

RESILIENT  
NAVIGATION  
*and* TIMING  
FOUNDATION

# **GNSS Jamming and Spoofing Europe, Mediterranean, East Asia**

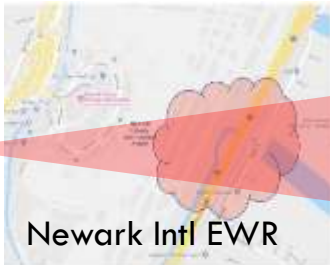
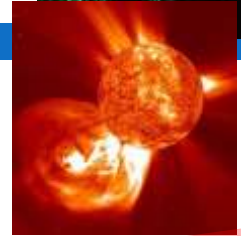
OCTOBER 2018

Melaha Conference - Cairo

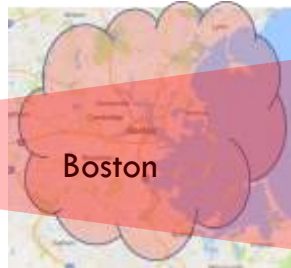


<https://www.youtube.com/watch?v=yhAh-vpuGCg>

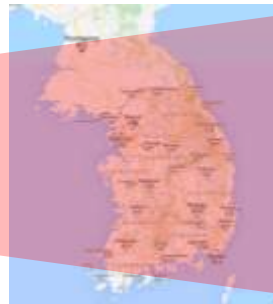
# Threats & Risk



Newark Intl EWR



Boston

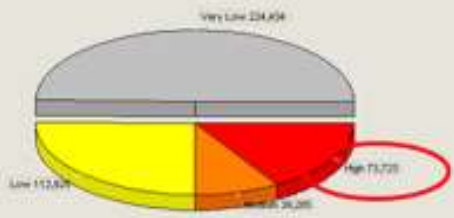


Seconds,  
Minutes

Weeks +

# Result 2: GNSS Denial Events

Event Priority Levels  
(By Classification Type)



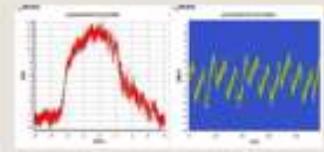
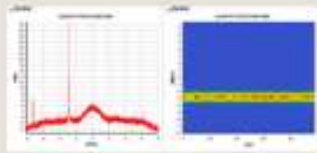
Classification Types



73,000 GNSS denial events

- 59,000 jammers
- 12,000 narrow band
- 2,000 other signals

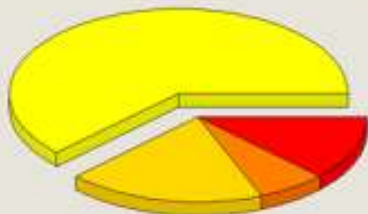
[450367] ALL   
  [222720] WHITE\_WB   
  [101811] NB\_ST   
  [59453] CHIRP  
 [13213] CDMA   
 [88170] OTHER



■ 1,065 WHITE\_WB   
 ■ 11,941 NB\_ST   
 ■ 59,453 CHIRP   
 ■ 570 CDMA   
 ■ 694 OTHER

# Result 3: Durations of interference events

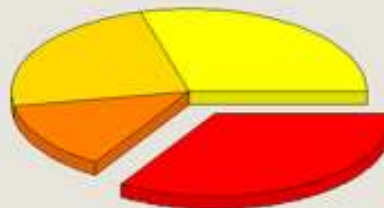
ALL events (450,363 events)



279,308 (00 to 20 sec) 16,832 (20 to 40 sec) 23,319 (40 to 60 sec) 9,504 (60+ sec)

Most events are very short durations  
12% of ALL events are greater than 60 seconds

High Priority events (73,723 events)

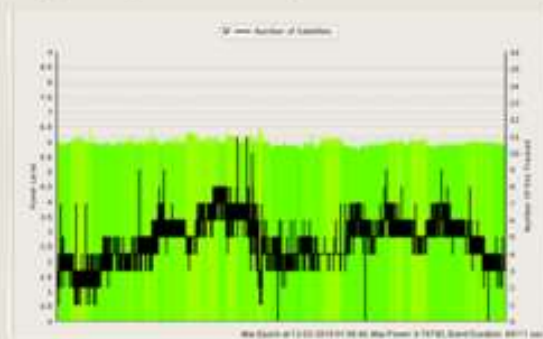


23,646 (00 to 20 sec) 17,275 (20 to 40 sec) 6,862 (40 to 60 sec) 26,940 (60+ sec)

34% priority events are greater than 60 seconds

**Some findings:**

- 7191 events > 5 minutes
- 1112 events > 30 minutes
- 610 events > 60 minutes
- 5 events > 1 day
- Longest event = 5 days



## Result 5: Comparisons of Sites

- Results from 8 Airport installations
- Most are “national” airports. Most are air-side installations.
- 30 days data (may not be the same 30 days)

	RFI events	Jammers	Jammer/events ratio	Duration > 60secs	GNSS denial	Denial/events ratio
National Airport	8716	95	1%	282	362	4%
National Airport	759	27	4%	200	211	28%
National Airport	2764	595	22%	395	753	27%
Regional Airport	556	31	6%	6	95	17%
National Airport	904	168	19%	158	182	20%
National Airport	776	19	2%	101	35	5%
National Airport	1819	73	4%	9	252	14%
National Airport	4519	133	3%	352	153	3%

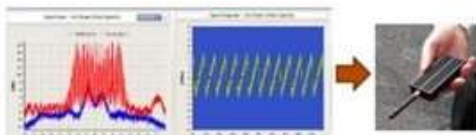
- Helps to diagnose issues with unintentional interference & jamming
- Helps to compare with other sites



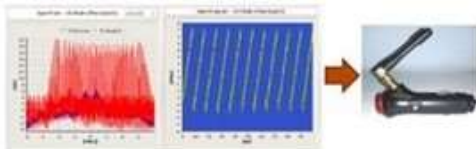


**STRIKE3**

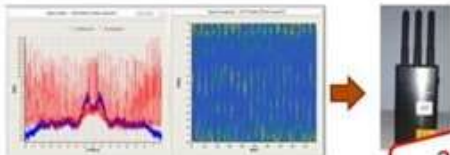
## STRIKE3 shows Jammer industry is evolving...



5Mhz bandwidth, 1575Mhz centred

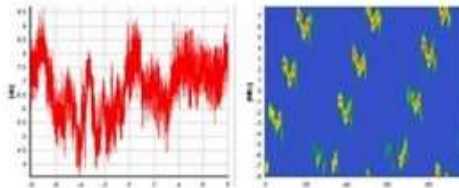


8Mhz bandwidth, drifting centre



Wideband

2012



Waveform detected at 4 STRiKE3 sites Europe and outside EU



USB L1/L2 jammer



# Fresh terror fears as hackers trying to disable planes at Cairo Airport

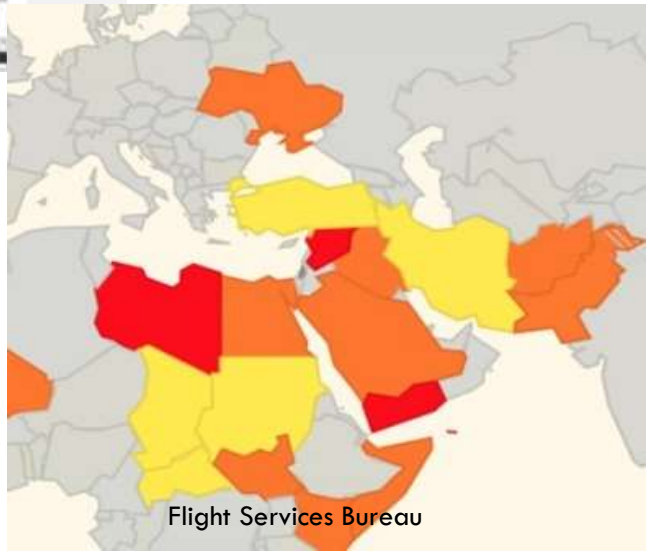
It is believed pilots are being targeted by 007s planning just days after the Egyptian tragedy



An advertisement for Advanced Medical Services. It features a red cross logo and the text "Every 8 minutes, we respond to a disaster." Below this, there is a red button that says "Book Now".

May 2016

# Aviation Jamming



Flight Services Bureau

April 2018

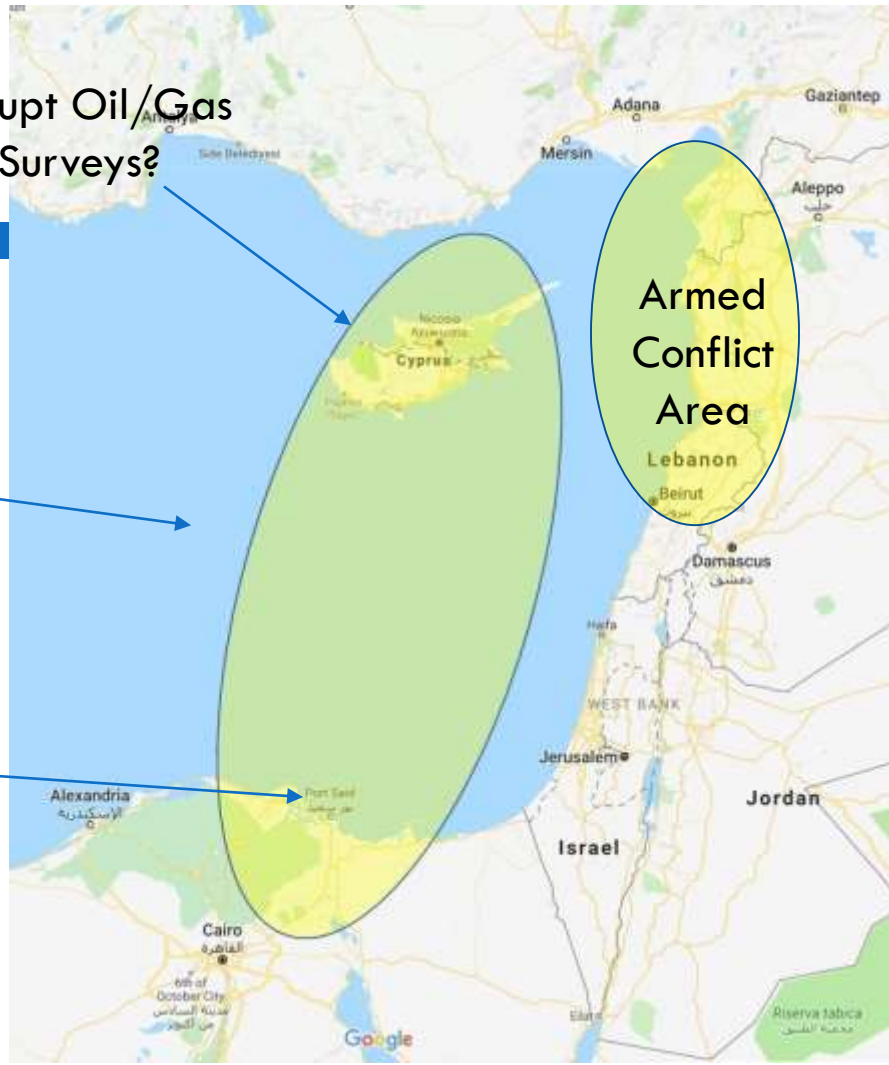


# Maritime Jamming

Disrupt Oil/Gas Surveys?

US Maritime Administration  
Alert Area  
March 2018

Illegal Fishing?



# Spoofting

December 2011



January 12, 2016



Reposition 2 RCB 90s  
from Kuwait to Bahrain  
through International  
Waters



January 12, 2016



January 12, 2016



Spoofting?



January 12, 2016



Spoofting?

- Right after US/Iran nuclear agreement
- Same day as President's last major speech to the nation

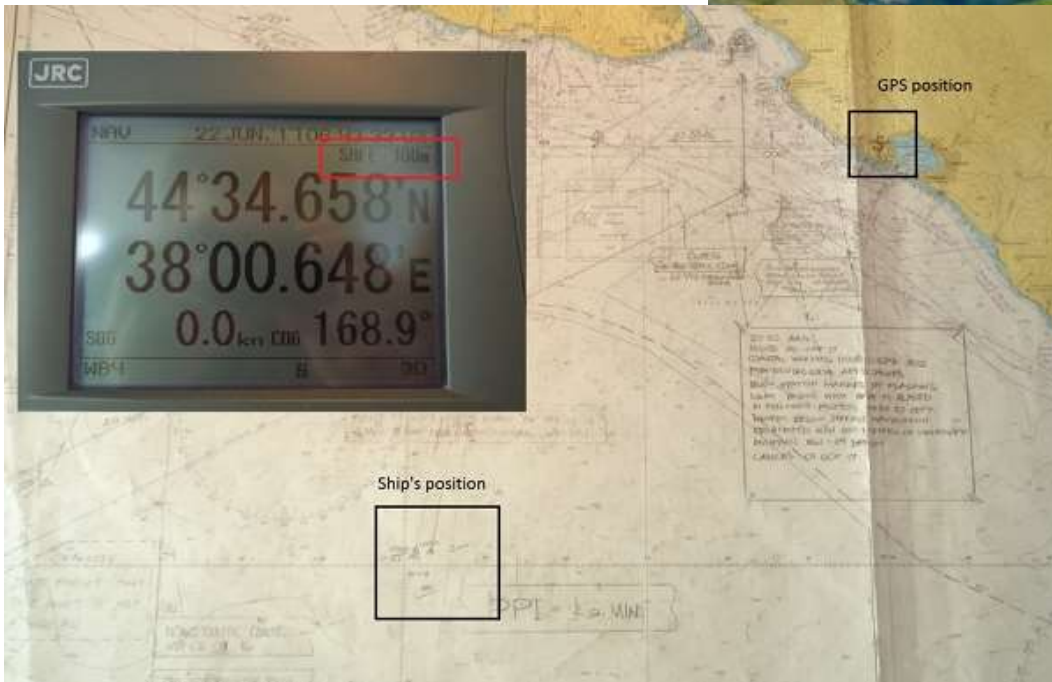
January 12, 2016



## Spoofting?



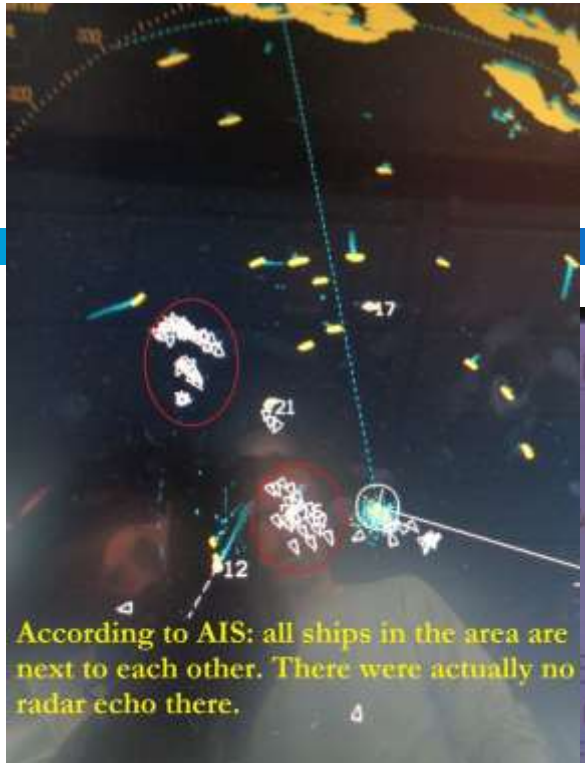
- Right after US/Iran nuclear agreement
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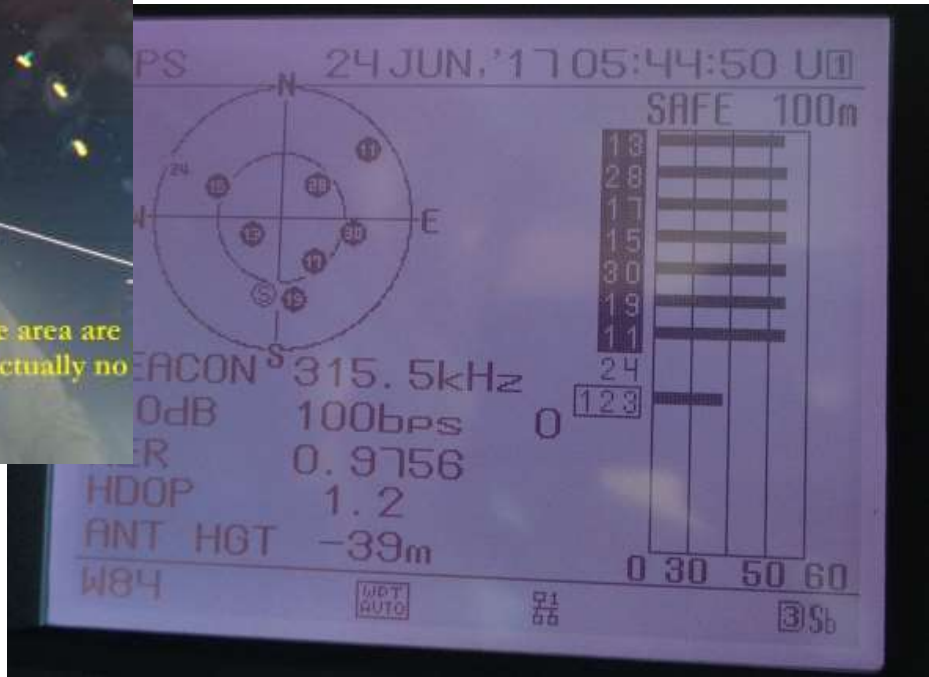
June 2017, M/V Atria



June 2017, M/V Atria



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



July 2017

Navigation: Skype My Account, New Tab, Dashboard - The Ash...

Use Map, Vessels, Ports, Photos, Participate, Services

### Comparises at Destination

For full access: Upgrade

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

11.9 / 19.4 knots

Reported ETA Revised: 2017-05-17 22:10 LT UTC +3

### Position

in Range

07:38:18 (UTC)

Show on Top Map 20

### VESSEL TIMELINE

Draught (m) Speed (kts)

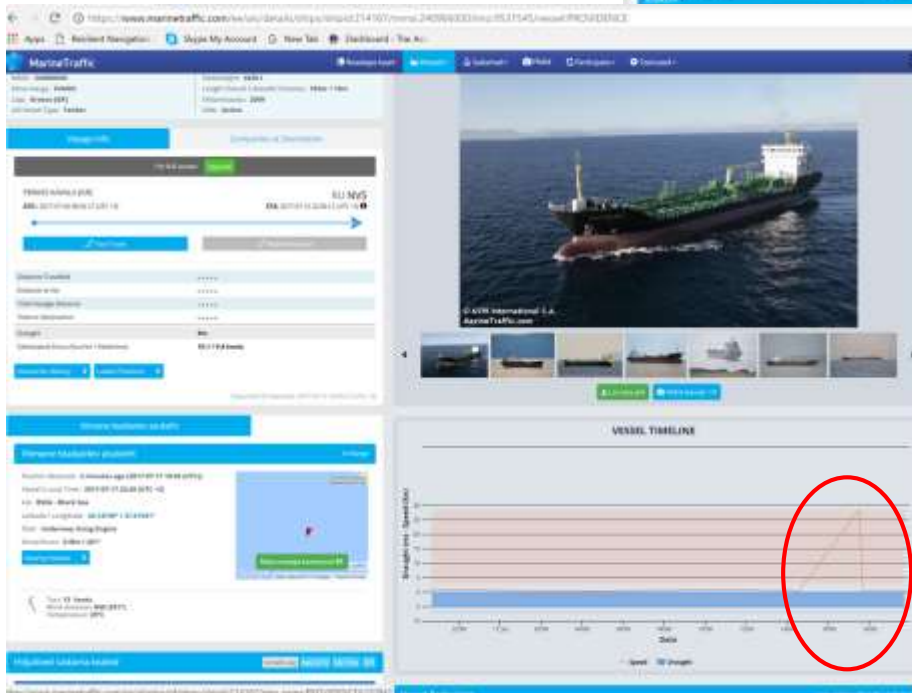
Date

2017-05-25 17:00 10:00 00:00 12:00 15:00

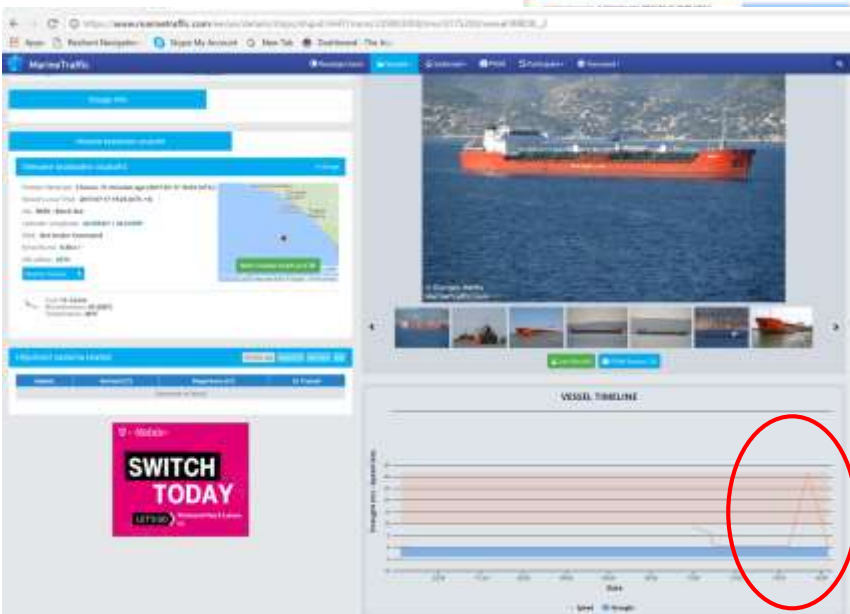
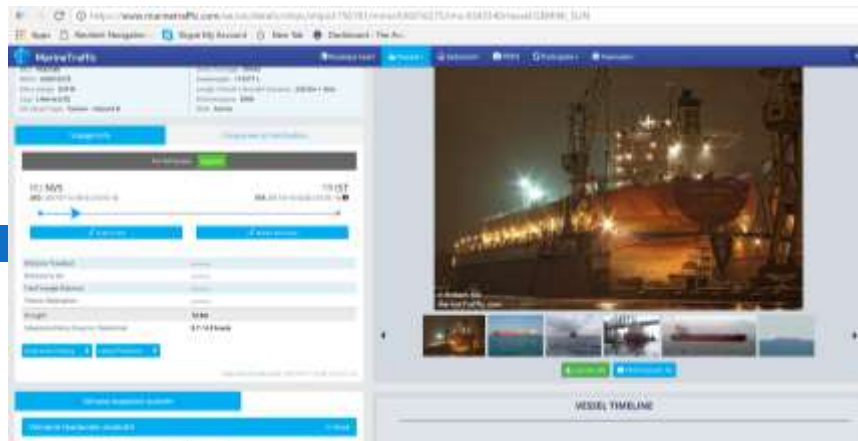
0 10 20 30 40 50 60 70 80 90 100

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

July 2017

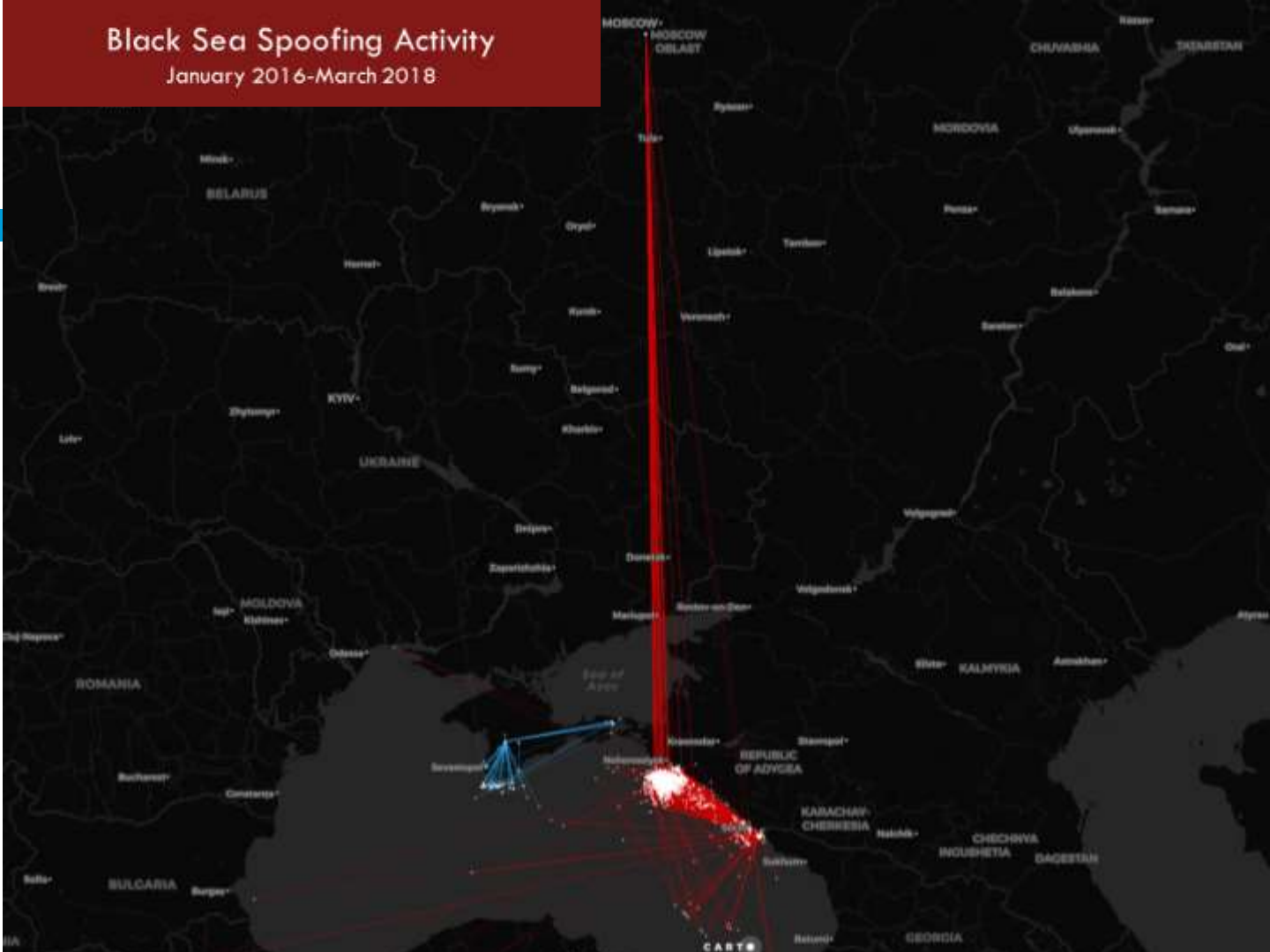


July 2017



# Black Sea Spoofing Activity

January 2016-March 2018



# Ships at Gelendzhik Airport



C/T "ВИНОГРАДАРЬ-3"

C/T "ВЕТЕРАН"

Gelendzhik Airport

GOLUBAYA BUKHTA

SOLNTSE DAR

Mooring area

Mooring area

# Black Sea Spoofing Activity

January 2016-March 2018



# Ships at Sochi Airport



Moldovka

Sochi International Airport

Mooring area

Mira St

Nasyrnaya St

Ulyanova St

Kirova St

A-147

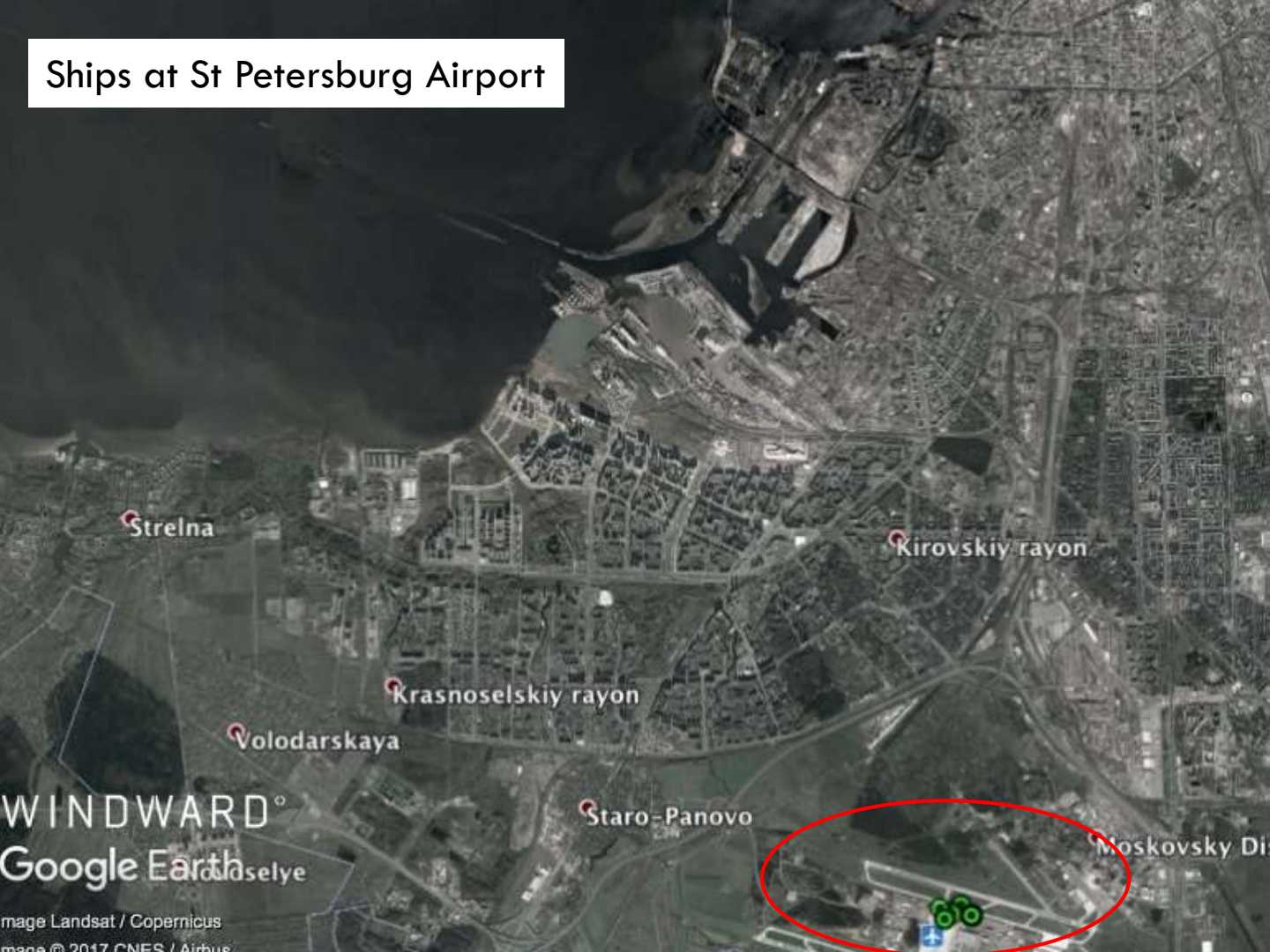
A-149

Chernovitskaya St





# Ships at St Petersburg Airport



WINDWARD<sup>®</sup>  
Google Earth

# Vladivostok Spoofing Activity

January 2016-March 2018



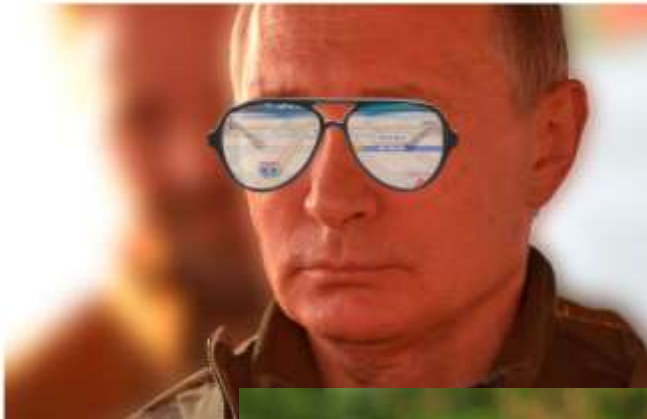
# The Moscow Times

Oct. 21 2016 · 8:10

## The Kremlin Eats GPS for Breakfast

Why geolocation in central Moscow has become a real headache

October 2016



# Spooing — A rapid evolution



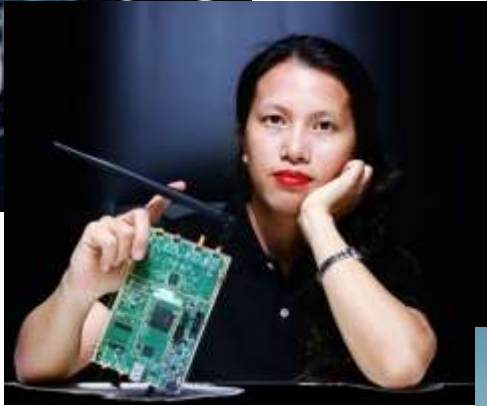
Iran, Dec 2011

Home » News » Feature Stories » Todd Humphreys' Research Team Demonstrates First GPS

## Todd Humphreys' Research Team Demonstrates First Successful GPS Spooing of UAV



UT Austin, Jan 2012



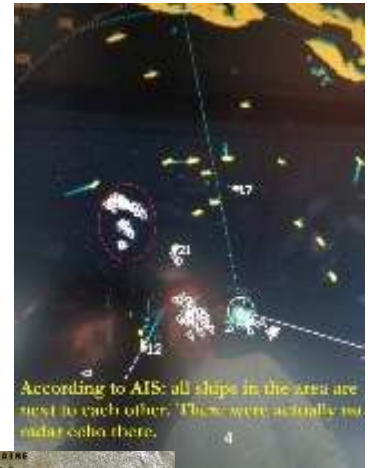
Las Vegas, Dec 2015



US Southern Border  
Dec 2015



Persian Gulf, Jan 2016



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



Russian waters  
600+ ships  
2016 - Present



Portland Oct 2017



Maps and all GNSS  
Jul 2018



# Spoofing – Hazardously misleading information

Cost ↓ Capability ↑ Ease of use ↑



Iran, Dec 2011

Source: © Steve J. Rasmussen/Reuters - Todd Humphreys' Research Team Demonstrates First Successful GPS Spoofing of UAV

Todd Humphreys' Research Team  
Demonstrates First Successful GPS  
Spoofing of UAV



UT Austin, Jan 2012



Las Vegas, Dec 2015



US Southern Border  
Dec 2015



Persian Gulf, Jan 2016



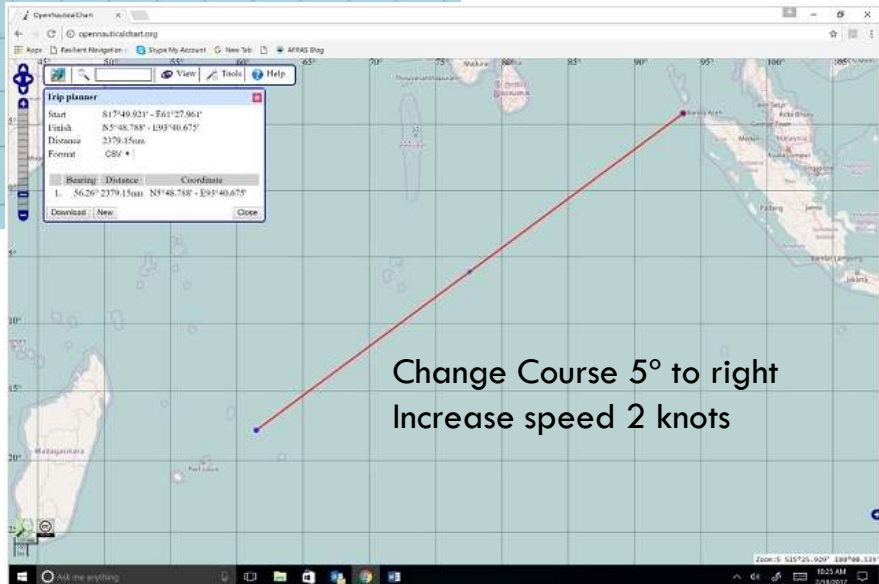
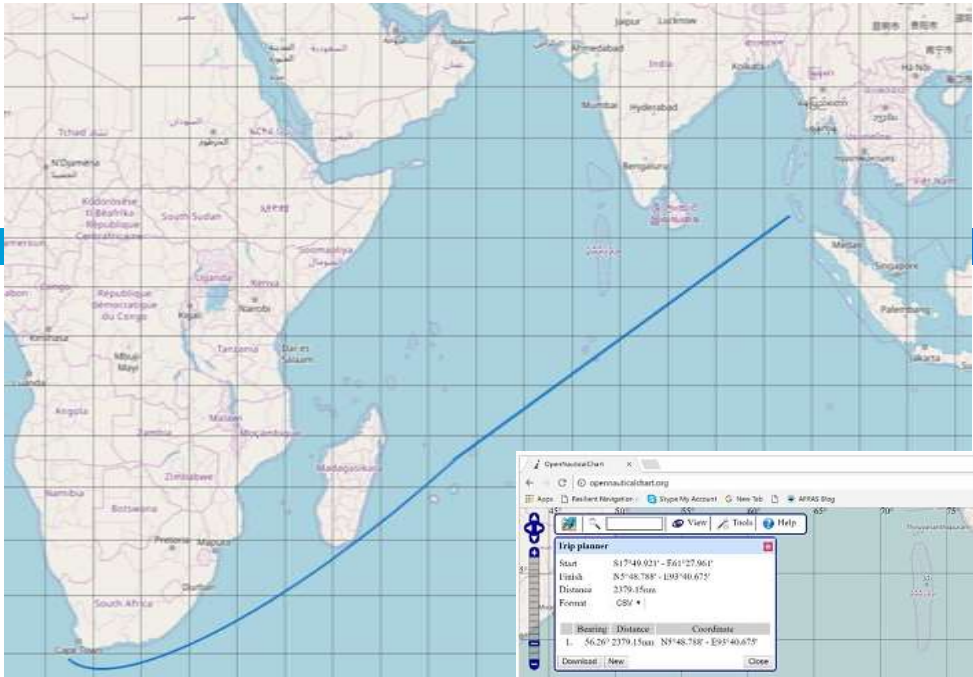
4 sites Russia  
600+ ships  
2016 - Present



Portland Oct 2017



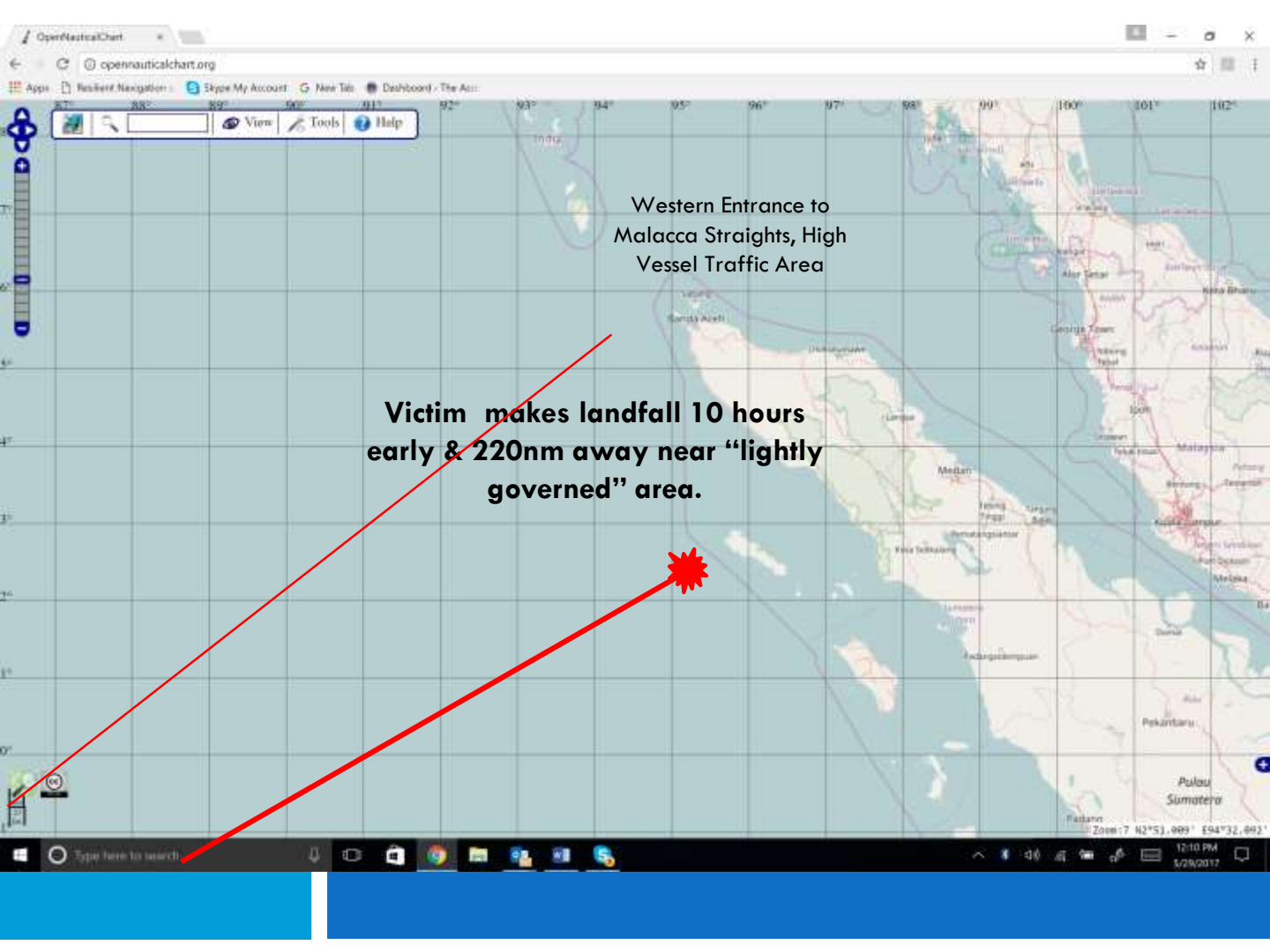
USA NSF Jul 2018



Change Course 5° to right  
Increase speed 2 knots

**The MARITIME EXECUTIVE**  
INTELLECTUAL CAPITAL FOR EXECUTIVES

“How To Steal A Ship”  
2 June 2017



Western Entrance to  
Malacca Straights, High  
Vessel Traffic Area

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

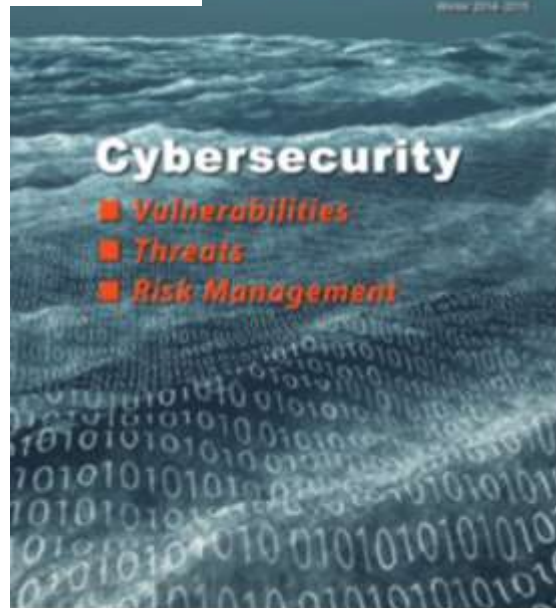


October | Safety & Security

## Hackers took 'full control' of container ship's navigation systems for 10 hours

Industry source warns that the attack carried out in February should serve as a warning to shipping of similar pirate cyber attacks to come.

Safety & Security



# “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

**1 White Van Man**  
+  
**All-GNSS & Map Spoofer**

**\$255**

**PNT Out of Balance**



# 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”





RESILIENT  
NAVIGATION  
*and* TIMING  
FOUNDATION

جميع أطفال الله بحاجة إلى ملاحه جيدة وتوقيت!

The Resilient Navigation and Timing Foundation is a 501(c)3  
scientific and educational charity registered in Virginia