

GPS JAMMING MITIGATION SYSTEM: AN OVERVIEW

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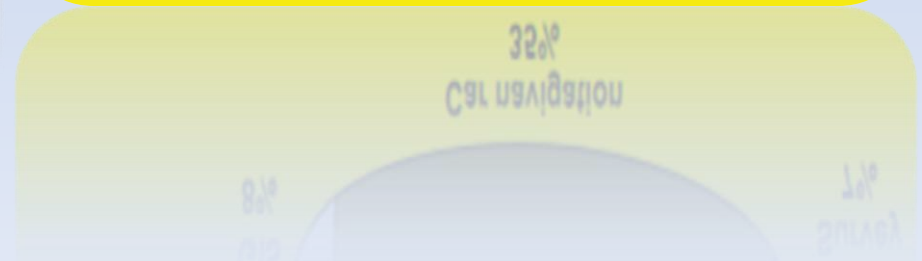
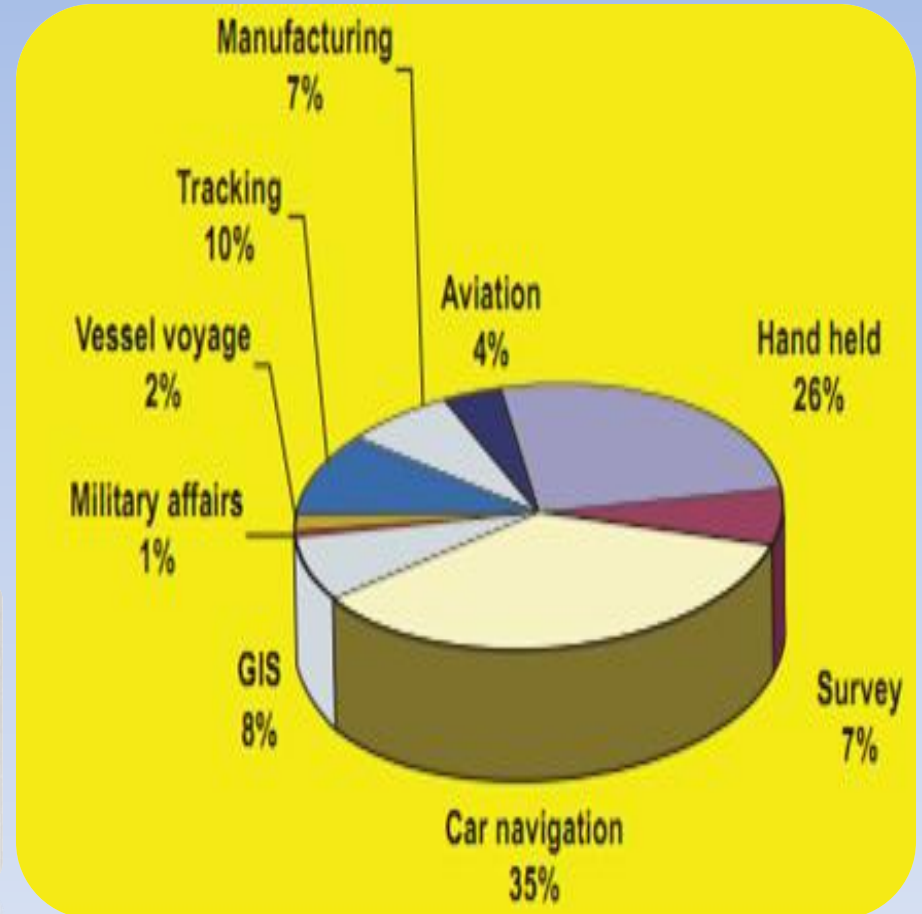
National Space Agency (ANGKASA)

Outline...

- Introduction
- Raising Issue on GPS Jamming
- Mitigation System and Devices
- Malaysia Initiative
- Concluding Remarks

Introduction

- GPS an essential tool in variety applications.
- Popularity and usages of GPS based guidance system have increasing.



GPS Vulnerability

- GPS signals are weak and easily be outpunched by poorly controlled signals from television towers or devices.
- Users not realise on vulnerable of devices to disruption and interference.
- Unintentional – *RFI, Multipath, signal errors, Ionospheric influence (solar max)...*
- **Intentional – GPS Jammer, Spoofing ...**



GPS Jammer

- Available through the internet --> RM 70.00
- Cheaper jammers are single antenna devices
 - interrupt 1 GPS signal frequency (L1) that is used by most users.
- More expensive jammers have multiple antennas
 - interrupt 3 GPS signal frequencies (L1, L2 and L5) and cell phone system.
- Not an offence to own such device.





GPS L1 Jammer (RM 70-RM100)



GPS L1/L2/L5 Jammer + Wifi Disable
(RM 900-RM1200)



GPS L1/L2 Jammer (RM 200-RM500)



GPS + cell phone Jammer (RM 800)

GPS Jamming: the Threat

- GPS jamming is believe occurs more frequently.
- Contribute to
 - erroneous GPS positions;
 - industrial and civilian transport;
 - misleading information by vessel (electronic chart display and information system, ECDIS)
 - military
 - criminals (car hijack cases)
 - and etc..



Cases

Newark airport (2009)

- The engineer noticed GPS receivers used in a new navigation aid were interrupted, daily breaks in signal reception.
- Local authority taken 2 months to determine the cause, where was a nearby truck driver who had jammer on truck and causing interference once past airport.



Impacted GPS Ground
Antenna by Jammer

Military:

- Enemy jammers deployed in Iraq to interfere with US weapons systems during Operation Desert Storm.
- Iraqi defense forces used jammers in the second Gulf War around Baghdad in 2007.
- North Koreans are repeatedly switched on 10 min for several hours, covered area 50 - 100 km to disrupt GPS navigation
- and etc...

U.S. Air Force Chief Warns against Over-Reliance on GPS

Latest News

January 20, 2010

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The Global Positioning System is vulnerable to threats such as jamming and anti-satellite weapons and the United States should reduce its dependence on the system while developing alternatives for precise positioning, navigation, and timing (PNT), the U.S. Air Force's top military leader said Wednesday (January 20).

Air Force Chief of Staff Gen. Norton Schwartz made the comments during his opening keynote address, "The United States as an Aerospace Nation: Challenges and Opportunities," at the Tuft University **Institute for Foreign Policy Analysis (IFPA) Fletcher Conference on National Security Policy**. The 2010 conference's theme is "Air, Space, and Cyberspace Century."

The Air Force is the Defense Department's executive agency charge maintaining and operating GPS.



Gen. Norton Schw

Warning on GPS jamming threats

March 11th, 2011

Researchers have warned that GPS systems are becoming increasingly vulnerable to accidental interference or deliberate jamming, raising concerns about reliability and security.

Professor Andrew Dempster, of the University of New South Wales School of Surveying and Spatial Information Systems, said GPS is relied upon for an ever-increasing number of applications including navigation, vehicle and freight tracking, and location-based smartphone services.

UK Focuses on GPS Jamming & Interference

February 28, 2010

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The noise floor seems to be rising on the subject of GNSS vulnerability to such things as jamming and interference.



In United Kingdom, a research has detected on increasing use of GPS jammer based on spectrum usage monitoring around the country.

Recently, the United Kingdom has been the focus for a trio of

the widespread global dependence of critical position, navigation, and timing (PNT) applications and infrastructures on

The Royal Institution of Engineering Surveyors at the University of Nottingham is leading an iteration of the "GPS Conference," to be held in Baska, Krk Island,

Funded at more than £2 million (\$3.1 million) by the UK government through Technology Strategy Board, GAARDIAN is investigating the data collection needed to create a GPS Interference Detection & Mitigation (IDM) network for mission & safety critical applications.

The Royal Institution of Engineering Surveyors has launched a study

**GPS Jamming:
Mitigation Systems
and
Devices**

eLoran

- Alternative PNT technology
- Ground-based radio-navigation system
- Broadcast of extremely high power signals in the low frequency portion of radio spectrum.
- Frequency of transmission = 10,000 lower than GPS
- Power of transmission = 1000 times greater than GPS
- Robust, resistant to interference and X, Y accuracies of about 20m
- Disadvantage = Lack of Z info

National GPS Interference Locating, Reporting & Elimination System

- Recommended by U.S. National PNT Advisory Board
- 2 elements: sensing of interference; communication channel to report the problem in real time.
- Consider to configure every cell phone tower to expand the functionality of their GPS timing receiver
 - promptly recognizing & reporting interference.

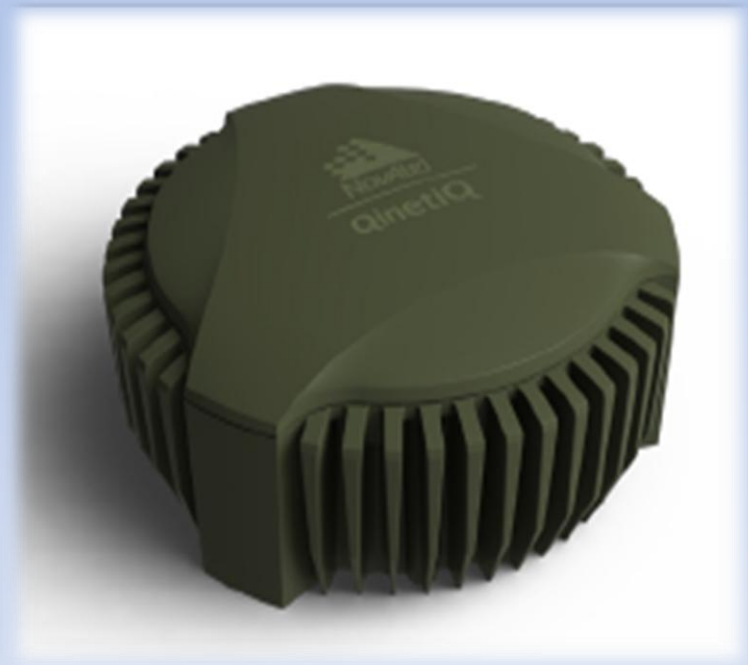
UK - GAARDIAN

- GAARDIAN or GNSS Availability, Accuracy, Reliability and Integrity Assessment for Timing and Navigation system completed in 2011 - experimental network.
- 3 elements: sensors (IDM), server & communication.
- IDM - monitor the integrity, reliability, continuity and accuracy of the locally received GPS and eLoran signals and report to the central server.
- Server - process the data received from IDM and external sources.
- Users be alerted in real time to any anomalous.

GPS Anti-Jamming Device

a) GPS Anti Jam Technology (GAJT)

- Novatel product
- Compact standalone system (290 mm in diameter)
- integrates into new platforms and compatible with existing GPS receivers and vehicle navigation systems



Concept of operation

Antenna to receive GPS signals in L1 / L2



Down-converted to intermediate frequency for high-speed and processing by gain-pattern shaping algorithms.



Optimizes power and phasing of the seven independent signals to create a high quality output signal



Output is up-converted to the original GPS frequencies

b) GPS Jamming Detection & Location (JLOC)

- NAVSYS product for military
- U.S. National Geospatial-Intelligence Agency (NGA) implemented JLOC in 2007
- Uses networked GPS receivers and other sensors (providing angle-of-arrival and time-difference-of-arrival data) as sensor inputs for monitoring.
- JLOC master station maintains threat database and provides automated alerts to users

c) Septentrio GPS anti-Jamming

- Septentrio product, Belgium.
- Designing pulse-blanking and adaptive notch filtering capabilities for AsteRx receivers, enable to mitigate the effects of continuous wave and pulsed interference at a number of GNSS frequencies.

Research Institutions

- Developing high performance antenna
- Multiple receiver design techniques
- High performance band pass filters
- New integrity algorithms

Malaysia Initiatives

The usage of Jammer govern under Spectrum Regulation, Technical Regulation and CMA 98.

Section 157:

Denotes restriction for the usage of radio spectrum

Section 238:

Person without reasonable excuse, causes a radio emission from any non-standard equipment commits an offense.

Section 182 &183:

Person who uses any technical equipment or systems which hinder network interoperability and which compromise public safety commits an offence

- National Space Agency (ANGKASA) is drafting Malaysia Outerspace Act and consider to include the prohibition of jammer in the act.
- Educate and spread the awareness to public about the illegal use of jammer (Cellular, GPS & others)
- Further discuss with investigation department on enforcement activity to available dealers or retailers
- MCMC may issue Public Notice or Advise on usage and possessing of Jammer

Concluding Remarks

- Satellite navigation system that costs billions of dollars can be easily disrupted with low cost jammer.
- GPS jamming is a raising issue.
- Local authority should take serious concern since the commercial jammer is easily obtainable with affordable price.
- The research institutions are encouraged to carry out join R&D programme focusing on antenna and receiver improvements or new devices that would enhance the resilience of GPS dependent systems against jamming threats.

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Thank you..

