Jamming

GPS susceptible to outages due to intentional & unintentional jamming
A small jammer can disrupt the GPS signal for a mile or more
People jam because they are smuggling, stealing or trying to escape tracking
Availability of low-cost GPS jamming devices has increased the risk
Real Risk of GPS Disruption

November 2009 Newark New Jersey
Ground-based Augmentation System (GBAS) Jammed
Took 8 months to find the source

PNT Advisory BD “We must quickly develop and field systems that will rapidly locate, mitigate and shutdown the interference”
U.S. Organizational Structure for GPS Governance

WHITE HOUSE

NATIONAL EXECUTIVE COMMITTEE FOR SPACE-BASED PNT
Executive Steering Group
Co-Chairs: Defense, Transportation

NATIONAL COORDINATION OFFICE
Host: Commerce

ADVISORY BOARD
Sponsor: NASA

Defense
Transportation
State
Interior
Agriculture
Commerce
Homeland Security
Joint Chiefs of Staff
NASA

GPS International Working Group
Chair: State

Engineering Forum
Co-Chairs: Defense, Transportation

Ad Hoc Working Groups
Summary: The United States is now critically dependent on GPS. For example, cell phone towers, power grid synchronization, new aircraft landing systems, and the future FAA Air Traffic Control System (NEXGEN) cannot function without it. Yet we find increasing incidents of deliberate or inadvertent interference that render GPS inoperable for critical infrastructure operations.

Most alarming, the very recent web availability of small GPS-Jammers suggests the problem will get worse. These so-called personal protection devices (PPDs) as well as other, readily available, more powerful devices can deliberately jam the Global Positioning System (GPS) signal over tens of square miles. They also can be devastating to the other, new foreign satellite navigation systems being deployed worldwide.

PPDs are illegal to operate, but many versions are available (for as little as $30) from foreign manufacturers over the Internet. The simplest models plug in to a cigarette lighter and prevent all GPS reception within a line of sight range of 5 to 10 miles. Current penalty for operation is simply that the device is confiscated.

We currently lack sufficient capabilities to locate and mitigate GPS jamming. It literally took months to locate such a device that was interfering with a new GPS based landing system being installed at Newark Airport, NJ.

We must quickly develop and field systems that will rapidly locate, mitigate and shutdown the interference.
Real Risk of GPS Disruption Is Getting Worse

Coast Guard Vice-Admiral Chuck Michel saw it happen in one Eastern Seaboard port.

“It was believed to be sort of a vandal or a person messing around, actually blocked that GPS signal from that computer’s ability to do that, and the port came to a halt,” he said.

*Maritime Cyber Security Symposium March 2-3 2015

The FCC said an aircraft tracking system at Newark Liberty International Airport experienced interference from a GPS jamming device used by a Readington man who claimed he was simply trying to hide his whereabouts from his employer. The FCC fined the driver $31,875 Aug 2012

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Signal Sentry® 1000
Answering the risk by locating the jamming source
Signal Sentry

- Designed to protect critical infrastructure from GPS disruption jamming & spoofing
- Situational Awareness of GPS Interference
- Real time geolocation of GPS interference
- Actionable Intelligence for quick mitigation of GPS disruption

Deployed Systems

- 2014 Super Bowl at Met Life Stadium
- Southampton Port United Kingdom
- Newark N.J DHS & Essex County Sherriff

Field Tested

- Sennybridge Test Range UK
- Vidsel test range in Sweden

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Signal Sentry 1000 Components

Includes antennas, sensors and a server
- Each Sensor has two antennas
- Sensors are connected to either a local or cloud-based server

System detects, locates and maps the jamming source

Data is available through an easy-to-use web enabled GUI

Information used for action – change navigation methods, alert authorities…
<table>
<thead>
<tr>
<th>Name</th>
<th>Configured Address/Port</th>
<th>Reported Address</th>
<th>Status</th>
<th>Interference State</th>
<th>Event Started</th>
</tr>
</thead>
<tbody>
<tr>
<td>sw200403 - Essex County Sheriff: FBI Building</td>
<td>71.250.253.59:12623</td>
<td>71.250.253.59</td>
<td>Registered</td>
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<td>N/A</td>
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<td>sw200470 - Essex County Sheriff: Integrity House</td>
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<td>71.250.253.61</td>
<td>Registered</td>
<td>No Event</td>
<td>N/A</td>
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<tr>
<td>sw200474 - Essex County Sheriff: Prudential Center</td>
<td>186.249.121.42:12623</td>
<td>186.249.121.42</td>
<td>Communication Fault</td>
<td>Unknown</td>
<td>N/A</td>
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<tr>
<td>sw200479 - Essex County Sheriff: Prudential Building</td>
<td>166.249.121.29:12623</td>
<td>166.249.121.29</td>
<td>Registered</td>
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<tr>
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<td>71.250.254.137</td>
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<td>N/A</td>
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<tr>
<td>sw200487 - Essex County Sheriff: One Gateway</td>
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<td>71.250.242.196</td>
<td>Registered</td>
<td>No Event</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### Sensor Information

**sw200403 - Essex County Sheriff: FBI Building**

**Sensor Info**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interference State</td>
<td>No Event</td>
</tr>
<tr>
<td>Sensor Status</td>
<td>Registered</td>
</tr>
<tr>
<td>GPS Fix Status</td>
<td>Has GPS fix</td>
</tr>
<tr>
<td>Configured Latitude</td>
<td>40.73020702</td>
</tr>
<tr>
<td>Configured Longitude</td>
<td>-74.1645826</td>
</tr>
<tr>
<td>Configured Geod (MSL) Altitude (m)</td>
<td>64.567</td>
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<tr>
<td>GPS-Reported Latitude</td>
<td>40.7301601</td>
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<tr>
<td>GPS-Reported Longitude</td>
<td>-74.16459790000002</td>
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<tr>
<td>GPS-Reported Geod (MSL) Altitude (m)</td>
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<tr>
<td>Configured Address/Port</td>
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<tr>
<td>Reported Address</td>
<td>71.250.253.59</td>
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<tr>
<td>Last Application Ping</td>
<td>9/24/2015 2:39:55 PM</td>
</tr>
<tr>
<td>Last Position Report</td>
<td>9/24/2015 2:39:51 PM</td>
</tr>
<tr>
<td>FFT Processing</td>
<td>Healthy</td>
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<tr>
<td>Firmware Version</td>
<td>2.18.01</td>
</tr>
<tr>
<td>GPS Version</td>
<td>CTL414V06 rev 2.15</td>
</tr>
</tbody>
</table>

**GPS DOP/TAAC**

**GPS Quickthresh**

**GPS Satellites**

**GPS Multipath by Azimuth**

**GPS SNR by PRN**

**Sensor Log**

**Raw Data**

**Event Frequency**

**Interference Settings**

**SNR Settings**

**GPS Settings**

**Position Override Settings**

---

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## Interference Frequency Events > 5 Min

### Interferers

**Interferer Frequency Chart**

Min. Interference Duration (hh:mm:ss)  0 : 5 : 0

- Show only Geolocated Interferers
- Show only Non-geolocated Interferers
- Show all Interferers

**Update**

<table>
<thead>
<tr>
<th>Interferer</th>
<th>Interference Duration (hh:mm:ss)</th>
<th>Interference Ended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ended event started 6/16/2015 2:07:07 PM</td>
<td>0:11:42</td>
<td>6/16/2015 2:18:49 PM</td>
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<tr>
<td>Ended event started 4/30/2015 12:18:59 PM</td>
<td>0:07:30</td>
<td>4/30/2015 12:26:29 PM</td>
</tr>
<tr>
<td>Ended event started 3/30/2015 10:20:44 AM</td>
<td>0:12:46</td>
<td>3/30/2015 10:33:30 AM</td>
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<tr>
<td>Ended event started 3/16/2015 2:29:07 PM</td>
<td>0:16:15</td>
<td>3/16/2015 2:44:22 PM</td>
</tr>
<tr>
<td>Ended event started 3/16/2015 2:10:00 PM</td>
<td>0:18:28</td>
<td>3/16/2015 2:28:28 PM</td>
</tr>
<tr>
<td>Ended event started 1/28/2015 1:46:58 PM</td>
<td>0:19:07</td>
<td>1/28/2015 2:06:05 PM</td>
</tr>
</tbody>
</table>
When Events Occur

Interferer Frequency

Geolocated Instances of Interference Lasting at Least 5 Minutes by Day of Week / Time of Day (One Hour Increments) From 1/1/2015 3:08:01 PM To 9/24/2015 3:08:01 PM

If the option Count only Geolocated Interferers is enabled, clicking chart items causes a map to be displayed in this area that shows the geo-located interferers pertaining to the selected chart items. Selected chart items are shown in red, and non-selected chart items are shown in blue.

Resolution: Day of Week / Time of Day (One Hour Increments)

Min. Interference Duration (hh:mm:ss): 0:5:0

- Count only Geolocated Interferers
- Count only Non-geolocated Interferers
- Count all Interferers

From Date (MM/dd/yyyy hh:mm:ss): 1/1/2015 3:08:01 PM
To Date: 9/24/2015 3:08:01 PM

- From Time of Day (hh:mm:ss): 12:0:0 AM
- To Time of Day (hh:mm:ss): 11:59:59 PM
Where Events Occur

Interferer Frequency

Geolocated Instances of Interference Lasting at Least 5 Minutes by Day of Week / Time of Day (One Hour Increments) From 1/1/2015 3:08:01 PM To 9/24/2015 3:06:01 PM

If the option Count only Geolocated Interferers is enabled, clicking chart items causes a map to be displayed in this area that shows the geo-located interferers pertaining to the selected chart items. Selected chart items are shown in red, and non-selected chart items are shown in blue.

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### Email Alert Notification

**Sign up for E-Mail or Text Message Notifications**

Notifications will be sent from IDGSS@somedomain.com

<table>
<thead>
<tr>
<th>Address</th>
<th>Notify on Interference Event Detections</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:2013213816@vtex.com">2013213816@vtex.com</a></td>
<td>0:15:00</td>
</tr>
<tr>
<td><a href="mailto:Brian.Flynn@exelisinc.com">Brian.Flynn@exelisinc.com</a></td>
<td>0:00:00</td>
</tr>
<tr>
<td><a href="mailto:jennie.womble@exelisinc.com">jennie.womble@exelisinc.com</a></td>
<td>0:01:00</td>
</tr>
<tr>
<td><a href="mailto:joseph.rolli@exelisinc.com">joseph.rolli@exelisinc.com</a></td>
<td>0:05:00</td>
</tr>
<tr>
<td><a href="mailto:josh.magnor@exelisinc.com">josh.magnor@exelisinc.com</a></td>
<td>0:05:00</td>
</tr>
<tr>
<td><a href="mailto:Kevin.W.Stone@ice.dhs.gov">Kevin.W.Stone@ice.dhs.gov</a></td>
<td>0:10:00</td>
</tr>
<tr>
<td><a href="mailto:mitchell.erickson@HQ.DHS">mitchell.erickson@HQ.DHS</a> GOV</td>
<td>0:05:00</td>
</tr>
<tr>
<td><a href="mailto:monty.graham@hq.dhs.gov">monty.graham@hq.dhs.gov</a></td>
<td>1:00:00</td>
</tr>
<tr>
<td><a href="mailto:raymond.ciaccio@dhs.gov">raymond.ciaccio@dhs.gov</a></td>
<td>0:10:00</td>
</tr>
<tr>
<td><a href="mailto:sarah.mahmood@dhs.gov">sarah.mahmood@dhs.gov</a></td>
<td>0:20:00</td>
</tr>
</tbody>
</table>

**E-Mail/SMS Address(es)**

<table>
<thead>
<tr>
<th>Send Notifications on Interference Event Detectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑</td>
</tr>
<tr>
<td>Geolocation Only</td>
</tr>
</tbody>
</table>

**Duration of Event for Notifications (hh:mm:ss)**

00:01:00

**Update**  
**Return**
Signal Sentry 1000 Test Results

- Tested during GPS jamming trials in Sennybridge, UK in September 2014
- Trials administered by the Defence Science and Technology Laboratory
- Off-the-shelf jamming devices were used during the tests
- Located stationary & moving jammers in open & obstructed environments
- Jammers in a moving vehicle scenario were located with an average accuracy of 10 meters

Jammer in car at 40 mph
Jammer Description

Two Jammers utilized during the trials
150mW and .5W
Used to disrupt the GPS L1CA code that operates at 1575.42 MHz

150mW jammer waveform

.5w jammer waveform
Open Field Tests

Test was constructed to geolocate jamming in an area with no obstructions
Test included static jammers and dynamic jammers
Six waypoints were surveyed for the purpose of evaluating location accuracy
Lessons Learned

- GPS Interference events occur on average of ~4 a month in Newark

- Law Enforcement Essex County Sheriff & NY/NJ Port Authority Police
  - Not illegal to possess a GPS Jammer & can’t prosecute
  - Most officers won’t recognize GPS Jammer Devices
  - Recommended State & Local legislation to make possession of Jammers Illegal
  - “Should not refer to them as Personal Privacy Devices they are Jammers”

- Jammers used by thieves to steal cargo put ports at risk of GPS disruption
  - Pharmaceutical Cargo Security Coalition Symposium
  - 46 Stolen Cars exported from LA Port found with GPS Jammers
  - DHS Maritime Cyber Security Symposium Port came to halt GPS signal was blocked

- Testing this technology in a real environment is challenging due to very limited opportunities to use live GPS jammers
For more information visit:

www.exelisinc.com/signalsentry