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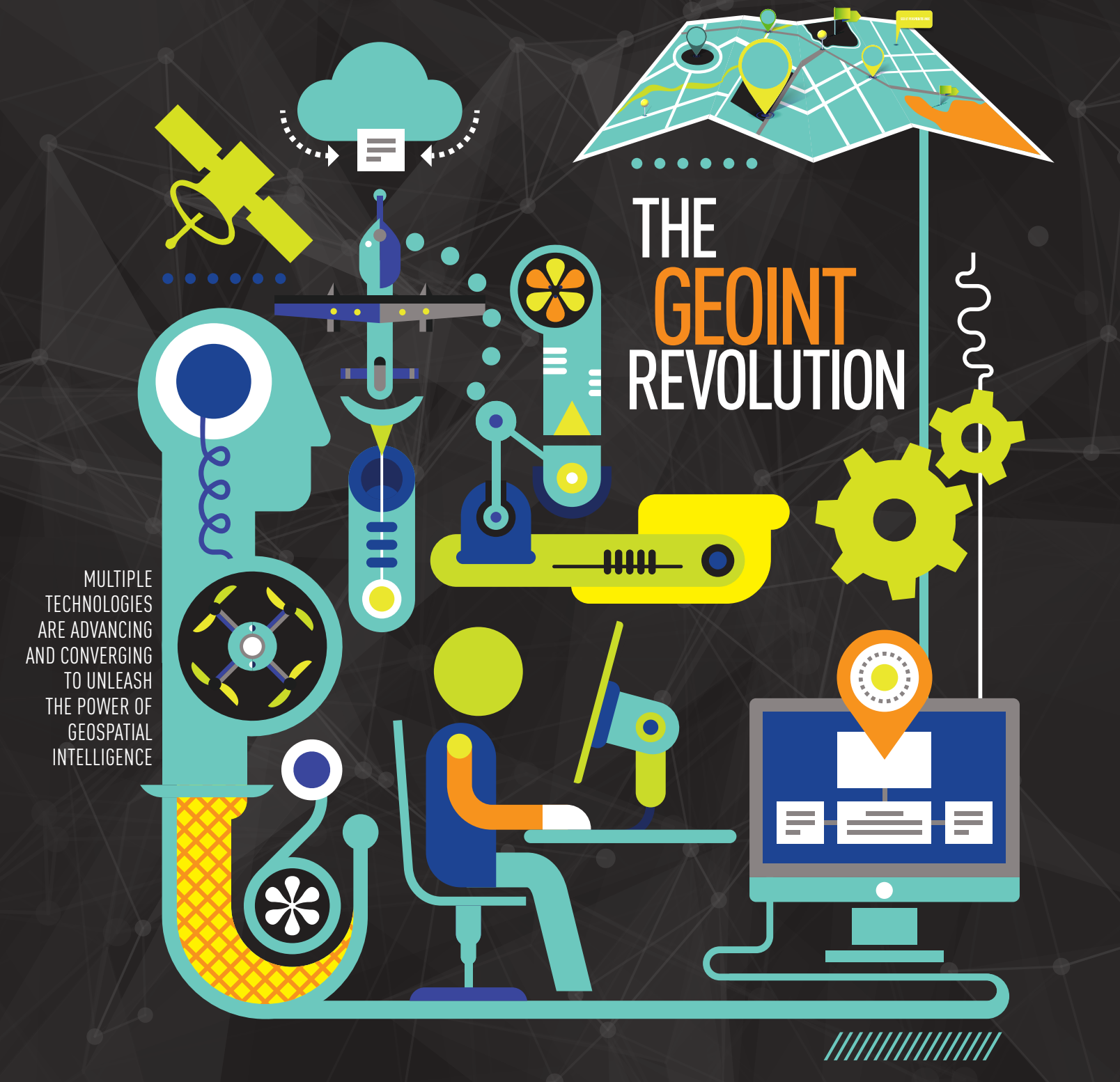
2015 ISSUE 4

trajectory

THE OFFICIAL MAGAZINE OF THE UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION



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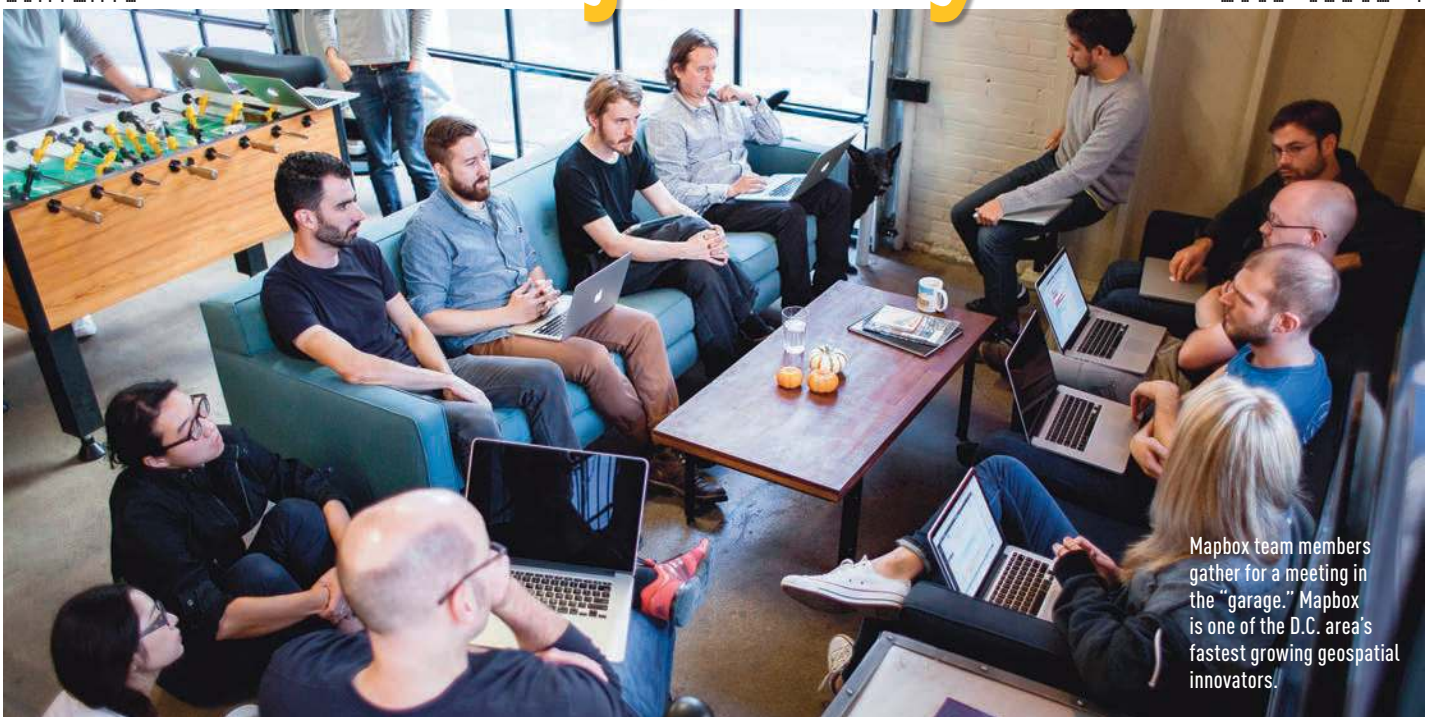

PHOTO COURTESY OF MAPBOX

Mapbox team members gather for a meeting in the "garage." Mapbox is one of the D.C. area's fastest growing geospatial innovators.

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TRAJECTORYMAGAZINE.COM

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Charts, videos, and more on the GEOINT Revolution.

IMAGERY
Hurricane Katrina and New Orleans: before, after, and today.

A DYNAMIC DISCIPLINE

The days after Labor Day in the D.C. area are always challenging as vacations end, college students return, and the local K-12 schools are back in session. It's a traffic nightmare, and those of us who live and work in the region know getting from one place to another takes even longer than usual. So, it's even more gratifying to see the daily flow in and out of the USGIF offices by our various working groups and committees, with dedicated volunteers making time in their schedules to contribute to the work of the Foundation and to the greater good of the GEOINT Community.

Our working groups have steadily grown to be an important action arm of the Foundation. They are initiated and managed by member volunteers with the support of our full-time staff.

This model flourished in the past 18 months thanks in part to Carrie Drake, who was the single point of entry for the working group chairs to access anything they needed from USGIF staff. Carrie developed a manual for the chairs, held plenary meetings to share best practices, and worked diligently to normalize the working group administration and structure. Carrie recently departed the Foundation after eight years to accept a position with a USGIF member company, and she will be missed. We will continue to build upon the legacy of Carrie's hard work.

Two great examples of relatively new working groups gaining considerable traction are the SmallSat Working Group and the Geospatial and Remote Sensing Law Working Group. Both have worked with USGIF staff to plan workshops for 2015 GEOINT Community Week in mid-November. These workshops follow in the tradition of superb events previously developed by the Commercial Synthetic Aperture Radar, Activity-Based Intelligence, Electro-Optical, and Africa working groups. Since the working groups are dynamic in nature, some will endure and some will inevitably become inactive, even as others are stood up.

We're gratified by the tremendous support we've experienced for our new Individual Membership program, and we recognize the responsibility that accrues to the staff based on our membership growth.

Speaking of dynamism, for the cover story in this issue of *trajectory*, I've attempted to capture the essence of a presentation I've given at conferences and on campuses throughout 2015 regarding the advent of the GEOINT Revolution. I intend for the article to serve as a starting point for discussion across our Community. I hope you'll find the article thought provoking because it's incumbent upon us to get out ahead of this revolution, as opposed to being dragged behind it.

Our second feature provides a glimpse into the DC-area startup scene, with some great exemplars from the GEOINT Community. Finally, we've included a snapshot of each of USGIF's 2015 scholarship awardees. An exciting milestone lies ahead next year when we will eclipse $1 million in scholarships awarded by the Foundation in the last decade.

I look forward to seeing you at one of our upcoming events, at the USGIF offices, and on our ever-growing membership list. We're gratified by the tremendous support we've experienced for our new Individual Membership program, and we recognize the responsibility that accrues to the staff based on our membership growth. USGIF will remain an innovative, learning organization focused on providing significant value to our individual and organizational members, and to the ever-expanding GEOINT Community.

KEITH J. MASBACK | CEO, USGIF
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NEWS UPDATES AND HIGHLIGHTS

FAA GRANTS 1,000 UAV EXEMPTIONS

In August, the Federal Aviation Administration (FAA) granted 1,000 Section 333 exemptions allowing commercial businesses to fly unmanned aerial vehicles (UAVs), bringing the total number of such exemptions to 1,008. Many of the grants allow aerial filming for uses such as motion picture production, precision agriculture, real estate photography, and inspecting infrastructure such as power distribution towers, railroads, and bridges. The move represents the FAA's efforts to streamline the process for operators to access national airspace.

INDUSTRY ACQUISITIONS

In September, **Apple** acquired San-Francisco-based mapping analytics company **Mapsense**. Mapsense is equipped to analyze billions of digitally connected devices streaming location data. The MapSense team will join Apple's headquarters in Cupertino, Calif.

In July, **Planet Labs** entered into a definitive agreement to purchase Canada-based **BlackBridge**, including its RapidEye satellite constellation. This acquisition is a strategic move by Planet Labs to expand quickly into new segments and gain access to a robust imagery archive. With BlackBridge, Planet Labs has access to a network of more than 100 distribution channels and customers globally, as well as a six-year archive of global commercial imagery totaling six billion square kilometers at five-meter resolution.

In August, **Nokia** sold its digital mapping unit **Here** for approximately $3 billion to a trio of German automakers. The automakers, including Audi, BMW Group, and Daimler acquired Here to use for autonomous driving initiatives. The three automakers have taken equal share of the mapping unit and the transaction is expected to close by 2016.

UrtheCast in July acquired earth observation business Deimos Imaging from **Elecnor**. This includes ownership and operation of the Deimos-1 and Deimos-2 satellites. The combination of UrtheCast and Deimos operations is expected to accelerate UrtheCast's goals related to distribution, web platform development, and building out its constellation.

Data analytics company **Splunk** procured security company **Caspida** for $190 million in July. Splunk will combine its machine data analysis to Caspida's ability to detect malware inside corporate networks to create a better overall security product.

In August, **Accenture** acquired D.C.-based cybersecurity company **FusionX** to further strengthen Accenture's security practices and help clients assess their ability to protect against, detect, and respond to cyber attacks.

CA Technologies signed a definitive agreement in August to procure **Xceedium**, an identity management solutions provider. The combination will reinforce CA's leadership in identity management and offer customers a flexible approach to managing identity compliance and risk.

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More than 680,000 apps in the Apple App Store use location services as of 2014.

SOURCE: APPLE WWDC 2014

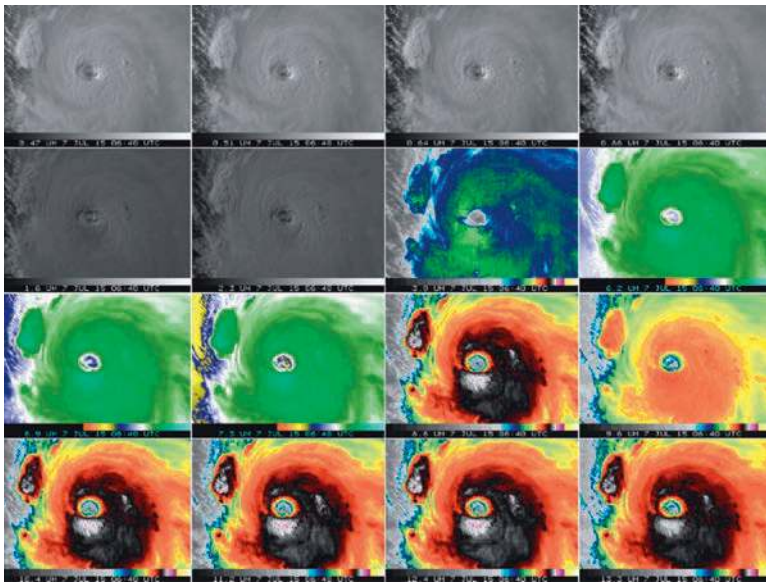

IMAGE COURTESY OF SSEC

HIMAWARI-8 DATA collected July 5–7, 2015, shows Typhoon Nangka as captured by all 16 AHI channels.

INTERNATIONAL EARTH OBSERVATION SATELLITE LAUNCHES

A number of countries launched earth observation satellites during summer 2015. The Sentinel-2A earth observation satellite, built by Airbus Defense and Space for the European Space Agency, was launched in June. The Sentinel 2 mission will contribute to the management of food security by providing information to the agricultural sector.

Five United Kingdom-built satellites were launched in July, making it the largest number of wholly British spacecraft to deploy in a single launch. Three of the satellites will be used to image the Earth and support disaster monitoring and relief, while the other two will test technologies for use on future spacecraft.

Sentinel-2A model

IMAGE COURTESY OF RAMA/WIKIPEDIA

The world's first geostationary weather satellite capable of capturing images in full color began operation in July. Japan's Himawari-8 can shoot 16 different kinds of images every 10 minutes. During its first full day in operation, Himawari-8 captured imagery of Typhoons Chan-hom and Nangka spinning in the western Pacific Ocean.

China plans to launch a commercial remote sensing satellite in October. Jilin-1 will provide photographs to commercial clients while helping with harvest assessment, geological disaster prevention, and resource surveys.

PROCRASTINATION TOOLS

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7 billion mobile subscriptions, a penetration rate of 97%, are projected by the end of 2015.

SOURCE: INTERNATIONAL TELECOMMUNICATIONS UNION

USGIF FILE PHOTO

USGIF'S DR. BABER SPEAKS AT NATIONAL GEOGRAPHY EDUCATION CONFERENCE

USGIF Director of Academic Programs Dr. Maxwell Baber spoke on a panel at the 2015 National Council for Geographic Education Aug. 7. Baber discussed "GEOINT for the High School Classroom," described classroom-ready exercises, and provided resources for the audience.

USGIF SMALLSAT WORKING GROUP ATTENDS SMALL SATELLITE CONFERENCE

In August, the USGIF SmallSat Working Group participated in a panel discussion during the Small Satellite Conference in Logan, Utah. Panelists included Rob Zitz, senior vice president and chief systems architect with Leidos; Dan Twomey, manager of engineering at NJVC; and Chris McCormick, chairman and CEO of PlanetiQ. The panel discussed the emerging and important role of SmallSats in the GEOINT Community. The working group is planning USGIF's first SmallSat Workshop for Nov. 16-17 as part of 2015 GEOINT Community Week.

SPOTLIGHT: USGIF SCHOLARSHIP RECIPIENT

2014 USGIF SCHOLARSHIP recipient Megan Miller visited the National Oceanic and Atmospheric Administration building this summer while conducting research for her Ph.D. dissertation.

PHOTO COURTESY OF MEGAN MILLER

2014 USGIF Scholarship recipient Megan Miller has always been interested in mathematics and analytics. After learning remote sensing and photogrammetry during her undergraduate studies and realizing its career opportunities, Miller knew it would be a good choice for her career path. Now, she is on her way toward achieving a Ph.D. in geomatics engineering at Purdue University.

While earning her master's degree in geomatics engineering at Purdue, Miller won a 2014 USGIF Scholarship.

"I learned about USGIF from my mentor Nathan Ovans," she said. "He proposed the scholarship as a way to get involved and have exposure in the GEOINT Community. The scholarship enabled me to attend the 2015 American Society of Photogrammetry and Remote Conference, where I presented my research in one of the technical sessions."

Miller spent this summer interning at the National Geospatial-Intelligence Agency's (NGA) Basic and Applied Research Office. She said her experience at NGA contributed to her Ph.D. research dissertation. Miller is studying algorithms and methodology that would enable digital surface model generation from low-altitude unmanned aerial vehicle imagery. The emphasis of her research is on maritime applications such as detection and safety of navigation.

Miller also attended USGIF's GEOINT 2015 Symposium in June, which she said was a rewarding experience.

"I benefited greatly from the keynote speakers on the direction and momentum of the GEOINT Community," Miller said. "The greatest benefit was from the interactions with peers and leaders who gave useful insight, and most importantly, vision for how to continue building an impactful skill set."

Miller is expecting to earn her Ph.D. in May 2017. After graduating she hopes to become a full-time member of the intelligence and defense community.

A CUSTOMER-CENTRIC NGA

Justin Poole of NGA's Xperience Directorate provides program updates

Justin Poole, director of the National Geospatial-Intelligence Agency's (NGA) Xperience Directorate, discussed the agency's new customer focus Sept. 8 at USGIF's GEOINTeraction Tuesday networking event.

Poole kicked off his speech by defining his emphasis on "customer centricity"—a philosophy by which the agency strives to provide not only what customers ask for, but what they need to accomplish their mission.

"[NGA's] Globe, Map of the World, IGAPP… those are just stuff," Poole said. "It's cool stuff and we've worked extremely hard on them, but at the end of the day we need to employ it in the manner that improves customer experience."

The Globe, NGA's new unified web presence featuring geospatial content, tools, and services, provides context on global events and makes GEOINT more accessible for NGA customers, according to Poole. It features enterprise search, advanced storytelling via traditionally trained journalists, a map application program interface, an ecosystem navigation bar, and responsive mobile design.

Poole went on to discuss NGA's upcoming GEOINT Services model. Set to launch in 2016, the GEOINT Services platform allows GEOINT producers and consumers to exchange geospatial content and services and provides on-demand access to geospatial, sensor, geo-referencing, enrichment, and processing services. Poole said GEOINT Services would help bring more small businesses, niche companies, and academic partners into the NGA fold by starting the development process on the low side then moving capabilities to classified networks.

Poole concluded with an update on NGA's Innovative GEOINT Application Provider Program (IGAPP), which launched in May under a four-year contract with TASC. The program facilitates the delivery of applications to NGA's GEOINT App Store with TASC acting as an app broker, lowering the barrier to entry and significantly speeding up the process for delivering new apps to agency customers. Poole said NGA has already approved more than 200 vendors and encouraged the audience to submit app proposals and partner with NGA to help the agency more fully embrace "mobile first."

"[IGAPP] is an innovative, groundbreaking way to bring capability," he said.

USGIF FILE PHOTO

JUSTIN POOLE, director of NGA's Xperience Directorate, addressed the audience at USGIF's GEOINTeraction Tuesday event in September.

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USGIF HOSTS NONPROFIT MANAGEMENT EXTERNS

In August, USGIF hosted a nonprofit management externship for four Gettysburg College students. USGIF staff provided a day and a half of panel discussions and shadowing opportunities to help students learn about the roles of various departments within nonprofit organizations.

USGIF FILE PHOTO

PICTURED FROM LEFT TO RIGHT ARE: USGIF CEO Keith Masback, Gettysburg College students Margaret G. Czepiel and Lesley A. Rompalo, former USGIF Senior Manager for Volunteer Engagement Carrie Drake, and former USGIF Intern and Gettysburg College student Conor Barry.

NGA-USGIF NEXTGEN TASKING INDUSTRY DAY

PHOTO COURTESY OF NGA

USGIF AND THE NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY (NGA) co-hosted an NGA Operations Technology Solution Discovery Day at NGA Campus East Sept. 14. The unclassified event welcomed industry and academia to hear NGA leadership discuss the agency's Next Generation Tasking Initiative and participate in Q&A discussions. In this photo, John Charles, NGA's National GEOINT Officer for Commercial Imagery, addresses the audience. More than 300 people attended, and the event was broadcast live to NGA facilities around the country.

LEAN INNOVATION

USGIF FILE PHOTOS

Steve Blank, the father of Lean Startup, shared with industry and government how to innovate faster, cheaper, and better during a USGIF and OGSystems special presentation Aug. 14.

Blank began his career in U.S. Air Force electronic warfare, then founded and sold eight tech companies, four of which went public. Now, as a retired serial entrepreneur-turned-educator, he is changing how startups are built and how entrepreneurship is taught. The National Science Foundation I-Corps adopted Blank's Lean Launchpad methodology, and his work inspired the General Services Administration's digital service agency 18F.

VISIT trajectorymagazine.com and search "Steve Blank" to watch a video of Blank's full presentation.

According to Blank, innovation is not a noun or physical place—having an incubator, accelerator, or startup does not guarantee an organization is producing innovative thoughts and ideas.

"I call this innovation theater," Blank said. "It looks good. It's great PR. But it doesn't move the dial."

In outlining the Lean Startup methodology, which champions a more agile approach to innovation, Blank emphasized the importance of speed.

"Our adversaries' speed is a threat, but our speed potentially is mitigation," he said.

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A NON-TRADITIONAL EDUCATION

Northeastern University offers online geographic information technology program

By Lindsay Tilton Mitchell

USGIF FILE PHOTOS

PARTICIPANTS GATHER AROUND the computer of Sophia Liu, a research geographer with the U.S. Geological Survey, during a "Crisis Mapping for Humanitarian Action" education session hosted by Northeastern University at the GEOINT 2015 Symposium.

A PRIVATE RESEARCH INSTITUTION, Boston-based Northeastern University emphasizes experiential learning, or the integration of the classroom with the real world by engaging students in professional internships, research, and service projects around the world. Northeastern's graduate geographic information technology (GIT) program within the university's College of Professional Studies has thrived under such experiential learning initiatives.

Since being awarded USGIF accreditation in September 2014 under the Foundation's Collegiate Geospatial Intelligence Certificate Program, Dr. Cordula Robinson, associate teaching professor, said the GIT program has greatly benefited from the designation.

"Northeastern has a robust, advanced online component," Robinson said. "We've recently seen the field of GEOINT just explode and have seen a crowd drawn to our program."

One reason for the program's popularity is the unique online element Robinson mentioned. Students have the option to either complete the program entirely online or partially online paired with brick-and-mortar classes at the Boston campus. The program is designed for working professionals seeking to expand their knowledge and advance their skills.

From project management to database design, the program offers a range of courses for students to explore, as well as concentrations in geographic

DR. CORDULA ROBINSON, associate teaching professor with Northeastern University's geographic information technology program, presented a lightning talk focused on C4ISR during GEOINT Foreword at GEOINT 2015.

information systems and remote sensing. Approximately 350 students have graduated since the program launched in 2009—and are now employed across U.S. government, military and industry, in addition to a handful of graduates located internationally.

"With the unleashed power of GEOINT, there's a real need to make these skills more available so the workforce is prepared," Robinson said.

One Northeastern University student who enhanced his skills through the program is George "Stan" Bosarge, a senior research laboratory manager at the University of South Alabama's Fisheries Ecology Lab. Bosarge completed the GIT program with a focus in remote sensing earlier this year, and was one of the first students to receive a USGIF GEOINT Certificate from Northeastern. Bosarge was also the recipient of the 2015 USGIF Academic Research Award.

"It was a very positive experience—the class participation in my mind was the best aspect because you're engaged with the instructors and it's more about application and discussion rather than learning the mechanics and assignments," Bosarge said.

U.S. Air Force Geospatial Intelligence Analyst Kevin Boyle was also one of the first students to achieve a USGIF GEOINT Certificate at Northeastern upon completion of the GIT program in June.

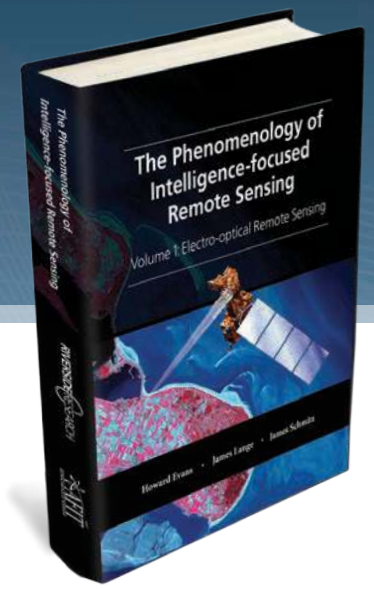
"Having been in the military since 2008, the biggest advantage was seeing the other side of GEOINT, and being more exposed to commercial software," Boyle said. "Bringing those skills and training back to the Air Force was a great bonus."

To showcase the GIT program, Northeastern had a strong presence at USGIF's GEOINT 2015 Symposium in June. Not only did the university exhibit in the Symposium's exhibit hall, but Northeastern faculty members also led training sessions on humanitarian crisis mapping and presented lightning talks on both crisis mapping and C4ISR.

"THE FACULTY LOVES SHARING THEIR EXPERTISE WITH STUDENTS AND—THIS YEAR, FOR THE FIRST TIME—GEOINT 2015 ATTENDEES."

—Dr. Cordula Robinson, associate teaching professor, Northeastern University

"The faculty loves sharing their expertise with students and—this year, for the first time—GEOINT 2015 attendees," Robinson said. "It all ties back to Northeastern's online experiential learning. We bring the best of what online education has to offer by fostering a powerful relationship between learning and working."



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KEEPING PACE WITH LAW AND POLICY

USGIF's new Geospatial and Remote Sensing Law Working Group aims to foster cross-education and collaboration among attorneys and policy-makers

By Jim Hodges

USGIF FILE PHOTO

KEVIN POMFRET, executive director of The Centre for Spatial Law and Policy, and Cynthia Ryan, general counsel at the National Geospatial-Intelligence Agency, spoke about legal and policy trends in the GEOINT Community on the Government Pavilion Stage at the GEOINT 2015 Symposium in June. Pomfret and Ryan co-chair USGIF's new Geospatial and Remote Sensing Law Working Group.

THE MOTTO in the office of National Geospatial-Intelligence Agency (NGA) General Counsel Cynthia Ryan is "Know the Law, Find a Way." It's a mantra easily transferable to USGIF's Geospatial and Remote Sensing Law Working Group, which met for the first time July 12. Ryan co-chairs the group with Kevin Pomfret, founder and director of the Centre for Spatial Law and Policy.

"We want to educate attorneys on legal issues, develop training on key legal issues on GEOINT for USGIF non-attorney members, and to develop a community of interest with lawyers to share information regarding geospatial law," Ryan said, summarizing the objectives outlined in the working group's charter.

The group will initially include about 20 attorneys from across government and industry and at least one academic. This cross section of participants represents what Pomfret calls "the evolving geospatial ecosystem, where industry, government, and the crowd are both data providers and data users, almost simultaneously, and where the impact of regulation on one has a much broader impact on the entire ecosystem."

The working group is reaching out to members of USGIF's Small Business and Small Satellite working groups to begin a dialogue and identify their concerns about geospatial law. It's a way for the lawyers to hear from industry and communicate their understanding of ongoing regulation changes and court findings, as well as begin to interpret what they mean to the GEOINT Community.

Driving the group is the understanding that technological development typically far outpaces the laws and policies that govern its use.

"As we embark upon the GEOINT revolution, the myriad technological advances related to location and remote sensing are significantly outpacing the development of associated policy and law," said USGIF CEO Keith Masback. "Decisions are being made daily at all levels of government in the U.S. (and abroad), as courts set precedents gavel drop by gavel drop. As this group gets up and running, we think it will play a crucial role in organizing a more coherent way forward."

The group strives to ensure laws and policies are considered at the front end of innovation, however that goal isn't always possible or practical.

"The key for non-lawyers is to understand the legal issues that arise when you're trying to conceptualize, develop, and deploy systems and data," Ryan said. "There's a whole host of issues

that industry needs to be aware of, legal issues that arise within government and companies in private industry as well."

Raising awareness becomes less of an issue as regulations and policies make their way through courts and legislatures. Reacting and conforming to new regulation is another matter.

"We want to give enough knowledge about what the law is in particular areas so that if the geospatial professionals see something they have a concern about, they can spot it and also articulate it to their lawyer in a way that their lawyer can understand," Pomfret said. "For the near-term, anyway, it's going to be incumbent upon the professionals to identify some of these issues and explain their concerns to their lawyers so that they can both work through a solution."

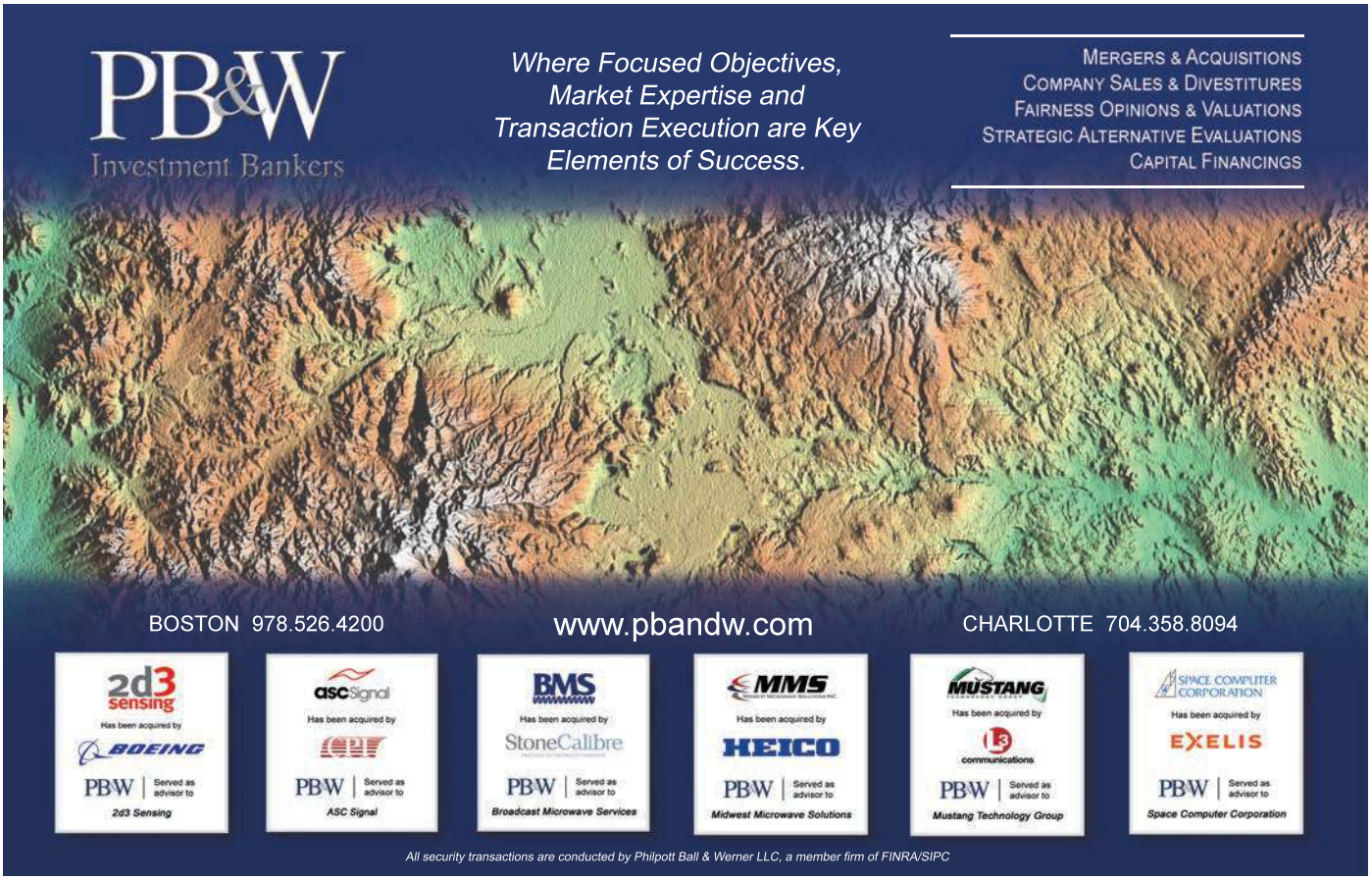
In March, USGIF and Pomfret's Centre for Spatial Law and Policy entered into a memorandum of agreement under which the Centre and USGIF will educate the geospatial community on the unique legal and policy issues that impact the collection, use, storage, and distribution of geospatial information. USGIF and the Centre will, in addition to the creation of the Geospatial and Remote Sensing Law Working Group, develop training and education materials for GEOINT practitioners, host workshops, and further an understanding of geospatial and remote sensing law.

The group's work begins with an understanding that if the GEOINT industry is going to continue advancing, the public perception of the technology must continue to evolve—with the help of lawyers.

"We need to be involved with the agency or company at the time of conceptualization [of technology], or at least as early as possible, so that we can identify appropriate legal paths to accomplish the mission," Ryan said. "Retrofitting to comply after the build [could cost] the organization financial and personnel resources or unacceptable risk of non-compliance." ■

"THERE'S A WHOLE HOST OF ISSUES THAT INDUSTRY NEEDS TO BE AWARE OF, LEGAL ISSUES THAT ARISE WITHIN GOVERNMENT AND COMPANIES IN PRIVATE INDUSTRY AS WELL."

—Cynthia Ryan, NGA General Counsel



MULTIPLE TECHNOLOGIES ARE ADVANCING AND CONVERGING TO UNLEASH THE POWER OF GEOSPATIAL INTELLIGENCE.

the GEOINT REVOLUTION

BY KEITH J. MASBACK, CEO, USGIF

Five years ago the United States Geospatial Intelligence Foundation (USGIF) and some of our members helped fund an innovative media project called "The Geospatial Revolution." The video series, by Pennsylvania State University's public broadcasting affiliate, chronicled how a number of elements were coinciding to create a revolution in geospatial technology and information.

Today, we're experiencing a similar convergence of technology swirling around this thing we call geospatial intelligence (GEOINT), a term coined by the U.S. government just 12 years ago. GEOINT—not to be confused with simply "geospatial"—is loosely defined as the derivation of information from imagery, geospatial data in all forms, and analytics. As the government defined and began shaping its approach to GEOINT, remote sensing and geospatial information were transforming in commercial areas even faster and with greater implications. Over the past 12 years, the concept of GEOINT expanded beyond the national security sector to play a critical role in the arena of business intelligence. GEOINT-like capabilities enabled location-based services and have transformed myriad areas, including logistics, marketing, agriculture, and data analytics. GEOINT is increasingly recognized as a key differentiator offering a competitive advantage in both the B2B and B2C worlds.

Just as GEOINT has crossed into sectors beyond government and national security, it has also traversed international boundaries. The concept first took hold among the Commonwealth nations, but now GEOINT is a globally accepted phenomenon. Because of this rapid growth, GEOINT professionals are in high demand. Simply put, if you are analyzing imagery, drawing information from it, and applying geospatial context to solve a problem, you are a "GEOINTer." Earlier this year, more than 21,000 people from 181 countries signed up for the first free massive open online course dedicated to GEOINT led by Penn State—proof the power of GEOINT is spreading around the globe.

The community is at an inflection point, embarked upon a GEOINT Revolution. Revolutions happen when a number of things come together serendipitously to create something new. Merriam-Webster defines revolution as "a sudden, radical, or complete change," such as "a fundamental change in the way of thinking about or visualizing something: a change of paradigm" or "a changeover in use or preference especially in technology."

While it is unclear where this revolution is headed, the GEOINT Community must immediately work to discern the end state of this transition and prepare to operate in the new paradigm. The GEOINT Revolution will change the way humans interact with where we are, what we're doing, and how we understand and characterize activity on Earth.

Each of the following technological components are arguably undergoing smaller revolutions in their own right, and together they create the synergy that is the larger GEOINT Revolution.

1 PRECISION LOCATION DATA

Most of us carry advanced geolocation devices in our pockets. They are nearly ubiquitous and have changed the way we view and interact with location. No one walked into the Verizon or AT&T store and asked for a mobile phone with integral GPS capability. It's there by law for enhanced 911. By the close of 2015 there will be more than 7 billion mobile cellular subscriptions worldwide—up from 738 million subscriptions in 2000—amounting to a penetration rate of 97 percent. Each one of those devices will have built-in geolocation capabilities. Precision location vastly expands and enriches the potential for applications to collect, aggregate, and make use of high-density information about a single locale and perform time-series analysis of data collected over time. The U.S. isn't the sole provider of precision location data. The rest of the world, with access to GLONASS, GALILEO, GAGAN, and BeiDou, is making tremendous advancements and adding precise data points with various sensors and systems.

Precision location data extends beyond our mobile devices. For instance, vehicles increasingly monitor their driver's location, ATMs record transaction locations and history, Internet browsers and search engines build geo-located history of an individual's online activities, etc.

2 REMOTELY SENSED INFORMATION

The hyper-availability of remotely sensed information—whether from platforms on the ground, in the air, or in space including electro-optical, radar, thermal, or multi- or hyper-spectral—was unimaginable just a handful of years ago. For instance, space-based, high-resolution imaging that was only available to select governments is now available to anyone with a checkbook. Commercial imagery provider DigitalGlobe can now sell images at 30-centimeter resolution and is moving toward 25 centimeters.

Meanwhile, SmallSat start-ups are changing the game with regard to how we approach remote sensing from space. Though high-resolution commercial satellites cost hundreds of millions of dollars to build, one of Planet Labs' Dove satellites can be produced for $60,000. Launch for a large satellite aboard an Atlas V rocket costs $10,000 per pound, but a ride on a reusable launch vehicle costs as little as $10 per pound. The next few years will be exciting as the optimal mix of larger, more capable satellites and smaller, less expensive satellites emerges.

Today, hobbyists, agriculturalists, disaster relief personnel, and many others are proliferating unmanned aerial vehicle (UAV) technology for imaging in their domains. In August, the Federal Aviation Administration made a significant step toward the commercialization of UAVs, approving more than 1,000 applications from companies seeking to operate the systems in U.S. national airspace. The agency predicts there will be more than 30,000 UAVs operating in national airspace by 2020. We are at the precipice of understanding how these vehicles will be deployed and employed.

The GEOINT Revolution is fueled by this next generation of remote sensing, which has made it much more accessible to create robust new sensing networks.

3 SOFTWARE

Incredibly capable geographic information systems and increasingly powerful software for imagery exploitation and data analytics continue to flourish. Without this elegant software, GEOINT data simply wouldn't be as accessible, retrievable, and user-friendly. Large companies such as Esri and Hexagon have invested heavily—in close and continuous contact with their massive respective user bases—to create capable software that has unlocked much potential from geospatial information.

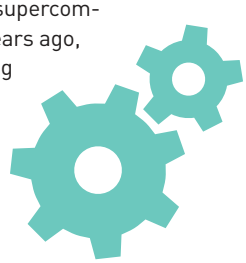
Another aspect of the ongoing GEOINT Revolution is the growing adoption of open-source software. GEOINTers of all stripes are increasingly familiar with and able to write or use scripts as part of their creative processes. A search of "geospatial" on GitHub turns up nearly 800 repositories and more than half a million code results. Traditional software engineer roles undoubtedly remain, but analysts whose second language is Python or another program to create "mashups" of information in a geospatial context now perform some of the work. The GEOINT Revolution will continue to transform how we think about and approach software development, integration, and adaptation.

4 BROADBAND COMMUNICATIONS

The spread of broadband communications infrastructure via fiber optics enables the rapid transfer of very large files, while the ordinariness of routers, switches, and increasing bandwidth in space allows broadband to be spread around the world in ways never anticipated. According to the United Nations Broadband Commission, more than 130 countries now have national broadband or information communication plans. As of December 2014, mobile broadband penetration had reached more than 81 percent, and fixed-line broadband subscriptions tallied 358 million according to the Organisation for Economic Co-operation and Development.

5 PROCESSING POWER

Processing power was once a primary limiting factor to combing through large imagery and geospatial files. According to *The Economist*, it may be only a decade before Moore's Law—the concept of shrinking transistors to double the amount that can fit on a microchip approximately every two years—hits a plateau. In the meantime the smartphones in our pockets have the same processing power of the massive Cray-2 supercomputer built only 30 years ago, and we're still moving forward. Decoding the human genome, which originally took 10 years, can now be accomplished inside of a week. Imagine the potential over the next decade, especially with regard to GEOINT-related data and information, as high-power computing becomes more widely available. Human processing remains important as well. Large-scale crowdsourcing efforts, made possible by platforms such as Tomnod, leverage the power of volunteers to train an unprecedented number of human eyes on imagery. Crowdsourced crisis mapping continues to be instrumental to the success of humanitarian relief efforts such as stemming the Ebola outbreak in West Africa or responding to the earthquakes in Nepal.



6 STORAGE

Storage limitations have been greatly minimized by the vast adoption of online server networks. The emergence of the cloud as a distributed way to manage how data and information are stored, processed, and delivered presents a seemingly endless set of options to approach a task. Should you process in situ or in the cloud? How much of your data should you store in the cloud versus on your device?

It took 26 years to develop a 1 GB hard drive but only four years—between 2007 and 2011—for hard drives to quadruple in storage from 1 to 4 TB. A 128 GB flash drive can now be purchased for less than $30, and some predict 20 TB hard drives will be commonplace in the near future.

The rise of the cloud can be largely attributed to the lowering cost of storage. As recently as 1990 it cost $10,000 to store 1 GB of data in the cloud. Today, anyone with an Internet connection has access to 15 GB of free storage via Google Drive and the ability to store 1 TB of video on Dropbox for $100 a year.

This increase in local and cloud storage provides infinite possibilities of combinations if you are a developer or analyst looking to solve a problem.

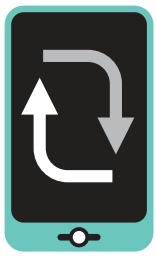
7 DATA ANALYTICS

Big Data was initially viewed as a problem, a "data tsunami" that would overwhelm users. The GEOINT Community realized this onslaught of data could be incredibly useful if the proper tools were in place to derive information from it. The emergence of data analytics has made volume, even huge volume, an advantage and a differentiator. Ninety percent of the world's data was created in the last two years alone. Half a million tweets full of open-source intelligence are generated each day. Dynamic data analytics is required to make use of this information. Data analytics, and now predictive analytics, are bringing about change in many fields, including health care, telecommunications, utilities, banking, and insurance. The GEOINT tradecraft both benefits from and contributes to the leapfrogging advances in data analytics.

8 MOBILE

The growing mobile device market, from smartphones to activity trackers and other wearables, is creating a rapidly proliferating sensor web. Nearly half a billion mobile devices and connections were added in 2014, when mobile data traffic equaled 30 times that of the entire Internet in the year 2000. By 2019, mobile data traffic is expected to increase tenfold.

Video uploads from smartphones have added to the boom in open-source intelligence. One hundred hours of video is uploaded to YouTube each minute, and Facebook video views have increased fourfold in the last year to about 4 billion per day.



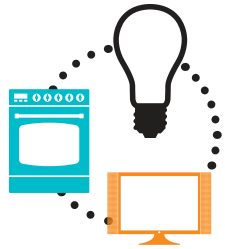
Building on the ubiquity of mobile devices and precision geo-location information, imaginative ways to leverage location are among the hottest areas of mobile app development. Enabled by mobile devices, location-based intelligence and services are changing the game in terms of consumer marketing, business intelligence, and academic research. Nearly 75 percent of smartphone owners use location-based services. We use location-based apps daily to locate friends, find restaurants and entertainment venues, check public transportation schedules, request ride services, and even to find our way around a building and receive offers from retailers based on our location (see pg. 32). More than $10 billion was spent on U.S. mobile advertising in 2014, with $3.5 billion spent on location-based mobile advertising alone—a number representative of GEOINT's permeation of business intelligence.

9 VIRTUAL & AUGMENTED REALITY

Virtual and augmented reality are entering into everyday tasks in fields ranging from medicine to vehicle maintenance, urban planning, and more. GEOINT data is essential to accurately model real locations in gaming, virtual reality, and augmented reality environments.

It is estimated that by 2018 the virtual reality market will grow more than 200 percent and acquire 25 million users. Analysts predict the augmented reality market will grow to $5.2 billion in 2016, and that by 2017, more than 2.5 billion augmented reality apps will be downloaded to mobile devices.

10 THE INTERNET OF THINGS



Not only are humans becoming sensors via our smartphones and wearable devices, but so are our possessions. The Internet of Things will provide a tremendous live-streaming set of data about our environment. It will facilitate an unprecedented understanding of where we are, what we do, and how we engage with one another and the items that surround us. Imagine your phone telling your garage door, thermostat, and television you've arrived home. Without lifting a finger your garage door is open, the AC is on, and the 6 o'clock news is queued up. The number of devices connected to the Internet already far exceeds the number of people on Earth, and conservative estimates project there will be 50 billion connected devices globally by 2020. Some experts posit the number of connected devices could actually reach as high as 250 or 300 billion by that time.

OPPORTUNITY AND RESPONSIBILITY

Throw these 10 elements in a pot, stir gently, put it on simmer, and you have the recipe for the GEOINT Revolution. And it's already happening.

It's imperative the GEOINT Community start thinking and talking about the GEOINT Revolution today, in the most expansive context possible, so we can shape its direction rather than be dragged along behind it. The revolution demands we explore challenges differently, such as thinking more broadly about GEOINT and remaining open-minded regarding new business methods. The Intelligence Community created and nurtured the idea of GEOINT over the past decade or so, but as GEOINT expands rapidly into almost every sector of the economy we will learn from others who are approaching the discipline with fresh sets of eyes, ideas, and motivations. We must not hold on stubbornly to the GEOINT that was, but rather embrace the GEOINT that is to be.

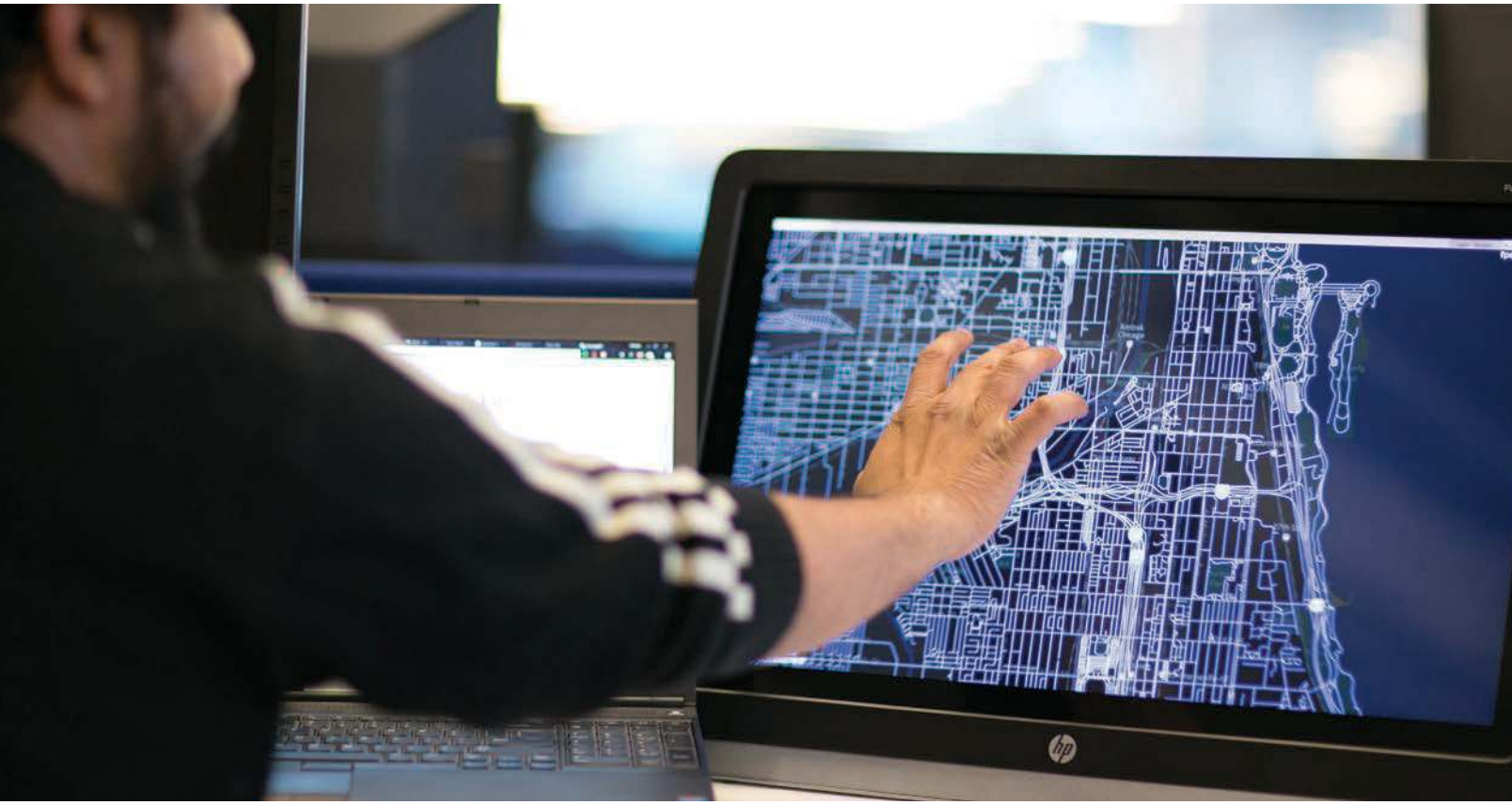
There's a tremendous opportunity at hand for the GEOINT Community, and along with that opportunity comes significant responsibility. It's incumbent on all who identify as GEOINTers to take some time to determine the role he or she will play in the GEOINT Revolution, and then to step up. Rapid change is underway, and although we don't quite know yet what the outcome will be, USGIF will remain at the forefront of fostering discussions regarding the impact of each of the revolutionary elements described above.

Indeed, the recognition of the capabilities inherent in these new technologies is very exciting, and new processes will be developed, but ultimately it's people that must have the tools to take advantage of all that technology has to offer. It is our duty to educate, train, and professionally develop the workforce of today, and of the future, to harness the technologies integral to the GEOINT Revolution. The people who are driving the revolution are an entirely different generation than those who launched it.

Consider the implications of the GEOINT Revolution, and appreciate that if we don't enable professionals in all industries to understand how GEOINT affects their particular field, and if we don't learn from them reciprocally, we won't be prepared to operate effectively in a profoundly changed world. ■

RESOURCES
Charts, videos, and more on the GEOINT Revolution are available at trajectorymagazine.com.

The Power Behind Efficient Government Solutions



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PROXIMA PROSPER

MAPBOX IS ONE OF Washington's fastest-growing geospatial companies. This summer, the company closed on $52 million of venture capital backing and now has more than 100 employees, 30 of whom are based in D.C. But locating the Mapbox office isn't easy. It sits in an alley north of Logan Circle on the backside of bustling 14th Street, where employees go for freshly brewed filter-drip coffees at Peregrine and local beer at Batch 13.

TECH CITY

THE D.C. AREA'S CONCENTRATION OF GOVERNMENT, ACADEMIA, AND TALENT CREATES A UNIQUE ADVANTAGE FOR STARTUP INNOVATORS.

BY MELANIE D.G. KAPLAN

PHOTO COURTESY OF MAPBOX

The Mapbox "garage" in D.C. is located in a former auto shop.

PHOTO COURTESY OF FIRST MILE GEO

FIRST MILE GEO is located in the Chinatown neighborhood of Washington, D.C.

Inside the former auto shop, dozens of bicycles compete for space on wall hooks, bare bulbs hang from the ceiling, and Herman Miller chairs roll around the concrete floor, catching occasionally on a manhole cover. The office is uncannily quiet as workers communicate through GitHub and Slack, standing or sitting at desks and tapping away on MacBook Pros.

The five-year-old, open-source startup builds maps for developers, including Foursquare and Pinterest, and recently partnered with MapQuest in an effort to overhaul the navigation company's branding and product. Although the commercial market primarily drives the company, the value of its proximity to the federal government is significant.

"We're working with federal agencies that are tackling some of the toughest and most complex geo problems in the world, like NGA mapping West Africa's malaria epidemic in real time or the U.S. Geological Survey finding better ways to serve terabytes of open imagery data," said Matt Irwin, Mapbox's government and humanitarian lead. "It's a ton of fun to have someone from the government approach you and say, 'We're trying to solve X.' These are massively compelling problems."

Clusters of geo-focused organizations are popping up in cities across the country, including San Francisco, New York City, and Boulder, Colo. But perhaps nowhere is this happening with more energy and potential than in Washington, D.C. In profound and exciting ways, the government and private sector are overcoming cultural differences and testing the waters of collaboration.

The days of government-designed and built capabilities such as GPS devices and unmanned aerial vehicles with virtually nonexistent civilian applications are long gone. Today, countless geospatially-enabled products are coming out of the commercial marketplace and being adopted not only by civilians but by the military. Earlier this year, the Department of Defense (DoD) gave a clear signal that it seeks private sector alliances with the opening of its first outpost in Silicon Valley, called the Defense Innovation Unit Experimental, or DIUX.

Still, geospatial technology opportunities inside the Beltway abound. Among government, academia, nonprofits, and startups, Washington boasts a density of geospatial professionals and enthusiasts unmatched in other cities.

Washington is an "amazing place to grow a business," Irwin said. "There's a ton of talent here." As Mapbox continues to grow—seeking people who are great communicators, have empathy, and are fired up about Mapbox technology and culture, according to its website—being in a city full of highly educated workers is vital.

THE WASHINGTON GEO-PLAYERS

Another D.C. area startup to watch is HumanGeo, based in Arlington, Va. The four-year-old company of 70 employees was acquired by Radiant Group this summer and focuses on building custom solutions for data analytics. President and CEO Al Di Leonardo said it's easy to see why GEOINT startups are clustering around D.C., which is home to agencies for which geospatial data is mission-critical—such as the National Geospatial-Intelligence Agency (NGA), U.S. Geological Survey, and U.S. Census Bureau.

Furthermore, trends such as the proliferation of location sensors, the rate at which publically available geospatial data and open-source software are growing, and the adoption by industry and government of cloud computing software are driving the expansion, awareness of, and demand for geospatial technology.

"The traditional ways of doing geospatial analysis simply cannot keep up with the volume and variety of data being generated in 2015," Di Leonardo said.

First Mile Geo, located in Washington's Penn Quarter neighborhood, is a cloud-based business intelligence platform provider that simplifies data analysis by combining Big Data with geospatial analytics. Co-founder and CEO Matt McNabb previously worked in international security and development at strategy consulting firm Caerus Associates.

"One of the problems I kept coming across was that the gap between what happens in the field and the conversations that take place in Washington was substantial," McNabb said. "The process was fragmented and not geared for non-technical people. So we did a lot of work bending technology to be useful for capturing insights and data and then connecting it rapidly to visualizations for the non-GIS person."

With a little more than a year under its belt, the company of five has worked with the World Bank and U.S. Special Operations Command South, and is

> **"It's a ton of fun to have someone from the government approach you and say, 'We're trying to solve X.' These are massively compelling problems."**
>
> —Matt Irwin, government and humanitarian lead, Mapbox

PARTYING WITH GEO-HIPSTERS

Once a month, at a Tex-Mex saloon on U Street in Washington, D.C., 100 entrepreneurs, students, investors, and federal workers can be found geeking out over maps and GIS. Stetson's hosts the GeoDC Meetup group, which attracts a diverse gathering of D.C. geo-enthusiasts and aims to connect individuals for networking, learning, socializing, and, as the website concedes, "probably some drinking."

While Washingtonians tend to work long office hours, those in the city's growing startup community understand how gathering in person with like-minded map-lovers can be just as valuable as online collaborations. Often, attendees make contacts for future work alliances, network for internships, or walk away with new ideas for a project. In and around D.C., one can find a growing number of opportunities to meet, greet, and learn.

Typically, the GeoDC organizers announce a meetup topic in advance, folks show up and mingle, and then everyone introduces themselves by name, employer, and three words. For example, "My name's Susan. I work for National Geographic. Maps tell stories."

Co-organizer Elizabeth Lyon (who also runs GeoNoVA, a similar but smaller scale meetup in Northern Virginia), said she's seen GeoDC diversify since it began in 2014—more women, federal workers, teachers, and students.

Another meetup group, DC Tech, attracts a broader, larger community of innovators to see demos, launch products, and meet fellow technology enthusiasts. The Data Science DC Meetup gathers to discuss predictive analytics, applied machine learning, statistical modeling, open data, and data visualization.

For those looking to break into the government sector, D.C.-based incubator and seed fund 1776 hosts events at its downtown and Crystal City campuses on topics such as "The State of Defense of Acquisition" and "Intro to the DC Startup Community." Global startup community Startup Grind also hosts events in each of its participating cities featuring local founders, innovators, educators, and investors who share lessons learned.

The General Services Administration's 18F has hosted a couple demo days and hackathons in addition to the first White House Mapathon this spring.

"If you know where to look and you're open to it, there's a really vibrant community in D.C. around mapping," said Mikel Maron, a Presidential Innovation Fellow at 18F. "The approach is that we're all trying to do this better together."

PHOTO COURTESY OF GeoDC

THE GeoDC MEETUP group hosts monthly gatherings for geo-enthusiasts. For more information, visit **www.meetup.com/Geo-DC**.

starting to move into basic machine learning to allow software to identify relationships between data sets and speed up the analytic process.

On the federal side, the General Services Administration's (GSA) 18F is an agency department with a startup vibe. The 100-person team of developers, designers, and product specialists is named for its downtown location at 18th and F streets. Under the 18F umbrella is the Presidential Innovation Fellowship (PIF), which attracts talented technologists to the civil service.

PHOTO COURTESY OF GSA/18F

WHILE 18F may be full of digital innovators, its welcome board is decidedly analog with photos showing where its team members are dispatched.

Mikel Maron—co-founder of the Humanitarian OpenStreetMap Team who helped set up Map Kibera, the first open-source map of the Nairobi slums—is a PIF posted to the U.S. State Department. He's now working on a project called MapGive, which developed a tool aimed at making geospatial technology more accessible called Imagery to the Crowd (ItC). (Just prior to press time, Maron joined Mapbox.)

ItC publishes high-resolution commercial satellite imagery for volunteers to convert into OpenStreetMap. Maron said ItC enables the State Department to work openly with the broader humanitarian community, which may be a model approach for the Intelligence Community.

"It's not just about open data," Maron said. "It's about unlocking the potential of those resources and understanding what kinds of relationships can be made. That's the widest benefit."

The nonprofit mapping scene in Washington is equally vibrant. D.C.-based MapStory.org is a two-year-old crowdsourcing resource that allows non-technical people to contribute "map stories" on a local, regional, or global scale. Users include scholars, urban historians, journalists, educators, practitioners, and policymakers. Like Wikipedia, anyone can edit the narratives about how the world has changed spatially over time.

"We're trying to provide a place that's a home for all that homeless spatial-temporal data," said MapStory creator and USGIF board member Chris Tucker. "We all experience this Earth differently. We think the facts plus narratives will lead to a very rich journey."

PHOTO COURTESY OF STARTUP SHELL

THE OasisVR team demonstrates the capabilities of virtual reality to fellow Startup Shell members.

> **"The traditional ways of doing geospatial analysis simply cannot keep up with the volume and variety of data being generated in 2015."**
>
> —Al Di Leonardo, president and CEO, HumanGeo

GeoMakers, another nonprofit organization, joined the D.C. scene this summer. The GeoMakers mission is to encourage a collaborative community that dreams up, builds, and implements open-source "makers" projects that involve mapping, remote sensing, and navigation. Based in Northern Virginia but still officeless and staffed by volunteers, GeoMakers capitalizes on the popularity of the DIY culture and provides a free educational platform where people can share ideas such as a "recipe" for a mapping project.

"The great ideas aren't going to come from us," said GeoMakers volunteer Scott Clark. "It's for anyone to use—from development to intelligence."

CULTURAL CHANGES

The defense and intelligence communities have made significant strides in cracking open their traditionally closed culture. The startup community has been thrilled by NGA Director Robert Cardillo's many speeches emphasizing transparency and collaboration.

"NGA has done an amazing job of forging these commercial partnerships and embracing different ways of doing business, including open-source software development," Irwin said. "The fact that an intelligence agency has a GitHub account, is sharing some of its code, and is inviting others to contribute is unprecedented." He said NGA—a "poster child" for tech innovation in the Intelligence Community—will end up with better software as a result.

Earlier this year, NGA launched its GEOINT Solutions Marketplace, a web-based platform that provides non-cleared, nontraditional vendors from industry and academia access to NGA needs, design standards, toolkits, and more. It also serves as a portal to submit white papers and pitch concepts to the agency. In parallel, USGIF is developing an Industry Solutions Marketspace, a digital demonstration sandbox for industry to showcase the functionality and interoperability of its solutions. ISM will allow anyone from industry—with or without government contract experience—to demonstrate existing solutions to real-world GEOINT problems, all while protecting intellectual property.

Similarly, the Defense Intelligence Agency is opening the door to nontraditional solutions with NeedipeDIA, which allows the agency to communicate capability needs to a larger community of innovators, and Open Innovation Gateway, which provides a mechanism for industry and academia to showcase capabilities without requiring security clearances.

Tucker said federal agencies should encourage their employees to "get out of the cage." For too long, he said, fraternizing with those outside of federal agencies was frowned upon.

"That's the worst message to new folks coming into the workforce," Tucker said. Rather, he continued, middle management should educate young workers about little-known government GIS forums and encourage them to go "party with geo-hipsters" (see sidebar) after work. "You can learn a lot so quickly that you simply can't within the walls of government."

The most common refrain from the commercial sector is that the government moves as quickly as the Beltway during rush hour and therefore doing business with federal agencies is clunky and tedious.

"D.C. is a bit of a difficult market because of the speed with which decision-makers make decisions," McNabb said. "It's incredibly slow in relation to the speed of innovation." He added that he still sees government buyers inclined to put everything on their office servers instead of in the cloud, while federal technical standards tend to be out of date.

Yet, there's a growing appetite to bring more commercially minded companies into the government fold. Two DoD offices—largely unknown among startups—fund and scale innovative projects: The Rapid Reaction Technology Office and the Combating Terrorism Technical Support Office.

This spring, tech veteran Meagan Metzger launched Dcode42 to foster innovation and help startups overcome the barriers of working with federal agencies. The selective, six-month program is designed to provide guidance through the federal maze, from bidding to networking with lobbyists.

But for all the talk of complex government systems and help slogging through them, the startup contingent could meet the agencies halfway and work to better understand federal needs.

"Many innovators in academia and industry don't understand the mission objectives of the federal agencies and their unique requirements," Di Leonardo wrote in an email, citing government's strong requirements related to IT system authentication, access control, and identity management.

Despite colliding cultures, the Washington geospatial scene continues to grow. At the University of Maryland's student-run tech incubator and coworking space Startup Shell, Executive Director Chris Szeluga said he is actively looking to add companies working in geospatial and data analytics. He said for students, being in the Washington area is a huge asset because the proximity to the federal government and density of universities gives the region an advantage over other tech hubs like San Francisco.

"In the next five or 10 years, the relationship between startups in the D.C. area and the universities will grow," he said, adding that the government has a unique opportunity to tap into Washington's future innovators. "Fostering that partnership between universities and the government is something they can't do out West." ■

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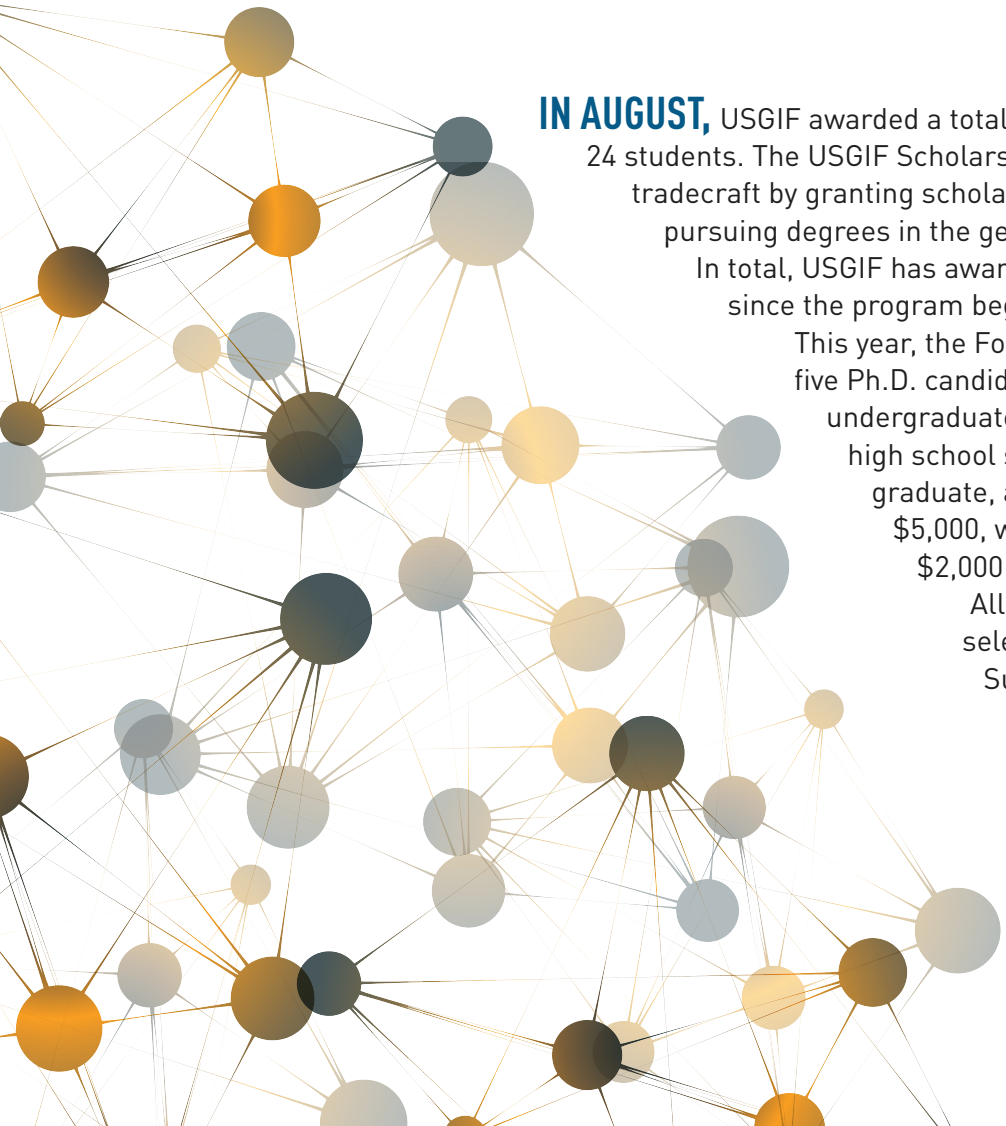
CARRYING ON THE TRADECRAFT

MEET THE 2015 USGIF SCHOLARSHIP WINNERS



IN AUGUST, USGIF awarded a total of $99,000 in scholarship funds to 24 students. The USGIF Scholarship Program advances the GEOINT tradecraft by granting scholarships to promising students pursuing degrees in the geospatial sciences or a related field. In total, USGIF has awarded $891,000 in scholarship funds since the program began in 2004.

This year, the Foundation granted scholarships to five Ph.D. candidates, six graduate students, six undergraduate students, and seven graduating high school seniors. Each undergraduate, graduate, and doctorate awardee received $5,000, while high school seniors received $2,000 toward their education.

All scholarship recipients were selected by USGIF's Scholarship Subcommittee, which evaluated applicants based on academic and professional excellence. Here are this year's scholarship winners:

DOCTORATE

CRYSTAL ENGLISH

San Diego State University/University of California, Santa Barbara

Geography & Geographic Information Science

English is researching the development of multi-dimensional geospatial and temporal attribute data models to assess location vulnerability. She is a certified crime and intelligence analyst for the California Department of Justice and a veteran of the U.S. Army Signals Intelligence Service.

MORTEZA KARIMZADEH

Pennsylvania State University

Geography

Karimzadeh is a graduate research assistant at the GeoVISTA Center at Pennsylvania State University. His research interests include geographic information retrieval and geovisual analytics, as well as their Big Data applications. His work bridges cognitive aspects of place, its definition and ontology, and computational methods to detect, disambiguate, and geolocate places in unstructured text.

RON MAHABIR

George Mason University

Earth Systems & Geoinformation Science

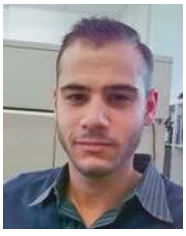
Mahabir received a bachelor's degree in computing and information systems from the University of London and a master's degree in geoinformatics with distinction from the University of the West Indies. His research interest lies in the fusion of open sources of information for automated slum detection and mapping in less developed countries.

MONICA MEDEL

Texas State University

Geographic Information Science

After more than 10 years working as a foreign correspondent in Latin America covering drug smuggling and cartel violence, Medel became deeply interested in the diverging patterns of transnational crime. Her main focus is developing models to better understand spatiotemporal patterns of drug trafficking while introducing policy constraints into the analysis.



TAYLOR OSHAN

Arizona State University

Geography

Oshan is a research assistant at Arizona State University's GeoDa Center for Geospatial Analysis and Computation. His research focus is on the specification and implementation of models for statistical analysis of big movement data and urban planning applications. Oshan previously studied geography, GIS, spatial data analysis, and computational modeling while completing his bachelor's and master's degrees.

GRADUATE

CHRISTOPHER S. BEDDOW

University of Washington

Geographic Information Systems

Beddow is a 2011 distinguished military graduate of Santa Clara University. He earned a bachelor's degree in political science and Arabic, Islamic, and Middle Eastern studies. In May 2011, he was commissioned as an infantry officer in the U.S. Army as a platoon leader, operations officer, and logistics officer. He was honorably discharged in August 2015 and is now pursuing a master's degree in geographic information systems.

SETH BISHOP

University of Utah

Geography

Bishop's master thesis examines spatial access and local demand for emergency medical services, and also evaluates these metrics alongside response times and patient survivability rates. This work was inspired by a previous stint in the Altiplano region of Bolivia, where he conducted research on emergency medical services in the city of Cochabamba.

STEVEN GILBERT

Pennsylvania State University

Geographic Information Systems

Gilbert has more than five years of experience conducting geospatial analysis in support of national security and international development, and specializes in using open-source information to understand human geography in remote and dangerous locations. While pursuing his master's degree, Steven works as a GIS specialist with Chenega Applied Solutions and Engineering, supporting the U.S. Agency for International Development.

BRIDGET KANE

University of Pennsylvania School of Design

Urban Spatial Analytics

Kane's research focuses on spatiotemporal data mining to address social network discovery. She received her bachelor's degree from the University of Pittsburgh and previously interned with the National Geospatial-Intelligence Agency. Kane is interested in urban environments and predictive analytics, and hopes to use her background in support of the Intelligence Community mission.

JOEL MAX

Pennsylvania State University

Geospatial Intelligence Applications

Max graduated from Colorado State University with a bachelor's degree in political science and international studies, focusing on North Africa and the Middle East with research interests in counterterrorism, nuclear deterrence, and Middle Eastern history. His current research interests revolve around GIS technologies as they relate to activity-based intelligence and natural language processing.

AISHWARYA VENKAT

Tufts University

Environmental and Water Resources Engineering

Venkat received her bachelor's degree in biological systems engineering from Virginia Polytechnic Institute and State University. Her thesis leverages remote sensing tools to assess aquifer vulnerability to pesticides in Vellore, India. Her geospatial analysis will be translated into a decision support system to empower farmers to grow sustainably.

UNDERGRADUATE

SARAH CAMPBELL

West Virginia University

Geography/Geographic Information Systems & Spanish

Campbell is an intern with the West Virginia GIS Technical Center and is interested in GIS, data analysis, statistics, computer science, and global affairs. She hopes to develop quick and effective decision-making methods combining a variety of data sets in a usable, sustainable, quantifiable, and visual format for the common user.

CHARLOTTE ECTOR

University of South Carolina

Geography

Ector is a GIS student interested in geospatial applications for researching and analyzing history, politics, and diplomacy. She is researching German and Austrian community awareness of concentration camps during World War II. Ector also studies German and Russian, and looks forward to combining GIS skills with an aptitude for foreign languages as a federal employee.

JORY FLEMING

University of South Carolina

Geography & Marine Science

Fleming's core interests are Big Data analysis to solve the problems facing the world's oceans and developing novel modeling methods to predict future intelligence scenarios. With anthropogenic impacts altering the ocean environment and increasing competition for marine resources and water, Fleming aims to become an expert in "blue" GEOINT.

COURTNEY KOCH

Harrisburg University

Geospatial Technology

Koch works at Harrisburg University's Geospatial Lab where she scans, georeferences, and digitizes maps of anthracite coal mines for the Pennsylvania Department of Environmental Protection. Additionally, she worked with the Harrisburg Fire Department and Harrisburg Police Department to create a fire response analysis map and crime analysis map, respectively.

JEFFREY SHERWOOD

Washington College

International Studies

Sherwood developed an interest in geospatial studies through the Washington College GIS lab. He has applied his GIS interest and skills in two internships with the U.S. federal government. He plans to further his education in the field and build a GIS career in the national security sector.

ELIJAH STAPLE

University of Colorado, Boulder

Computer Science

After interning at two Silicon Valley companies, Staple gained a strong interest in the deep machine learning systems used for Big Data analysis and hidden pattern recognition. After college, he plans to employ these advanced computational techniques to the geospatial field to provide more detailed, relevant feedback from large data sets.

GRADUATING HIGH SCHOOL SENIORS

ELIZABETH CADY VAN ASSENDELFT

Robert E. Lee High School; Staunton, Va.
Now attending Yale University
Van Assendelft participated in a dual enrollment GIS course through the Shenandoah Valley Governor's School and James Madison University (JMU). Her research project used mapping technology to track the territories of migratory red-eyed vireos. Her project received second place in JMU's geospatial semester poster contest.

KYLE BATHGATE

Carbondale Community High School; Carbondale, Ill.
Now attending the University of Illinois at Urbana-Champaign
Since he was a child, Bathgate has been fascinated by maps, Google Earth, and the relationship between humans and the environment. He recently graduated with valedictorian honors and now studies civil engineering.

CHRISTINA BOHNET

South Lakes High School; Reston, Va.
Now attending Calvin College
Bohnet is a double major in Japanese and geography. She became interested in geospatial topics after taking a dual enrollment course in GIS through James Madison University. Over the summer, she worked as a student contractor at the U.S. Geological Survey. Her interests include analyses of Japan, geological GIS, and linguistic or dialectal GIS.

EXTENDED PROFILES
Learn more about the 2015 USGIF Scholarship Award winners at trajectorymagazine.com.

KELLY CARNEY

South Lakes High School; Reston, Va.
Now attending Virginia Polytechnic Institute and State University
Carney's interest in geospatial intelligence began when she took a geospatial analysis class her senior year of high school. There are a variety of areas she has an interest in pursuing including post-disaster relief, urban planning, national security, and human and physical geography.

ANDY FLEMING

Dominion High School; Sterling, Va.
Now attending Texas A&M University, West Texas
Fleming discovered GIS when his high school offered a dual enrollment course with James Madison University. After taking the class for one year he was hooked. He studies geographic information science and technology and hopes to transfer to Texas A&M, College Station, in fall 2016.

COLIN FLYNN

Heritage High School; Leesburg, Va.
Now attending Northern Virginia Community College
In a dual enrollment GIS class through James Madison University (JMU), Flynn learned the importance of GIS and its endless applications. For his final project, he created maps to visualize the quick spread of ISIS attacks and performed analysis to predict potential sites of future attacks. He hopes to transfer to JMU in 2017 to pursue a bachelor's degree in GIS.

DANIEL GURLEY

South Lakes High School; Reston, Va.
Now attending James Madison University
Gurley previously interned with GIS & Mapping Services within the Fairfax County Department of Information Technology, where he gained hands-on experience with digitizing features and completing fieldwork in local parks. He is pursuing a degree in geographic science with dual concentrations in applied geographic information science and environmental conservation, sustainability, and development.

MAKING BETTER DECISIONS

INTERGRAPH GOVERNMENT SOLUTIONS INTRODUCES NEW GEOSPATIAL CLOUD PRODUCTS AT GEOINT 2015

Intergraph Government Solutions (IGS) helps decision-makers in the United States federal government make rapid and intelligent decisions based on its geospatial solutions.

In 2010, IGS was formally established as an independent company within Intergraph Corp., a Hexagon company, to create a business focused on providing geospatial and other advanced solutions to the U.S. federal government. Though IGS is only five years old, it is backed by Intergraph's more than 45 years of support to the defense and intelligence communities. Additionally, IGS has access to industry-leading technology from Hexagon Geospatial and other Hexagon companies, such as Hexagon Geosystems, formerly known as Leica Geosystems. IGS has grown to about 450 employees with headquarters in Huntsville, Ala., an office in Reston, Va., and many personnel based at government agencies and military bases both within the U.S. and overseas.

Rob Mott, IGS vice president for geospatial solutions, said the company's objective is to bring a range of solutions and services to the U.S. federal government with a strong focus on geospatial.

"IGS helps government customers transform their complex data from disparate sources into actionable intelligence. This enables those defense and intelligence agencies to carry out their missions

IMAGE COURTESY OF LEICA GEOSYSTEMS

< IGS PROVIDES a range of geospatial solutions that enable users to visualize complex, dynamic data in vivid and meaningful ways for more effective decision-making.

more effectively by optimizing and streamlining their operational performance and protecting critical assets," Mott said.

IGS's primary customers include the National Geospatial-Intelligence Agency (NGA) in support of its map production mission as well as the U.S. Army, Navy, Air Force, and Coast Guard. IGS also serves a range of civilian federal agencies, including the Department of Homeland Security, Department of the Interior, and Department of Agriculture.

DRIVING IMAGE ANALYSIS

IGS delivers Hexagon Geospatial's ERDAS IMAGINE remote sensing and photogrammetry applications, which are used around the globe and include image processing, LiDAR, radar processing and analysis, and automated change detection features. Mott said ERDAS IMAGINE plays an essential role at organizations such as NGA by creating standard imagery and mapping output products from a broad range of imagery sources, as well as revealing environmental change detection through imagery analysis and many other critical functions.

The defense and intelligence communities use ERDAS IMAGINE to detect changes in adversarial regions such as the construction of military facilities. The application is also used in commercial markets such as energy, utilities, communications, and safety and security.

"The geospatial solutions division plays an important role at IGS because we provide continuous input back to Hexagon Geospatial, which builds those commercial off-the-shelf products," Mott said. "We provide input regarding emerging requirements that enables future versions of those products to be more relevant and meaningful to our government customers."

IGS also offers Cartographic Web Services (CWS), which automates the map finishing process and dramatically reduces the time to send current, on-demand maps to the warfighter. A soldier approaching an unfamiliar and potentially dangerous area in the field, for example, can request information from CWS on his or her mobile device and receive an up-to-date map within minutes.

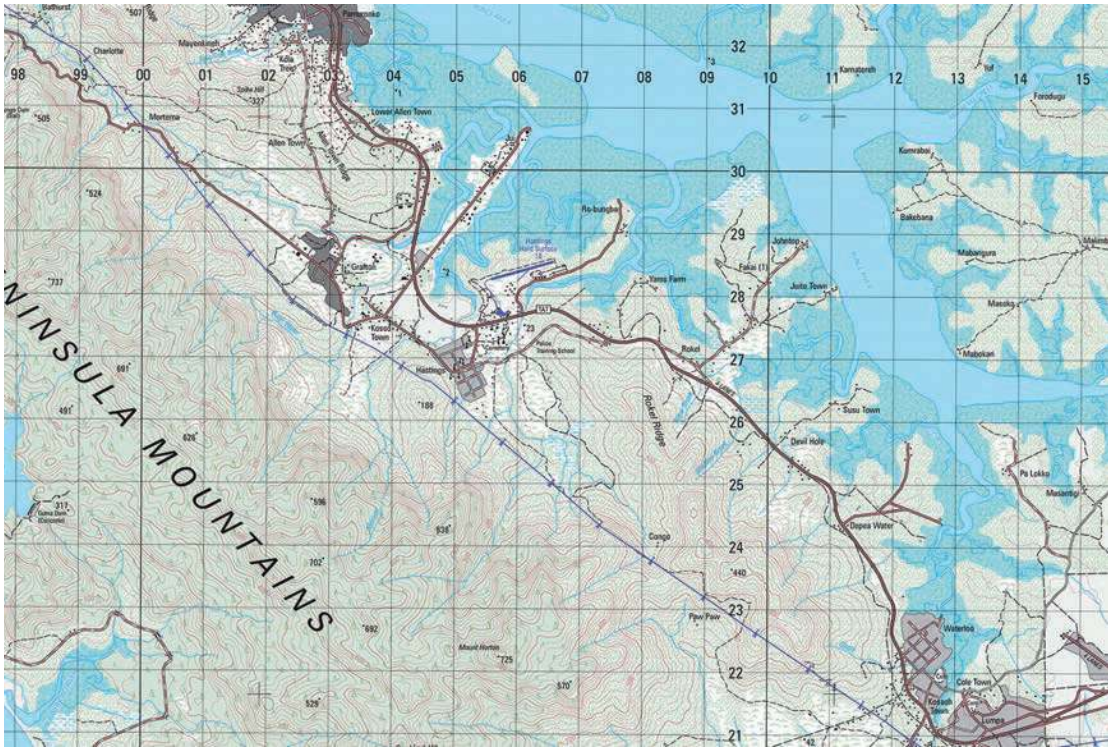


IMAGE COURTESY OF INTERGRAPH GOVERNMENT SOLUTIONS

MIGRATING TO THE CLOUD

At USGIF's GEOINT 2015 Symposium in June, IGS highlighted its move into cloud-based solutions for GEOINT visualization, analysis, and processing. Mott said IGS's cloud offerings support customers moving toward cloud-based geospatial computing and reflect the Intelligence Community's priorities.

"Moving into the cloud is a key strategy across the DoD and Intelligence Community—IC ITE [the Intelligence Community Information Technology Enterprise] being an example of that," Mott said.

At GEOINT 2015, the company introduced a trio of applications Mott described as capable of "heavy-lifting" in the cloud. Web GLT is a web-based electronic light table that provides imagery analysts a better way to assess large imagery and data sets.

"It's completely on the cloud now and that's something we haven't seen anyone else in the industry do yet," Mott said.

Another addition to IGS's cloud product suite is Smart M.App. A play on the words "app" and "map," Smart M.App is a mission-specific application that harnesses geospatial processes and business analytics.

"Smart M.App delivers more than just a static map," Mott said. "It's a dynamic graphical experience that delivers valuable information in a more meaningful way than ever before for making critical decisions. The benefit to customers is an exciting new way to bring GEOINT expertise to their constituents."

The app includes the Smart M.App Studio option, which allows organizations to build and customize their own Smart M.Apps. Operating on a user-friendly wizard interface, customers without any web programming experience can drag, drop, resize components, and build a fully-functioning application. The end product is an interactive geospatial experience in which customers can collaborate with their business data. Mott said Smart M.App could be applied under a large umbrella of purposes, from helicopter landing zones to tracking wildfire outbreaks to much more.

"We're hoping to lead the way, set some trends, and help organizations realize their missions by adopting our solutions," Mott said. ■ BY LINDSAY TILTON MITCHELL

THE CARTOGRAPHIC WEB SERVICES solution from IGS accelerates map production with automated map-finishing processes.

INSIDE GAME

Indoor wayfinding brings location awareness in from the elements

By Matt Alderton

BYTELIGHT combines beacons with visible light communication inside LED lighting systems.

GEOINT MAY SEEM UBIQUITOUS, but there's at least one place its long arms have yet to fully reach: indoors.

Whether you're driving through the desert in an MRAP or across town in a Prius, you can use the GPS in your vehicle to access turn-by-turn navigation. When you're out and about, you can use your smartphone's location-based apps and services to find the nearest gas station, grocery store, or coffee shop. You can even use location technology to find the nearest eligible single for a date. When you step indoors, however—inside a hotel, hospital, shopping mall, museum, or convention center, for example—your signal fades. Or sometimes disappears altogether.

That's because GPS is a line-of-sight technology. To work most effectively, it needs a clear path from your device on the ground to a satellite in the sky. Pesky things like walls, floors, and roofs make it a challenge to find an unobstructed patch of sky. And because humans spend approximately 89 percent of their time indoors, there's a huge potential market for those seeking to solve this challenge.

Indoor wayfinding technology eschews the skies for ground-based technology that delivers the same location awareness indoors as GPS delivers outdoors. So finding your way from one booth to another inside a convention center or navigating to a certain store within a large shopping mall is now as simple as getting driving directions to those buildings.

FIRST TRY: WIRELESS

Indoor wayfinding dates back more than a decade. Recognizing the indoor limitations of GPS, early Wi-Fi vendors hypothesized that wireless Internet could be leveraged for indoor positioning. When consumers connected their device to a wireless network, the thinking went, the network could use the strength of their wireless signal relative to various access points to determine the user's location inside a building and report it back to them for indoor navigation.

There was just one problem: Early adopters discovered Wi-Fi location technology is imprecise, slow, and unreliable. It can tell consumers roughly where they are, but not precisely, resulting in plenty of "way" but very little "finding."

Lacking a high-quality user experience, the much-hyped technology stalled.

A 'BEACON' OF HOPE

Indoor wayfinding reached an inflection point in 2013 when Apple introduced its iBeacon standard, begetting a new class of indoor location hardware called "beacons." Made by companies such as Aruba Networks, among others, beacons determine location by leveraging the connection between consumers' mobile devices and on-premises access points. Rather than Wi-Fi signals, however, battery-powered beacons emit Bluetooth Low Energy (BLE) signals—radio waves that require very little smartphone power—to transmit a location signal with sub-meter accuracy. When mobile apps and operating systems in the proximity receive a BLE signal, devices can register a location or trigger a location-based activity, such as a social media check-in or push notification.

IMAGE BY BYTELIGHT

As the number of beacons inside a facility increases, so does the accuracy and breadth of location services. Combining beacons with other technologies can therefore further enhance their performance. Boston-based ByteLight, for example, combines beacons with visible light communication (VLC) inside LED lighting systems. Coupled with Bluetooth signals, VLC emits a unique lighting pattern that can be registered through smartphone cameras. Using both signals in tandem, consumers' devices send their location and direction of movement to the ByteLight platform, and in turn receive location-based services through a mobile app.

ROOM TO IMPROVE

Beacons represent a huge improvement over Wi-Fi-enabled indoor wayfinding. They're not perfect, however, leaving room for advances in accuracy and speed. Battery life is another concern, with many beacon batteries lasting less than a year. Finally, facilities must consider security—both the beacons themselves and the data they collect are vulnerable to theft—and cost: The time and money needed to configure, deploy, and maintain beacons can add up quickly.

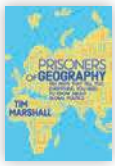
WAY MORE THAN WAYFINDING

App developers such as Meridian are leveraging beacons to help department store customers find the women's shoe department, stadium-goers find the bathroom, family members find their loved one's hospital room, and air travelers find their gate. Indoor wayfinding's "killer app," however, will likely be far more evolved than indoor navigation alone. Already, for example, beacons are used by retailers to send coupons when customers pass or linger at a certain product, by hotels to automatically check in guests upon arrival, and at tourist attractions to send visitors on self-guided explorations.

A Google project known as Project Tango, which endeavors to "give mobile devices a human-scale understanding of space and motion," offers a glimpse of what's next. By combining indoor wayfinding with augmented reality, motion tracking, and environmental sensors, the project aims to provide real-time, 3D contextual information—without GPS, Wi-Fi, or even beacons. One day, for instance, Tango-equipped smartphones may be able to help the visually impaired navigate by "seeing" obstacles in front of them. Homeowners could use the technology to instantly capture dimensions of a room before shopping for furniture as well as to model how the room would look with the furniture in it. Miniature unmanned aerial vehicles outfitted with Tango could even help emergency responders determine the layout and contents of a burning building, then locate and rescue occupants trapped inside.

The possibilities have no boundaries—even though the buildings do.

READING LIST



PRISONERS OF GEOGRAPHY: TEN MAPS THAT TELL YOU EVERYTHING YOU NEED TO KNOW ABOUT GLOBAL POLITICS

By Tim Marshall

Penned by a former foreign correspondent, this book uses maps, essays, and personal experience to offer insight on how geopolitics plays a role in the past, present, and future.

THE SCIENCE OF AMERICAN GIRLS: A HISTORICAL PERSPECTIVE

By Kim Tolley

Educational historian Kim Tolley explores moments in history that altered societal gender norms, including how geography was the first scientific discipline to appear widely in textbooks for girls following the American Revolution.

UNRULY PLACES: LOST SPACES, SECRET CITIES, AND OTHER INSCRUTABLE GEOGRAPHIES *By Alastair Bonnett*

Take a tour of some of the world's hidden geographies. From disappearing islands to forbidden deserts, Bonnett reveals some of the most extraordinary places hiding in plain sight.

USGIF EVENTS CALENDAR

NOVEMBER

16-20

GEOINT Community Week
Northern Virginia

DECEMBER

1-2

GEOINT 101
Herndon, Va.

MAY

15-18

GEOINT 2016 Symposium
Orlando, Fla.

PEER INTEL

Carrie Drake in September joined OGSystems as its director of communications. Previously, Drake was USGIF's senior manager of volunteer engagement. She had been with the Foundation since 2007 in positions including membership and exhibitor services, event operations, and community relations.

Northrop Grumman's aerospace systems portfolio underwent an organizational realignment. **Chris Hernandez** was appointed vice president of the newly formed research, technology, and advanced design organization; **Mary Petryszyn** was named vice president of the new global business development organization; and **Tom Pieronek** is now vice president of basic research. Additionally, Northrop Grumman appointed **Bruce Walker** vice president of homeland security, civil, regulatory, and international affairs.

Raytheon named **Wesley D. Kremer** president of integrated defense systems. Kremer previously served as vice president of the air and missile defense systems product line of Raytheon Missile Systems.

IN MEMORIAM

Dino Brugioni, who helped found the National Photographic Interpretation Center and was a key imagery analyst in the Cuban Missile Crisis, passed away in September. Brugioni received a citation from President John F. Kennedy for his work during the Cuban Missile Crisis. He also received several CIA medals and recognitions, including being twice awarded the Sherman Kent Award, the agency's top honor for outstanding contributions to intelligence literature. Brugioni published five books and more than 100 articles, mostly on the application of overhead imagery to intelligence and related fields.

Gina Lundy, vice president of government relations and corporate communications for PIXIA, passed away in June. Lundy, a lieutenant colonel in the U.S. Air Force, had a 20-year military career, which included serving as a special assistant for intelligence and space in the Office of the Secretary of Defense and as deputy director in the Office of Strategic Communications for Congressional and Public Affairs with the National Reconnaissance Office. Lundy was an active supporter of USGIF and one of the first co-chairs of the Foundation's Small Business Advisory Working Group.

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IMAGES COURTESY OF DIGITALGLOBE

10 Years Later

Aug. 29, 2015, marked 10 years since Hurricane Katrina devastated the U.S. Gulf Coast. The above DigitalGlobe images, from left to right, show New Orleans' 17th Street levee (the dark strip running under the highway toward the top of each image) and were captured March 9, 2004; Sept. 3, 2005; and Dec. 10, 2014; respectively. These images from before the hurricane, immediately afterward, and present day illustrate how the city was forever altered when the Category 5 storm breached its shores. The natural disaster profoundly changed the GEOINT Community as well, as it was a turning point in public awareness about the civil utility of geospatial intelligence, particularly in times of crisis. The National Geospatial-Intelligence Agency played an important role in the Katrina response effort by visualizing the locations of key infrastructure, providing the first clear satellite image of downtown New Orleans, developing the first comprehensive overview of the damage, and more. In 2015, the community continued its legacy of contributing to disaster response by providing essential imagery and data for relief efforts following the West Africa Ebola outbreak and the Nepal earthquakes.

To view the above images in their entirety as well as others, visit **trajectorymagazine.com**.

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