

The background features a light blue globe with a grid of latitude and longitude lines. A large, stylized compass rose is centered on the globe, with several arrows pointing outwards from its center. The overall theme is navigation and global connectivity.

C4ADS

innovation for peace



RESILIENT
NAVIGATION
and TIMING
FOUNDATION

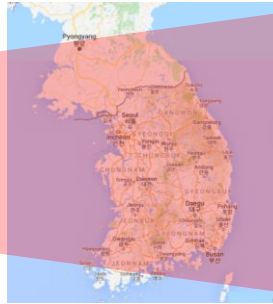
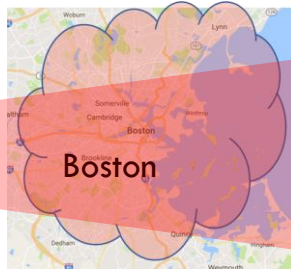
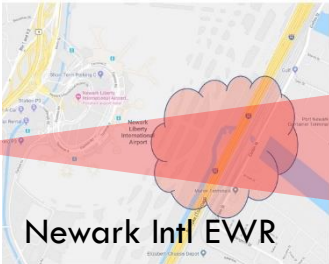
GNSS Spoofing – A Technology Re/evolution

DECEMBER 2018

US National PNT Advisory Board



Jamming/Denial of Service



Seconds,
Minutes

Weeks +

Spoofting?



December 2011



Spoofing Demo

June 2012

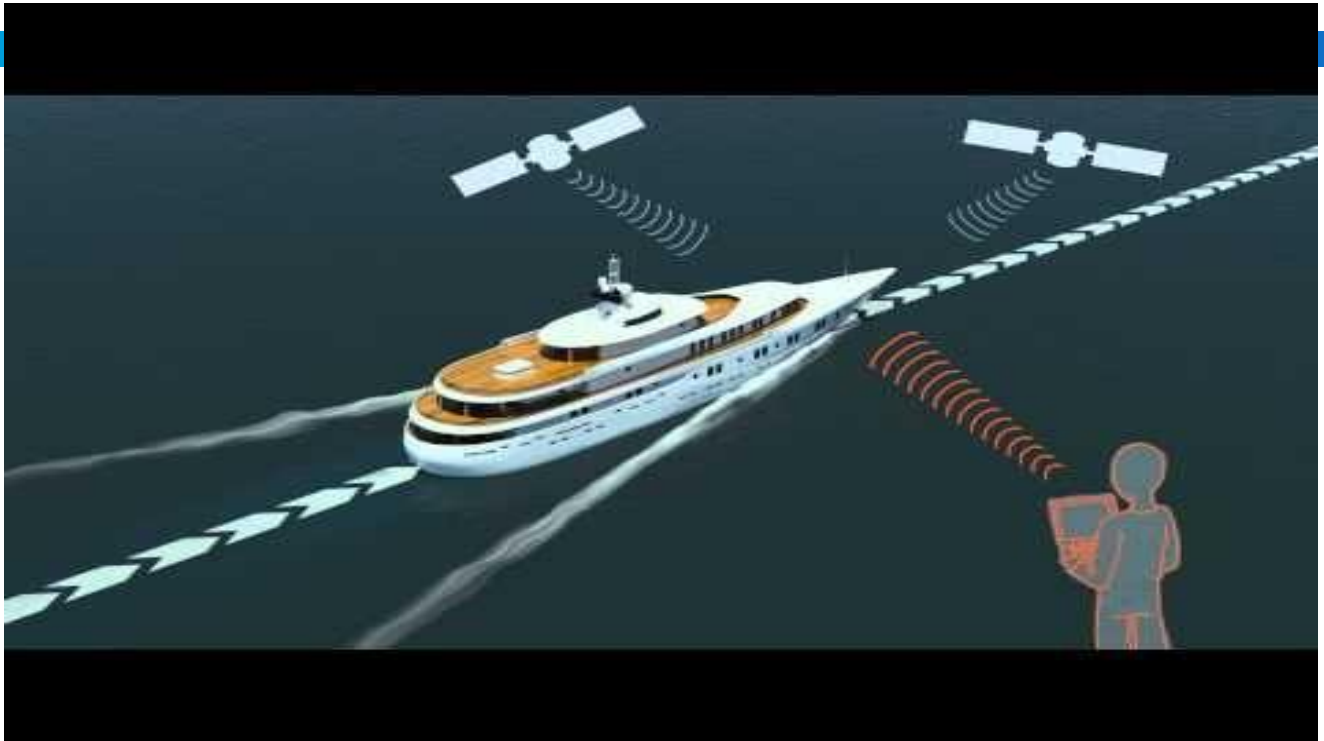
University of Texas,
Austin

Prof Todd Humphreys

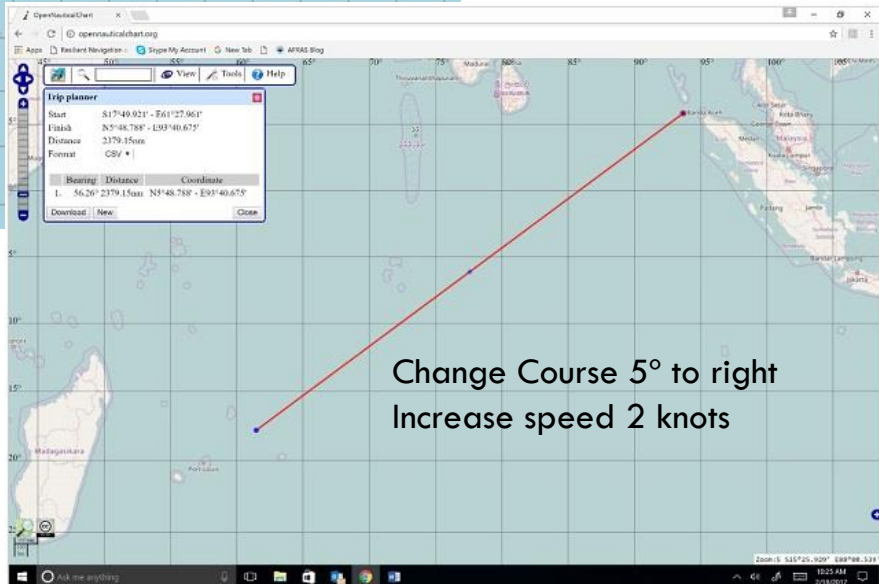
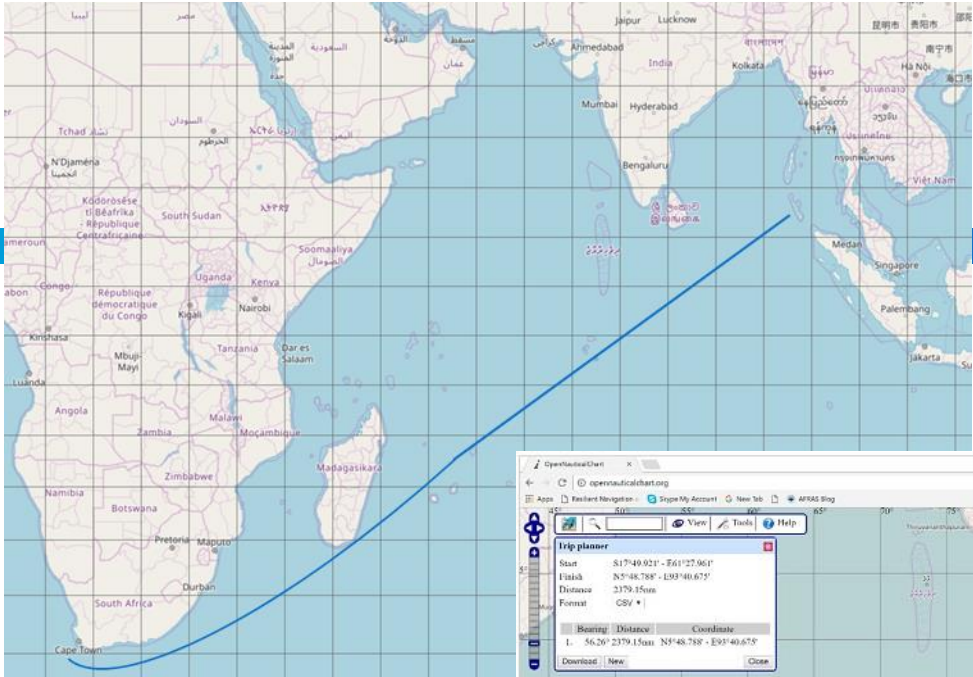


Spoofing Demo

June 2013



<https://www.youtube.com/watch?v=ctw9ECgJ8L0>



The MARITIME EXECUTIVE

INTELLECTUAL CAPITAL FOR EXECUTIVES

“How To Steal A Ship”
2 June 2017

Change Course 5° to right
Increase speed 2 knots

Resilient Navigation Skype My Account New Tab Dashboard · The Assc

View Tools Help



Western Entrance to
Malacca Straits, High
Vessel Traffic Area

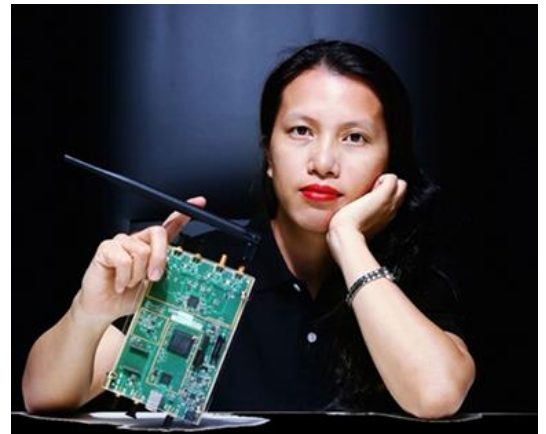
**Victim makes landfall 10 hours
early & 220nm away near "lightly
governed" area.**

Tutorial – Build Your Own GPS Spoofer

December 2015



Hackers Convention
Las Vegas



First Open Source Spoofing Report in U.S.

December 2015

DHS: 'Drug Traffickers Are Spoofing Border Drones' –
Defense One



January 2016

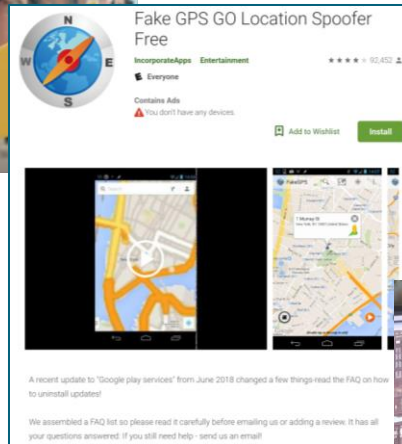


Spoofting?



Pokémon Go – Location Deception for All

July 2016



Phone App



Software Defined Radio

June - July 2016



RUSSIA BEYOND

English

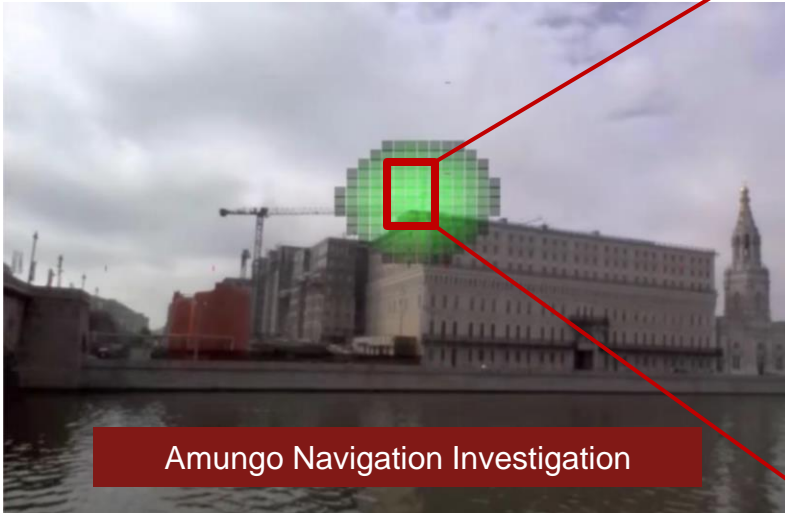
Lifestyle Culture Travel Education Business His

Why is the Kremlin 'transporting' GPS users to Vnukovo airport?

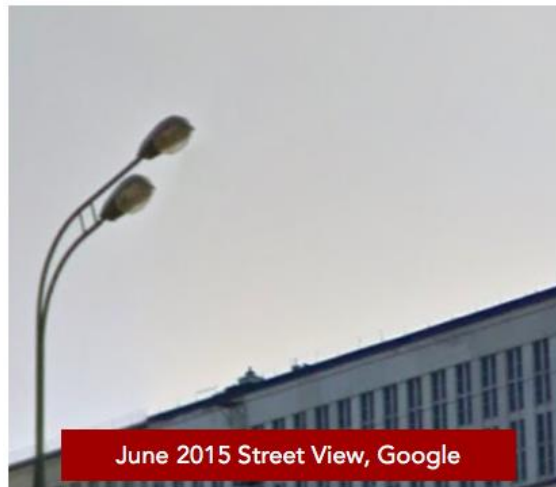
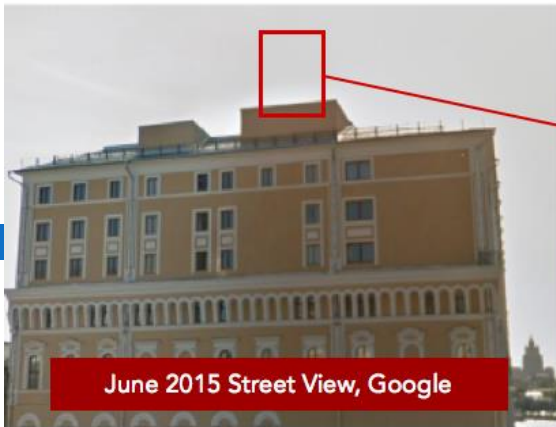
LIFESTYLE OCT 24 2016 YEKATERINA SINELSCHIKOVA RBTH



September 2017

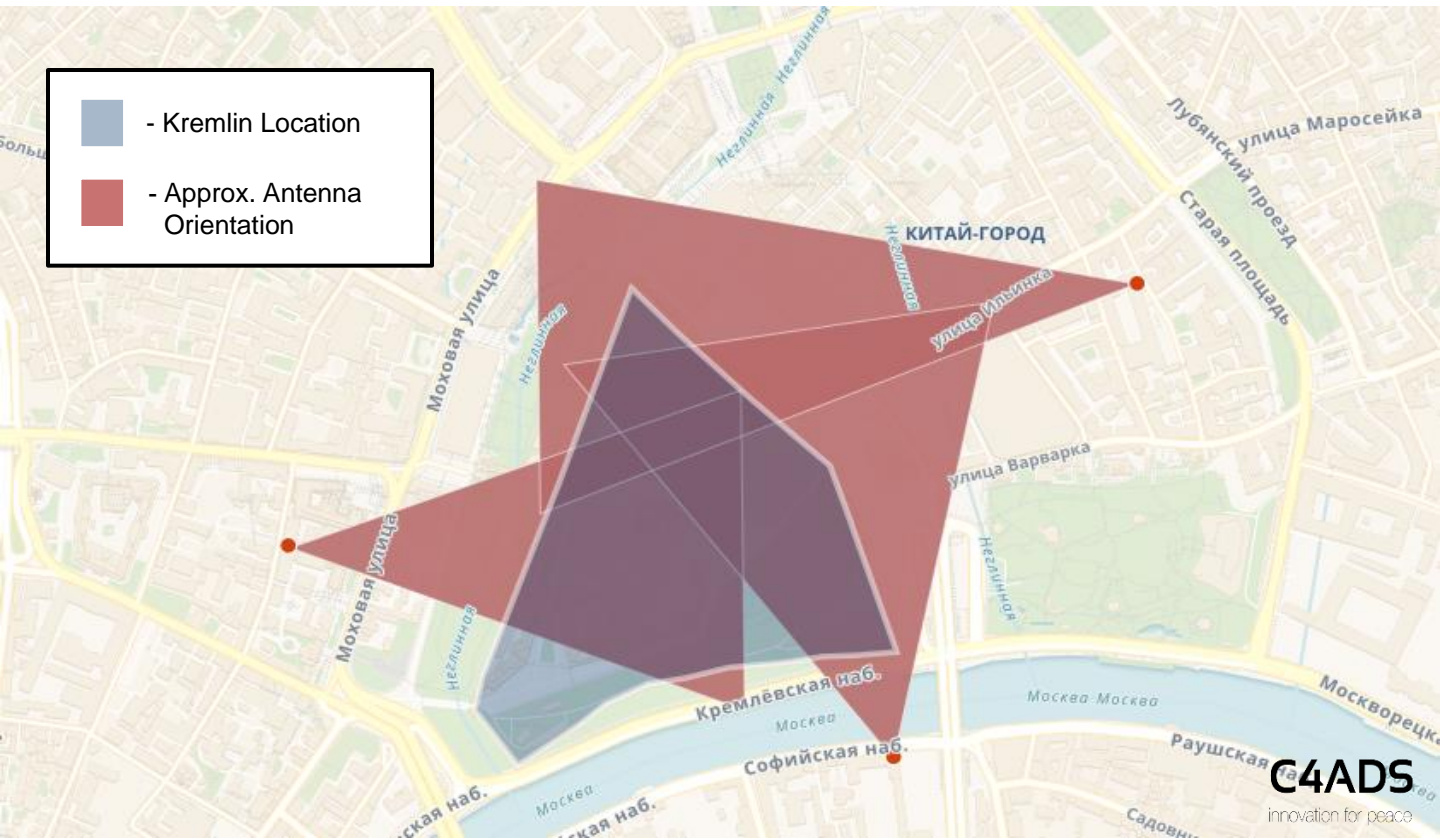


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June 2016: First Public Reports of GNSS Spoofing Near Kremlin

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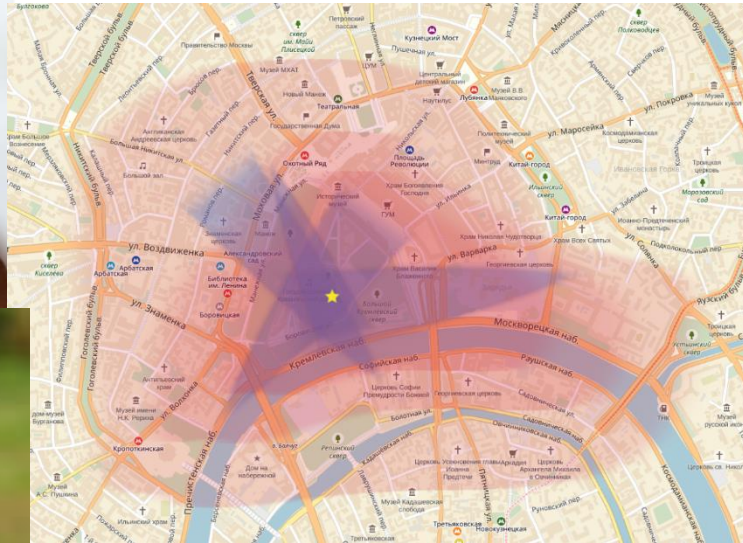
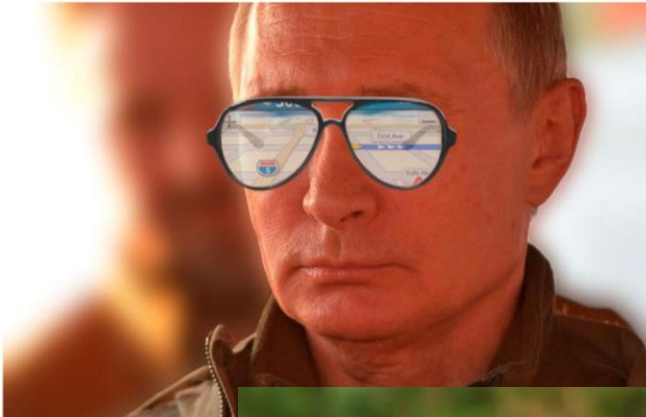
The Moscow Times

Oct 21 2016 - 03:10

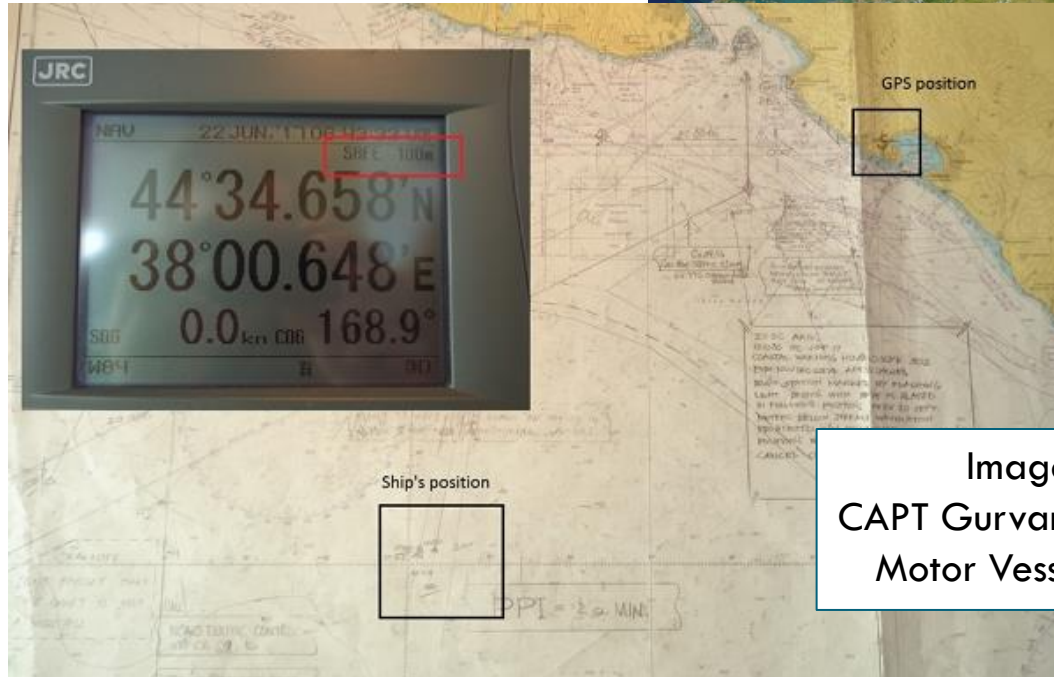
The Kremlin Eats GPS for Breakfast

Why geolocation in central Moscow has become a real headache

October 2016



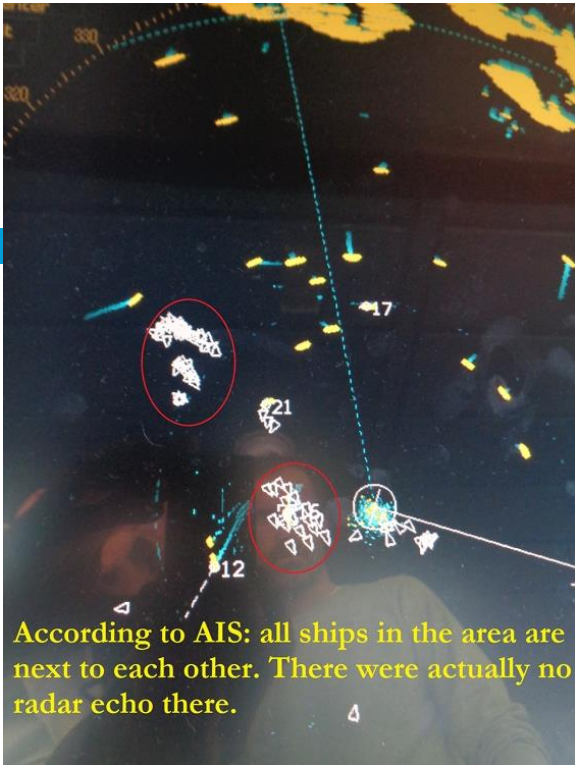
June 2017, M/V Atria



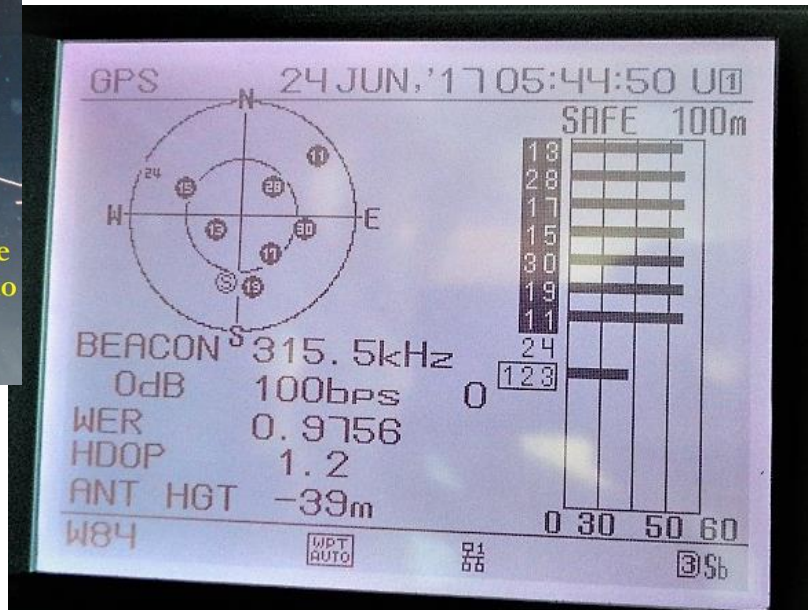
Images
CAPT Gurban LE MEUR
Motor Vessel Atria

June 2017, M/V Atria

Images
CAPT GURVAN LE MEUR
Motor Vessel Atria



According to AIS: all ships in the area are next to each other. There were actually no radar echo there.



Companies at Destination

For full access [Upgrade](#)

RU NVS
ETA: 2017-07-16 00:00 LT (UTC +3)

Route Forecast

7m
11.9 / 10.6 knots

Latest Positions

Reported ETA Received: 2017-07-17 22:19 LT (UTC +3)

Position
In Range



MarineTraffic
The world's most trusted ship tracking service

W (327°)
C

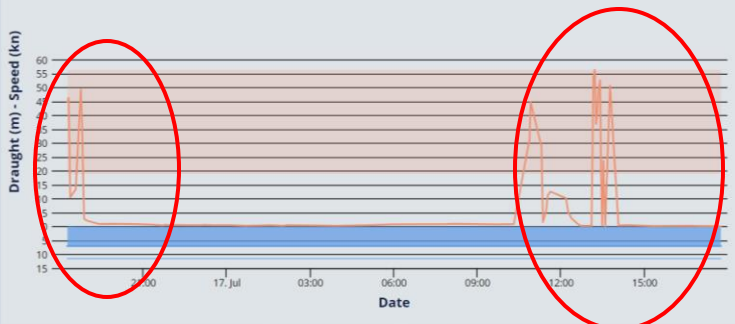
www.clickTag: void(0);

July 2017



Upload a photo | Ship Photos: 37

VESSEL TIMELINE



July 2017

MarineTraffic

For full access [Upgrade](#)

EG SKT RU NVS
ATD: 2017-06-28 22:37 LT (UTC +3) ETA: 2017-07-15 08:00 LT (UTC +3)

[Past Track](#) [Route Forecast](#)

Distance Traveled: *****
Distance to Go: *****
Total Voyage Distance: *****
Time to Destination: *****

Draught: 9.5m
Salvestatud kiirus (Suurim / Keskmine): 13.4 / 7.4 knots

[Vimarsena History](#) [Laheld Positions](#)

Reported ETA Received: 2017-07-17 22:46:17 (UTC +3)

[Vimarsena teadaolev asukoht](#) [in Range](#)

[Live Ship pin](#) [Pildid laevast: 11](#)

2017-07-17 19:23 UTC
Speed: 8.80 knots
Speed range (avg-max): 6.93-42.80 knots
Draught: 9.50m
Max Draught: 17.22 m

VESSEL TIMELINE

MarineTraffic

For full access [Upgrade](#)

PRINOS KAVALA (GR) RU NVS
ATD: 2017-07-06 08:36 LT (UTC +3) ETA: 2017-07-16 22:09 LT (UTC +3)

[Past Track](#) [Route Forecast](#)

Distance Traveled: *****
Distance to Go: *****
Total Voyage Distance: *****
Time to Destination: *****

Draught: 9m
Salvestatud kiirus (Suurim / Keskmine): 13.1 / 8.4 knots

[Vimarsena History](#) [Laheld Positions](#)

Reported ETA Received: 2017-07-17 18:49 LT (UTC +3)

[Vimarsena teadaolev asukoht](#) [in Range](#)

Position Received: 2 minutes ago (2017-07-17 19:45 (UTC))
Vessel's Local Time: 2017-07-17 22:45 (UTC +3)
Alo: BSEA - Black Sea
Latitude / Longitude: 44.14749° / 37.41941°
Cik: Underway Using Engine
Kiirus(kiirus): 8.8kn / 201°

[Nearby Vessels](#)

Truul: 15 knots
Wind direction: NW (333°)
Temperatuur: 26°C

Hiljutised sadama teated [Pildid laevast](#) [Arukirjeld](#) [Arukirjeld](#) [Arukirjeld](#)

Vimarsena Particulars

Vessel Particulars



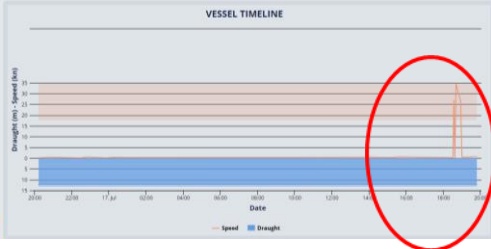
July 2017

MarineTraffic

RU NVS

Distance Travelled: *****
 Distance to Go: *****
 Total Passage Distance: *****
 Time to Destination: *****
 Draught: 12.0m
 Salvestatust kirjutatakse (Keskmine): 8.7 / 4.9 knots

Võimalik teaduslike asukoht



MarineTraffic

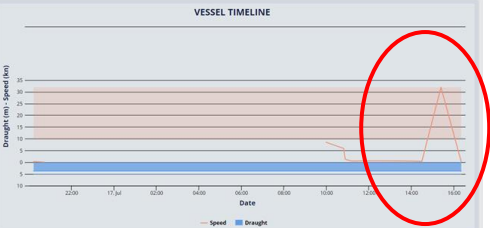
Wimane teaduslike asukoht

Wimane teaduslike asukoht

Position received: 3 hours, 31 minutes ago (2017-07-17 16:23 (UTC))
 Vesseli lokal time: 2017-07-17 19:23 (UTC +3)
 Aia: BISA - Black Sea
 Latitude / Longitude: 44.00022° / 36.61099°
 Disk: Not Under Command
 Kõrgus: 8.2m
 AIS allikas: 2970

Hiiglasel sadama teatel

| Sadama | Arrival (LT) | Departure (LT) | In Transit |
|--------|--------------|----------------|------------|
| Sadama | | | |



MarineTraffic
 The world's most trusted ship tracking service

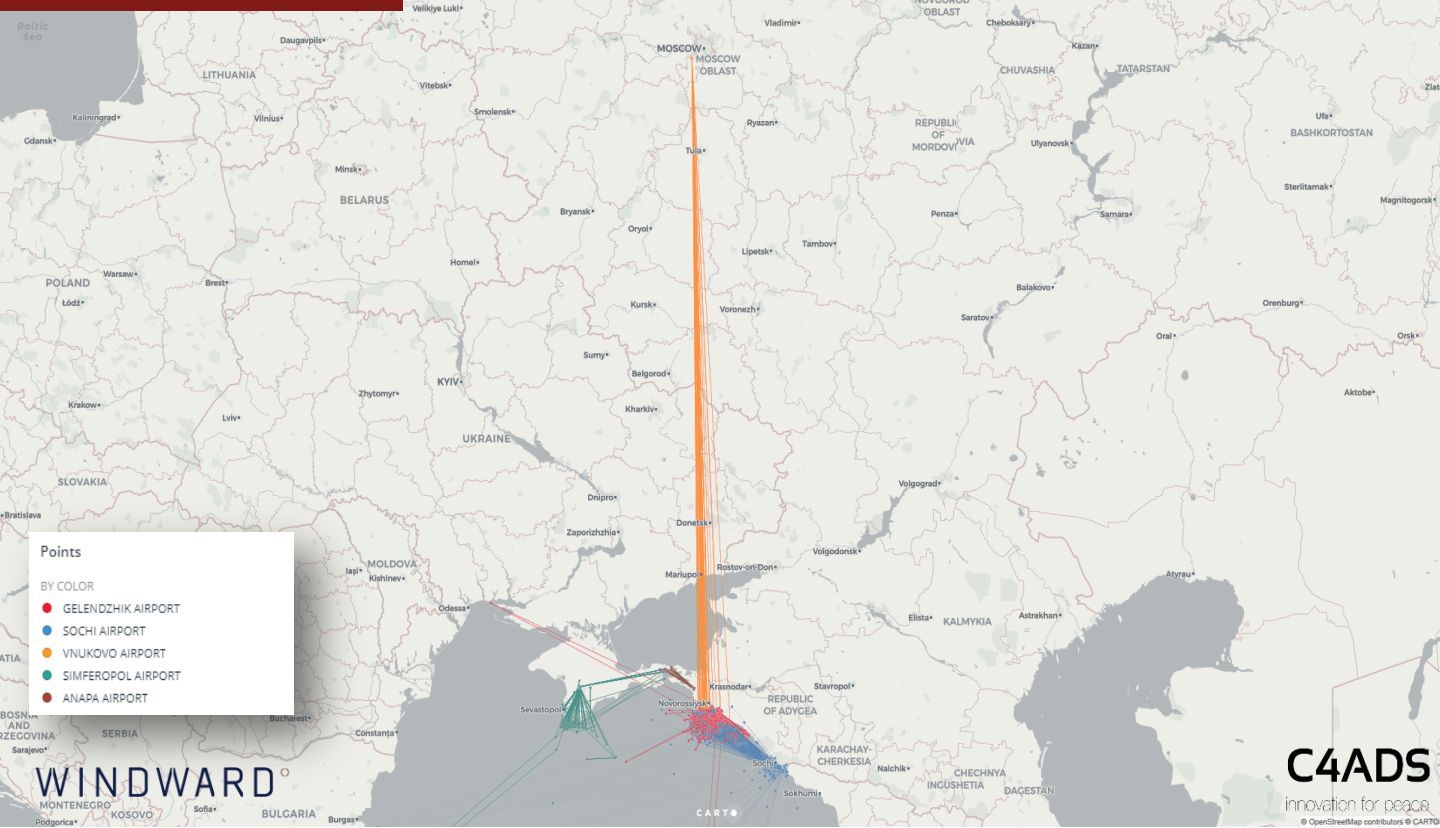
T-Mobile

SWITCH TODAY

LET'S GO Richmond Hwy & Lakeside Ln

Black Sea Spoofing Activity

January 2016-November 2018



WINDWARD

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Ships at Gelendzhik Airport



С/Т "ВИНОГРАДАРЬ-3"

С/Т "ВЕТЕРАН"

Gelendzhik Airport

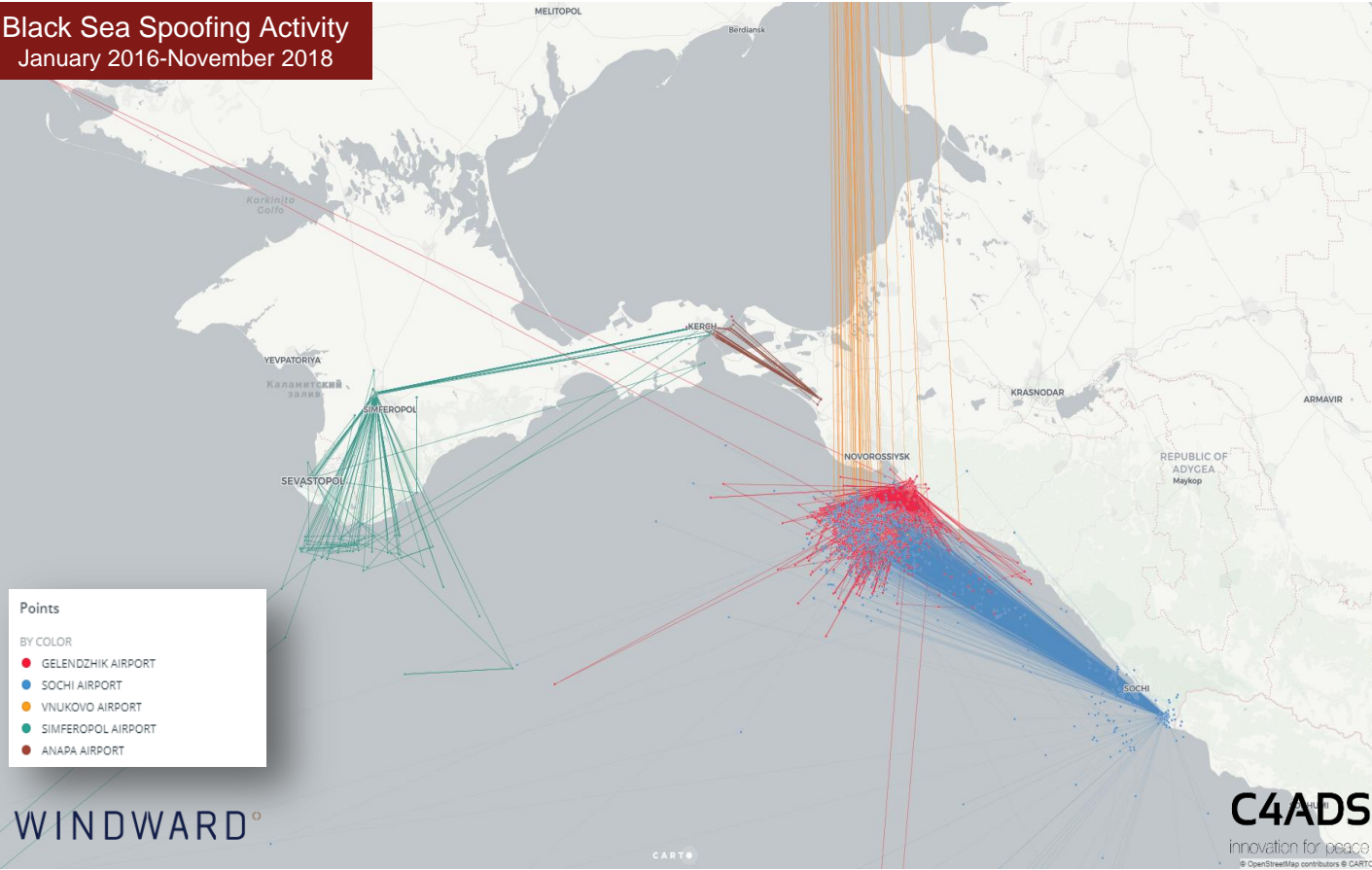
GOLUBAYA BUKHTA

SOLNTSEDAR

Mooring area

Mooring area

Black Sea Spoofing Activity January 2016-November 2018



WINDWARD

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Ships at Sochi Airport



Moldovka

Mira St

Sochi International Airport

Mooring area

A-149

Nasyphaya St

A-147

A-149

WINDWARD

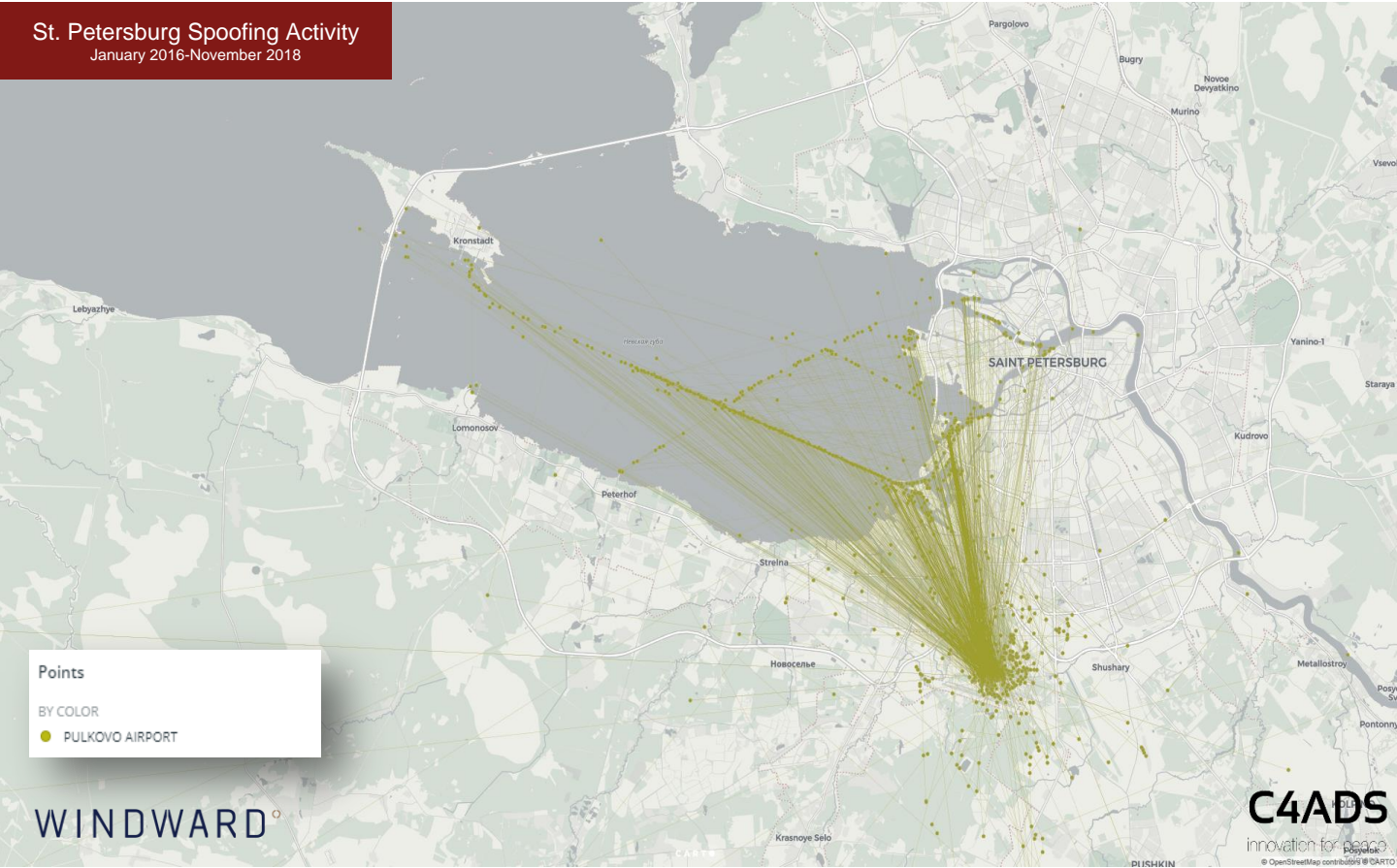
Yokova St

Kirrov

Chernovitskaya St

St. Petersburg Spoofing Activity

January 2016-November 2018

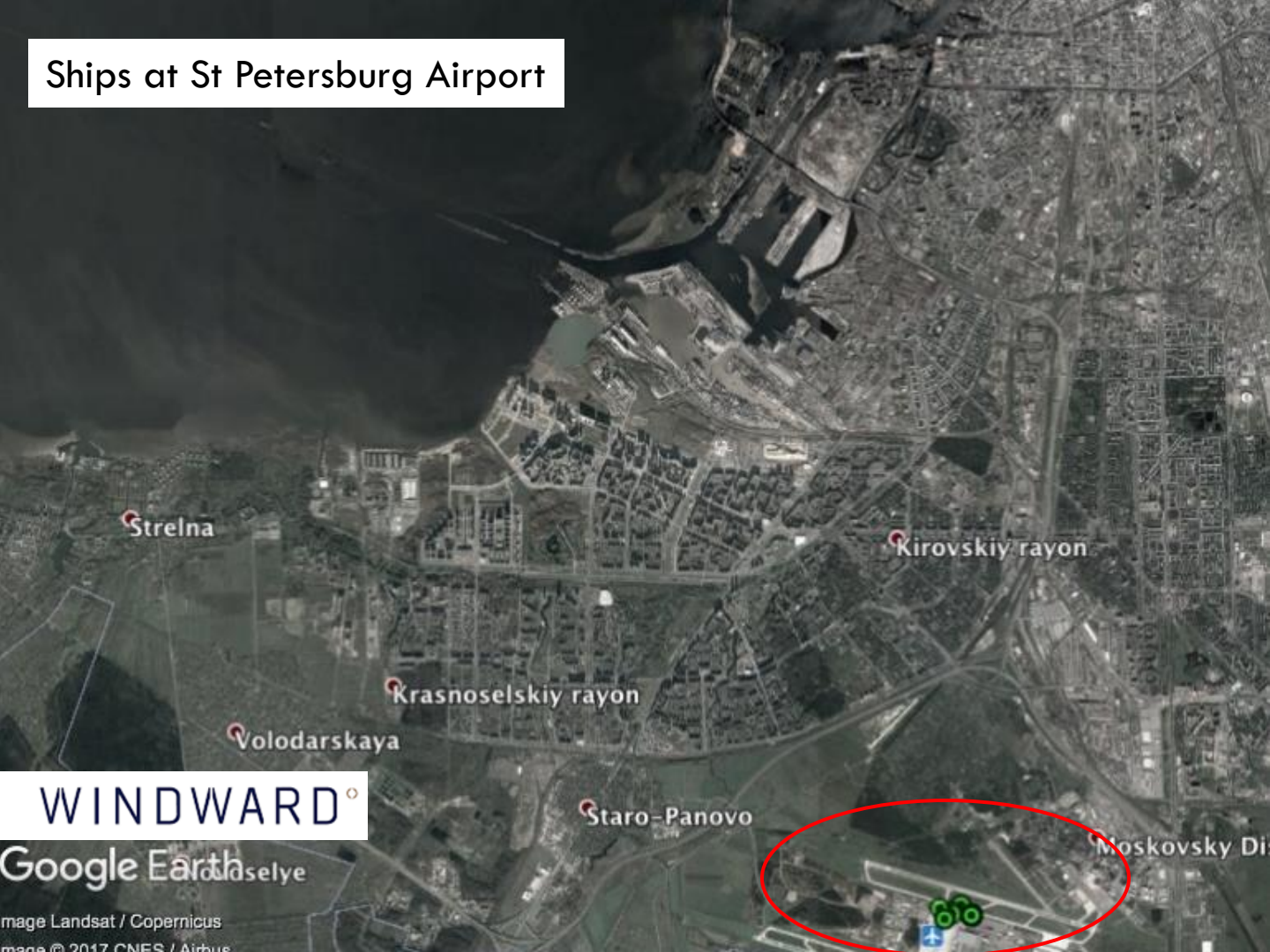


WINDWARD

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Ships at St Petersburg Airport



Strelna

Kirovskiy rayon

Krasnoselskiy rayon

Volodarskaya

Staro-Panovo

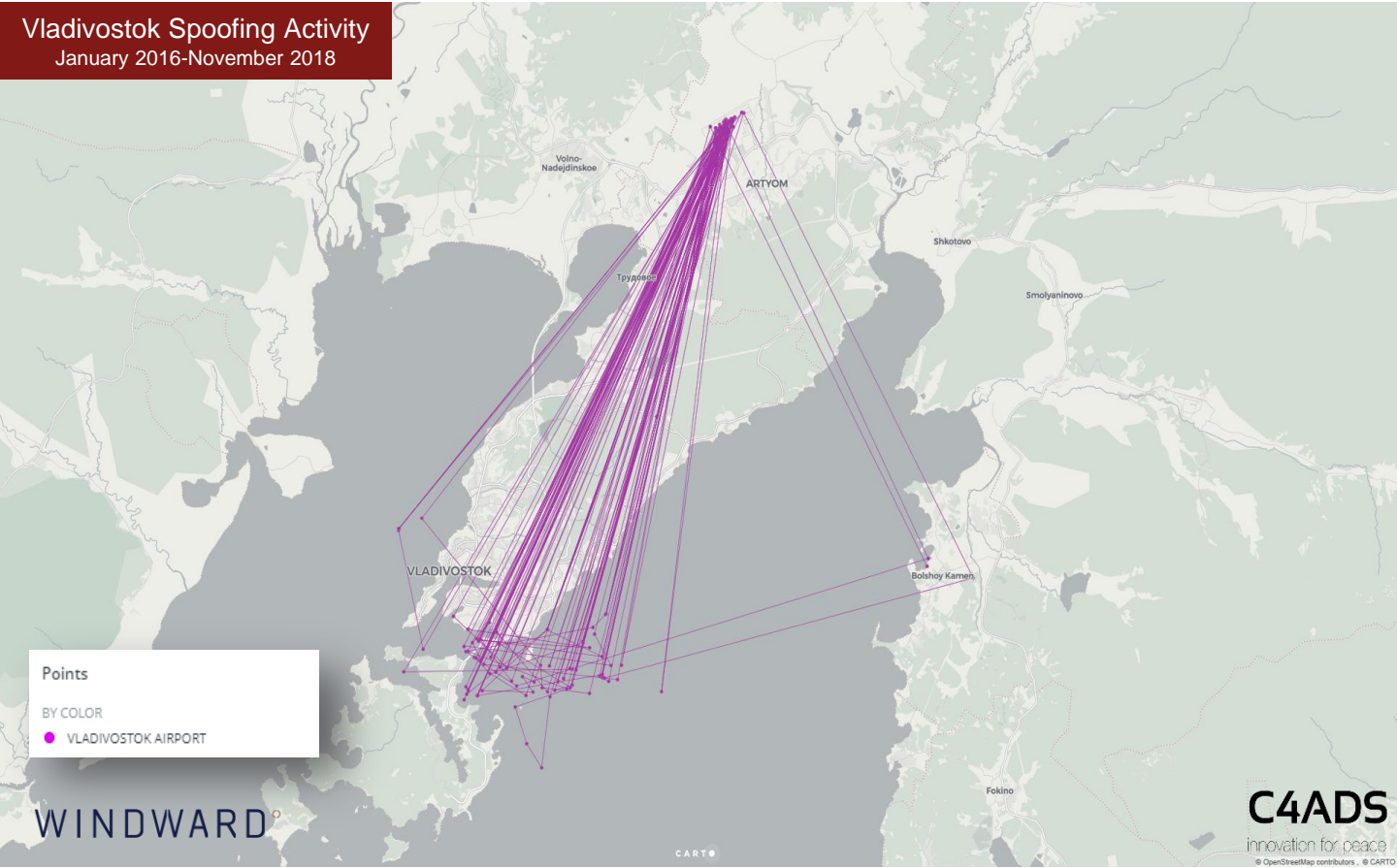
Moskovsky Di

WINDWARD^o

Google Earth

Vladivostok Spoofing Activity

January 2016-November 2018



Points
BY COLOR
● VLADIVOSTOK AIRPORT

WINDWARD

CARTO

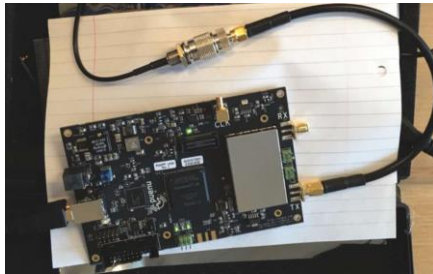
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Accidental GPS Spoofing Nails Cell Phones in Portland



Oct 2017



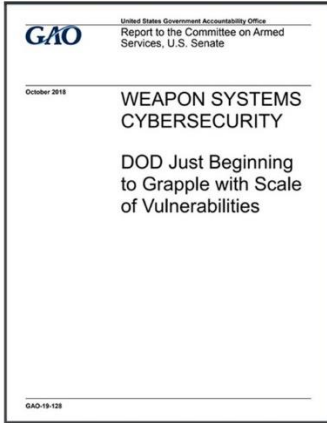
June 2018

Easily Spoofing Them All at Once – Inside GNSS

Next Level of Danger
“All Your GPS Are Belong to Us”
Spoofing GPS & Maps



Virginia Tech & UEST China
July 2018



‘GPS Hackers could send weapons to wrong target.’

17 Oct 2018

Russia claims US spoofed drones to attack base.

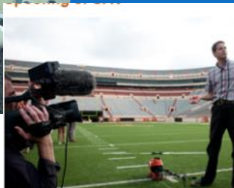
25 Oct 2018



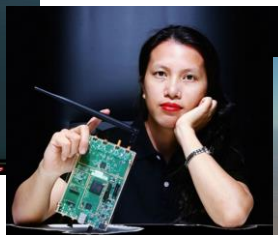
Spooing — Cost ↓ Capability ↑ Ease of use ↑



Iran, Dec 2011



UT Austin, 2012-13



Las Vegas, Dec 2015



US Southern Border
Dec 2015



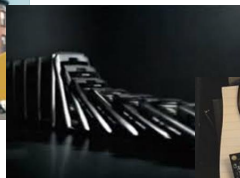
Persian Gulf, Jan 2016



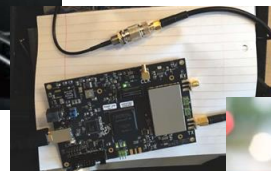
4 sites Russia
600+ ships
2016 - Present



Pokemon
July 2016



Portland
Oct 2017

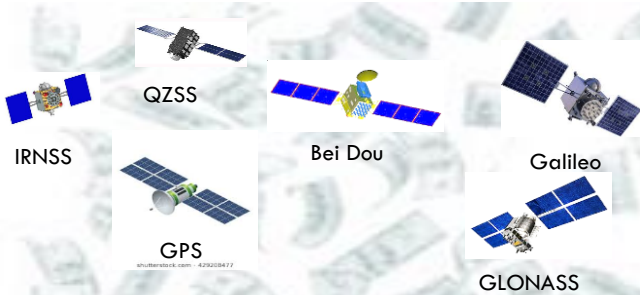


All GNSS at Once
June 2018

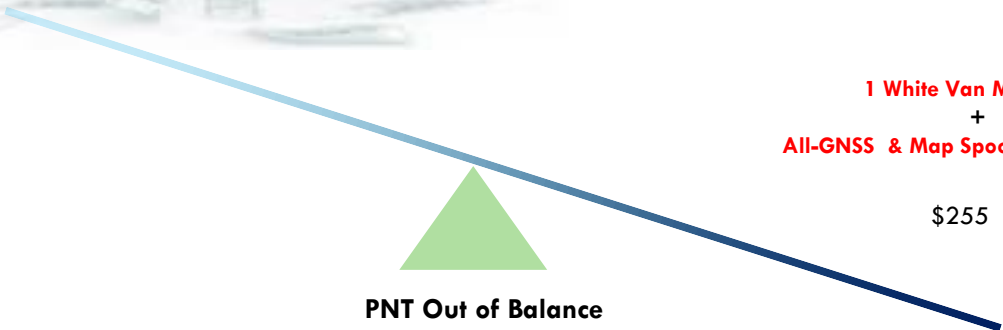


Signals & Maps
Jul 2018

"GNSS alone is insufficient for Safety of Life and other critical applications" – European Union



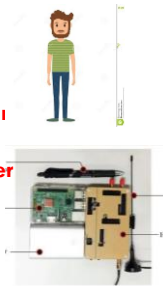
\$100,000,000,000 invested +
\$6,000,000,000 per year to run +
200,000 people in industry



PNT Out of Balance

1 White Van Mar
+
All-GNSS & Map Spoofers

\$255



What to Do?

- **Protect** — GPS Signals
 - Interference detection
 - Enforcement
- **Toughen** — Users & Equipment
 - Anti-jam, anti-spoof
 - Standards, requirements, costs
- **Augment** — w/other signals & sources
 - US Govt Announcements 2008, 2015 “eLoran”





4 December 2018

National Timing Security and Resilience Act of 2018

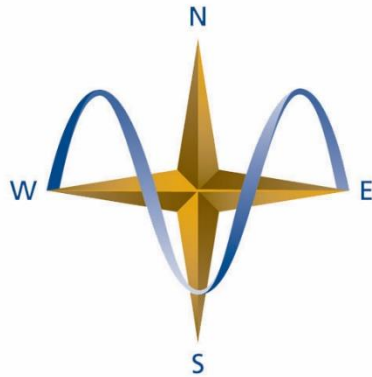
(part of Frank LoBiondo Coast Guard Authorization Act of 2018)

Global Disruption Monitoring Potential from Low Earth Orbit

- Global situational awareness
- Near real time
- Ability to alert users
- Special benefit to aviation and maritime



Encourage further research and publications



RESILIENT
NAVIGATION
and TIMING
FOUNDATION

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