

CARNAC

Multi-Role Automatic Flight Inspection system



■ ■ ■ ■ Sagem DS Company Presentation



Sagem Défense Sécurité is part of the Defense and Security business of the SAFRAN group, which contains four businesses:

- ▶ **Aeronautical Propulsion**
- ▶ **Aeronautical Equipment**
- ▶ **Telecommunications**
- ▶ **Defense and Security**



■ Sagem: an avionics supplier



Sagem Avionics Division products:

- Inertial navigation systems
- Aircraft Condition Monitoring Systems (ACMS)
- Flight Data Monitoring (Analysis Ground station)
- Flight Inspection System



- ↪ **20 years AFIS design experience**
- ↪ **Operational in more than 40 countries**
- ↪ **Cat III accuracy positioning system certified for more than 10 years**
- ↪ **Adaptable to any aircraft**
- ↪ **Easily removable FIS (dual mission)**
- ↪ **High reliability and after-sales service support**

■ CARNAC Inspection Capabilities



↪ ILS Up to Cat III

↪ RNAV procedures

↪ MLS

↪ SSR

↪ MKR

↪ PSR/ SRE

↪ VASI - PAPI

↪ PAR

↪ VOR - D/VOR

↪ VHF/UHF Comm

↪ TACAN

↪ VHF/UHF Gonio

↪ DME

↪ GNSS – ABAS : NPA

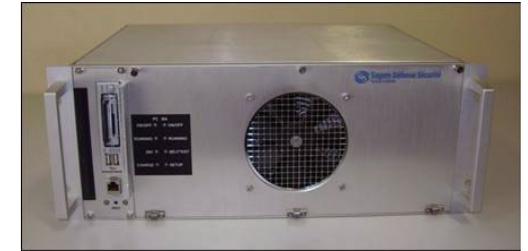
↪ NDB

↪ GNSS – SBAS: WAAS, EGNOS, MSAS

■ CARNAC CORE SYSTEM



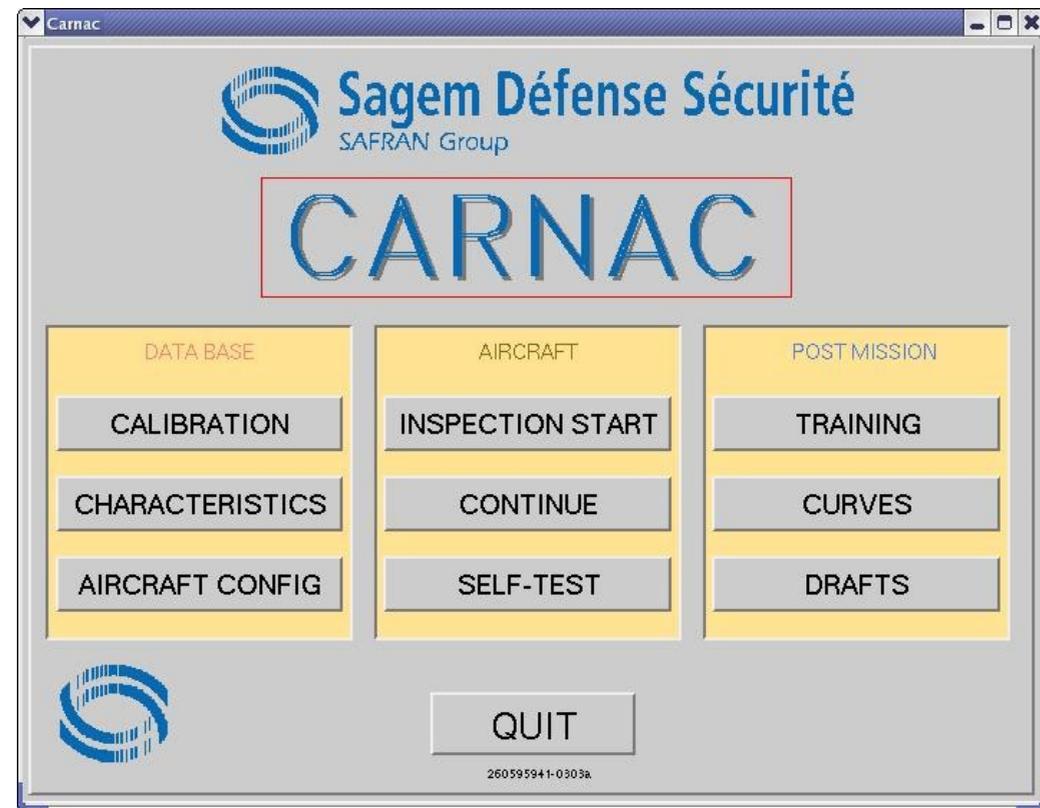
- ↪ **Dual acquisition and processing compact unit**
- ↪ **Real-time acquisition & processing (up to 20 Hz)**
- ↪ **Simultaneous acquisition of all sensors**
- ↪ **COTS equipment**
- ↪ **Transfer of FIS data by flash memory**
- ↪ **Dual Operating System (Virtual Machine)**
- ↪ **Network configuration**
- ↪ **1 or 2 displays**
- ↪ **Back-up capability**



■ CARNAC MULTITASK SOFTWARE



- ↪ **Flight Preparation**
- ↪ **Flight Inspection**
- ↪ **Post-Flight Analysis**
- ↪ **Report Edition**
- ↪ **Operator's Training**



■ CARNAC MAIN FUNCTIONS



- **Data base set-up**

- To create or to modify the files to be used before or during the mission

- **Flight Inspection**

- Real time processing
- Automatic receivers tuning and pilot guidance
- Display of all parameters on efficient graphics
- Storage of curves, computation results and operators comments
- Real-time Display in aircraft AND to Ground Maintenance Team
- Preliminary report before landing

■ CARNAC MAIN FUNCTIONS



• Reporting

- Post flight processing
- On-board final report
- Exporting to any network (Intranet or Internet)

• Training

- Re-processing of all flight inspection missions on-ground or on-board
- On-board training simultaneously to operational Flight Inspection (≥ 2 operators)

• System maintenance

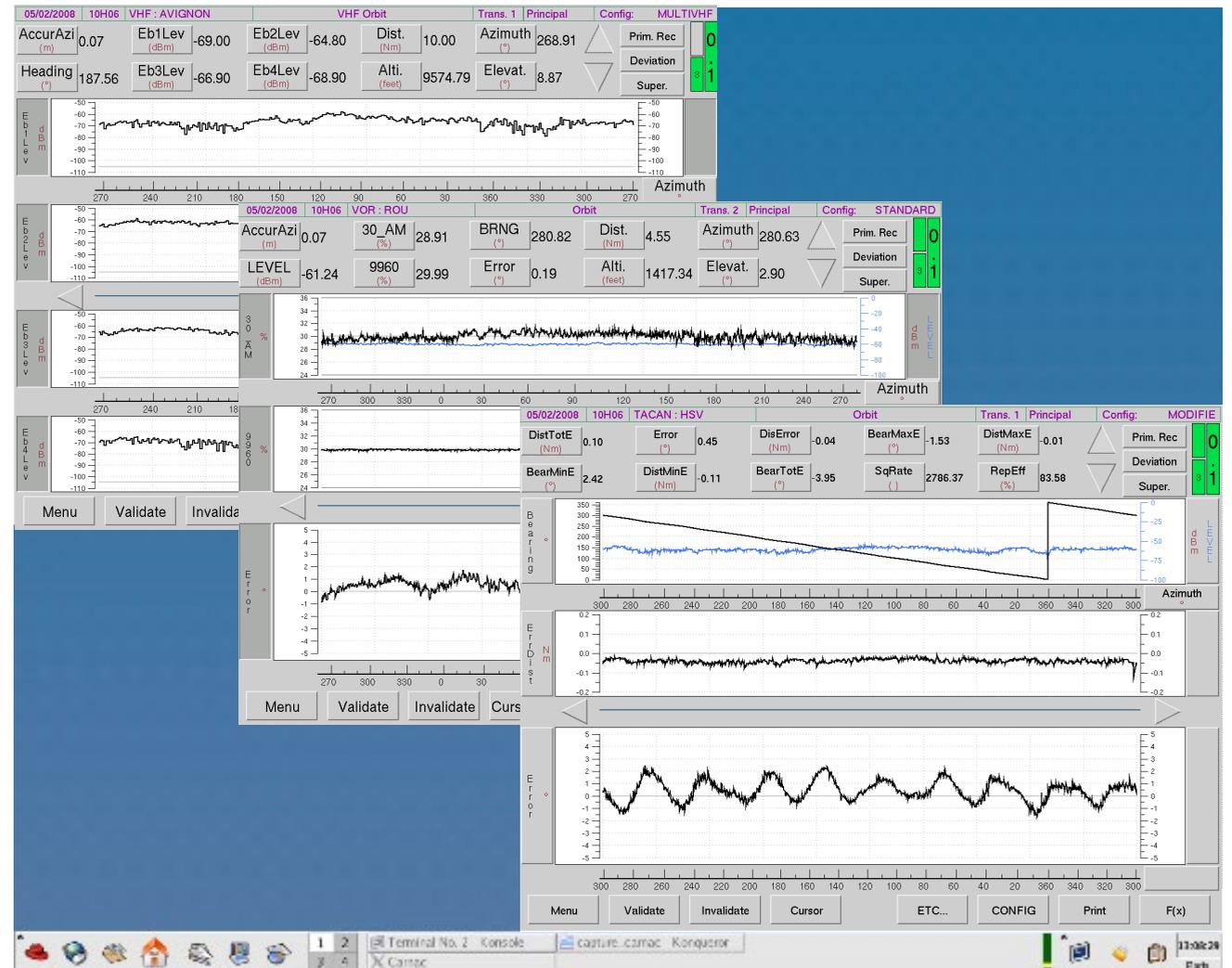
- Automatic receivers calibration
- On-board self-test
- Ground Maintenance Support System to check FIS equipment



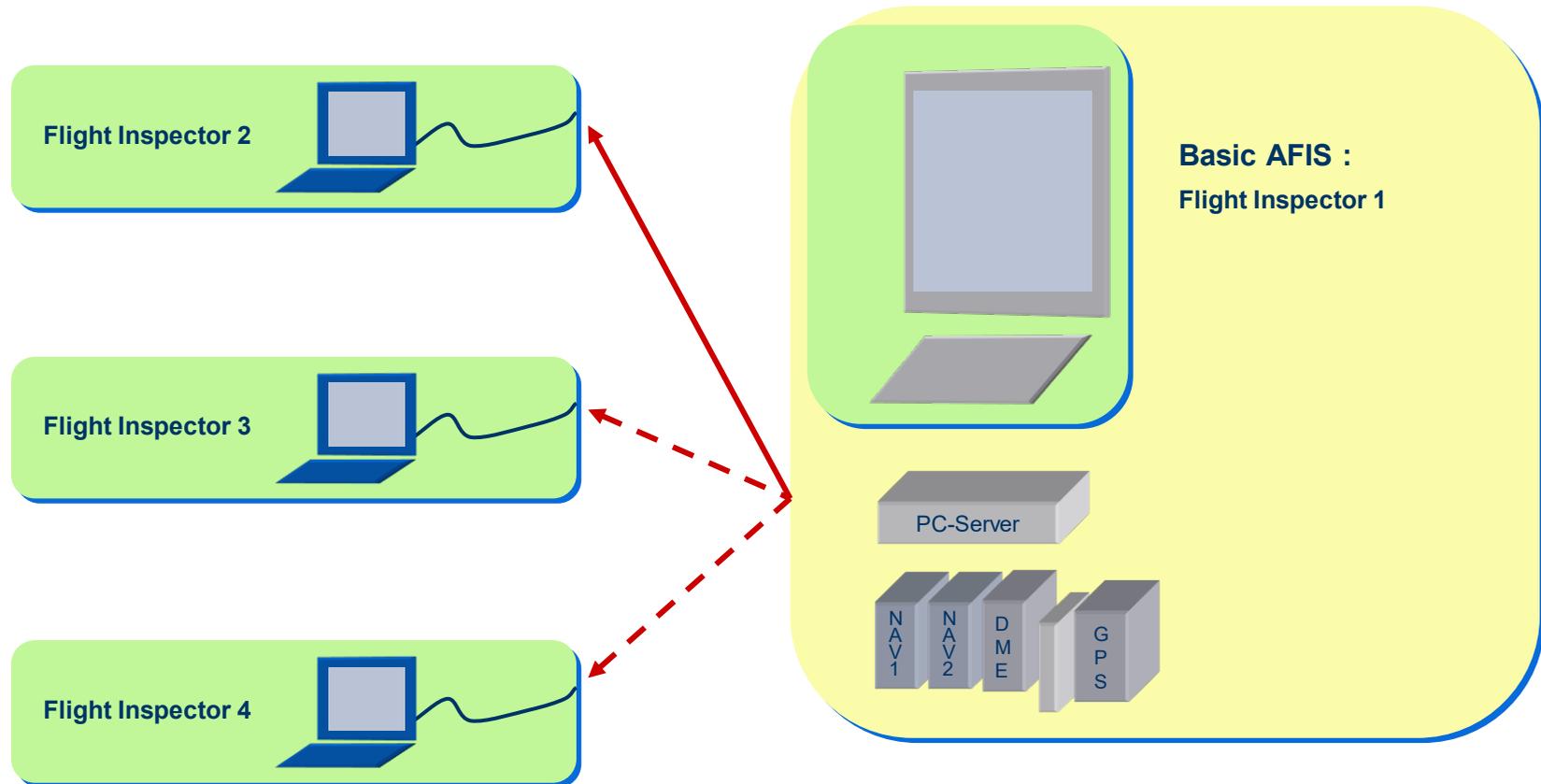
▶ MULTI-NAVAIDS ACQUISITION and PROCESSING

Simultaneous real-time flight check of:

- ↪ ILS
- ↪ VOR/DME
- ↪ TACAN
- ↪ ADF
- ↪ VHF
- ↪ ...



CARNAC MULTI-OPERATORS CAPABILITY

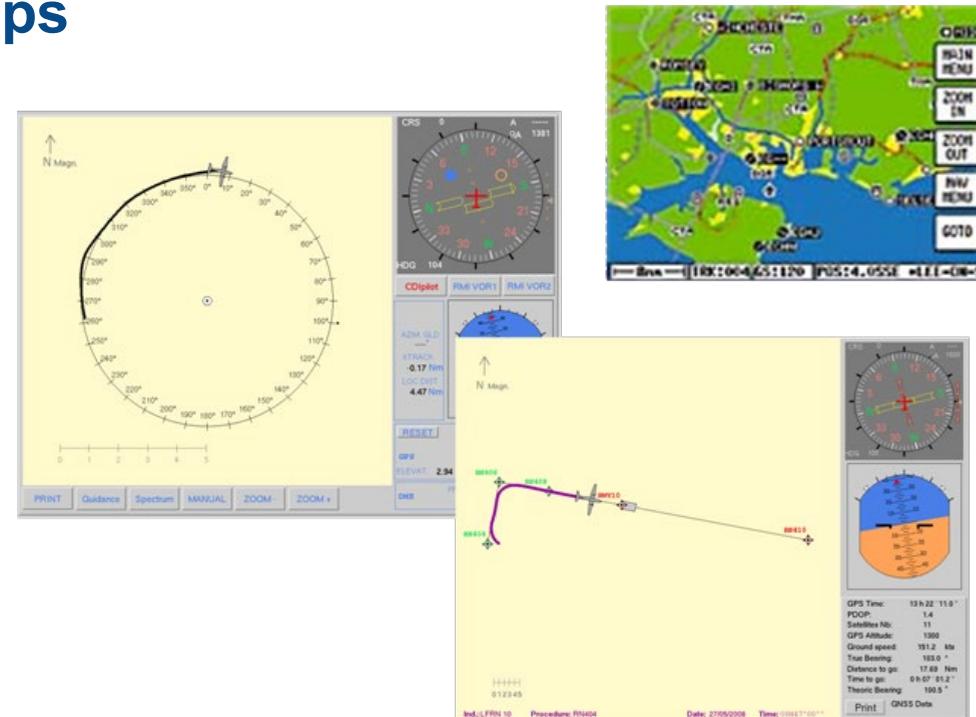


2 or more flight inspectors may operate simultaneously

CARNAC AIRCRAFT DISPLAY



- ↪ Aeronautical and geographic maps
- ↪ Flight pattern procedure
- ↪ Aircraft path plotting
- ↪ Automatic or manual zoom
- ↪ CDI/EHSI/RMI
- ↪ DME & GPS indicators



Real-time GPS MONITORING & MANAGEMENT



VP-DGPS status:

- ↪ Position
- ↪ Solution quality
- ↪ Satellites data
- ↪ Satellite invalidation
- ↪ GPS configuration

POSITION INFORMATIONS							SOLUTION COMPUTATION INFORMATIONS						
Aircraft Latitude	Aircraft Longitude	Aircraft Altitude	Horiz. Error	Vert. Error	Mode	DLK 100 %	Solution P						
48°43'39.3771" N	2°24'11.6790" E	131.56 m	0000.015	0000.015	Différentiel Précis								
Ground Latitude	Ground Longitude	Ground Altitude	Phase Residual	Ratio Solution	Datalink Age								
48°43'39.37700" N	2°24'11.67900" E	131.56 m	0.002	09999.90	218 ms	Datalink received liaison OK							

PDOP	SATELLITES INFORMATIONS						Visible	> mask	Gnd recv	Gnd OK	Common	Used		
1.70	Number of satellites						09	9	8	8	8	9		
Channel	Numb	Used	A/C recv	Gnd recv	Elev.	Bearing	Qual L1 Gnd	Qual L2 Gnd	C/A snr	P1 snr	P2 snr	Health	UDRA	Residu
1	30	U.	R.B.	R.S.	26	241	L1 BON	L2 BON	45	43	39	00	00	2.6mm
2	22	U.	R.B.	R.S.	18	276	L1 BON	L2 BON	44	42	37	00	00	0.4mm
3	17	U.	R.B.	R.S.	25	047	L1 BON	L2 BON	49	46	41	00	00	1.0mm
4	78	U.	R.B.	R.S.	77	237	N/A	N/A	37	38	33	00	00	
5	15	U.	R.B.	R.S.	18	164	L1 BON	L2 BON	39	39	35	00	00	-1.3mm
6	12	U.	R.B.	R.S.	65	239	L1 BON	L2 BON	48	48	43	00	00	0.2mm
7	9	U.	R.B.	R.S.	79	076	L1 BON	L2 BON	49	47	43	00	01	0.0mm
8	5	U.	R.B.	R.S.	48	245	L1 BON	L2 BON	49	47	43	00	00	-1.5mm
9	14	U.	R.B.	R.S.	26	314	L1 BON	L2 BON	45	43	38	00	01	-1.9mm
10														
11														
12														

elev. < mask	elev. > mask	highest (pivot)	Gnd recv	unrecev Gnd	Used in comput.
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RX GPS	ON/OFF		GND Pos.		Reset		Return
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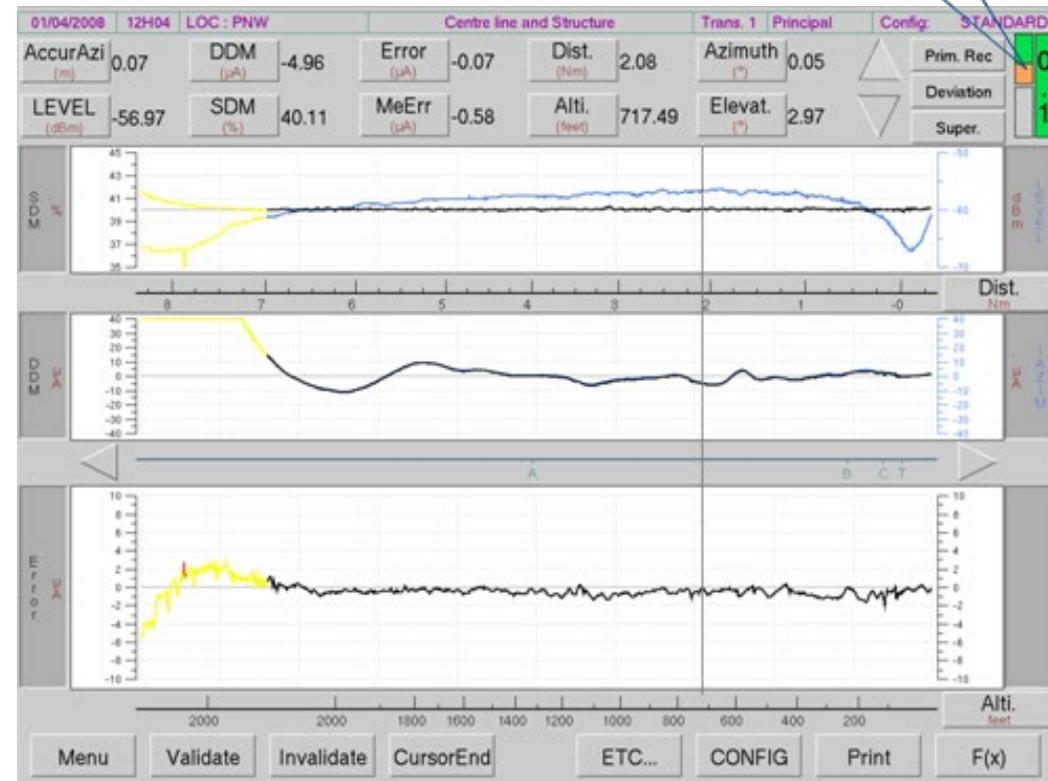
REAL-TIME DUAL RECEIVERS MONITORING



Deviation between receivers computed in real-time:

- ↪ Indicator for instantaneous Alarm
- ↪ User's Alarm configuration
- ↪ 3 deviation value colors
- ↪ Automatic deviation curves of plotted parameters

Alarm indicator

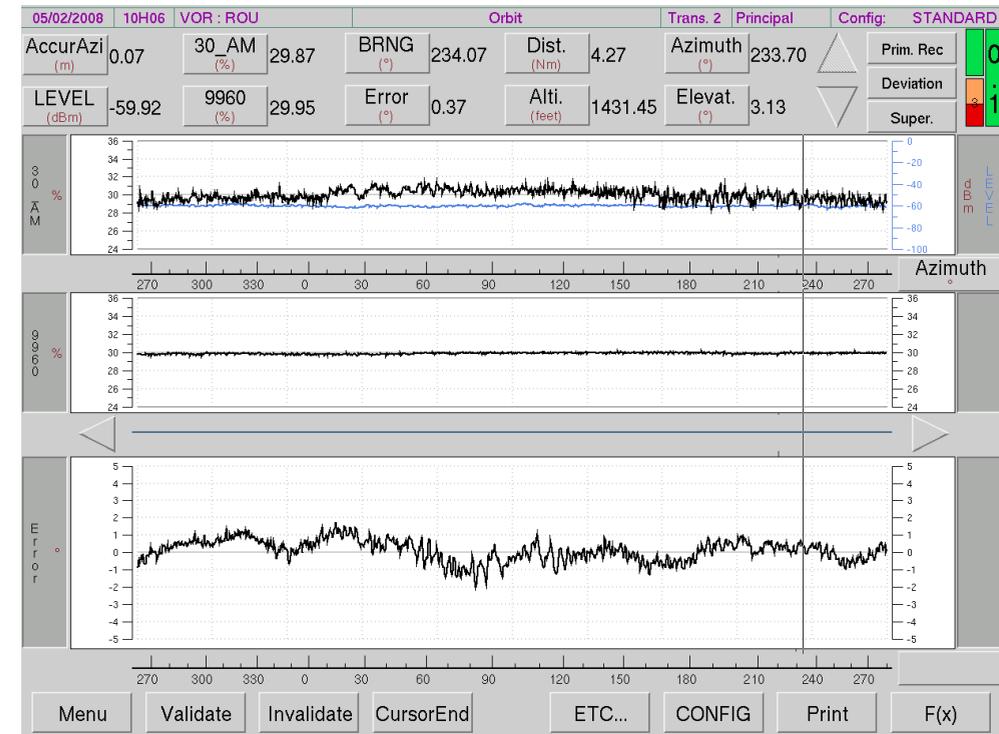


REAL-TIME TRAJECTOGRAPHY WARNING



► To compare 2 Satellite Positioning Systems

- ↳ Monitoring of trajectory validity
- ↳ Instantaneous warning indicator
- ↳ User's warning tolerance configuration
- ↳ Used for landing or en-route nav aids
- ↳ FIS trajectory system compared with:
 - ❖ Data from differential GPS correction Services
 - ❖ Other satellite positioning system
- ↳ Deviation between receivers computed in real-time

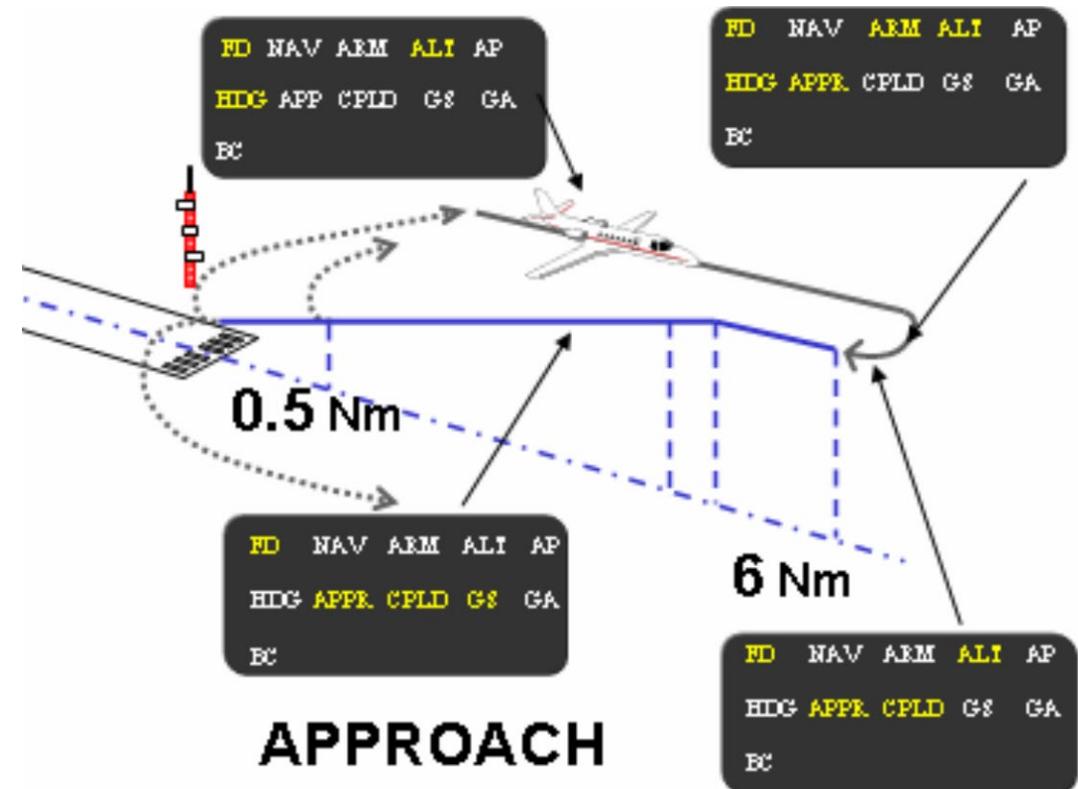


CARNAC AUTOPILOT INTERFACE



▶ Pilots comfort improvement with automatic approach procedures

- ↳ Less tiredness
- ↳ Less failed approaches
- ↳ Coupled to the autopilot via ARINC 429 MLS input
- ↳ Flight Plans sent to the cockpit on dedicated display

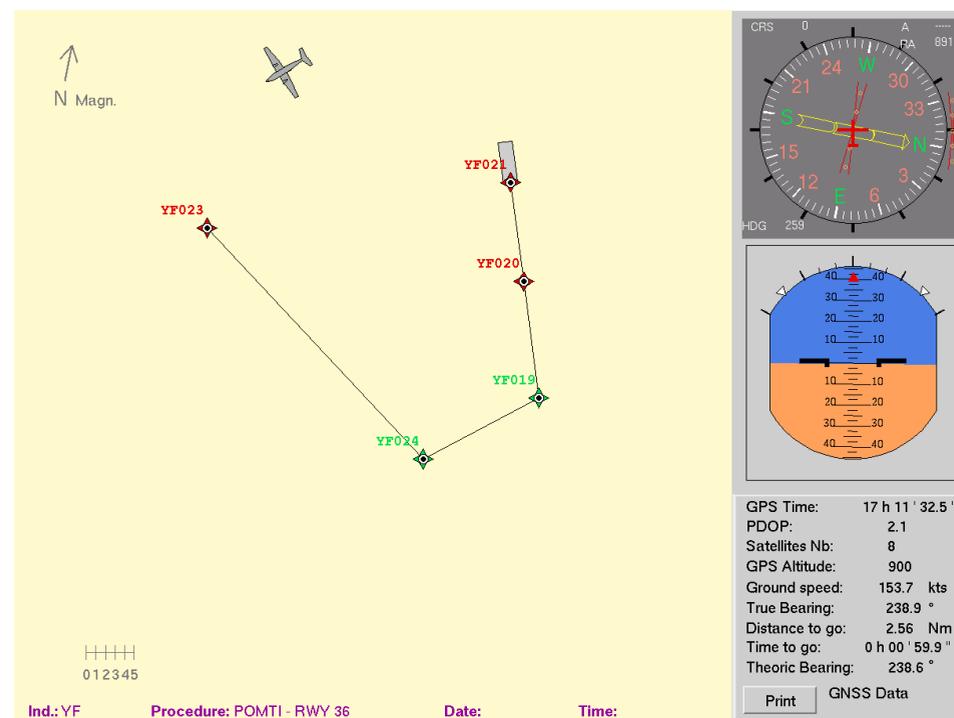


CARNAC AUTOMATIC NAVAID LINK



▶ Automatic flying measurement procedures

- ↪ Check of successive or simultaneous nav aids
- ↪ Procedures configuration set-up
- ↪ Automatic link of runs
- ↪ Flight plans to cockpit
- ↪ Real-time curves and results
- ↪ Post-processing of all reports

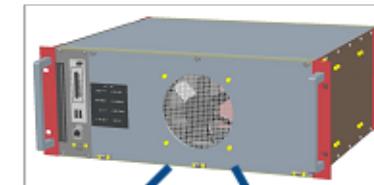


■ CARNAC IN-FLIGHT TRAINING



- ↪ Independent from operational console
- ↪ During operational flight inspection
- ↪ Full data available from the acquisition system to allow different and simultaneous Nav aids inspection
- ↪ Fittable at any seat without any modification

Acquisition and operational computer



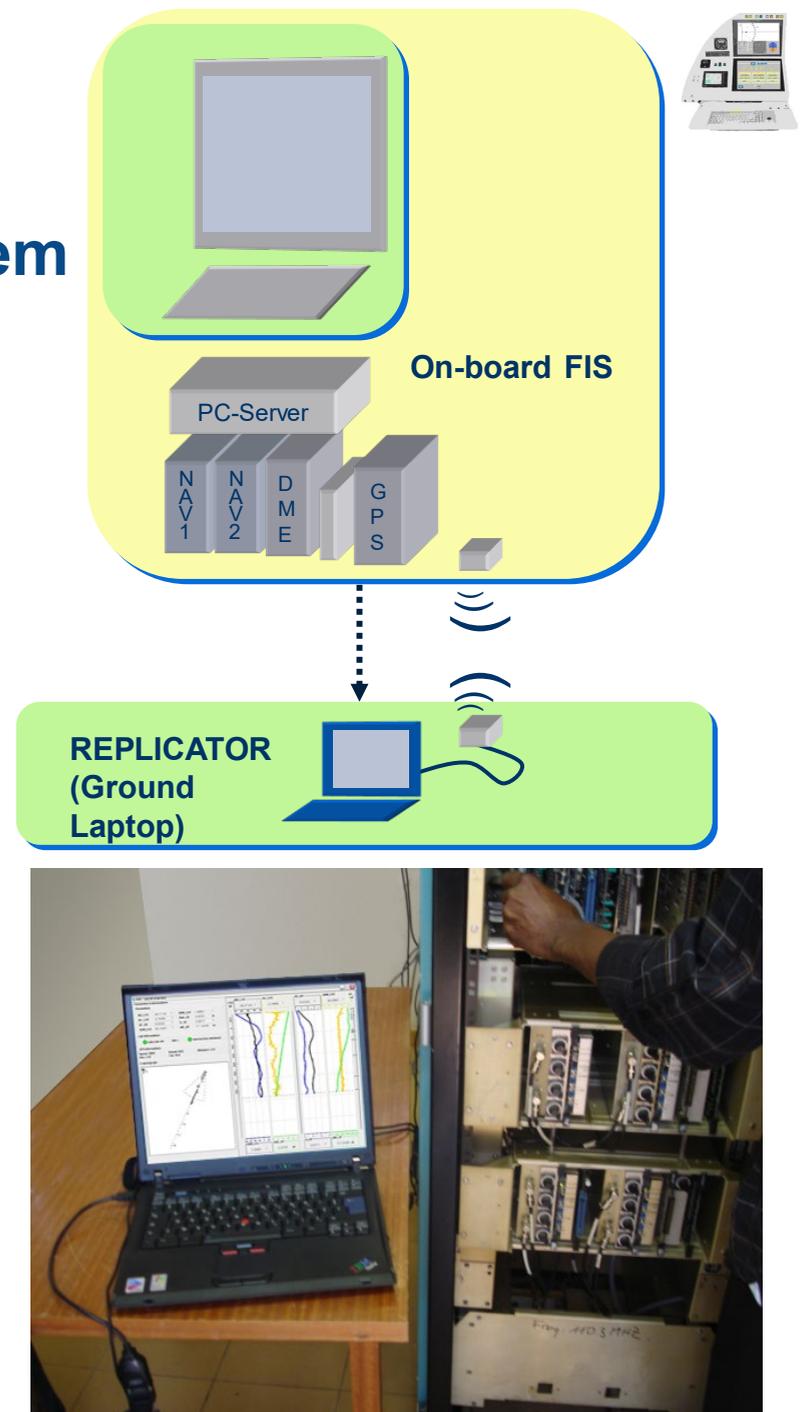
Operational console



Training Laptop

CARNAC REPLICATOR

- ▶ Real-time air-to-ground replicating system
- ↪ Real-time curves plotting for instantaneous adjustments
- ↪ No action required by flight inspector
- ↪ Aircraft map display
- ↪ All nav aids supported
- ↪ Avoid language misunderstanding
- ↪ Maintenance team ready to do the good thing at the good time



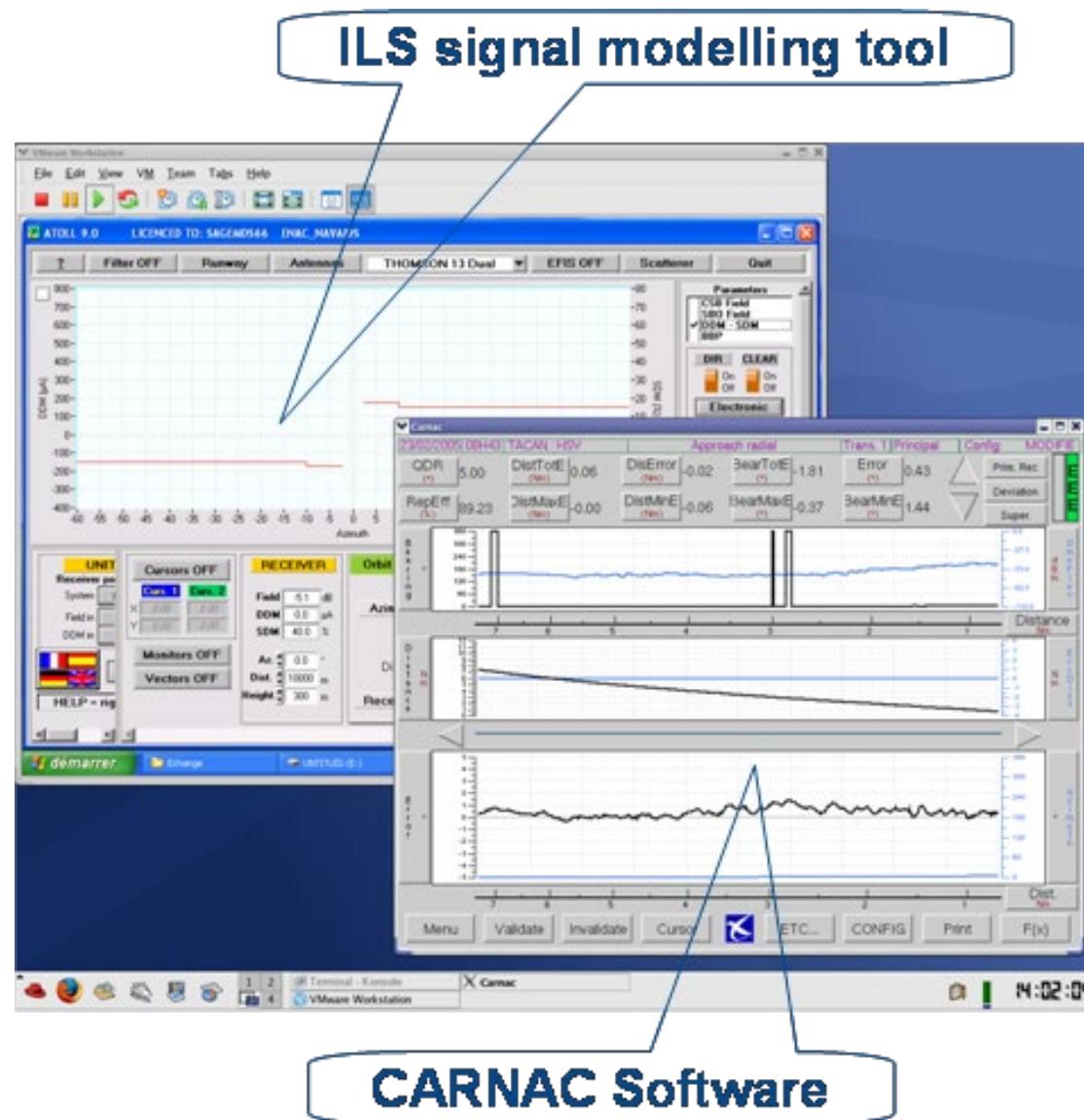
CARNAC MULTI-ROLE



▶ VIRTUAL MACHINE

Real-time multi-operating system:

- ↪ CARNAC operating under Linux
- ↪ Working simultaneously with others OS as Windows for others software's
- ↪ CARNAC software not affected by any Virtual Machine malfunction or virus



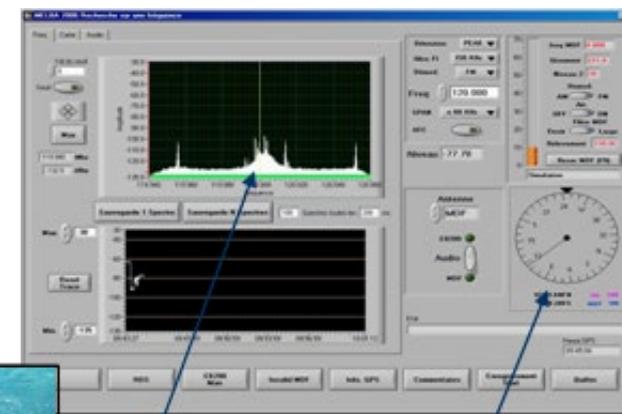
■ ■ ■ ■ ■ Detection & Localization of Jamming



▶ Detection and localization of aeronautical interferences

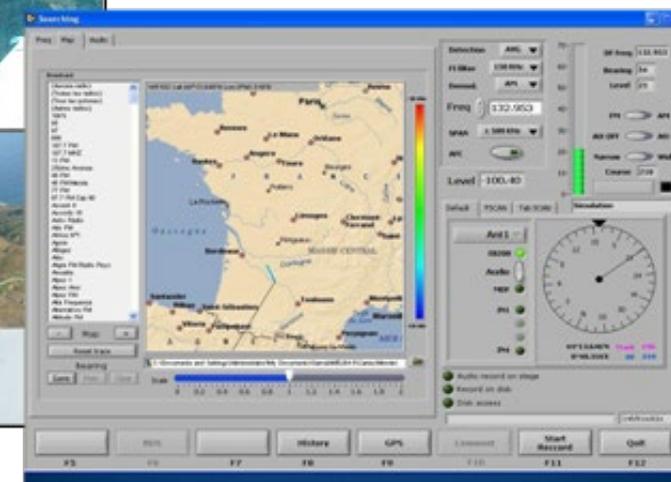
- Software provided by the French CAA

- ↪ Radio-monitoring of the aeronautical band and NAVAID frequency (VHF and BF spectrum) during ferry-flights, flight inspection campaign, specific requests
- ↪ Simultaneously or separately of Flight Inspection mission
- ↪ Using MELBA and CARL softwares developed by the DGAC/DSNA/DTI
- ↪ Data plotted on a cartographic background automatically adapted to the area crossed during the flight



Spectrum

Direction-Finder

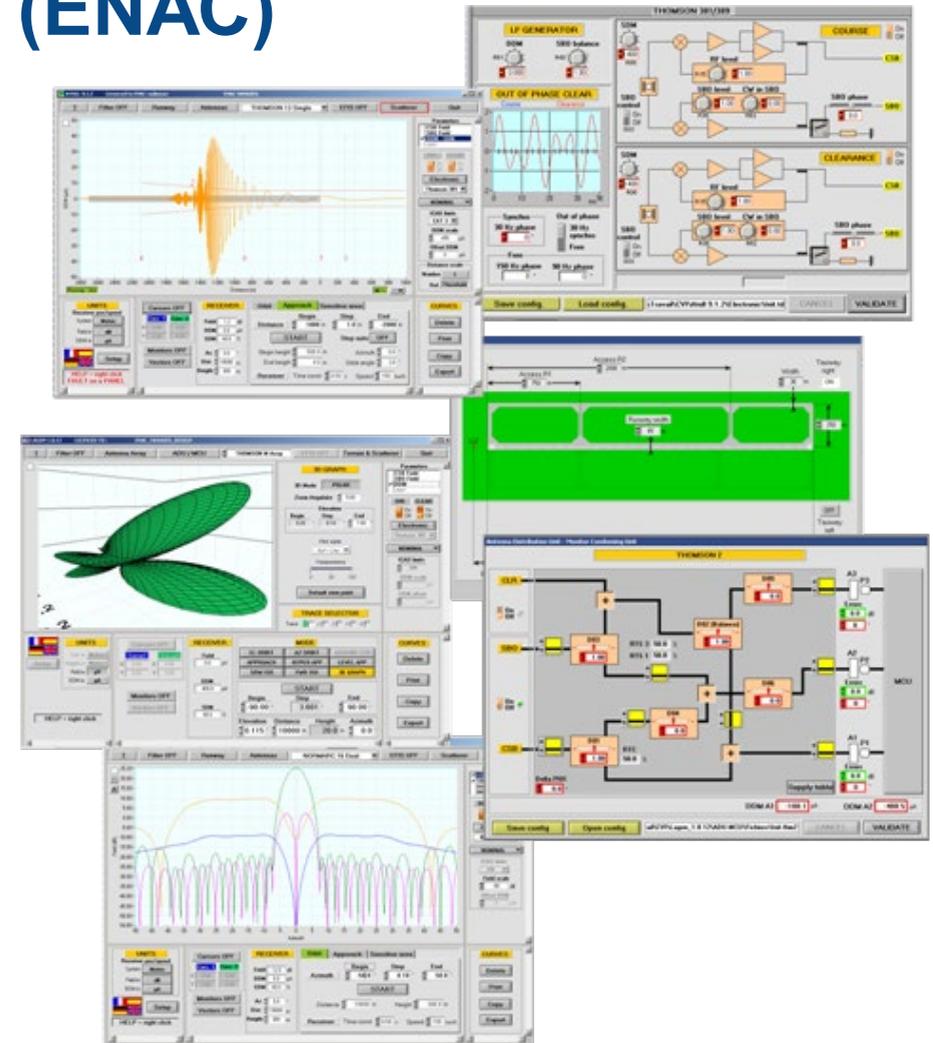


ILS Signal modelling tools



▶ **ATOLL & LAGON** are designed and produced by the **French Academy of Civil Aviation (ENAC)**

- ↪ **Training for LOC and GS**
- ↪ **Simultaneously or separately of Flight Inspection mission**
- ↪ **Radiation Simulation**
- ↪ **Simulation of adjustment/obstacles**
- ↪ **Investigation of LOC & GS radiation**
- ↪ **Reduce commissioning time**



THANK YOU FOR YOUR ATTENTION

If you have any questions, please meet us at
the SAGEM booth
to get more information about
CARNAC
Multi-Role Automatic Flight Inspection system

