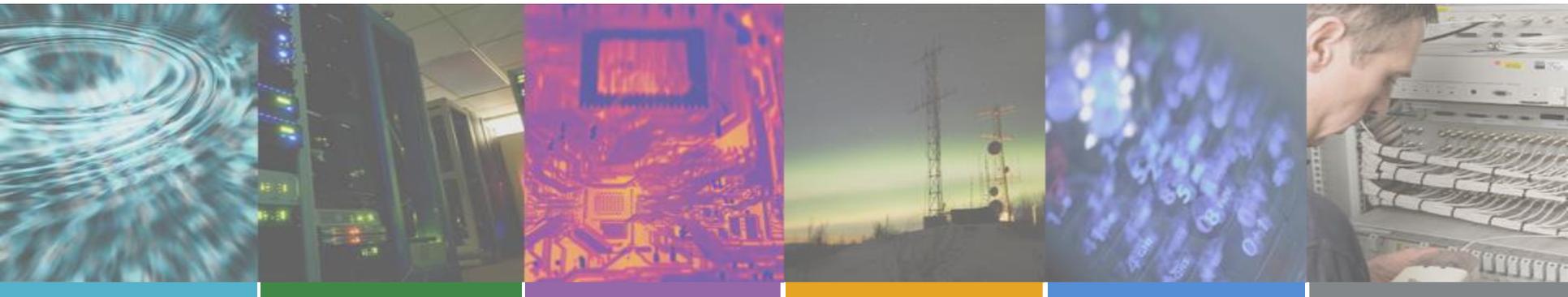


GPS Jamming – Threat Scenarios

CGSIC 2013 Nashville



Prof. Charles Curry BEng, CEng, FIET

Managing Director

Chronos Technology Ltd

Presentation Contents

- Background
- How we detect
- Who is doing it
- Threat scenarios
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- Conclusions

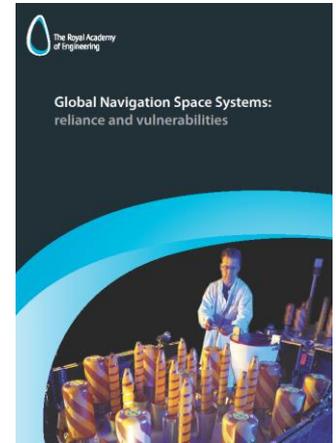
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Background

- GPS Interference & Jamming
 - Royal Academy of Engineering Report
 - Published 2011

http://www.raeng.org.uk/news/publications/list/reports/RAoE_Global_Navigation_Systems_Report.pdf



- Space Weather
 - Royal Academy of Engineering Report
 - Published 2013

http://www.raeng.org.uk/news/publications/list/reports/space_weather_full_report_final.pdf



The SENTINEL Project



- GNSS **SE**rvices **N**eeding **T**rust **I**n **N**avigation, **E**lectronics, **L**ocation & timing
- 2011: UK Government Funded R&D Project, 2 years, ~£1.5m
 - through **Technology Strategy Board**
 - ***“Trusted Services”*** Call
- Research to establish extent to which GNSS PNT signals can be trusted





The SENTINEL Partners



- ACPO-ITS – Association of Chief Police Officers
 - User Community – Law Enforcement
 - Brings other Government agencies into the collaboration
- GLA – General Lighthouse Authorities
 - User Community - Maritime
 - eLoran
- University of Bath - Dept. of Electrical & Electronics
 - GPS & Space Weather
- Ordnance Survey
 - User Community – Land Geolocation
- NPL – National Physical Laboratory
 - Time, UTC Traceability
- Thatcham Vehicle Security
 - Certification of safety critical services
- Chronos Technology Ltd
 - GAARDIAN Research
 - SENTINEL Project Leader



Headlines!



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TECH SUCCESS AWARDS
The Winners have been announced.
Click here to see the names of the winners.

sentinel **Illegal GPS Jammers Are Widespread, Study Finds**
Research by the Government-backed Sentinel consortium shows dangerous GPS jammer use in the UK is on the rise

On February 23, 2012 by Max Smolaks 26

Illegal systems which jam GPS are widely used in the UK, leading to serious accidents, according to a new study conducted in Scotland.

The Sentinel study, a £1.5m government project run by a consortium that includes the police and the National Physical Laboratory, found 60 violations in six months by monitoring just 20 roadside locations, according to a paper presented at the *GNSS Vulnerability 2012: Present Danger, Future Threats* conference held at the National Physical Laboratory yesterday.

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22 February 2012 Last updated at 00:01

Sentinel project research reveals UK GPS jammer use

By Chris Vallance
BBC News

The illegal use of Global Positioning System (GPS) jammers in the UK has been revealed in a groundbreaking study.

GPS jammers are believed to be mostly used by people driving vehicles fitted with tracking devices in order to mask their whereabouts.

In one location the Sentinel study recorded more than 60 GPS jamming incidents in six months.

The research follows concern that jammers could interfere with critical systems which rely on GPS.

The project was the work of a consortium which included Acpo and the National Physical Laboratories

Related Stories

Lords Question: 16 Mar 2011

- ***From Lord Patel of Blackburn:*** To ask Her Majesty's Government what steps they plan to take to reduce the vulnerability of global navigation satellite systems to terrorist attacks.[HL7534].
- **The Minister of State, Home Office (Baroness Neville-Jones):** Global navigation satellite systems such as global positioning systems (GPS) are widely used within industry systems in the UK.....
-The Centre for the Protection of National Infrastructure (CPNI) provides advice and guidance to organisations on protective security measures to reduce vulnerability to national security threats including **terrorism**.....These measures include **Project SENTINEL** which aims to provide the capability to detect and locate the source of GPS interference, warn critical users and enable law enforcement agencies to take action when criminal activity is involved.....

Jammers

- Over 60 active Chinese Web Sites
- Power ~ 100mW to 20W!



GPS Jammers Reviews

- ★★★★★ [Really convenient since via the car charger it can be used in the car directly like this design ver...](#) Posted by: Gilberto Feldker
- ★★★★★ [This desktop jammer always works well and the quality is really high and by now no problem has happe...](#) Posted by: Onita Widgeon
- ★★★★★ [This jammer is easy to use and install, also works well. I am satisfied with it!!!](#) Posted by: Earnestine Burrows
- ★★★★☆ [Arrived in the UK only 3 days after the shipment, thanks a lot!!!](#) Posted by: Gavin Rochford
- ★★★★☆ [Owns the portable style, this GPS jammer is really easy to take out. I love this style!!!](#) Posted by: Jeana Gilhousen

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 <p>High Power 6 Antenna Cell Phone, GPS, WiFi Jammer</p> <p>GBP £178.09 ★★★★☆ <input type="checkbox"/> Compare Add To Cart</p>	 <p>High Power 6 Antenna Cell Phone, GPS, WiFi, VHF Jammer</p> <p>GBP £178.84 ★★★★☆ <input type="checkbox"/> Compare Add To Cart</p>	 <p>High Power 6 Antenna GPS, WiFi, VHF, UHF and Cell Phone Jammer</p> <p>GBP £178.84 ★★★★☆ <input type="checkbox"/> Compare Add To Cart</p>	 <p>High Power 8 Antenna Cell Phone, 3G, WiFi, GPS, Jammer</p> <p>GBP £198.85 ★★★★☆ <input type="checkbox"/> Compare Add To Cart</p>
 <p>High Power Handheld Portable Cellphone+GPS+Wi-Jammer-Omnidirectional Antennas</p> <p>GBP £106.94 GBP £111.07 ★★★★☆ <input type="checkbox"/> Compare</p>	 <p>High Power Portable GPS (GPS L1/L2/L3 /L4/L5) Jammer</p> <p>GBP £126.45 ★★★★☆ <input type="checkbox"/> Compare Add To Cart</p>	 <p>High Power Portable GPS and Cell Phone Jammer(CDMA GSM DCS PCS 3G)</p> <p>GBP £120.13 GBP £111.06 ★★★★★ <input type="checkbox"/> Compare</p>	 <p>High Power GPS and Cell Phone Jammer with Carry Case</p> <p>GBP £113.80 ★★★★☆ <input type="checkbox"/> Compare</p>
 <p>High Power Portable GPS and Mobile Phone Jammer(CDMA GSM DCS PCS 3G)</p> <p>GBP £121.36 ★★★★★ <input type="checkbox"/> Compare Add To Cart</p>	 <p>High Power Portable GPS and Mobile Phone Jammer(CDMA GSM DCS PCS)</p> <p>GBP £106.94 ★★★★★ <input type="checkbox"/> Compare Add To Cart</p>	 <p>Mini GPS jammer for Car</p> <p>GBP £34.08 ★★★★★ <input type="checkbox"/> Compare Add To Cart</p>	 <p>Mini GPS Satellite Isolator</p> <p>GBP £37.13 ★★★★★ <input type="checkbox"/> Compare Add To Cart</p>

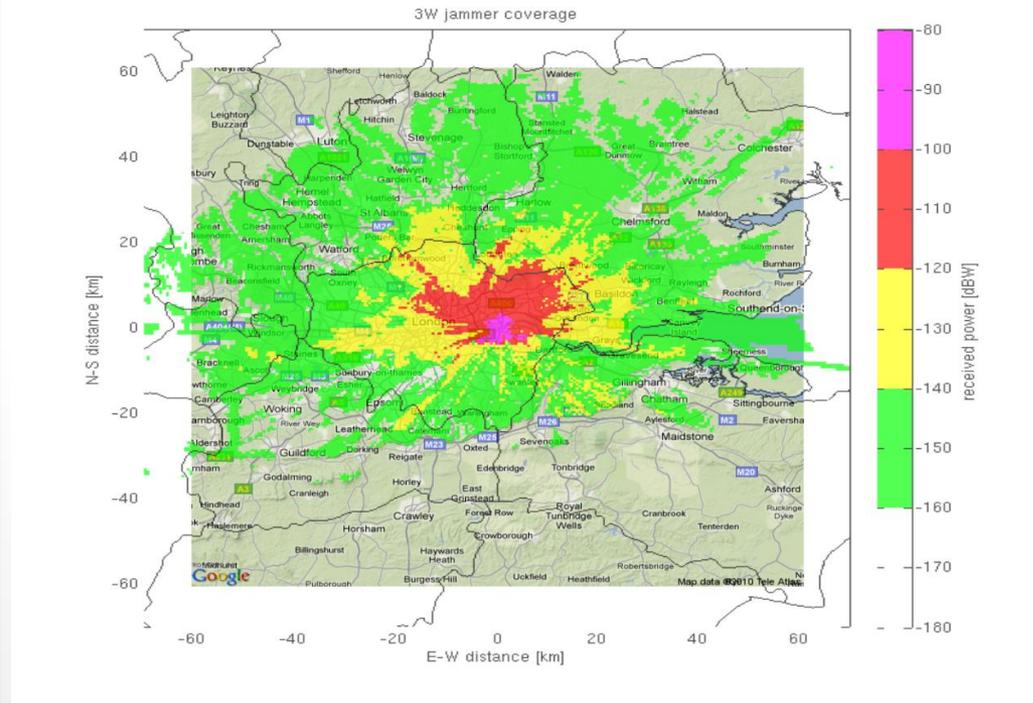
Scale of the Threat – 3 Watt Jammer

25m off ground near
City Airport

Purple – Total Denial of
Service

Red – Major Errors and
Unable to get Fix

Yellow – Large Errors,
possible loss of lock

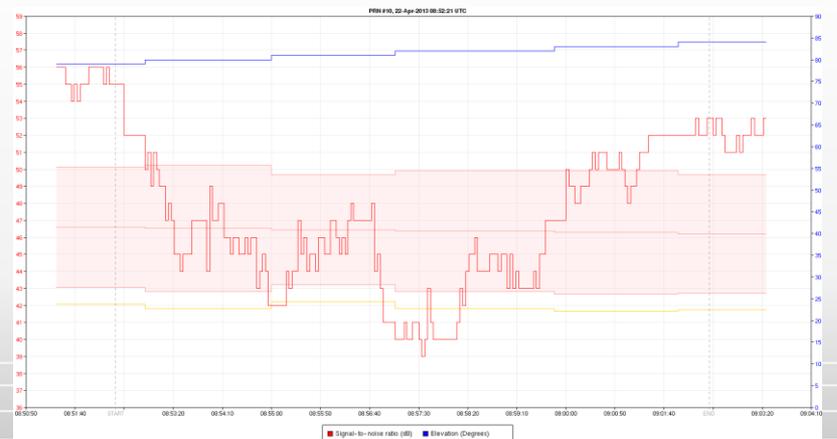
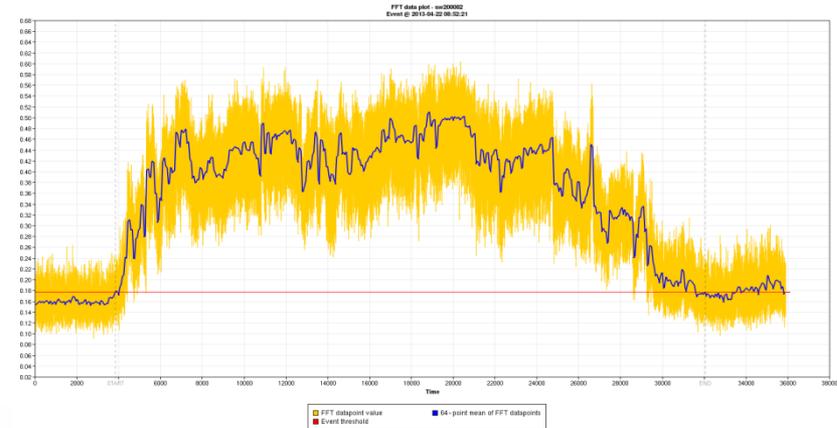


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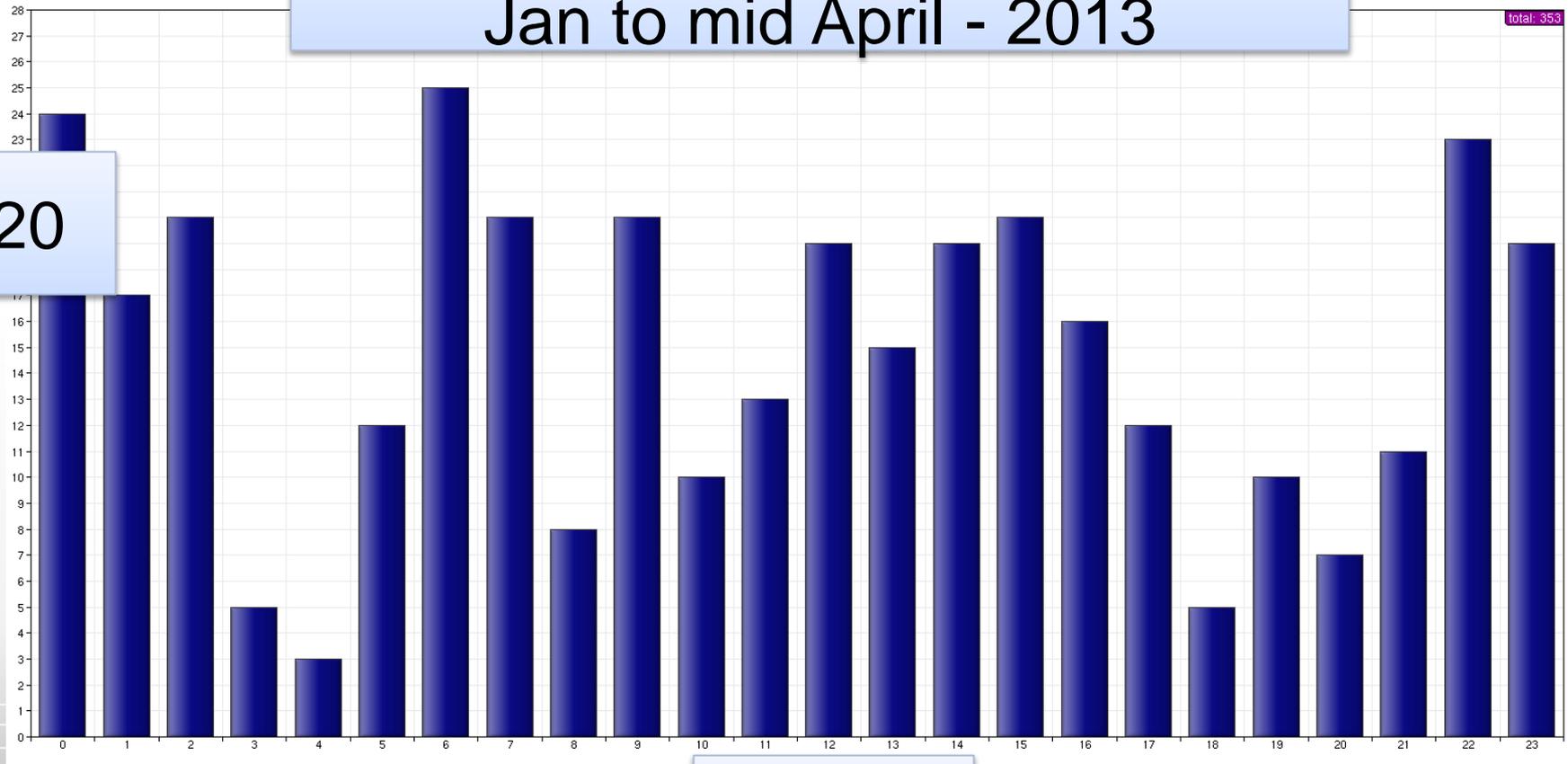
Dissimilar Detection Techniques

- A recent 10 minute “event” outside the Stock Exchange!
- 1: Power in L1 Spectrum using FFT
- 2: Susceptibility of GPS by measuring C/No



City – Data Analysis

Total of all events by Hour of Day
Jan to mid April - 2013



20

Midday

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Who does Jamming?

- ***Civil, Criminal, Terrorist and State***
- Evasion of GPS tracked car insurance
- Evasion of Company Vehicle Tracking Systems
- Evasion of Road User Charging Schemes & tachographs
- Stealing High Value Assets, Cars, Vans, Loads
- Evasion of Covert Tracking
- Securing Off-Site Meetings
- Evasion of Criminal Tagging
- Intentional attack by foreign power or non-state

GPS Tracked Car Insurance

- Pay as you drive insurance
- Young driver insurance
- Fleet insurance
- “Black box” insurance
- Telematics insurance



GPS Company Vehicle Tracking



GPS Asset Tracking

The Telegraph

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Barbour jacket shortage after 1,000s stolen

Barbour jackets, sported by everyone from the Queen to Peaches Geldof, could be in short supply in the coming weeks after thousands were stolen from a lorry.

Asset & Plant GPS Tracking System



Blackbox Telematics clients tell us that they require ultimate protection of their equipment by providing them with accurate GPS real time location, efficient use and accurate servicing of their assets & plant machinery as this vital to the day to day success of their construction or plant hire businesses. [Find out more...](#)

Stop asset & plant theft, by insuring your tracking your equipment now



Criminal Tagging

The Telegraph

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Tagged criminals may be tracked by GPS satellite 24 hours a day

Convicted criminals will be monitored 24 hours a day by satellite under moves being considered by ministers.



Convicted criminals will be monitored 24 hours a day by satellite Photo: Nasa

London Evening Standard

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London Crime Politics Mayor

Criminal intelligence: GPS tracking for community sentences



You've been tagged: Electronic Tag



State Based GPS Jamming



ars technica Build for the new Windows Store
Microsoft

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TECHNOLOGY LAB / INFORMATION TECHNOLOGY

North Korea pumps up the GPS jamming in week-long attack

Taking out its frustrations with its failed satellite launch?

by Sean Gallagher - May 9 2012, 11:53pm GMTDT

BLACK HAT CYBERWAR IT



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2 May 2012 Last updated at 11:19

'North Korea jamming' hits South Korea flights

Jamming signals thought to be from North Korea have affected GPS navigation on at least 250 flights, South Korean officials say.

Nine South Korean and nine foreign airlines have been affected since Saturday, the Transport Ministry said.

The flights had to rely on alternative navigation systems but were in no danger, the ministry added.



South Korean officials said that the jamming affected at least 250 flights

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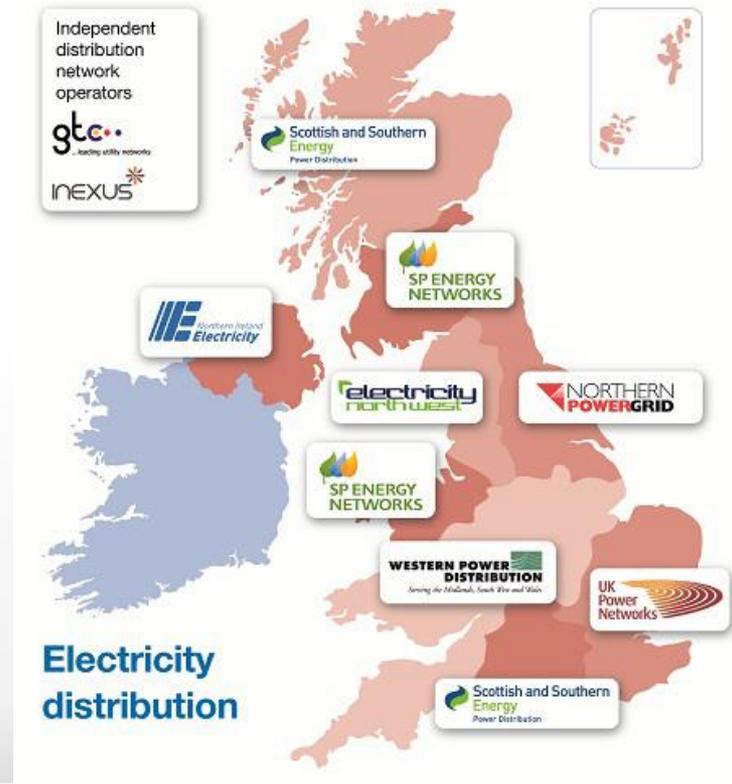
Taxi Drivers

- Jammer enables extra income
- Drivers sit in holding area waiting to be called
- *“At the expense of their colleagues, those using a jammer could make up to \$200 extra a week.”*
ACMA & Victorian Taxi Directorate, Melbourne Airport



Unauthorised Work

- Distribution Network Operator - DNO
- Uses Jammer to hide whereabouts
- Performs unofficial work
- Drives onto Airport with jammer still operating



Geo-Fenced Train Doors

- “Selective Door Opening”
– SDO
- Fitted to “Electrostar”
Trains – Southern and
Thameslink
- Jammer in vicinity.....
- Train doors don’t open....



EXPRESS Home of the Daily and Sunday Express

HOME NEWS SPORT COMMENT FINANCE ENTERTAINMENT
UK WORLD SHOWBIZ ROYAL WEIRD HEALTH PROPERTY SCIENCE & TECH RETIREMENT

Home > News > UK > We can't stop train, our satnav is down

We can't stop train, our satnav is down

OVER the years railway passengers have become used to the wrong sort of snow and leaves on the line bringing chaos to their journeys.

Published: Fri, January 2, 2009

Comments Like Tweet +1



But the rail industry has now come up with a new blight: The wrong sort of satellite connection.

Passengers on a Southern service from East Croydon were stunned when they were told that their stopping train would skip six stations and go direct to the end of the line in Caterham, Surrey.

Geo-Fenced Money Transit

- Cash in Transit
- Hold up a van
- Doors geofenced
- Use Jammer to defeat or...
- Spoofer to broadcast apparent "OK" position



Compromised Ports & Harbours

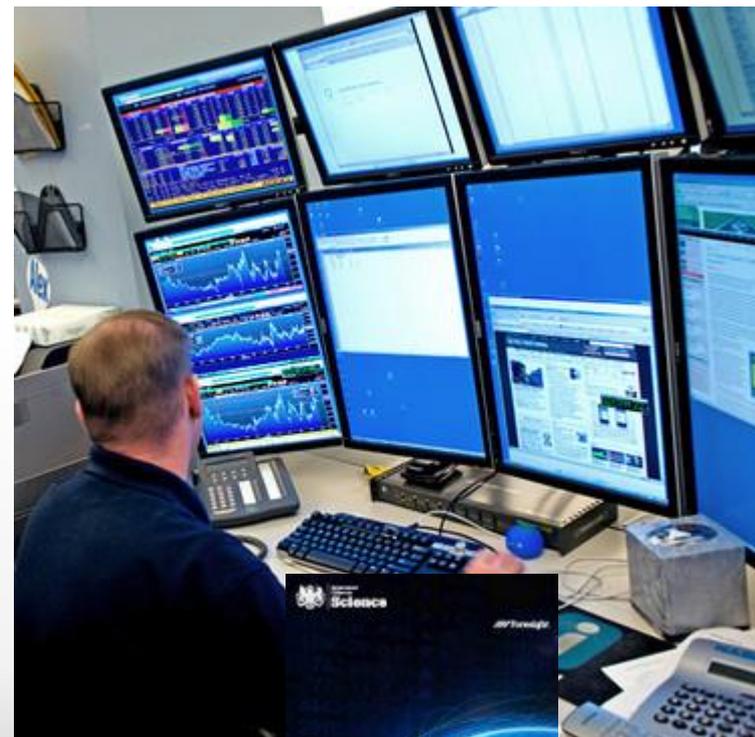
- Jammer used to hide vehicle or asset
 - High Value Cars
 - Plant & Construction
 - Just want to go home!
- Avoidance of Road User Charging
 - Trucks from Eastern Europe



Timing in Money Markets

- High Frequency Trading – HFT
- UK Report, BIS
- www.bis.gov.uk/foresight/our-work/projects/current-projects/computer-trading

A.4 Standards should play a larger role.
Legislators and regulators should consider implementing **accurate, high resolution, synchronised timestamps** because this could act as a key enabling tool for analysis of financial markets.



- Spoofers?



Aerial Deployment of Jammers

- Deployment of jammers near critical infrastructure
- Fly in, drop and fly away
- Up to 20 hours of continuous jamming



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- Conclusions

Who Should be Worried?

- CNI
 - Airports, Harbours, Power Utilities
- Financial Institutions
- Insurance Companies
- GNSS Dependent Services

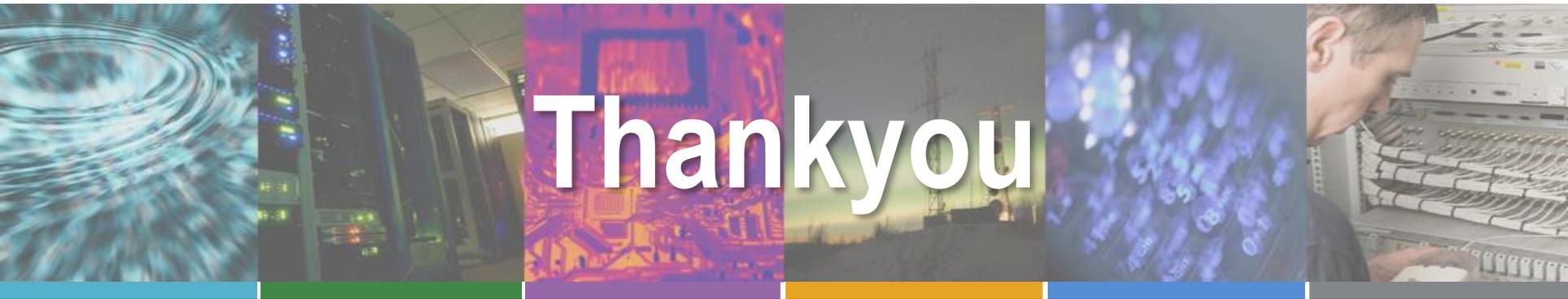
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Conclusions

- GNSS Jamming is the “Elephant in the Room” for Cyber Security and Space Applications
- A plague of Jammer web sites
- Civilian and Criminal Jamming
- Terrorist jamming?
- Is anyone taking notice?

Questions?



Thankyou

www.chronos.co.uk

www.gpsworld.biz

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charles.curry@chronos.co.uk