



International Committee on  
Global Navigation Satellite Systems

# Experience with Radio Navigation Satellite Service (RNSS)

International Satellite Communication Symposium  
International Telecommunication Union (ITU)  
Geneva, 13-14 June 2016

MITOME, Takahiro  
Co-Chair of Compatibility and Spectrum Sub-Group of  
ICG of UN-COPUOS

# Overview

- What is RNSS? How it works?
- RNSS Spectrum Used and to be Protected
- RNSS Applications
- RNSS with Critical Infrastructure
- Interference Threats
- Jamming

# What is RNSS? How it works?

- **Example RNSS Systems:**

US GPS, Russia GLONASS, European Galileo, Chinese COMPASS, Japan's QZSS etc.

- **How it works?**

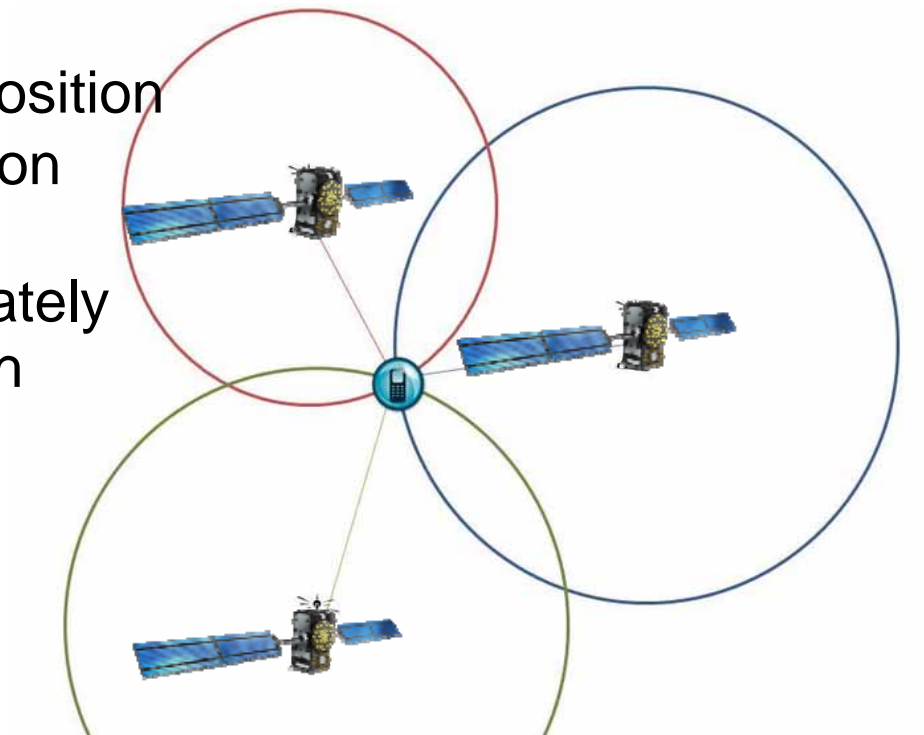
- Measure distance from the satellite (reference points) to the receiver

$$\text{Distance} = \text{Speed} \times \text{time} (t_{\text{received}} - t_{\text{sent}})$$

- Knowing at least three distances from three reference points gives position

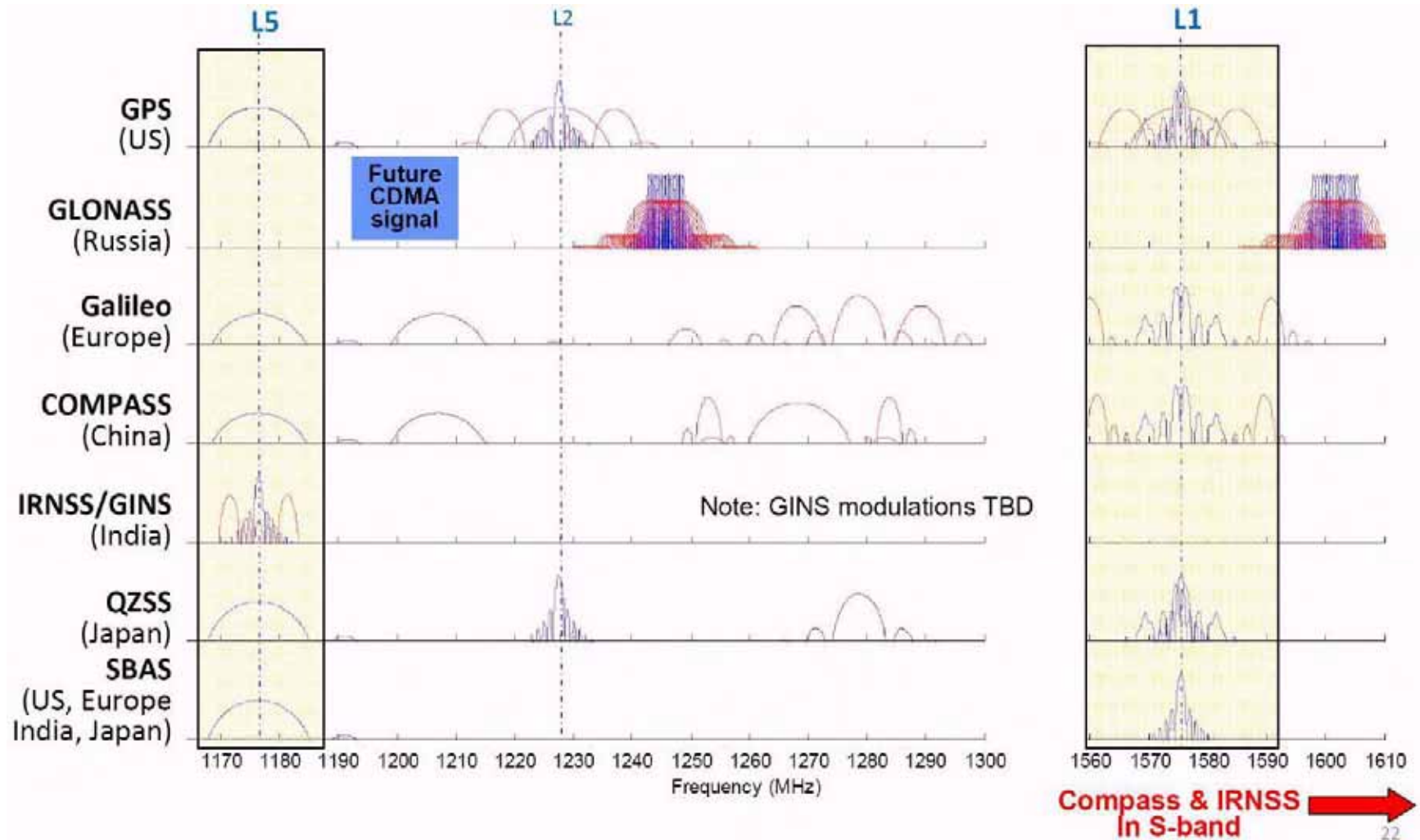
- RNSS signals contain the information about satellites' position and time

- Because receiver time is not accurately known, the time stamp from a fourth satellite is measured



# RNSS Spectrum Used and to be Protected

- L1 and L5 are known as the bands for common signals



# RNSS Application in Cell Phones

- Sparked by the E911 requirement
- Use of Location Based Service is exploding



- More than billion RNSS users

# RNSS Application in Precision Agriculture

- 1 to 10 cm accuracy
- Enables better productivity, efficiency and protection of the environment



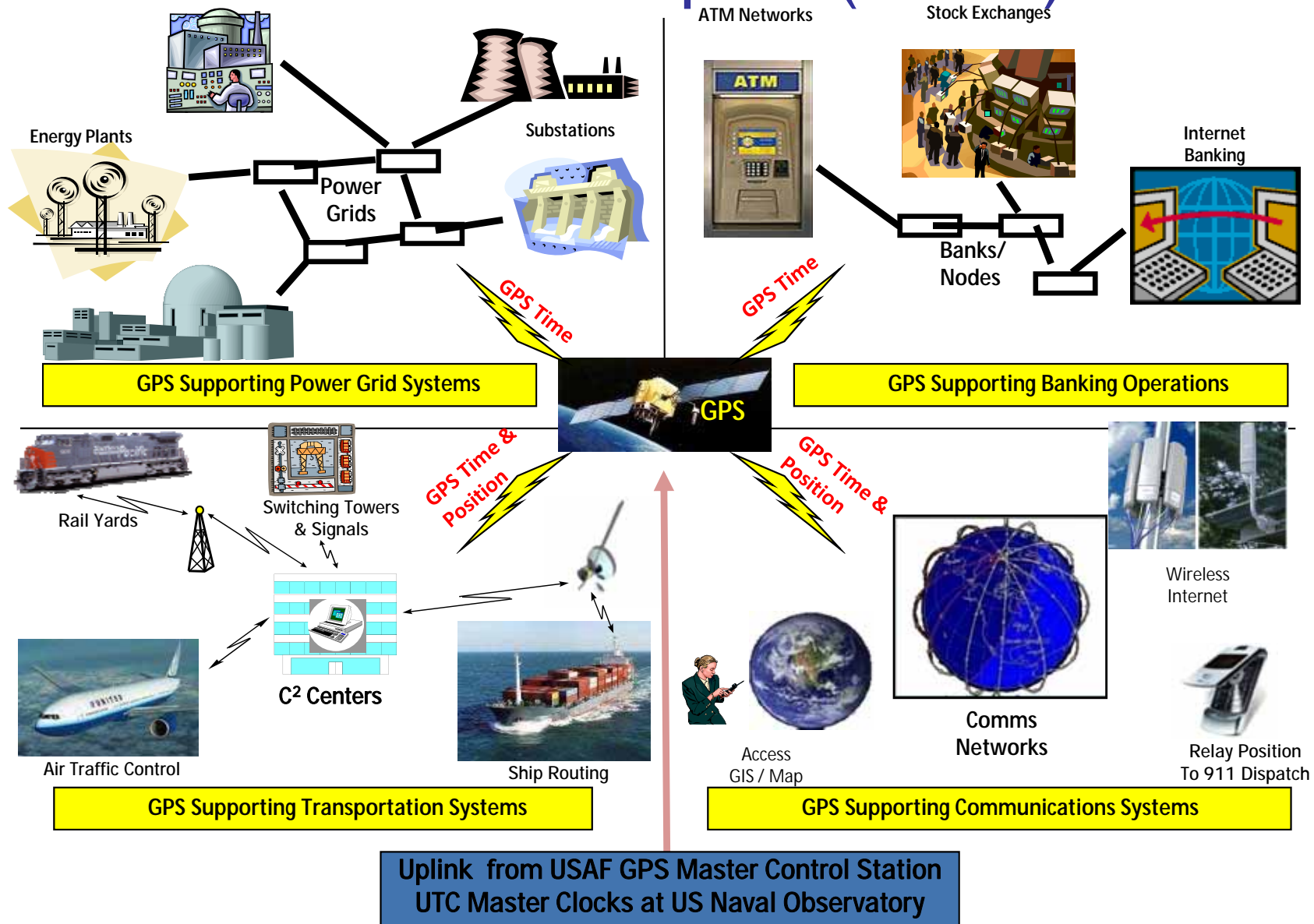
↑ Automatic Steering



← Automatic Spray Control

# RNSS with Critical Infrastructure

## GPS Examples (1 of 2)



# RNSS with Critical Infrastructure GPS Examples (2 of 2)

- GPS is deeply integrated in almost all critical infrastructure



## 16 Critical Infrastructure Sectors in the U.S.

- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Financial Services
- Food & Agriculture
- Government Facilities
- Healthcare and Public Health
- Information Technology
- Nuclear Reactors, Materials and Waste
- Transportation Systems
- Water & Wastewater Systems

*Critical Infrastructure Defined: "Assets, systems, and networks, whether physical or virtual, so vital to the United States that their incapacitation or destruction would have a debilitating effect on security, national economic security, national public health or safety, or any combination thereof."*



# RNSS with Critical Infrastructure Worldwide

- Russian GLONASS is integrated in the majority of priority development directions of science and technology
- European Galileo is critical to most of the energy and transport critical infrastructure
- Chinese COMPASS is integrated in almost all economy branches

Sources: ICG-9 and ICG-10 meetings

# Interference Threats

- Jamming: by transmitting radio wave, intentionally prevent RNSS receivers from acquiring, tracking or navigating with RNSS signals
- Spoofing: by transmitting fake RNSS signals, fool RNSS receivers with false position, navigation and timing information
- Interference: In-band and Adjacent band  
Different cases in different countries  
(Some on-going issues exist in some countries)

# Jamming Experience Example

- Newark Airport, 2009 (USA)
    - So called “personal privacy jammer” affected aircraft safety

<http://www.insidegnss.com/node/3676>

<http://gpsworld.com/personal-privacy-jammers-12837/>
  - Cargo theft using jammers
    - Stolen Cargos were hidden by criminals, 2014 (USA)

<http://fleetowner.com/technology/gps-jammers-recovered-cargo-thieves-says-freightwatch>
  - Other jamming incidents and suspicions of jamming were also Reported in other parts of the world
- <http://www.insidegnss.com/node/3982>

# Jamming – Threat to Your Life

- **Jamming will disable RNSS tracking.**



Prevent  
emergency  
phone calls  
from getting  
through



Interfere with  
ambulance, police and  
other law enforcement  
communications.

Overwhelm  
anti-theft  
devices on  
cars



# Jamming - Threat to Society

- Have been used in vicinity of airports and disrupted air traffic

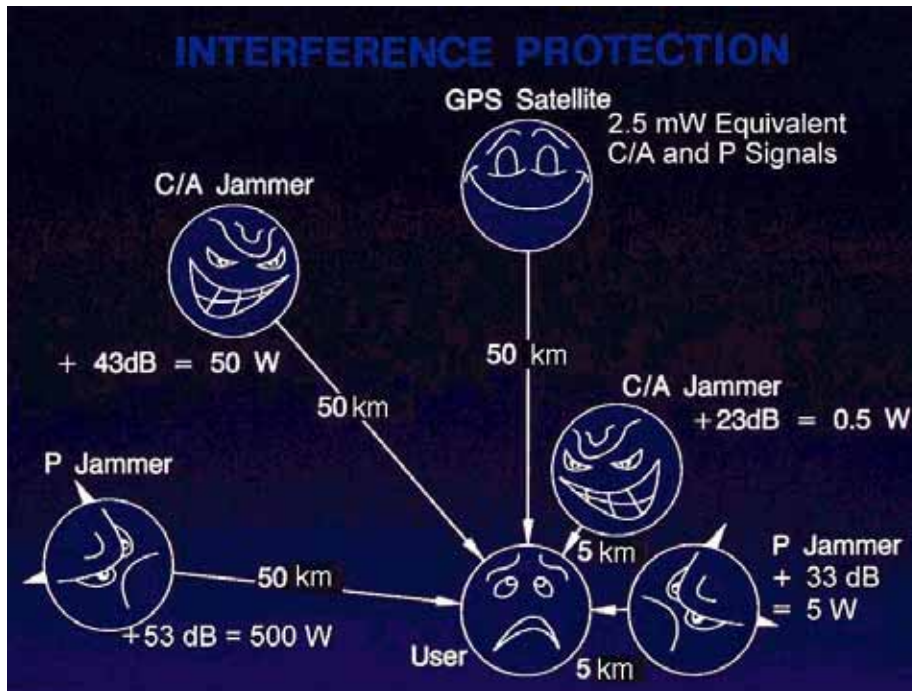


- Have been used in vicinity of a major port disabling RNSS on large cruise ships attempting to dock



# What Are Jammers?

Generally includes devices commonly called signal blockers, GPS jammers, Privacy jammers, Cell phone jammers, Text blockers, etc



# Jammer Proliferation Examples

The screenshot shows a website with a blue header containing navigation links: Home, Why Buy From Us, Contact Us, About Us, F.A.Q., Articles, Manuals, Customer Testimonials, Privacy Policy, Shipping, and Returns. A left sidebar lists categories such as Cell Phone Jammers, Portable Accessories, GPS Jammers, Prison, Vehicle, Signal Detectors, IED and VIP Protection, Laser Radar, WiFi, High Powered (Indoor/Outdoor), and Government Contracts. It also features security badges for 'SECURELY VERIFIED & SECURED VERIFY SECURITY', 'McAfee Site Advisor', and 'FREE'. The main content area is titled 'GPS Jammers' and includes a 'Sort by: Bestselling' dropdown. A descriptive paragraph states: 'To prevent GPS monitoring on your person, cell phone, or vehicle, a GPS signal blocker will stop tracking signals. Maintain your privacy, keep your movements private, and avoid unauthorized surveillance by utilizing a jamming device.' Below this are several product listings:

- GPS Jammer:** Price: ~~\$199.00~~ \$119.00. Description: 'For car, truck, bus, van, or even boat security, stop GPS tracking signals by simply plugging this into any cigarette lighter or vehicle power outlet. With up to 10 meter coverage, it will protect you from being logged...'
- Cell and GPS:** Price: ~~\$299.00~~ \$199.00. Description: 'One of our most popular units, it will silence all nearby mobile phones as always on local signals...'
- GPS Mini:** Price: ~~\$239.00~~ \$139.00. Description: 'One of the best GPS signal units available for sale, this pocket model will help you defeat GPS tracking. Block tracking signals on your person or vehicle in a 10 meter (30 foot) radius. Give those following your...'
- GPS Tracker Detector:** Price: ~~\$229.00~~ \$179.00. Description: 'Locate Bugs with a GPS Tracking Detector Concerned about a covert GPS tracking device on your person or vehicle? Locate them with this GPS tracking detector. This high sensitivity GSM and GPS detector will not...'
- Cell GPS Mini:** Price: ~~\$239.00~~ \$159.00. Description: 'This combination mini model is a fusion of our popular cell phone blocker mini and GPS mini units. Simultaneously create a silent zone and prevent unauthorized tracking signals up to 30' away with the flip of a...'

A 'High Power Component' is also featured, described as 'Not Rated' and 'If you need a large area of coverage for your business or home, this high power unit will cover a large area with its aluminum alloy case that is...'

On the right side, there is a 'Currency Converter' section with options for Default Currency, EURO, and GBP, and a 'Our Newsletter' section with a 'Subscribe to Our Mailing List Get a \$5 Coupon Instantly!' offer and a 'Your First Name:' input field.

# Summary

- Benefits and importance of RNSS should be recognized.
- RNSS is used in many applications, including critical infrastructure
- Interference (including jamming and spoofing) into RNSS will affect physical and cyber security of personal life and society
- Proliferation of jammers is growing and is a threat to RNSS