. Linda Urrutia-Varhall, director of operations for NGA, spoke to 140 people at USGIF's GEOINTeraction Tuesday event Nov. 15. NGA Deputy Director of Plans and Programs Heidi Smith also gave remarks.

Urrutia-Varhall, who came to NGA in June from her position as assistant deputy chief of staff of the Air Force for ISR at the Pentagon, began her speech by sharing how excited and energized she is.

"This is truly where I've wanted to be for some time," she said. "Why? [NGA is only] 20 years old. Realize the opportunity at NGA. Small sats are just one. Commercial imagery. GEOINT overall. Bringing in open source—how do we mix in Twitter, Facebook? Think of the potential out there. What is and should NGA be doing? We're helping to drive that—what is the answer for the community at large?"

Smith discussed how her office would also help shape the future of GEOINT. For example, the strategic shift to rename NGA's InnoVision Directorate to NGA Research earlier this year.

Regarding acquisition, Smith said NGA Plans and Programs has put a "laser focus" on defining programs and articulating to industry what the agency needs to accomplish its mission.

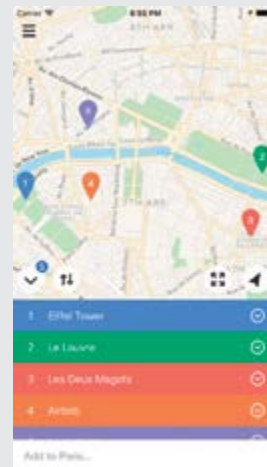
Other items Smith described as "imperative" that her office is driving aggressively toward included advancing analytic modernization, GEOINT services, IC ITE migration, and mission talent alignment.

## PROCRASTINATION TOOLS

### DroneDeploy

DroneDeploy is an aerial mapping, image capture, and data analytics platform. Using the platform's free app, drone enthusiasts can fly their unmanned aerial vehicles as well as create and share interactive maps and models straight from their mobile device.

[dronedeploy.com](http://dronedeploy.com)



### Relay

Traveling or running errands with multiple destinations? Relay allows users to search for and pin multiple locations on a single, customized map, making navigation for multi-destination trips easier and quicker. The app is available for \$2 on iOS devices.

[relaymaps.com](http://relaymaps.com)

### MapSwipe

Launched by the Missing Maps project, the MapSwipe app lets users search satellite imagery to help put the world's most vulnerable populations on the map and assist humanitarian relief efforts. Users can swipe through satellite images of unmapped regions to identify settlements, structures, roads, and other important features.

[mapswipe.org](http://mapswipe.org)





USGIF FILE PHOTO



Dewey Houck II of Boeing spoke about machine learning at a workshop USGIF's Young Professionals Group hosted during 2016 GEOINT Community Week.



YPG

## Young Professionals, AI, and Transitioning Careers

Machine learning and transitioning from government to industry were the main topics of discussion at a workshop hosted by USGIF's Young Professionals Group (YPG) Nov. 15 as part of the Foundation's GEOINT Community Week.

About 50 individuals attended the workshop to hear from GEOINT Community leaders. Dewey Houck II, USGIF board member and vice president and chief data analytics officer at Boeing Defense, Space, and Security, gave a keynote address on how machine learning and artificial intelligence have evolved since the 1980s.

"For any species to evolve, it needs to adapt and adjust," Houck said. "Machine learning is happening so fast that I don't think [humans] have a good perspective on how fast it's changing."

Houck also spoke about the White House's recently released National Artificial Intelligence Research and Development Strategic Plan, which outlines the further development of the emerging technologies.

In the second half of the workshop, attendees listened to a panel discussion about transitioning between jobs in industry and government. Panelists included Tom Burns of the Defense Advanced Research Projects Agency, Al Di Leonardo of HumanGeo (now part of DigitalGlobe), Victoria Nguyen of Whitespace Solutions, John Sanders of Pramantha Solutions, and moderator John Goolgasian of OGSystems. Each shared their varied perspectives and career paths, providing interesting insight in how to navigate the complex decisions of moving between government and industry jobs throughout a career.



**GET INVOLVED!** To join the Young Professionals Group, visit [usgif.org/community/YPG](http://usgif.org/community/YPG).



USGIF staff gave a "GEOINT 101" presentation to 50 fifth graders at Moorefield Station Elementary School in Ashburn, Va., in celebration of GIS Day Nov. 16.



GIS DAY

## USGIF Presents "GEOINT 101" to 5th Graders

USGIF created a "GEOINT 101" presentation to share with 50 fifth grade students at Moorefield Station Elementary School in Ashburn, Va., Nov. 16 in celebration of international GIS Day.

The Foundation worked with DigitalGlobe to develop this iteration of GEOINT 101, which is intended for grades five through eight. The presentation by USGIF staff gave students a glimpse of GEOINT's history, tools, and platforms as well as potential career paths. USGIF staff

also led the students in fun, interactive activities to help them learn basic geospatial concepts.

Additionally, a USGIF Individual Member volunteered to present GEOINT 101 to students at Daniel Boone Elementary School and Francis Howell Middle School in Missouri. The Foundation hopes to expand this model and encourage more members to take this introductory GEOINT lesson into their communities across the country.



TECH SHOWCASE WEST

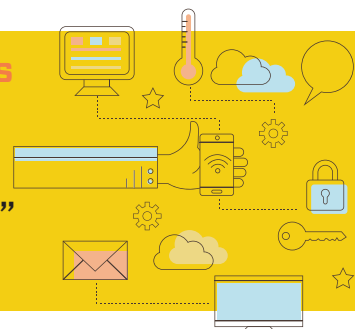
## USGIF Attracts Almost 200 to Innovation Day in St. Louis

The spirit of citywide innovation, plans for the new NGA Campus West, and the tradecraft of the future were common themes during a series of events USGIF hosted in St. Louis, Mo., in October.

USGIF hosted an unclassified Innovation Day as part of its Tech Showcase West in St. Louis, at the @4240 building in the Cortex Innovation Community—a burgeoning innovation hub and technology district. Innovation Day featured

**"The Internet of Things can be an extremely powerful tool for intelligence gathering."**

— EXCERPT FROM "SMART STUFF." SEE PAGE 18 FOR THE FULL STORY.





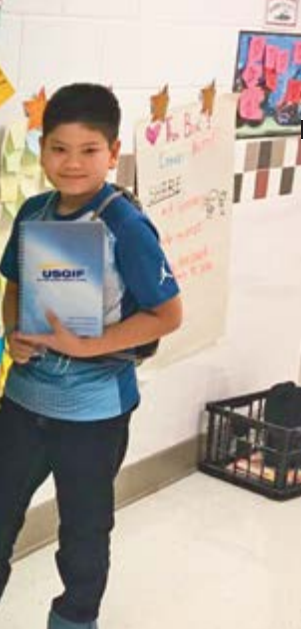


PHOTO COURTESY OF MOOREFIELD STATION ELEMENTARY SCHOOL

a keynote by NGA Director Robert Cardillo, a panel on public-private collaboration, and industry flash talks. It was the first time USGIF hosted this event, and attendees noted the unique collaboration and interaction.

This half-day innovation session was preceded by a morning State of GEOINT Content Exchange. Cardillo and other NGA seniors participated in this exchange before having lunch with USGIF Strategic Partner members, and then attending the innovation session.

The next day, USGIF hosted almost 200 people for its NGA Tech Showcase West at NGA's Second Street location. The classified event featured an address by NGA Chief of Staff Ed Mornston, more than 20 technology demos

throughout the facility, and tours of the NGA Operations Center.

That evening, USGIF's Young Professionals Group (YPG) hosted a "Mappy Hour" networking event at the @4240 building, showcasing *National Geographic's* Giant Traveling Map of the Solar System. YPG kept the giant map at @4240 the following day for the GEOx geospatial technology showcase hosted by Cortex. During GEOx, USGIF hosted 15 fifth through eighth grade students from La Salle Middle School in St. Louis for activities using the Giant Traveling Map of the Solar System as well as the Giant State Map of Missouri. USGIF then donated the giant map of the Solar System to the St. Louis Science Center for the remainder of its rental period.



PHOTO BY DAVE RICHARDS, NGA

*More than 150 attendees participated in USGIF's Tech Showcase West event in St. Louis. Citywide innovation and plans for the new NGA Campus West were themes throughout the two-day event.*







Riverside Research continues its 50-year legacy of solving our customers' toughest challenges by performing research to develop artificial intelligence and machine learning (AI/ML) techniques for the GEOINT community that will improve automated processing of sensor data collected by a variety of air-, sea-, and space-based systems.

TRUSTED SOLUTIONS FOR THE GEOINT COMMUNITY

[riversideresearch.org](http://riversideresearch.org)

## GEOINT CAREERS

## USGIF Shares Knowledge with JMU Students & Faculty

In November, USGIF's Dr. Darryl Murdock, vice president of professional development, visited students in James Madison University's (JMU) Department of Integrated Science and Technology to discuss careers in the GEOINT Community. Murdock told students about the variety of jobs available and skills required in geospatial intelligence fields. He also visited with department faculty and JMU's student-run AFCEA chapter. JMU is one of USGIF's most recently accredited universities and is now able to award USGIF's academic GEOINT Certificate to graduating students.

The University of Missouri



## DATA SCIENCE

## USGIF-Accredited MU Wins NGA Workforce Education Contract

When the National Geospatial-Intelligence College held open enrollment for its first set of data science classes, the slots filled up in "record time," according to Lou Halbert, NGA's chief data officer.

The courses, which began in October, are being offered under a five-year, \$12 million contract NGA awarded The University of Missouri (MU) College of Engineering in August. Under the contract, MU will deliver a comprehensive data science education program to provide analytics training for the NGA workforce, which includes onsite instruction in Washington, D.C., and St. Louis, Mo.

"The workforce has heard data science as a buzzword," Halbert said. "They are craving an understanding for [it]. The current program of study for data science is available to all employees throughout NGA. We want to grow the data science tradecraft, but also introduce data science to the broader workforce."

The program is a collaboration between the MU College of Engineering's Center for Geospatial Intelligence and the MU Informatics Institute's new Data Science and Analytics (DSA) master's degree program. Although the program is offered solely online, the university is ramping up to offer tailored onsite instruction for the NGA program at National Geospatial-Intelligence College locations in D.C. and St. Louis. All course material delivered to NGA will be unclassified, but professors will be cleared and able to discuss classified questions and challenges with participants.



This GOES-16 image shows the winter storm system that crossed North America Jan. 15, 2017.

PHOTO COURTESY OF NOAA

## WEATHER IMAGING

## NOAA's GOES-16 Satellite Sends First Images

NOAA's new advanced weather satellite scans the hemisphere five times faster and at four times higher resolution than current systems. GOES-16 (formerly GOES-R) reached geostationary orbit Nov. 29 and transmitted its first images of Earth in January. GOES-16 is the first in a four-satellite program that will provide more precise weather forecasting in addition to real-time mapping of lightning activity and improved solar activity monitoring.

Harris built GOES-16's main instrument payload, the Advanced Baseline Imager. GOES-16's imager will provide rapid-refresh imagery as often as every 30 seconds, especially during severe weather events, according to Eric Webster, vice president and general manager, Harris Space and Intelligence Systems.

Current weather instruments, which were also built by Harris in the '90s, offer about five spectral channels—the advanced imager has 16, of which 10 are infrared.

"[GOES-16] will be able to tell and measure forest fires, fog, vegetation changes, sea surface temperature, volcanic ash, and more," Webster said. "It has many more products and capabilities than current instruments because it's able to discern different heat changes and have that at a higher resolution."

Harris also built the ground system for GOES-16 and will be responsible for flying and controlling the satellites, operating the instruments, and processing the data.

"Because it's a more capable instrument, there will be about 40 times the data," Webster said. "Everyone's really excited to see how to utilize the data and have better forecasts and a better understanding of severe weather."

Lockheed Martin is responsible for the design, creation, and testing of the four satellites. GOES-16 is expected to be fully operational in about one year.

GOES-16's imager will provide rapid-refresh imagery as often as every **30** seconds, especially during severe weather events.





**HEXAGON**

US FEDERAL

# IT'S TIME TO EVOLVE.

## **INTERGRAPH GOVERNMENT SOLUTIONS IS NOW HEXAGON US FEDERAL**

After six years as a Hexagon company, we're changing our name to better reflect our business. Intergraph Government Solutions will now be known as Hexagon US Federal.

By better aligning ourselves with our parent company, we're able to offer the very best of the Hexagon family technology directly to the US government. We'll continue our priority of high quality services, solutions, and products to you - our partners and customers.

Visit our new website to get acquainted with our new brand and learn more about this exciting change.

[www.hexagonusfederal.com](http://www.hexagonusfederal.com)

## GEOINT HACKATHONS

### Blue Compass Hosts Nationwide Events for NGA

Blue Compass is hosting a series of hackathons around the country on behalf of NGA, aiming to reach talented individuals beyond the D.C. beltway.


In 2016, hackathons were held in Huntsville, Ala., San Francisco, Chicago, and New York City, with nine more locations planned for 2017, including a potential event during the GEOINT 2017 Symposium in San Antonio.

The hackathons are created around NGA problem sets and translated into an unclassified scenario so anyone can participate. Col DiPaolo, chief of innovation mainstreaming at NGA, said the hackathons are first and foremost to help the agency better connect with the tech community at all levels.

"We won't be able to stay ahead of the threats we exist to defeat if we don't tap into the genius that's out there," DiPaolo said.

Blue Compass is driving new talent to the NGA hackathons through its network of more than 100,000 developers worldwide, in addition to boots-on-the-ground marketing efforts meeting with various developer groups in target cities, according to company president Christine Jung.

The hackathons not only serve as an avenue for NGA to attract new ideas, but also potentially new employees.

 VISIT [expeditionhacks.com](http://expeditionhacks.com) or email [hackathon@bluecompass-llc.com](mailto:hackathon@bluecompass-llc.com) to learn more.

*"If your software provides geospatial interoperability using OGC Standards, then OGC Certification is essential."*



Certification provides:

- **CONFIDENCE** for Buyers
- **SATISFACTION** for Users
- **BUSINESS VALUE** for Vendors



To learn more, visit:  
[www.opengeospatial.org/compliance](http://www.opengeospatial.org/compliance)



Blue Compass is hosting hackathons across the country to help NGA solve challenges and attract new talent.



"This gives us a nice pipeline for scouting talent," DiPaolo said. "The workforce is going to change over time to be even more tech savvy, more familiar at a detailed level with data science."

The hackathons so far have focused on disaster response, the effects of climate change, and disparate data, and moving into 2017 will explore topics such as artificial intelligence and modeling, DiPaolo said.

USGIF-affiliated organizations are invited to sponsor a hackathon or to send a judge or team of developers to an event.

## INDUSTRY NEWS

### DigitalGlobe Acquires Radiant

In November, DigitalGlobe acquired The Radiant Group from Aston Capital in a \$140 million cash transaction. The combination of the two organizations, which already have a strong history of partnership, will broaden DigitalGlobe's customer relationships across NGA, establish the National Reconnaissance Office as a new customer, and augment the company's presence at the Defense Intelligence Agency and U.S. Special Operations Command. Radiant Group comprised USGIF member organizations RadiantBlue and HumanGeo as well as other holdings.





# Take Your GEOINT Career a Step Further With the **Universal GEOINT Certification Program**

**Three exams and three certifications tailored to your career needs.**

- GIS and Analysis Tools (CGP-G)
- Remote Sensing and Imagery Analysis (CGP-R)
- Geospatial Data Management (CGP-D)

Earn all three certifications and become eligible to be a Universal GEOINT Professional (UGP).



*"Certification represents a way to identify geospatial professionals invested in lifelong learning. Given two applicants for a geospatial position, a manager will likely choose the one who is already certified. Certification requires someone who is willing to invest their time, prepare and study, and is dedicated to developing their subject matter expertise—all qualities you would want within a potential employee."*

**LTC Michael L. Wood, Geospatial Engineer & Army Geospatial Information & Services Officer, is a recipient of USGIF's Universal GEOINT Professional designation.**





# future *framework*

The Next NGA  
West will  
usher the IC  
into an era of  
open-source  
information and  
mobility.

BY KRISTIN QUINN

*In October 2015, the City of St. Louis presented NGA with a briefing book detailing why the agency should select the Jefferson and Cass Avenues site for the Next NGA West. The book included concepts and renderings such as the one shown here.*





## THE NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY (NGA) once again has the opportunity to build an intelligence facility from scratch, but much has changed in the short time since the agency drew up plans for NGA Campus East in Springfield, Va.

The decade since NGA Campus East (NCE) was in the planning stages has brought a boom in commercial GEOINT and open-source data, the rise of cloud computing as well as smartphones and tablets, and sweeping changes in the way technology professionals want to experience work. As a result, unprecedented use of unclassified space, an environment friendly to mobile and wireless devices, and modern, collaborative workspaces make up the vision for the Next NGA West (N2W).

NGA in June announced it would keep its western campus in St. Louis and relocate just four miles north from its current location at South 2nd Street to an area near the underdeveloped intersection of Jefferson and Cass Avenues.

NGA's mission was the No. 1 priority in selecting the new site, said Sue Pollmann, NGA's N2W program manager. She highlighted how the new site offers proximity to St. Louis's burgeoning startup scene and incubators, industry counterparts already located in the city, and academic institutions such as Washington University and St. Louis University, with which the agency enjoys strong relationships.

"All of that is characterized as energy," Pollmann said. "It was an energy the north city site brought to the equation that we didn't see in the other sites."

The search for an N2W site began in 2012 with 186 suggestions, which were quickly narrowed to 22, and later four possibilities, including a 182-acre parcel of land near Scott Air Force Base in Illinois. The final decision was long awaited, as the South 2nd Street facility faces many challenges such as close flood plains and dated infrastructure that fails to meet post-9/11 security requirements. N2W will be built on 99 acres compared to the approximately 22 acres NGA's western operations currently call home.

The North St. Louis site met NGA's requirements in that it wouldn't be too disruptive to the routines of current employees; offered a central, urban location attractive to new talent; and would allow the agency to continue to draw upon synergies with St. Louis's expanding technology and innovation base.

For many, the decision to keep NGA in St. Louis wasn't only practical—it was sentimental. NGA and its predecessors have resided at the South 2nd Street location since 1952, and the site—called "the arsenal"

by many—has been a fully operational military station since 1827.

"We want to make sure N2W is as adaptable as it can be to take us into the next 100 years," Pollmann said.

This is a tall order considering although the shell of a building is resilient, IT infrastructure continues to progress daily—not to mention the scope of the project. N2W will include 800,000 square feet of office space and house approximately 3,150 employees.

The Army Corps of Engineers plans to break ground at the site in 2018, and NGA has set the goal to move into the facility in 2022. While the Corps manages the construction process, NGA will actively engage with industry to get IT requirements on contract in the 2019 time frame, according to Pollmann.

### OPERATING IN THE OPEN

One important lesson learned from the construction of NCE that the N2W team plans to apply is to bring security experts into the planning process much earlier, considering everything from how to secure the site during construction to how to handle reviews of information for classification, Pollmann said. The latter becomes even more important as NGA Director Robert Cardillo sets his intent to "skate to where the puck is going to be" and harness the power of open-source intelligence (OSINT).

In October, Cardillo gave a keynote at USGIF's Innovation Day held at the Cortex Innovation Center in St. Louis. The director described how the agency is beginning to move its plans for N2W from ideas into the design phase, noting how different the ideas are from when NCE was at the same stage roughly a decade ago.

"While our proud past was tied quite closely to our exclusive control over source, our future is just the opposite," Cardillo said. "We will have very little control over source in the future. What we will have control of in the future is how we use it."

Pollmann said N2W will have more unclassified space than current facilities but it's difficult to quantify because flexibility will be most important.

"The team has come up with a great plan to make that space as flexible and adaptable as possible so it will be able to easily change from a SCIF setting to a non-SCIF—back and forth," she said. "Certainly with much shorter time frames and with a lot fewer dollars



NGA Director Robert Cardillo spoke about the Next NGA West in October during USGIF's Innovation Day at the Cortex Innovation Center in St. Louis.

**“We will go where the data is. How quickly the mindset has changed from going low when we have to. We’re planning to turn that on its head.”**

—ROBERT CARDILLO, DIRECTOR, NGA

involved than the way it would work today if we wanted to say, ‘de-SCIF,’ part of a building.”

Cardillo and Pollmann both emphasized the need for unclassified space that would allow the agency to easily meet with talented individuals from the many tech companies and universities in the St. Louis area, and asked industry to help develop solutions to facilitate that connectivity.

Chris Rasmussen, NGA’s public software development and GEOINT Pathfinder lead, described how participants in the Pathfinder project—launched in 2015 to help the agency learn to operate in a commercial, unclassified environment—had to disconnect from NCE and work from a “WiFi bubble” at an offsite location.

NCE now faces hurdles in a closed environment as it aims to transition elements of Pathfinder to be operational and create wireless, innovative hubs of technology, according to Cardillo.

“Now, classified is the baseline with unclassified sprinkled on top. We need to invert,” Rasmussen said in a presentation at USGIF’s Small Satellite Workshop in November.

During a keynote address at the Small Satellite Workshop, Cardillo echoed Rasmussen’s sentiments.

“We will go where the data is,” the director said. “How quickly the mindset has changed from going low when we have to. We’re planning to turn that on its head.”

Rasmussen said classified data will always be needed, but GEOINT is moving quickly toward OSINT.

“There is value in fusion, but you aren’t going to re-host the internet on JWICS to utilize that,” Rasmussen said. “We need to go down, the world isn’t going to come up.”

Once again, Cardillo’s words mirrored Rasmussen’s, as he said the approach at N2W would be to “build low and find a way to lift as necessary.”

Cameron Chehreh, chief technology officer for Dell EMC Federal, advocates for bringing as much data as possible forward in the unclassified environment without exposing sources and methods, then moving the information to the high side when it gets fused to the point that it must be classified.

“Mission requirements should be the forcing function and IT should be a very agile enabler to allow the mission to execute,” Chehreh said.

He explained it’s possible to strike this balance and support the OSINT mission by handling unclassified data in a highly secure environment to ensure there’s no

chance of the classified side bleeding over. For example, Chehreh recommended treating collaboration rooms as SCIFs but not accrediting them as such so unclassified talent could still be brought in, or treating unclassified data with the same best practices applied to TS/SCI information, but not classifying it as such to incorporate the value of OSINT and uncleared expertise. He added that a “robust and flourishing” insider threat detection program would be essential as well.

Andy Kemp, director of Dell EMC Federal’s national security group, said the trend toward OSINT isn’t exclusive to NGA—open-source now comprises 60 to 70 percent of data for most of the company’s customers, and Dell is actively building systems to address such a sea change.

## CLOUD FIRST

In addition to security protocols, Chehreh said the cloud is essential to safely leverage OSINT. He clarified the cloud doesn’t always mean public and explained there is a rapidly emerging demand for private, hybrid cloud architectures.

“Cloud native infrastructure is a must, it’s not a desire,” Chehreh said, adding the cloud is more of a business and service delivery model than a technology. Dell has built portable, mission-specific clouds for several customers, including U.S. Special Operations Command.

Jim Manzelmann, assistant deputy director of national intelligence for facilities, said the Office of the Director of National Intelligence has mandated a “cloud first” strategy across the Intelligence Community (IC) in an effort to eliminate the tradition of each facility having its own data center and to promote greater flexibility, increase open space, and reduce energy costs.

Chehreh said fourth-generation, cloud native apps are the future of OSINT data fusion. For example, he pointed to an Adobe product introduced at the Defense Intelligence Agency (DIA) under Lt. Gen. Michael Flynn that allowed the director to not only view the final product, but to trace the fusion process from the raw data all the way through annotations by various analysts—SIGINT, HUMINT, GEOINT—to check the sovereignty and pedigree of the raw data and ensure accuracy.



"It was an early sign that we can apply these fourth-generation apps in the OSINT world," Chehreh said. "We absolutely can embrace this head-on with a high degree of success."

Bradley Beach, federal storage CTO at IBM, said flexibility and adaptability are as important to modern IT infrastructure as they are to facility design and classification levels.

"Make [the infrastructure] modular enough that you can swap out pieces—be it cooling, compute, storage, networking, or even a software stack," Beach said. "When you're doing the overall design of a forward-thinking infrastructure, consider how you could replace any component without making disastrous results for any of the remaining components."

Beach also observed as IT hardware becomes commoditized, software-defined networking and storage is becoming the new norm—in other words, implementing an intelligent layer of software on top of the hardware that can increase mission effectiveness and decrease costs.

When paired with machine learning, Beach sees a future in which the infrastructure can learn where it needs to move workloads, and then move the data to get the best performance in support of the mission.

"The next generation is about having the infrastructure itself make those decisions for you," he said.

## WELCOMING WIRELESS

Another essential element of the N2W IT infrastructure will be to create as mobile an environment as possible given security considerations.

"We tell our exciting, excited, vibrant new teammates—interns, 21-year-olds, even 41-year-olds joining from the military—'Whatever you do, take that smart device and lock it up,'" Cardillo said in October during USGIF's State of GEOINT Content Exchange in St. Louis. "But we won't do that in the new campus. Now, will we have rooms in which we won't have wireless devices inside? Yes, but those will be the exception. A rule will be a secure, wireless, mobile environment."

The next generation not only seeks to use smart, mobile devices in the

## A SPIRIT OF CITYWIDE INNOVATION



*Chad Dalton, a developer with OGSystems, and Carrie Drake, director of communications, in the company's St. Louis headquarters at the Cortex Innovation Community. Several USGIF Organizational Members have a presence at Cortex, and NGA is expanding its staff at the innovation hub.*

NGA Director Robert Cardillo views N2W as an opportunity for the agency to "reset" its relationship with the broader St. Louis community.

"We are quite proud of our history here and of the engagement we've had," he said in October during a keynote at USGIF's Innovation Day held at the Cortex Innovation Community in St. Louis.

Cortex is a 200-acre innovation hub and technology district in the city's historic Central West End and Forest Park Southeast neighborhoods. St. Louis is also home to T-REX, a co-working space and technology incubator downtown that houses nearly 200 companies. Further, the city is known for its nationally ranked universities and medical centers, including

St. Louis University, Washington University, Barnes-Jewish Hospital, and more.

"The fact of [this citywide innovation] as we approached the decision on our new campus was important," Cardillo said.

At the time of Cardillo's speech, three NGA employees had worked full-time at Cortex for about a year sharing space with industry partners. He noted that by the end of 2016 the agency would have its own space and 15 employees stationed at Cortex supporting cloud migration, development activities, and industry and academic interaction.

"The growth in technology here and the innovation we're seeing has been tremendous," said Otis Williams, executive director of the St.

Louis Development Corporation with the mayor's office.

Arch Grants, a nonprofit organization that provides \$50,000 of equity-free grants to entrepreneurs who locate their early-stage businesses in St. Louis, has played a significant role in this growth—particularly as many businesses launched in St. Louis decide to stay there.

Dr. Patricia Hagen, president and executive director of T-REX, said several of the incubator's startups are already partnered with NGA.

"We've been talking with a number of NGA representatives about what kinds of partnership opportunities there might be in helping NGA achieve its objectives around connecting with the community," Hagen said. "The new facility is going to be less than 1.5 miles away from T-REX. The opportunities for partnership within the community are great."

St. Louis Mayor Francis Slay is excited for N2W to continue to foster vibrancy throughout the city—both technologically and economically.

Slay said he is pleased NGA isn't "an island," and that Cardillo is committed to connecting with the community and having the agency engage with area academic institutions from the K-12 through university level.

"I'm looking forward to a mutually beneficial relationship that will not only enhance the mission of NGA but also one that will enhance the St. Louis community," the mayor said.



**St. Louis Arsenal Postcard from 1911:** The cavalry was moved from the former arsenal to Jefferson Barracks in 1878. The following year, the facility became a depot for the Quartermaster Corps. The U.S. Army Medical Corps occupied the site from 1923 to 1952 when control passed to the U.S. Air Force. The Aeronautical Chart Service moved from downtown St. Louis to the arsenal. As the mission grew, the name was changed to the Aeronautical Chart and Information Center.

office, but also to gather and collaborate from wirelessly connected laptops rather than being tethered to stationary desktops.

"Wireless is here," Manzelmann said. "[The key is] how to manage it to address security concerns but at the same time give analysts the opportunity to be more collaborative and work together in a more flexible way."

Manzelmann said the National Counterterrorism Center is looking at the development of wireless policies for the community. He added some agencies, such as NGA, DIA, and the National Security Agency (NSA), have initiated test pilots, allowing wireless devices in parts of their buildings on a limited basis.

The movement to wireless, coupled with the migration to the cloud, is poised to help intelligence agencies reduce costs.

Thought it may seem counterintuitive, the more connected devices in a building, the more secure the building may actually become—and the more cost-saving data you have on the building itself, according to Jason Vollen, high performance building principal with AECOM.

A wirelessly networked building provides data and analytics on who is using what rooms, where people are located, and other information necessary to understand how the workforce uses the facility.

"High-performance smart buildings operating today can actually be more secure because there's so much more data available—there are no surprises," said Jill Bruning, executive vice president and general manager for AECOM's Intelligence Community and services strategic business unit. "You have total situational awareness all the time."

The opportunity to maintain so much data on the building dovetails into energy use, as the data can help organizations conserve resources by better understanding heating, cooling, and lighting needs.

"Energy costs basically become overhead and it takes money away from the mission," Manzelmann said, adding that eliminating the actual wires also yields savings.

"Add up all the wiring in a [federal] building and you have miles of it," Manzelmann said. "If you can get part of a building to a wireless environment successfully within security guidelines, it saves a lot of money in cabling costs."

Although the move to wireless is exciting, security must remain paramount in today's landscape of cybersecurity threats. Bruning warned wireless is "the next battle space," and therefore it is essential for the IC to build secure wireless communications.

"Keeping pace with the future of secured wireless is going to be really critical in how IC ITE (the Intelligence Community Information Technology Enterprise) evolves and transforms to be able to incorporate wireless, whether segmented and outside of the SCIF or inside SCIF spaces," Bruning said.

The cloud-based nature of IC ITE lends itself to the expansion into wireless and the embrace of OSINT, she continued.

However, experts agree there are many policy discussions to be had surrounding wireless, and those charged with security policy will have to make judgment calls on where acceptable risk lies.

## SEEING THE LIGHT

Beyond wireless, it's going to take more than allowing smartphones in the building to ensure a good quality of life for employees.

"Perception is reality" when it comes to a facility's design, according to Vollen. "If one perceives themselves to be in an open space, in a place where they can be collaborative and have access to fresh air and daylight ... then [they] feel connected to the world in a way that feels most comfortable and able to be productive," Vollen said, adding workforce productivity directly affects an organization's bottom line.

Bruning said it's important to consider even outdoor areas for open-source collaboration and mobility.

Manzelmann, who recalled working in facilities with concrete walls and no natural light, said the IC is learning to evolve in its design approach.

"The main purpose of the facility is to make that agency's workforce successful in meeting the mission," he said.

Design concepts in the commercial sector are much different than they were even five to 10 years ago, he continued, with a "cityscape" approach that includes open space, "touch down areas" for visitors from other facilities, and "huddle rooms" for collaborative work becoming the norm.

"The IC needs the best and brightest," Manzelmann said. "We're competing with the private sector—Microsoft, Google, those kinds of companies—for talent. A better facility makes us more competitive."

Chuck McGaugh, vice president of business development for the western region with NJVC, joked he's "a little too old to appreciate feng shui," but applauded modern design concepts such as the relatively new NCE facility as "visionary" for changing the employee experience.

"All of a sudden going to work became less of going to a map making factory and became an experience. It's fun, exciting, new, fresh," McGaugh said, referring to NCE's airy glass atrium, cafes, and color-coded floors.

**"High-performance smart buildings operating today can actually be more secure because there's so much more data available—there are no surprises. You have total situational awareness all the time."**

—JILL BRUNING, EXECUTIVE VICE PRESIDENT AND GENERAL MANAGER, INTELLIGENCE COMMUNITY AND SERVICES STRATEGIC BUSINESS UNIT, AECOM



Like Manzelmann, McGaugh cautioned N2W “won’t be the only geospatial business in town,” even as NGA continues to explore new ways of producing, examining, and integrating data.

Pollmann’s team assembled a group of cross-agency personnel to visit dozens of locations around the country and in Canada, including the Bill & Melinda Gates Foundation, the National Renewable Energy Lab, and Canada’s NSA equivalent—the Communications Security Establishment.

The group toured facilities known to be exemplars in at least one area such as sustainability, use of open space, or workplace mobility. The benchmarking trips, paired with about 600 interviews with agency personnel, helped the N2W team both realize the art of the possible and recognize which concepts might be a bridge too far for an intelligence agency.

“It’s amazing that as new as NCE is, it’s not where we need to be today,” Pollmann said. “All of these trips and interviews are helping us determine what are the adaptability features we need to weave into the design, and where we can push the agency culturally and even from a policy and process standpoint.” She added the City of St. Louis is seeking input from the NGA workforce on what sort of amenities it would like to see in the neighborhood surrounding N2W.

To ensure coordination and collaboration among neighborhood revitalization, transportation, and other re-development efforts in support of NGA, the city launched the Project Connect action plan and welcomes public opinion.

A strong mix of housing, shopping, services, dining, and transportation at the new location promises to improve quality of life for N2W’s neighbors and the current workforce as well as lead to new dynamics in NGA recruitment.

#### PAVING THE WAY

As NGA enters uncharted territory for the IC, it is looking to the commercial sector to help envision what the future will look like and to provide the IT infrastructure for the next era.



“[N2W’s IT requirements] won’t look like what it takes today to support NCE or 2nd Street, or any of our other facilities,” Pollmann said. “We will be looking for industry ideas on how to take this forward and be part of a wireless and cross-domain environment.”

Manzelmann predicts N2W will take the IC to “the next level” in many ways, including the ability to adjust facilities internally to different levels of classification, to incorporate more wireless devices into the environment, and to create the employee workspace of the future.

“How you handle the internal part of the building to be adaptable and flexible in the most agile way is really going to be the measure of how well we do on this facility,” he said.

Pollmann also said adaptation is a high priority for N2W.

“We have to adapt and we have to change,” she said. “[Director Cardillo] has been very clear—operating in the open is the new of the game. We have to build N2W to allow that.” ☺



## Join Today as an Individual Member

### Grow your Network

- Be a part of your professional association dedicated to the GEOINT Community
- Network with your peers while developing new business opportunities
- Complimentary attendance at GEOINteraction Tuesday networking events

### Stay Informed and Save Money

- Receive up to \$200 off the cost to attend each USGIF event, including GEOINT 2017
- Save \$100 on each Certified GEOINT Professional (CGP) exam
- Attend members-only events

**connect.usgif.org**



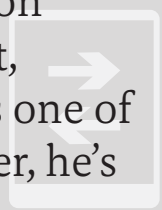
# smart stuff



The Internet of Things offers convenience, efficiency, and intelligence value, but also brings new risks to networks and data security.

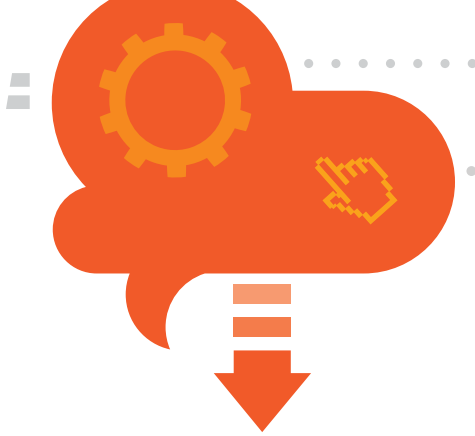
*BY MATT  
ALDERTON*

**HAVING CO-DESIGNED** the communication protocol on which the virtual world was built, computer scientist Vint Cerf is best known as one of the “fathers of the internet.” To his friends, however, he’s better known as an oenophile.









Cerf's passions for wine and technology are not mutually exclusive. Along with more than 1,000 bottles of vintage vino, the wine cellar in his home near Washington, D.C., stores a sophisticated technology suite that tracks in real time the condition of his fine wine collection. It starts with a network of sensors that monitor the light, temperature, and humidity in every room of his house; if the temperature in the wine cellar rises above 60 degrees Fahrenheit, Cerf receives a text message on his smartphone. The system tracks when the lights are turned on, notifying him if someone enters the cellar without his

permission. And because every bottle he owns is outfitted with an RFID chip, Cerf can take a quick inventory with his handheld RFID detector.

Cerf's high-tech wine cellar isn't just a technophile's quirky hobby. It's also a bellwether for the Internet of Things (IoT), which will be the nervous system of the hyper-connected world currently under construction all around us.

"Anything that is programmable that can communicate through the internet is potentially a 'thing' in the Internet of Things," explained Cerf, a former Defense Advanced Research Projects Agency (DARPA) scientist who is now vice president and chief internet evangelist at Google.

Beyond sophisticated wine cellars, the IoT includes picture frames that can automatically download photos from the cloud, thermostats that can be controlled from one's smartphone, and light bulbs that can be dimmed wirelessly. And that's just for starters.

"By 2020, we're going to have 50 billion 'things' that are connected to the IoT and performing various tasks in a massively interconnected way, from phones to blenders to printers to cameras," said University of Montana Research Fellow Dr. Alex Philp, founder and vice president of special programs at Adelos, which specializes in fiber optic sensors. "The breadth of devices associated with the IoT will create a lot of complexity, but also overwhelming possibilities."

Because each and every IoT device will have a physical and temporal location alongside its virtual footprint, GEOINT will be a key enabler to manage the challenges and harness the opportunities.

#### BEHIND THE BUZZ

British technologist Kevin Ashton coined the term "Internet of Things" in 1999 to describe the network connecting objects in the physical world to digital

**"By 2020, we're going to have 50 billion 'things' that are connected to the IoT and performing various tasks in a massively interconnected way, from phones to blenders to printers to cameras."**

—DR. ALEX PHILP, FOUNDER AND VICE PRESIDENT OF SPECIAL PROGRAMS, ADELOS

*The Internet of Things, based in part on technology from Hexagon AB, enables integrated managing of critical assets in "Smart Cities," which improves efficiency, citizen safety, and overall quality of life.*



IMAGE COURTESY OF HEXAGON US FEDERAL





infrastructure in the virtual one. The buzzword, however, is actually the convergence of four much older concepts, according to Dr. Thomas Yen, technical director of the Internet of Things Lab at the University of Wisconsin-Madison.

The first, according to Yen, is embedded sensing, whereby microprocessors make everyday objects “smart.” The second is pervasive connectivity, which allows one to be connected to the internet at all times. The third is ubiquitous computing, which makes computing possible across devices. Finally, there’s virtual interfaces, which describes the ability to engage devices without physically touching them.

“These four technologies coming together is what best defines the Internet of Things,” explained Yen.

According to Barry Barlow, chief technology officer at Vencore, “The Internet of Things is about objects that have embedded sensors that are connected so they can either transmit information or receive information, and in some cases act on that information.”

For example, take a connected refrigerator that photographs its contents and uploads the pictures to the cloud, where they can be accessed alongside recipes in a smartphone app so the consumer knows what to buy at the grocery store. “There are Samsung refrigerators on the market right now that provide that service to the owner,” Philp said.

Aggregate, real-time data captured from refrigerator-generated recipes and shopping lists could tell food manufacturers and marketers what consumers are buying, where, and in what quantities, allowing entire industries to turn on a dime.

Along with smart homes, another IoT growth sector will be health care. Devices like connected insulin pumps and pacemakers already help doctors and patients identify and target risk factors for conditions such as diabetes and heart disease.

“Eventually, I think you’ll see nanoscale devices that are put into our bodies intravenously or orally to help us understand our heart rates and rhythms; measure and sample the microbiomes of our mouth, esophagus, and intestines; monitor cholesterol and blood pressure; and look for

## RISKY BUSINESS

At approximately 7:10 a.m. EST on Oct. 21, 2016, unidentified hackers executed a large-scale cyberattack against Dyn, a New Hampshire-based company that monitors and routes internet traffic. The distributed denial of service (DDoS) attack—the largest ever of its kind—blocked access to websites such as Twitter, Tumblr, Netflix, Reddit, and Airbnb for internet users on the East Coast. Although no significant damage occurred, the attack was alarming because of the hackers’ modus operandi: They discreetly infected hundreds of thousands of “smart home” devices like internet-connected cameras, baby monitors, and thermostats with malware that hijacked the devices and used them to flood websites with so much junk traffic the sites could no longer accommodate legitimate visitors.

In a world abuzz with excitement about the Internet of Things (IoT), the attack was a blunt reminder that technology poses as many risks as benefits.

“It re-energized the conversation in this country about security,” said Rob Mott, vice president of military and intelligence solutions at Intergraph Government Solutions (now Hexagon US Federal). “People are beginning to understand: The more we rely on the internet, the more power we have—but also the more risk there might be.”

Indeed, the IoT comes bundled with threats as well as opportunities, according to Vint Cerf, vice president and chief internet evangelist at Google. Along with DDoS attacks, Cerf worries about specters like privacy breaches and data theft.

“Let’s suppose you have temperature sensors in a house

and an unauthorized person is collecting data from them every five minutes. After six months, that person will have a pretty good idea of how many people live in the house and when they come and go, all of which might be very useful if they were planning to break into your house,” Cerf said.

It’s not just information that’s vulnerable. It’s the devices themselves, which could be hijacked by criminals or terrorists, according to Argonne National Laboratory Senior Scientist Pete Beckman.

“Suppose someone can turn off a hall light in your home. That’s annoying. But if someone can turn off all the lights in a hospital, that’s more than annoying,” he said, suggesting hackers could just as easily hijack connected thermostats to deny Americans heat in their homes, or turn all traffic lights in a city green or red to wreak havoc. “Those are the kinds of quick attacks that could have a really big impact.”

Policymakers have a responsibility to ensure public safety by passing IoT rules and regulations. Security must start, however, with the technology itself, according to Beckman, who said engineers and developers must design IoT products with security in mind. In particular, he advocates using distributed networks to make the IoT more resilient. “We have to build in distributed decision-making and distributed response so a single attack can’t disable an entire network,” he said.

Hardware and software likewise need to be reengineered with less vulnerability, which is a focus at the National Geospatial-Intelligence Agency (NGA), according to Deputy Director for IT Mark Munsell. “[NGA is] looking at new methods of securing our network,” Munsell said. “A lot of our old systems have thousands if not millions of doors into our network. By moving to the cloud, we’re ... building a house that only has one door, which we keep a real close eye on.”

NGA is well positioned to protect not only its own network, but also the networks of the nation at large. “Just like we have a role in securing the nation from physical threats, NGA has been asked to help secure the nation from cyber threats,” Munsell continued. “We’ll do this by using our expertise in mapping ... to understand the physicality of the world’s networks, then take that up a notch through spatial analysis of devices and actors and activities.”

But the best line of defense in the IoT era might be citizens and consumers.

“All the people who were involved in [the DDoS attack against Dyn] had no idea their baby monitors had been hacked. But then again, they probably didn’t read the instructions to change their default passwords, either,” Barlow said. “As we move forward, there needs to be a cyber-education campaign to inform the public about the risks from technology and how to protect themselves.”



certain diseases,” said Philp, who added such devices will collect and transmit biological information via miniaturized versions of the RFID chips Cerf uses in his wine cellar.

In manufacturing, connected machinery could yield similar benefits by helping diagnose problems with equipment, materials, and processes.

“Sensors in machinery generate a great deal of data that can help manufacturers detect a bad product almost instantaneously and correct it as the problem is happening,” noted Yen, who said IoT-enabled diagnostics can help manufacturers eliminate not only wasted product, but also wasted time. “If a factory has 2,000 pieces of identical machinery, and 300 pieces failed after being used in a particular manner for a particular length of time, the company should be able to use that data to predict when the remaining machines will fail and pre-emptively fix them, thereby reducing unscheduled downtime.”

#### CONNECTED GOVERNMENTS

Although most IoT innovation lies in the commercial sector, some of the most promising IoT use cases belong to government.

One such use case is public safety. “Imagine your house is on fire and the fire department is on its way,” Cerf said. “If you have webcams in the

“The GEOINT Community is very important to the Internet of Things because it provides a visual understanding of trends and patterns.”

—ROB MOTT, VICE PRESIDENT OF GEOSPATIAL SALES AND MARKETING, HEXAGON US FEDERAL

house and temperature sensors, you might want the fire department to be able to access those to determine: Where is the hottest part of the fire? Where did the fire start? Is someone unconscious? If so, in which room of the house?”

Or, imagine a connected camera at a busy intersection, suggests Pete Beckman, co-director of the Northwestern-Argonne Institute of Science and Engineering (NAISE), a collaboration between Argonne National Laboratory and Northwestern University through which he’s developing secure wireless sensors that leverage “edge computing” to quickly process and exploit data locally. With local rather than cloud architecture, Beckman said, sensors in streetlights could automatically deploy salt trucks after detecting cars sliding on ice, or emergency responders after detecting an automobile accident.

“Suppose a camera is looking down on an intersection when it sees a car strike another car. Based on the mass of the vehicles and their deceleration, a sensor connected to that camera could determine whether an airbag deployed and automatically alert 911. It could then immediately start routing traffic around the intersection in different ways by changing the traffic lights,” said Beckman, whose project is named Waggle after the dance bees do to communicate the location of nectar, pollen, and water to others in their hive. “You can imagine a whole set of autonomous reactions in our infrastructure based on collecting good data and being able to process it locally instead of sending it to a central server.”

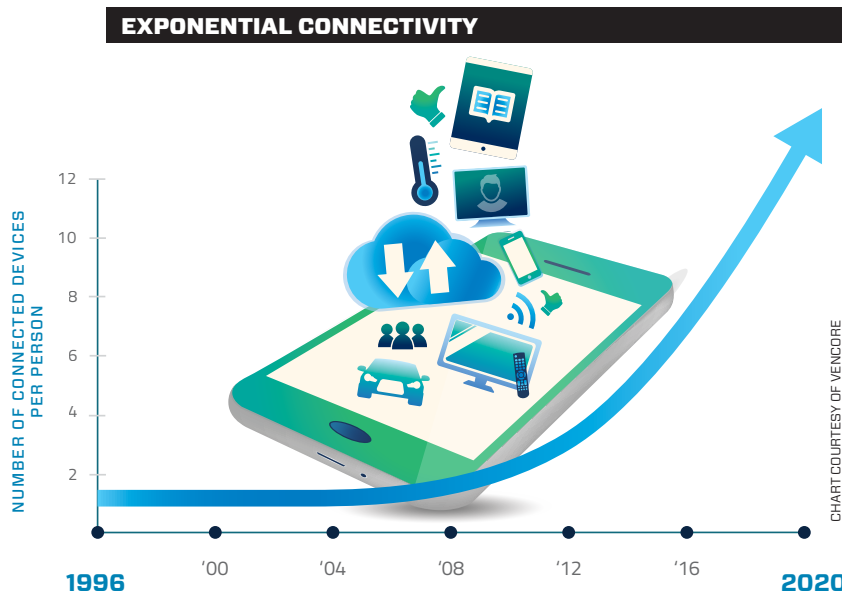
Waggle is the foundational platform for the Array of Things, a Chicago-based project that will outfit the city with 500 modular sensor boxes, called “nodes,” by the end of 2017. Inside each node, a bundle of sensors will collect a cornucopia of urban intelligence—including 24/7 data on traffic, air quality, weather, and noise—that could help the city optimize resources and enhance services.

“The Array of Things is a science project to understand how we might instrument a city, what we could learn about a city, and how we could use that information to improve a city,” Beckman said.

Like local governments, the federal government can leverage the IoT to fulfill its mission—including that of national security. Where it’s open and accessible, for example, IoT data such as thermostat readings could be used by the military to determine building occupancy when responding to a natural disaster or performing reconnaissance on enemy targets.

“I think the Internet of Things can be an extremely powerful tool for intelligence gathering,” Cerf said.

The National Geospatial-Intelligence Agency (NGA) agrees. As part of its GEOINT Services platform, the agency





*The Array of Things (AoT) is a research project to deploy hundreds of interactive, modular sensor boxes around Chicago to collect real-time data on the city's environment, infrastructure, and activity for research and public use. The AoT combines Waggle technology developed at Argonne National Laboratory with architecture and design execution from the School of the Art Institute of Chicago. One of the early design prototypes from SAIC is shown here outfitted with Waggle.*



IMAGE COURTESY OF WAGGLE

is researching ways to stand up its own “Array of Things” to serve warfighters on the battlefield, according to NGA Deputy Director for IT Mark Munsell. “If you happen to be in an area with a geofence around it, all the devices in that area—drones, artillery, handheld weapons, and various other sensors—will be interconnected and working together to provide a multitude of services, be they intelligence-, combat-, or logistics-related,” he said. “Instead of your refrigerator, television, and thermostat, your weapons will be hooked up to the internet.”

Consider, for example, a sniper with a connected rifle. “[The rifle] will know its location from GPS, just like your phone would. It will know its orientation from a magnetometer, just like your phone would. And it will know its pitch and yaw from an accelerometer, just like your phone would,” Munsell said. “Now imagine it knows the terrain around you based on a service [NGA is] providing. With that, you can do a viewshed analysis and automatically determine whether your target is in range. If it’s not, when you look through the scope it will guide you to the location on the ground where you can see the target you’re aiming for. That’s what the concept of the Internet of Things will look like when it’s applied to combat operations.”

## POWERED BY GEOINT

In both public and private sectors, the IoT’s promise is manifold, according to Barlow, who cites three benefits in particular.

The first is relevance. “Take an app like Waze,” Barlow said, referring to the smartphone app that uses real-time traffic reporting to crowdsource navigation. “Instead of getting traffic updates every 10 minutes on the radio, you’re getting traffic information that’s current and affecting you right away.”

The IoT’s second benefit is accuracy. “The information you’re getting [from sensors] is raw and untouched. It hasn’t been manipulated,” Barlow continued. “In an emergency room setting, for instance, doctors can act quickly when a patient is connected because they know they’re in a certain room and that they’re having a certain problem.”

Finally, there’s the IoT’s scale. “We’re able to collect information from sensors not just on a local level, but also at regional and even global levels,” Barlow explained. “Because we have connected readers at cash registers all over the world, for example, credit card companies can detect massive fraud as it’s happening and take action to mitigate its impact.”

To Cerf, the benefits are quite practical—the IoT can save lives, time, and money. “For many of these devices, convenience, safety, and efficiency are the

drivers,” he said, citing an example from Google, which recently conducted an experiment wherein it used an artificially intelligent neural network instead of human operators to control the cooling system at one of its large data centers. “We used machine learning to determine what was the optimal setting for various parameters, and we discovered that it worked better than people did. It was faster, it recognized patterns, and it saved us about 40 percent on our cooling costs.”

Because GEOINT adds spatial and temporal context to IoT services and analytics, it is the linchpin that makes such returns possible, according to Rob Mott, vice president of geospatial sales and marketing at Intergraph Government Solutions (now Hexagon US Federal). “The GEOINT Community is very important to the Internet of Things because it provides a visual understanding of trends and patterns,” he said, suggesting GEOINT’s major contribution to the IoT would be providing geospatial processing and web services to companies and consumers in the same way NGA seeks to provide them for warfighters. “Working with open standard data that’s readable by GEOINT processes, you can develop web services that provide answers to very tough questions but do not necessarily require looking at a map or interfacing with an app.”

Consider, for example, the Amazon Echo. Using its built-in voice service, Alexa, consumers can ask simple questions about weather, sports, movie times, and more. Thanks to predictive analytics, future Echo-like devices will be able to help commercial, industrial, and government users answer more complex questions in a similar fashion; by accessing web services that leverage geospatial data aggregated from sensors across the IoT, they’ll be able to predict everything from floods to traffic accidents.

“By looking at past trends and other parameters, a geospatial service could give you an answer without you ever having to interact with a map,” Mott said. “It will be a very elegant and powerful GEOINT process that will give you a very reliable, ‘X-marks-the-spot’ kind of answer.”

A multisensor field deployment uses Botts Innovative Research's OpenSensorHub (OSH) service node and OSH Web Client Toolkit. The OpenSensorHub project supports development of software to automatically fuse data from disparate sensors and actuators.

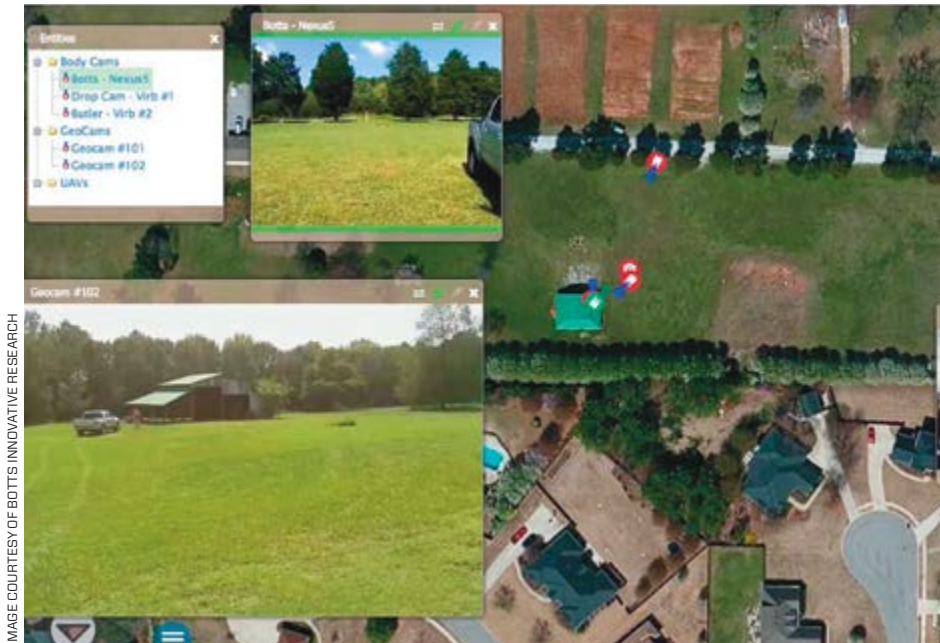


IMAGE COURTESY OF BOTTS INNOVATIVE RESEARCH

### NEXT STOP: INTEROPERABILITY

Indeed, the connected future looks bright. Turning the IoT from a series of cool gadgets to an integrated network providing actionable information, however, will require industry and government to collaborate on policies, procedures, and protocols to mature IoT technology.

Among the areas most in need of attention, experts agree, is interoperability. “The real benefits of the IoT will come from integrating sensors and using multiple data sources to process information and make decisions,” said Dr. Mike Botts, president and chief technology officer of Botts Innovative Research, which designs open standards for sensor systems and geospatial-temporal data. In 2000, Botts developed the OGC Sensor Web Enablement (SWE) standards, a set of IoT standards established to achieve “plug-and-play” functionality of IoT sensors and actuators via web services. “Without [standards], you’re left with a big conglomerate of proprietary systems that force you to take a different approach every time you want to engage a different sensor. Standards give us a common language to query the world of sensors and extract observations from them.”

In 2014, Botts co-founded the OpenSensorHub project to support the development of software through which to automatically fuse data from disparate sensors and actuators. Based on SWE standards, the project’s goal is to accomplish for IoT web services what the USB standard accomplished for computer peripherals.

But SWE is just one potential standard in a single domain. In addition to web services, standards are needed for IoT architecture, communication, connectivity, and more.

“I don’t want a separate app on my smartphone for every device in my house or my office; it would take me six minutes to flip through all my apps every time I wanted to flush the toilet or turn off the lights.”

—VINT CERF, VICE PRESIDENT AND CHIEF INTERNET EVANGELIST, GOOGLE

“It will take some time to get to a common standard for the kind of data that’s collected, the way in which it’s described, the format it takes, the commands you can give to a device, and the response you can expect in return,” explained Cerf, who expects IoT innovators to spend another five years locking horns over competing standards before a universal one is adopted. At that point, he predicts, it will take another five years to solve the next big challenge: consolidation.

“I don’t want to have a separate app on my smartphone for every device I have in my house or my office; it would take me six minutes to flip through all my apps every time I wanted to flush the toilet or turn off the lights,” Cerf said. “What we need is a much broader kind of control environment—a multi-brand hub we can use to manage and configure all of our devices locally from one place.”

Along with a physical hub for devices, the IoT needs a regulatory hub for policymaking, according to Barlow, who cites security risks as an impetus for government rulemaking. Because the IoT will be so ingrained in citizens’ lives, he argues, the federal government should publish minimum security standards for IoT devices the way it does safety standards for medical devices.

“Medical devices such as catheters and pacemakers must go through certain tests to ensure they’re not going to do more harm than good,” Barlow said. “IoT devices need similar scrutiny, particularly in highly regulated industries like transportation, health care, energy, and the environment.”

IoT challenges and questions abound. But so do the opportunities—especially for GEOINT.

“The IoT adds a whole new dimension to geospatial intelligence by giving us a new way to detect and understand the world at a particular time and in a particular place,” Botts concluded. “It’s no longer just grabbing an image and storing it somewhere to make a map. It’s dynamic, and that’s going to give us a lot of new capabilities.”





**JUST LAUNCHED**



# Career Center

Find your next GEOINT job or employee  
on the online job board.

## Find a Job

Search jobs & internships, create an account, and post your resume for employers to review.

## Post a Job


List available positions and attract top talent.



careers.usgif.org



# autonom agronomy

A yellow and white autonomous agricultural drone is shown from a low angle, flying over a lush green field. The drone has a white fuselage and yellow wings with black stripes. It is equipped with a camera and various sensors. The background is a vast, green agricultural field with rows of crops.

Precision agriculture  
applies technology to  
improve crop yields and  
reduce costs as well as  
to provide early warning  
signs about food insecurity  
and regional conflict.

*BY MELANIE D.G. KAPLAN*





IMAGE COURTESY OF AGEAGLE



## THE U.S. GEOLOGICAL SURVEY

opened its Earth Resources Observation and Science (EROS) Data Center in 1973, northeast of Sioux Falls, S.D., surrounded by farmland. The then high-tech center included rooms for photo processing, computer storage, and microfilming. “Remote sensing” was still a novel term, and researchers couldn’t begin to imagine all the ways it would be used.

But those working at the center understood that much of the data gathered by the Earth Resources Technology Satellite, later renamed Landsat, would be useful to the U.S. Department of Agriculture (USDA) for crop forecasting. An EROS news release from 1966 said photographs taken from space indicated that lands “can be examined, evaluated, and mapped, and the type and vigor of plants can be determined.”

USDA became EROS’s largest customer, according to Tom Holm, chief of the EROS policy and communications office. Holm served as chief of the data services branch in the ’80s, when images were converted to digital tapes and shipped to customers by mail.

“USDA’s Foreign Ag Service was the largest user of Landsat data, using thousands of images every year for global crop yield predictions,” Holm said. “The other user, almost equally large, was the Intelligence Community.”

Precision agriculture, the use of technology to improve crop yields and reduce costs, is considered the next big thing among venture capitalists, app designers, and tech-savvy farmers. But long before the first unmanned aerial vehicle (UAV) flew over a cornfield or the first app helped manage irrigation, the U.S. government was using satellite images to gather information about agriculture, which remains the foundation of economies throughout the world.

During the Cold War, Holm said, intelligence analysts looked at satellite images of Soviet fields. Analysts could determine the total wheat crop yield before harvest and before the USSR announced it would have a production shortfall—valuable intelligence on this side of the Iron Curtain.

*An AgEagle fixed-wing UAV captures aerial maps of plant health to optimize the application of chemicals and increase harvest yields.*

Agricultural service providers use the SoilCares Scanner to provide Kenyan farmers with soil analysis.



PHOTO COURTESY OF SOILCARES FOUNDATION

“Sometimes people think of national security as having a well-trained army,” said Torreon Creekmore, program manager for the Intelligence Advanced Research Projects Activity’s HFGeo program, which develops high-frequency communication technologies. “We don’t think about how food security plays into that.”

When crops fail and prices rise, people don’t have the money to purchase food, which can lead to stealing, then riots, social unrest, and mass migrations. National security depends on agriculture, Creekmore continued. “In a global economy, it’s an integrated system.”

Industry experts and those working in humanitarian aid agree higher-yield farming can’t come fast enough as population growth and climate change increase demands on the world’s food supply chain. The United Nations predicts the world population of 7.3 billion will reach 9.7 billion in 2050.

“In that time, we need [to achieve] 50 to 70 percent more output per acre,” said Alex Thomasson, an agricultural engineering professor at Texas A&M University. “I’m very confident we can. Precision agriculture is one of the biggest ways we have to improve the situation.”

#### VENTURE CAPITAL TURNS TO THE FARM

Farmers aren’t generally known to be risk takers. But every season—whether they’re farming soybeans in the Midwest or sugar cane in Melanesia—they take chances and make decisions about how to produce a higher yield, minimize waste, and reduce environmental impact. With every tweak and modification, they determine when, where, and how to apply inputs: water, seed, fertilizer, pesticide, herbicide, fuel, and labor. Some decisions are based on experience and history, others on science. More than ever, those who work the land are turning to geospatial imagery and analytics to fine-tune practices and improve their bottom line.

According to Thomasson, who is working on multiple UAV projects, variability in weeds, soil type, and plant health, for example, calls for inputs on an as-needed basis—ideally

on a plant-by-plant basis. “We’re far from that now,” Thomasson said, “but I’ll be working on it until I retire.”

The combined rise of small satellite constellations, cloud technology, and predictive analytics has led to a boom in precision agriculture. But the real value is in the analysis, and Silicon Valley is leading the way. According to a report from AgFunder, which funds startups in food and agriculture, investment in precision agriculture has nearly doubled since 2014, reaching \$4.6 billion in 2015.

Precision agriculture includes revolutionary advances such as: self-driving tractors; tractors communicating with each other in the field; farmers making data-informed decisions about when to plant; consultants referencing UAV images to determine when specific plants are under stress; and growers receiving automated alerts when there’s a problem in the field. Such advances are significant. For

---

“Many farmers have bought a drone thinking they can do something with it. The gap between getting images and getting actionable information is a gulf a mile wide.”

— SETH MURRAY, SENIOR ADVISOR FOR AGRICULTURAL SYSTEMS, USDA



example, in a farm of 1,000 acres precision agriculture can enable a tractor to self-drive within an inch of accuracy or show a farmer where he or she could add an extra row of soybeans.

“The holy grail for farmers right now is, ‘When will my crop mature?’” said Rob Laudati, director of Harris Geospatial Solutions. A strawberry grower in Florida, for example, needs to estimate his crop months in advance so a retailer can plan pricing and advertising. Laudati said machine learning is one of the key analytic advancements in precision agriculture—and a significant disruptor to the industry. Training a neural network could help determine not only whether a strawberry plant is under stress, but what is causing the stress.

### AMONG FARMERS, CAUTIOUS OPTIMISM

In the United States, about one-third of commercial farmers fall into the category of those who are “completely consumed with wanting to know exactly what’s going on in their fields,” said Chris Clayton, Ag Policy editor for DTN/The Progressive Farmer. As the global population grows and the amount of arable land declines, the margin for error during a short growing season gets smaller.

“Farmers turn to technology to boost yields per acre, and everyone’s looking for an angle,” Clayton said, adding that farmers—generally not GIS experts—are feeling overwhelmed by all the new vendors, products, and services. “It’s kind of like the beginning of the Blue Ray, HD, and DVR. Which technology is going to win out? There are so many startups in this field—which is pretty cool—but you don’t know which will survive and catch fire.”

Steve Hoffman, president of InDepth Agronomy, an independent crop consultant in Wisconsin, said farmers love new technology, but it needs to make sense for their bottom line. Most of them, he said, aren’t there yet. “There’s a lot of excitement among farmers,” he said. “It would be easy to adopt the technology and march ahead before we knew what the data meant.”

Among the precision agriculture startups are Descartes Labs and Orbital Insight, which both use

satellite imagery and monitor conditions in real time. Descartes, for example, releases a weekly forecast for every corn and soy producing state and county in the U.S., well ahead of the monthly forecasts created by USDA’s National Agricultural Statistics Service. Customers ranging from humanitarian organizations to commodity traders use these highly accurate forecasts and similar products from Orbital.

Other leading startups include FarmLogs, which develops mobile apps to help farmers track metrics for their fields, and Farmers Edge, which offers field-centric data management and analysis. Both rely on satellite imagery from Planet. In October, Planet signed a \$20 million contract with the National Geospatial-Intelligence Agency to provide imagery of at least 85 percent of the Earth every 15 days.

“If you were looking at images twice a year, that frequency of observation is only good for looking in the rearview mirror,” said Andrew Zolli, Planet’s vice president of global impact. “It doesn’t tell you anything that’s happening now and doesn’t get into the human decision cycle. Being able to look all the time not only tells you what happened and what is happening, but what may happen in the future.”

Planet operates the largest constellation of Earth imaging small satellites, which hit the sweet spot of low cost, high resolution, and high frequency. The company expects to have 100 satellites in orbit in 2017, collectively imaging the Earth daily at 3- to 5-meter resolutions.

“When you have that kind of daily imagery you will see patterns that not only tell you with much greater sophistication what’s happening on the ground, but a hint of what might be coming,” Zolli said.

IBM’s The Weather Company, which works with Farmers Edge to install advanced weather stations, uses predictive modeling to provide customers with real-time, hyper-local weather information.

In one case, IBM worked with Gallo Wines, which owns 15 wineries and had discovered—through satellite imagery—vines under varying degrees of water stress. Gallo’s new variable rate irrigation prototype allows the company to optimize the amount of water applied to each vine based on its specific need, resulting in a 23 percent larger grape harvest and the use of 20 percent less water. Carrie Gillespie, agriculture lead for The Weather Company, said in the future the company would deploy more than 400 personal weather stations

*Today, new farming equipment comes with tech on board, including in-cab touchscreen displays, GPS guidance, wireless file transfer, and machine telematics. Farmers can use their phone or tablet to locate equipment, set geofences, receive maintenance alerts, and check fuel levels.*



PHOTO COURTESY OF JOHN DEERE

in underdeveloped countries to help growers improve their agriculture and protect people from severe weather.

Large seed companies such as Monsanto—which bought The Climate Corporation in 2013—are getting into the game, providing variable-rate seeding prescriptions and recommendations to farmers about specific zones on their farm—executed through a planter control system. And John Deere offers web and mobile apps to its farmers to help analyze all the data collected by the company’s high-tech machines.

Lane Arthur, director of digital solutions for John Deere Intelligent Solutions Group, said the data is

controlled by the growers, who can choose whether to share it with John Deere as well as their seed and chemical companies. Arthur said John Deere strives for transparency in its data use (to improve tractor performance, for example), but across the industry tension exists regarding how much data should be shared. Younger farmers are more comfortable in a sharing economy, but older generations are more private and often consider their data proprietary. This complicates things, as massive amounts of data are needed to make forecasts, predict trends, and support machine learning.

Startups aim to improve the lives of farmers, but selling aggregated information to third parties (i.e. chemical and seed companies) is also part of their business plans, said an executive who asked not to be named. The margin for selling data to farmers is so slim companies need additional income to remain profitable. He said while data sharing will benefit many, it could hurt agricultural retailers (which have historically made it difficult for farmers to compare prices) and agronomists (whose recommendations likely can’t touch the accuracy of those made by machines).

### TURNING IMAGES INTO ACTION

In many ways, it seems as though UAVs were designed for farm work. They can image frequently, fly low, and capture detail about individual plants that satellites cannot. Analysts expect precision agriculture to be the largest U.S. end market for commercial UAVs, with a potential of \$1.4 billion in sales before achieving saturation.

One of the market leaders in UAV-based precision agriculture is Kansas-based AgEagle, which offers a UAV that can fly in the wind, cover hundreds of acres in one flight, and land in the fields. AgEagle’s UAV creates stitched, geo-tagged images while airborne, and its multispectral sensors capture near-infrared bands that identify for farmers and agronomists which plants are stressed—days before the anomalies could be seen with the naked eye. Healthy plants show up green; stressed, yellow; dead, black.

USDA Senior Advisor for Agricultural Systems Seth Murray said the department may not be as engaged in precision agriculture as it is in some other fields such as plant breeding, but added it is yet to be determined exactly how UAV technology will be used.

“Many farmers have bought a drone thinking they can do something with it,” Murray said. “The gap between getting images and getting actionable information is a gulf a mile wide.”

He added USDA is working with partners to design and test UAV technologies and educate both farmers and the public; the department’s National Institute of Food and Agriculture is currently funding hundreds of UAV-related projects. He noted that research has been difficult, partly because of strict FAA regulations that USDA and their researchers must follow (while private companies may choose not to).

One company bridging the gap between image-gathering and data-driven decisions is Agribotix, which processes and analyzes UAV-gathered data to help farmers increase yield while reducing the environmental footprint. The company uses a cloud-based system called FarmLens to create useful tools such as prescription maps for fertilization and weed reports for geo-locating resistant patches.

“Our focus is how to make it easy after you’ve flown a drone to get the data,” said Agribotix Chief Operating Officer Paul Hoff. He said he expects UAV use for agricultural purposes to skyrocket in the next two years, more than any other precision technology.

What’s the next big thing? Creekmore suggests “nowcasting”—which tells a farmer, for example, the best time in the next hour to water a field or transport goods. Creekmore also predicts a move from multispectral to hyperspectral sensors will provide growers a more detailed fingerprint of their crops. For example, a multispectral sensor can be used to show forested areas versus crop areas, while hyperspectral sensors, which are more sensitive to subtle variations in reflected solar energy, can detect an oak, maple, or spruce tree within the forest.

Work is underway at a number of universities to further development of precision agriculture tools. At Texas A&M, Thomasson is exploring various remote

PHOTO COURTESY OF PLANET



*This is a true-color image of sugar cane crops abutting the protected forest of Iguazu National Park, Sept. 23, 2016.*

“If you were looking at images twice a year, that frequency of observation is only good for looking in the rearview mirror. It doesn’t tell you anything that’s happening now and doesn’t get into the human decision cycle.”

— ANDREW ZOLLI, VICE PRESIDENT OF GLOBAL IMPACT, PLANET





Analysts expect precision agriculture to be the largest U.S. end market for commercial UAVs, with a potential of **\$1.4 billion** in sales before achieving saturation.

PHOTO COURTESY OF AGRIBOTIX

and proximal forms of sensing—from robots in the field to the possibility of UAVs talking to tractors. One project looks at identifying a disease in cotton using UAV images, and another focuses on assessing the water and nutrition need of individual plants.

### PRECISION AG FOR PEACEKEEPING

While farmers both large and small use precision agriculture to improve efficiency, humanitarian leaders and the Intelligence Community are interested in how the technologies can be used globally to address food insecurity and the potential unrest it can create.

Global Harvest Initiative (GHI) is an organization that advocates for ways to help low-income countries boost agriculture through better information, training, irrigation, and seeds. High-tech farming tools are critical, said GHI Executive Director Margaret Zeigler, but equally important is making sure broadband is available for precision agriculture in rural areas. GHI's recent Global Agricultural Productivity Report describes innovations such as the Soil Cares Scanner, being piloted in Kenya, which uses the infrared spectrum to provide affordable, real-time analysis about variability in soil and fertilizer recommendations through an app. Zeigler also pointed to the success of the International Center for Tropical Agriculture, which worked with Colombian rice farmers to avoid millions of dollars in losses after using weather and crop data to understand how climatic variation impacts rice yields.

Nonprofit PeaceTech Lab's Noel Dickover leads the Open Situation Room eXchange project, which works to make big data more readily available in peacekeeping. He said big agriculture can provide an early warning sign about food insecurity and regional conflict, and can be a key decision support tool for local peace advocates. PeaceTech Lab is integrating weather data and agronomic

models with existing indicators of conflict, working with Colorado-based aWhere, which monitors the weather at a nano level and communicates with farmers via SMS text messages.

"The military spends a lot of money and time trying to figure out all kinds of threats and risk assessments," Zeigler said, referencing the Office of the Director of National Intelligence's Global Food Security report, which concluded declining food security will "almost certainly contribute" to social disruptions and political instability. "So understanding where food crises might be coming is a way they can prepare." As an example, Zeigler points to the failed wheat crops across continents, and a series of droughts in Syria that triggered global wheat shortages, caused a spike in wheat prices, and led to the Arab Spring.

"Because of that, the Intelligence Community has always focused on trying to get a handle on food prices and crop failure. There are now many more tools to do that." 🌐

*UAV imagery taken over palm plantations in Sumatra is used to map the plantation, locate all of the trees, and plan for future improvements.*



**WEB  
EXCLUSIVE**  
Learn how  
precision  
agriculture  
can predict  
civil unrest.  
Visit  
[trajectory  
magazine.  
com](http://trajectorymagazine.com).





## General Dynamics Mission Systems: Simplifying the Analyst

*Mike Manzo, director of geospatial intelligence*

**Q** General Dynamics Mission Systems is a relatively new business unit. How would you describe your role in the GEOINT Community?

General Dynamics Mission Systems is just more than a year old and is an aggregation of a number of acquisitions and the combination of General Dynamics Advanced Information Systems and General Dynamics C4 Systems. When we talk to our customers, we bring to bear the strength of two large companies with deep-rooted histories in helping solve our customers' problems. Our combination has been contributing to the national security of this nation both at the strategic and tactical levels for more than 30 years. Our role is truly in the global GEOINT Community and we've been involved since

before the term "GEOINT" was coined. We're constantly working with our users and customers to examine what technologies are emerging, the nature of threats and how they are changing, and how we can help the end user be successful to ultimately save lives.

**Q** What are your core products and services?

We've broken up our offerings into three areas: motion GEOINT, enterprise workflow, and open platforms. Motion GEOINT is focused on MAAS—the Multi-INT Analysis & Archive System—which enables full-motion video exploitation for tactical and strategic users. MAAS gives real-time analysis and a window into an event. Enterprise workflow focuses on the EMTK—Enterprise Mission-Management

Toolkit—which enables intelligence production mission management for U.S.-based customers and the Five Eyes coalition. The third focus area is open platforms, which contains our Analytic Modeling capability and develops platforms to leverage future investments by our customers.

**Q** How is your company preparing for the future of GEOINT?

One solution we're gaining traction with is our open platform. We want to move away from large system deployment and toward rapid acquisition of capabilities. We don't want people to buy a capability they'll have to replace in three years. Instead of the government waiting to get a platform, you aggregate that and begin to provide them with smaller capabilities. The



time of deployment dramatically changes from years to months and sometimes weeks. That's one of the major shifts we're seeing in the intelligence and defense communities.

There's also a large need for analysts to be able to collaborate and bounce ideas off each other and refine their hypotheses, which is what we call "Analytic Modeling." This is beginning to come into its own with the inception of the Intelligence Community Information Technology Enterprise (IC ITE). As the community adopts IC ITE, analysts are exposed to a wealth of data. There's a need for a platform where the analyst can share and communicate with the data. We're working with end users to better understand how access to more data will help them. The last thing you want to do is provide analysts with "analysis paralysis" when searching through mountains of data—we want to help them analyze the data and relax the cognitive burden required of them. We're offering a platform in which third parties can try out their technologies and provide solutions in a "Darwinian space," meaning solutions being used survive and those that do not are replaced with other capabilities. We also want to better understand and model with users where they see themselves in two to five years to determine what technologies need to be invented to see them into the future.

## S2 Analytical Solutions: Honest and Uncomplicated

*Steve Bailey and Sam Burton, founding partners*

### Q What is something most people don't know about S2?

Not only are we managing partners of the company, but the company gets its name from ours—Steve and Sam—S2. This is highly important to us because we stake our personal reputations on the quality of our company—this is a value that is sometimes difficult to find. We took a risk starting our veteran-owned small business in 2011 in a turning market, but we wanted to better the GEOINT mission after both having supported the Department of Defense and Intelligence Community for many years.

### Q Who are S2's customers?

S2 provides full lifecycle, mission-focused systems engineering, analytical, and business services and capabilities. The National Geospatial-Intelligence Agency (NGA) is our primary customer. We provide NGA with systems engineering and integration, program management, portfolio management, and cloud and agile services. We have capabilities that span

the agency's entire systems engineering lifecycle. We also support the National Reconnaissance Office, the Office of the Director of National Intelligence, and the Defense Intelligence Agency.

We have had many firsts—S2 was the lead engineer on the implementation of the first IC capability into the cloud. We led the first agile development effort at NGA, we were the first to implement lean startup for a project at NGA, and we led the integration of the first commercial technologies through the GEOINT Solutions Marketplace. We currently lead the activity-based intelligence/structured observation management/next-generation tasking efforts that will bring the first NGA enterprise-wide capabilities in these areas. We continue to take the risk in leaning forward to be the first to try something for our customers, and it's even better to be the first to succeed in those areas.

### Q What are some GEOINT Community trends you are witnessing?

We see ever-increasing implementations of commercial technologies and best practices. S2 has been on the leading edge of this at NGA and we like to think of ourselves as a company that strives to not only talk about these things, but to execute them—hence our motto, 'Excellence in Execution.'

The other trend we see is a movement to gap the chasm between the end user and systems engineers and integrators. The closer we are to the end user, the better we can enable the

**"We like to think of ourselves as a company that strives to not only talk about these things, but to execute them—hence our motto, 'Excellence in Execution.'"**

—STEVE BAILEY AND SAM BURTON,  
FOUNDING PARTNERS,  
S2 ANALYTICAL SOLUTIONS



Sam Burton (right) with Dr. Greg Arnold, an S2 senior account executive, in the company's booth at the GEOINT 2016 Symposium.

Tina Patterson



**“I leveraged USGIF materials and events to stay abreast of hot topics and trends in the GEOINT field since I interact with clients who provide services to the defense and intelligence communities.”**

—TINA PATTERSON, PRINCIPAL, JADE SOLUTIONS

implementation of IT and business capabilities to support their mission needs. This will ensure engineers, integrators, subject matter experts, and project managers fully understand and mentally take ownership of the mission they support, and mission folks understand what technologies and processes exist to support them.

**Q How quickly has S2 grown?**  
Within NGA, we’ve grown from two to 75 employees in the last five years. We just had our first set of employees hit their five-year mark with S2, which we are very proud of. Our people are our treasure and we invest internally for their professional development. Since we began the company, we’ve doubled in size every two years. We’re currently looking for the best of the best in forward-leaning data and cloud architects, agile engineers, financial auditors, and portfolio and program managers as we continue to develop new capabilities and services for our customers.

### Individual Member Spotlight: Saying ‘Yes’ to Opportunity

*Tina Patterson, principal, Jade Solutions*

Jade Solutions is a woman-owned small business providing clients with business and marketing consulting services including proposal development and management, product management, and project management. Patterson has been a USGIF Individual Member since 2015 and is a member of the Foundation’s Small Business Advisory Working Group.

**Q Why did you choose to become a USGIF Individual Member?**

When I became a USGIF member I was seeking to be involved with organizations that might support my clients. I leveraged USGIF materials and events to stay abreast of hot topics and trends in the GEOINT field since I interact with clients who provide services to the defense and intelligence communities. As a small business owner, USGIF

Individual Membership has been very helpful. USGIF’s Small Business Advisory Working Group is wonderful and so is meeting other individuals at meetings and USGIF events such as GEOINTeraction Tuesday. I don’t feel lost like I have with other associations. USGIF volunteers and staff are very welcoming and open.

**Q What led you to start your own business?**

After working for federal contractors and experiencing layoffs, I decided it was time to stick my toe in the water and see what it’s like to have a business of my own. I began my business in 2014 with the intent to provide my clients the same level of customer service I would want to receive from a business. Jade Solutions has four guiding principles: fortitude, integrity, focus, and accountability. There’s a public perception that running a small business is glamorous, but that’s not always the case. Some days you’re up late working to meet a deadline or anxiously awaiting a payment from a client. But at the end of the day, it’s rewarding and worth it.

**Q What is something most people don’t know about you?**

I’m a polyglot. I speak five languages: Arabic, Brazilian Portuguese, English, French, and Spanish.

**Q What excites you about being a part of the GEOINT Community?**

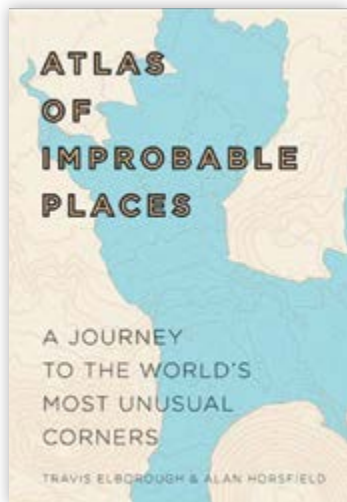
The cross-cutting effects and applications of geospatial intelligence excite me. Whether talking about weather, human and drug trafficking, identification and neutralizing cybersecurity threats, or tracking the spread and eradication of human viruses—all of this information is GEOINT.

**Q What advice do you have for other small business owners?**

Don’t give up! Say ‘yes’ to opportunity and find or establish a network of individuals you can run ideas by, but who are also supportive and provide honest feedback about your goals and dreams. Join organizations such as USGIF that support small businesses, and attend networking events as your schedule and budget allow. 🌐



## READING LIST + USGIF EVENTS CALENDAR



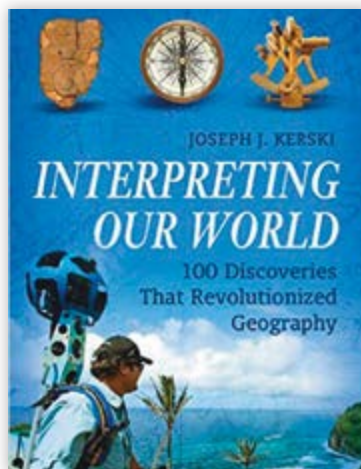
**Atlas of Improbable Places:  
A Journey to the World's  
Most Unusual Corners**

By Travis Elborough &  
Alan Horsfield

Containing beautiful maps and stunning photography, this book illustrates more than 50 of the most bizarre hidden destinations around the globe. Readers not only get to discover the stories, but also the culture and influence of each location.

**Interpreting Our World:  
100 Discoveries That  
Revolutionized Geography**

By Joseph J. Kerski, Ph.D.  
Combining geography and history, Kerski demonstrates why geography is important by examining 100 significant world events. The book describes how these historic events affected the study of geography and society as well as how geography influences decision-making.



**Overview: A New  
Perspective of Earth**

By Benjamin Grant

Grant offers an impressive collection of 200 satellite images of Earth depicting the state of industry, agriculture, architecture, and nature. The book was inspired by the "overview effect," the sensation astronauts experience when looking down from space to view Earth as a whole.

**MARCH 14**  
**GEOINTeraction**  
**Tuesday**  
Tysons Corner,  
Va.

**APRIL 17**  
**USGIF**  
**Invitational Golf**  
**Tournament**  
Ashburn, Va.

**MAY 9**  
**GEOINTeraction**  
**Tuesday**  
Northern Virginia

**JUNE 4-7**  
**GEOINT 2017**  
**Symposium**  
San Antonio,  
Texas

### PEER INTEL



Planet hired **KARTHIK GOVINDHASAMY** as its chief technology officer and executive vice president of engineering.

Accenture appointed **BRIGITTE GWYN** managing director of government relations. Gwyn is responsible for all of the company's government relations activities in North America.

MDA president and CEO **HOWARD LANCE** will now also serve as chairman, president, and CEO of SSL MDA Holdings. **DONALD SCHAEFER**, formerly vice president of Noblis, was appointed president at MDA Information Systems.

**DOUG MCGOVERN** was named associate partner for intelligence application development and innovation at IBM. Previously,

McGovern served as chief information officer and director of IT services at NGA.

**HAROLD "HAL" SMITH**, former associate deputy director of NSA, joined Accenture Federal Services as managing director of its intelligence practice. Smith has held intelligence, security, and technology roles at various companies and served on several Intelligence Community senior advisory boards.

AECOM announced **LAMONT WELLS** as executive vice president of business development in the company's management services group. Following a 30-year career in the government and private sector, Wells joins AECOM having most recently served as president and chairman of the board of directors at Technology Management Associates.

# perspective

## BEYOND THE QUANTITATIVE APPROACH

Dr. Peggy Agouris is dean of the College of Science, director of the Center for Earth Observing and Space Research, and professor of spatial informatics at George Mason University. She is also a member of the USGIF Board of Directors.

### **Q** How did you become interested in the geospatial sciences?

My early background is in infrastructure engineering. I grew up in Greece and that's where I did my undergraduate work. During my undergraduate studies I got into photogrammetry and applications related to imagery depicting structures, and when I came to the U.S. for my master's degree and Ph.D. I started learning more about satellites and the evolution of digital imagery. The computational part of that was very interesting to me, and automation excited me the most.

### **Q** You've received more than \$30 million in external research funding. What are you currently researching?

How to combine information from a variety of sources—databases, social media, traditional satellite and airborne sensors—and automate the extraction of information and the detection of change. It's exciting to work in the lab with graduate students on incorporating the human component into traditional computational approaches, like for example, how to infuse predictive features into safety monitoring for military operations support, crisis management, and humanitarian response—among other applications.


### **Q** What research are you most proud of?

From an early stage, before the explosion of social media, my group recognized the importance of the human aspect in our work. We are engineers and scientists so we weren't used to dealing with things beyond the computational and the quantitative. I consider it one of my most significant scientific contributions when I started

integrating and expanding my work to include the human component, tracking movement and human behaviors in a way that can guide and enhance the underlying quantitative approach.

### **Q** What do you predict for the future of GEOINT education?

Geospatial science was always multidisciplinary and didn't have a defined niche. It comprises people like me who came from different backgrounds, discovered it along the way, and became interested. One of the major trends I see—and which is already reflected in our college's geospatial programs—is the universal recognition that location and geospatial aspects exist in everything. Another trend is that people who are educated in this field cannot be one thing anymore. They have to be good at understanding data constructs and quantitative methods as well as developments in social media analytics and much more. GEOINT is becoming more its own field yet still demands several layers of education in order to be effective.

 Interested in sharing your perspective? Email [trajectory@usgif.org](mailto:trajectory@usgif.org).

### **Q** What advice do you have for students and young professionals?

Be open minded in terms of where you gain the knowledge you seek. Even though we are becoming more centered on the human aspect you should sharpen and maintain your quantitative skills because the combination of the two differentiates geospatial science from other fields. And you can't just extract and present information. You have to understand how reliable this information is and its origin. Given the recent spread of fake news, you have to be able to understand truth, accuracy, and precision. Finally, I recommend looking beyond the surface and deeper into the expertise and knowledge offered by the faculty who teach you. The experience you get from working with people actively involved in cutting-edge research, who have made significant contributions to the field, is more valuable than what can be taught through textbooks in the classroom or online. 🌐

#### QUICK FACTS

**AIRPLANE READING** Early 20th century British mystery novels

**FAVORITE SOFTWARE** Any smart calendar app

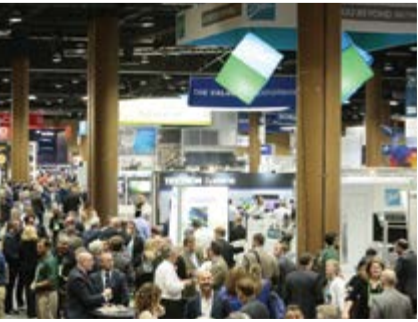
**IDEAL WEEKEND** With my family, at the beach, anywhere in Greece



**USGIF**  
**geoint** 2017  
SYMPOSIUM 7



SEE YOU IN



**SAN  
ANTONIO**



**JUNE 4-7, 2017**



**HENRY B. GONZALEZ CONVENTION CENTER  
SAN ANTONIO, TEXAS**



**GEOINT2017.com**



# SUSTAINING YOUR MISSION

AECOM provides a blend of global reach, local knowledge, innovation and collaborative technical excellence in delivering solutions and services to our intelligence Community.

[www.aecom.com](http://www.aecom.com)

**AECOM**