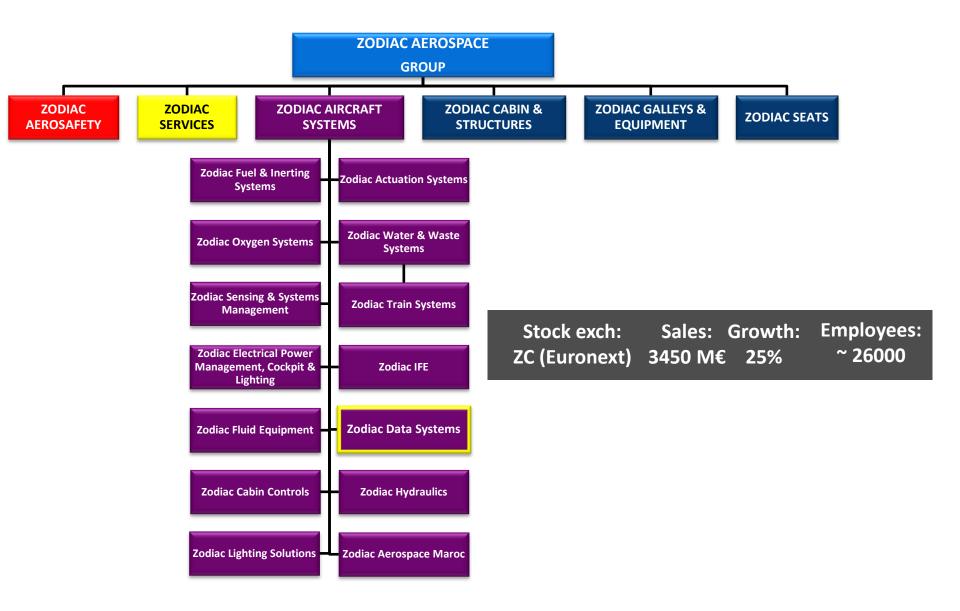
ZODIAC DATA SYSTEMS

AEROSPACE



ZODIAC AEROSPACE

Mastering The Elements

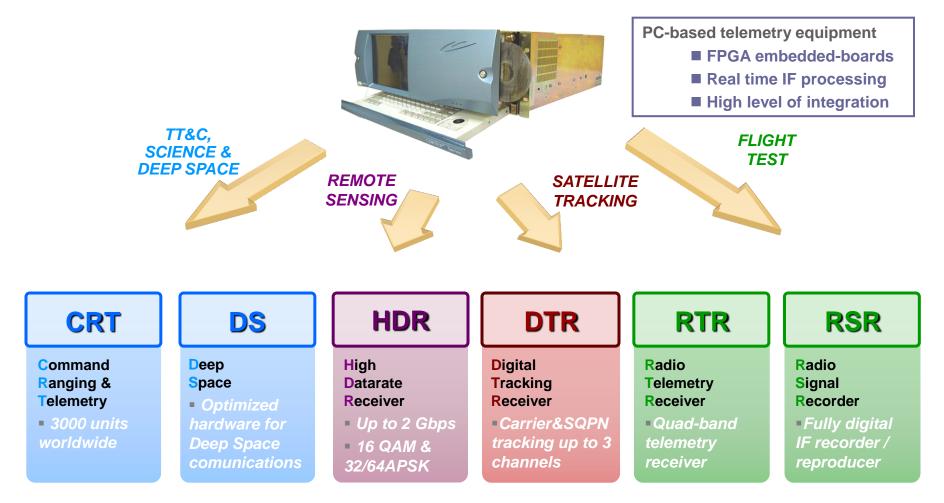


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The CORTEX Family

One philosophy, Multiple applications

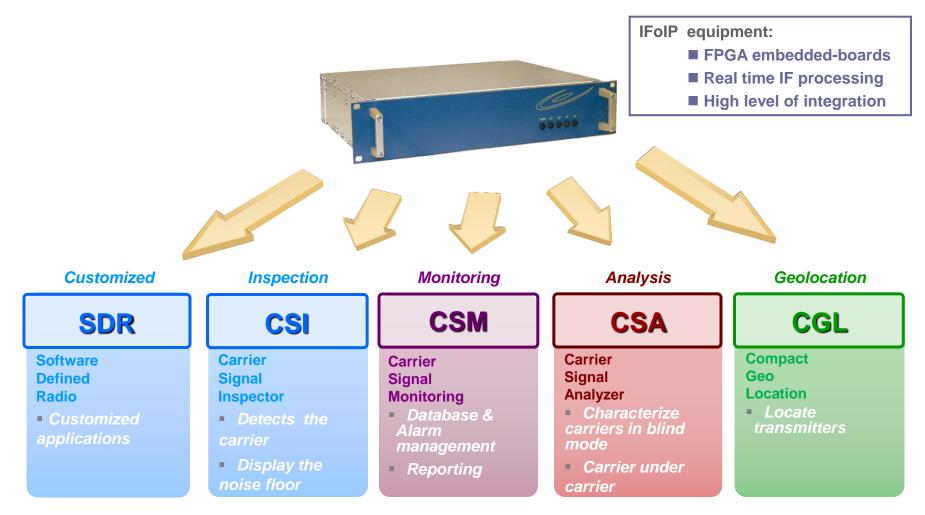


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The IFoIP Family

One hardware, Multiple applications



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48°19'07.61" N 3'58'08.33" E

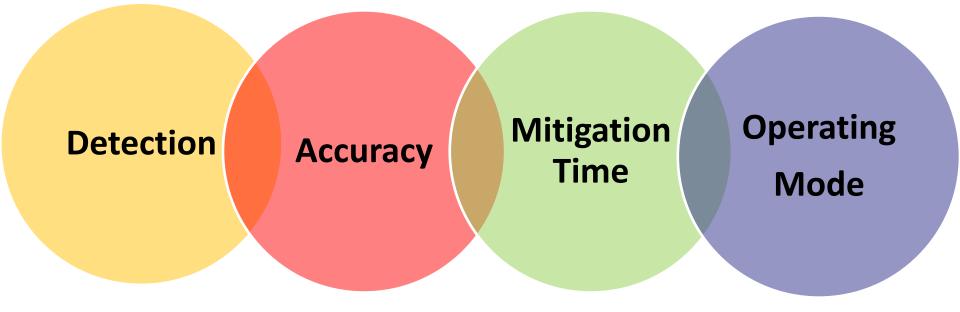
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• Brienne-le-0

Geolocation Performance Pilars



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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

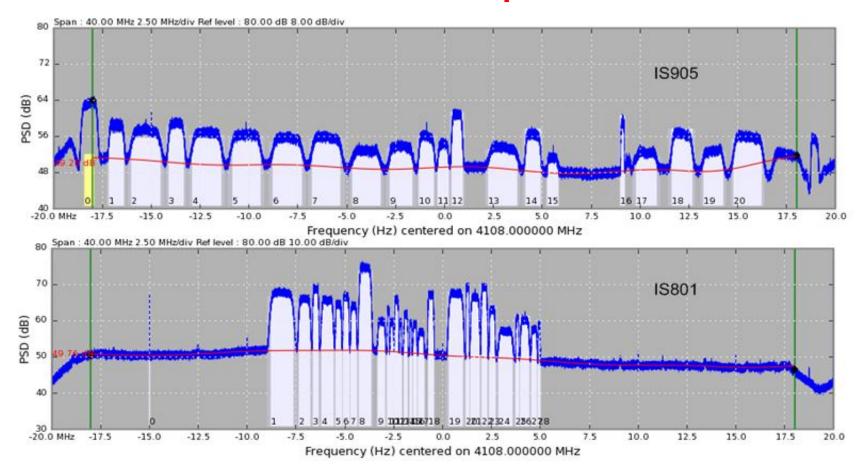
Highly flexible, high throughput digitizer architecture

Ability to perform wide band recording during tens of seconds



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Detection – Computation of accurate TDOA / FDOA Geoloc Examples

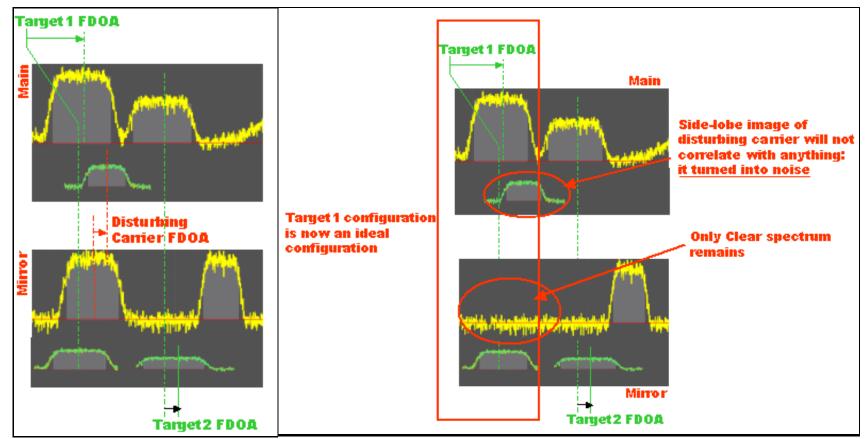


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Detection – Computation of accurate TDOA / FDOA Carrier Cancellation

Up to 60 MHz wide Carrier cancellation before correlation



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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

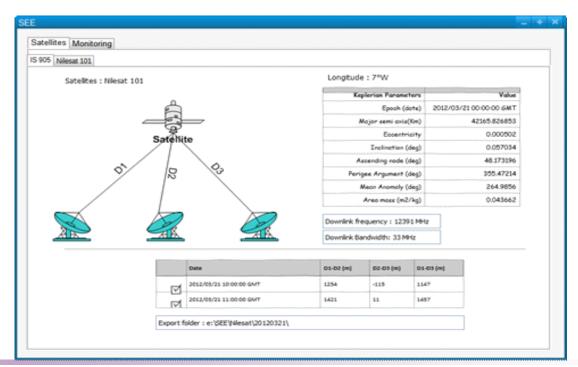


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Satellite Ephemeris Estimator Passive ephemeris estimation add-on to geolocation system

Principles

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.







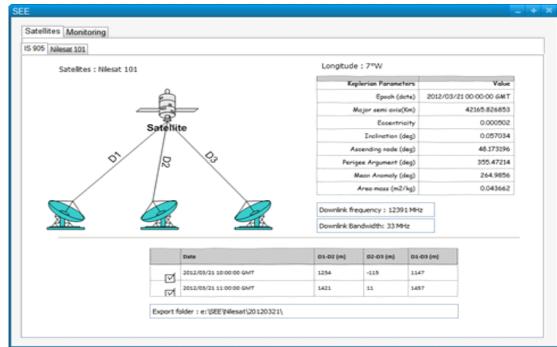
Satellite Ephemeris Estimator

Passive ephemeris estimation add-on to geolocation system

Accuracy

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

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



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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

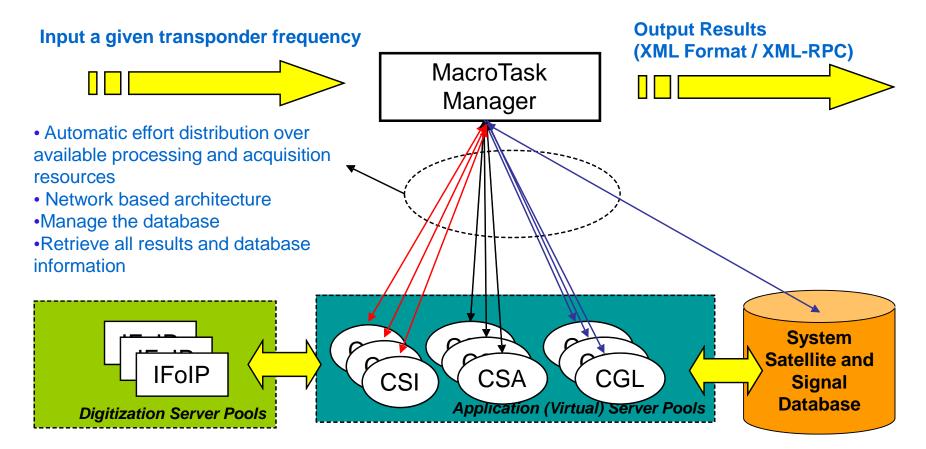
Geolocation-aware transponder monitoring Continuous Co-Orbit Estimation Multi-Carrier oriented Hardware Design

- Expert mode
- Multi-site GPS synchronisation
- → XML interfaces
- Scalable system architecture
- Stand alone system



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Operating Mode: Automated MacroTasks Architecture Main principles



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Operating Mode: Automated MacroTasks Architecture A simple configuration process



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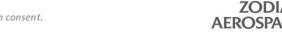




Operating Mode: Automated MacroTasks Architecture Select your satellite and transponder

New task configur	ration wizard			—
Context and tran		Fixed satellites services		
transporter to				
ransponder to	process name:	FZ		`
		Transponder properties : - downlink center frequency = 12541.6700 MHz - uplink center frequency = 14041.6700 MHz - bandwidth = 72000.000 kHz - frequency translation = 1500.0000 MHz		
		Selection of the Transponder to Geolocate (based on the Main Database)		
Others Reload transpon Interceptor prop			J	
			< Back Next >	Cancel

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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

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Operating Mode: Automated MacroTasks Architecture Select your secondary references

N	lew task configuration wizard									
	Task specific parameters									
	Main reference Sampling parameters Targets Seco	undary references								
	Use multi-references geolocation algorithm:									
	Secondary references sampling strategy:	fore and after targets								
	Make orbit estimation:									
	Satellite orbit to estimate:									
	Delay between secondary references acquisitions [min]	25								
	Peak scan parameters	Edit								
		Available sec. references Selected sec. references								
		DENGES-7A-12543.9-V - 12543.9212 MHz (EUTELSAT 7A) [KIRUNA-7A-12541.4629 MHz (EUTELSAT 7A) [KIRUNA-7A-12541.4629 MHz (EUTELSAT 7A) [KIRUNA-7A-12541.4629 MHz (EUTELSAT 7A) [KIRUNA-7A-12553.7V - 12553.6772 MHz (EUTELSAT 7A) [KIRUNA-7A-12553.7V - 12553.6772 MHz (EUTELSAT 7A) [KIRUNA-7A-1256.5-V - 12526.5409 MHz (EUTELSAT 7A) [KIRUNA-7A-12526.5-V - 12526.5409 MHz (EUTELSAT 7A)								
Select •Autom estimat • Auton	<i>dary Reference</i> <i>ion for :</i> natic Ephemeris tion natic Multi- nce Correction	<								

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Operating Mode: Automated MacroTasks Architecture Select the carriers to locate

/iew; No filter		 Results: All 101 iter 	15								Sampler moni	itor
Frequency [MHz]	Bandwidth [kHz]	SNR [dB]	Occupation [%]	Mean TDOA [us]	Std. TDOA [us]	Mean FDOA [Hz]	Std. FDOA [Hz]	Location [deg, deg]	Ellipse size [km, km]	Status	Sampler monit	
19.5815	9921.511	12.73	100.00	incar room (as)	otal foor (a)	neurroonting	oldin bon (hil)	cocoson (acg) acg)	Captor and faily and	0.000	RF monitors	
26.5575	3781.128	12.19	100.00								RF 1	Status: Unknown
28.9566	43.945	0.63	100.00								RF 2	Status: Unknown
30.0085	1107.851	16.90	100.00									
31.7133	2301.341	17.27	100.00								E	
33.2849	316.861	18.80	100.00									
33.5394	159.084	5.68	100.00									
33.7165	156.694	5.34	100.00									
33.8910	152.168	5.99	100.00									
34.0657	159.687	6.32	100.00									
34.2656	199.331	6.86	100.00	Oat			!					
34.4647	162.141	20.06	100.00	Set	nt all	proce	ssed	carrie	rs			
34.7496	18.311	21.74	100.00	000		p1000	0000	Junio				
34.7646	16.479	15.10	100.00									
34.8159	65.918	18.31	100.00									
34.9055	51.270	7.98	100.00									
36.0267	88.832	19.39	100.00									
36.2058	89.308	16.16	100.00									
38.0388	1553.085	16.12	100.00									
539.4558	49.438	12.42	100.00									
539.4992	42.114	12.98	100.00									
539.5346	25.635	13.87	100.00									
539.5768	45.776	14.32	100.00									
539.6470	111.694	13.28	100.00									
39.7880	140.991	15.63	100.00									
39.8854	49.438	14.39	100.00									
39.9468	64.087	12.81	100.00									
40.0055	49.438	12.69	100.00									
540.0839	90.633	8.67	100.00									
40.1787	89.684	14.17	100.00	D					1			
40.2527	49.438	9.25	100.00	Proc	<u> </u>	ransn	onde	r Spec	ctrum	1721/	Tasmonior	Operations Sampler n
		-		1100	000 1	runop	Unde		Juan		·· · · ∠ /	
nal PSD and detecte	d carriers											
	_											
	DSP (dBm/Hz)	75 70 65 60 55					Mulli					

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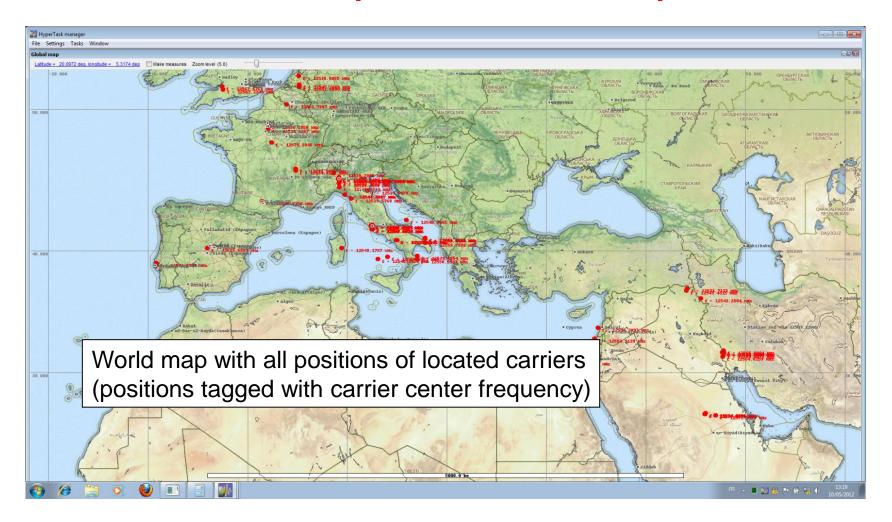
Operating Mode: Automated MacroTasks Architecture Results: positions & information on the carriers

225.4.59 225.4.59 225.4.59 225.4.59 225.4.59 225.4.59 255.4.		Frequency [MHz]		Results:A	JI 101 items								Operations
			Bandwidth [kHz]	SNR [dB]	Occupation [%]	Mean TDOA [us]	Std. TDOA [us]						
1283.676 0.0.4 (14892.47), (1987.19) 000 (14992.47), (1987.19) 000 1283.676 7.0.6.27 146.3 00.0 47.02.20 0.009 1594.037 0.014 (1499.24.90) 0.015 (1499.26.90) 000 1283.676 7.0.6.27 146.3 00.00 47.06.20 0.003 1295.022 0.014 (1499.25.02) 0.001 (1499.26.00) 000 1199.022 <		مالم	d Dat	o for		o rri o	ro						
1283.676 0.0.4 (14892.47), (1987.19) 000 (14992.47), (1987.19) 000 1283.676 7.0.6.27 146.3 00.0 47.02.20 0.009 1594.037 0.014 (1499.24.90) 0.015 (1499.26.90) 000 1283.676 7.0.6.27 146.3 00.00 47.06.20 0.003 1295.022 0.014 (1499.25.02) 0.001 (1499.26.00) 000 1199.022 <		alle	a Dai	a ioi		carne	ers ⊨						
NAME			• •		•••••								
Name													
Link Age Dirac Dira Dirac <thdirac< th=""> <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<></thdirac<>													
1255 17.6 4.6 10.00 54.34 10.39 263.090 0.004 (H=93.312, be=45.77 (8.0, 1.09) Doe 1255.8607 43.46 17.90 10.00 44.2766 1.321 258.3883 0.004 (H=44.294, be=12.46 (12.58, 1.56) Dore 1255.8607 9.341 6.40 10.00 44.2766 1.321 258.3883 0.007 (H=44.294, be=12.46 (12.58, 1.56) Dore 1255.9507 9.343 0.000 44.293 0.277 258.3812 0.000 (H=44.494, be=12.46 (12.58, 1.55) Dore 1255.9507 9.341 0.000 45.692 0.051 (H=44.592, be=12.47 (12.58, 1.53) Dore													record dates : 2012/05/10 10:30:38.7901460420 GMT 2012/05/10 10:31:11.1020395824 GMT
1394 259 1000 44.276 1.281 243.886 0.046 (14+4.894, bm-12.46) (17.53, 13.65) Dee 1238.8647 42.41 14.40 0000 44.393 0.727 2458.815 0.007 (14+4.64, bm-12.46) (17.55, 15.06) Dee 1258.9647 9.929 18.61 1000 43.993 0.727 258.815 0.007 (14+4.64, bm-12.46) (17.55, 55) Dee 1258.9647 9.929 18.61 1000 45.992 1.150 258.982 0.009 (14+4.57, bm-12.46) (13.71, 14.30) Dee Dee De De <td></td> <td>10:30:36.7420406529 GMT', 'Tracking')</td>													10:30:36.7420406529 GMT', 'Tracking')
$\frac{1}{1000}$ 1													
1258.9320 0.929 18.61 00.00 43.993 0.6131 258.8822 0.003 (kt=41.64), (n=12.4) (12.56, 6.55) Dore Interest ever et al.900 1.9218900 (11.921.800) 1.9218900 (11.921.800) Dore Interest ever et al.800 1.9218900 (11.921.800) Dore Interest ever et al.800 Interest ever e													- 10:30:36.7420406529 GMT', 'Tracking')
1255 9964 9.70 9.31 00.00 45.692 1.345 256.3021 0.006 (tet=41.697, lon=12.37) (17.46, 13.55) Dore 1255 0.027 67.891 17.54 00.00 43.690 1.4015 256.3038 0.004 (tet=41.697, lon=12.37) (17.46, 13.55) Dore 1255 0.027 67.891 00.00 43.345 1.574 256.3038 0.004 (tet=41.697, lon=12.31) (13.01, 16.00) Dore Dore 10.0014 12.0126/10 10.21 / tradestrate 10.02058264 Gut 1255 0.127 0.784 9.445 0.000 43.345 1.574 2563.7452 0.0055 (tet=41.697, lon=12.41) (13.01, 16.00) Dore 10.03.93.790 146420 Gut 2012/05/10 10.31.11.1020595824 Gut 1255 0.217 27.46 13.44 00.00 43.335 1.594 2564.0121 0.0014 (tet=45.67, lon=3, 160 Dore 10.03.93.790 146420 Gut 2012/05/10 10.31.11.1020595824 Gut 10.011 10.03.93.790 10.03.11.11.020595824 Gut 10.011 Dore 10.011 10.011 10.020 10.011 10.011 10.011 10.011 10.011 10.011 10.011 10.011 10.011 10.011													reference server status : (1, '2012/05/10 10:27:14.5286476920 GMT, '2012/05/10
2590.079 43.945 17.54 100.00 43.8690 1.4015 2563.038 0.0049 (bt=41.922, lon=12.4) (bt=37, 14.49) lone Intervent status (1, '17 status)'' intervent status (1, '17 status)'' <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>record dates : 2012/05/10 10:30:38.7901460420 GMT 2012/05/10 10:31:11.1020395824 GMT</td></t<>													record dates : 2012/05/10 10:30:38.7901460420 GMT 2012/05/10 10:31:11.1020395824 GMT
1255:1082 87.891 18.54 100.00 41.335 1.574 256.742 0.005 (late+1.927, lon=12.51 (20.10) 16.00) Done 1255:125 12.99 18.97 100.00 43.345 1.574 256.7462 0.0055 (late+1.927, lon=12.51 (20.10) 16.00) Done 1255:125 21.47 13.94 100.00 44.3287 15.824 256.37452 0.0055 (late+1.927, lon=12.51 (20.10) 16.00) Done Incord state: 201206/10 10.23.38.7601460420 GMT 201206/10 10.31.11.102059524 GMT 1255:125 27.46 12.94 100.00 44.3287 15.824 256.37452 0.0051 (late+3.52, lon=2.057) (57.74, 37.37) Done 1255:125 14.74 100.00 49.3297 0.0031 1264.0122 0.0004 (late+3.52, lon=0.57) (57.74, 37.37) Done 1255:125 14.74 100.00 49.3297 0.0231 2564.0243 0.0003 (late+3.58, lon=3.18) Ome													reference server status : (1, '2012/05/10 10:27:14.5286476920 GMT', '2012/05/10
1259:176 299 18.97 100.00 43.345 1.574 2963.742 0.005 (tet=41.927, bn=12.31; (20.10, 16.00) Dore 1259:176 3945 15.41 100.00 44.3367 1.5924 2963.7452 0.0055 (tet=41.927, bn=12.31; (20.10, 16.00) Dore 1259:176 3945 15.41 100.00 44.3367 15924 2963.7452 0.0055 (tet=41.927, bn=12.31; (20.10, 16.00) Dore 1259:176 3945 15.944 2963.7452 0.0055 (tet=41.927, bn=12.41; (20.10, 16.01) Dore 1259:176 14.92 10.00 49.339 0.091 2564.0211 0.0014 (tet=45.97, bn=9.519; (E8.00, 115) Dore 1259:170 14.074 14.30 100.00 49.377 0.642 2564.0315 0.0009 (tet=45.168, bn=9.169; (Est=0.61)) Dore 1259:170 16.00 16.00 49.377 0.642 2564.0315 0.0009 (tet=45.168, bn=9.169; (Est=0.61)) Dore													record dates : 2012/05/10 10:30:38.7901460420 GMT 2012/05/10 10:31:11.1020395824 GMT
1259.232 27.46 12.94 100.00 400.195 0.499 2564.0321 0.0014 (let=45.282, lon=50.75 (9.75, 4.73) 0.001 1259.232 140.074 129 100.00 95.309 0.0331 2564.012 0.0004 (let=45.074, lon=5.191 (10.00, 1.15) 0.001 1259.232 141.074 12.0 100.00 95.309 0.0331 2564.012 0.0003 (let=45.65, lon=5.191 (10.00, 1.15) 0.001 1259.253 14.074 12.0 10.00 95.779 0.2581 2564.012 0.0003 (let=45.65, lon=9.16) (let=45.282, lon=50.75 (9.75, 4.73) 0.001 1259.253 14.074 12.0 10.00 95.00 95.00 95.00 95.0003 (let=45.074, lon=5.191 (10.00, 1.15) 0.001 1259.253 14.074 12.0 10.00 95.00 95.0003 (let=45.010, 1.15) 0.001 1259.253 14.74 10.000 96.779 0.2581 2564.012 0.0003 (let=45.010, 1.15) 0.001 1259.254.012 0.000 96.779 0.2581 2564.012 0.0003 (let=45.010, 1.15) 0.000 1259.254.012 0.000 96.779 0.2581 2564.012 0.0003 (let=45.010, 1.15) 0.000 1259.254.012 0.000 96.779 0.2581 2564.012 0.0009 (let=5.010, 1.15) 0.000 1259.254.012 0.000 96.779 0.2581 0.0000 96.779 0.2581 0.0000 96.779 0.000 96.			32.959	18.97	100.00	-43.3345	1.5794	-2563.7462	0.0055	(lat=41.927, lon=12.51 ((20.10, 16.00)	Done	
1259.3108 89.221 14.92 100.00 98.309 0.0931 -2540.0182 0.0004 (Mat+6.57%, Ion-9.191 (8.00, 1.15) Dore 1259.5123 14.074 14.30 100.00 98.417 0.0423 -2540.0243 0.0009 (Mat+6.58), Ion-9.196 (Mat+0.51) Dore Control (Mat+6.58) 0.0004 (Mat+6.37%, Ion-9.196 (Mat+6.58), Ion-9.196		12559.2147	43.945	19.41	100.00	-44.3287	1.5824	-2563.7455	0.0055	(lat=41.890, lon=12.45 ((20.10, 16.01)	Done	
1259-3108 09.221 14.92 100.00 98.309 0.0931 2594.0182 0.0004 (tet=45.074, ton=9.191 (8.00, 1.15) tone 1259-3123 14.074 14.23 100.00 98.4777 0.231 2544.0143 0.0003 (tet=45.56, ton=9.191 (8.00, 1.15) tone 1259-3123 25.35 14.74 100.00 98.7779 0.231 2544.0145 0.0009 (tet=45.36, ton=9.191 (8.00, 1.15) tone Space Test to the state of the state		12559.2523	27.466	12.94	100.00	-100.1996	0.4049	-2564.0321	0.0014	(lat=45.282, lon=9.075 ((9.75, 4.73)	Done	
25.53 24.74 20.00 96.779 0.251 2564.0345 0.0009 (Ist=45.334, Ion=9, Ist) Signal FSD and detected carriers	sp.173 26.5 4.4 00.0 49.779 0.281 254.045 0.009 (tet+5.334, ip=9.16) mapped detectories	12559.3108	89.221	14.92	100.00	-98.3809	0.0931	-2564.0182	0.0004	(lat=45.074, lon=9.191 ((8.00, 1.15)		
Signal PSD and detected carriers	Particular detected carries Magnetic basis for selected carries Magnetic basis for	12550 4229	141.074	14.00									
				19.20	100.00	-98.4817	0.0423	-2564.0243	0.0003	(lat=45.168, lon=9.186 ((7.89.0.50)	Done	
		12559.5173	25.635						0.0009	(lat=45.334, lon=9.168 (Ma	De De	tails for selected carri

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Operating Mode: Automated MacroTasks Architecture Results: positions on the map



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Latest technologies

New request

TDMA signal	•
Ka Band	
Spotted satellites	•

ZDS Upcoming Features

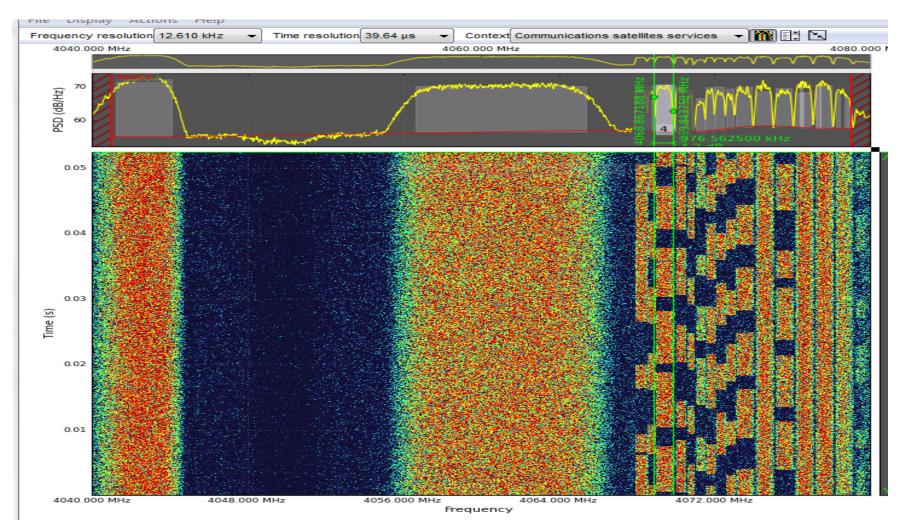
- ➔ Geolocation of the users
- ➔ Better accuracy with One Sat
- ➔ Downsizing system configuration

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Burst signal

In TDMA context



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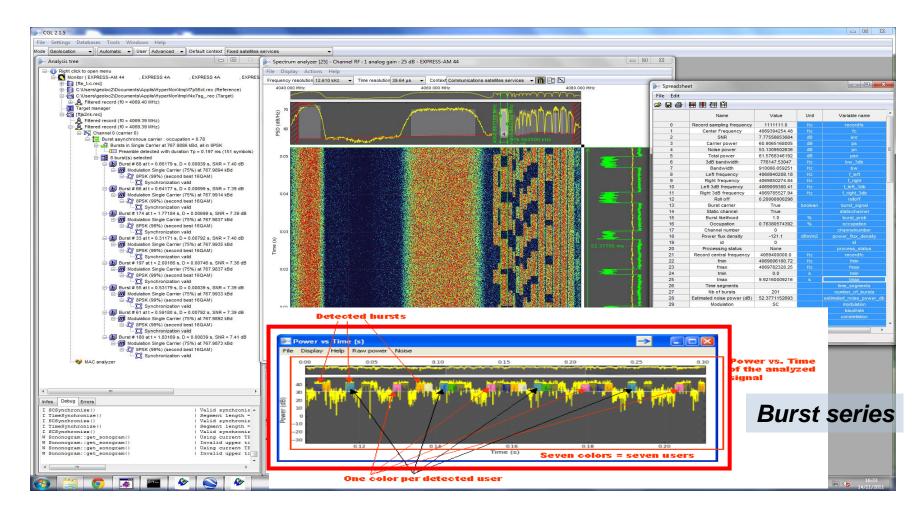


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Burst Signal

In TDMA context



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Burst Signal

In TDMA context

File Options					
Select target measurement for geolocatio	n				
From date 💽 🔽 to d	late	from frequency [MH:	z] to free	uency [MHz] Filter	
Sampling date	Frequency (MHz)	Located at (lat, lon) [deg]	Ellipse size (km)	Process information	т
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

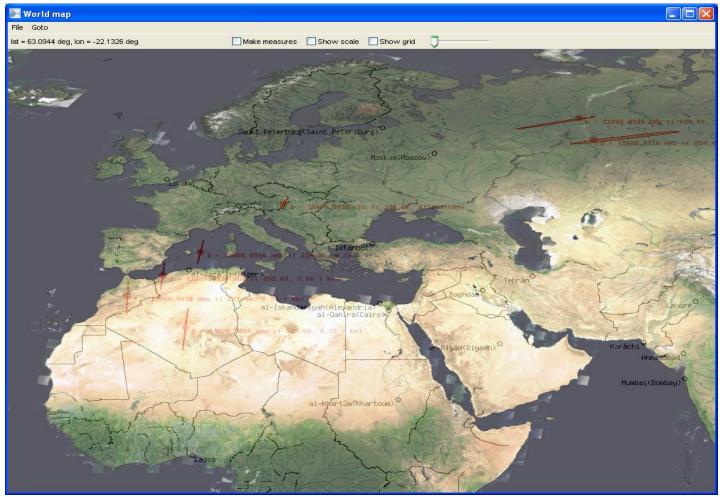
Several distinct locations



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Burst Signal

In TDMA context



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Thank you !