Spectrum Monitoring applied to the Detection and Geolocation of GPS Jammers
Portfolio

We have the knowledge, the experience, and the human capital to fulfil your needs and wishes in all fields of business!

Products & Services

- Radio Monitoring
- Spectrum Management Systems
- Strategic Consulting
- Training Academy
- System Integration
- Network Planning Tools
- Radio Engineering
- Airborne Measurement

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Our staff of more than 260 highly specialised employees and affiliated subject matter experts in our headquarters and our international subsidiaries are committed to excellence and innovation.

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Representative Offices: Hungary, Oman
LS telcom Partner Office: Argentina
Markets We Serve

- Broadcast
- Spectrum Regulation
- Military
- Telecommunications
- Security
- Utilities
Detection & Geolocation of GPS Jammers
LS OBSERVER
Typical System Configuration

Continuous Monitoring

Portable Monitoring

Mobile Monitoring

Control & Operating Centre

Ethernet, LTE/UMTS, WiMax

3G-UMTS, 4G-LTE

WiMax, 3G-UMTS, 4G-LTE
LS OBSERVER
Full Remote Control

List of Remote Monitoring Units

Position of the units shown on the map
Continuous Spectrum Monitoring

- Principles of operation
  - Wideband monitoring
  - Monitor radio-frequencies 24/7
  - Record measurement results

- Benefits
  - Monitor several frequency bands
  - Quick identification of anomalies
  - Allow quick geolocation
  - Automated monitoring system
  - Look back in the past
Fixed Monitoring Stations

- Installed at fixed sites
- Remotely controlled
- Wideband MHz – GHz ranges
- Measuring RF continuously
- Automatically looking for unwanted emissions
- Raising alerts
Transportable Monitoring Stations

- Same features as FMS
- Easily transportable
- Installation within minutes
- Temporary measurements
Portable Monitoring Units

- Mainly handheld usage for in field measurements but also applicable as mobile and portable unit
- Manual or remote controlled operations
- Display of measurement result files
- Geolocation of using PDoA
- Direction Finding: sequential AoA/LoB
- Useful in dense populated areas, like big towns, where fixed stations can’t hear between the buildings
- Like fixed stations, recording Raw Data for later processing
LS OBSERVER PMU
Off-the-shelf Configuration Options

Frequency range
- 12.4 GHz
- 4.4 GHz
- 100 kHz
- 9 kHz

Storage
- up to 2 years monitoring data
- Environmental parameters
- Ruggedised

Geolocation
- PDoA
- Direction Finding Software

Connectivity
- 3G-UMTS
- WiFi
- Bluetooth
- Ethernet
- Remote Control

Accessories
- Monitoring Antenna
- Battery
- Directional-Antenna Bag Case
- Case

SW Option
HW Option
standard
LS OBSERVER
Automated Continuous Monitoring

Wideband monitoring 24/7 → Comparing measurement with expected levels → Raising alerts to control center

Interference quickly stopped → Trigger geolocation to locate the interferer
How many Monitoring Units?

**Number of LSObservers per km²**

- **WLAN**: 4940-4990 MHz, 100 mW - 250 mW, 2 LSObservers per km²
- **WLAN**: 3650-3690 MHz, 100 mW - 250 mW, 2 LSObservers per km²
- **WLAN**: 2412-2484 MHz, 100 mW - 250 mW, 1 LSObservable per km²
- **UMTS**: 2100-2200 MHz, 100 mW - 100 W, 1 LSObservers per km²
- **Mobile Radio**: 890-915 MHz, 100 mW - 300 W, 2 LSObservers per 10 km²
- **Tetra**: 380-395 MHz, 4 W - 25 W, 5 LSObservers per 100 km²
- **DAB**: 174-240 MHz, 10 W - 10 kW, 1 LSObservable per 100 km²
Where to place the monitoring units? Simulation & Planning

- LS telcom’s Software to
  - calculate the coverage of a monitoring unit
  - find the best place for new installations
Geo-location methods

- **AoA** (Angle of Arrival)
- **TDoA** (Time Difference of Arrival)
- **PDoA** (Power Difference of Arrival)
- **Hybrid** (Combination of at least 2 methods)
Geo-location with AoA

List of Monitoring Units

Bearing results
What are PDoA and TDoA?

- PDoA is based on measuring the signal strength at different places and then computing the location using the different signal strengths that have been measured at different places.

- PDoA can be computed live or at a later time using recorded data.

- TDoA, like PDoA, is a computation based on a difference between measurement realised at different places but using time instead of signal strength. Each monitoring unit is equipped with a high precision GPS receiver that allows to exactly know when signals are received. Comparing the time when a same signal has been received by different monitoring stations allows to determine the area where the emitter is located with a good precision.

- TDoA must be performed live. It can’t be computed backwards.
Quick comparison of PDoA and TDoA

<table>
<thead>
<tr>
<th></th>
<th>PDoA</th>
<th>TDoA</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum number of units</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Typical accuracy</td>
<td>200 m</td>
<td>45 m</td>
<td>45 m</td>
</tr>
<tr>
<td>Speed of geo-location</td>
<td>1 s</td>
<td>1 s</td>
<td>1 s</td>
</tr>
<tr>
<td>Minimum signal duration*</td>
<td>0.1 s</td>
<td>live signal</td>
<td>live signal</td>
</tr>
<tr>
<td>Minimum signal bandwidth</td>
<td>none</td>
<td>200 kHz</td>
<td>200 kHz</td>
</tr>
<tr>
<td>Maximum signal bandwidth</td>
<td>20 MHz</td>
<td>20 MHz</td>
<td>20 MHz</td>
</tr>
<tr>
<td>Can be computed live</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Can be computed on recorded data</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

*: the signal must be in the air until three stations completed one scan
Geo-location with TDoA / PDoA
Monitoring of a wide area Coverage for Detection and Geolocation
Where to place the monitoring units?
Along roads, at „way points“

Copyrights pictures:
Where to place the monitoring units?
Around particular sites
QUESTIONS?

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