Geolocation for the IoT
Never lost again in the Internet of Things
Where’s the bike?

“Eight out of 10 times, those who tried Mobike could not find the bicycle.”

“even with GPS integration...the bikes weren't at their supposed locations”
Company Overview

- Nestwave develops signal processing technology and solutions enabling **accurate, low-power geolocation, both indoor and outdoor**

- Over 10 patents granted, pending or being filed

- Our company is based in Paris (2014)
Our Solution

Low power, multi-signal beacon receiver IP and cloud service: GPS/4G/WiFi/LoRa sniffing with cloud offloading
Powered by Technology

10 Patents granted & pending

+ Timestamp Algorithms
+ Multilateration Solution
+ System and antenna database database optimization

Dramatic accuracy gains in high multipath and low signal environments, and reduced power consumption
Fast Prototyping with MATLAB

MATLAB enables very efficient development cycle of novel algorithms and solutions:
Research → Prototyping → Field Test → Analysis → Research
Easy deployment with MATLAB

- MATLAB allows a direct and quick path from prototype to production
- Native vectorization in MATLAB
- Parallel and GPU computing also supported
- Server software mainly written in MATLAB: extremely fast deployment, maintenance, evolution and upgrade
End-to-End Solution using MATLAB

Fast end-to-end development cycle from research to product

Research → Prototyping → Field Test → Analysis

- DSP Prototype
- DSP Firmware
- FPGA Prototype
- RTL Coprocessors

Support from MATLAB’s automatic code generation

Cloud software

Soft core IP

Blocks mainly in MATLAB
Our Multipath Mitigation in GPS

- Simulation of multipath mitigation at low SNR with 2 interfering paths
- Current multipath mitigation algorithms fail at low SNR

3.5 times more accurate
Our Multipath Mitigation in GPS

Standard comparison of ranging error envelopes for 1 interfering path

Multipath ranging error envelopes (phase 0, 180 deg)

- Conventional 5MHz
- Narrow spacing 50ns 4MHz (Kaplan)
- Narrow spacing 0.2us 6MHz
- MEDLL (Chang)
- Nestwave 6MHz

Delay between direct path and interfering path in chips (1 chip = 300 meters)

Range Estimation error in chips (0.1 chip = 30 meters)
Our Indoor & Outdoor Field Results

Our Solution

5 times more accurate

San Francisco
Mountain View
Gennevilliers

Competition in 2013
Mountain View
4G Trial

- True position
- Estimated position
San Francisco 4G Trial

- True position
- Estimated position
Multipath Mitigation in LoRa

**Timestamp Estimation**: simulation comparison for LoRa in two different channels

Nestwave’s algorithm achieves strong gains in difficult channels (i.e. in worst case scenarios)
Multilateration Solver

Our multilateration Solver for GPS, 4G and LoRa incorporates several advanced features such as novel M-Estimation:

- **Least Squares**: Best in Gaussian noise.
- **Huber**: Better for Laplacian noise.
- **Tukey**: Can handle outliers.
- **Nestwave**: Novel Loss Function.