P.T.A. Progress, June - November

National PNT Advisory Board

16 Nov 2017

"Protect" – Increasing Awareness

Russian Jamming

PHOTO: JAN HARALD TOMASSEN / NRK

Russian Exercise Jams Aircraft GPS in North Norway for a Week - NRK

Published on October 6, 2017   ✏ **Edit article** | 📈 **View stats**

Dana A. Goward
President, Resilient Navigation & Timing Foundation; Propriet...
300 articles

👁 46   👍 9   💬 1   ↪ 1

Russian Jamming

Russian Spoofing - Black Sea

Actual ship's position was:
44°14.0'N - 037°43.1'E
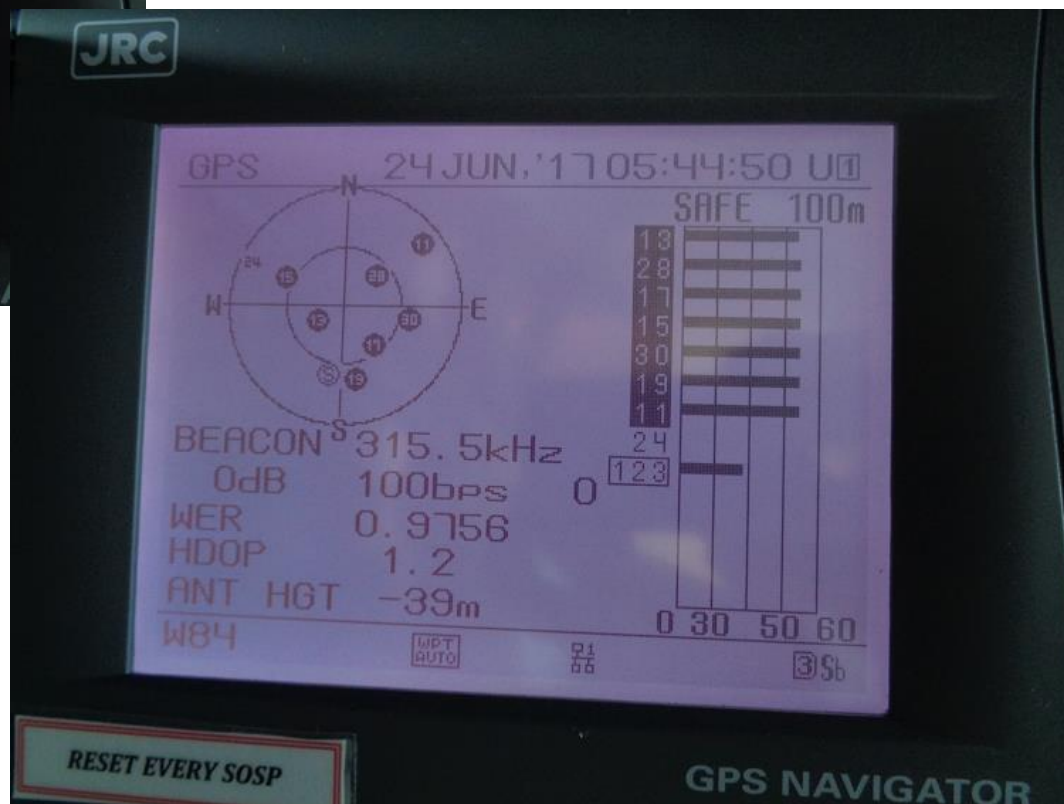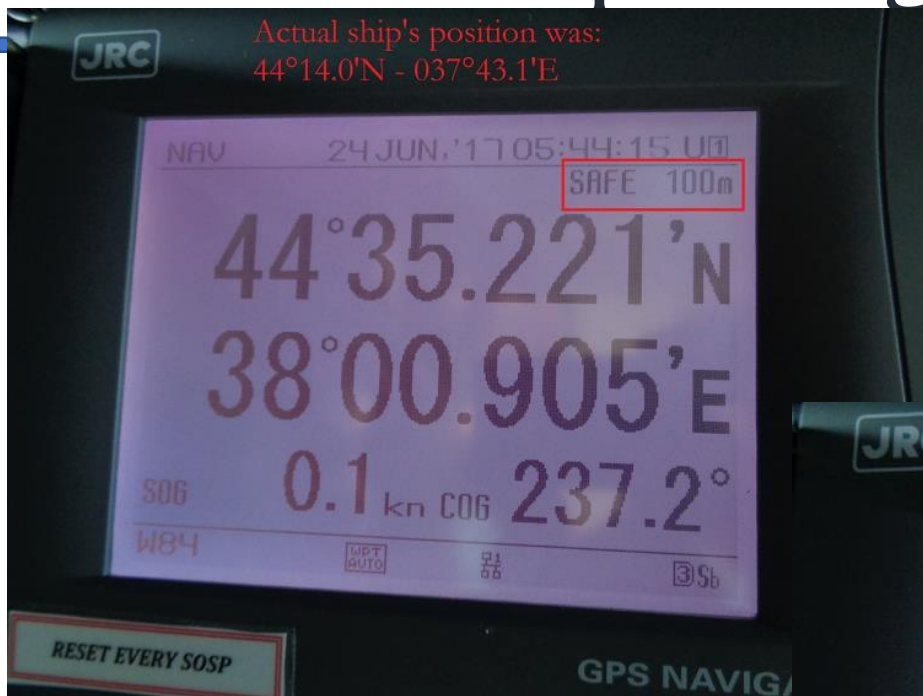
Russian Spoofing > 600 vessels
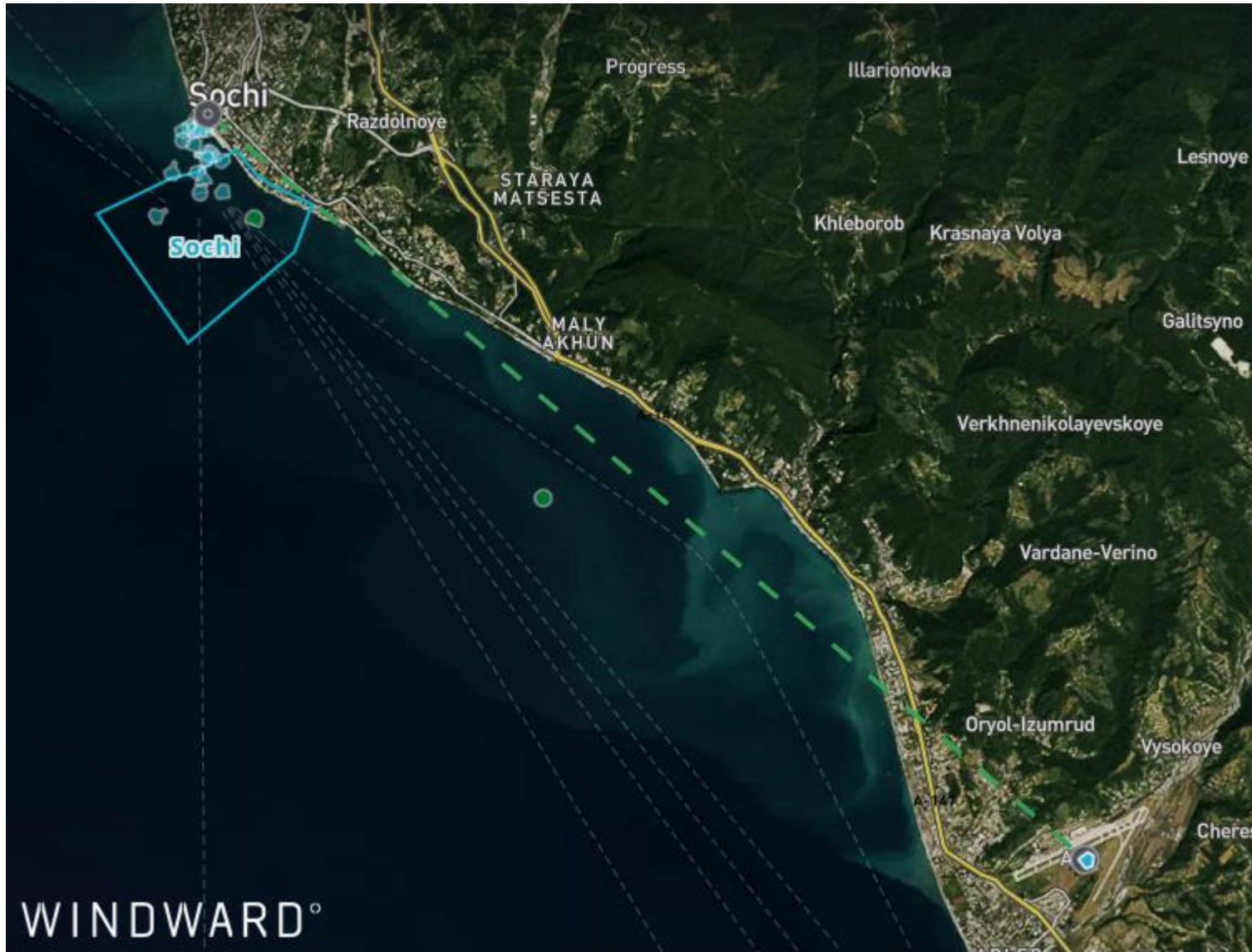
Russian Spoofing - Moscow

Russian Alternative
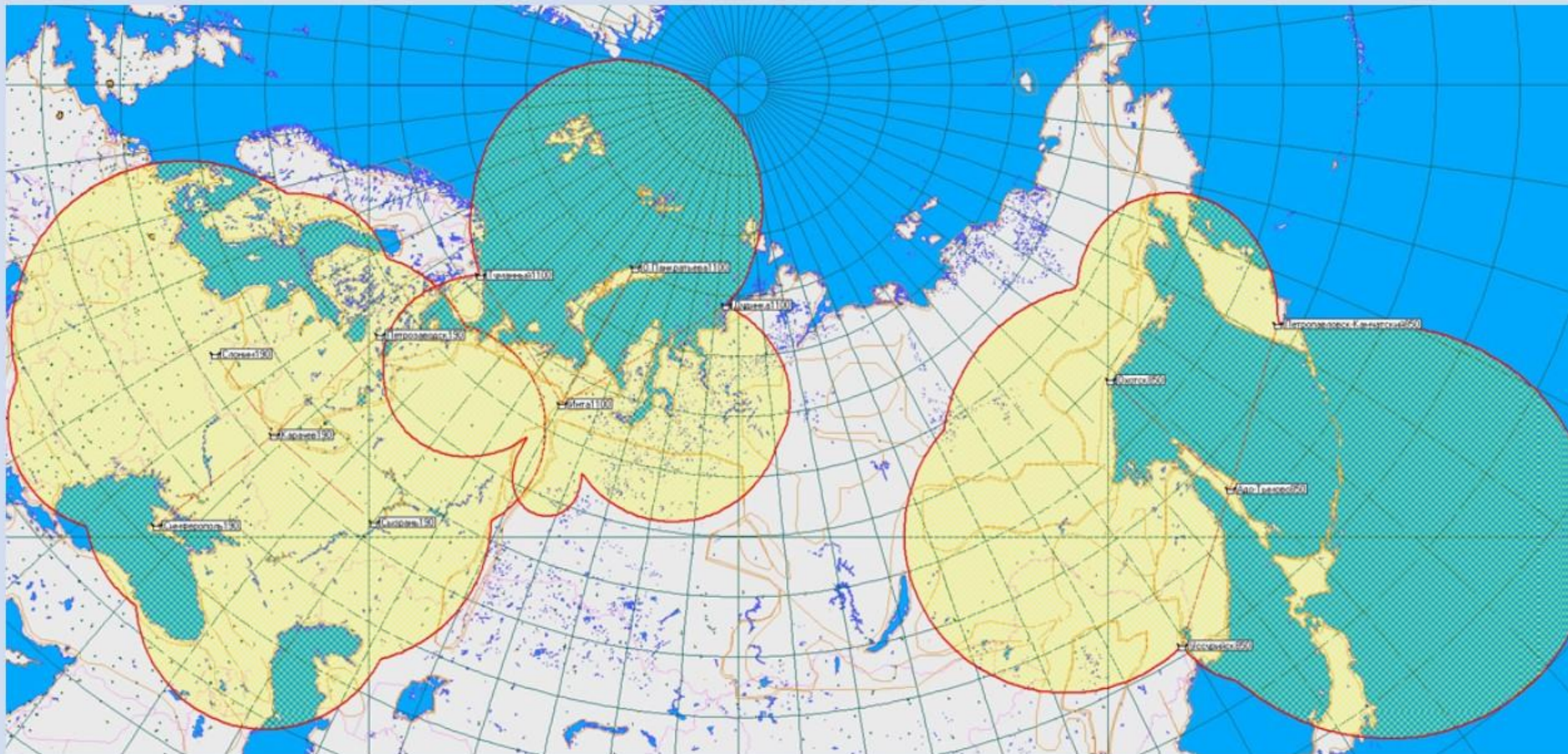
Russia's Chayka (Loran) Coverage
Internavigation Research & Technical Centre of Advanced Navigation
Technologies, August 2017

Accidental Spoofing – "Smart" phones

ION GNSS+ Portland, Or

Not the First Time

"Protect" Progress in USA

Vulnerability Awareness ⬆

ABC Issue ➡

Interference Detection ⬇

Adversary Capabilities ⬇

Enforcement

    Laws ⬇

    Resources ⬇

"Toughen" - European Efforts

1. Radio Equipment Directive ETSI EN 303 41*
   - Effective June 2017 – still to be published in official EU Journal
   - Covers Adjacent Band Compatibility and spurious emissions for GNSS equipment
   - For all new GNSS receivers or equipment for sale in Europe. Exemption for aviation or maritime (existing standards)
   - Testing against really just starting, but going OK, not a lot of failures
   - Summary of requirements in table:

Table 4-2: Frequency bands, adjacent frequency signal test point centre frequencies and power levels for the 1 559 MHz to 1 610 MHz RNSS band

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency signal power level (dBm)	Comments
1 518 to 1 525	1 524	-65	MSS (space-to-Earth) band
1 525 to 1 549	1 548	-95	MSS (space-to-Earth) band
1 549 to 1 559	1 554	-105	MSS (space-to-Earth) band
1 559 to 1 610	GUE RNSS band under test		
1 610 to 1 626	1 615	-105	MSS (Earth-to-space) band
1 626 to 1 640	1 627	-85	MSS (Earth-to-space) band

* Radio equipment operating in the 1 164 MHz to 1 300 MHz and 1 559 MHz to 1 610 MHz frequency bands; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

"Toughen" – European Efforts

2. GNSS Standard ETSI TS 103 246-1 Satellite Earth Stations and Systems (SES); GNSS based location systems

- Not intended to be compulsory

- Purpose is <u>test specification</u> for GNSS-based location systems(GBLS) –'solutions in which GNSS technologies are complemented with other technologies to improve robustness and performance'

- The test specification states 'This TS is not intended for GNSS only receivers.' but most of the performance tests specified are GNSS Receiver-centric

"Toughen" – US Efforts

Project T. C. Mits *(working title)*

Goal: More robust, resilient <u>stationary precision GNSS timing receivers</u> in
telecommunications, finance & electrical grid

Objective: Users better educated & informed on GNSS rcvr characteristics & capabilities

Initial Activities (April 2018 Workshop):
- <u>Identify GNSS rcvr attributes</u> important to telecom, finance, electrical grid
- <u>Discuss methods of objectively evaluating</u> GNSS receivers
- Discuss, identify path forward

Leadership: DR Mark Weiss, NIST

Partners: NIST, DHS, ATIS, RNTF

The Ask: Support, participation from govt, industry, SMEs

"Toughen" – US Efforts

DHS Best Practices ⬆

Project T. C. Mits ⬆

Adoption of Technology ⬇

"Augment" - International

Timing Only/
1 LOP

Loran/Chayka
Service Areas
2017

RESILIENT
NAVIGATION
and TIMING
FOUNDATION

Service Areas Approximate. Consult national authorities in UK, Saudi Arabia,
Russian Federation, China, & South Korea for more information
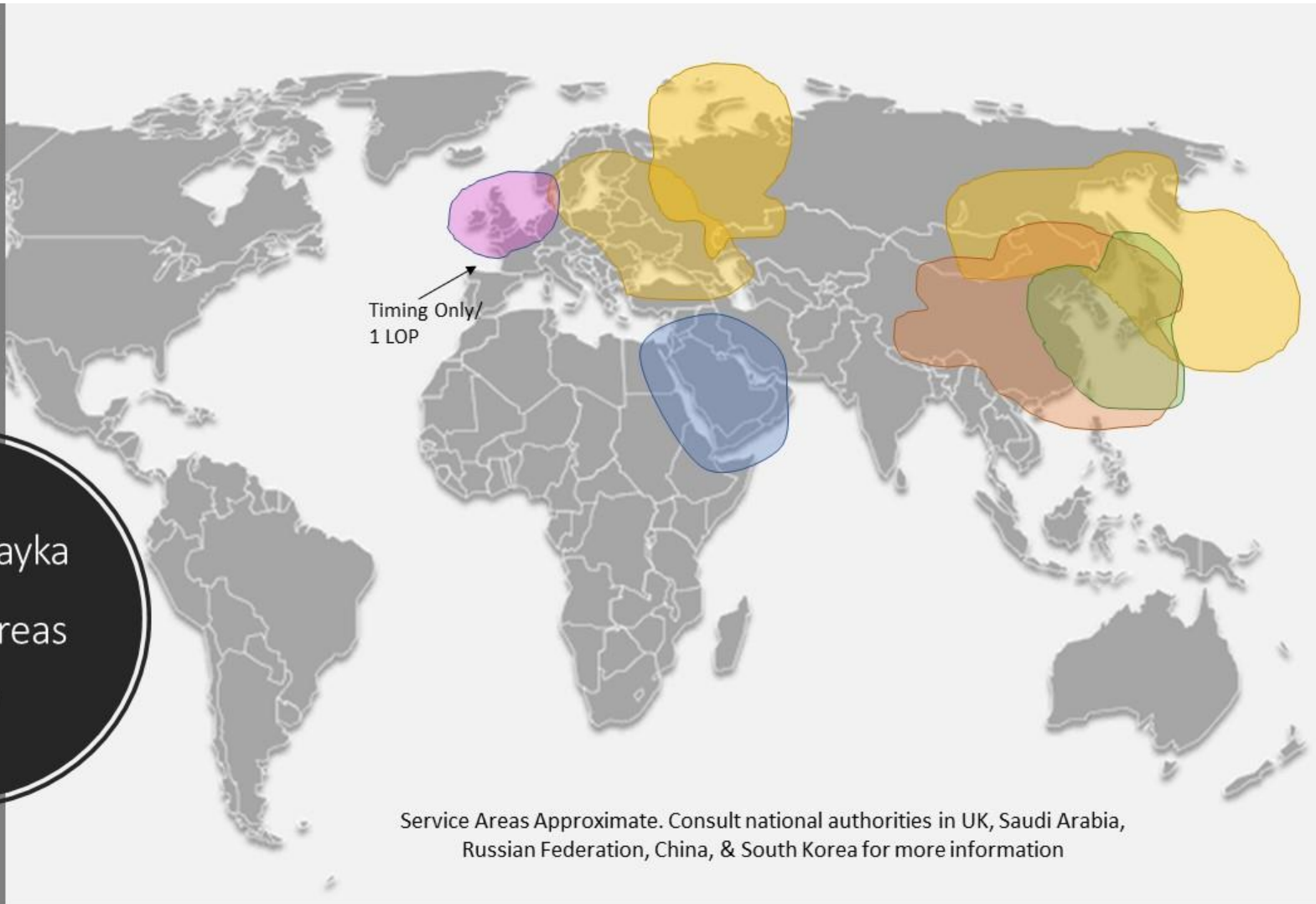
"Augment" – U.S. Telecoms

"GPS Vulnerability" September 2017

New Actions:
- Telecom carries explore time-sync networks
- Govt consider GPS signal-side security
- eLoran or equivalent should be implemented
- Receiver testing

Continue:
- DOT & DHS efforts to augment timing for critical infrastructure
- NIST & USNO cooperate, coordinate with ATIS on sync
- Sector Coord Council share ideas with ATIS

"Prioritizing Dangers to the United States from Threats to GPS"
December 2016, RNT Foundation

	Vector	Vulnerability	Consequence	Threat		Risk Score
				Intent	Capability	
I. Natural & II. Accidental	1. Built structure obstruction	1	2	5		10
	2. Terrain obstruction	1	2	5		10
	3. Foliage (pines, hvy canopy)	1	1	5		5
	4. Solar Activity – mild	1	1	5		5
	5. Solar Activity - moderate	3	2	4		24
	6. Solar Activity -powerful	5	5	2		50
	7. Human Error/software	5	1 5	3		15-75
	8. Satellite malfunction	1	1	4		4
	9. Control Segment Failure	5	5	1		25
	10. Space Debris	1	4	2		8
	11. Unintentional RF	5	1 4	5		25 - 100
III. Malicious	12. Privacy seeker (1 event)	5	3	√5	√5	75
	13. Criminal Jamming (1 event)	5	3	√5	√5	75
	14. Criminal + Privacy 1 Yr Total	5	5	√5	√5	125
	15. Criminal Spoofing (1 event)	4	3	√4	√4	48
	16. Terrorist Jamming	5	5	√5	√5	125
	17. Terrorist Spoofing	4	4	√3	√4	55
	18. Military-style Jamming	5	5	√5	√5	125
	19. Nat. Agent Spoofing	3	4	√4	√4	48
	20. Attack on Satellites	5	5	√1	√1	25
	21. Attack on Control Segment	1	1	√1	√2	1.4
	22. Cyber Attack Control Segment	2	5	√3	√2	24

Total Risk to GPS Services &
US National and Economic Security
Table - 1

Table – 3

Proposed and Ongoing Mitigation Measures Vs Risk Vector

Vector	Risk Score	Protect – Space Fence for debris detection	Protect – Offensive (anti-Satellite weapons) (deterrence)	Protect – Quiet adjacent bands, no authorized in-band terrestrial transmissions	Protect – Legal changes to counter jamming and spoofing equipment and use	Protect – Establish jamming detection systems & enforcement capability	Toughen – Improve receivers standards, implement better receivers	Toughen – Improve GPS signal, supplement with other GNSS signals	Toughen – Require critical users to be able to operate 30 days w/o space-based PNT	Augment – Provide 2nd Wide Area PNT signal (e.g. eLoran) for US free to users
14. Criminal + Privacy Jamming (1 Year)	125					░			▓	▓
16. Terrorist Jamming	125					░			▓	▓
18. Military-style Jamming	125				░				▓	▓
11. Unintentional RF	25 - 100			░					▓	▓
7. Human Error/Software	15 - 75						░		▓	▓
13. Criminal Jamming (1 event)	75					░			▓	▓
12. Privacy Seeker (1 event)	75					░			▓	▓
17. Terrorist Spoofing	55				░				▓	▓
6. Solar Activity - Powerful	50							░	▓	▓
19. Nat. Agent Spoofing	48				░				▓	▓
15. Criminal Spoofing (1 event)	48				░				▓	▓
20. Attack on Satellites	25		░						▓	▓
9. Control Segment Failure	25								▓	▓
5. Solar Activity - Moderate	24						░		▓	▓
22. Cyber Attack on Control Segment	24								▓	▓
2. Terrain Obstruction	10							░	▓	▓
1. Built Structure Obstruction	10							░	▓	▓
10. Space Debris	8	░							▓	▓
3. Foliage (pines, hvy canopy)	5						░		▓	▓
4. Solar Activity - Mild	5						░		▓	▓
8. Satellite Malfunction	4								▓	▓
21 Attack on Control Segment	1.4								▓	▓

Some Risk to US Security/Economy Mitigated*	Most or All Risk to US Security/Economy Mitigated*

"Prioritizing Dangers to the United States from Threats to GPS" www.RNTFnd.org/Library

"Augment" – U.S. Administration

"GPS Vulnerabilities in the Transportation Sector"

Volpe Transportation Systems Center, August 2016

Table 4-1: Alternative Systems Available for Positioning and Navigation

Table 4-2: Alternative Systems Available for Timing

"Augment" – U.S. Administration

	Study	Announcement	Action
2001	Volpe Transportation Sys Cntr		
2004		NSPD-39 PNT Policy	
2007	Institute for Defense Analysis		
2008		DHS Press Release	
2009	Volpe Transportation Sys Cntr		
2011	DHS National Risk Estimate		
2012	DHS Wireless Timing CRADA		
2014	DoD-DoT-DHS Tiger Team		
2015		Excom Ltr to Congress	
2016	Volpe Transportation Sys Cntr		
2018	DoD-DoT-DHS NDAA Report		

"Augment" – Legislation

Passed Both Houses

- **GPS Backup Tech Demo** $10M, Section 1606
- **DoD use Galileo & QZSS** Section 1607
    HR 2810, National Defense *Authorization* Act for 2018

Passed House of Representatives

- **$10M GPS Backup Proof of Concept**
    Amendment 32 of Section D to HR 3219, The Make
    America Secure (Defense) *Appropriations* Act

- **Tasking to Build eLoran System to Complement & Backup
    GPS** - Chapter 807 of HR 2825, Department of Homeland
    Security *Authorization* Act

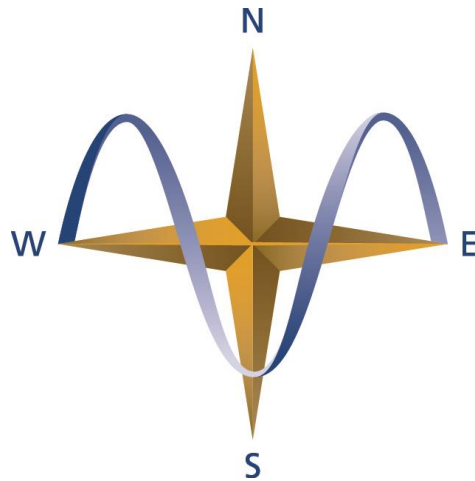# "Augment" – US Efforts

Public Awareness ⬆

Administration ⬇

Congress ⬆

Protect – Toughen - Augment

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