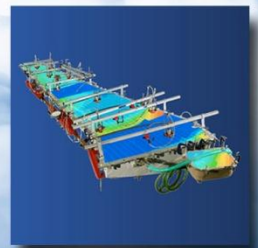
ZODIAC DATA SYSTEMS

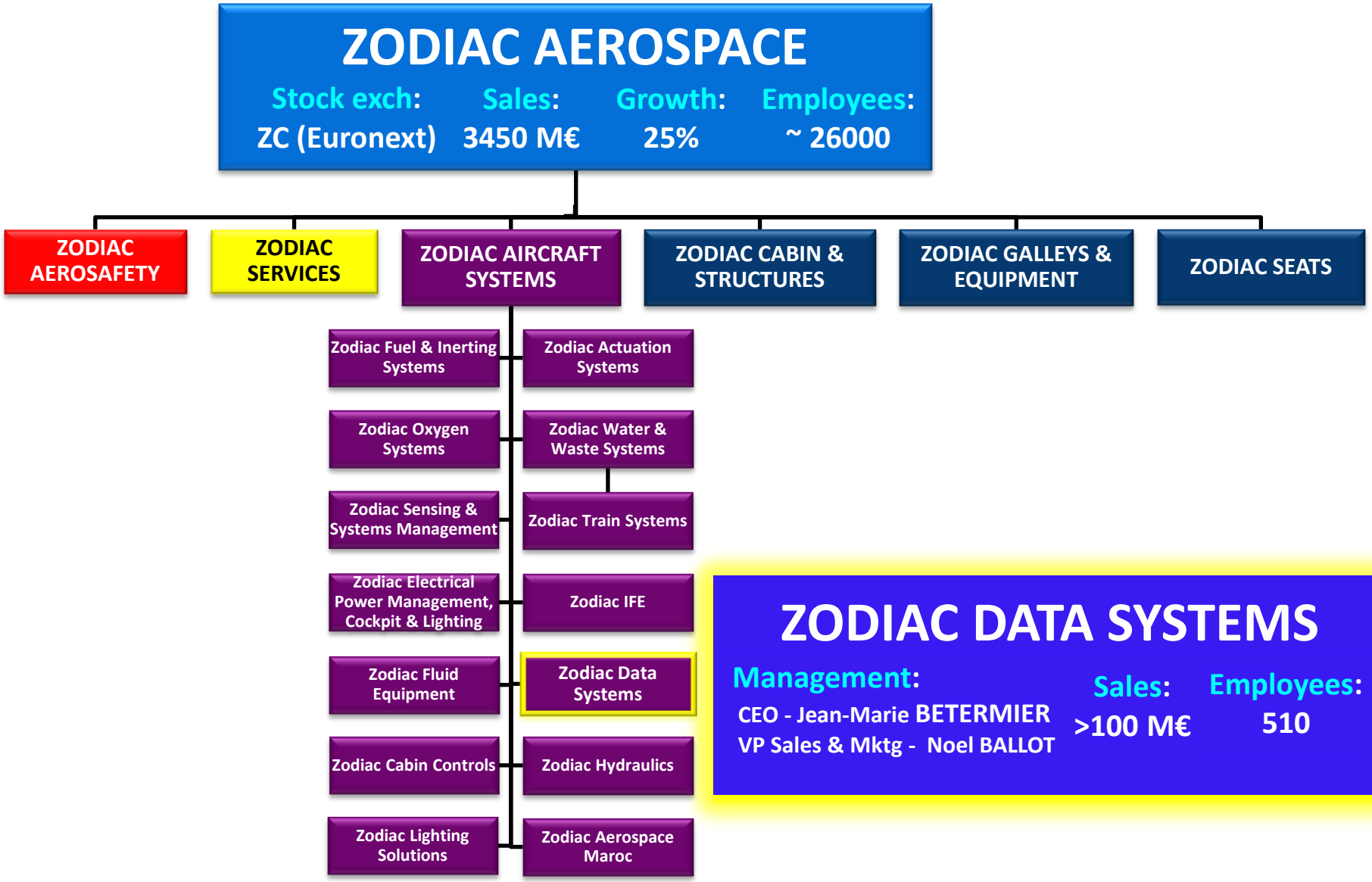
ZODIAC AEROSPACE






MASTERING THE ELEMENTS

ZODIAC AEROSPACE



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	DS	HDR	DTR	RTR	RSR
Command Ranging & Telemetry ▪ *3000 units worldwide*	Deep Space ▪ *Optimized hardware for Deep Space comunications*	High Datarate Receiver ▪ *Up to 2 Gbps* ▪ *16 QAM & 32/64APSK*	Digital Tracking Receiver ▪ *Carrier&SQPN tracking up to 3 channels*	Radio Telemetry Receiver ▪ *Quad-band telemetry receiver*	Radio Signal Recorder ▪ *Fully digital IF recorder / reproducer*

ZODIAC AEROSPACE

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

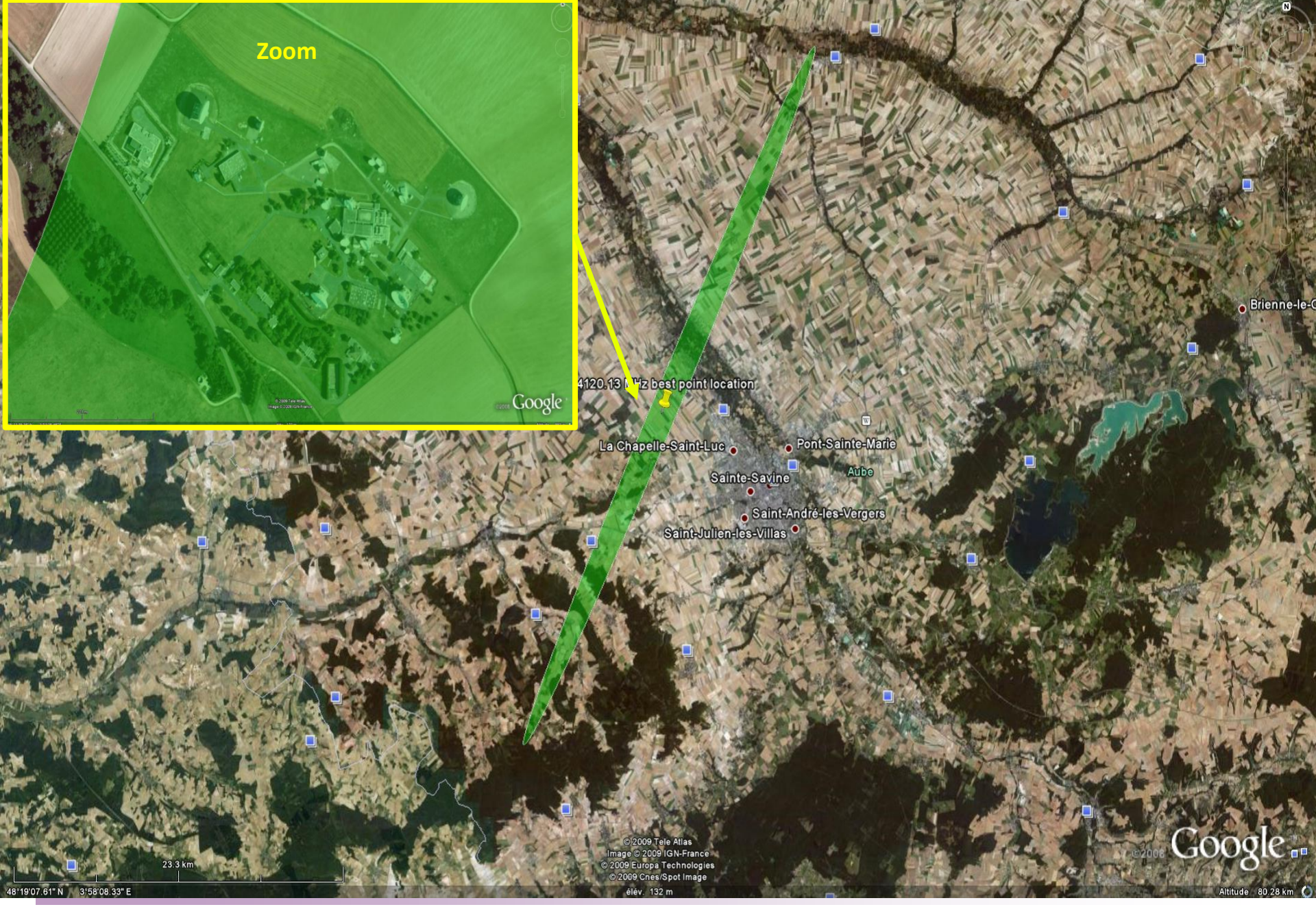
Carrier Signal Analyzer
- *Characterize carriers in blind mode*
- *Carrier under carrier*

Geolocation

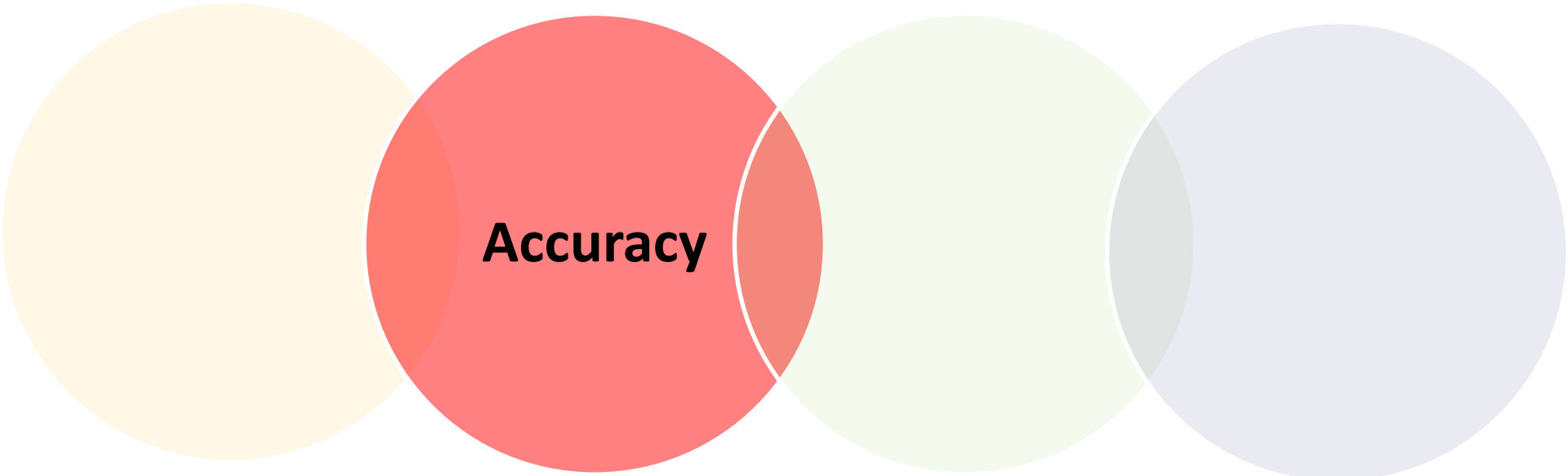
CGL

Compact Geo Location
- *Locate transmitters*

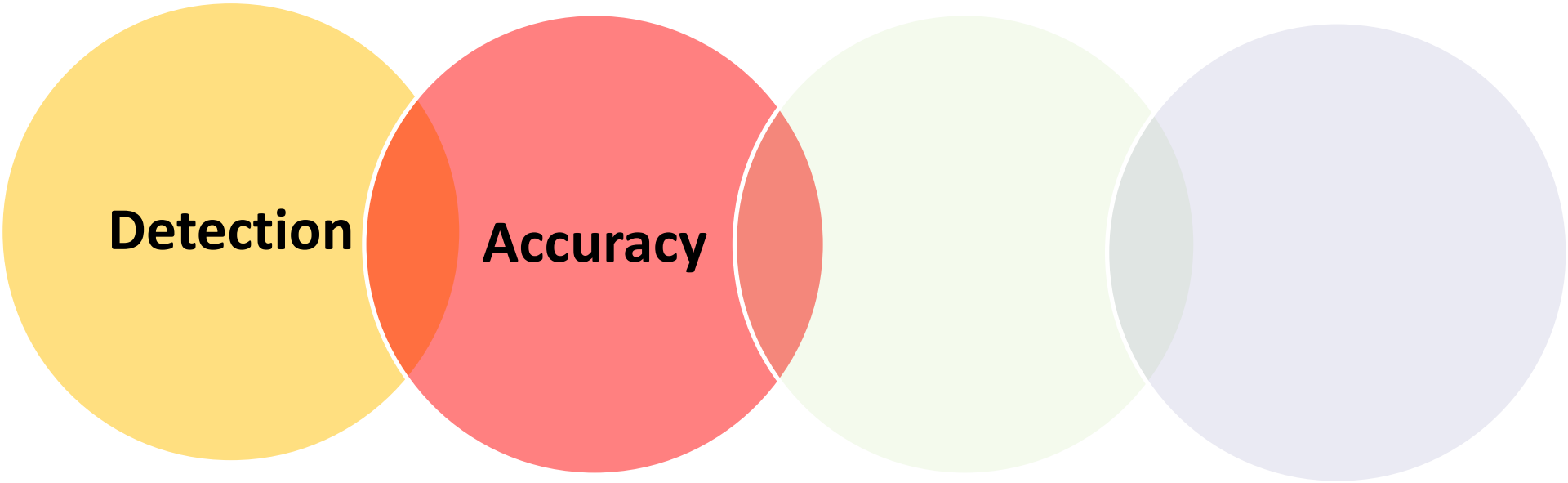
ZODIAC AEROSPACE



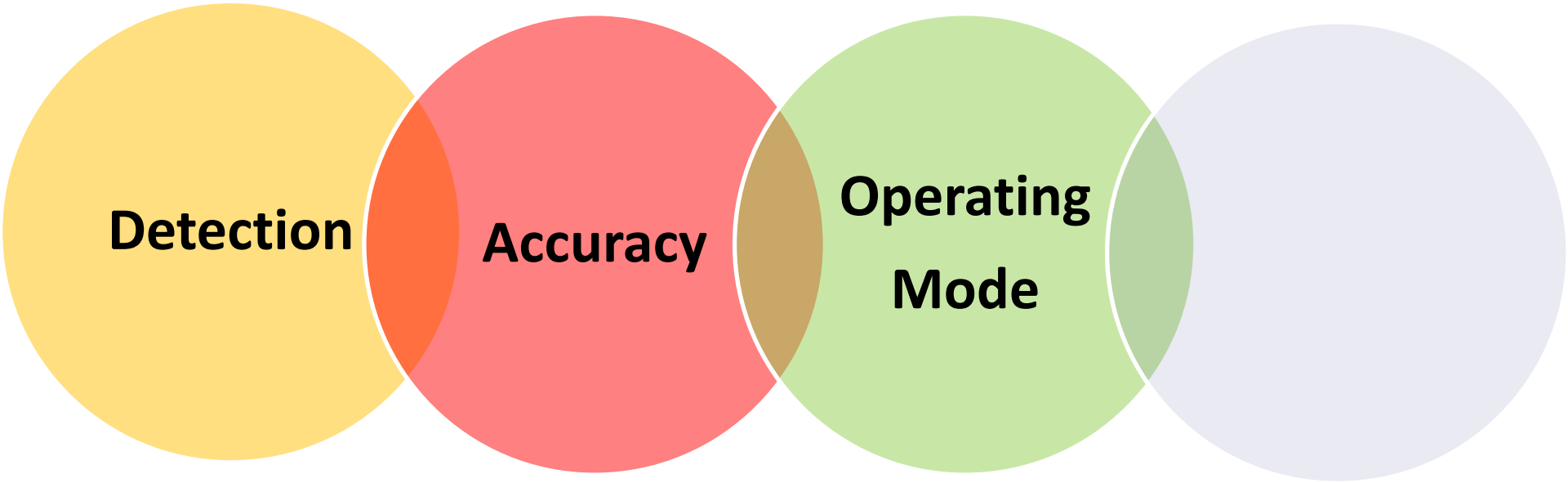
Geolocation Performances Pilars



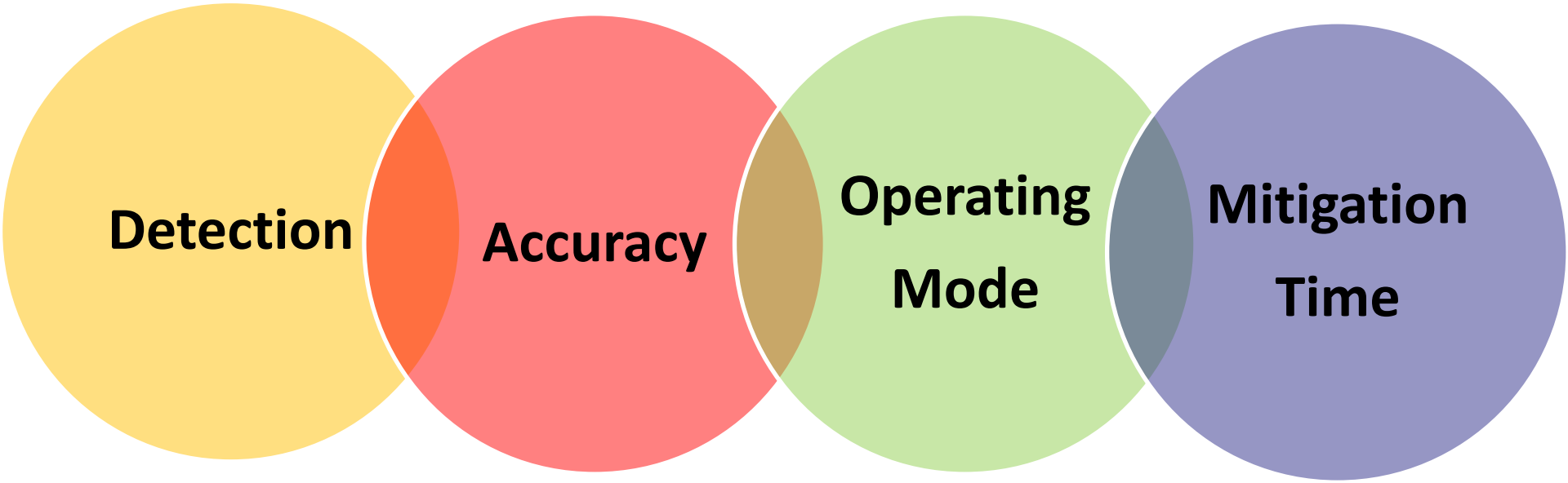
Geolocation Performances Pilars



Geolocation Performances Pilars



Geolocation Performances Pilars



CGL Performances

Detection – Computation of accurate TDOA / FDOA

Factors affecting detection

Size of the antennas and .....
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**

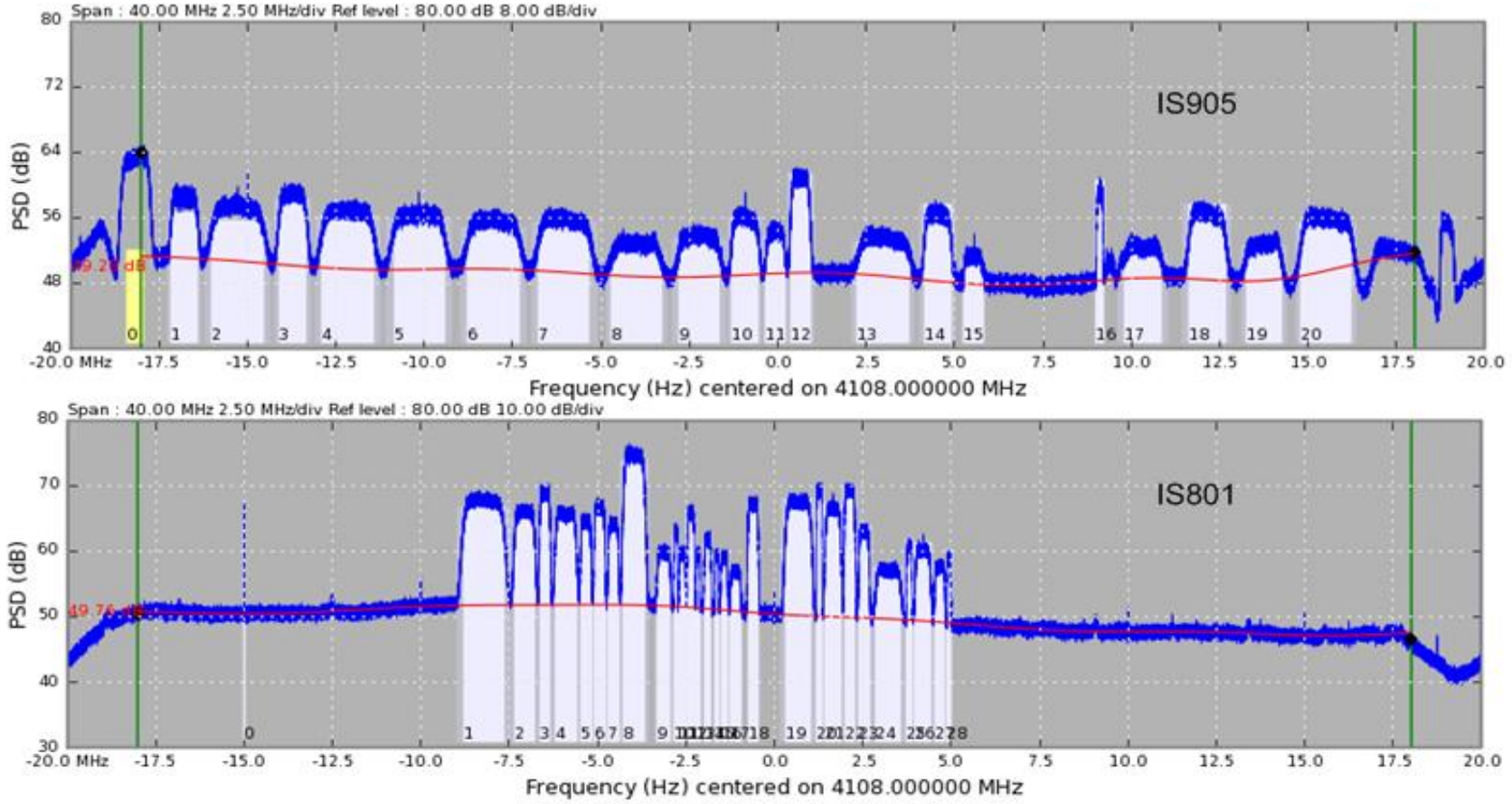
➔ **Highly flexible, high throughput digitizer architecture**

Ability to perform wide band recording during tens of seconds

CGL Performances

Detection – Computation of accurate TDOA / FDOA

Geoloc Examples

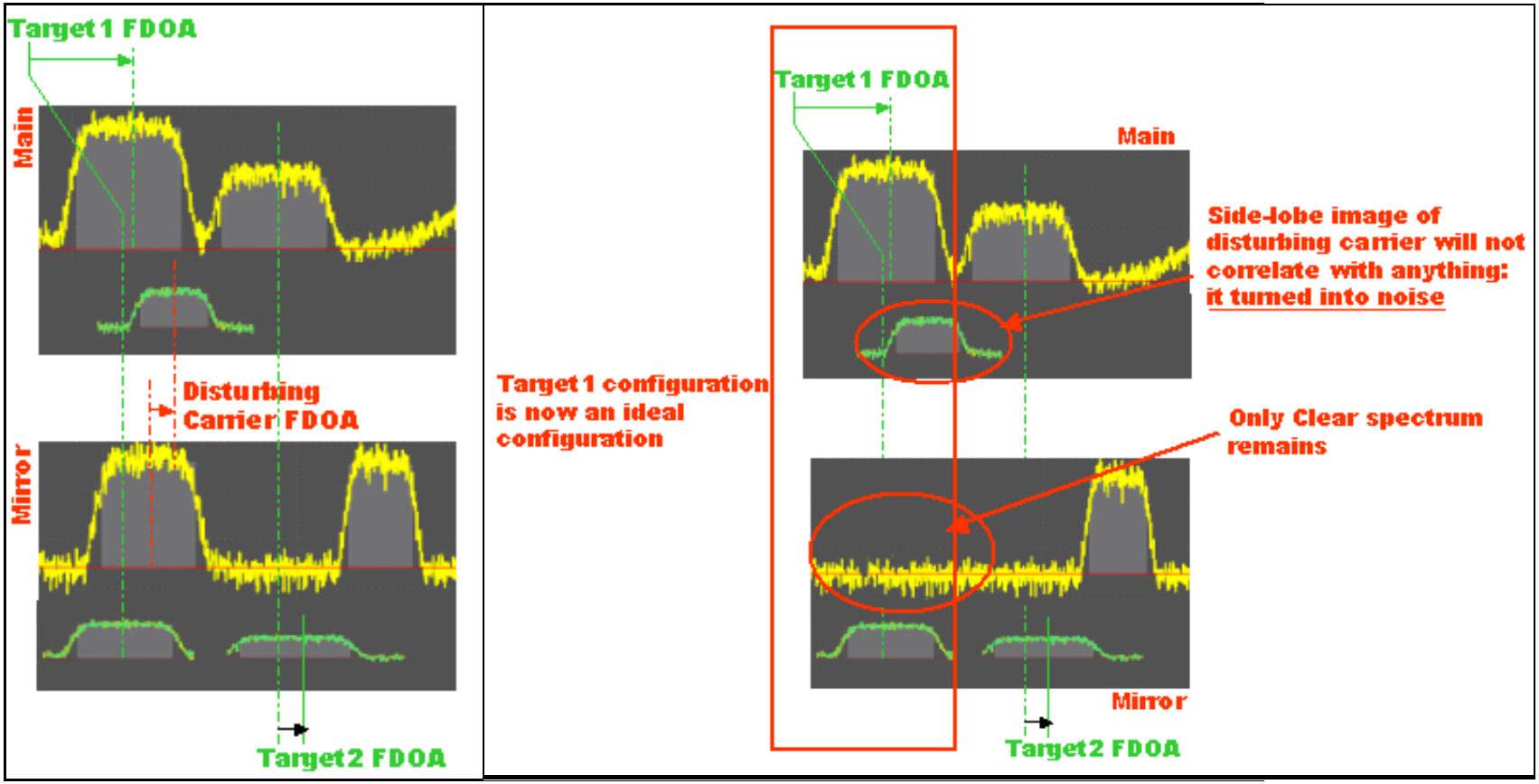


CGL Performances

Detection – Computation of accurate TDOA / FDOA

Carrier Cancellation

- Up to 60 MHz wide Carrier cancellation before correlation



CGL Performances

Location Accuracy – Resolution of the final position

Factors affecting location accuracy

FDOA/TDOA accuracy……..

Ephemeris ……..

Relative positions of the satellites ..
and position of the references

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 and configuration

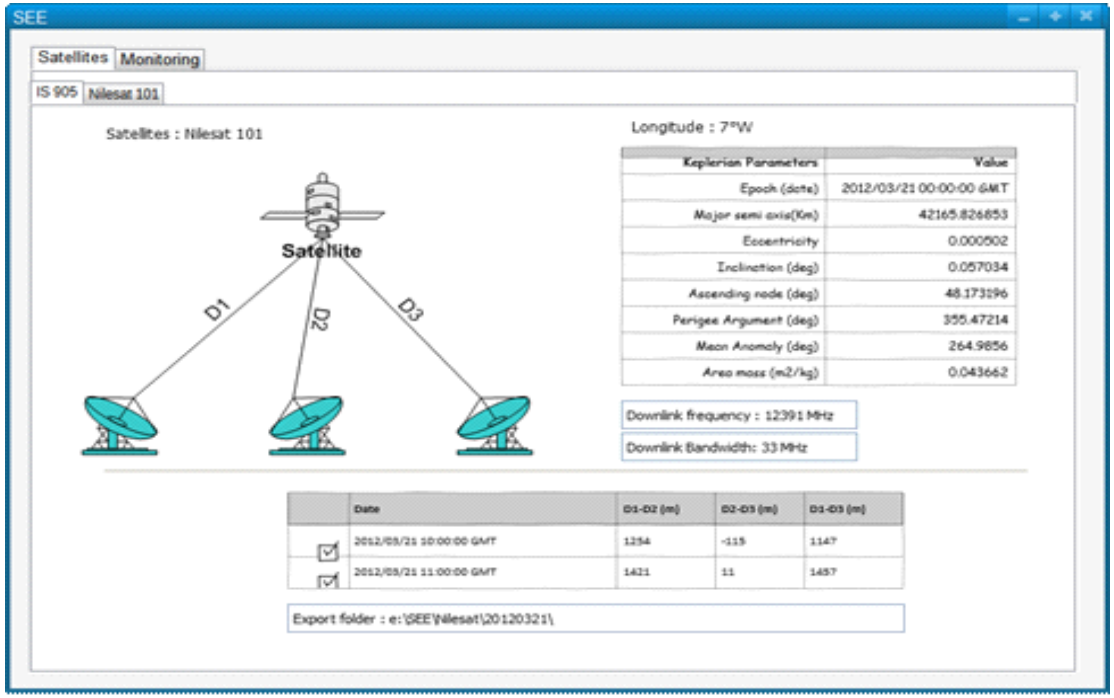
CGL Performances

Location Accuracy – Resolution of the final position

Principles

Passive ephemeris estimation add-on to CGL 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.



CGL Performances

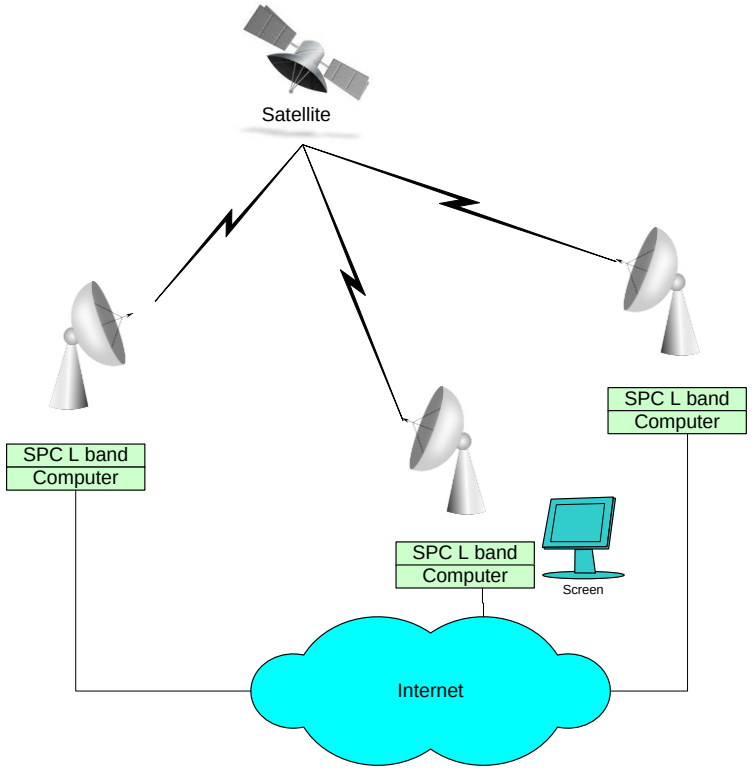
Location Accuracy – Resolution of the final position

Operating mode

The operating mode then solely relies on a single reference carrier.

The main purpose is to reach the accuracy at which one can use geolocation results without the use of additional reference transmitters.

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



CGL 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

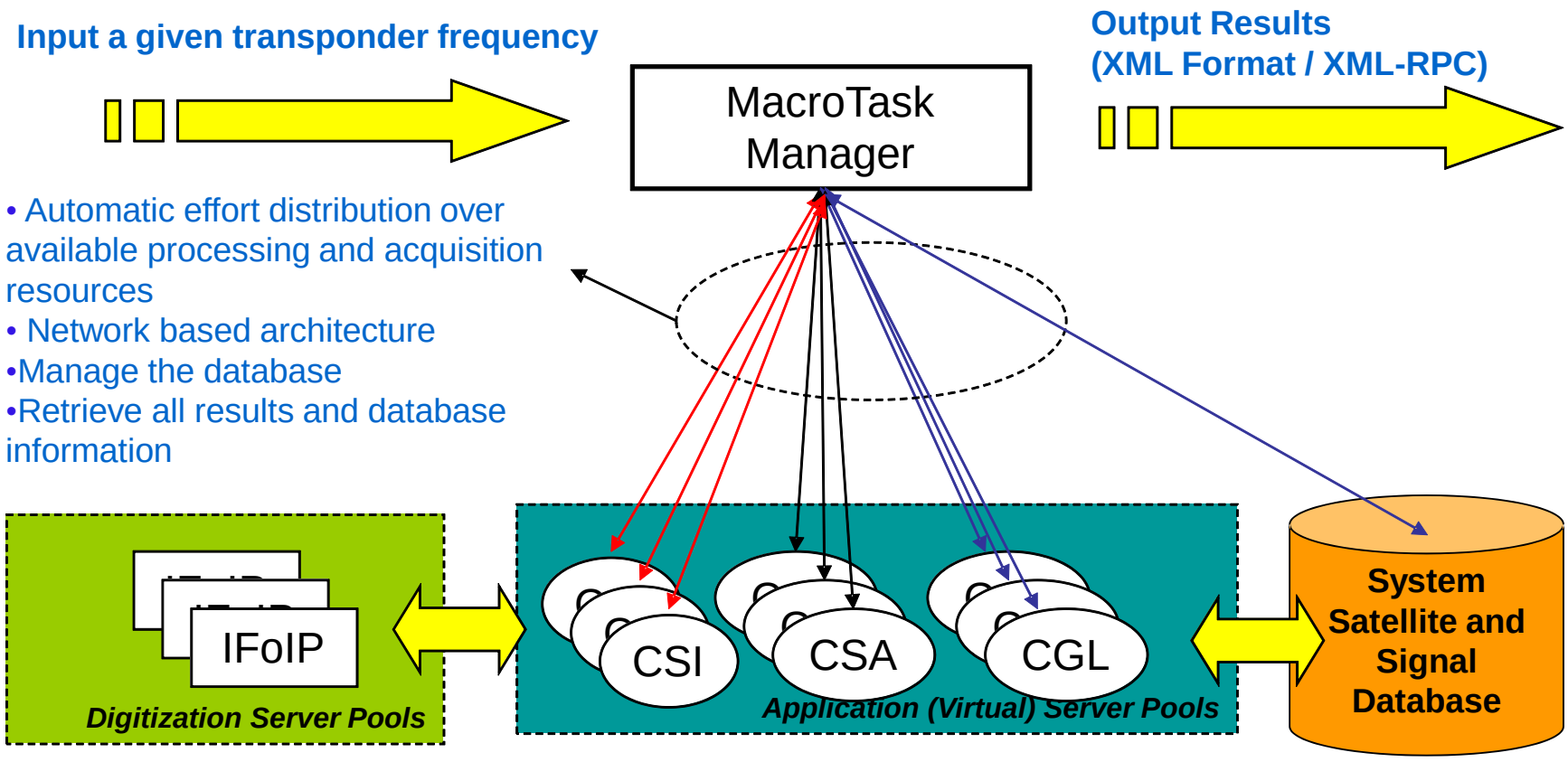
➔ Scalable system architecture

➔ Stand alone system

CGL Performances

Operating Mode - Automated MacroTasks Architecture

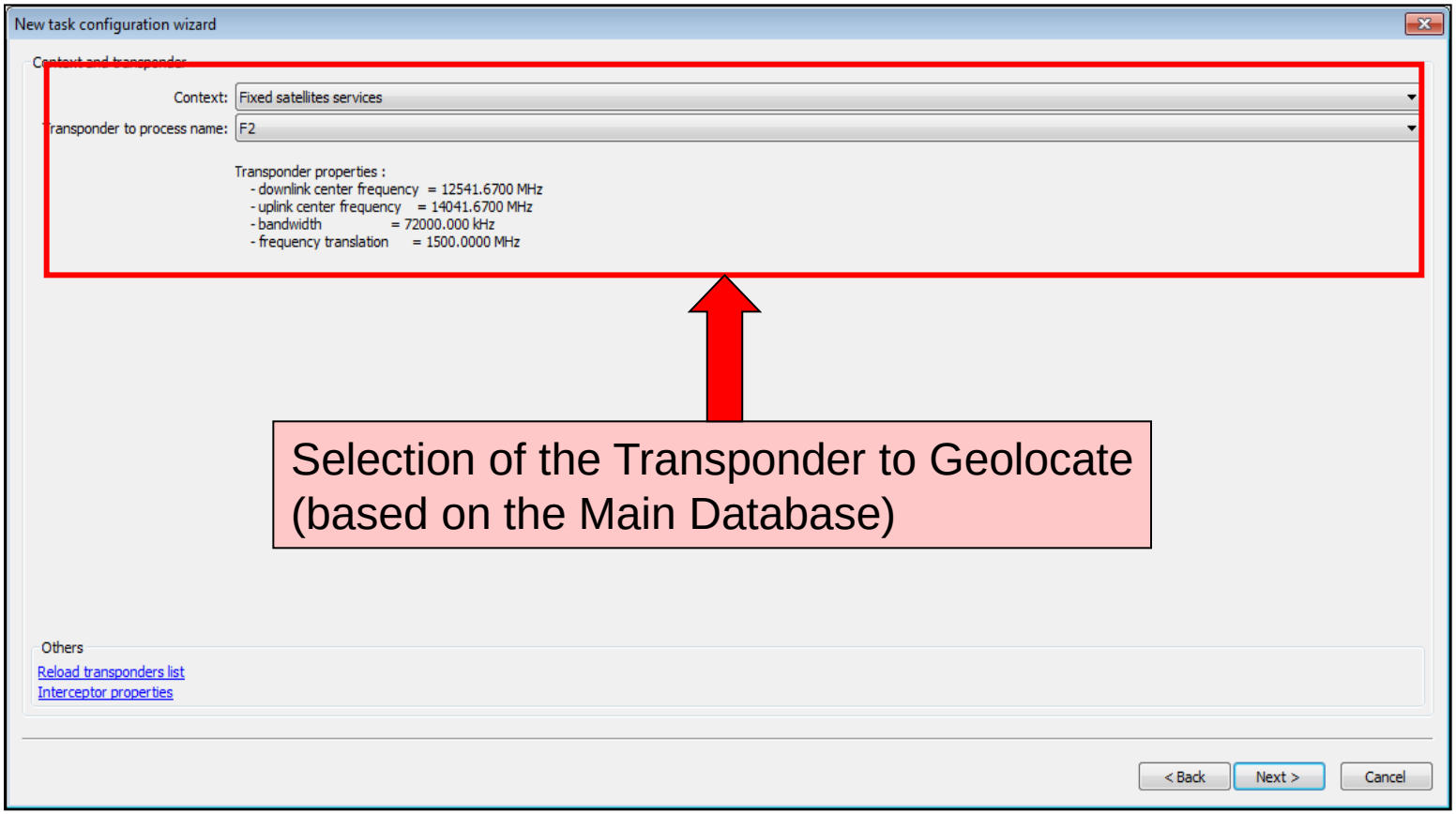
Main principles



CGL Performances

Operating Mode - Automated MacroTasks Architecture

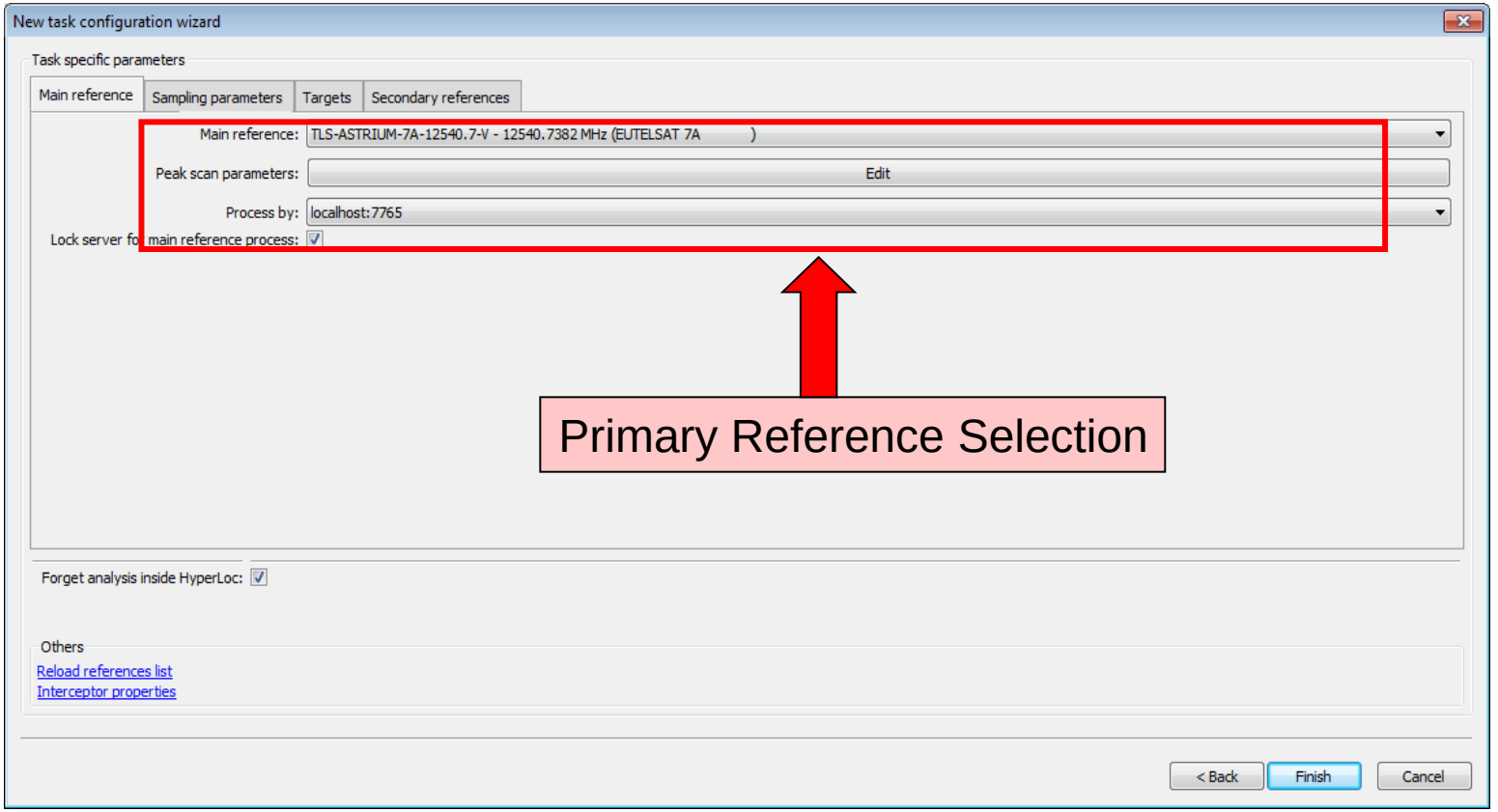
Select your satellite and transponder



CGL Performances

Operating Mode - Automated MacroTasks Architecture

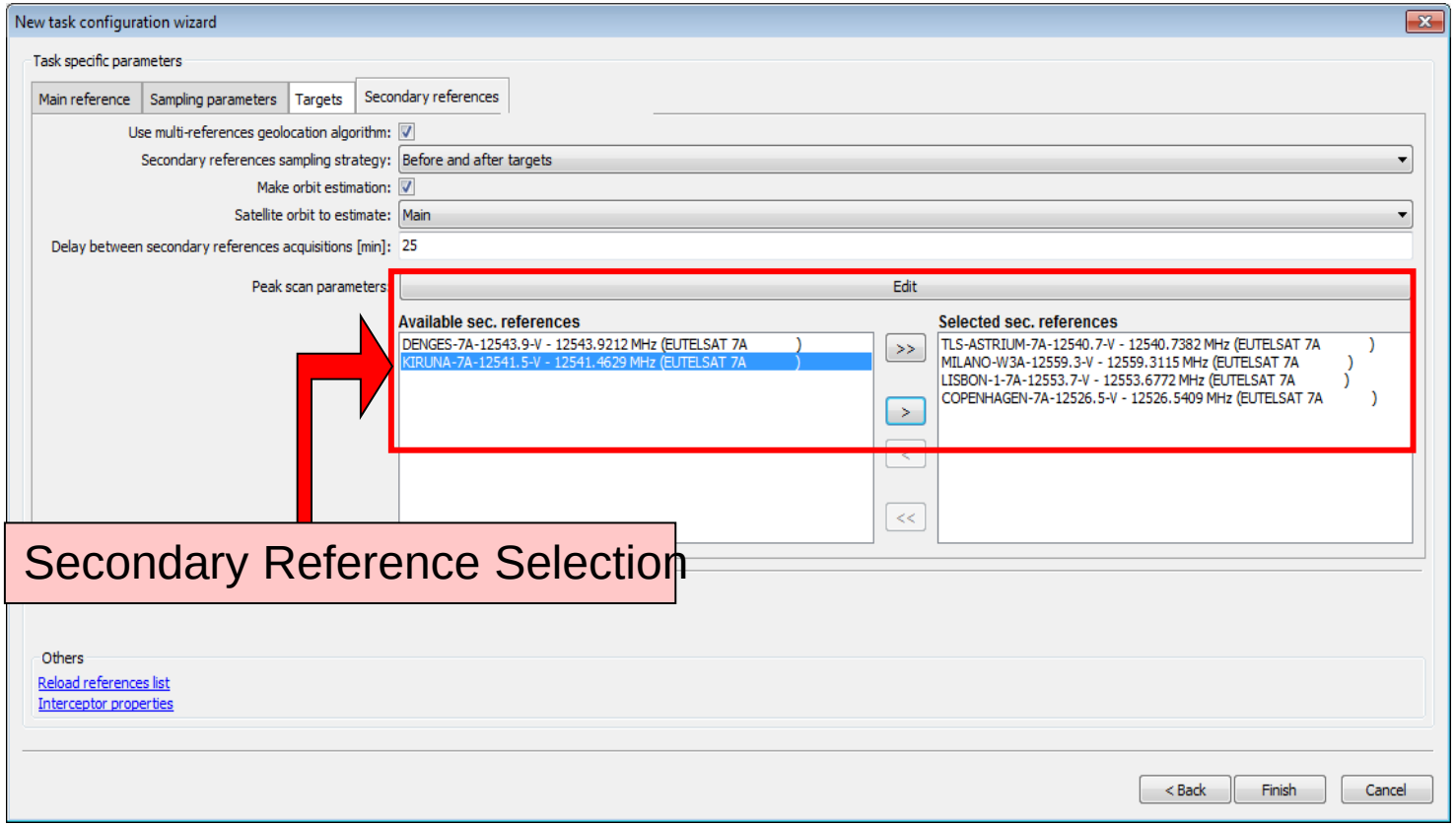
Select your primary reference



CGL Performances

Operating Mode - Automated MacroTasks Architecture

Select your secondary references

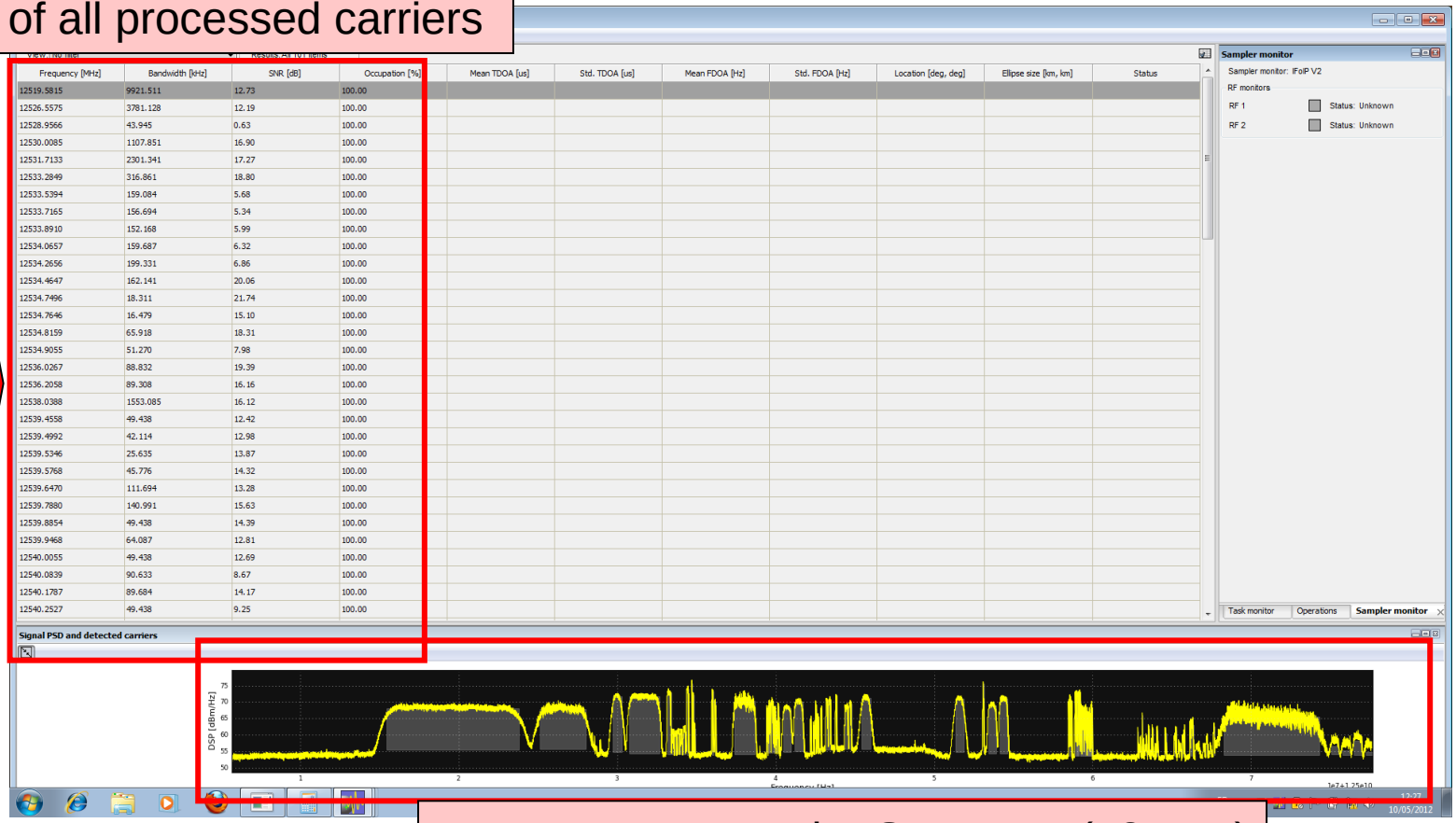


CGL Performances

Operating Mode - Automated MacroTasks Architecture

Select the carriers to locate

Set of all processed carriers



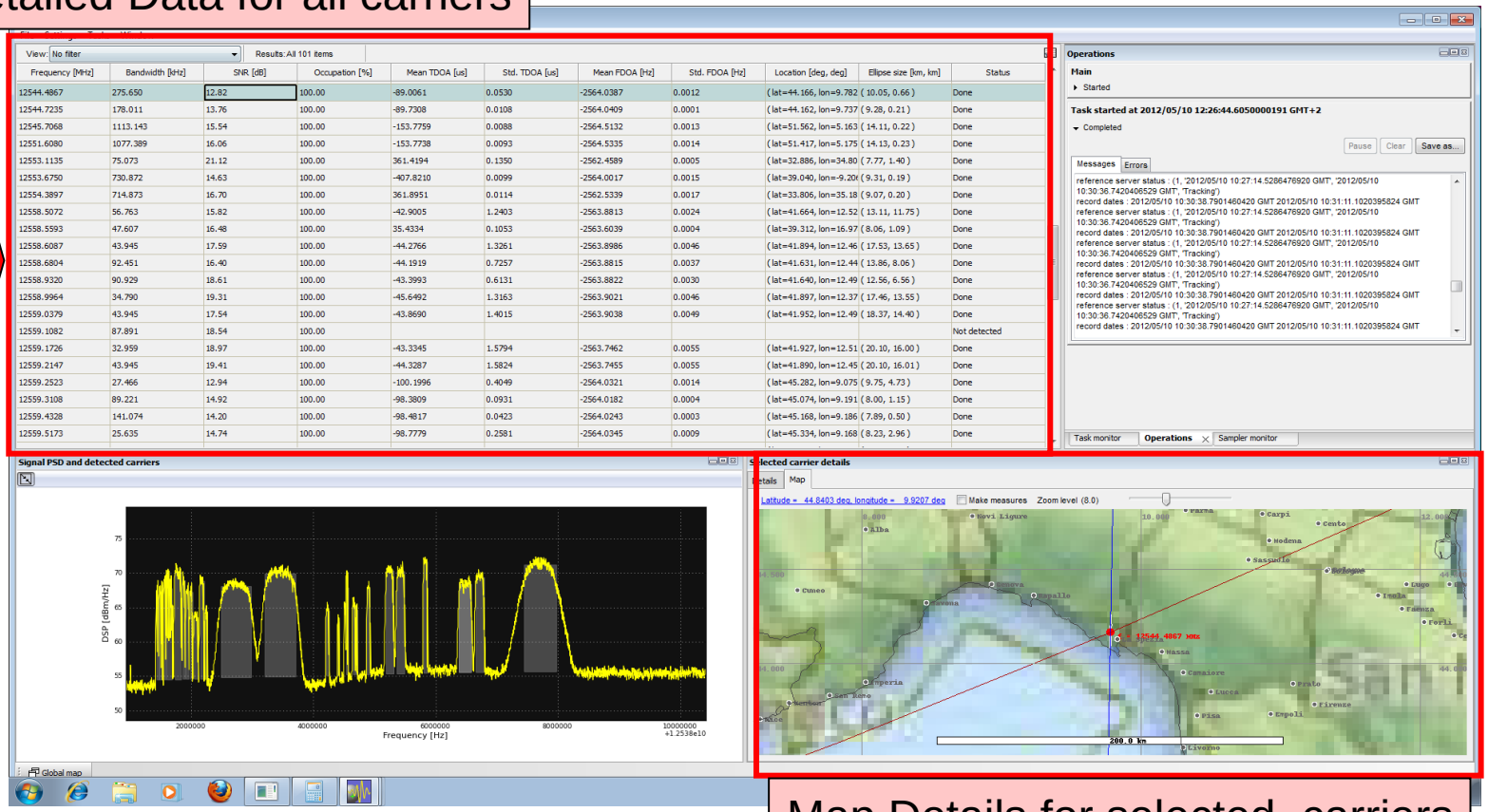
Process Transponder Spectrum (72MHz)

CGL Performances

Operating Mode - Automated MacroTasks Architecture

Results: positions & information on the carriers

Detailed Data for all carriers

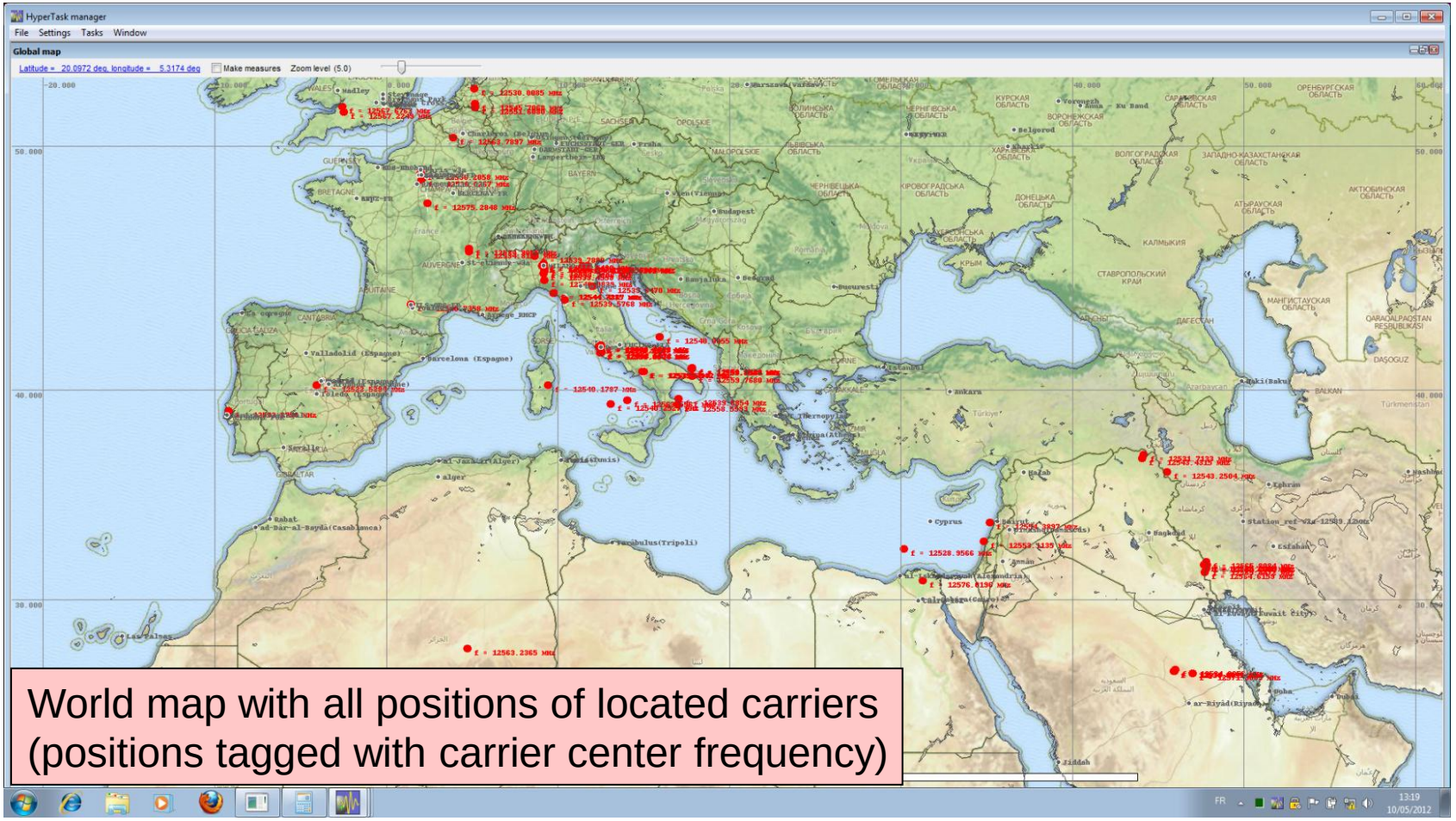


Map Details for selected carriers

CGL Performances

Operating Mode - Automated MacroTasks Architecture

Results: positions on the map



World map with all positions of located carriers (positions tagged with carrier center frequency)

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CGL Performances

Mitigation time – Automated interference detection and geolocation

Mitigation time

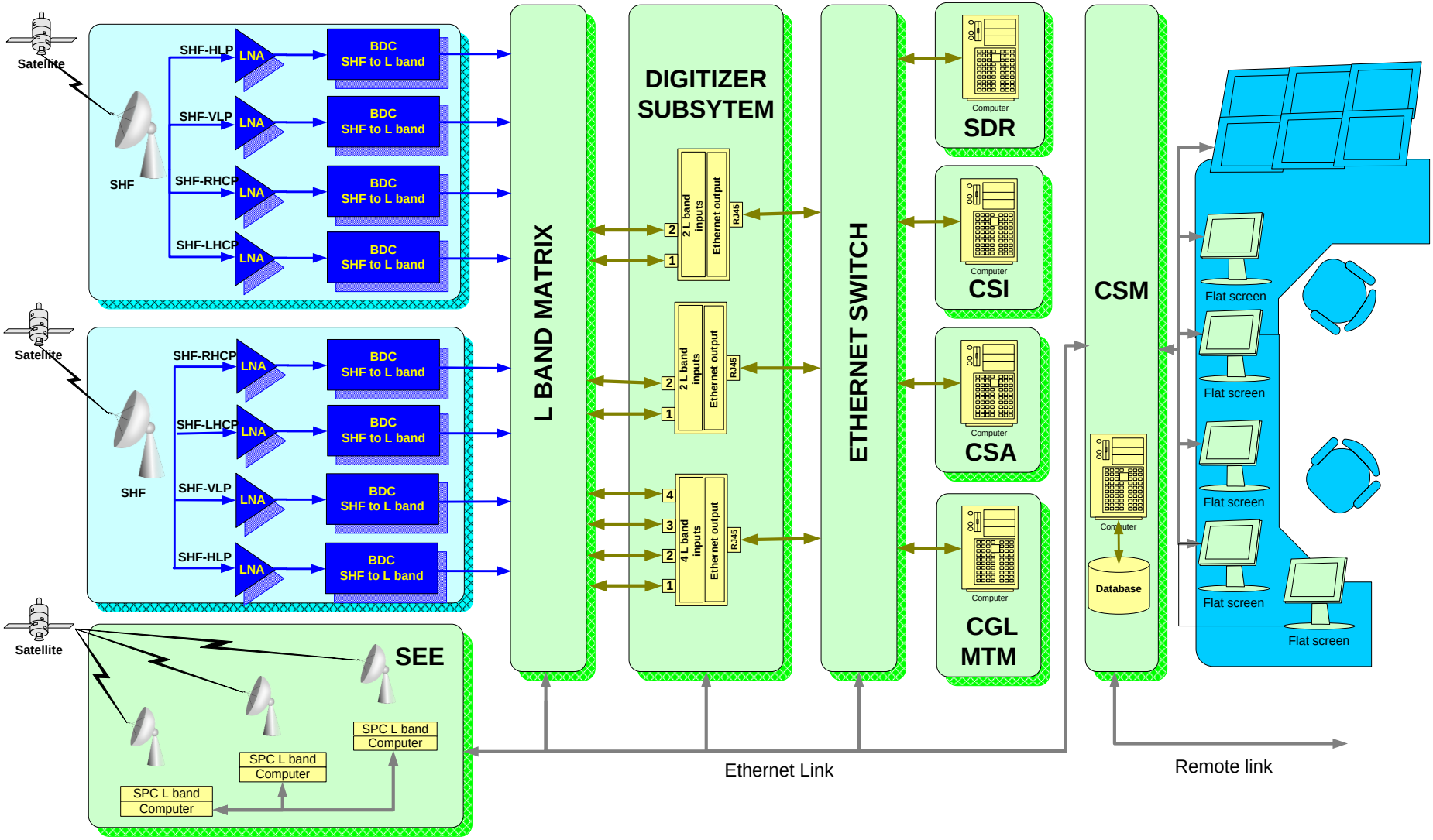
Hardware performances ……
Number of samples to process ……
High processing ……
Detection and Geolocation ……

ZDS supplies

- ➔ Dedicated Hardware filtering architecture
- ➔ Multithreaded software
- ➔ 64-bit Multi-Core Optimized software
- ➔ Automated detection and Geolocation included in the CSM feature

CGL Performances

Mitigation time – Automated interference detection and geolocation



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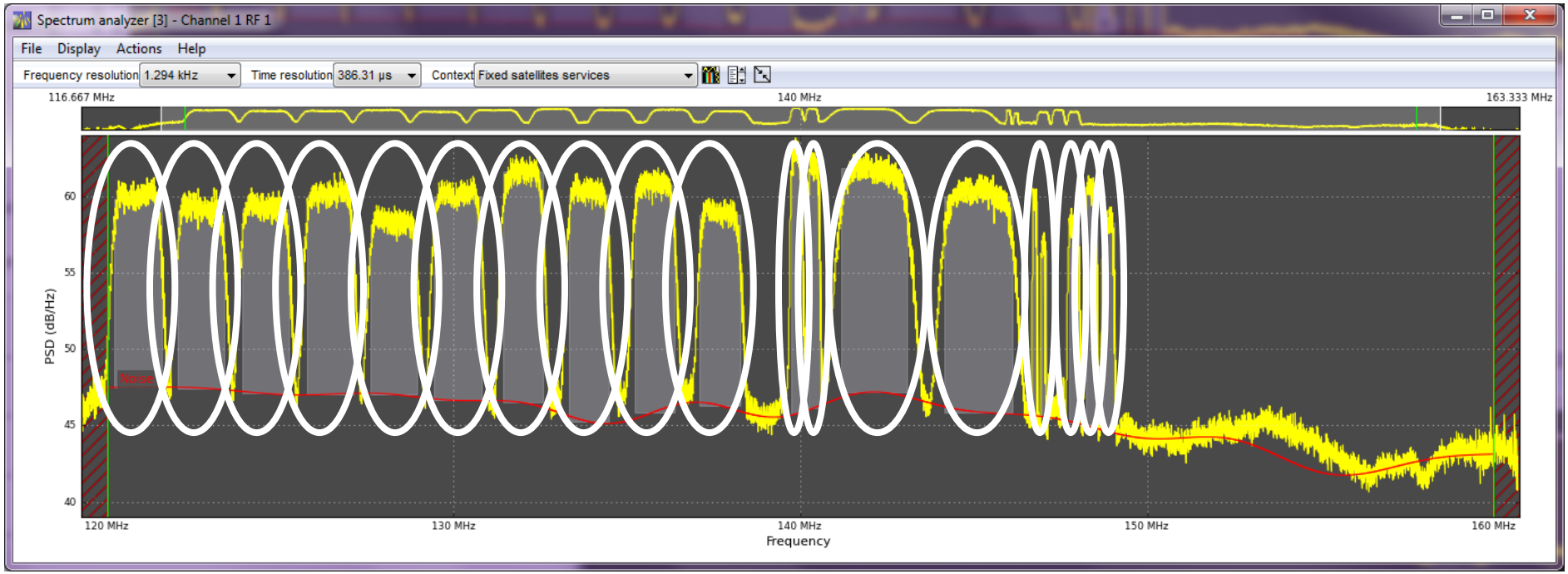
CSM Performances

Learning mission – Detection of all carriers

Case of a new satellite



- CSM uses CSI to detect carriers
- CSI sends list of detected carrier to CSM

CSM Performances

Learning mission – Analysis of all carriers

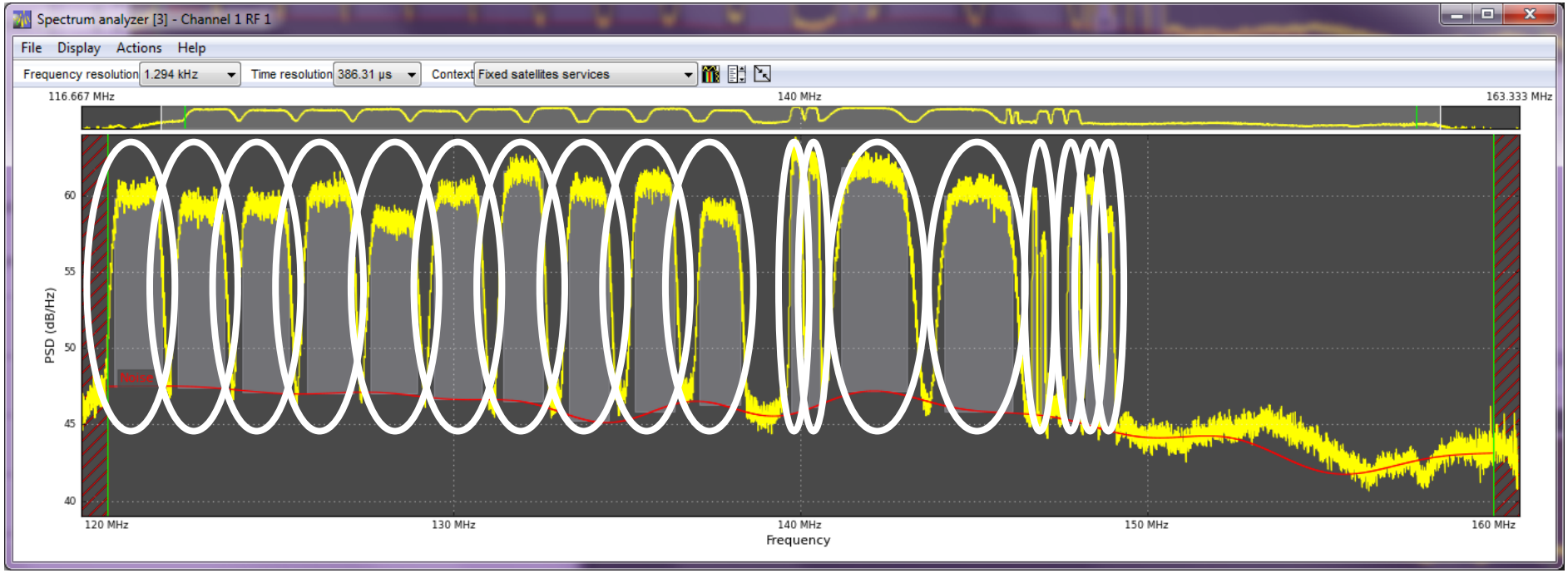
Case of a new satellite

Id	Fc	BW	Bit rate	Symbol rate	SNR	Constellation	Inner code	Outer code	Overhead	Standard
6	132.01 MHz	1.57 MHz	2.048 Mb/s	1.17 MBd	15.6 dB	QPSK	CV(7,7/8)	None	None	IESS-309
7	133.89 MHz	1.67 MHz	2.048 Mb/s	1.17 MBd	14.5 dB	QPSK	CV(7,7/8)	None	None	IESS-309
8	135.79 MHz	1.79 MHz	2.048 Mb/s	1.17 MBd	12.2 dB	QPSK	CV(7,7/8)	None	None	IESS-309
9	137.68 MHz	1.59 MHz	2.048 Mb/s	1.17 MBd	12.6 dB	QPSK	CV(7,7/8)	None	None	IESS-309
10	139.9 MHz	557.45 kHz	512.000 kb/s	341.33 kBd	15.3 dB	QPSK	TPC 3/4	None	None	IESS-309
11	140.4 MHz	484.23 kHz	512.000 kb/s	341.33 kBd	14.5 dB	QPSK	TPC 3/4	None	None	IESS-309
12	142.12 MHz	2.87 MHz	3.072 Mb/s	2.05 MBd	15.1 dB	QPSK	CV(7,3/4)	None	None	IESS-309
13	145.14 MHz	2.69 MHz	3.072 Mb/s	2.05 MBd	14.6 dB	QPSK	CV(7,3/4)	None	None	IESS-309
14	146.77 MHz	169.68 kHz	128.000 kb/s	128.00 kBd	10.3 dB	QPSK	CV(7,1/2)	None	None	IESS-308
15	147.02 MHz	157.51 kHz	128.000 kb/s	128.00 kBd	9.9 dB	QPSK	CV(7,1/2)	None	None	IESS-308
16	147.9 MHz	447.67 kHz	512.000 kb/s	341.33 kBd	13.1 dB	QPSK	CV(7,3/4)	None	None	IESS-309
17	148.4 MHz	450.06 kHz	512.000 kb/s	341.33 kBd	15.4 dB	QPSK	CV(7,3/4)	None	None	IESS-309
18	148.9 MHz	447.5 kHz	512.000 kb/s	341.33 kBd	14.6 dB	QPSK	CV(7,3/4)	None	None	IESS-309

- CSM uses CSA to do for all detected carriers blind analysis and to fill database.

CSM Performances

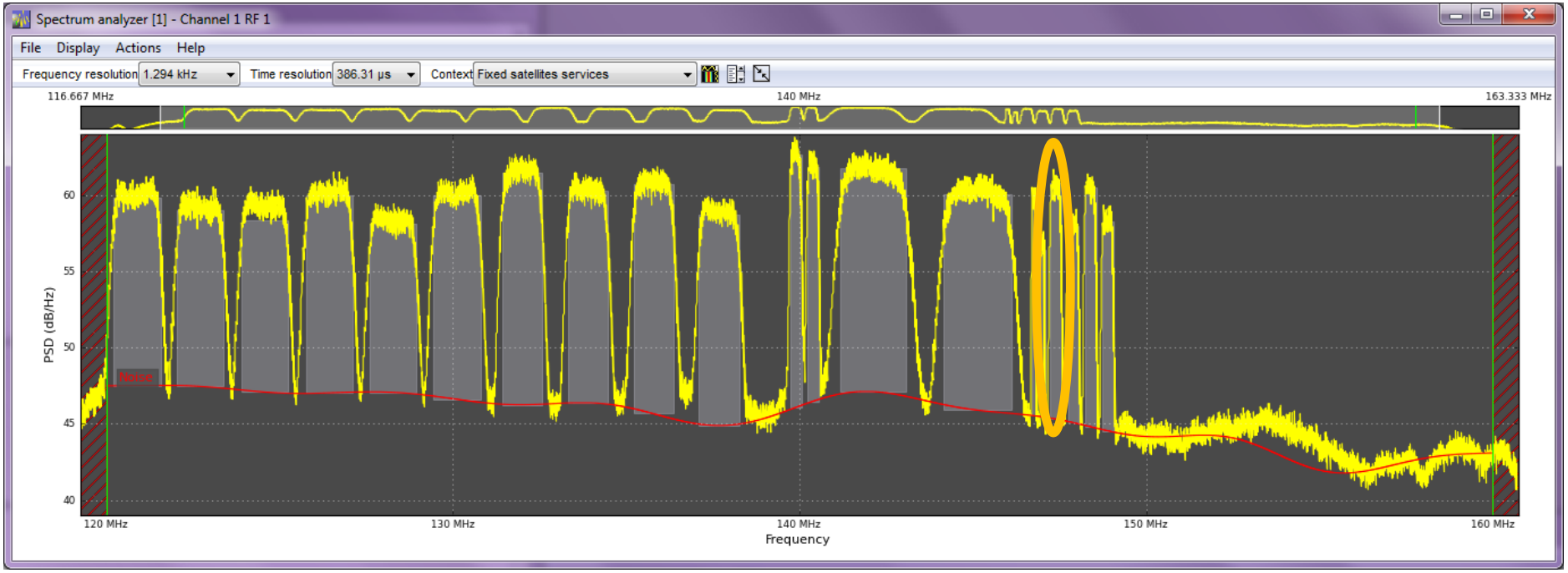
Monitoring mission – Monitoring of all carriers



- CSM uses CSI to check Quality of service for each defined carrier
- CSI sends list of results to CSM

CSM Performances

Monitoring mission – Monitoring of all carriers



- CSI sends list of new detected carrier, also list of disappear carrier to CSM

CSM Performances

Monitoring mission – Analysis and Geolocation of interference

- For a monitoring mission, operator can defined tasks will be launch when a new carrier is detected, like:
  - Blind analysis;

Id	Fc	BW	Bit rate	Symbol rate	SNR	Constellation	Inner code	Outer code	Overhead	Standard
16	147.4 MHz	458.69 kHz	512.000 kb/s	341.33 kBd	15.5 dB	QPSK	CV(7,3/4)	None	None	IESS-309

  - Blind analysis + save results in database;
  - Geolocation;
  - Blind analysis + geolocation …

CGL Latest technologies

Roadmap – Coming up in the future

New request

TDMA signal ……
Ka Band……
Spotted satellites ……

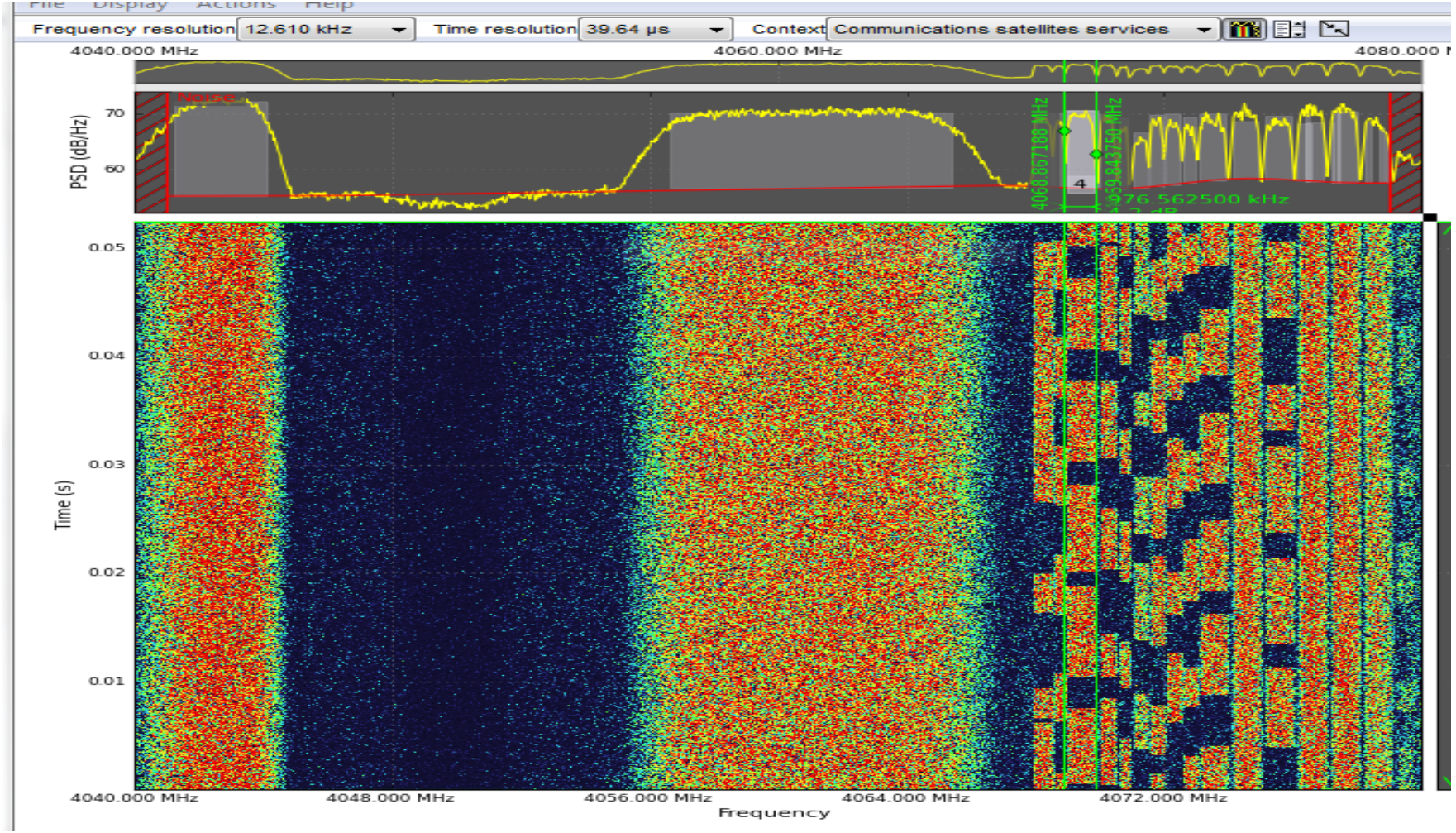
ZDS Upcoming Features

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

CGL Performances

Roadmap – Geolocation of TDMA users

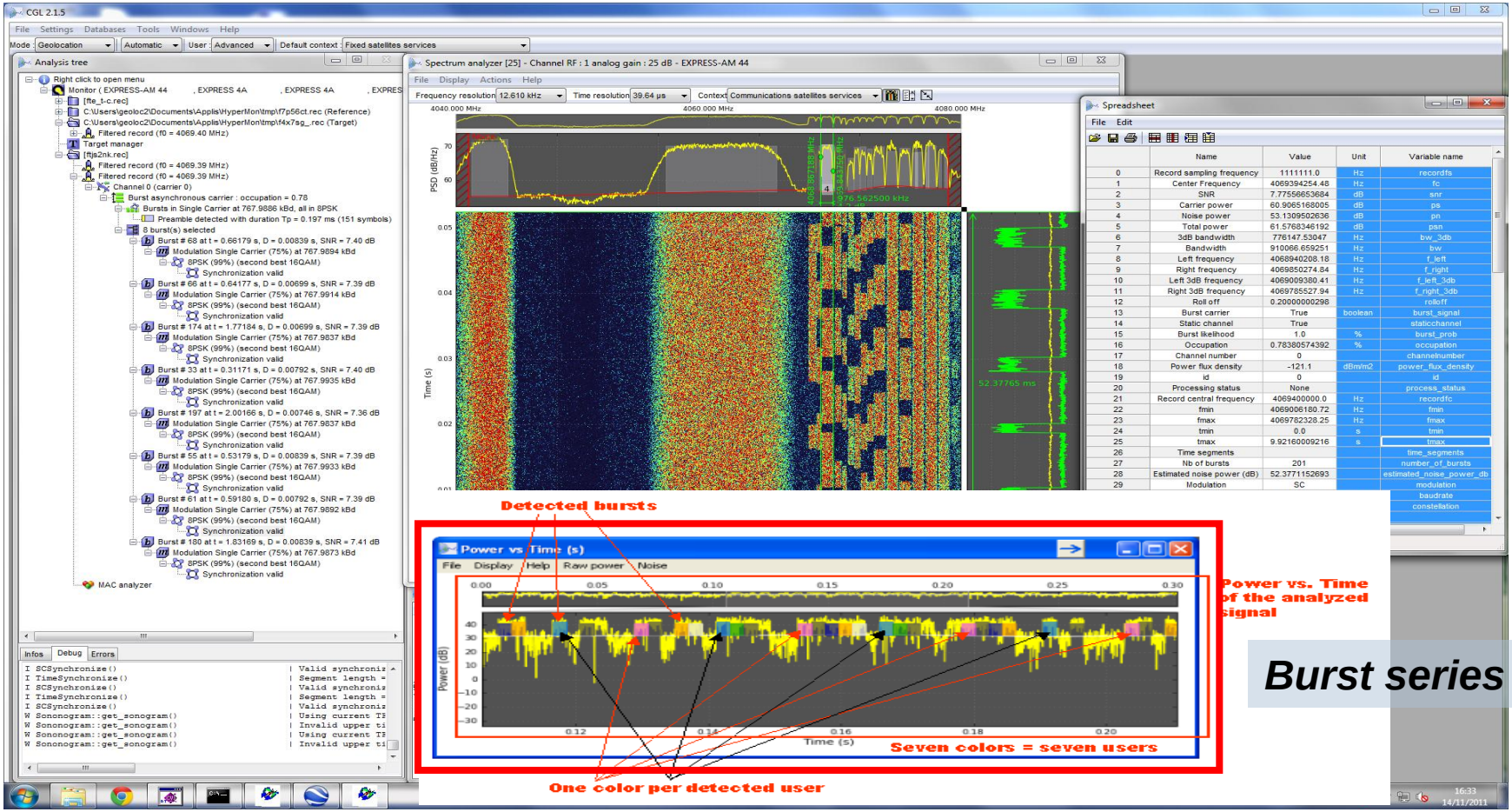
In TDMA context



CGL Performances

Roadmap – Geolocation of TDMA users

In TDMA context

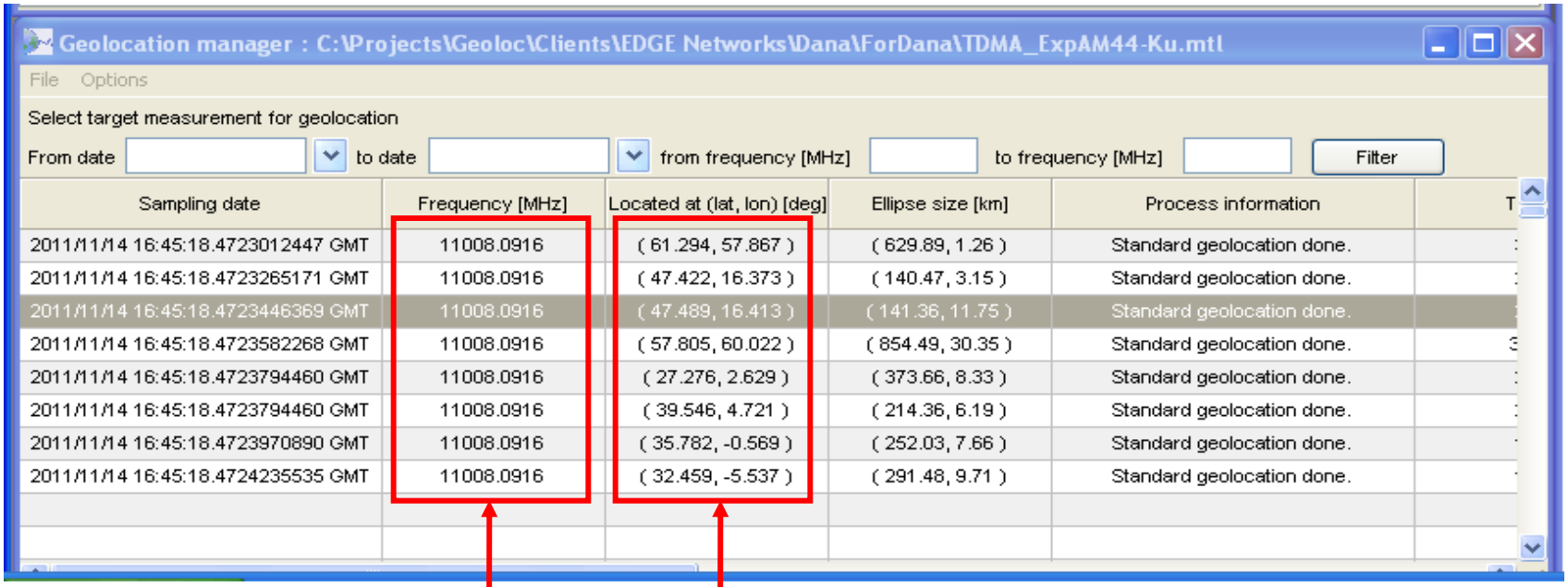


ZODIAC AEROSPACE

CGL Performances

Roadmap – Geolocation of TDMA users

In TDMA context



Sampling date	Frequency [MHz]	Located at (lat, lon) [deg]	Ellipse size [km]	Process information
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.
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

CGL Performances

Network example – Geolocation of TDMA users

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Thank you !