ION GNSS 2011 will roll out a cluster of new activities and high-profile speakers at the world’s oldest and largest GNSS conference, scheduled September 19 – 23 in Portland, Oregon.

In addition to the usual extensive technical presentations, this year’s highlights include the engineering director for Google’s Street View speaking in the plenary session, the launch of ION’s own pre-conference tutorial program, a pre-conference workshop on China’s Compass/BeiDou program, and a panel discussion series with such provocative themes as “Can LightSquared and GPS Coexist?”, “Improving Security of GNSS Receivers,” and “Space Weather Effects on GNSS in the 21st Century.”

Dr. Alberto Broggi and Dr. Pier Paolo Porta, Artificial Vision and Intelligent Systems Laboratory (VisLab), Parma University, Italy, will present the keynote for Tuesday night’s plenary session on “Modern Navigation Serving the Information Society”. Their topic: “The Intercontinental Autonomous Drive from Parma to Shanghai.”

An extension of such ventures as DARPA’s Grand Challenge and Urban Challenge, the Intercontinental Autonomous Challenge was conceived by VisLab as an extreme test of autonomous vehicles. Between July 26 and October 28, 2010, four vehicles drove with virtually no human intervention on a 9,000-mile journey from Parma, Italy to the 2010 Shanghai World Exposition in Shanghai, China.

They will be joined by Dr. Luc Vincent, engineering director, for Google’s Street View, who will discuss the navigation and mapping technologies used to implement the project. Paul Verhoef, program manager of the European Union satellite navigation programs, will speak on GNSS as the backbone of intelligent transport systems. Dr. Chris Rizos, professor & head, School of Surveying & Spatial Information Systems, University of New South Wales, Australia will assess the prospects for achieving “ubiquitous positioning.”

Another promising innovation this year is a pre-conference workshop on “Compass: Progress, Status, and Future Outlook,” sponsored by the International Association of Professionals in Global Positioning Systems (CPGPS). It will take place the morning of Tuesday, September 20.

The CPGPS has invited Compass experts from the BeiDou Management Office, the Chinese government agency that oversees the Compass program, as well as representatives from China’s GNSS industry and institutions involved in design and implementation of Compass/BeiDou-2.

The workshop is sponsored and organized by CPGPS as a commemorative event to celebrate the 10th anniversary of the association. Co-chairs of the workshop are Dr. Jade Morton, of Miami University (Ohio), CPGPS president, and Professor...

---

ION GNSS 2011 continued on page 5
FROM THE ION PRESIDENT

DR. TODD WALTER

2011 ION GNSS: LightSquared Debate, JNC 2011, Kepler Award Nominations

In the last issue of the ION Newsletter, you may have read the letter that ION executive director Lisa Beaty, sent to The Honorable Julius Genachowski, Chairman of the Federal Communication Commission (FCC), regarding LightSquared’s application to modify its authority to operate a terrestrial wireless voice and data broadband service in the L-band frequencies.

The ION Council requested this letter because the issue has a direct impact on our community. ION has not heard back from the FCC directly, but several organizations, and many of our members, continue to work on this problem.

The FCC has issued an order and authorization in favor of LightSquared, subject to resolving GPS interference issues.

LightSquared and the U.S. GPS Industry Council have formed a technical working group as is required by the FCC. They are studying the situation and conducting multiple tests.

During the Satellite Division’s upcoming ION GNSS meeting (September 19-23, 2011 in Portland, Oregon) interference test results will be presented during the Civil GPS Service Interface Committee (CGSIC) meeting on Tuesday, September 20.

On Wednesday, September 21, ION will hold an interactive panel discussion, moderated by Tom Stansell, which will debate the question of whether or not LightSquared and GPS can coexist. The panel will feature participants from the U.S. GPS Industry Council, Trimble, Garmin, NovAtel, NavCom/John Deere, CSR/SiRF, and Broadcom. LightSquared has also been invited to send a representative. It is sure to be a lively exchange, and I invite you to take part. (See the article on page 12 in this issue of the newsletter to learn more details about the situation.)

JNC 2011

This summer, the ION will be co-sponsoring the Joint Navigation Conference (DOD/DHS US-ONLY FOUO military meeting) with the Joint Services Data Exchange (JSDE) on June 27-30 at the Crowne Plaza Hotel in Colorado Springs, Colorado.

This year’s conference attracted 180 abstracts — a new record! The large number of submitted abstracts prompted the program committee to expand the length of the formal presentation portion of the technical program by a half day.

The JNC presentations will begin on the afternoon of Monday, June 27. As in prior years, pre-conference tutorials will be provided on Monday morning.

GLONASS-K, CDMA

I would like to extend my congratulations to the GLONASS program for its rapid turn around from last December’s launch failure. The launch of the first GLONASS-K satellite and subsequent transmission of its first CDMA signal on L3 demonstrates the program’s resilience and Russia’s commitment to its GNSS future.

All four GNSS core constellation providers are planning launches this year that extend both the number of satellites and signals being broadcast. I look forward to seeing how our community takes advantage of these additional offerings.

Kepler Award

And finally, I want to remind you that June 30 is the last day to submit a nomination for the Satellite Division’s prestigious Johannes Kepler Award. It honors an individual for sustained and significant contributions to the development of satellite navigation.

All members of the Institute are eligible for nomination. You will find a nomination form on the ION’s web site at: http://ion.org/awards/kepler.cfm. I encourage you to submit a nomination for a worthy individual. ☺
June 2011

This year’s Joint Navigation Conference (JNC 2011), co-sponsored by the Joint Services Data Exchange (JSDE) and the ION, will gather June 27–30 in Colorado Springs, Colorado, to explore the theme, “Military Navigation Technology: The Foundation for Military Ops.”

A plenary session during the morning of June 28 will feature presentations by high-ranking Department of Defense (DoD) officials, including Rear Admiral Jonathan W. White, Commander, Naval Meteorology and Oceanography Command, and Major General John E. Hyten, Director, Space Programs, Office of the Assistant Secretary of the Air Force for Acquisition. Many other officials have been invited to brief the plenary audience.

Sessions will carry a U.S. For Official Use Only (FOUO — June 27–29) and a Classified “4-eyes” status (open to citizens of Australia, Canada, United Kingdom, and United States — June 30) requiring advance registration and clearance.

The GPS Directorate (GPSD) and Joint Navigation Warfare Center (JNWC) will have a strong presence at this year’s JNC, with GPSD representatives chairing three technical sessions and several classified papers authored by GPSD and JNWC personnel.

Among other topics, the GPS Directorate will present an update on the LightSquared frequency allocation controversy, which will have just resulted in a June 15 report to the Federal Communications Commission (FCC) on the 4G/LTE broadband system’s potential interference to GPS L1, based on the current FCC schedule.

Located near the GPS Master Control Station at Schriever Air Force Base and Air Force Space Command at Peterson AFB, the conference will also draw expertise from Air Force and industry representatives responsible for the GPS ground control and space segments.

Participation in the two-day exhibition is also particularly strong this year, with 30 companies and organizations occupying 54 booth spaces at the time this newsletter went to press.

A full day of tutorials will take place on Monday, June 27, with six different courses: Alternative Navigation, Fundamental Reference Systems, GPS 101, Precise Time & Frequency Applications, Vector Tracking Theory and Implementation, and Urban Indoor Navigation. Although the plenary opens Tuesday’s program, two FOOU technical sessions will take place on Monday afternoon — Marine Applications and Micro Navigation Applications.

An Alternative Navigation Technologies track will feature separate sessions on RF, Vision, Natural Occurring Phenomena. Other session highlights include GPS Modernization and GPS Constellation Performance as well as Integrated Systems Design and Performance.

A session on “Warfighter Requirements and Solutions” will include an update from the AFSPC GPS Operations Center (GPSOC) at Schriever AFB. The session will also include a presentation on “Modernizing the Warfighter Handheld Navigation System,” by Ken McKnelly, Jr., Dave McDonnell, and colleagues at Johns Hopkins University’s Applied Physics Laboratory.

McKnelly and McDonnell recently briefed the GPS Partnership Council Meeting on the results of a year long study of next-generation handheld military GPS receiver requirements. The study included extensive feedback from 99 uniformed military personnel experienced in use of current DoD and consumer GPS products.

Classified sessions will include presentations on “Adversary Developments in NAVWAR,” “NAVWAR Testing,” and a Warfighter Cross Talk Panel. In the “Flexibility in NAVWAR” 4-eye session, Col. Jon Anderson, chief of the GPSD User Equipment Division, will discuss “M-Code: The Way Forward.”

The plenary, FOOU conference sessions, and exhibition will be held at the Crowne Plaza Hotel in Colorado Springs. For additional information on JNC 2011 and registration, visit the conference website at http://www.jointnavigation.org.
The 2011 European Satellite Navigation Competition (ESNC) opened its registration web page on April 1 for entries in this year’s international search for new GNSS applications and product developments.

This year’s competition offers business start-up aid worth €1 million ($1.4 million) and a prize pool of €100,000.

Organized by the Anwendungszentrum Oberpfaffenhofen (AZO) and held under the patronage of the Bavarian Ministry of Economics, Transport, Infrastructure and Technology, ESNC 2011 will have more than 20 regional competitions around the world.

The USA Challenge, ESNC’s North American regional competition, will make a formal appearance at ION GNSS 2011 for the first time.

Organized by ION corporate member Inside GNSS, sponsored by corporate member NovAtel, Inc., and cosponsored by the ION, the USA Challenge entries are evaluated by an expert panel of judges, including ION members. As the ESNC’s North American regional event, the USA Challenge winner is entered into the international competition for the Galileo Master award and an accompanying €20,000 ($29,600) cash prize.

Entries are submitted on-line at http://www.galileo-masters.eu during a three-month window from April 1 through June 30, 2011. Regional evaluations take place during July/August, an international judging on September 8–9, and an October 19 awards ceremony at a state reception in der Residenz in Munich, Germany.

In the 2010 competition, an Austrian start-up company, Mobilizy, took home the €20,000 grand prize for its Wikitude Drive navigation system, which uses augmented reality to superimpose driving directions over live street video on smartphones. Last year’s USA Challenge winner was Elliot Klein, of New York City, who developed a mobile voting application, eVOTZ.

Six industrial and institutional partners will sponsors special topic prizes: the European GNSS Agency (GSA), the European Space Agency (ESA), the German Space Agency (DLR) and the GNSS Living Lab prize. NAVTEQ will award two special topic prizes.

At ION GNSS 2011 in Portland, Oregon, the five finalists for the USA Challenge will be announced during a special event in the exhibitor presentation area. The winner of the regional competition will be announced during the ESNC Awards Ceremony in Munich, Germany, on October 19.

USA Challenge finalists will be invited to attend ION GNSS 2011 and offer brief “fast pitch” presentations and/or send poster presentations about their satnav ideas. They will also have the opportunity to be present in the USA Challenge exhibit (Booth 720/722) in the exhibition area to discuss their ideas.

In addition to their regional competitions, ESNC participants can either apply for one of the special topic prizes or for the prototyping prize. The overall ESNC winner — designated as the Galileo Master — will be chosen from among the regional winners and the special topic winners.

The main prize will be a grant of €20,000, awarded by AZO and the GSA. In addition, the Galileo Master will get the chance to enter a six-month incubation program in a region of his or her choice to realize the winning idea.

The USA Challenge exhibit will feature presentations on USA Challenge finalists. Competition sponsors and ESNC representatives from organizer, Anwendungszentrum Oberpfaffenhofen have also been invited to attend.

Visitors to the ION GNSS 2011 exhibition will be able to vote for their favorite application among the five finalists to select the...
USA Challenge “People’s Choice Award,” which will be announced on the final day of the conference.

How to Enter ESNC 2011
Once participants have created a personal account on the ESNC website, a confirmation e-mail will be sent to them. They then validate their account by clicking on the provided link and log-in with their username (i.e., e-mail address) and their chosen password.

Participants can submit more than one idea using the same personal account and can log into the database to continue developing their idea as often as they like before the database closes on June 30. Participants can also upload images, logos or figures to clarify and support their proposals.

The database is divided into three different sections: technical, commercial, and legal. The technical section asks participants to describe their idea as clearly and accurately as possible; the commercial section addresses the market potential of their idea; and the legal section deals with the idea’s formal project aspects and its trademark and patent rights.

Regional and international judges will assess the ideas based primarily on the following criteria:

- Benefit of the idea
- Advantage of the idea compared to other existing or traditional solutions
- Technological feasibility of the idea
- Significance of the use of GNSS for the realization of the idea
- Time it would take to implement this idea (time to market)
- Chances of this idea becoming a commercial success
- Ability to patent the idea
- Legal risks involved in the idea
- Investment potential for the idea
- Innovation level of the idea

Voting on the go: The eVOTZ platform. Last year’s USA Challenge winner was Elliot Klein, of New York City, who developed the eVOTZ mobile voting application.
Brooklyn is New York city’s most populous borough with a population of 2.5 million. Recently, it has become known for residential gentrification, a premier arts district, and as the financial back office for New York. The borough is not often thought of as a maritime and navigation hub.

A new museum scheduled to be opened this year will likely change that perception when the massive Brooklyn Navy Yard complex opens to the public. The centerpiece of the transition will be a museum housing relics from the 210-year history of the maritime facility.

In 1801, federal authorities purchased 40 acres of land and the old docks in Wallabout Basin, a semicircular bend of the East River across from Corlear’s Hook in Manhattan. By 1806, it had become an active U.S. Navy shipyard.

Among the 19th century ships built or outfitted at the Brooklyn shipyard were Robert Fulton’s steam frigate, *Fulton*, and the nation’s first ironclad ship, the *Monitor*, of Civil War fame. By the 1860s, the yard had expanded to employ about 6,000 men. In 1890, the ill-fated *Maine* was launched from the yard (and famously destroyed in Havana Harbor eight years later).

In the first quarter of the 20th century, Brooklyn was the home of the Sperry Corporation. By this time, the shipyard included the Navy’s Material Laboratory, which performed research and development in naval materials, electronics and navigation. Elmer Sperry’s gyrocompasses were tested at the shipyard in the first inertial instrument testing laboratory.

On the eve of World War II, the yard contained more than five miles (eight kilometers) of paved streets, four drydocks ranging in length from 326 to 700 feet (99 to 213 meters), two steel shipways and six pontoons and cylindrical floats for salvage work, barracks for U.S. Marines, a power plant, a large radio station, and a railroad spur, as well as the expected foundries, machine shops, and warehouses.

The battleship *North Carolina* was laid down in 1937. In 1938, the yard employed about 10,000 men, of whom one-third were Works Progress Administration (WPA) workers. The battleship *Iowa* was completed in 1942 followed by the USS *Missouri*, on which Japan surrendered to the Allies on September 2, 1945.

In 1953, test operations began on the *Antietam*, America’s first angled-deck aircraft carrier. It, too, was built in the yard.
In 1964, the Materials Laboratory at the Brooklyn Navy Yard became the Naval Applied Sciences Laboratory (NASL). NASL continued to be the Navy's lead activity in shipboard navigation, conducting research, development, and testing of stable platforms; gyrocompasses; radio-navigation aids including OMEGA, LORAN and LORAC, and ocean bottom transponder systems.

In 1971, after a Base Relocation and Closure action of NASL, a contingent remained in Brooklyn and became the Naval Strategic Systems Navigation Facility (NSSNF). The government changed names several times but the personnel and facilities in Brooklyn continued to excel in shipboard navigation.

The USS Compass Island, a research vessel at the Brooklyn facility, was converted in 1956 from a cargo ship for the Polaris Fleet Ballistic Missile (FBM) Program. The ship was first used to evaluate the FBM navigation subsystem methodology, a complex system of gyroscopes, accelerometers, and computers that related a ship's movement over the Earth from an initial position to give a continuous report of its location without frequent reference to external position fixes.

The electrically suspended gyro, still the mainstay of the TRIDENT submarine's navigation subsystem, was evaluated on the ship in the late 1960s, which also tested the Navy Navigation Satellite System or TRANSIT, a GPS forerunner, in the 1960s as well.

Compass Island scientists established precise gravity and bathymetric ranges that were used to evaluate geophysical map matching techniques. In the late 1970s, they tested Phase I GPS receivers and examined initial GPS-INS integration methods.

Brooklyn's role in navigation systems ended in 1974, when the Navy decided to consolidate its ship navigation expertise with its air navigation capabilities in Johnsville/Warminster, Pennsylvania.

The USS Compass Island sailed from Brooklyn to Port Canaveral Florida where she was decommissioned in 2003 and now lives on in a Facebook page of her own: USS Compass Island AG-153.

Brooklyn's significant role in shipboard navigation research and development hopefully will be told in the new museum, which opens in November, 2011, as the centerpiece of the Brooklyn Navy Yard Industrial Park. Admission will be free at BNYC92, the center at Building 92, built in 1857 and designed by the architect of the U.S. Capitol dome. (www.brooklynnavyyard.org)

The USS Compass Island subsequently tested generations of SINS, celestial trackers, navigation computers, speed logs, gravity meters, radio aids, and sonar devices. Early at-sea gravimeters were pioneered on the ship, including demonstrations of the first-at-sea compensation of vertical deflection effects.

Marvin B. May is Chief Scientist of the Navigation Research and Development Center of Pennsylvania State University where he also teaches navigation courses.
WON’T LET GO

Privacy, Location and the Tightening Web of iPhones, Androids, iPads, Browsers, Computers, WiFi Networks, GPS, Cell towers, and Mobile Devices

“You think you’re lost
But you’re not lost on your own
You’re not alone”
— from “I Won’t Let Go,”
by Rascal Flatts, available as a cell phone ringtone

The Apple iPhone keeps track of a device’s latitude, longitude, and time of activation. It does not tell users what it is doing nor does it give them a choice to opt out.

That information remains permanently on your phone and back at headquarters. And it puts the data in an unencrypted file on the phone that someone’s hacker nephew could handle.

HOW YOUR ELECTRONIC DEVICES FIND OUT WHERE YOU ARE (And Who They Tell)
The Wall Street Journal, as part of its continuing coverage of location data gathering controversy explained how and on which devices location data is collected.

<table>
<thead>
<tr>
<th>WiFi-connected Apple laptops, desktop computers</th>
<th>iPhone and iPad</th>
<th>Android phones</th>
<th>Google search toolbar, Chrome browser, Firefox browser</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the user sends a location-based request from some laptops and desktops, computer sends WiFi access points data to Apple.</td>
<td>Collects latitude, longitude and time from cell towers, GPS, and nearby WiFi networks and Apple stores it when you make a call or use a location-based app.</td>
<td>Uses cell towers, GPS and WiFi to get latitude and longitude, WiFi names and access points, cell tower data. Creates a unique device ID. Google stores information every few seconds.</td>
<td>Every time you give a website your permission to find your location, your computer sends WiFi network information to Google.</td>
</tr>
</tbody>
</table>

(These information was published in graphic form in the Wall Street Journal on April 27, 2011)

So say two researchers, Alasdair Allan and Pete Warden, who uncovered this lack of transparency and released their study of the California-based computer giant’s surreptitious iPhone data gathering on April 20. The news broke on the technology website O’Reilly Radar and at the Where 2.0 location conference in Santa Clara, California.

Allan is a senior research fellow in astronomy at the University of Exeter, United Kingdom, and Warden is a former Apple graphics engineer.

Their study awoke a flurry of media attention and congressional concern, sparked an investigation by the Illinois Attorney General, led to two citizen lawsuits in Florida and launched an inquiry in Korea.

Within days, Samy Kamkar, an independent analyst for the Wall Street Journal, found that Google does much the same thing.

It appears that both companies are using their smartphone customers as unwitting legmen in building a giant database for commercial location-based services. Of course, location is also key to a number of features — maps and commercial apps and social networking among them — that people like very much.

But there’s a difference between tracking an individual — this concerned the researchers — and gathering aggregate data, said the companies in reply.

By the end of the week, the consumer electronics companies had released statements of reassurance, full of technological details and technical fixes, while policymakers and electronic privacy advocates worried about the slippery slope and set up a congressional subcommittee hearing.

That’s where the debate stands.

Apple, Google, and Location Information
After Allan and Warden’s announcement, the Wall Street Journal launched its own investigation and published a series of stories beginning April 25.

They found that the 4G operating system (OS) on the iPhone and 3G iPad, which has been available for about a year, tracks and records location and time on those devices. The location data, which is turned on by default and can’t be turned off, is collected in an unencrypted file. The OS also collects location information from any computer connected to WiFi.

Kamkar found out that Google’s Android phone collects even more information and adds a unique device identifier. It does not store location data in a file on the phone, however.

Kamkar tested an HTC Android phone, which recorded location every few seconds and sent the information, complete with a unique identifier, to Google several times an hour. There was no indication that this information...
was not transmitted nor stored securely.

Over the next few days, reporters found that location data was also collected from Apple computers connected to WiFi and from users of Google’s Chrome browser.


However, in their original story, Allan and Warden had said, “We’re not sure why Apple is gathering this data, but it’s clearly intentional, as the database is being restored across backups, and even device migrations.”

The researchers also published a map of one cell phone’s location data gathered by Apple over the course of a year. (See accompanying graphic.) So, whether the company was interested in a particular user or not, the raw material they gathered would make it possible for a marketer — or a stalker — to follow one mobile device with coarse accuracy over a long period of time.

In its response, Apple said the purpose of location tracking on the iPhone was to build a WiFi hotspot database that helped speed the positioning fix.

“Calculating a phone’s location using just GPS satellite data can take up to several minutes. iPhone can reduce this time to just a few seconds by using WiFi hotspot and cell tower data to quickly find GPS satellites, and even triangulate its location using just WiFi hotspot and cell tower data when GPS is not available (such as indoors or in basements).”

Apple did not explain why the data was kept permanently, why users were not informed, nor why the data was not kept secure. The fact that the software still kept collecting data when the user turned off location services “is a bug,” they said.

The company plans to release a software update “in a few weeks” that reduces the size of the location database, encrypts the data, stops backing it up, and deletes it when the location services option is turned off.

Follow the Data

As days passed, it became apparent that a number of devices and software made using the Apple and Google technology collected

Senate Subcommittee Takes a Meeting

The discovery that Apple and Google both track longitude and latitude and other location data — using GPS, WiFi, and cellular network-based techniques — on individual smartphones, pads, and linked computers without the knowledge of the user has caused a media furor and congressional concern.

The resulting controversy will be one of the first topics addressed by a new U.S. Senate judicial subcommittee on Privacy, Technology and the Law, that was formed in February to review just such issues.

The first meeting of the committee was scheduled on May 10. The subject was “Protecting Mobile Privacy: Your Smartphone, Tablets, Cellphones and Your Privacy.”

Subcommittee chair Al Franken (D-Minn) wrote a letter to Apple on April 20 asking the company to explain their location data collection practices and to attend the subcommittee meeting.

Google CEO Larry Page and Apple CEO Steve Jobs and Apple have been urged to attend by Senate Judiciary Committee chair Patrick Leahy (D-Vt), who sent letters to both of them on April 27. Leahy was the force behind the 1986 Electronic Communications Privacy Act (ECPA) and is now leading the charge to update it.

In his letter, Leahy said “The collection and storage of sensitive location information has serious implications regarding the privacy rights and personal safety of American consumers [and they] deserve to know the potential risks . . .”

Apple CEO Steve Jobs confirmed that Apple “looked forward to testifying” at the May 10 meeting in an April 27 interview with All Things Digital. “We haven’t been tracking anyone,” he said. The iPhone location data files that started the controversy earlier this week “were basically files we have built through anonymous, crowd-sourced information that we collect from the tens of millions of iPhones out there,” Jobs said.

According to the Senate website, other confirmed witnesses include officials from the Department of Justice and the Federal Trade Commission; Ashkan Soltani, independent privacy researcher and consultant; and Justin Brookman, Director of the Center for Democracy and Technology’s Project on Consumer Privacy.

The subcommittee will oversee laws and policies that concern collecting, protecting, using and disseminating commercial information about people by the private sector, including online behavioral advertising, social networking and other online privacy issues.

It will enforce and implement privacy laws and policies for identifiable personal information and will encourage transparent and innovative privacy standards that keep up with the new technologies of our information age.
We began our discussion in the Winter issue of this newsletter by briefly describing the early history of the Global Positioning System and its predecessors. This concluding part addresses some common misconceptions about those predecessors.

One common error is thinking that satellite navigation pioneers did not anticipate worldwide time synchronization as an offshoot of their system. For instance, in the January 2008 *GPS World* defense on-line column, Don Jewell wrote, "You need to know that in those days, GPS was seen as a military system only, and there were no thoughts of granting public, much less worldwide, free access to the GPS signals. It was basically a military en route navigation system, and not much was thought about it beyond that. Certainly there was no serious consideration given to GPS becoming the de facto world standard for time."


This statement is incorrect. Both Roy Anderson, Senior Research Scientist at General Electric and Roger Easton, Branch Chief at the Naval Research Laboratory (NRL), proposed systems that were primarily used for navigation. However, they also anticipated worldwide time synchronization as a consequence of their proposals.

In an article titled "A Navigation System Using Range Measurements From Satellites With Cooperating Ground Stations," in the Autumn 1964 issue of the ION's *NAVIGATION* journal, Anderson wrote that his system would provide worldwide synchronization to approximately one microsecond. Easton wrote in a 1967 memo that, "Possible fallouts from such a system [Timation] are worldwide time synchronized to better than 0.1 microsecond."

An NRL press release about the lab’s satellite-based timing and ranging system cleared for public distribution June 16, 1969, stated that “Timation has been proposed as a vehicle by means of which time standards for the United States could be synchronized.” In 1971, the Timation Development Plan stated that the system would result in worldwide clock synchronization to 0.01 microsecond.

Even though time transfer was less prominent in the original military conception of the system, it was extremely important to Timation’s inventors. In July 1972, the Timation 2 satellite was used for international time transfer between the Royal Greenwich Observatory and the DoD Master Clock at the United States Naval Observatory.

A second myth is that the Timation system was only capable of providing two-dimensional positioning (2D) and required an atomic clock in the receiver. A vast amount of primary source material refutes these statements. I have discussed these issues before in the Winter 2007-8 ION Newsletter and the May 2010 issue of *Inside GNSS* and refer readers to the arguments presented there.

Multiple Timation documents, a presentation to the 1969 EASCON conference, a 1973 article in *Aviation Week and Space Technology*, and the autobiography of Dr. John McLucas, who was Secretary of the Air Force from 1973–75, all state that Timation was a three-dimensional (3D) system. However, this fact is still being disputed, and I will present several new references here.

The Timation Development Plan, *NRL Report* 7227, March 2, 1971, contains numerous references to 3D capabilities. A passage on page 9 of the 1971 report states that, “This system will provide global, all-weather, passive, continuous navigation fixes in three dimensions with accuracies better than 50 feet.”

On page 10, the report further asserts:

*The satellites provide the necessary data for the navigator to determine his latitude, longitude, altitude, and time. Not all navigators need to determine all of these parameters. The user with the most stringent requirements will use four satellites in view and the equipment to receive signals from all four satellites; reduced requirements will result in one or more of the four signals being ignored by that user’s equipment. This system was configured within the JCS [Joint Chiefs of Staff] navigation accuracy requirements and with close attention to producing a cost-effective configuration.*

Thus, Timation requirements were identical in providing 3D position and time transfer where necessary, as is the case with GPS.

Moreover, allegations that, in the absence of time transfer, Timation was limited to 2D are without merit. The accompanying figure from page 10 of the NRL report shows an airplane receiving signals from four satellites, therefore allowing it to fix its 3D position and time. Note also Anderson’s and Easton’s previously mentioned statements that Timation...
would provide worldwide time synchronization. This would not be the case if the system had required a synchronized clock in the receiver.

The NAVSTAR Global Positioning Project Management Plan from July 1974, approved by the Joint Program Office’s (JPO’s) first director, Dr. Bradford Parkinson, asserts on page 1-1, chapter 1 page 1, that TIMATION was, “A technology program to advance the development of high stability oscillators, time transfer, and three dimensional navigation.”

Page iv of the Timation Development Plan refers to “the implementation of a satellite position fixing and navigation system that meets the requirements promulgated by the JCS Navigation Study Panel in 1968.”

I have not found a 1968 document that sets forth these requirements. However, page two of an August 6, 1970, memo to file from Harry Sonnemann, then chairman of the Navigation Satellite Executive Steering Group (NAVSEG), states that NAVSEG “has considered the implementation of a satellite navigation system has been primarily directed at the requirement to precisely determine positions of a fixed point or moving platform in three dimension near instantaneously on a global basis.”

The TIMATION Development Plan was designed to meet these requirements; therefore, TIMATION was a three-dimensional system.

Another issue that has been raised is the value of the first atomic clocks in orbit, which were launched on NRL’s Navigation Technology Satellites NTS-1 and NTS-2. Dr. Parkinson recently asserted that these clocks were not space-hardened and failed rapidly. Captain David Holmes, who supported Space Surveillance described in Part 1, wrote in the December 1976 issue of Countermeasures (pages 53-54):

_However, six months before the NTS-1 scheduled launch date a rubidium clock made by EFRA- TOM was brought to the attention of Mr. Easton. Being an atomic clock, the rubidium oscillator offered the promise of both higher accuracy and higher, long term stability. With joint program office approval, [emphasis mine] NRL decided to take the risk and install it, even though time available for testing and installation of space qualified parts was minimal. Thus, Dr. Parkinson criticizes the decision to launch NTS-1 without space-hardened clocks that be, as the first head of the GPS Joint Program Office, approved of at the time. Holmes then asserts that the decision paid off since both rubidium clocks demonstrated satisfactory performance in the space environment. The performance of the NTS-2 clocks was excellent.

None of this detracts from the vital role Dr. Parkinson and the GPS JPO played in the successful implementation of GPS. But repeating historical inaccuracies that are refuted by an abundance of primary source material leads to confusion about the origins of this vital system and needs to be corrected. ♦

Richard Easton and co-author Eric Frazier are writing a narrative history of GPS to be published by Potomac Books.
LightSquared Has a Fast Track to L-Band

The GPS community faces a compressed timeline in which to respond to an initiative by LightSquared to establish a terrestrial network of high-powered cellular transmitters broadcasting in the radio spectrum next to the GPS L1 frequency centered at 1575.42 MHz.

As reported in the Winter ION Newsletter, the Federal Communications Commission (FCC) International Bureau has granted a waiver to the Ancillary Terrestrial Component (ATC) rule regarding mobile satellite service (MSS) space-to-Earth transmission in the 1525-1559 MHz band. That would allow LightSquared to build up to 40,000 transmitters broadcasting at 1,500 watts of power, which would wholesale the network to ATC-only operators offering so-called 4G/LTE broadband services.

The FCC’s January 26 order also required LightSquared to set up a working group to design, conduct, and analyze results of a test program to assess the potential of LightSquared transmissions to interfere with GPS. LightSquared faces a June 15 deadline to provide a final report and recommendations to the FCC. (See accompanying figure with test and decision timeline on page 13.)

In a January 26 letter sent at the request of the ION Council to FCC Chairman Julius Genachowski, executive director Lisa Beaty expressed concern about potential interference. She also said that the Institute “is prepared to work within its membership in identifying technical experts who might best assist the FCC in evaluating the risks and impacts of LightSquared’s proposal.”

So far, the FCC has not responded, but many ION members have been appointed to a Technical Working Group (TWG) established by LightSquared in cooperation with the U.S. GPS Industry Council (USGIC) to plan the test program.

The LightSquared working group submitted a second monthly report on April 15 which outlined the categories, receiver types, qualified test facilities, and metrics for evaluating the effects of ATC transmissions on GPS equipment.

As of early May, the TWG has established seven “sub-teams” to test various types of GPS receivers: aviation, cellular, general location/navigation, and space-based receivers. Three closely collaborating sub-teams will work on high-precision, networks, and timing receivers.

Independent of the FCC-ordered study, the National Space-Based PNT Systems Engineering Forum (NPEF) is conducting its own testing of the potential interference to GPS from LightSquared’s terrestrial network. The NPEF consists of engineers and other experts from across the interagency community that conducts assessments and makes recommendations on technical issues to the National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee.

That effort came at the initiative of Tony Russo, director of the National Coordination Office for Space-Based PNT.

Three types of potential LightSquared effects on GPS receivers are being investigated: “saturation” of GPS receiver front ends by RF energy coming from an adjacent band, out-of-band emissions (OOBEs), and “intermodulation products” caused by harmonics from LightSquared transmissions that appear in the GPS band.

Testing Is Under Way
Some initial tests have already been conducted: April 4–7 tests in White Sands, New Mexico; tests at the Jet Propulsion Lab in Pasadena, California, conducted by NASA; and NPEF “live-sky” tests using actual GPS signals in space and simulated LightSquared transmissions, held April 15–16. Test data have not been fully analyzed yet, although interference appears definitely to be present.

Some of the sub-team tests, however, will not begin until May 15, allowing little time for thorough assessment of results by a May 31 deadline.

Direct OOBES do not appear to be occurring because LightSquared has designed filters for its ATC transmitters to prevent that; however, front-end saturation and intermodulation products caused by dual-channel LightSquared transmissions have appeared in the GPS band. The latter effects were first detected in the NASA testing at the Jet Propulsion Lab.

In addition to the ATC broadcasts below the GPS band, LightSquared-capable handsets transmitting with a few watts of power would be authorized to transmit in spectrum above the L1 radionavigation band, between 1626.5 and 1660.5 MHz. Although testing of these handsets is planned as part of the response to the FCC order, they do not appear to present a high risk of significant interference to GPS at this time, Russo says.

Burden of Proof . . . and Costs
One worrisome aspect of the situation is an apparent effort to shift the burden of proof and associated costs for mitigating interference onto the GPS community.

LightSquared has made a big issue out of USGIC’s support over the past decade for the original ATC rule and LightSquared’s application for an earlier ATC waiver. Moreover, because it will filter out OOBEs, LightSquared is arguing that the interference is caused by GPS receivers that operate partially in the MSS band.

LightSquared has a lot of support behind it. Several billion dollars have been raised by Harbinger Capital Partners, which controls LightSquared.

Despite a long-established telecommunications regulatory principle that would-be entrants into an RF band must ensure non-interference, the FCC also appears to be inclined to accept LightSquared’s arguments. FCC Chairman Julius Genachowski, who leads the Obama administration’s campaign to reallocate 500 megahertz of spectrum to broadband services, has spoken in favor of LightSquared.

On April 6, in what was nominally a report and order on opening up MSS for broadband, issued on April 6, the FCC said, “... responsibility for protecting services rests not only on new entrants but also on incumbent users themselves, who must use receivers that...
reasonably discriminate against reception of signals outside their allocated spectrum. In the case of GPS, we note that extensive terrestrial operations have been anticipated in the L-band for at least eight years."

**GPS Supporters Fight Back**

The LightSquared plan has awakened substantial opposition. Many companies that offer GNSS products and services, as well as key user groups, have formed a group called Save Our GPS Coalition.

In an April 27 webinar sponsored by the Coalition, Jim Kirkland, vice-president and general counsel for Trimble, said “Some LightSquared advocates are trying to contend that [ATC ] use of the L-band ... was settled by the FCC back in 2002. They claim that GPS providers should have been anticipating today’s current events or designing GPS receivers differently — that it’s somehow the ‘fault’ of the GPS community. Nothing could be further from the truth.”

He added, “If the issue had been settled in 2002, LightSquared wouldn’t have sought this unusual waiver in the first place.

Instead, the Coalition presenters argue, the 2002–2003 discussions involved a “limited number” of low-power ground stations: 2,415 stations in the United States transmitting just 26 watts of power toward the horizon. As for claims that GPS equipment with inadequate filtering is the problem, not LightSquared’s planned transmitters, Kirkland called that “blaming the victim.”

“GPS receivers use high-quality filters that can resist signals in adjacent bands hundreds of thousands of times the power of the GPS signal,” he said. “But the laws of physics can overwhelm those filters with signals that are a billion times stronger than GPS. No existing filter can overcome this power differential.”

Coalition speakers laid out four talking points in the webinar:

- The burden of proof should be on LightSquared to demonstrate non-interference to GPS.
- The “new entrant” to the spectrum, LightSquared, must bear the cost of preventing interference.
- The FOC should make clear that LightSquared and its investors are proceeding at their own risk in building infrastructure that may not be used or have to be modified if causes interference to GPS.
- This is a matter of “critical public national interest” that requires “a reasonable opportunity for public comment” of at least 45 days.

**Government and Military User Perspective**

Federal, state, and local government users of GPS — especially those in public safety and aviation — have also expressed their concern through a letter to the FCC by the National Telecommunications and Information Administration.

Military officers have spoken out as well. General William L. Shelton, commander of the U.S. Air Force Space Command, said:

“If we allow that system to be fielded and it does indeed jam GPS, imagine the impact,” Shelton told the Air Force Association’s Air Warfare Symposium in Orlando, Fla., in February. “We’re talking about $110 billion industry in GPS; we’re talking about dependence on so many things in our infrastructure. This is just unbelievable.”

Congressional supporters have also weighed in. In an April 15 “Dear Colleagues” letter, U.S. Senators Pat Roberts, a Kansas Republican, and Ben Nelson, a Democrat from Nebraska, argued that the full FCC “must be involved and require LightSquared to objectively demonstrate non-interference as a condition prior to any operation of its proposed service. Anything less is an unacceptable risk to public safety.”

In a March 25 letter to Genachowski, the second-ranking officials from the U.S. departments of defense (DoD) and transportation (DoT) issued a strong message regarding LightSquared’s proposal. Deputy Secretary of Defense William Lynn III and Deputy Secretary of Transportation John Porcari expressed “several concerns” about the LightSquared Working Group (WG) process, starting with a “lack of inclusiveness regarding input from federal stakeholders” in GPS.

They told Genachowski that “active engagement” with DoD and DoT as stewards of the GPS service “is essential to protect this ubiquitous defense, transportation, and economic utility. . . .”

Lynn and Porcari are co-chairs of the National Space-Based PNT Executive Committee, which oversees federal management and policy regarding the Global Positioning System and other PNT resources.

---

**TWG Process Timeline**

<table>
<thead>
<tr>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
</table>

Define the TWG structure
Form the TWG
Announce the Advisor application process
Report - 3/15
Report - 4/15
Second Progress Report - 4/15
Third Progress Report - 5/15
Final Report - 6/15

Operational scenarios tested
Test results analysis methodology defined
Test plan documented
Test methods engaged

Test results analysis methodology defined
Test plan documented
Test methods engaged

Test analysis completed
Reference operational scenarios tested
Mitigation measures defined
Mitigation measures defined

Document results and findings for the final FCC report
Final report filed
The release in April of the 2010 Federal Radionavigation Plan (FRP) provides an updated version of the official source of U.S. positioning, navigation, and timing (PNT) policy and planning.

Since the first edition appeared in 1980, the FRP has served as a baseline document for government agencies, GPS users, and manufacturers. The FRP also charts the rise and fall of various navigation technologies and program. Copies of the plan can be downloaded from the U.S. Coast Guard Navigation Center. [http://www.navcen.uscg.gov/pdf/2010_FRP_FINAL_Signed.pdf](http://www.navcen.uscg.gov/pdf/2010_FRP_FINAL_Signed.pdf).

Originally intended to address coordinated planning by the Department of Defense (DoD) and the Department of Transportation (DoT) for federally provided radionavigation systems, the planning process has evolved to include other elements of navigation and timing.

With the advent of the Global Positioning System in the 1990s and other GNSSes later, space-based PNT began to inform — even dominate — the FRP discussion. The last couple of plans, however, have reflected a growing awareness of the limitations and vulnerability of GNSS and begun to emphasize the need for backups and alternatives to space-based PNT.

The 219-page 2010 FRP document was released officially under the signatures of the secretaries of defense, transportation, and homeland security.

Key players behind the scenes for producing the 2010 FRP included the U.S. Department of Transportation’s Research and Innovative Technology Administration (RITA) and staff at the Joint Planning and Development Office (JPDO), who did the heavy lifting on coordination of the 2010 FRP. Congress established the multi-agency JPDO in 2003 to plan and coordinate the development of the Next Generation Air Transportation System (NextGen).

The DoT Extended Pos/Nav, DoD PNT, and Department of Homeland Security (DHS) PNT Working Groups also met regularly to facilitate the coordination process.

As a “living document,” much of the content of FRP carries over from one version to the next, but is often reorganized and presented in different parts of the publication. Consequently, readers may need to look carefully to detect apparently minor tweaks that may signify important changes.

**Winners and Losers**

In its description of program plans, the FRP necessarily reflects the rise and decline of PNT programs, many of which will be familiar to ION members.

Repitition of language from one version to the next may also reflect delays in a program or initiative.

Completion of the Nationwide Differential GPS System (NDGPS), for instance, has not moved much since 2008, when the system was nearing full continental United States (CONUS) coverage (then 92 percent). The system is still at the 92 percent level, and 2008 milestones for full single-station and two-station CONUS coverage, 2010 and 2012, have been extended by two years each, with the caveat “pending funding availability.”

The system’s design is based on the USCG’s DGPS maritime service that began initial operation in 1996 and transmits real-time differential corrections from the reference stations on a medium frequency maritime radiobeacon band of 285-325kHz.

The 2010 document does, however, acknowledge completion in 2009 of an NDGPS recapitalization project for the maritime sites introduced in the previous version. This project will extend system life at least 15 years and provide a substantial increase in performance (accuracy and integrity), flexibility, and maintainability.

Two years after the 2008 FRP, the identical language appears in the section on Backup for Critical Infrastructure regarding the DHS responsibility for “determining whether alternative backups or contingency plans exist across the critical infrastructure and key resource sectors identified in the National Infrastructure Protection Plan in the event of a loss of GPS-based services.”

The same goes for the section on Interference Detection and Mitigation (IDM), again, primarily a DHS responsibility.

Vulnerability of GPS for Critical Infrastructure adds a section noting that the new National Space Policy released by the Obama administration in June 2010 states that “the U.S. shall invest in domestic capabilities and support international activities to detect, mitigate, and increase resiliency to harmful interference to
GPS, and identify and implement, as necessary and appropriate, redundant and backup systems or approaches for critical infrastructure, key resources, and mission-essential functions.”

The new space policy document also emphasizes international cooperation and states that foreign GNSS systems “may be used to strengthen resiliency” of U.S. PNT.

Sections on Loran-C, of course, have been scrubbed from the policy and operations sections in the 2010 version, and a new section added on Loran’s termination last year, following a decision by President Obama. The consequences of this decision appears clearly in the section on GPS Backups, where the corresponding reversal of fortunes of enhanced Loran (eLoran) is reflected in changes between the 2008 and 2010 versions.

The DoD Operational Management section elaborates on the role of the Joint Chiefs of Staff, adding details on Joint Staff (J-3) and Joint Staff (J-8) responsibilities, in addition to those of Joint Staff (J-6) described in the 2008 plan.

The Context for PNT Requirements

As the opening of Section 4, PNT User Requirements, underlines, “The FRP is not intended to be a requirements document.” Instead, it is designed “to provide context” for the PNT systems provided by the U.S. government.

However, by bringing the requirements of the various modalities together in the same place, updating them as needed, and referencing the original requirements-document sources, the FRP provides a convenient codification for the various transportation user communities.

In particular, the sections on aviation and maritime requirements — both with safety-of-life ramifications — provide extensive details on what users can expect from GPS and other navigation systems. Here the discussion goes beyond requirements to describe the environments and procedures for phases of operation.

In the 2010 edition, land transportation gets more attention with tables laying out highway and trucking user services with associated measures of PNT performance criteria familiar to other modes of transportation, such as accuracy, availability, integrity, and time to alert.

Similarly, Space PNT requirements received more extensive treatment than in the previous version of the plan, with a table outlining various categories of metrics — with specifications not yet determined — for on-board autonomous navigation and a variety of scientific missions.

Subsurface PNT in both marine and land applications joins the user requirements section in the new version. As the new FRP observes, “The subsurface environment makes practical employment of traditional PNT sensors and systems, such as GPS, more of a challenge.”

Although the minimum performance criteria charts are filled with TBD notations, indicating that these are still to be determined, the new category marks an interesting expansion of the FRP’s scope.

The FRP discussion ends with a description of the National PNT Architecture, an ambitious project to advanced by DoD and DoT to sketch an overarching view of an “as-needed” system of systems circa 2025.

Recommendations from a National PNT Enterprise Architecture Study were accepted by DoD and DOT leadership in June 2008. But the 2010 section seems to add a caveat to realizing this vision.

“The product of transition planning, the National PNT Architecture Implementation Plan, can be viewed as an evolving structure that encompasses many separate but interrelated plans, system capabilities, standards, and policies,” the new FRP states.

“Developing these products and implementing the plan requires a strong and continued commitment of the PNT community stakeholders who have developed the plan. The processes that coordinate stakeholder activities will likely need to evolve as the implementation of the PNT architecture progresses and the PNT architecture itself continues to evolve.”

Several appendices offer useful resource information: PNT System Parameters and Descriptions, PNT Information Services, and Geodetic Reference Systems and Datum.
Modernization efforts move ahead

**GPS**

Next launch of a GPS satellite — the second Block IIF space vehicle (SV) — is currently scheduled for July 12. It will join an already overpopulated constellation — 31 SVs versus the GPS 24-satellite requirement. The new satellite, built by the Boeing Company, will take the recycled pseudorandom noise code (PRN01) identification of the unhealthy SVN49, which will become PRN 37.

The change will actually provide military GPS users access to an additional satellite, because their legacy equipment does not use PRN 31 or 32 as navigation ranging signals. A new assignment for PRN01 will also allow the Federal Aviation Administration to drop their masking of that code from the Wide Area Augmentation System database, from which it had been removed due to SVN49’s unhealthy status.

Upgrades to the Operational Control Segment (OCS) give military users the capability to have their P/(Y)-code receivers with Selective Availability/Anti-Spoofing modules (SAASM) keyed over the air, rather than in the field.

Despite its robust current status, the GPS program is not without its uncertainties. Aside from the threat of interference from the proposed LightSquared broadband system, anticipated cuts in the Department of Defense (DoD) funding could ripple down to the program.

Officials at the GPS Directorate responsible for designing and acquiring the space and ground control elements of the system expect that in the next few years funding for GPS will be “flat, at best.” As occurred during previous phases of its development, GPS may become a target for poaching by other Air Force programs.

Some recent DoD decisions appear likely to stretch out the GPS III program, which is currently ahead of schedule for an April 2014 launch. Completion of the first phase of the modernized control segment (OCX), is now projected for February 2015. It will be able to support the new civil code (L1C) on GPS IIIA SVs as well as the modernized military signals (M-code).

On April 15, 2011, President Obama signed the Department of Defense and Full-Year Continuing Appropriations Act, 2011 (H.R. 1473, Public Law 112-10), the last in a series of government-wide funding measures for Fiscal Year 2011 (FY11). The final act fully funded all GPS program items in the defense budget, a total of $1.032 billion, except for $25 million cut from the Next-Generation Operational Control Segment (OCX) request.

The act also funded for FAA Facilities and Equipment by $233.8 million compared to the request, but it remains unclear whether the cuts will affect the civil GPS funds to support modernization, the Wide Area Augmentation System, and Ground-Based Augmentation System funding lines, which are part of that account. Section 1119 of the H. R. 1473 imposed a 0.2 percent rescission (cut) across all non-military programs, on top of any specific reductions spelled out in the budget measure.

The measure does include $40.9 million to continue work on the Navy’s High-Integrity GPSA (HiGPS, also known as iGPS) which is intended to demonstrate the capability to use Iridium satellites to enhance GPS navigation for military users. Earlier this year, President Obama submitted an FY12 defense budget proposal with $1.46 billion for procurement and development of the Global Positioning System, including:

- $17.89 million for GPS IIF and Operational Control Segment (OCS) development
- $463.08 million for GPS IIIA satellite development
- $390.89 million for the Next-Generation Operational Control Segment (OCX) development
- $515.34 million for procurement of two GPS IIIA satellites
- $67.69 million for procurement of GPS IIF satellites and launch support
- $7.6 million for ground segment equipment procurement.

**GLONASS**

Russia succeeded in launching its first new-generation satellite GLONASS-K on February 26, but that did not save the head of the Russian Federal Space Agency (Roscosmos) from being forced into retirement, as polit-
cal fallout continued from last December’s botched launch of three GLONASS-Ms spacecraft.

A Soyuz-2.1b rocket carried the GLONASS-K into orbit from Plesetsk cosmodrome north of Moscow, a first for both the facility and the launcher. Until now, GLONASS launches have taken place from Baikonur, Kazakhstan, on board Proton rockets.

Meanwhile, on April 29, Russian Prime Minister Vladimir Putin appointed Vladimir Popovkin, formerly First Deputy Defense Minister, as head of the Russian space agency Roscosmos, replacing Anatoly Perminov.

Putin signed an executive order accepting Perminov’s resignation of head of the Federal Space Agency on the grounds of his having reached the mandatory retirement age for civil servants — 65.

However, Perminov’s replacement has been rumored for some time, following a series of launch failures of Russian satellites, including the December 2010 loss.

The GLONASS-K has a service life of 10 years and will transmit five navigation signals — civil and military signals in each of the GLONASS L1 and L2 bands and a new CDMA signal for civilian applications in the L3 band.

Russia will add CDMA signals to its FDMA satellites, beginning with this GLONASS-K satellite and continuing on to a full set in orbit by 2020. On April 7, the GLONASS Information-Analytical Center announced activation of the experimental CDMA navigation signals on GLONASS-K1, and several GNSS receiver manufacturers and other organizations have said they are tracking the new signal.

At the L1 frequency (1575 MHz) favored by civil service providers, GLONASS will offer a BOC(1,1) — discarding the BOC(2,2) option that had disturbed guardians of U.S. military signals. And, according to GLONASS deputy designer Grigory Stupak, a BPSK(10) signal will eventually appear at the GPS L5 band centered at 1176.45.

The Russian GNSS constellation currently contains 22 operational satellites, plus the GLONASS-K1 and a couple of others undergoing maintenance, which might be brought back into service. However, the GLONASS orbital plane one has only 7 satellites in it and needs 8 in order to realize the full 24-SV constellation.

**Galileo**

The European GNSS program continues on track to launch its first two in-orbit validation (IOV) satellites from Kourou, French Guiana, this summer. A Russian Soyuz rocket will carry the SVs from a newly built facility at the European spaceport.

Four IOV satellites will be launched, followed by 14 full operational capability (FOC) satellites, so that by 2015 Galileo will have an initial operational configuration of 18 satellites.

In February, navigation payloads being developed by Surrey Satellite Technology Ltd. (SSTL) for the FOC Galileo satellites passed the preliminary design review (PDR) and demonstrated that they have a sufficient level of design maturity. SSTL is teamed with OHB System of Bremen, Germany for the provision of the first 14 FOC satellites. OHB is the prime contractor and builder of the spacecraft platform.

Meanwhile, the European GNSS Agency, also known by the acronym — GSA — of its former name, is looking for a new home in Prague, Czech Republic. The agency expects to move there from its Brussels, Belgium, offices sometime next year.

Carlo des Dorides, the GSA’s new executive director who assumed office in January, intends to establish a Galileo Security Monitoring Center (GSMC) for Galileo and the European Geostationary Navigation Overlay Service (EGNOS). The GSMC will be responsible for coordinating the terms of access and use of the encrypted Publicly Regulated Service (PRS) signals that Galileo satellites will transmit.

Under the terms of a European Union (EU) regulation approved by the European Parliament and European Council last September, the GSA serves as operator of the GSMC, and “ensure[s] that the secretariat and all the resources necessary for proper functioning are provided to the Security Accreditation Board and to the bodies set up under its authority.”

However, responsibilities for security matters, including accreditation, will be handled by an autonomous Security Accreditation Board (SAB) for European GNSS systems within the GSA. It will be composed of representatives from each of the EU members states, one from the European Commission (EC), and one from the High Representative for Foreign Affairs and Security Policy.
Compass

China launched the eighth Compass/BeiDou-2 satellite on a 3A Long March carrier rocket on April 10 from Xichang launch center in Sichuan Province.

According to the Chinese government BeiDou website, the spacecraft is an inclined geosynchronous orbit (IGSO) satellite, the third IGSO launched thus far for the BeiDou-2 constellation. The spacecraft will join four geostationary satellites, a middle Earth orbiting spacecraft, and the two other IGSO satellites now on orbit.

The satellite and rocket were built, respectively, by the China Aerospace Science and Technology Corporation of China Academy of Space Technology and China Academy of Launch Vehicle Technology Development.

China still has not published an interface control document (ICD) for Compass signals, but the nation is still meeting its schedule to have a 12-spacecraft regional system in place by 2012.

According to reports by China’s state news agency Xinhua, Guo Shuren, deputy director of the China Satellite Navigation Management Office, said that “the first two satellites are for testing only. The current navigation and positioning service will mainly be provided by the other six satellites.”

Guo added, “After the launch, we will have an all-round assessment on the design of the navigation network. As a result, we can ensure the future plan of the network, and make necessary improvements if possible.”

An illustration of the planned Soyuz launch of the first Galileo IOV satellites. Photo credit: ESA illustration.
The Institute of Navigation is pleased to welcome these new ION corporate members:

CTAE – Aerospace Research Technology Centre
http://www.ctae.org

LinQuest Corporation
http://linquest.com

For more information on corporate membership in The Institute of Navigation, please contact Kenneth P. Esthus at 703-366-2723, ext 104, or visit us at www.ion.org.

LinQuest Corporation is an employee-owned small business focused on the engineering, integration, deployment and operation of state-of-the-art command and control, communications, navigation, surveillance and reconnaissance, launch, and information systems that deliver critical network centric capabilities to the warfighter. LinQuest provides domain expertise to its customers in system architecture, engineering, design, analysis, and simulation; test and verification; network design, analysis, and simulation; and system operations and training.

http://linquest.com

PRIVACY continued from page 9

location data and communicated that information back to the companies.

Both companies said they used the accumulated information, but did not identify individual users — although, Google’s location information carried a unique identifier for each phone.

Google spokesman Chris Gaither said in an e-mail that “All location sharing on Android is opt-in by the user.” He also said that Google “anonymizes and aggregates” WiFi network location data transmitted by Chrome browser and Google Toolbar IE users.

The Android location screen says the location function does not routinely employ GPS, and the user may disable the function.

Google gives the user a choice to allow anonymous location “even when no applications are running.”

The user may also choose to use “My Location,” a GPS-enhanced function. If the user does not customize the phone, location services is turned off by default, said Gaither.

It appears that there is no option to enable location services and at the same time with- hold part or all of that information from being transmitted to the Google mother ship.

In addition to building a location database, Google uses the information to help the company target advertising to the right consumers. Most people find this useful, but not all.

Right now, it appears that neither Apple nor Google “tracks” individuals in a purposeful way, but they could. The iPhone preserves location data in a file over time and will continue to do so until the software update is installed.

And Android location information is sent with a unique identifier from each device.

In short, location information has been collected for a while as part of huge databases that are or will be used commercially by companies for LBS services and also to make the user experience better and more sophisticated. (Location information is one of the smartphones selling points, after all.)

Congress has been concerned enough to set up a special subcommittee of the Senate Judiciary Committee that deals solely with the issues of Privacy, Electronics and the Law. They planned to hold a hearing on May 10 where Google, Apple, privacy experts, and senators gathered to discuss the subject.

The web of information about all of us is dense. And it’s harder and harder to do without our location-based tools.

It may not be as touching as the Rascal Flatts’ song, but, like the guy in the song, these iPhones and Androids and iPads and browsers and mobile devices just won’t let go.
Get Off Your Duff, Says Your Fitness Watch

So, this year we found out that aerobics and Pilates and spinning aren’t enough. If you sit down the rest of the day, you’re gonna die, according to a recent American Cancer Society study.

Nooooooo, we say as we lounge by the pool. . . . What to do?

Whatever it may be, we know someone is going to make a buck, right?

ABI research, the London-based GPS market experts, predicts a $2 billion market by 2016 for watches, and smartphone apps, and even shirts and shorts that tell you to get off your duff.

The personal navigation device (PND) market is flattening out, as we know, with smartphone GPS and Google maps saturating every nook and cranny. But Garmin, for one, is, er . . . not sitting still.

A leading PND manufacturer, the Olathe, Kansas–headquartered company’s outdoor and fitness division now accounts for 40 percent of its operating income, according to ABI Research. And GPS-augmented watches lead the pack.

TomTom and Nike are not sitting still, either. GPS cycle computer and golf caddy markets continue to grow, and mobile applications from a number of companies are wildly successful.

Of course, GPS watches are still pricey, and not on everyone’s wrist. But, today, hikers can use these to collect and record all of the data created by their body, the weather, the trail, or the topography, and then share that information on social networking sites.

Right now, a GPS watch can connect to a heart-rate monitor and keep track of time, distance, elevation, pace, and calories burned as well as heart rate. A runner can look at the data on the screen, on a computer, or online or even compete with a virtual partner.

Tomorrow, such devices will certainly record the time and location of that bakery you stopped off at that makes such wonderful cream puffs. It will perceive the calories you ingest.

And, shortly thereafter, it will yell at you in public.

GPS and its Discontents

British consumers are falling out of love with their satellite navigation systems. Especially men, who, if you rely on the common wisdom, hate to ask for directions anyway.

Swinton, a major British insurance company, released the results of a study of 3,000 drivers in March that said the respondents believe their satnav systems to be “untrustworthy, inaccurate and a major cause of in-car bickering.”

More than half (58 percent) said their GPS has led them astray.

The study found that nearly four out of five drivers ignore GPS directions and 63 percent keep a map in the car, just in case they need it. (Not a bad idea, actually.)

Even more interesting — women trusted the GPS more than men. Among men, 83 percent said they regularly defy the suggested directions, compared to 74 percent of women.

Fighting over car navigation seems to be a common problem in general. A 2010 survey by UK auto accessory retailer Halfords said a third of drivers argue in the car.

It also found that 85 percent of women argued over their partner’s refusal to ask for directions when they got lost.
Royal Wedding?
There’s an App for That . . .

The April 29 wedding of HRH Prince William and Miss Catherine Middleton had everything, including a downloadable smartphone app for the uninvited but enthusiastic fan.

“The Royal Wedding — Your Personal Guide” featured an interactive map wheel that synchronized the progress of the royal processions with the timetable, audio commentary, text, and photos all linked with GPS for anyone in the center of London.

It also indicated useful places such as cafes and toilets close to the wedding route and where you stood in relation to them.

But that’s not all — you also got an exhaustive background and photos of everyone involved.

It’s the perfect wedding souvenir to keep on your iPad or iPhone, say the developers, London’s HeavyLight Design, at http://royalwedding.locatify.net.

[Sigh]

We remember when a royal wedding “souvenir” was limited to a commemorative china plate with a badly painted picture of the bride and groom. . . . ◆

DUE JUNE 30
Kepler Award Nominations

The purpose of the Johannes Kepler Award is to honor an individual for sustained and significant contributions to the development of satellite navigation. The winner of this award will be determined by a special nominating committee. The Kepler Award is presented only when deemed appropriate. All members of The Institute of Navigation are eligible for nomination. You are encouraged to submit the names of individuals for consideration.

To submit a nomination, go to the ION website at www.ion.org. Click on Awards, scroll down, click on Kepler Award, then click on the Awards form for complete nomination instructions. Nominations must be received by June 30. Nomination packages may be sent to: Satellite Division Awards Committee Chair, The Institute of Navigation, 8351 Rixlew Lane, Suite 360, Manassas, VA 20109.

DUE JUNE 30
Parkinson Award Nominations

Graduate students in GNSS technology, applications, or policy who have completed a single-author thesis or dissertation and who are ION members are eligible for this prestigious award and $2,500 honorarium. Nominations are to be submitted by a regular or research faculty member of a college or university.

This award honors Dr. Bradford W. Parkinson for establishing the U.S. Global Positioning System and the Satellite Division of The Institute of Navigation.

For application details and entry rules go to www.ion.org. Nominations must be received by June 30.

CALENDAR

SEPTEMBER 2011
19-23: ION GNSS 2011, Oregon Convention Center, Portland, Oregon
Contact: The ION
Tel: +1 703-366-2723
Fax: +1 703-366-2724
Web: www.ion.org

OCTOBER 2011
3-5: 17th Ka and Broadband Communications Navigation and Earth Observation Conference, Villa Igiea Hilton, Palermo, Italy
Contact: Ms. Clotilde Canepa Fertini
Tel: +39 338-700-1650
Web: www.kaconf.org

NOVEMBER 2011
Contact: The Royal Institute of Navigation
Tel: +44-20-7591-3135
Fax: +44-20-7591-3131
Web: www.enc2011.org

JANUARY 2012
JAN. 30 - FEB. 1: ION International Technical Meeting (ITM) 2012, Marriott Newport Beach Hotel & Spa, Newport Beach, California
Contact: ION
Tel: +1 703-366-2723
Fax: +1 703-366-2724
Web: www.ion.org

APRIL 2012
23-26: IEEE/ION PLANS 2012, Myrtle Beach Marriott Resort & Spa, Myrtle Beach, South Carolina
Contact: ION
Tel: +1 703-366-2723
Fax: +1 703-366-2724
Web: www.ion.org

JUNE 2012
11-14: JSDE/ION JNC 2012, Crowne Plaza Hotel, Colorado Springs, Colorado
Contact: The ION
Tel: +1 703-366-2723
Fax: +1 703-366-2724
Web: www.ion.org

SEPTEMBER 2012
17-21: ION GNSS 2012, Nashville Convention Center, Nashville, Tennessee
Contact: The ION
Tel: +1 703-366-2723
Fax: +1 703-366-2724
Web: www.ion.org
It seems we have awareness and an understanding of GPS dependence and vulnerabilities and the need to build resilience. Why then do we seem so unwilling to act?


The cover letter draws attention to “five major” recommendations to consider as the United States seeks to manage the GPS system and its underlying services: 1) completing the modernization of the GPS enterprise; 2) ensuring backup systems; 3) developing better space weather predictions; 4) setting standards for satellites and receivers to handle extreme space weather conditions; and 5) examining GPS resilience through an all-hazards lens.

The 2010 Federal Radionavigation Plan (FRP) was released in April 2011 and is available at http://www.navcen.uscg.gov/pdf/2010_FRP_FINAL_Signed.pdf. Although no answers to our opening question appears in this document, it does speak to dependencies, vulnerabilities, and the need for GPS back-ups.


These documents are just part of a decade-long clarion call for GPS back-ups. GPS dependencies and the inherent vulnerabilities of our reliance on civil GPS are not new issues. Though we have for over 10 years clearly understood GPS dependency and vulnerability, we have done little to mitigate the risk. The risk to our nation is rooted in our critical infrastructures’ dependence on positioning, navigation and timing (PNT) data derived from civil GPS.

The 2004 NSPD-39 providing U.S. Space-Based PNT Policy provides clear policy direction to DHS on these issues. Specifically, the policy states that the Secretary of the Department of Homeland Security shall:

- Identify space-based positioning, navigation, and timing requirements for homeland security purposes to the Secretary of Transportation, and coordinate the use of positioning, navigation, and timing capabilities and backup systems for homeland security purposes by Federal, State, and local governments and authorities.

- In coordination with the Secretaries of Defense, Transportation, and Commerce, develop and maintain capabilities, procedures, and techniques, and routinely exercise civil contingency responses to ensure continuity of operations in the event that access to the Global Positioning System is disrupted or denied.

The Departments of Defense and Transportation collaborated from 2006 to 2009 with more than 30 federal agencies, including DHS, to develop a National PNT Architecture that presented an enterprise level view of augmentations and complements to a modernized GPS, along with specific implementation recommendations for near-term action.

In June 2010, the current administration issued a new national space policy that reaffirmed U.S. commitments to GPS. One of the provisions in this policy states that the government will: “Invest in domestic capabilities and support international activities to detect, mitigate, and increase resiliency to harmful interference to GPS, and identify and implement, as necessary and appropriate, redundant and back-up systems or approaches for critical infrastructure, key resources, and mission-essential functions.”

Our policy guidance is clear and the architecture work demonstrates our understanding of the issues as matured. Why then has so little been done to reduce vulnerability and build resilience into our critical infrastructure?

I am of the opinion that we do understand the problem, and we know where the answers lie. Unfortunately, it appears we are unwilling to bear the cost of confronting these issues head on. Instead we seem content to paper over the risk and continue to presume upon the benevolence of Mother Nature and the forbearance of our adversaries.

If this is true, I predict we will live to regret our inaction before the next 10 years have passed.
Section News and Notes

WASHINGTON DC SECTION NEWS

For the past eight years, Dr. David Winfield has been voluntarily teaching high-school students the art and science of GPS navigation. David was the co-founder and principal participant of the Washington DC Section’s Student Activities Committee (SAC).

Starting in December 2002, the Washington DC Section embarked on a mission to increase the educational outreach of the ION to students in the DC Metropolitan area. After considering several alternatives, the membership determined that a Student Activities Committee was the preferred method of introducing the field of navigation to local high-school level students. Dr. Terence McGurn and David Winfield volunteered as co-Chairman of the SAC from 2003 through 2005. Dr. Winfield has been the Chairman of and principal volunteer for the SAC since 2005.

The Student Activities Committee (SAC) of the ION Washington DC Section has conducted navigation-related activities at Walt Whitman and Watkins Mill High Schools in Montgomery County, MD. SAC activities involved classroom activities conducted at a SMART Board (an interactive, electronic whiteboard that can enhance instruction and learning). Some materials used are posted at http://sites.google.com/site/gpsnavigattonnow. Eight Garmin GPS 72 and four Garmin GPS 76 handheld receivers, purchased with ION educational outreach funds, were used in the classroom in simulation mode and outdoors at a football field. To improve the student experience, SAC members David Winfield, Terence McGurn, and Franck Boynton installed a GPS monument at the Watkins Mill High School in 2004.

Dr. Winfield has also been developing a video game called “Ships and Shoals” to assist in teaching navigation skills. The objects are shipping firms, ships, and shoals. Shipping firms compete to maximize their cash-on-hand plus ships and cargo in port. Subject to random effects are the location of the shoals after a tsunami, the ship navigator’s clock, and errors in the ship achieving its commanded speed. The navigator estimates the ship’s position by ranging to pseudo-lites. The firm estimates the shoal locations from the last transmitted positions of ships which are wrecked upon them.

We regret that, after many successful years, Dr. Winfield is stepping down from his SAC voluntary teaching role. However, David will continue to work on completing his Ships and Shoals game. We wish Dr. Winfield “Fairs Winds and Following Seas” as he transitions from physical to virtual teaching.

On March 19 and 20, the Washington DC Section helped host and support the DC Regional Competition of the Mini-Urban Challenge (MUC) at Osbourn Park High School in Manassas, VA. This year, 20 teams from the Washington, DC metropolitan area participated in the event. Members of the DC Section, including Karen Barker and Larry Hothem, helped judge again this year. Chuck Schue, the DC Section Chairman, gave a short speech about the MUC and its importance in helping students engage in mathematics and science careers. He also introduced Congressman Gerald E. “Gerry” Connolly, who was serving his second term in the U.S. House of Representatives from Virginia’s 11th District. Chuck then assisted Congressman Connolly and the ION’s Executive Director, Lisa Beaty, in handing out the competition awards.

SOUTHERN CALIFORNIA SECTION

At the March 2011 Meeting, The Southern California Chapter held elections for new officers. Here are the results of those elections: Chair: Steve Rounds, L-3/Interstate Electronics Corporation; Vice Chair/Treasurer: Len Jacobson, GSAM, Inc.; Secretary: Cecelia Feit, Raytheon; Program Director: Jim Litton, Jim Litton Consulting Group; Publicity Officer: Liwen Dai, NavCom Technology; Student Outreach Co-Chairs: Kevin Rudolph, Raytheon; Taehwan Kim, The MITRE Corporation; Immediate Past Chair: Jerry Knight, NavCom Technology.

March 2011 Meeting Summary
Tom Stansell gave a talk entitled “LightSquared and the FCC Threat to GPS” to the Southern California Section on Mar. 17, 2011, at NavCom Technology. Stansell reported that the GPS community is deeply concerned by LightSquared’s proposal to transmit high power signals from about 40,000 cell “towers” across the entire U.S. in the frequency band immediately below GPS L1. The threat to GPS is real because the FCC is “fast tracking” its approval as a way to expedite the government’s objective of significantly expanding wireless broadband access. Stansell’s presentation traced the origins of the LightSquared proposal, outlined why it is a major threat to GPS, described the actions being taken by the GPS community, and suggested ways to help.

February 2011 Meeting Summary
Col. Bernie J. Gruber of the GPS Directorate spoke to the Southern California Section of the ION on February 22, 2011 on the status and future plans for the GPS system. His talk was followed by a lively question and answer session.

January 2011 Meeting Summary
Col. Gaylord Green spoke to the Southern California Section about Gravity Probe B on Jan. 27, 2011, at NavCom Technology.

The Gravity Probe B (GP-B) program tested two distinct effects of General Relativity: The Geodetic Effect and Frame-Dragging. General relativity holds that a massive body like the Earth warps the space-time around it, creating the geodetic effect. Frame-dragging is the predicted effect that occurs when a rotating body spins on its axis, “dragging” the space-time around it. GP-B tested the two predicted effects of general relativity, the geodetic effect and frame-dragging.

For detailed information about the Southern California Section Meeting Summaries, please visit: http://www.ion.org/sections/southcalifornia.cfm
ION GNSS 2011
The Premier GNSS Technology Event!

September 19–23, 2011
Oregon Convention Center • Portland, Oregon
Pre-Conference Tutorials: September 19 & 20
Show Dates: September 21 – 23

www.ion.org