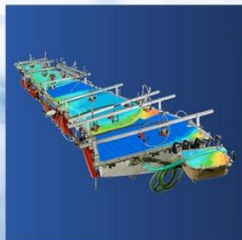


# ZODIAC DATA SYSTEMS

ZODIAC  
AEROSPACE



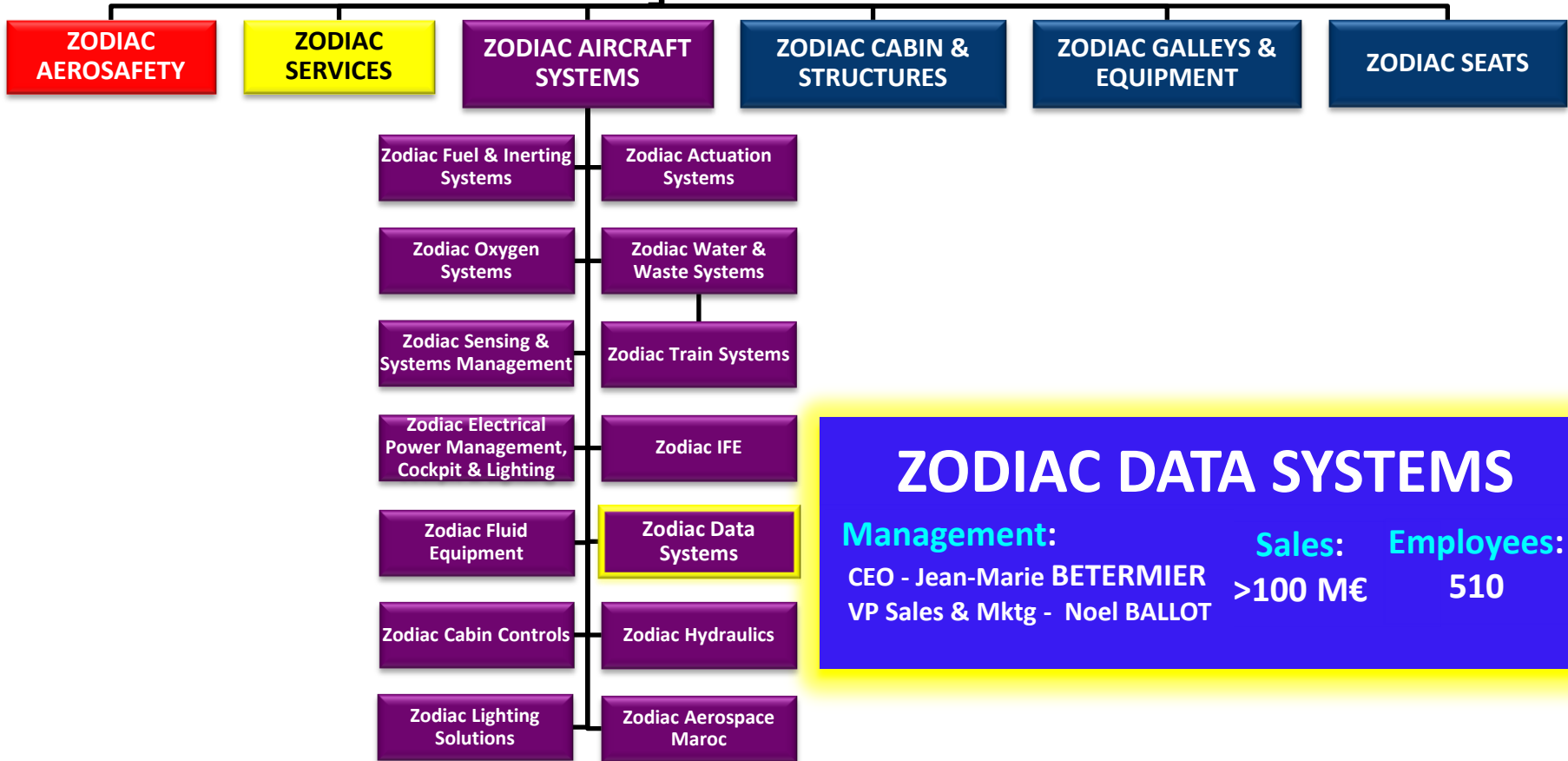
MASTERING THE ELEMENTS

ZODIAC  
AEROSPACE



# ZODIAC AEROSPACE

Stock exch: ZC (Euronext)   Sales: 3450 M€   Growth: 25%   Employees: ~ 26000



## ZODIAC DATA SYSTEMS

**Management:**  
CEO - Jean-Marie BETERMIER  
VP Sales & Mktg - Noel BALLOT

**Sales:** >100 M€

**Employees:** 510

### ZODIAC AIRCRAFT SYSTEMS

# The CORTEX Family

One philosophy, Multiple applications



- PC-based telemetry equipment
- FPGA embedded-boards
  - Real time IF processing
  - High level of integration

TT&C,  
SCIENCE &  
DEEP SPACE



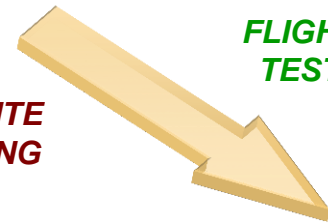
REMOTE  
SENSING



SATELLITE  
TRACKING



FLIGHT  
TEST



**CRT**

Command Ranging & Telemetry

- 3000 units worldwide

**DS**

Deep Space

- Optimized hardware for Deep Space communications

**HDR**

High Datarate Receiver

- Up to 2 Gbps
- 16 QAM & 32/64APSK

**DTR**

Digital Tracking Receiver

- Carrier&SQPN tracking up to 3 channels

**RTR**

Radio Telemetry Receiver

- Quad-band telemetry receiver

**RSR**

Radio Signal Recorder

- Fully digital IF recorder / reproducer

# The IFoIP Family

One hardware, Multiple applications



IFoIP equipment:

- FPGA embedded-boards
- Real time IF processing
- High level of integration



*Customized*

**SDR**

Software Defined Radio

- Customized applications

*Inspection*

**CSI**

Carrier Signal Inspector

- Detects the carrier
- Display the noise floor

*Monitoring*

**CSM**

Carrier Signal Monitoring

- Database & Alarm management
- Reporting

*Analysis*

**CSA**

Carrier Signal Analyzer

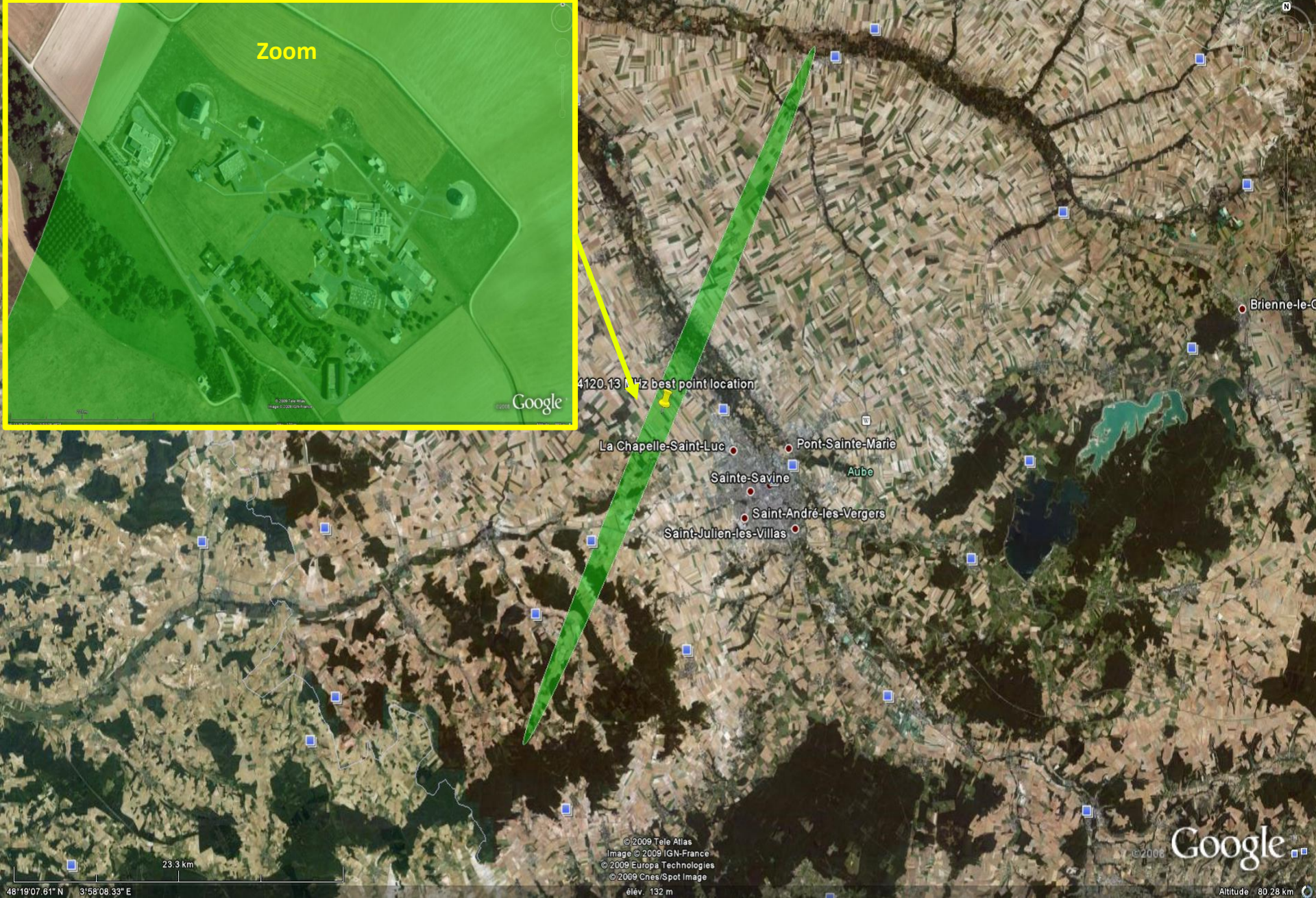
- Characterize carriers in blind mode
- Carrier under carrier

*Geolocation*

**CGL**

Compact Geo Location

- Locate transmitters



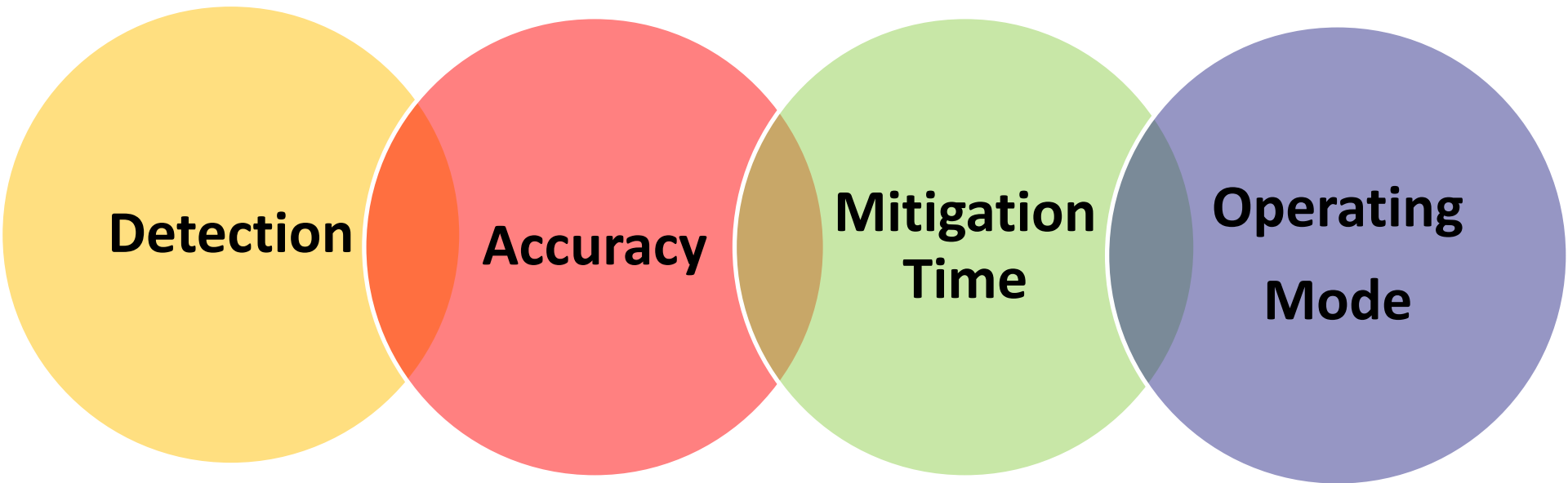
## ZODIAC AIRCRAFT SYSTEMS

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23/06/2013

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# Geolocation Performances Pillars



# Performances

## Detection – Computation of accurate TDOA / FDOA

### Factors affecting detection

#### Size of the antennas

Transmitters .....

Satellites angular separation .....

Mirror Satellite occupancy .....

Satellite Characteristics.....

Phase noise

Local Oscillator drift

Acceleration

Signal RF parameters.....

### ZDS supplies

➔ High processing gain

Up to 81dB (depending on carrier param.)

➔ Broad Carrier Cancellation capabilities

➔ Improved Compensation Algorithms

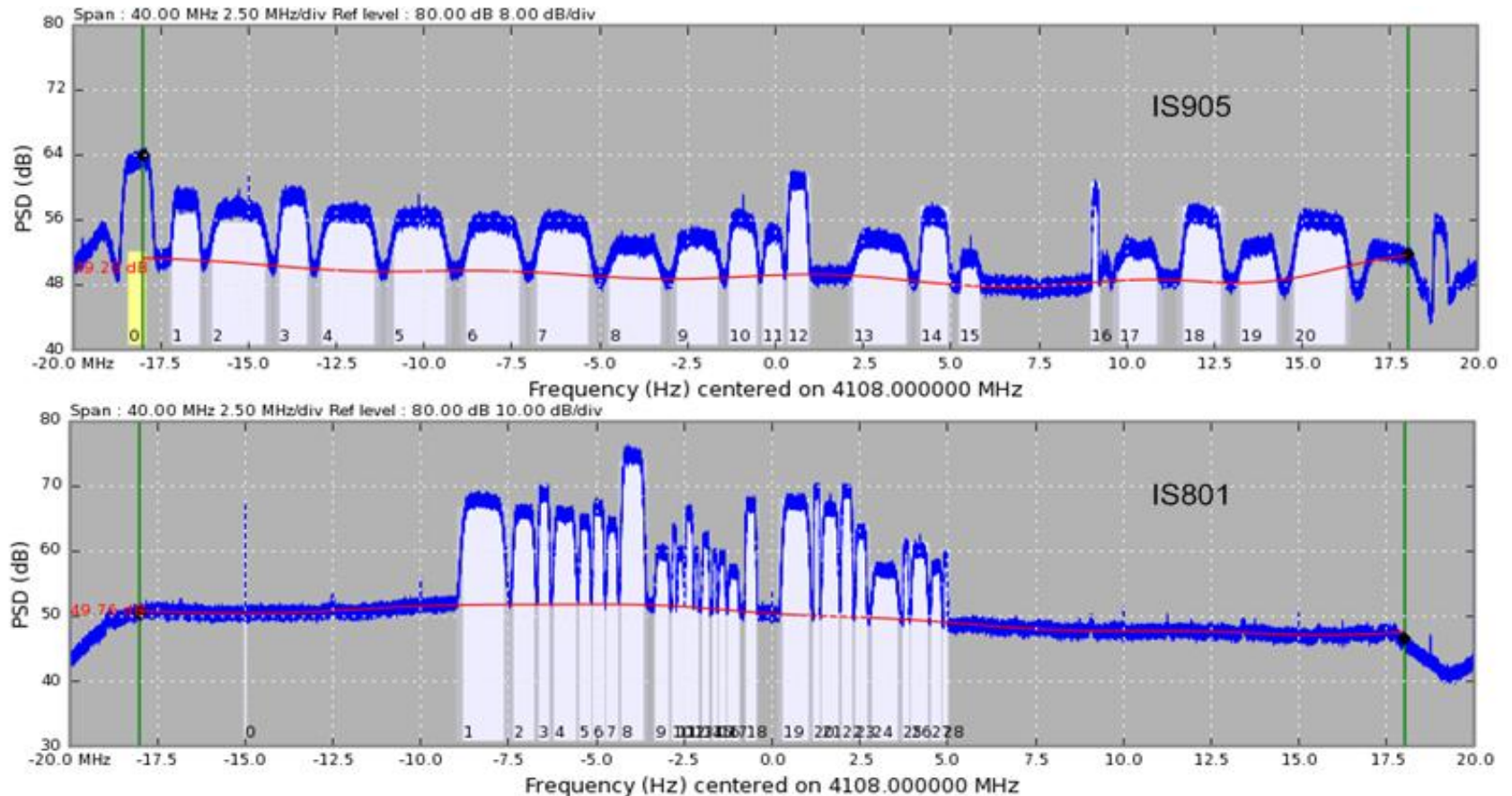
➔ Highly flexible, high throughput digitizer architecture

Ability to perform wide band recording during tens of seconds

# Performances

## Detection – Computation of accurate TDOA / FDOA

### Geoloc Examples



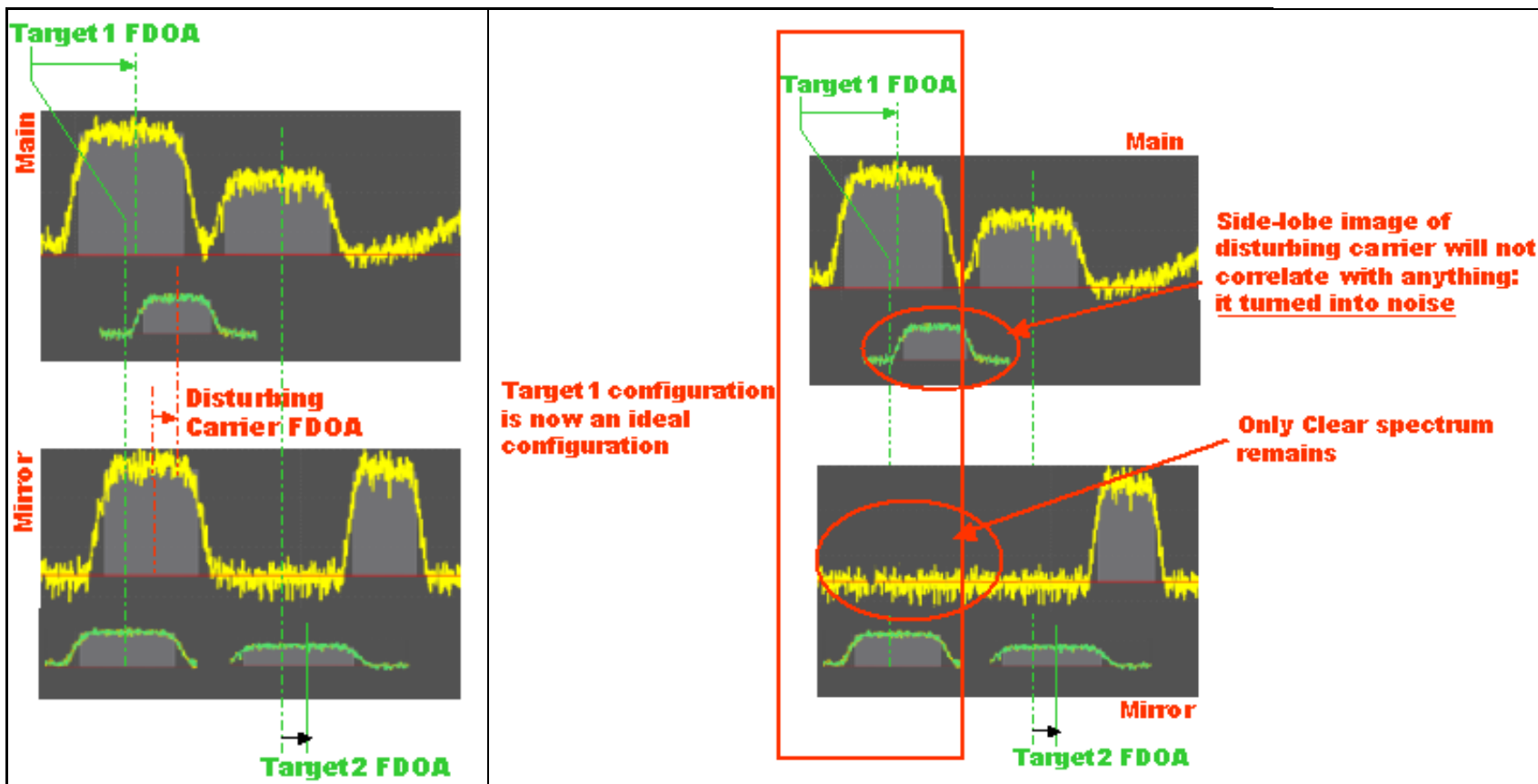


# Performances

**Detection** – Computation of accurate TDOA / FDOA

## Carrier Cancellation

- Up to 60 MHz wide Carrier cancellation before correlation



# Performances

## Location Accuracy – Resolution of the final position

### Factors affecting location accuracy

FDOA/TDOA accuracy.....

Position of the references .....

Ephemeris .....

Relative positions of the satellites ..

### ZDS supplies

- Hardware / Algorithm design to guarantee the best achievable processing gain
- Ephemeris generation tools  
Mono-site (Co-Orbits) / Multi-Site (passive)
- Expert system to analysis the most suitable measurement time

### Speed

Hardware performances .....

Number of samples to process .....

High processing .....

### ZDS supplies

- Dedicated Hardware filtering architecture
- 64-bit Multi-Core Optimized software

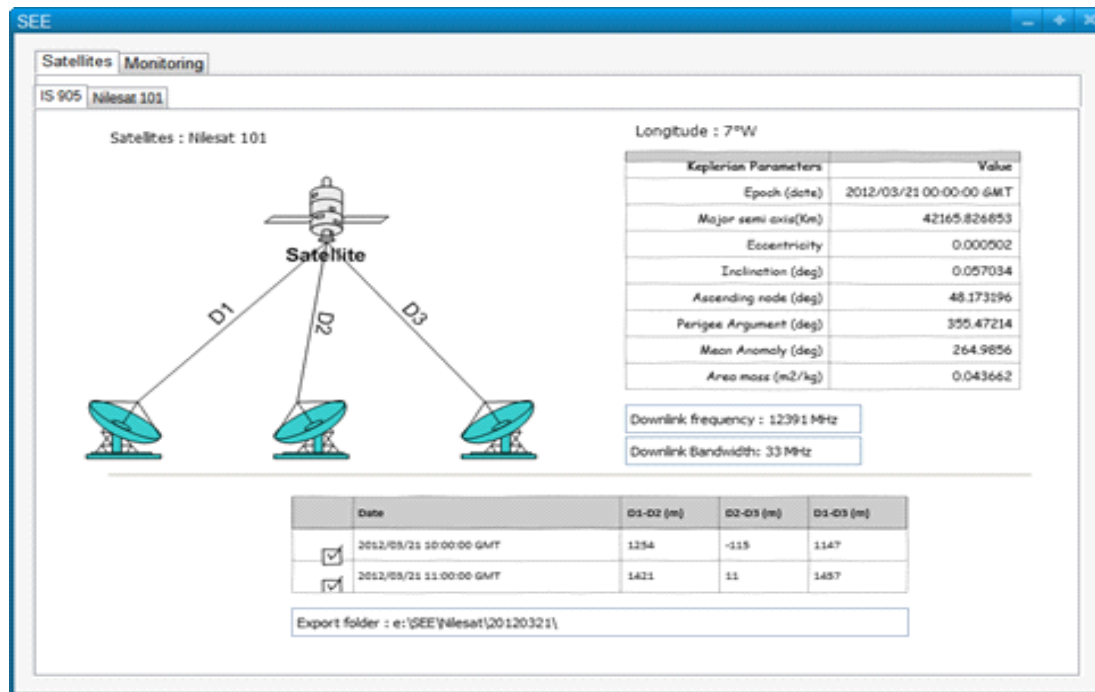
# Performances

## Location Accuracy – Resolution of the final position

### Principles

Passive ephemeris estimation add-on to geolocation system

The passive method for geostationary satellite ephemeris estimation is based on differences distances measurement between the satellite and three ground stations installed in three different locations with an average 300 km distance gap.



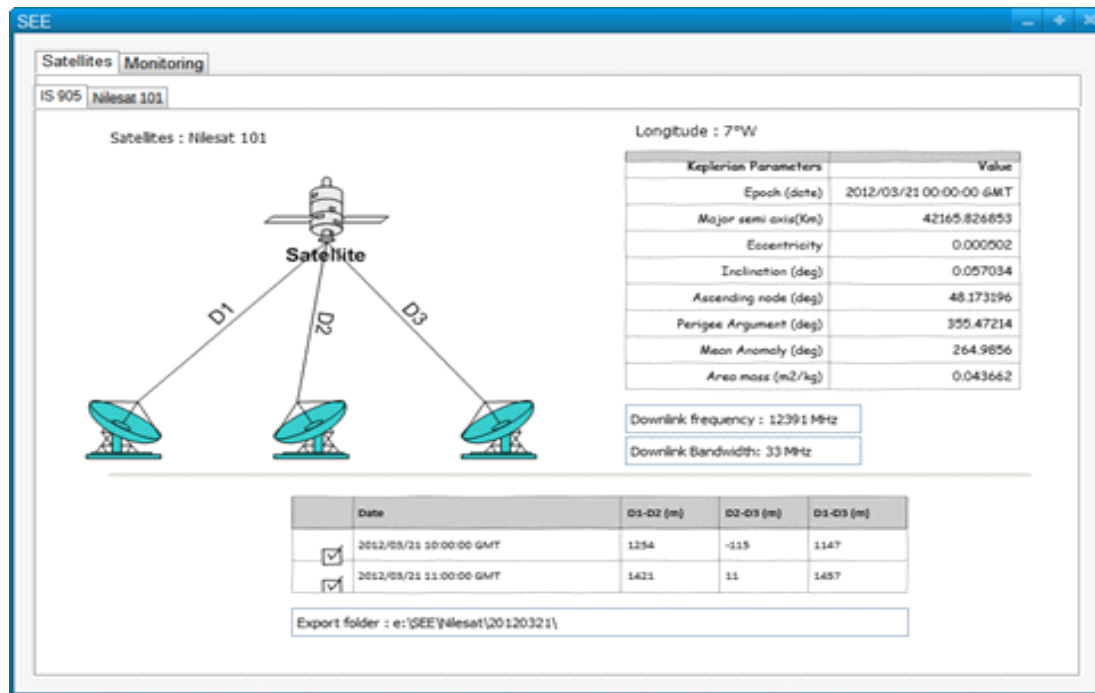
# Performances

## Location Accuracy – Resolution of the final position

### Accuracy

The main purpose is to reach the accuracy at which one can use geolocation results without the use of additional reference transmitters: the operating mode then solely relies on a single reference carrier.

The system continuously streams main/mirror orbital data to the geolocation system: after stabilization phase, up to date, accurate data are available upon triggering of a geolocation task



# Performances

## Operating Mode - Easing-up the process

### Operating mode

#### Automated

Detection & Geolocation .....

Full transponder.....

Full Manual (Metrology Approach) ..

Distant Antennas .....

Interface with other applications .....

Multi sites .....

Autonomous system .....

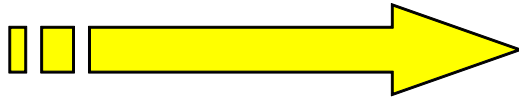
- ➔ One-Click Modes
- ➔ Macro Task Manager
- Geolocation-aware transponder monitoring
- Continuous Co-Orbit Estimation
- Multi-Carrier oriented Hardware Design
  
- ➔ Expert mode
- ➔ Multi-site GPS synchronisation
- ➔ XML interfaces
- ➔ Scalable system architecture
- ➔ Stand alone system

# Performances

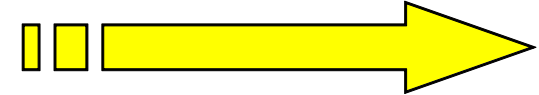
## Operating Mode - Automated MacroTasks Architecture

### Main principles

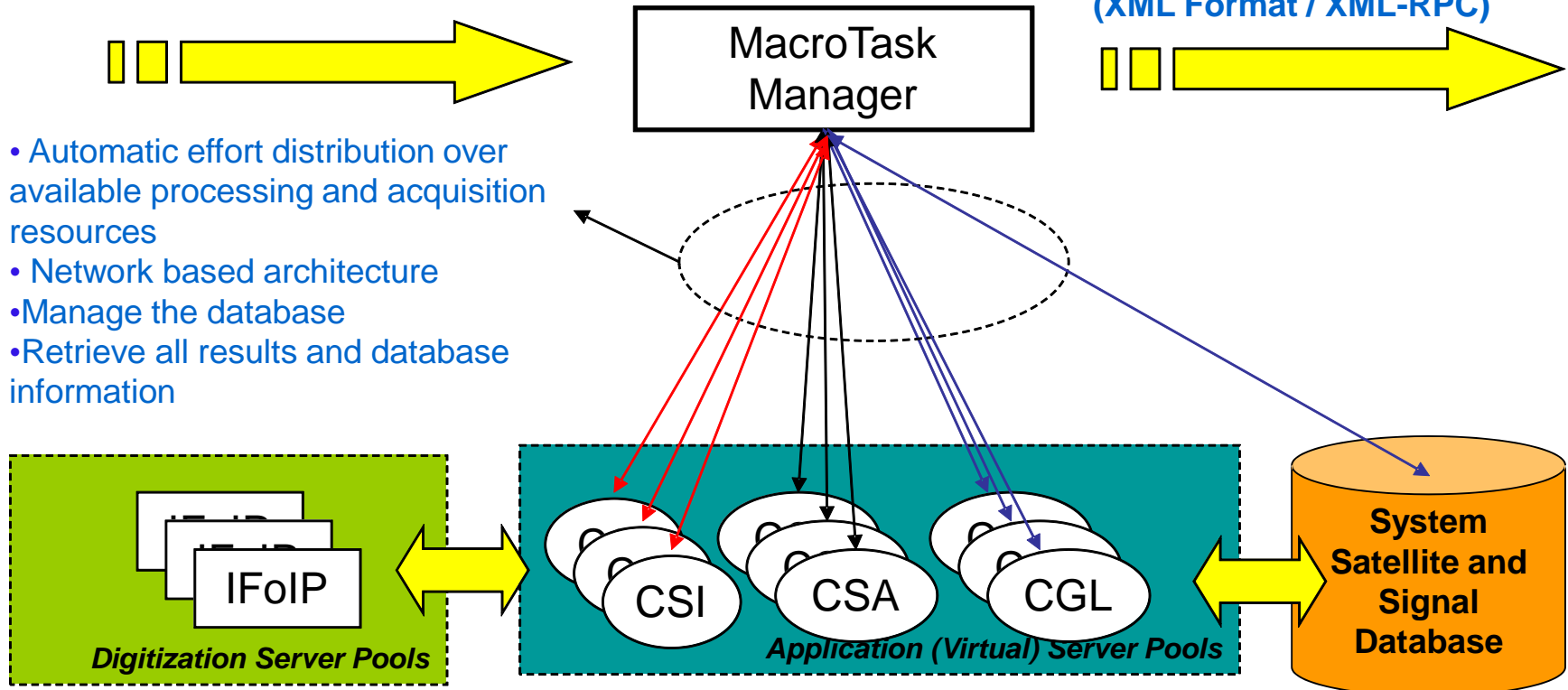
Input a given transponder frequency



Output Results  
(XML Format / XML-RPC)



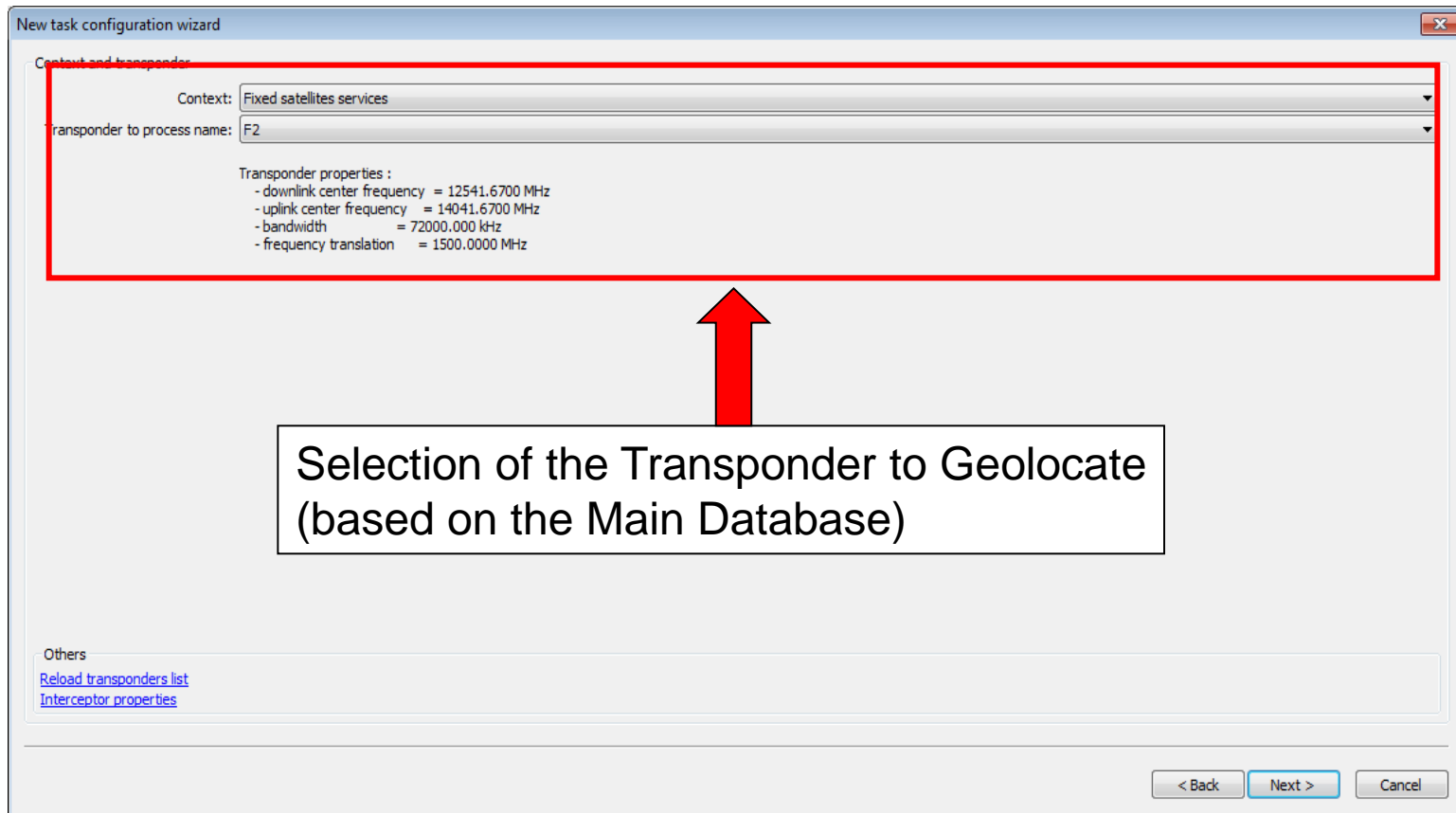
- Automatic effort distribution over available processing and acquisition resources
- Network based architecture
- Manage the database
- Retrieve all results and database information



# Performances

## Operating Mode - Automated MacroTasks Architecture

Select your satellite and transponder



# Performances

## Operating Mode - Automated MacroTasks Architecture

Select your primary reference

New task configuration wizard

Task specific parameters

Main reference | Sampling parameters | Targets | Secondary references

Main reference: TLS-ASTRIUM-7A-12540.7-V - 12540.7382 MHz (EUTELSAT 7A)

Peak scan parameters: Edit

Process by: localhost:7765

Lock server for main reference process:

Forget analysis inside HyperLoc:

Others

[Reload references list](#)

[Interceptor properties](#)

< Back Finish Cancel



# Performances

## Operating Mode - Automated MacroTasks Architecture

### Select your secondary references

**Secondary Reference Selection for :**

- Automatic Ephemeris estimation
- Automatic Multi-Reference Correction

**New task configuration wizard**

Task specific parameters

Main reference | Sampling parameters | Targets | **Secondary references**

Use multi-references geolocation algorithm:

Secondary references sampling strategy: Before and after targets

Make orbit estimation:

Satellite orbit to estimate: Main

Delay between secondary references acquisitions [min]: 25

Peak scan parameters

Available sec. references

DENGES-7A-12543.9-V - 12543.9212 MHz (EUTELSAT 7A )	>>
KIRUNA-7A-12541.5-V - 12541.4629 MHz (EUTELSAT 7A )	>

Selected sec. references

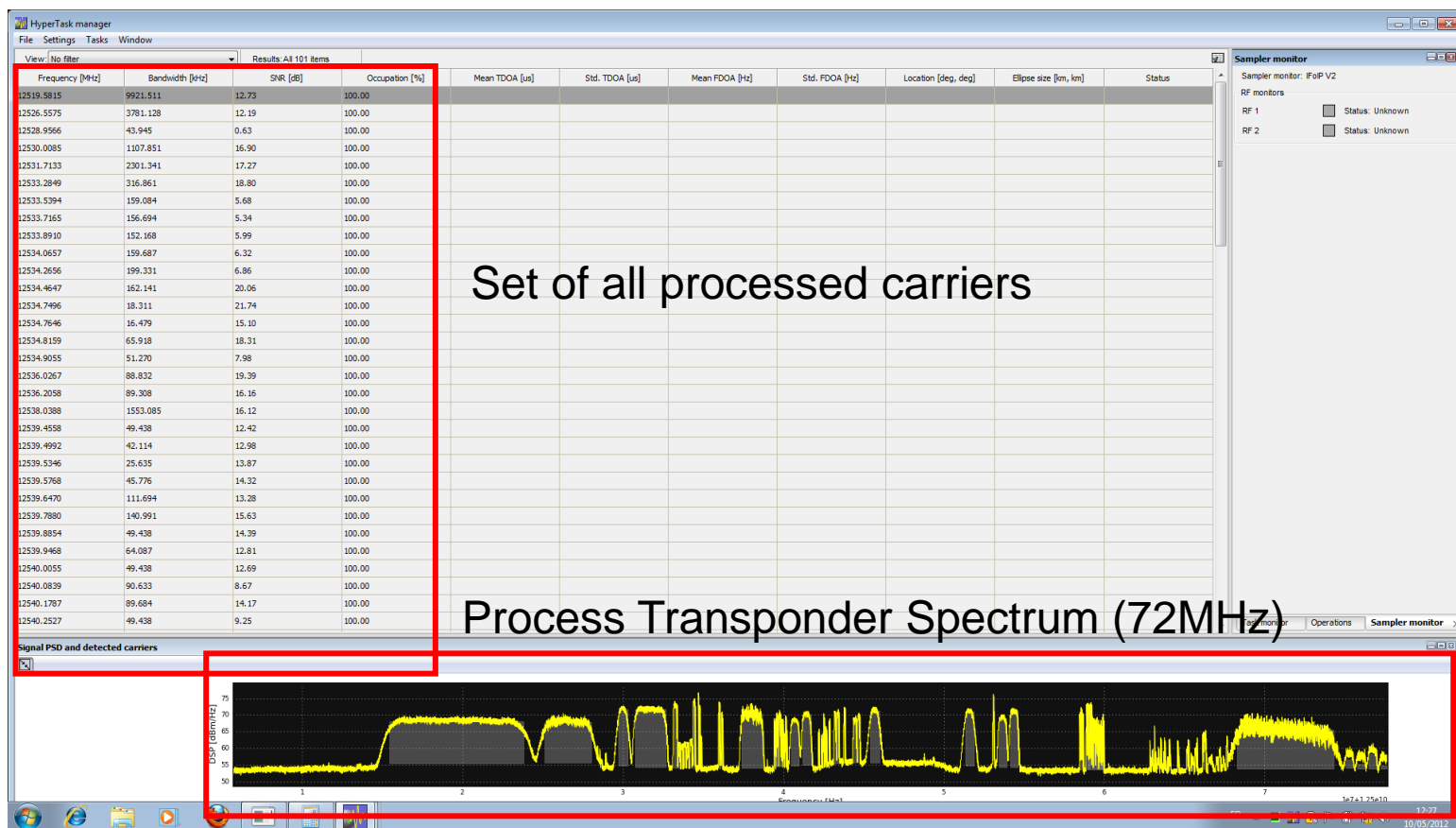
TLS-ASTRIUM-7A-12540.7-V - 12540.7382 MHz (EUTELSAT 7A )	<
MILANO-W3A-12559.3-V - 12559.3115 MHz (EUTELSAT 7A )	<<
LISBON-1-7A-12553.7-V - 12553.6772 MHz (EUTELSAT 7A )	
COPENHAGEN-7A-12526.5-V - 12526.5409 MHz (EUTELSAT 7A )	

< Back Finish Cancel

# Performances

## Operating Mode - Automated MacroTasks Architecture

Select the carriers to locate



# Performances

## Operating Mode - Automated MacroTasks Architecture

### Results: positions & information on the carriers

**Detailed Data for all carriers**

Frequency [MHz]	Bandwidth [kHz]	SNR [dB]	Occupation [%]	Mean TDQA [μs]	Std. TDQA [μs]	Mean FDOA [Hz]	Std. FDOA [Hz]	Location [deg, deg]	Ellipse size [km, km]	Status
						-2564.0387	0.0012	(lat=44.166, lon=9.782 ( 10.05, 0.66)		Done
						-2564.0409	0.0001	(lat=44.162, lon=9.737 ( 9.28, 0.21)		Done
						-2564.5132	0.0013	(lat=51.562, lon=5.163 ( 14.11, 0.22)		Done
						-2564.5335	0.0014	(lat=51.417, lon=5.175 ( 14.13, 0.23)		Done
						-2562.4589	0.0005	(lat=32.886, lon=34.80 ( 7.77, 1.40)		Done
						-2564.0017	0.0015	(lat=39.040, lon=-9.200 ( 9.31, 0.19)		Done
						-2562.5339	0.0017	(lat=33.806, lon=35.18 ( 9.07, 0.20)		Done
						-2563.8813	0.0024	(lat=41.664, lon=12.52 ( 13.11, 11.75)		Done
						-2563.6039	0.0004	(lat=39.312, lon=16.97 ( 8.06, 1.09)		Done
						-2563.8986	0.0046	(lat=41.894, lon=12.46 ( 17.53, 13.65)		Done
						-2563.8815	0.0037	(lat=41.631, lon=12.44 ( 13.86, 8.06)		Done
						-2563.8822	0.0030	(lat=41.640, lon=12.49 ( 12.56, 6.56)		Done
						-2563.9021	0.0046	(lat=41.897, lon=12.37 ( 17.46, 13.55)		Done
						-2563.9038	0.0049	(lat=41.952, lon=12.49 ( 18.37, 14.40)		Done
										Not detected
						-2563.7462	0.0055	(lat=41.927, lon=12.51 ( 20.10, 16.00)		Done
						-2563.7455	0.0055	(lat=41.890, lon=12.45 ( 20.10, 16.01)		Done
						-2564.0321	0.0014	(lat=45.282, lon=9.075 ( 9.75, 4.73)		Done
						-2564.0182	0.0004	(lat=45.074, lon=9.191 ( 8.00, 1.15)		Done
						-2564.0243	0.0003	(lat=45.168, lon=9.186 ( 8.00, 1.15)		Done
						-2564.0345	0.0009	(lat=45.334, lon=9.168 ( 8.00, 1.15)		Done

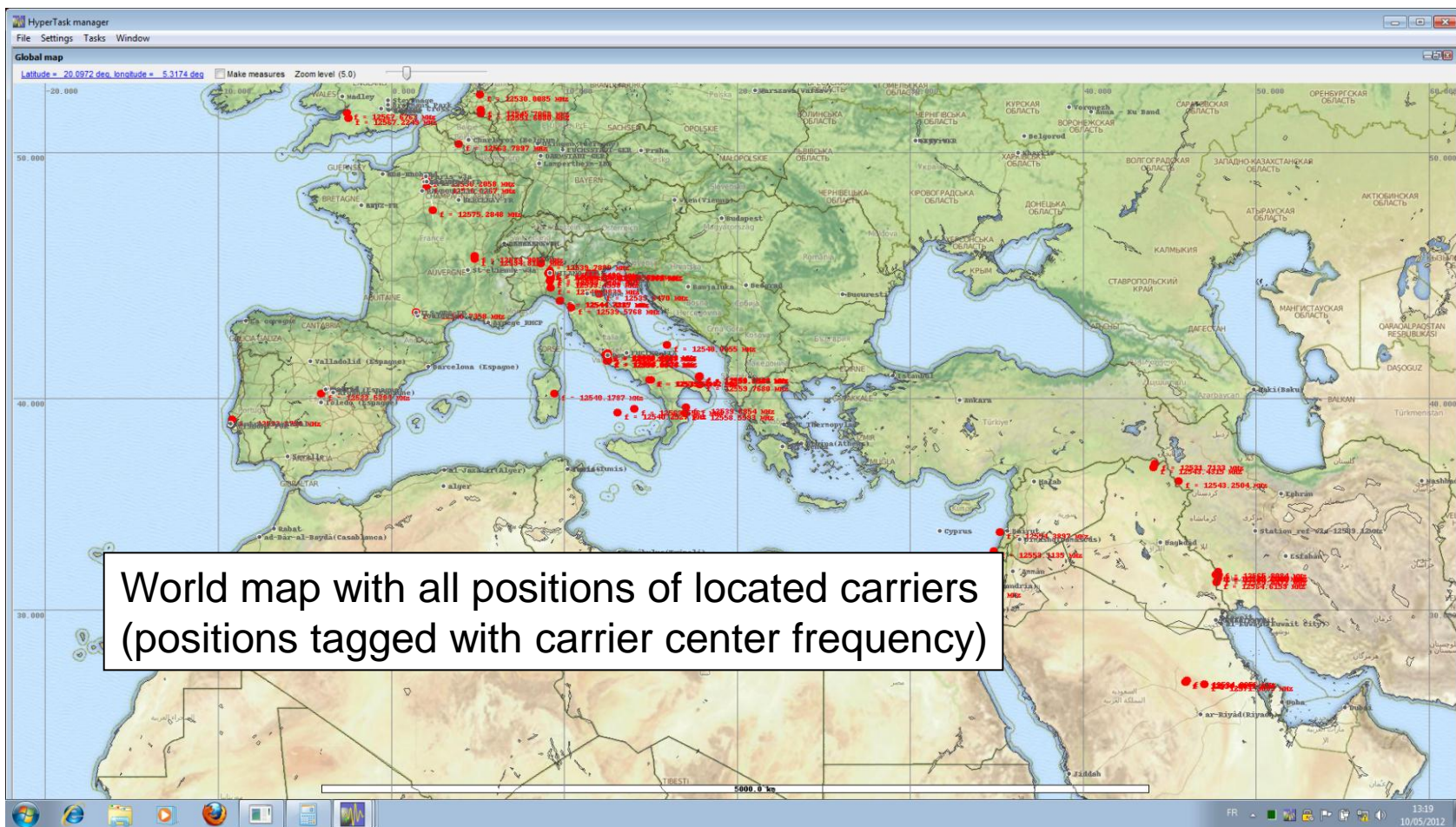
**Map Details for selected carriers**

**Signal PSD and detected carriers**

# Performances

## Operating Mode - Automated MacroTasks Architecture

### Results: positions on the map



# Latest technologies

## New request

TDMA signal .....

Ka Band.....

Spotted satellites .....

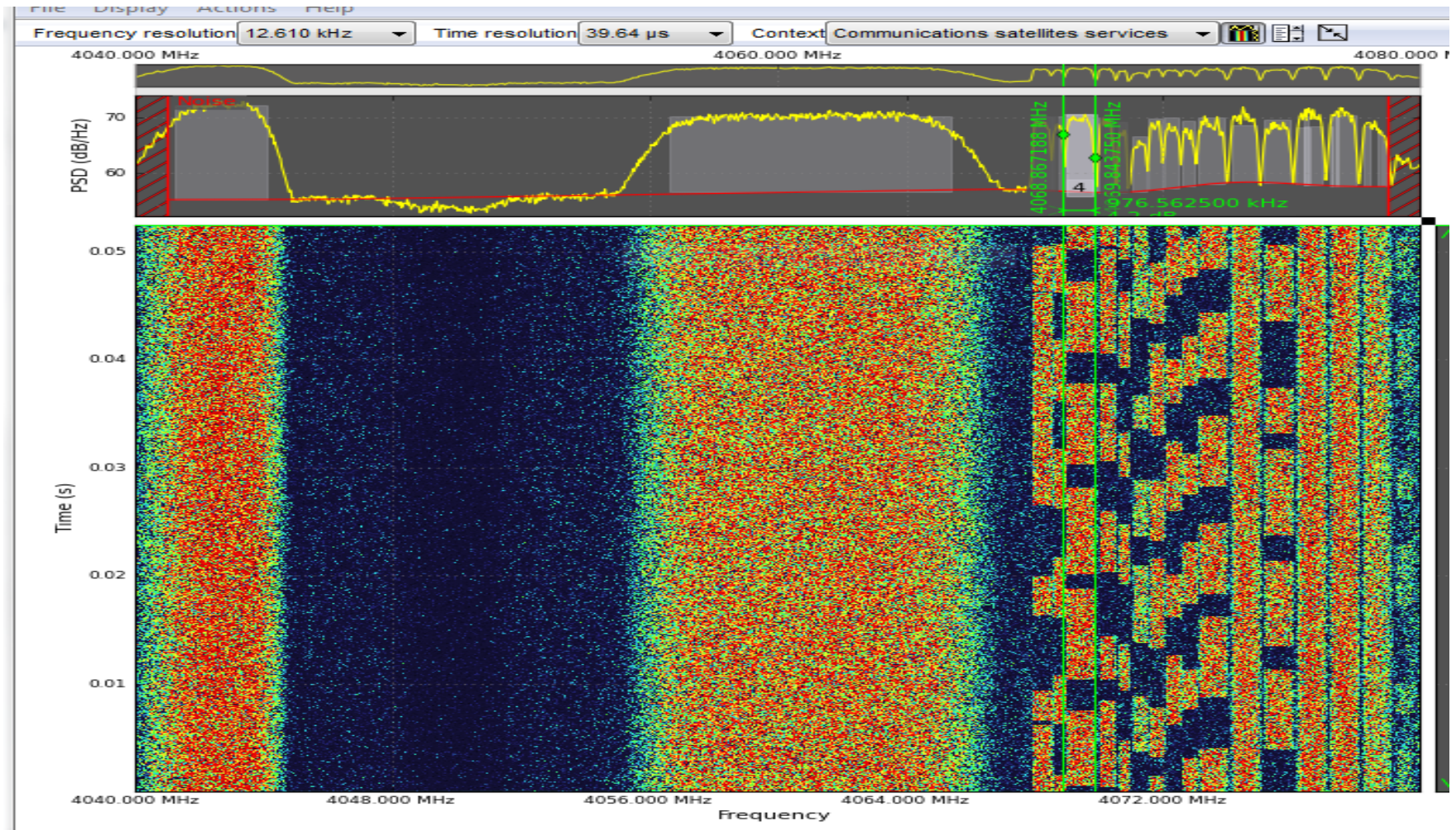
## ZDS Upcoming Features

- Geolocation of the users
- Better accuracy with One Sat
- Downsizing system configuration

# Performances

## Burst signal

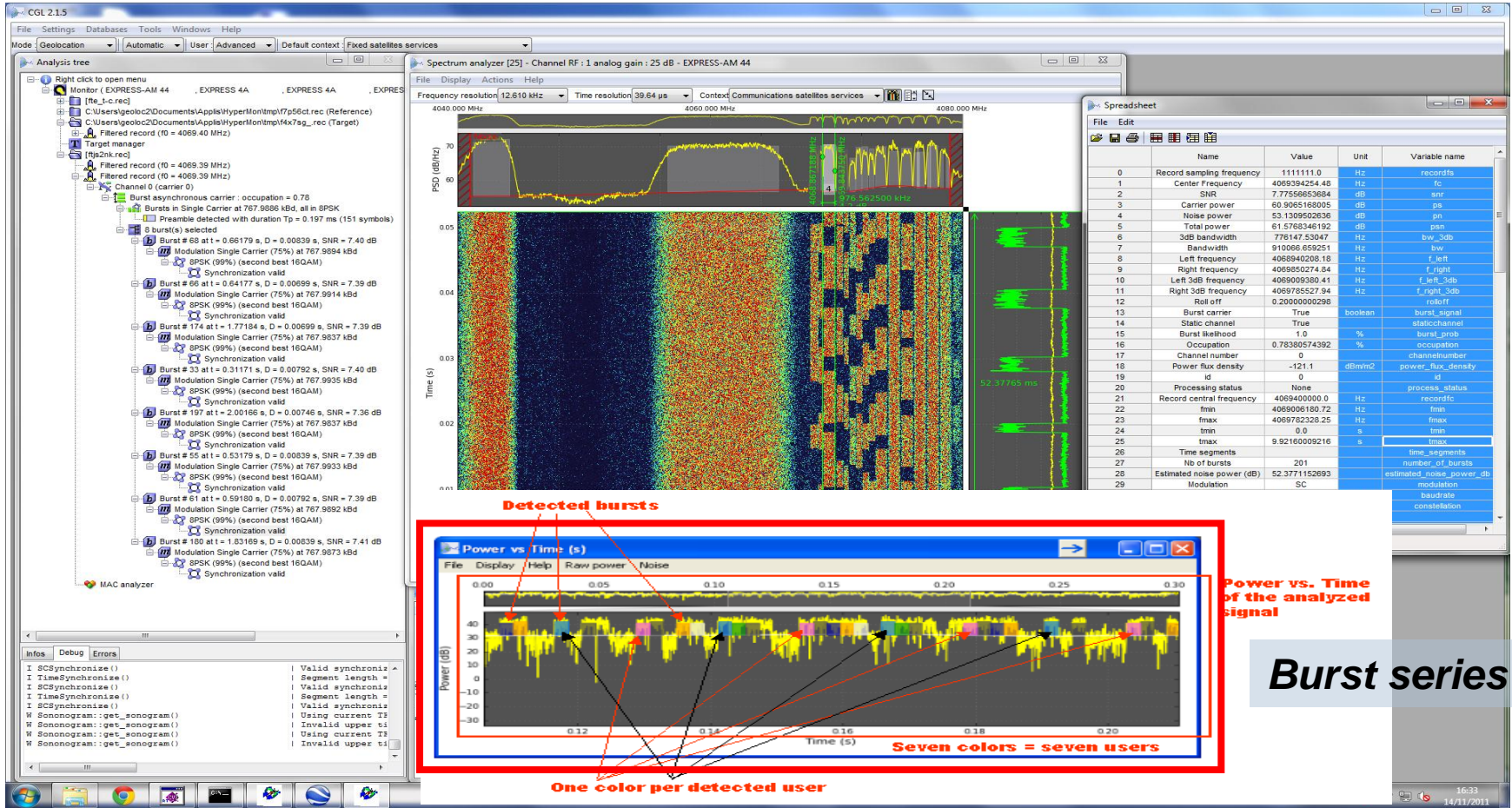
In TDMA context



# Performances

## Burst signal

In TDMA context



# Performances

## Burst signal

In TDMA context

Geolocation manager : C:\Projects\Geoloc\Clients\EDGE Networks\Dana\ForDana\TDMA\_ExpAM44-Ku.mtl

Select target measurement for geolocation

From date [ ] to date [ ] from frequency [MHz] [ ] to frequency [MHz] [ ] Filter

Sampling date	Frequency [MHz]	Located at (lat, lon) [deg]	Ellipse size [km]	Process information	T
2011/11/14 16:45:18.4723012447 GMT	11008.0916	( 61.294, 57.867 )	( 629.89, 1.26 )	Standard geolocation done.	:
2011/11/14 16:45:18.4723265171 GMT	11008.0916	( 47.422, 16.373 )	( 140.47, 3.15 )	Standard geolocation done.	:
2011/11/14 16:45:18.4723446369 GMT	11008.0916	( 47.489, 16.413 )	( 141.36, 11.75 )	Standard geolocation done.	:
2011/11/14 16:45:18.4723582268 GMT	11008.0916	( 57.805, 60.022 )	( 854.49, 30.35 )	Standard geolocation done.	3
2011/11/14 16:45:18.4723794460 GMT	11008.0916	( 27.276, 2.629 )	( 373.66, 8.33 )	Standard geolocation done.	:
2011/11/14 16:45:18.4723794460 GMT	11008.0916	( 39.546, 4.721 )	( 214.36, 6.19 )	Standard geolocation done.	:
2011/11/14 16:45:18.4723970890 GMT	11008.0916	( 35.782, -0.569 )	( 252.03, 7.66 )	Standard geolocation done.	:
2011/11/14 16:45:18.4724235535 GMT	11008.0916	( 32.459, -5.537 )	( 291.48, 9.71 )	Standard geolocation done.	:

One single  
central frequency

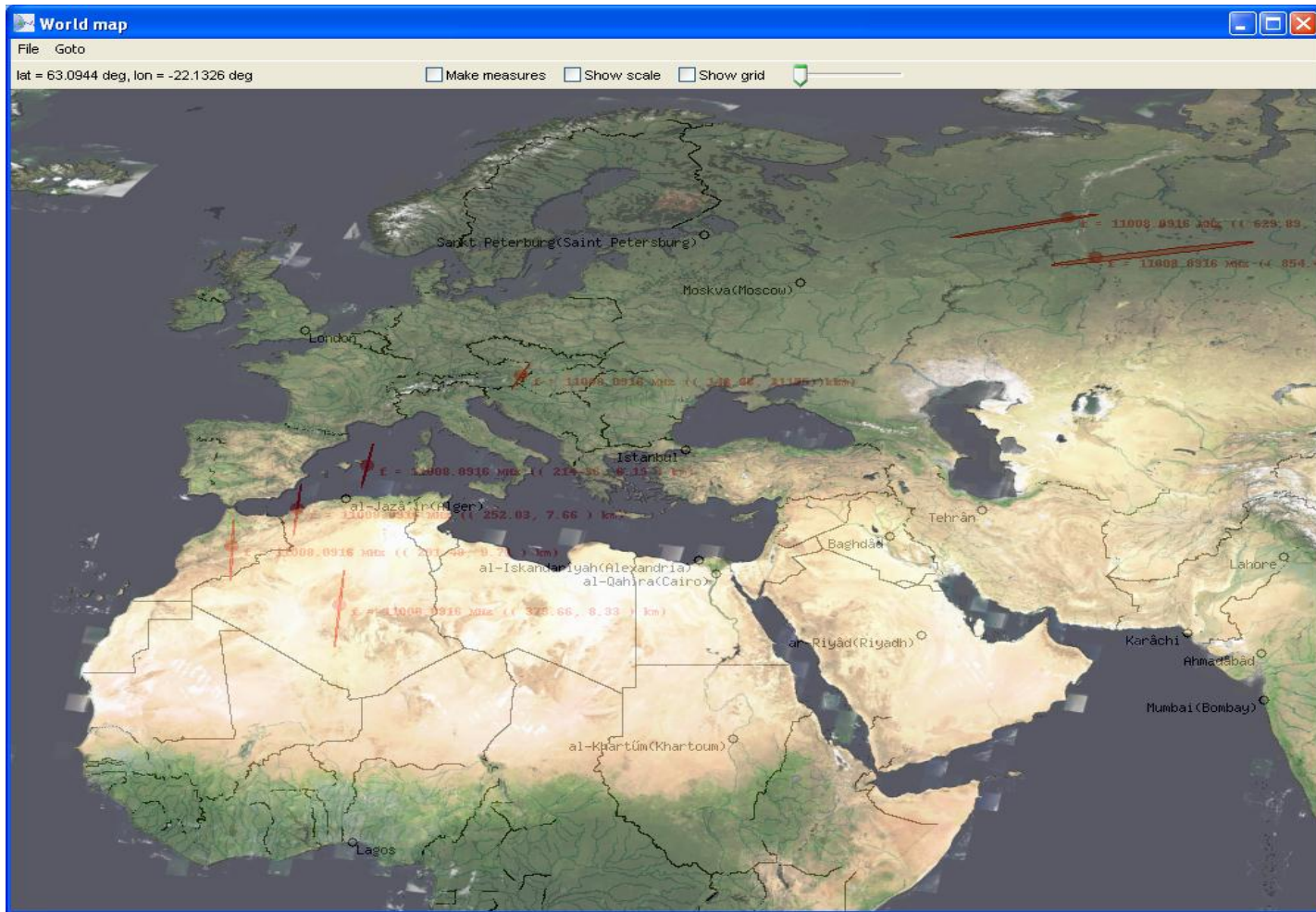
Several distinct  
locations



# Performances

## Burst signal

### In TDMA context





**Thank you !**