# Risk =

Threat x Vulnerability x Consequence

P(Bad event) x P(damage) x Damage

S. Florida Snow Risk

The Miami Herald

Massive Blizzard Hits S. Florida!

Threat

Probability of snow = .000,000,000,1

Vulnerability   X

Prob Snow causes damage = 1.00000

Consequence   X

Amount of Damage = $5,000,000,000

Risk = $5.00

S. Florida Hurricane Risk

The Miami Herald

Massive Hurricane Hits S. Florida!

Threat

Probability of Hurricane = 1

Vulnerability   X

Prob Hurricane causes damage = .7

Consequence   X

Amount of Damage = $5,000,000,000

Risk = $3,500,000,000

Risk (malicious) =

Threat (Intent x Capability)

x Vulnerability x Consequence

Mars Attacks!

Vulnerability

Prob they will kill us = 1
X

Consequence

Damage = We all Die
X

Intent

They REALLY want to kill us = 1
X

Capability

They can't get here = 0

Risk = 0

Risk =

Natural event/ Accident:
   P(vector) x P(damage) x Damage

Malicious Act:
   (Intent x Capability) x P(damage) x Damage

Threat Vectors for GPS

Natural/Accidental

1. Built structure obstruction
2. Terrain obstruction
3. Foliage (pines, hvy canopy)
4. Solar Activity – mild
5. Solar Activity - moderate
6. Solar Activity -powerful
7. Human Error/software
8. Satellite malfunction
9. Control Segment Failure
10. Space Debris
11. Unintentional RF

Malicious Acts

12. Privacy seeker (1 event)
13. Criminal Jamming (1 event)
14. Criminal + Privacy 1 Yr Total
15. Criminal Spoofing (1 event)
16. Terrorist Jamming
17. Terrorist Spoofing
18. Military-style Jamming
19. Nat. Agent Spoofing
20. Attack on Satellites
21. Attack on Control Segment
22. Cyber Attack on Control Segment

Vector Assessment Criteria		
Vulnerability		
1	Low	Vector able to impact less than 5% of users
2	Moderate	Difficult for this vector to impact overall GPS service, or more than 10% of users
3	Significant	Fairly easy for this vector to impact many unsophisticated users and high performance users
4	High	Fairly easy for this vector to impact all or most users
5	Severe	Very easy for this vector to impact all or most users
Consequence		
1	Low	No noticeable economic losses, unlikely impact to safety of life
2	Moderate	Probable economic losses, possible safety of life impacts
3	Significant	Documented economic losses, probable safety of life impacts
4	High	Economic losses > $1B, injuries, probable loss of life
5	Severe	Economic losses > $5B, and/or loss of life
Threat of Natural Phenomena & Accident = Probability of Occurrence		
1	Low	Probability/history of occurrence < once every 100 years
2	Moderate	Probability/history of occurrence $\geq$ once every 100 years
3	Significant	Probability/history of occurrence $\geq$ once every 50 years
4	High	Probability/history of occurrence $\geq$ once every 10 years
5	Severe	Probability/history of occurrence $\geq$ once every year
Threat of Malicious Acts = Bad actor intent x Bad actor capability		
Intent		
1	Low	No expressed desire or interest
2	Moderate	Rarely expressed desire or interest
3	Significant	Repeat expressions of interest, some attempts, possible successes
4	High	Repeat expressions of interest, some attempts, some successes
5	Severe	Repeat expressions of interest, many attempts, many successes
Capability		
1	Low	No known ability to access and use this method
2	Moderate	Available to some nations & sophisticated actors (global criminal networks, terrorist organizations)
3	Significant	Available to all nations & sophisticated actors
4	High	Available to moderately sophisticated actors (individual technologists, criminals, etc.)
5	Severe	Available to unsophisticated actors (low cost, easy to access or build and use)

Example:

5. Solar Activity – Moderate   **Risk Score = 24**

Vulnerability - 3

The great preponderance of GPS receivers in use across applications are relatively unsophisticated and subject to disruption by moderate solar activity. Moderate events are of limited duration and only some users were exposed and impacted.

Significant – Fairly easy for this vector to impact many unsophisticated and high performance users

Consequence - 2

Events in Sept 2005, Dec 2006, Sept 2014 were well documented, but none resulted in resulted in reports of significant economic damage or impact to safety of life. This may change as use of GPS equipment and signals continues to increase and broaden, but there is no documented history of significant impacts.

Moderate - Probable economic losses, possible safety of life impacts

Threat – 4

There have been three events in the last 11 years.

High – Probability/history $\geq$ once every 10 years

				Threat		
	Total Risk to GPS Services & US National and Economic Security Table - 1					
	Vector	**Vulnerability**	**Consequence**	**Intent**	**Capability**	**Risk Score**
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

Table 2 - Vectors by Risk Score	
14. Criminal + Privacy 1 Yr Total	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
22. Cyber Attack Control Segment	24
5. Solar Activity - moderate	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
Colors added to show natural groupings	

Paper available at www.RNTFnd.org/Library

Result 2: GNSS Denial Events

73,000 GNSS denial events
- 59,000 jammers
- 12,000 narrow band
- 2,000 other signals

Classification Types

Event Priority Levels
(By Classification Type)

Very Low 224,434
Low 112,829
High 73,723

WHITE_WB   NB_ST   CHIRP   CDMA   OTHER

1,065 WHITE_WB   11,941 NB_ST   59,453 CHIRP   570 CDMA   694 OTHER

European Commission Project

www.nsl.eu.com

STRIKE3
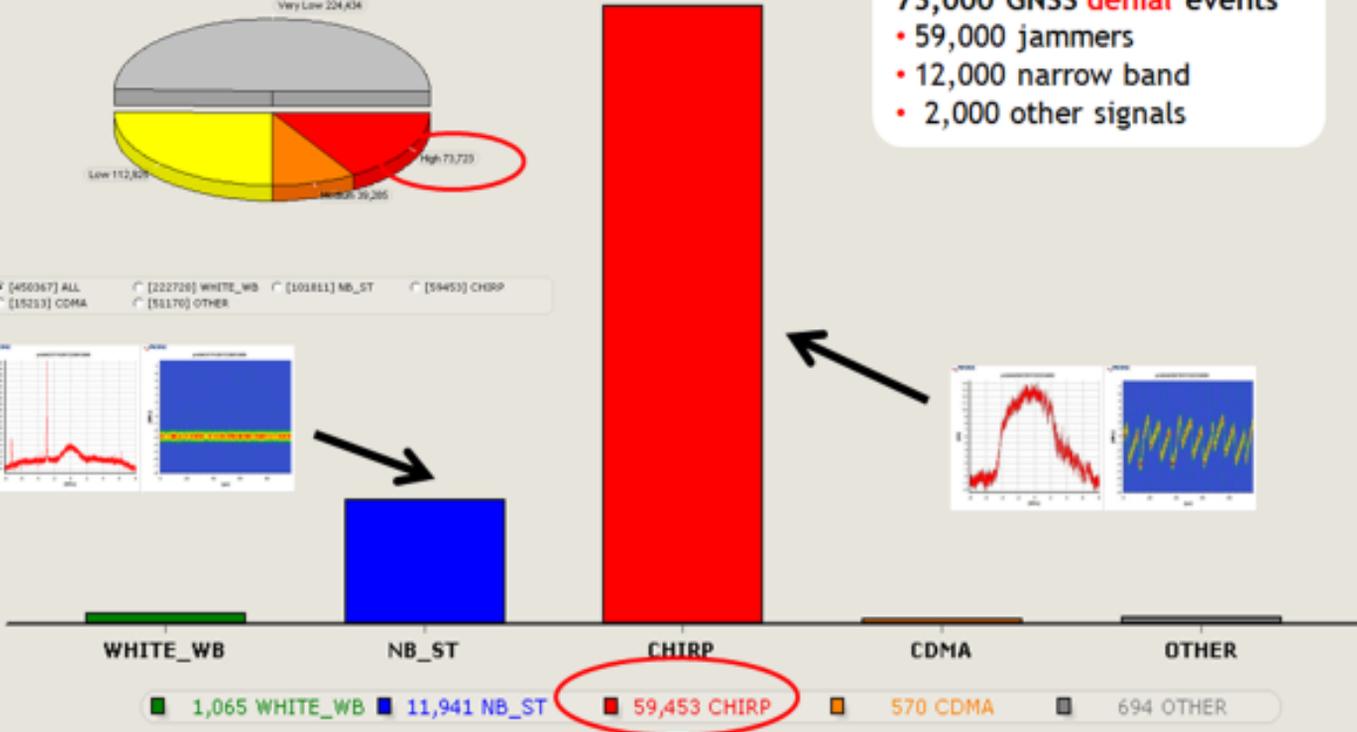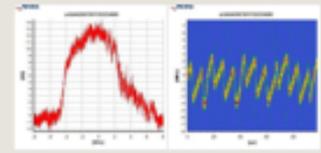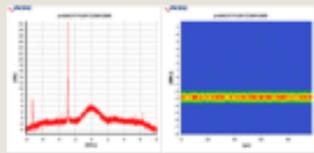
Result 3: **Durations** of interference events

ALL events (450,363 events)
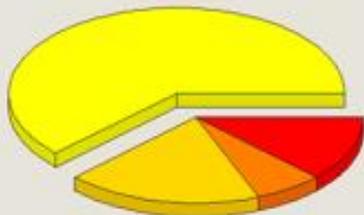
High Priority events (73,723 events)

Most events are very short durations
12% of ALL events are greater than 60 seconds
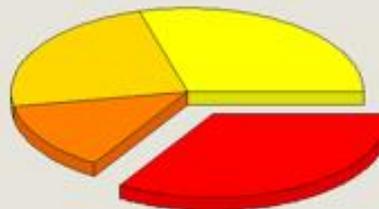
34% priority events are greater than 60 seconds

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

www.nsl.eu.com

European Commission Project
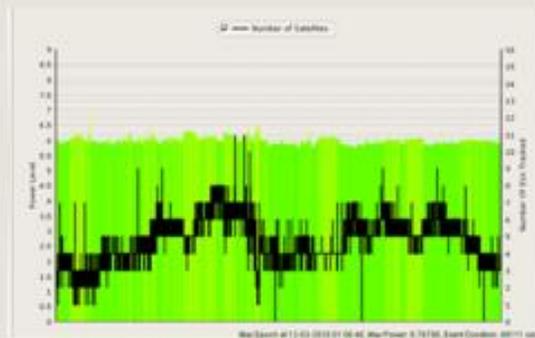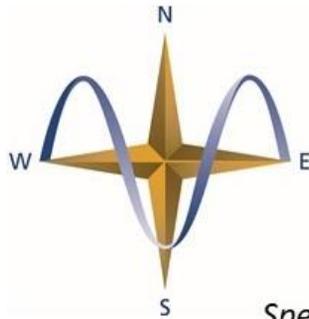
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