



WEDNESDAY  
September 22, 2010

ION GNSS 2010

# Show Daily

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Written in Cooperation With:

**InsideGNSS**  
GPS | GALILEO | GLONASS

## Sustainment, Robustness, Interchangeability

# Plenary: Taking Aim at “Big 3” for Global Positioning & Timing

Imagine yourself to be a system provider of satellite-based global positioning and timing. You have completed your constellation — overpopulated it even. The ground control and reference network is being built out. Users are adopting your technology by the hundreds of millions.

What next? What do you do for an encore? What comes to the top of the GNSS agenda.

If you heeded the speakers at Tuesday night’s ION GNSS 2010 plenary session, you would take up the “big three” issues of sustainment, robustness, and interchangeability.

Moderated by Dr. Brad Parkinson, the founding commander of the GPS Joint Program Office and a Stanford University professor emeritus, the panel discussion drew a diverse set of experts: David Turner, deputy director, Office of Space & Advanced Technology, U.S. Department of State; Phil Ward, of Navward GPS Consulting; Dr. Mike Miller, Air Force Research Laboratory (AFRL); and Dr. Paul Massatt, senior engineering specialist, in The Aerospace Corporation’s Navigation and Geopositioning Systems Department.

Parkinson laid the groundwork by outlining the elements of sustaining constellations to ensure positioning and timing availability, as well as address interference and jamming threats as the means for ensuring GNSS robustness.

Under the guise of “nibbling at the GNSS interference problem” Parkinson outlined a variety of partial solutions improving signal power and signal frequency diversity, receiver techniques (such as use of all “certified” phase-locked GNSS signals), approaches that employ back-up systems such as enhanced Loran (eLoran), and regulatory efforts to prevent, detect, and shut down interferers and jammers.

Parkinson finished up by focusing on the ideal interoperability: interchangeability, in which user equipment can “mix and match” signals from different GNSS systems with the same ranging accuracy. Attaining that goal will require agreements on signal designs and frequency plans, as well as true clock synchronization (i.e., a common clock) and a common geodetic reference system.

Parkinson presented his concept for a cross augmentation reference system (CARS) as a path toward interchangeability. In CARS, each satellite broadcasts WAAS-like corrections to allow it to be seamlessly operated as a part of another constellation.

Ward highlighted the issue of robustness, including ownership of the issue of ensuring GNSS resistance against interference. “The military takes ownership for specifying interference robustness in military GPS user equipment,” he said, but noted that “commercial GNSS manufacturers take little or no ownership for interference robustness.”

Federal laws and regulations are supposed to protect the GNSS frequency bands from interference, Ward pointed out, and the Department of Homeland Security (DHS) has a role that assumes the eventual capability for rapidly detecting and locating jammers and interference sources.

Ward then took the plenary audience through an exercise investigating the nature of GNSS interference and possible mitigation techniques, focusing on low-cost options.

In spite of high jammer-to-signal performance in GNSS receivers, “GNSS ultimately loses to intentional jamming,” Ward concluded.

Within the GNSS-centric techniques, he suggested that assisted-GNSS “has great potential for lowest-cost robust-

ness to jamming,” including military user equipment. But ultimately, Ward believes, the best mitigation will come from use of un-jammed signals of opportunity, preferably from a robust ground-based, low-frequency system such as was proposed for the United States in the form of eLoran.

In a presentation titled, “GNSS Sustainment: The Challenge of Availability,” Massatt focused on the role of satellite constellations and associated policy and budgetary considerations in managing expectations. First off, Massatt pointed out, signal and positioning availability affects many areas of GNSS operations: coverage, robustness to failures, accuracy, integrity, anti-jamming, and bounded inaccuracy.

“The challenge of availability is to balance the cost of availability against the cost of unavailability,” Massatt said.

If people expect GPS to be available and it is not, they will experience unanticipated costs, such as effects on schedule and productivity or the expense of substituting modernized weapons with conventional weapons. On the other hand, if people do not expect GPS to be available and it is, they will spend unnecessarily to make up for expected service deficiencies.

Robust constellations limits service interruptions, improves worst-case performance, and reduces the cost to users of having to adopt of compensatory measures against the risk of unavailability, Massatt said. Satellite availability also enables receiver-based integrity monitoring techniques, improves accuracy, and facilitates anti-jamming applications.

For his part, Turner addressed the efforts of the State



2010 ION GNSS Plenary Speakers, L to R: Dr. Mikel Miller, Air Force Research Laboratory; Mr. David Turner, U.S. Department of State; Mr. Phil Ward, Navward GPS Consulting; Dr. Bradford Parkinson, keynote and moderator, Stanford University; Dr. Paul Massatt, The Aerospace Corporation

Department to achieve GNSS interoperability through international cooperation. He covered the long history of U.S. bilateral and multilateral activities and agreements with other GNSS providers, including Japan, Russia, China, India, and the European Union.

As for achieving interchangeability, Turner defined the goal as navigating using signals from four or more systems with no additional receiver cost or complexity.

But do users and manufacturers want it, he asked, adding that the answer is “not clear,” even though it may have some value for certain types of users and equipment. GNSS receivers “can self-correct for most system differences with enough satellites in view,” Turner suggested.

In any case, he concluded, improving interoperability methods will require multi-GNSS constellation monitoring, more frequency commonality with common signal spectrum, and greater service provision transparency. ♦

## ION GNSS 2010

# Welcome to ION GNSS 2010

*Opening Day features GNSS Updates with USA, Russia, EU, India and Japan plus high integrity systems experts on WAAS, EGNOS, MTSAT, LAAS and Boeing*

Welcome to the City of Roses – Portland, Oregon – and ION GNSS 2010!

This conference series is the world’s largest technical meeting and showcase of GNSS technology, products, and services.

Today’s must-see events include the GPS Program Update Panel Discussion in the morning, led by The MITRE Corporation’s John Betz. It features updates on satellite-based navigation systems by leading experts from the Air Force GPS Wing (GPS), Russia’s Central Institute of Machine Building (GLONASS), Europe’s Galileo Program, the Indian Space Research Organization (IRNSS) and Japan’s QZSS.

This afternoon, you’ll also want to attend the High Integrity Systems Program Update panel discussion led by Ohio University’s Dr. Frank van Graas and featuring speakers Deborah Lawrence, WAAS program manager,

Federal Aviation Administration; Dr. Didier Flament, head of EGNOS mission and system engineering, European Space Agency; Carlos Rodriguez, GPS local area augmentation system (LAAS) program lead, Federal Aviation Administration; and Tim Murphy, technical fellow at Boeing Commercial Airplane Group.

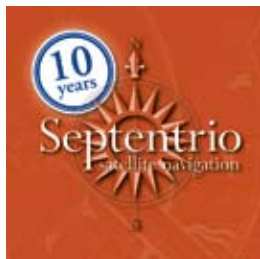
In between and after sessions, make time to enjoy Portland and experience the Pacific Northwest. It’s beautiful out here with lots to do and see.

Walk Portland’s many parks and gardens, explore its burgeoning restaurant scene, hit one of its 28 micro-breweries, or “shop-‘till-you-drop” downtown and in Nob Hill, the Pearl District, or the Lloyd District. And getting around Portland is easy and environmentally clean with its MAX Light Rail transportation system.

WELCOME, continued on page 3



## Exhibitor News



### Celebrate Septentrio's 10th Anniversary and You May Win an iPod

Septentrio invites attendees to stop by **Booth 516/518** to help the company celebrate its 10th anniversary and take a chance to win a new iPod. Since its incorporation a decade ago, Septentrio has grown from a small startup company to its present position by pioneering the early development of Galileo receiver technology and producing the world's first Galileo receiver in 2004. The company's high-precision GNSS receivers are used for industrial applications including land and

marine survey, machine control, avionics, UAVs, robotics and automation on every continent. Septentrio was involved in new receiver technology for L2C, L5, Beidou, and Galileo. The company was involved in the testing of the first GIOVE-A satellite and received the world's first Galileo signals from space. As prime contractor for the Galileo Test User segment, Septentrio continues to play a prominent role in the program. The Septentrio team says, "Come visit our Booth at ION GNSS and celebrate with us. Who knows, you may even win a fun prize. The earlier you come, the bigger your chance to win!"



The International Association of GNSS downstream Industries focussed on the Galileo Programme is very pleased to invite you to participate in a raffle...



Visit our **Booth 206**, drop your business card and try your luck for being the Winner of a Navigation Receiver!

The drawing will take place tonight during the Exhibitor Hosted Reception.



### IFEN GmbH to Demonstrate Constellation Simulator's Emulation Capabilities

IFEN GmbH will demonstrate how its GNSS RF navigation constellation simulator, NavX-NCS, supports the emulation of various vehicle motion sensors for testing of multi-sensor vehicle navigation systems at **Island Booth H** in the exhibition hall. According to IFEN, the NavX-NCS can coherently generate the GNSS RF signals and the signals from various vehicle motion sensors. A CAN bus interface with customized CAN

messages is also supported. IFEN offers different classes of GNSS RF constellation signal generators for testing applications. The company says the NavX-NCS is the most flexible and capable RF signal generator for multi-GNSS constellations on the market. With up to 108 signal channels and nine L-band frequencies, GPS, Galileo, GLONASS, and QZSS can be simultaneously simulated, the company says.



### Industry Meeting on Galileo OS SIS ICD

Paul Verhoef, Michel Bosco, Cedric Seynat and Javier Perez Bartolome of the European Commission will discuss the Galileo OS SIS ICD during a program

on the Commission's Galileo and EGNOS projects. The event will take place **Wednesday from 5:30 p.m. to 6:30 p.m. in Room C123-124** of the Oregon Convention Center.

### National Geodetic Survey

NOAA's National Geodetic Survey (NGS) defines and manages a national coordinate system. This network, the National Spatial Reference System (NSRS), provides the foundation for transportation and communication; mapping and charting; and a multitude of scientific and engineering applications.

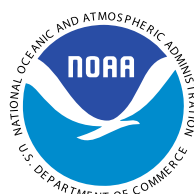
Committed to making transportation and navigation safer, NGS conducts aerial photography surveys near airports in the United States and its possessions to position obstructions and aids to air travel. NGS also maps the coastal regions

of the United States and provides data for navigational charts.

NGS develops Federal standards for geodetic surveys and helps to coordinate surveying methods. NGS State Geodetic Advisors are stationed in several states to work with local communities to expand surveying capabilities.

For more information go to our website: [www.geodesy.noaa.gov](http://www.geodesy.noaa.gov).

We look forward to seeing you at the ION GNSS 2010 — **Booth 623!**



### Spirent, AGI Announce Joint SW Integration

Spirent (**Island Booth E**) and Analytical Graphics, Inc. (AGI) have integrated AGI's STK (Satellite Tool Kit) and Spirent's SimGEN software. Spirent says the link enables the software packages to communicate to allow trajectories created in STK to be readily used to define the motion in Spirent's hardware GNSS simulators. SimGEN test-case

motion also can be visualized in STK. STK is used for mission modeling, engineering, and operations in many areas, including space, aircraft, missile defense and electronic systems. Spirent's simulation systems, many of which use the SimGEN software, enable hardware testing of GNSS receivers, systems, and applications in these areas.

## NEW PRODUCT ANNOUNCEMENTS

### Ashtech's MobileMapper 100 Promises Handheld GNSS Accuracy for GIS

New from Ashtech (**Booth 721/723**) is the MobileMapper 100, a GIS handheld designed for high-precision mobile mapping and data collection. Ashtech says the unit complements the MobileMapper line of products, including the MobileMapper 6 and MobileMapper CX GPS/GIS data collectors. The unit is designed to provide real-time sub-meter to centimeter accuracies in a 22-ounce (0.62 kg) unit. The MobileMapper 100 integrates an open operating system, built-in communications, and Ashtech's BLADE technology designed to allow the MobileMapper 100 to deliver high accuracies even in extreme GNSS environments, including urban and rural canyons and under dense canopies. The MobileMapper 100 includes built-in GSM, Bluetooth, USB and RS232 communications and multimedia features such as Internet access, E-compass, G-Sensor, and a 3-megapixel camera. According to Ashtech, the MobileMapper 100's GNSS scalability – GPS or GPS/Glonass configuration – and its compatibility with third-party networks (VRS, FKP, MAC) enables GIS users to experience optimal data collection.



### Hemisphere GPS Introduces Eclipse II Multi-GNSS Receiver with Advanced ASIC

Hemisphere GPS (**Booth 617/619**) has announced its next-generation Eclipse II GNSS receiver technology and the release of the Eclipse II OEM board. Based on new firmware and application specific integrated circuit (ASIC) designs, Eclipse II has the ability to track and process a wide range of GNSS signals including current and modernized GPS, GLONASS, satellite-based augmentation system (SBAS), OmniSTAR, and the future Galileo and Compass system signals. The ASICs offer a reduced number of board components, thereby simplifying the design, reducing power consumption, and improving reliability, according to company. The new digital ASIC reportedly can process five separate GNSS frequencies and up to 90 separate satellite signals at one time. The new Eclipse II receiver technology is currently available as the P320 OEM board and evaluation kit. Hemisphere GPS is integrating Eclipse II technology into other form factors and into many of its existing GPS receiver products and plans to introduce those products in the coming months.

### NovAtel Introduces SMART-MR10



NovAtel Inc. (**Island Booth C**) recently introduced the latest addition to its SMART antenna line. The SMART-MR10 is the first in a new family of GPS+GLONASS L1+L2+L-band integrated receiver and antenna products, designed for on-machine agriculture, construction and mining applications. The SMART-MR10 is designed to provide scalable positioning accuracies down to two centimeters using NovAtel's AdVance Real Time Kinematic (RTK). It supports GLIDE firmware, which, NovAtel says, uses carrier-phase measurements to provide ultra smooth positions and highly accurate pass-to-pass capabilities for superior performance in agricultural steering and guidance applications. ALIGN firmware also is supported.

### Javad GNSS Introduces TRIUMPH-VS

Javad GNSS (**Island Booth I**) has announced its Triumph VS, a complete 5-hertz RTK base station or rover system featuring 216 All-In-View Channels capable of processing the following signals: GPS L1/L2/L2C/L5; GLONASS L1/L2. It includes a 256 MB internal data storage; 4 GB MicroSD card, two USB ports, a communication channel (UHF or GSM/GPRS/EDGE), internal triple-frequency GPS/GLONASS/Galileo geodetic antenna; integrated high-resolution (800x480 pixels) controller and software, advanced multipath reduction technology, WAAS/EGNOS capability, and WiFi 802.11b and Bluetooth.

### Topcon Announces IP-S2 HD Mapping System

Topcon Positioning Systems (TPS) (**Island Booth D**) recently announced the addition of the IP-S2 HD Mapping System to its line of mobile mapping solutions. The IP-S2 HD is a vehicle-mounted surveying and mapping system featuring a high-definition LiDAR scanner from Velodyne Lidar, Inc. Topcon says the system



incorporates state-of-the-art technologies, including high-precision GNSS receivers, an inertial measurement unit (IMU), vehicle wheel encoder, 360-degree digital cameras and Velodyne's HDL-64E S2.2 LiDAR scanner. It is designed to allow users driving at normal traffic speeds to collect precise vehicle position/bearing data and spherical imagery of objects such as sidewalks, buildings, tunnels, bridges and overpasses.

### CSR/SiRF Launches SiRFAtlasV Aimed at Consumer Devices

CSR (SiRF Technology, **Booth 319**) has introduced the SiRFAtlasV multifunction GPS system processor, a system-on-chip (SoC) device designed for integration into high-volume consumer navigation and location-aware products. Available now in production quantities, the SiRFAtlasV processor combines on a single chip a 500- or 664-MHz ARM11 processor core with vector floating point unit; advanced, autonomous GPS/Galileo baseband DSP core with available SiRFAlwaysFix technology, DDR2, Mobile DDR, SD/MMC/MMC+ and NAND flash memory controllers; audio DAC; LCD touch panel controller, video post processing accelerator; USB 2.0 and other connectivity interfaces and a complete power management unit. CSR is working with Microsoft Corporation to optimize the SiRFAtlasV's integration with Windows Embedded CE 6.0 real-time operating system on a wide range of small footprint consumer and enterprise devices.

**EXHIBITORS — Information for the Show Daily: You may drop off press releases, new product announcements and other information for the Show Daily at the ION Membership Booth 820 in the Exhibit Hall or at the Registration Desk in the foyer.**

WELCOME continued from page 1

### ABOUT YOUR HOSTS: THE INSTITUTE OF NAVIGATION SATELLITE DIVISION

This is the 23rd International Technical Meeting of ION's Satellite Division and the world's largest technical meeting and showcase of GNSS technology, products and services.

Since its founding at the time of the first ION GPS meeting in 1987 in Colorado Springs, Colorado, the Satellite Division has grown into the ION's most active division.

The ION GNSS conference series has drawn worldwide attention, attendance, and recognition as the forum for announcing new policy and technology developments and applications of global navigation satellite systems.



**General Chair:** Prof. Naser El-Sheimy, *University of Calgary, Canada*

Dr. El-Sheimy is a professor of geomatics engineering. He holds a Canada Research Chair (CRC) in Mobile Multi-sensor Systems and is the scientific director of Tecterra Research Centre. His research expertise includes GPS/INS integration, multi-sensor systems,

and mobile mapping systems. A prolific author, he has received more than 20 national and international paper awards. El-Sheimy has participated in organizing several ION conferences and many other international conferences. He is president of Commission I on "Sensors and Platforms" of the International Society for Photogrammetry and Remote Sensing (ISPRS).



**Program Chair:** Patricia Doherty, *Boston College*

Ms. Doherty directs the Institute for Scientific Research at Boston College where she oversees a variety of projects on space weather studies, ionospheric effects on space-based systems, ionospheric measurement techniques, chemical reactions in space and magnetospheric physics. Her research interests include GNSS as a space weather sensor; ionospheric effects on satellite-based augmentation systems; and promoting research and education in GNSS technology in developing countries. She serves on the ION's Executive Committee, chairs

the ION's New England Section and is treasurer of the ION Satellite Division.

#### Technical Chairs:

Dr. John Betz, *The MITRE Corporation*; Dr. Anthea Coster, *MIT Haystack Observatory*; Dr. Didier Flament, *European Space Agency, France*; Deborah Lawrence, *Federal Aviation Administration*; Martin Lopez, *Overlook Systems Technologies*; Dr. Alexander Mitelman, *Cambridge Silicon Radio, Sweden*; and Dr. Mark Petovello, *University of Calgary, Canada*.

#### Satellite Division Officers:

**Chair:** Dr. Pratap Misra, *The MITRE Corporation*; **Vice Chair:** Dr. John Raquet, *Air Force Institute of Technology*; **Secretary:** Dr. Demoz Gebre-Egziabher, *University of Minnesota*; **Treasurer:** Patricia Doherty, *Boston College*; **Immediate Past Chair:** Dr. A.J. Van Dierendonck, *AJ Systems*; **Asian Technical Advisor:** Prof. Andrew Dempster, *University of New South Wales, Australia*; **European Technical Advisor:** Dr. Christian Tiberius, *Delft University of Technology, The Netherlands*; **Galileo Advisor:** Prof. Günter W. Hein, *ESA/ESTEC, The Netherlands* ♦

8:30 a.m.  
MORNING SESSIONS BEGIN

PANEL DISCUSSIONS —  
PROGRAM UPDATES:  
(GPS, GLONASS, Galileo,  
IRNSS, QZSS)  
Room C123-124

12:15 p.m. – 1:15 p.m.  
INFORMAL LUNCHEON  
Exhibit Hall  
This event is included with any type of registration. Enjoy lunch with colleagues and new acquaintances.

1:15 p.m. – 1:45 p.m.  
FREE TIME IN EXHIBIT HALL

1:45 p.m.  
AFTERNOON SESSIONS  
BEGIN

PANEL DISCUSSIONS —  
PROGRAM UPDATES: HIGH  
INTEGRITY SYSTEMS  
Room C123-124

5:30 p.m. – 6:30 p.m.  
PANEL DISCUSSIONS —  
GALILEO OS SIS ICD  
EXCHANGE OF VIEWS  
WITH INDUSTRY  
Room C123-124

6:30 p.m. – 7:30 p.m.  
ION/AAAS GOVERNMENT  
FELLOWS INFORMATION  
HOUR

Outside Exhibit Hall Entrance  
Hosted by Dr. Clark Cohen, ION Government Fellows Committee chair. Talk to former ION Government Fellows about the many benefits of these ION-sponsored fellowships. Experience government behind the scenes and use your expertise to help shape policy.

7:00 p.m. – 9:00 p.m.  
EXHIBITOR HOSTED  
RECEPTION

Exhibit Hall  
Join this year's exhibitors as they host a social evening of information and cuisine. All exhibit booths will be open. Take this opportunity to review developments in GNSS technology, talk shop, get the specifics directly from the vendors, and learn about what has been happening in the GNSS marketplace during the past year. This event is included with any type of registration. Spouses and traveling companions 21 and older are welcome.



### PROGRAM CHANGES

**Session C1b:** Paper #4 by Heinrichs, cancelled. Alternate #1 by Viola cancelled. Alternate #2 by Xu cancelled.

**Session F2:** Session Chair Christopher, cancelled. Replaced with Dr. Yang Gao, University of Calgary, Canada.

**Panel Program Updates:** High Integrity Systems: Presentation #3 by Michinobu Utsunomiya, cancelled.



### CHECK IT OUT

#### Self-Service Business Area.

The use of computers, a printer and a copier is being provided by Rx Networks on a self-service basis in the ION registration lobby. Internet access is not available on these computers. For Internet access, please use the computers in the Internet Access Center. As a courtesy to others, please limit your time when others are waiting.

#### Copies of Technical Papers Online.

Author submitted technical papers will be available for download at [www.ion.org](http://www.ion.org) to technical conference registrants. The registration number on the back of your badge is your user I.D. If a paper is not available online, we recommend you contact the author directly. After the official conference proceedings are distributed in December, regular download policies and prices will apply.

**Messages.** If your office needs to contact you, we recommend that you leave your hotel's phone number with your office and have messages sent to your hotel.

#### ION GNSS Internet Access Center.

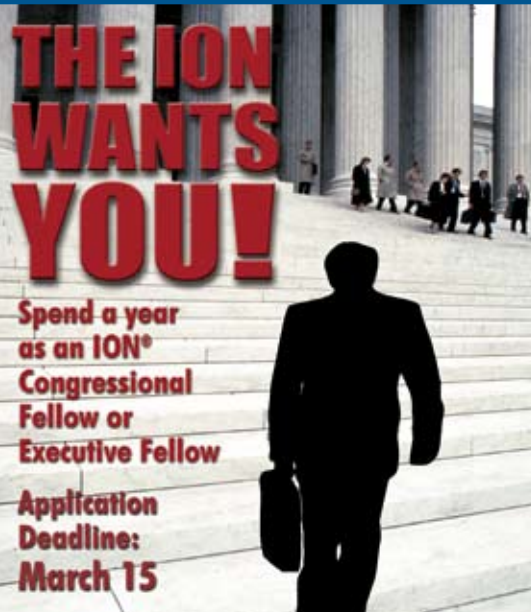
Use of the computers is **FREE** in the Internet Access Center. Please limit your time when others are waiting. Special thanks to NovAtel, Lockheed Martin and InsideGNSS for sponsoring this year's Internet Access Center.

**Job Board.** Use the job board in the business area to post openings.

### Visit The ION/ AAAS Government Fellows Booth

Wednesday, Sept. 22  
6:30 – 7:30 p.m.  
Exhibit Hall Entrance

Help shape policy in Washington, D.C. Meet with, and talk to, former ION government fellows and learn about the many benefits of participating in this program. This may be a perfect fit for you now, or in the future!



### ION GNSS 2010 Membership Promotion

## MEMBERSHIP SPECIAL FOR YELLOW BADGES AT ION GNSS



The Institute of Navigation (ION) invites everyone at GNSS 2010 to JOIN as a member.

If you have a **YELLOW** registration badge, that means you are not currently a member of ION. But we want ALL GNSS attendees to enjoy the benefits of ION membership. So trade in your yellow badge for a **GREEN** badge by joining The Institute of Navigation during GNSS 2010.

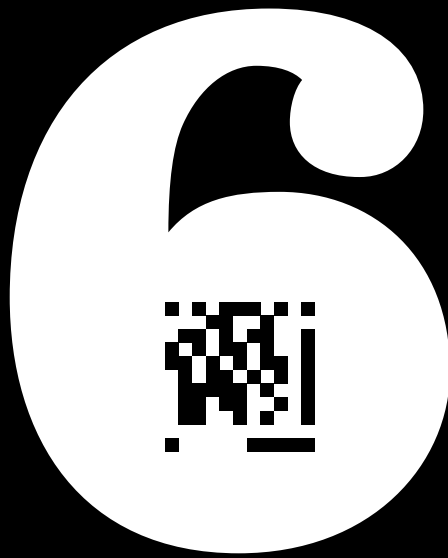
It's easy AND fun.

If you have a **YELLOW** badge, chances are you are eligible to join ION for just \$15 (\$35 outside U.S.) Plus, if you join ION during GNSS 2010, you will get a free spin of the prize wheel located in **Booth 820** in the exhibit hall.

Two easy ways to join: 1) Go to **Booth 820** in the exhibit hall and complete the membership form, or 2) go to the registration desk and complete the membership form there.

After you join, bring your membership receipt to **Booth 820** and spin the prize wheel for a free gift. Everyone wins! Prizes include Starbucks gift certificates, ION lapel pins, ION shirts, ION ear buds, ION ties and other fun prizes.

This is the best opportunity to join ION at a great price. ♦



**Get in on the secret.**



**Integrate success into your** [REDACTED].