

Galileo Interference Measurement Campaign

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ESA/ESTEC Contract No
15024/01/NL/DS



Goals

- To assess the amount of interference caused by known (ie. DME) and unknown interferers in all Galileo frequency bands (except C-band)
- To record spectrum data
- To record baseband data with high resolution and high speed sampling

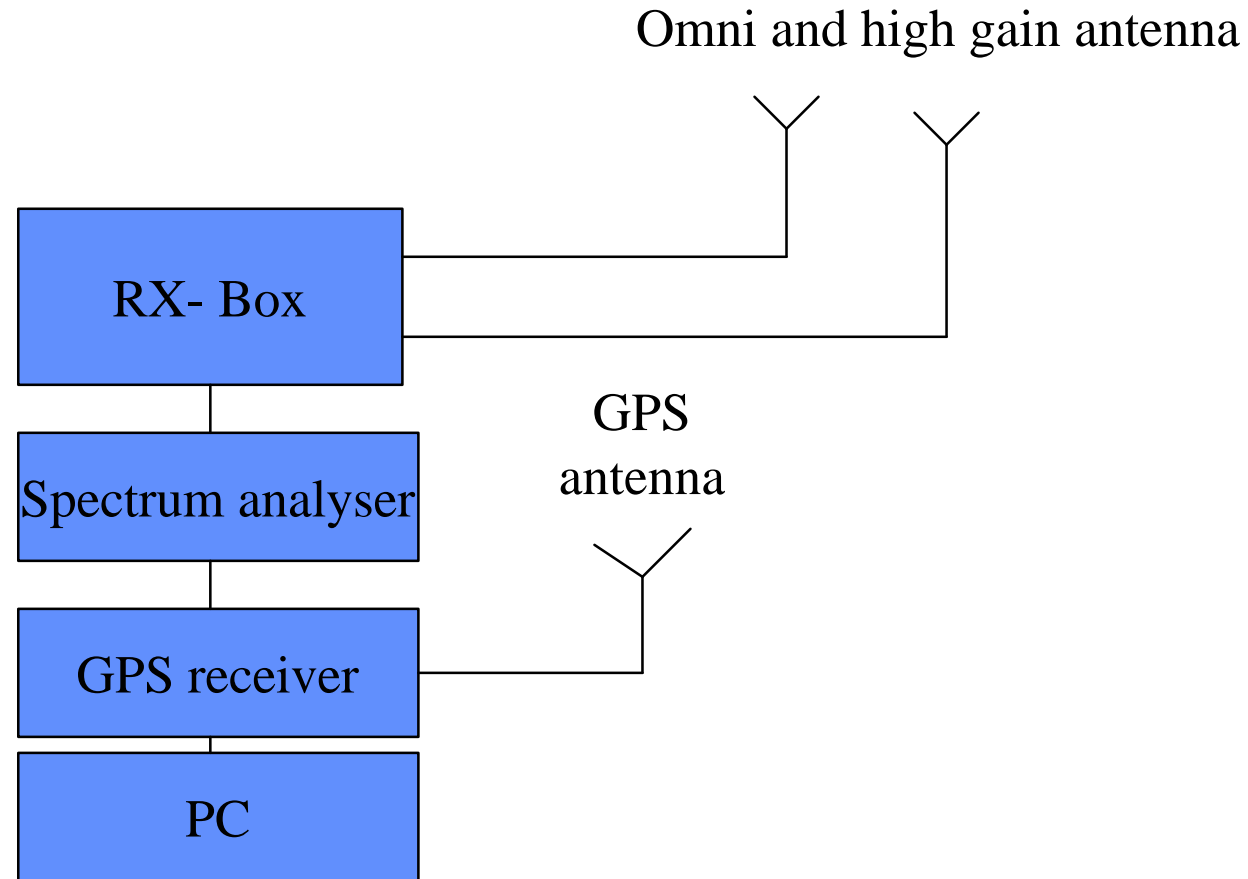
Intermediate Goals

- To develop the data acquisition unit on a mobile platform
- Review of location of known interferers
- Devise a suitable scheme for automatic data acquisition
- Route planning (considering important user environments, i.e. airports)
- Measurement campaign
- Data analysis

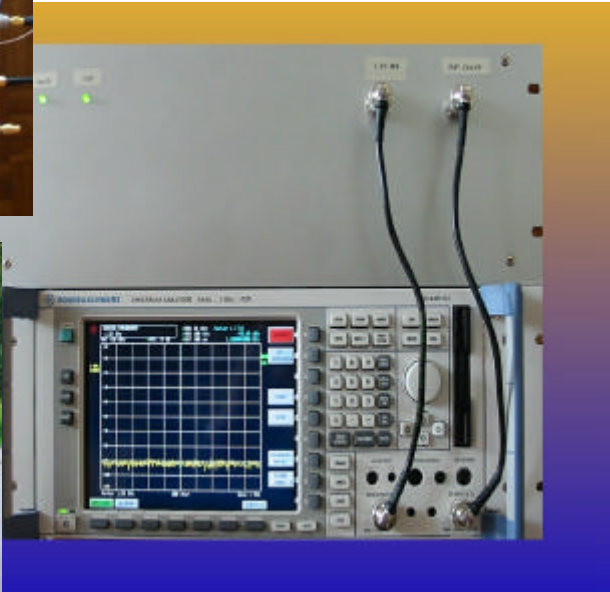
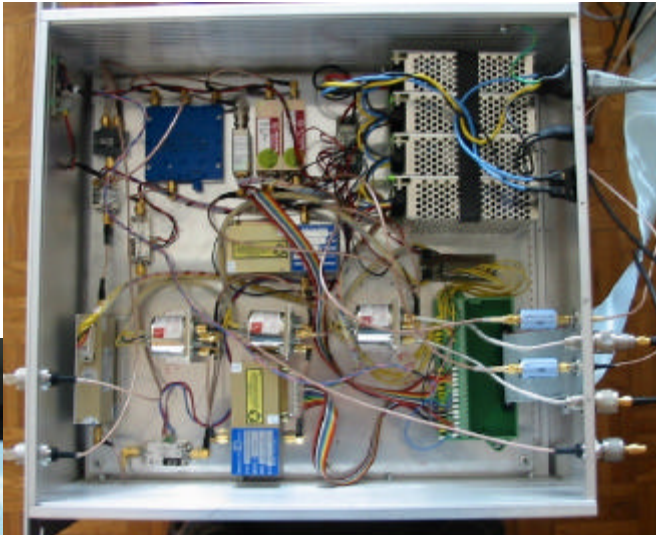
Frequency Bands Investigated

√	L5/E5	1,164 – 1,215	MHz
√	(E4	1,254 – 1,260	MHz)
√	E6	1,260 – 1,300	MHz
√	E1	1,559 – 1,591	MHz
√	E2	1,587 – 1,591	MHz
	(C	5,010 – 5,030	MHz)

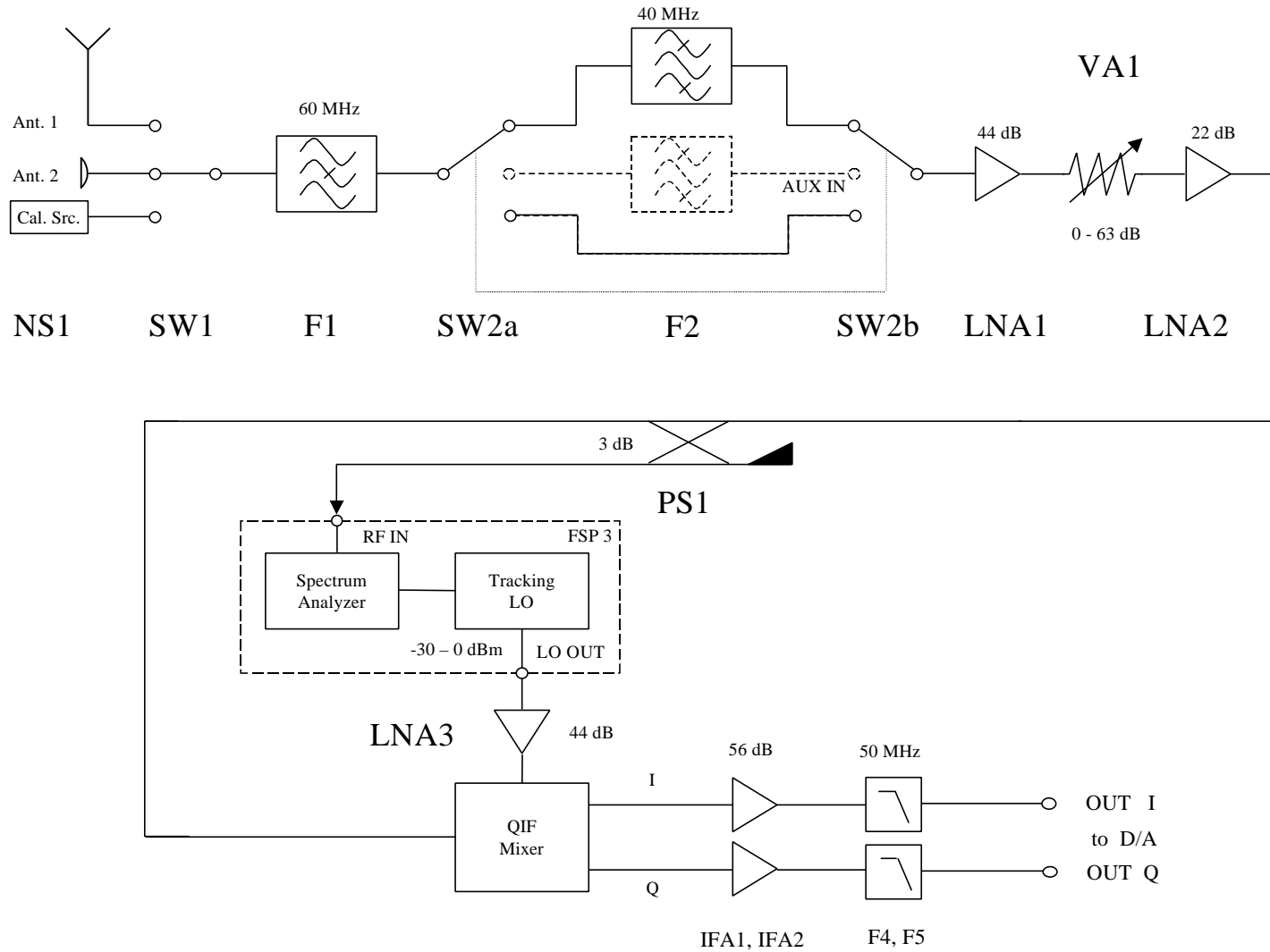
Block Diagram



Measurement equipment and Platform



Hardware Scheme



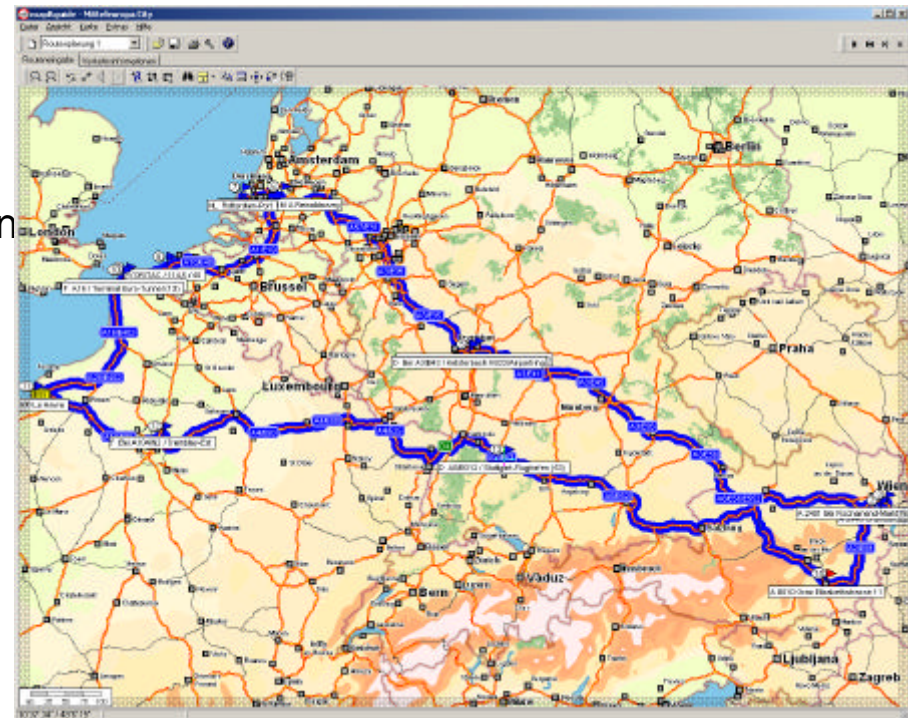
Receiver Specs

- RF – Frequency Range: 1- 2 GHz
- Spectral + Baseband I/Q Recording
(12 bit, 125 MS/s resp 62.5 MS/s, rec. duration 8 seconds)
- Sensitivity : -139 dBW / MHz (noisefloor)
- 2 Tunable YIG Filters (bp 40 MHz, notch 60 MHz)
- Rohde & Schwarz FSP 3 Spectrum Analyzer
- Tracking Local Oscillator from FSP3
- Omnidirectional & high gain antenna
- 12 channel GPS receiver

Route

10 route sections, route length about 3700 km, measurements along route and stationary at locations with high air / sea traffic

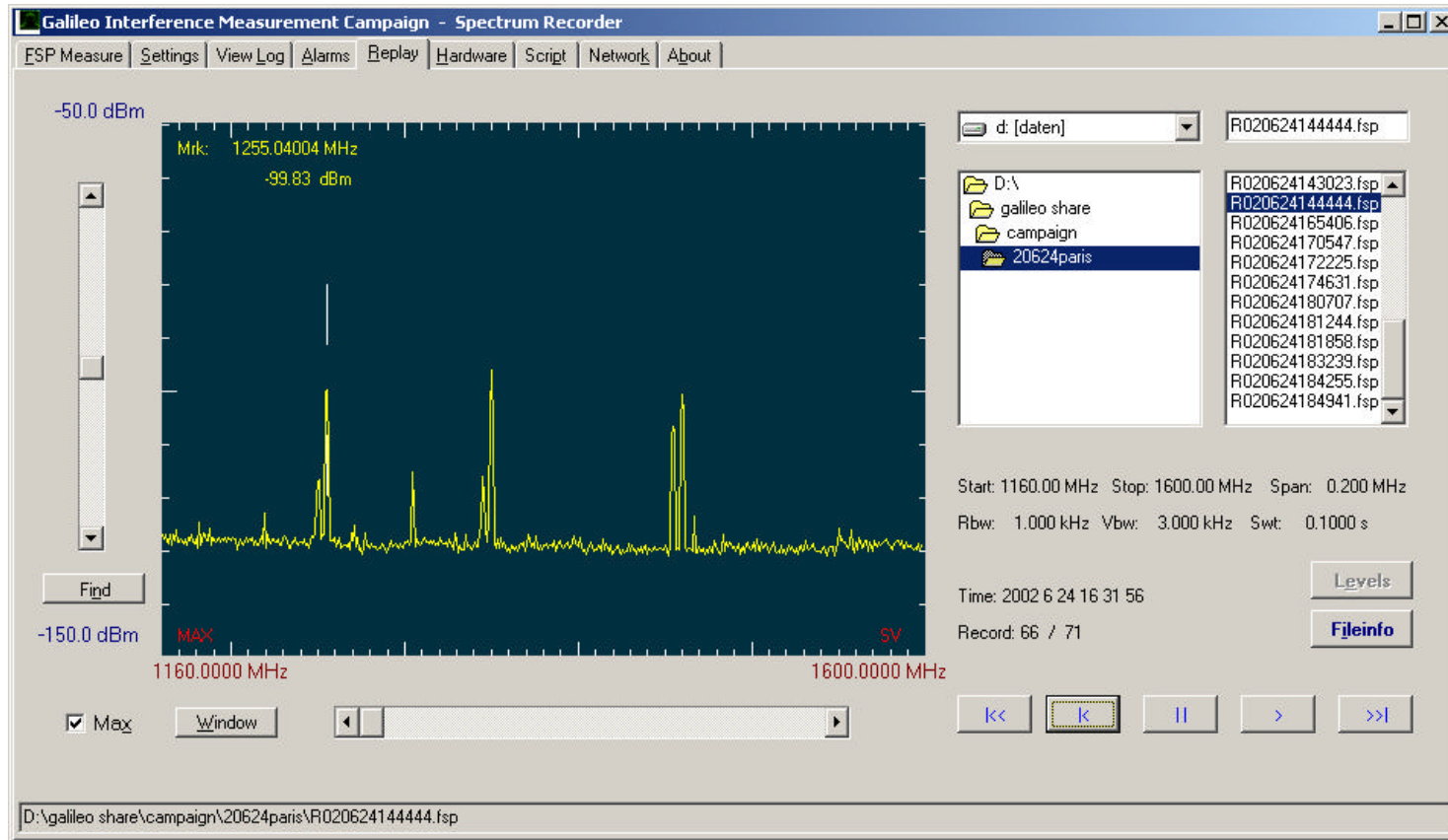
- Graz (AT) - Vienna (AT)
- Graz (AT) - Erlensee (GE)
- Erlensee (GE) - Frankfurt - Noordwijk (NL)
- Noordwijk (NL) - Cabouw - Rotterdam - Leiden
- Noordwijk (NL) - Koksijde (BE) - Calais (FR)
- Calais (FR) - Eurotunnel - LeHavre (FR)
- LeHavre (FR) - Paris (FR)
- Paris (FR) - Chateau Thierry (FR)
- Munich (GE) - Graz (AT)



Data acquisition and viewing software

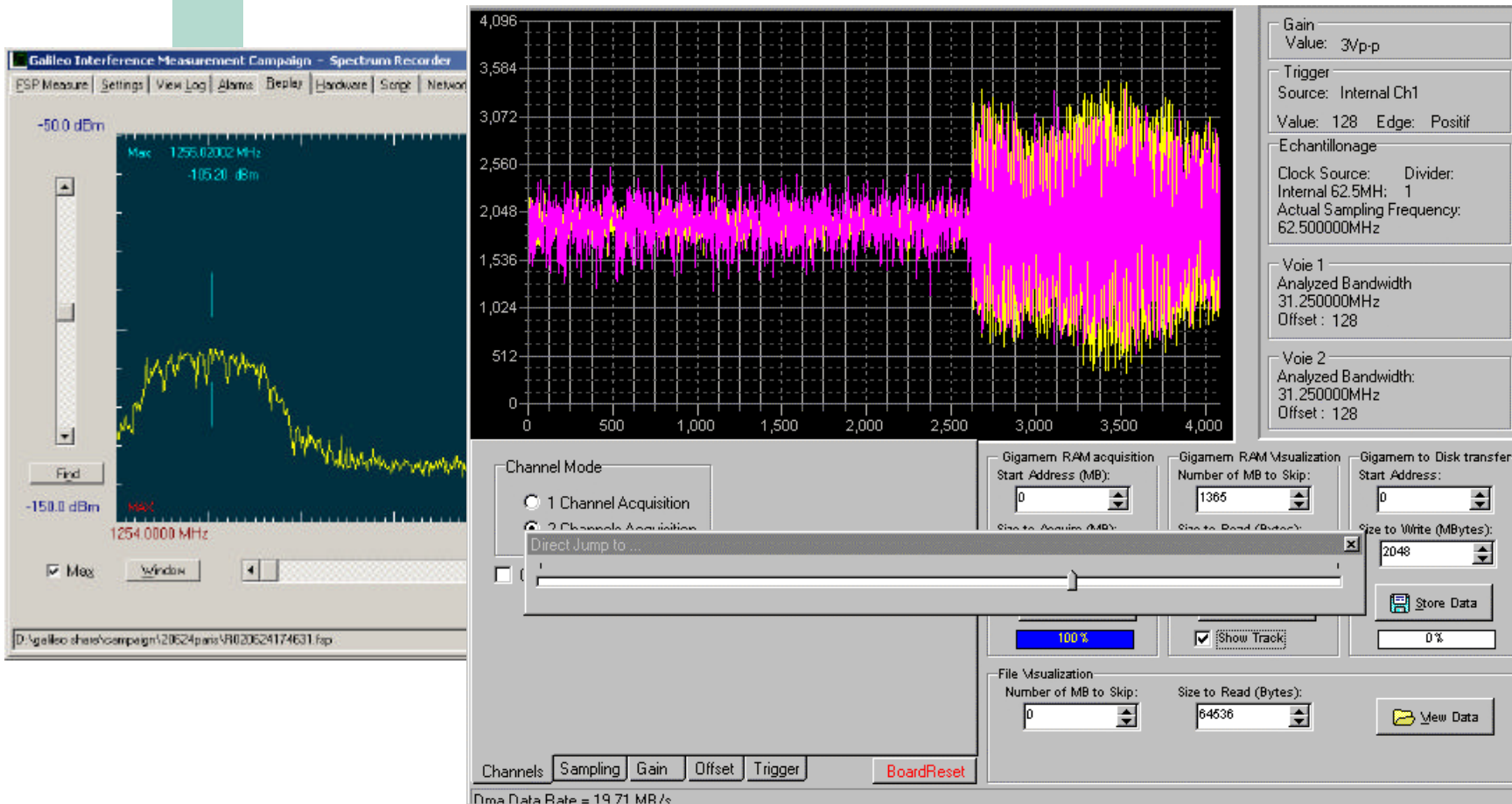
- Spectrum Analyzer Programming (via LAN Interface)
- Measurement Hardware (via Digital I/O)
- On-Line / Off-line Display (Multi Sweep Display)
- Data Recording (Spectra and High Speed Baseband)
- Simple Statistics Processing

Spectrum Recorder



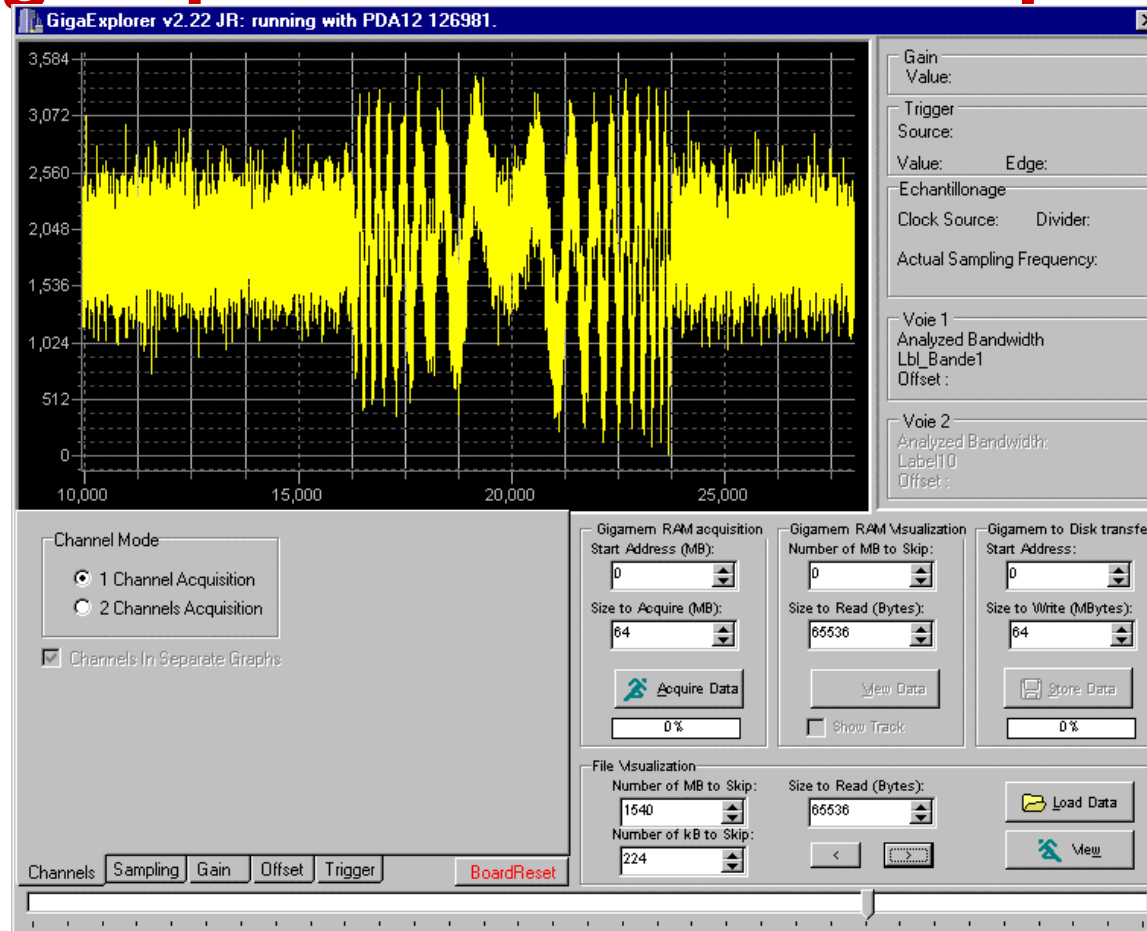
Charles DeGaulle
DME interference

High Speed Baseband Sampling



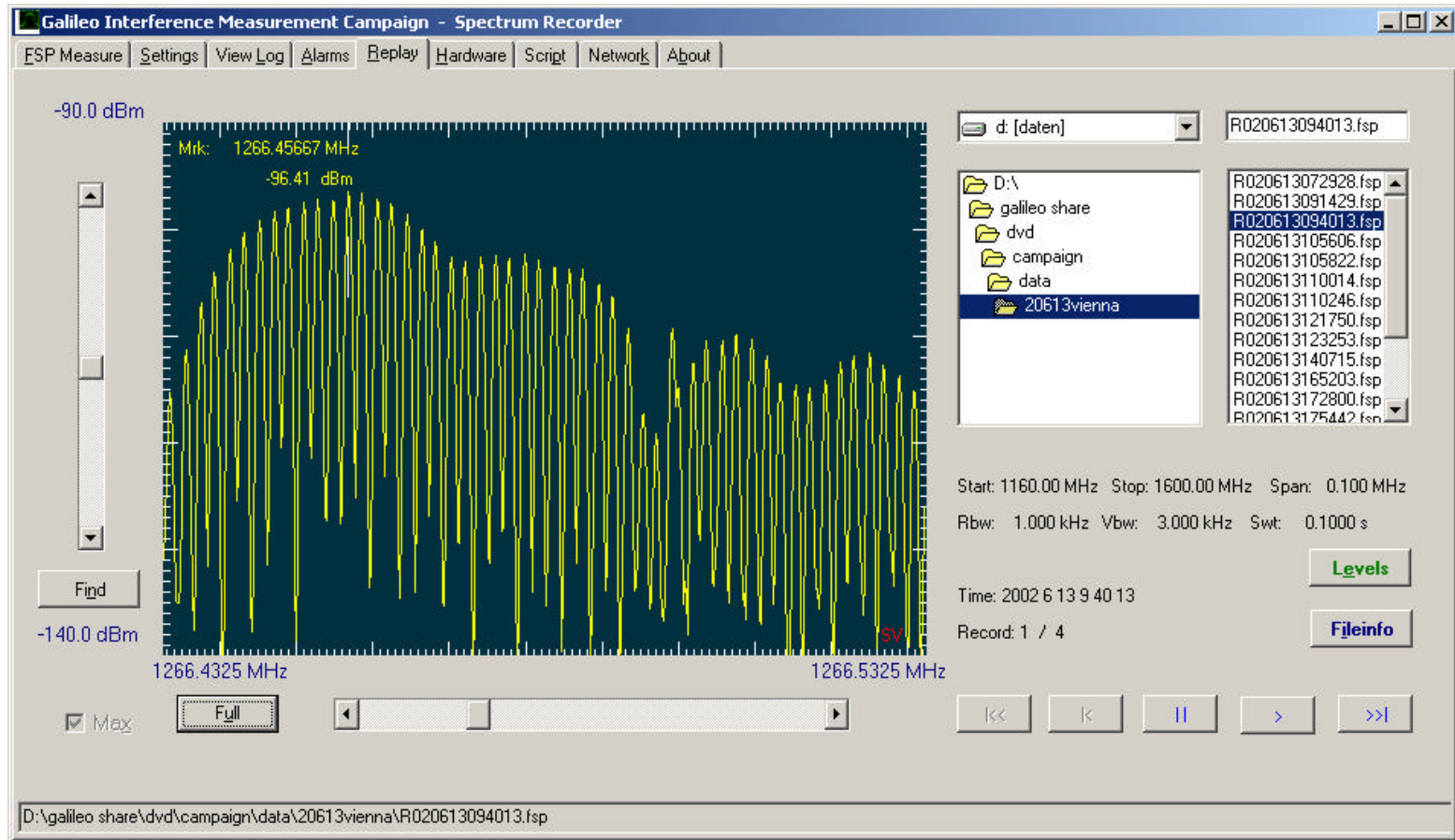
Charles DeGaulle (E4 1255 MHz)

High Speed Baseband Sampling



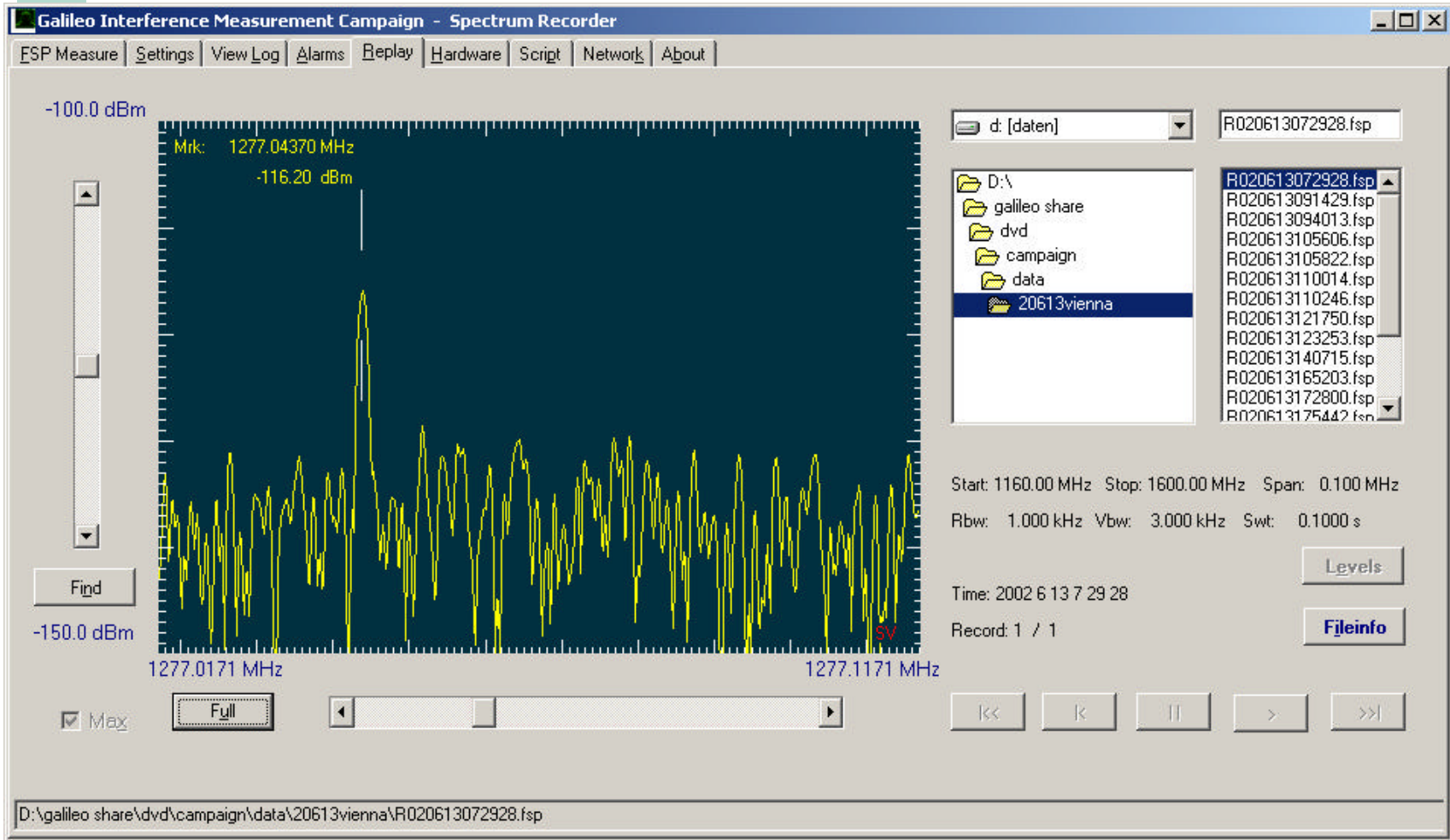
Charles DeGaulle (E6 1260 - 1300 MHz)

Interference due to Radar in Graz/Austria

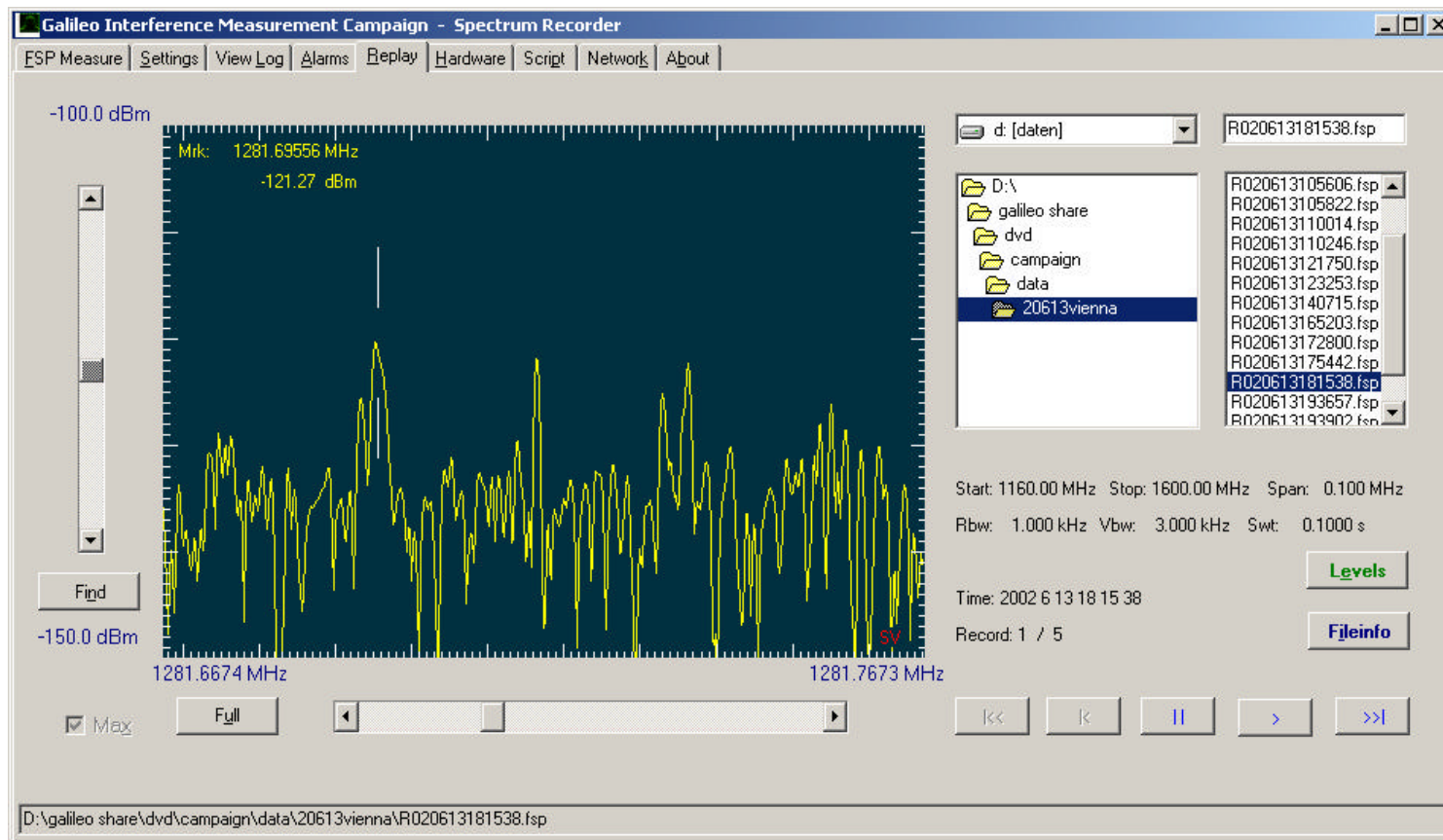


Primary Radar Koralpe, AustroControl, bw about 10 MHz,
Max allowed frequency range: 1250 - 1350 MHz

Unidentified Source in Graz / Austria



Relais / Austria



Amateur FM-ATV-Relais OE3XOS; Hohe Wand, Kleinkanzel-haus (160055/474950); 1280 MHz, 16M0F8W; License GZ 420920-JD/95, Change GZ 103908-JD/01 in progress; max allow bw: 16 MHz

Statistics

	E1/2	E4	E5	E6	SV	UN	Total
	1,559 – 1,591	1,254 – 1,260	1,164 – 1,215	1,260 – 1,300	1,160 – 1,600		
Nr Det	671	63,617	15,419	41,786	104,178	1,677	227,348
Det [%]	0.003	1.03	0.035	0.139	0.071	0.287	0.246
Max [%]	0.35	31.1	2.04	15.7	2.44	0.99	31.1
Dev [%]	0.026	4.33	0.179	1.028	0.25	0.387	1.97
Aver [dBm]	-145.0	-143.9	-144.1	-144.8	-139.2	-143.3	-143.2
Peak [dBm]	-131,7	-129,3	-128.4	-125.8	-117.0	-126.9	-125.9

Overall: 1,727 scans 91 Mio Samples (res. bdw 0,3 kHz) 227,348 detections (0.25 %)

Threshold: - 130 dBm (SV: - 124 dBm)

Conclusions

- Spectrum Recordings and High Speed Baseband Data have been obtained along route and at traffic centers in 5 European countries (AT – BE – FR – GE – NL)
- Statistics has been obtained to provide first estimates of interference
- A number of unknown interferers were found (i.e. in Austria 8 out of 12 measured interferers could be identified)
- Baseband recordings for the most important locations and measured interferers are available