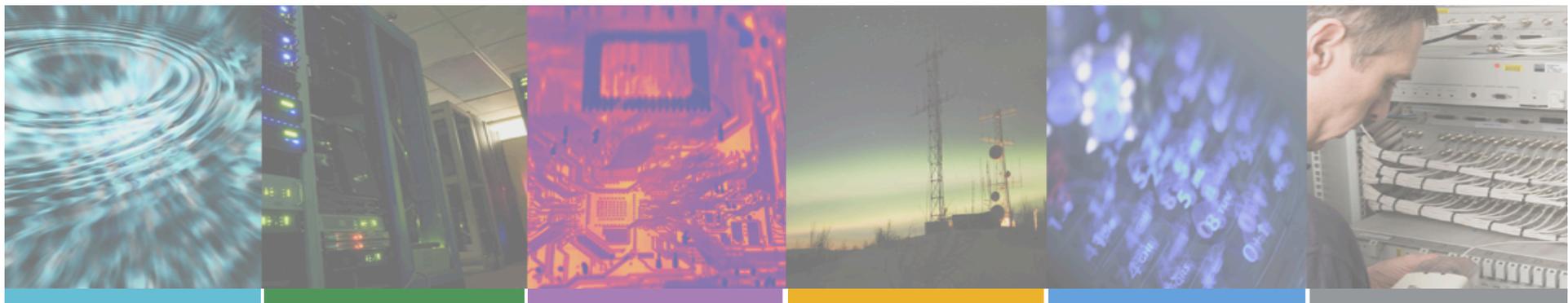


Report on GPS Jamming Trials and Criminal Use of Jammers



Prof. Charles Curry BEng, CEng, FIET
Chronos Technology Ltd

WSTS, San Jose, Tuesday 10th March – Session 2

Presentation Contents

- Background & Research Projects
- Jamming Trials
- Who or What is Jamming?
- Where to buy your jammers
- Detection Stories

The SENTINEL Project – 2011 - 2013



- GNSS **S**ervices **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
 - Competition – Autumn 2010
- Research to establish the extent to which GPS signal are being jammed by commercially available jammers.



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



Project AJR – Just Starting



Automatic Jamming Recognition
Colocation of GPS Jamming
Detection with ANPR



Photos: With the permission of the Commandant, Sennybridge Training Area

Sennybridge 2014



- Testing during MoD Trials
 - Sponsored through CPNI
- Geolocation of stationary and moving jammers
 - Using remote sensors and a central server
- Identification and localisation of a jammer
 - Using handheld and fixed DF technology
- Detectability testing of J242-G half watt jammer
- Tests in Open Space and Urban Environment
 - Significant multipath environment



Participants & Activity

- Participants
 - Chronos Technology Ltd
 - University of Bath
 - EE
 - General Lighthouse Authorities
 - Hampshire Police
 - Exelis
 - Others

- Activity
 - Day 1 Open Space
 - Day 2 Simulated Urban Environment

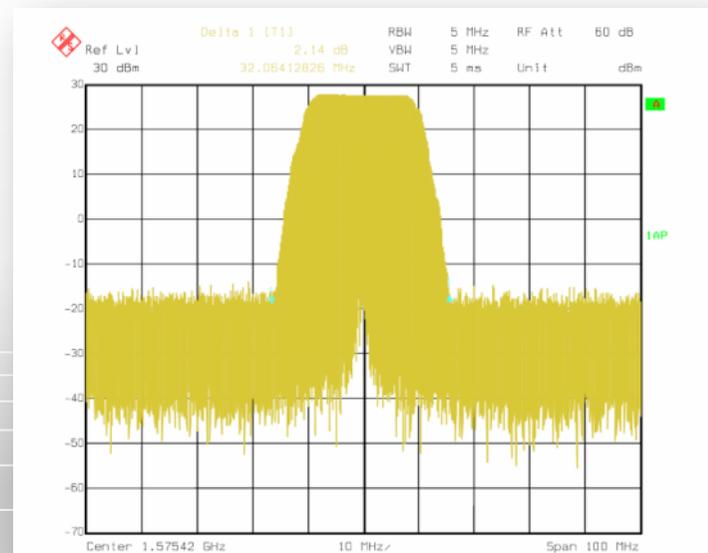


Photos: With the permission of the Commandant, Sennybridge Training Area

“Blue” GNSS Jammer



- 500 mW, L1,L2,L3,L4,L5
- L1 Detectable at 1.6m
 - Ran out of line of sight!
- Tear-Down Report from UoB



High Speed Logging

- 5900GB IQ data captured
- Day 2 – all jamming events
- Available to team for further analysis



Photos: With the permission of the Commandant, Sennybridge Training Area

Geolocation Testing

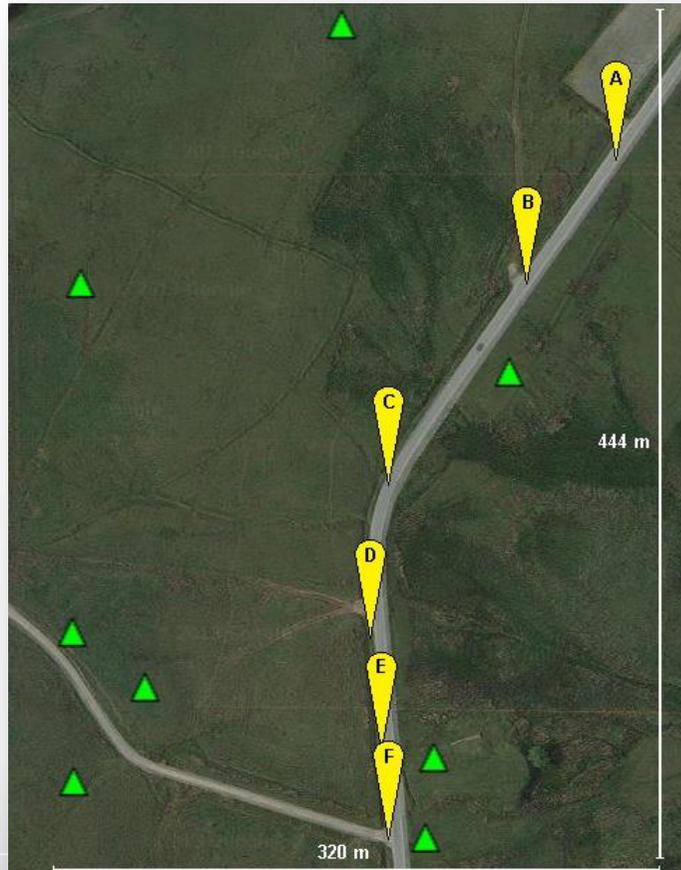


- Exelis Signal Sentry® 1000
 - Uses Chronos Sensors
- Mesh – Open Space & Urban
- Wireless Links
- Sensors in weatherproof enclosures

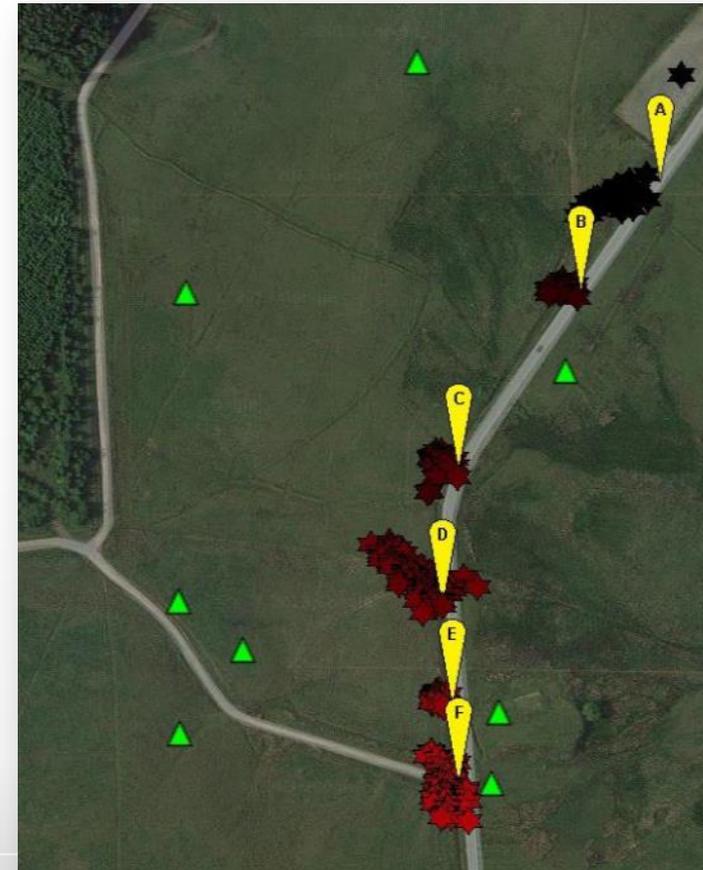


Photos: With the permission of the Commandant, Sennybridge Training Area

Mesh Tests – Open Space - Static

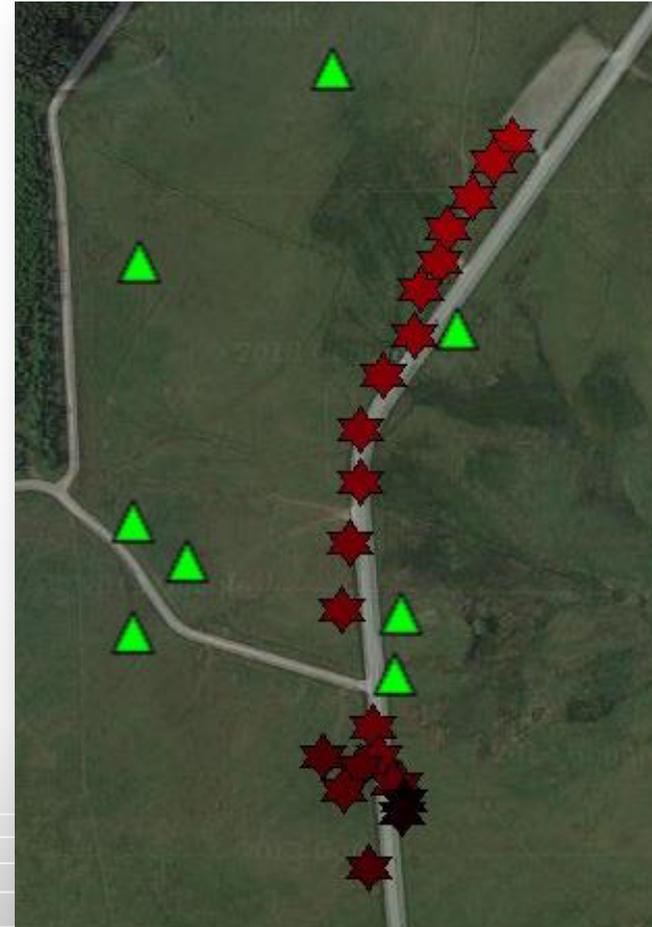
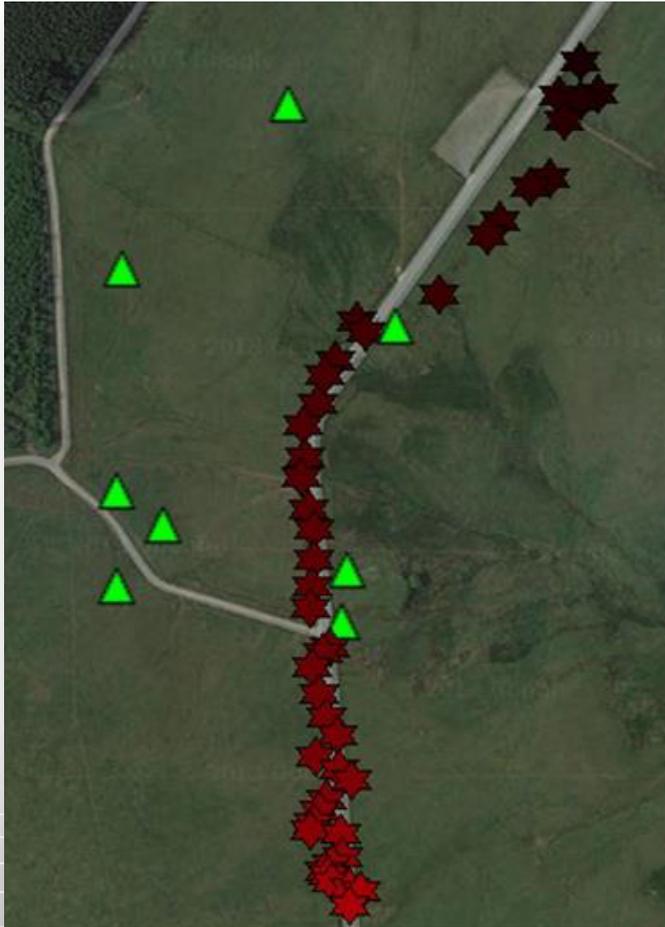


Way Points Set up South of Car Park



Static Testing at Waypoints

Mesh Tests – Open Space - Car



Mesh Tests – Urban - Bicycle



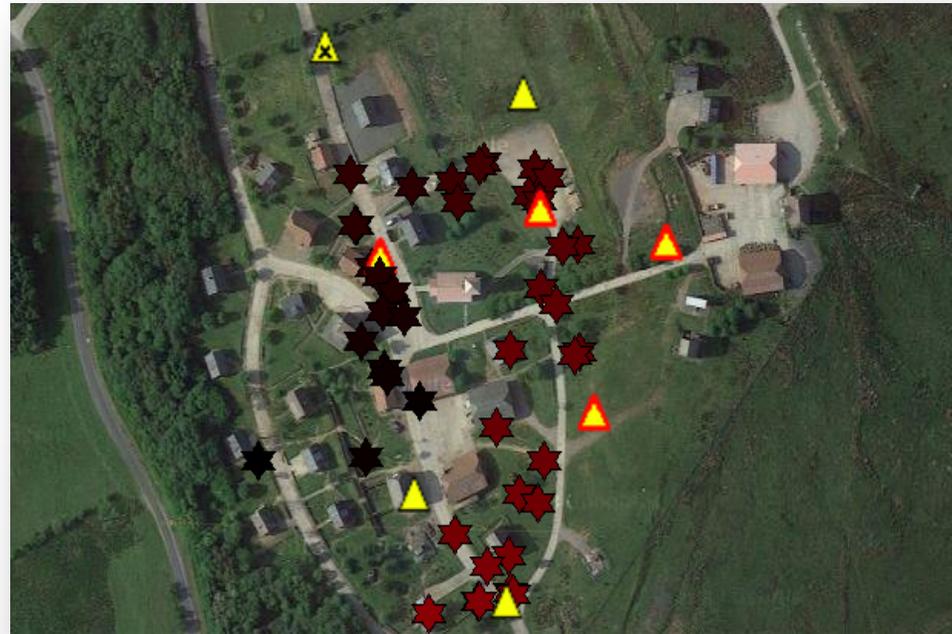
Photos: With the permission of the Commandant, Sennybridge Training Area

Mesh Tests – Urban - Car



Photos: With the permission of the Commandant, Sennybridge Training Area

Drive Through



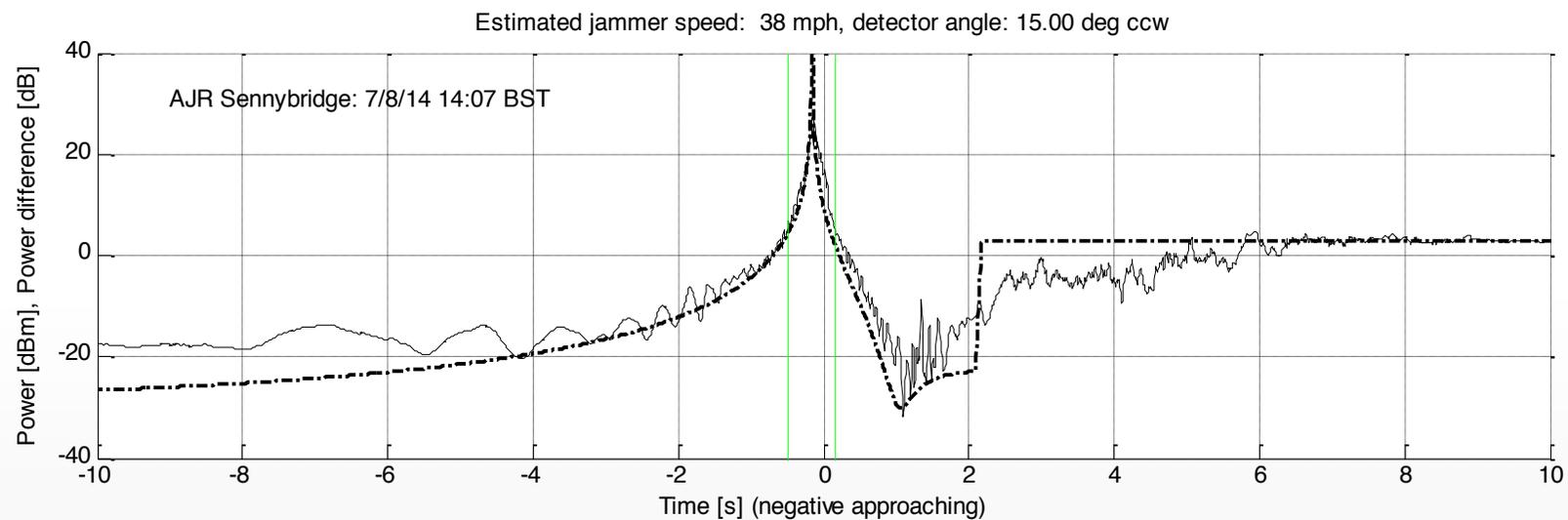
Photos: With the permission of the Commandant, Sennybridge Training Area

Sennybridge Videos



Photos: With the permission of the Commandant, Sennybridge Training Area

AJR – Automatic Jamming Recognition



T0-0.33s



T0



T0+0.33s



Research with Hampshire Police



GPS Jamming Assisted Crime

- Top end vehicles & plant
 - Doors open in 10 seconds
 - Jammer on back seat
 - Gone in 20 seconds!
 - Break up or export



Photos courtesy of AVCIS

Car Crime Videos



<http://www.bbc.co.uk/programmes/p014f7jk>

<https://www.youtube.com/watch?v=l8fe3nNUmBg>

Scene of Crime Photos

Cigarette Lighter
style Jammer hot
wired to car battery



Photo courtesy of Hampshire Police

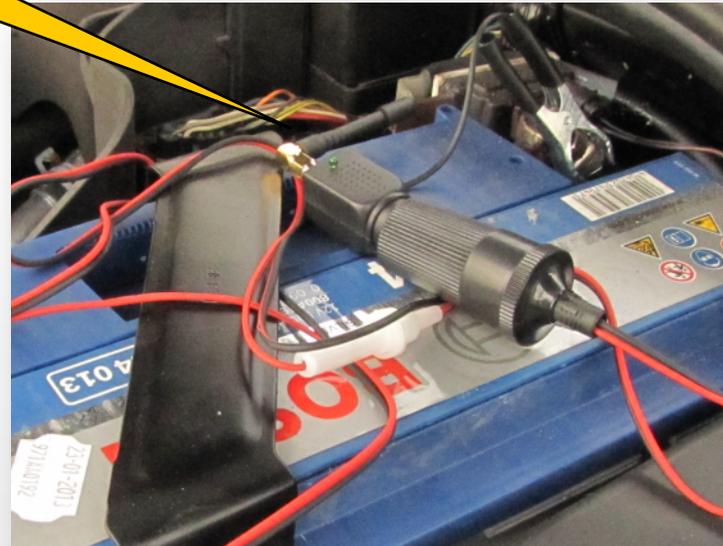


Photo courtesy of AVCIS

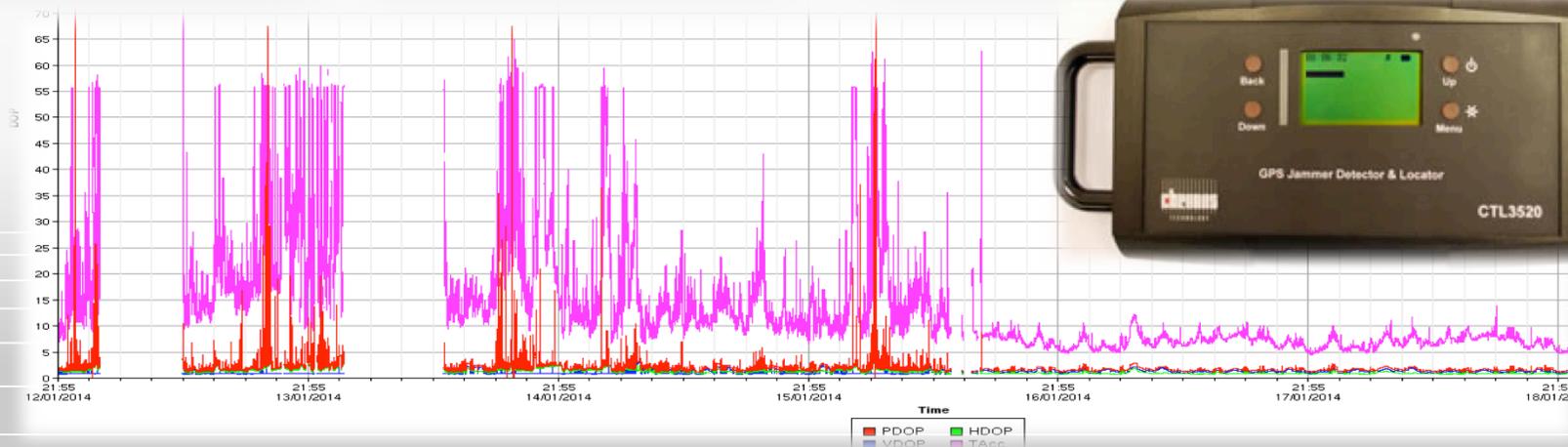
Unauthorised Truck Journeys



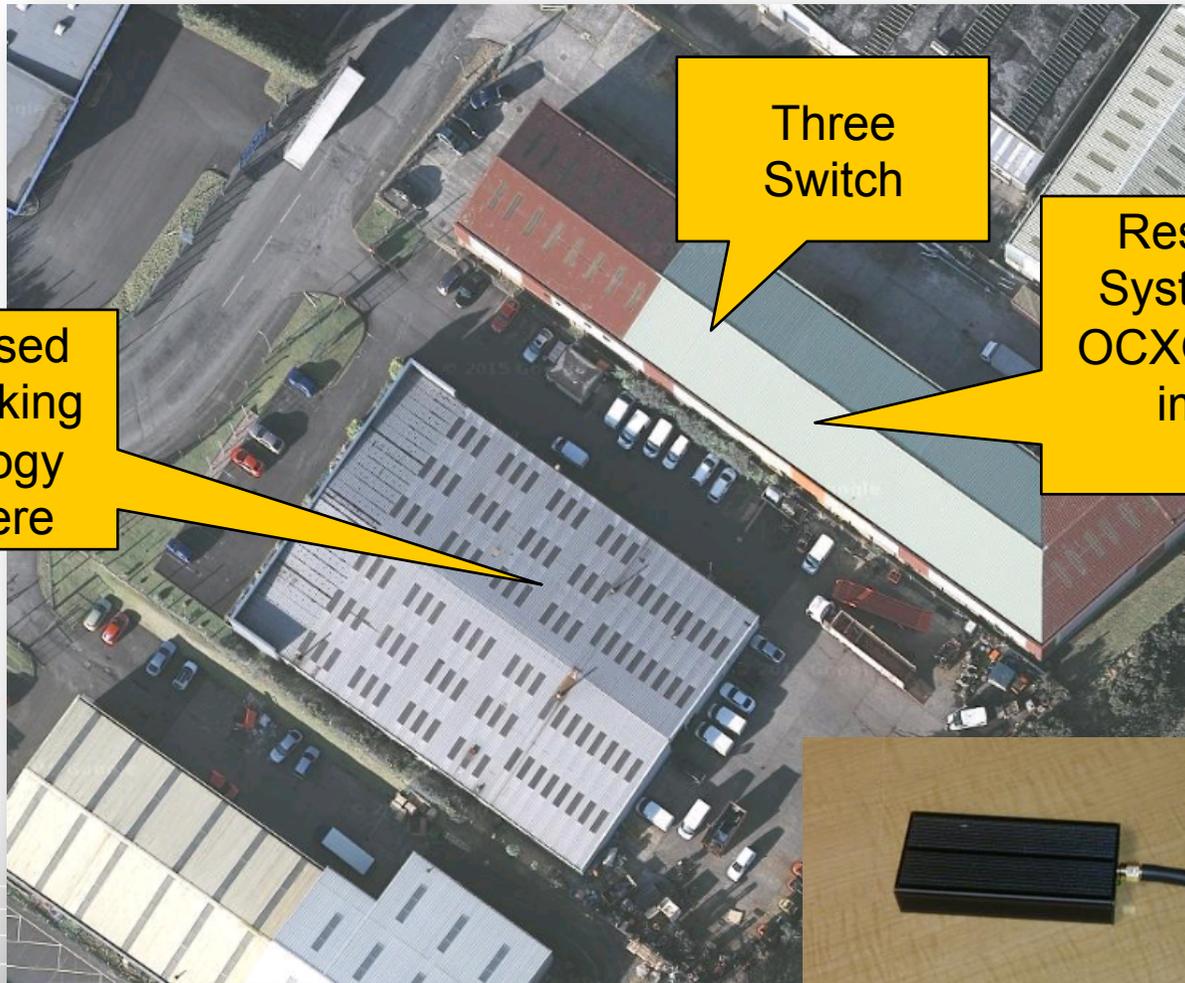
Truck driver uses Jammer so
he can sleep at home not at
the Highway Truck-Stop
Cell Site off-air for 8 hours!!



Rogue Antennas



Jamming Fleet Tracking Technology



GPS based
fleet tracking
technology
used here

Three
Switch

Resilient Timing
System using Rb/
OCXO holdover not
impacted by
jamming



Where to buy Jammers

- Over 50 active Chinese Web Sites
- Power ~ 100mW to 50W!



« Previous Pages: 1 2

<p>Free Shipping</p> <p>High Power 6 Antenna Cell Phone, GPS, WiFi Jammer</p> <p>GBP £178.09</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>	<p>Free Shipping</p> <p>High Power 6 Antenna Cell Phone, GPS, WiFi, VHF Jammer</p> <p>GBP £178.84</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>	<p>Free Shipping</p> <p>High Power 6 Antenna Cell Phone, GPS, WiFi, VHF, UHF and Cell Phone Jammer</p> <p>GBP £178.84</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>	<p>Free Shipping</p> <p>High Power 8 Antenna Cell Phone, 3G, WiFi, GPS, Jammer</p> <p>GBP £198.85</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>
<p>Free Shipping</p> <p>High Power Handheld Portable Cellphone+GPS+WiFi Jammer-Omnidirectional Antennas</p> <p>GBP £198.04 GBP £111.07</p> <p>★★★★☆</p> <p>Compare</p>	<p>Free Shipping</p> <p>High Power Portable GPS (GPS L1/L2/L3 /L4/L5) Jammer</p> <p>GBP £126.45</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>	<p>Free Shipping</p> <p>High Power Portable GPS and Cell Phone Jammer(CDMA GSM DCS PCS 3G)</p> <p>GBP £198.48 GBP £111.06</p> <p>★★★★☆</p> <p>Compare</p>	<p>Free Shipping</p> <p>High Power Portable GPS and Cell Phone Jammer with Carry Case</p> <p>GBP £113.80</p> <p>★★★★☆</p> <p>Compare</p>
<p>Free Shipping</p> <p>High Power Portable GPS and Mobile Phone Jammer(CDMA GSM DCS PCS 3G)</p> <p>GBP £121.36</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>	<p>Free Shipping</p> <p>High Power Portable GPS and Mobile Phone Jammer(CDMA GSM DCS PCS)</p> <p>GBP £106.94</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>	<p>Free Shipping</p> <p>Mini GPS jammer for Car</p> <p>GBP £34.08</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>	<p>Free Shipping</p> <p>Mini GPS Satellite Isolator</p> <p>GBP £37.13</p> <p>★★★★☆</p> <p>Compare</p> <p>Add To Cart</p>

More Powerful Jammers



- Many Web sites
- Easy to get

Kills @ Feb 2015!



- Four white vans are shown in a row. The first van is not circled, while the second, third, and fourth vans are each circled with a red oval.
- Two cartoon burglars wearing striped shirts and caps are shown. Both are circled with red ovals.
- Two icons depicting a radar or signal tower with concentric circles. The first is not circled, and the second is circled with a red oval.
- Three electronic components, possibly antennas or sensors, are shown. The first is not circled, while the second and third are circled with red ovals.
- Two electronic components, similar to the ones in the previous row, are shown. Both are circled with red ovals.

Conclusion

- Research is on-going
 - Detection, Mitigation, Resilience
- Not always Criminal Use
 - Jammer Assisted Crime
 - RFI from harmonics
 - Reradiating GPS Antennas
 - Personal Privacy
- Download the SENTINEL Report
 - [Here](#)
- Linked in Discussion – GNSS Vulnerabilities





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