A Spectrum Management view about VBLBI2010: the CRAF experience

CRAF

(Committee on Radio Astronomy Frequencies)

is an *Expert Committee* of the

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Why modern VLBI should care about the tiny channels protected by international regulations?

Soon after the start of the Radio Astronomy era, it was realized that only an ***international regulatory*** approach could permit to reach the **SENSITIVITY** limits set by nature, i.e. the ***sky observable.***

It took a lot of efforts to get ***Frequency Allocations*** with the following priorites:

Exclusive (S5.3409)

Primary

Secondary

ITU-R 769 was even harder to get approved with tables quoting the detrimental levels to RA observations, in typical Continuum, Spectral and VLBI setup.

The present status of radio spectrum (1)

Wireless was born to connect only remote users, now it has become the "easy way" for ***any, possibly wideband,*** application.

Why did it happened? Just because this smart scientific community has shown to all world that

- The *maximum information content* (in a given number of bits) is made by Gaussian Noise.
- The maximum measurement resolution comes by using *broadband sampling*.
- Electronics now is so cheap and powerful that *any complex algorithm* is feasible.

The present status of radio spectrum (2)

Ultra Wide Band devices are offered for ANY kind of applications, even when conventional methods could work the same way.

Interference is felt as a byproduct manageable simply by proper selection of the S/N in the radio link.

"Free market" is considered to be the ***best*** spectrum manager

- The RFI Temperature is a proposed concept (not yet approved!)
- "Free licence" is forecast for most low power services

Driving force in all kind of confrontations is assumed to be their

commercial value

CRAF answers now come to mind:

Regulatory free tiny channels are the only ones where:

we can get real natural sensitivity limits;
unambiguous efficiency verification of the best mitigation techniques;
losing them will mean for competitors that we do not care about spectrum;
CRAF, CORF, RAFCAP, IUCAF are tracking UWB & other performance

Only at the ***International regulatory level*** we can proof and legally defend:

what is the ***"value" of Fundamental Science*** vs any kind of active service;
societal value of all passive services and Geophysics in particular is evident for us, but we ***have the duty to show it*** at the ITU, CEPT and local levels.

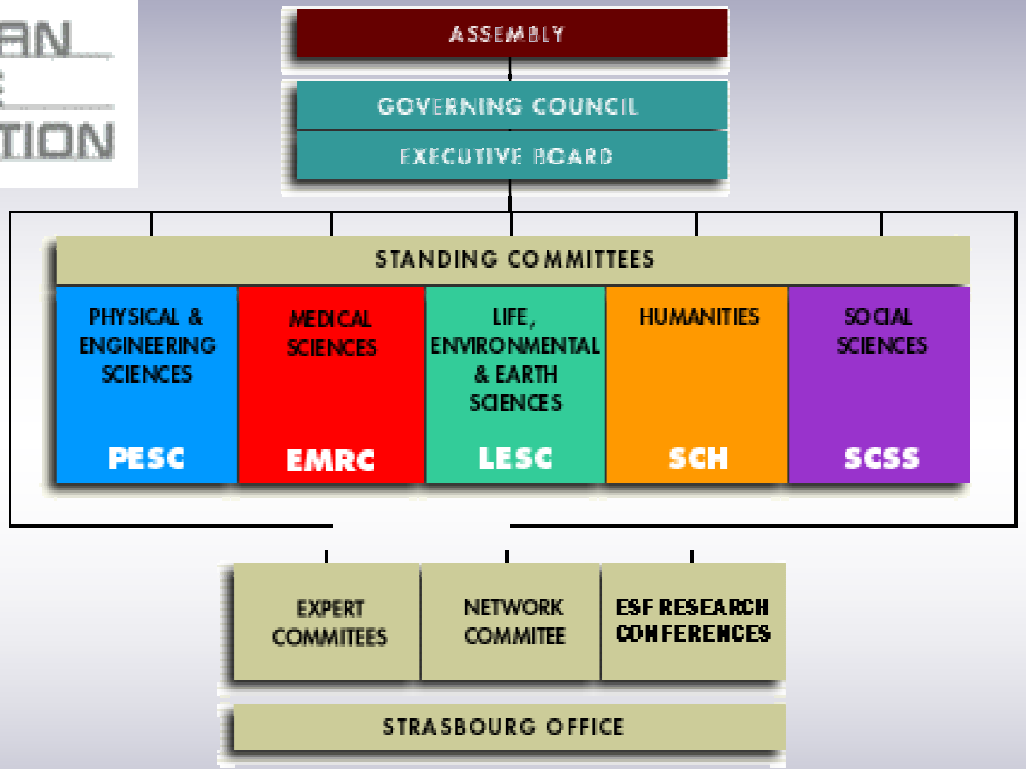
Definitions of ***Radio Quiet Zones*** might be the best strategies for our future. Only ITU and National Administrations can enforce that.

The ***EC and the National Administrations***, believe it or not, see in our activity a counterbalance vs the aggressive attitude of the ones that want to minimize THEIR decisional power.

CRAF in practice: I part

77 Member Organizations

Over 30 countries



One of the Expert Committe of PESC is:

CRAF, Committee for Radioastronomical Frequencies

CRAF in practice: II part

CRAF is made of

- ***CRAF members,*** *at least one from each of the* ***19 EU Member Institutions***
  (last to join: **Greece and South Africa**)
- ***ESF Liaison (Neil Williams) + Secretary (Carole Mabrouk)***
- ***Frequency Manager (Laurentiu Alexe)***
  - full-time position; funded by Observatories/Agencies (not EC), through ESF
- ***CRAF secretary (Pietro Bolli)***
- ***CRAF chair (Axel Jessner)***

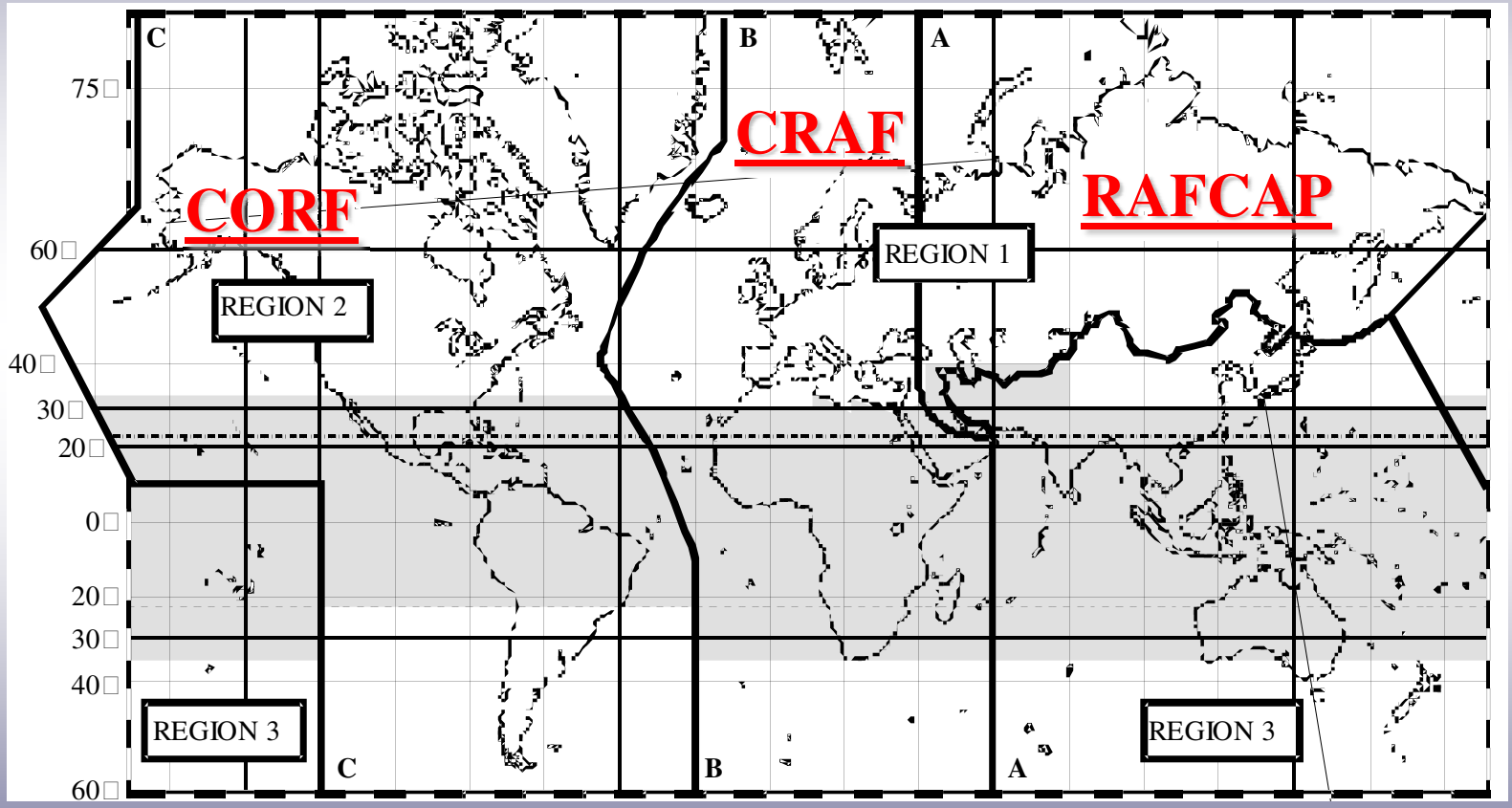
CRAF activity

CRAF has the status of: Observer in CEPT, Sector Member in ITU, so it participates to:

- ***ECC Working Group FM, ECC Working Group SE, FM and SE project teams….***
- ***World Radio Conference, ITU study groups, Working Parties (7D Radio astronomy, etc)***
- 2 ***Plenary*** meetings and 2 ***Newsletters*** per year;
- a well established ***Website*** ***http://www.craf.eu*** made of many hundreds of pages
  (docs, formulas, specific and general info)
- 2 ***Handbooks*** ***(published by ESF)*** :
  CRAF handbook for Radio Astronomy (new edition 2005);
  CRAF Handbook for Frequency Management;

RA committees over the ITU-R Regions

IUCAF



African bloc: *only RAS in South Africa*; **Arab bloc**: *no radio astronomy*

Passive versus Active Radio Services

	Passive	Active
Transmitting Power	Weak natural sources	Selectable
Transmitting / Receiving Frequency	Determined by the observable	Selectable
Receiving Sensitivity	From best to ultimate	Selectable
Cabled (=non wireless) alternative	NO	Often, Yes
Time scale of return profits vs investment	Very Long	Cashable almost immediately
Commercial Value (=Intrinsic + Return)	NON-commnen surable	Large

Regulatory strategies

- ***Internationally*** ITU-R RA.769 gives the detrimental levels to RA observations (typ. values are 10^{-26} W/m^2/Hz)
- Protection should be enforced by ***National Administrations.*** In Europe now the ***European Commission*** has coordination rights on all of them.
- Often Observatories have to detect ***by their own*** the source (local or remote, terrestrial or from satellites)

Then there are four levels of actions to be taken:
International (ITU → IUCAF), European (CEPT → CRAF),
National (CRAF members), Local (Observatory technicians)

Societal tradeoffs

Radio Astronomy can offer Society:

- a better understanding of the Universe and man's role in it
- a ***driving force*** for the most advanced technological developments;
- many good ***educational*** opportunities (all grades).

Radio astronomy is looking for a continued ***coexistence***
with all radio services.
As non commercial experts we can be ***good advisor***
for all general public.

Primary & Secondary allocations (I)

Primary Allocation

1 400.000	1 427.000	**MHz**	**RAS - Exclusive**
1 610.600	1 613.800	**MHz**	RAS
1 660.000	1 670.000	**MHz**	RAS
2.200	2.300	**GHz**	RICERCA SPAZIALE (sp.lont.) (s-T) 147 151
2.690	2.700	**GHz**	**RAS - Exclusive**
8.175	8.650	**GHz**	RICERCA SPAZIALE 207 208 208A
10.680	10.700	**GHz**	**RAS - Exclusive**
15.350	15.400	**GHz**	**RAS - Exclusive**
22.000	22.500	**GHz**	RAS
23.600	24.000	**GHz**	**RAS - Exclusive**
31.300	31.500	**GHz**	**RAS - Exclusive**
31.500	31.800	**GHz**	RAS
31.800	32.300	**GHz**	RICERCA SPAZIALE (sp.lont.) (s-T) 263

Secondary Allocation

1 330.00	1 400.00	**MHz**
1 718.80	1 722.20	**MHz**
2 655.00	2 690.00	**MHz**
3 260.00	3 267.00	**MHz**
3 332.00	3 339.00	**MHz**
3 345.00	3 352.50	**MHz**
4 825.00	4 835.00	**MHz**
4 950.00	5 000.00	**MHz**
4 990.00	5 000.00	**MHz**
6 650.00	6 675.20	**MHz**
10.60	10.68	**MHz**
14.47	14.50	**GHz**
22.81	22.86	**GHz**
31.20	31.30	**GHz**
36.43	36.50	**GHz**

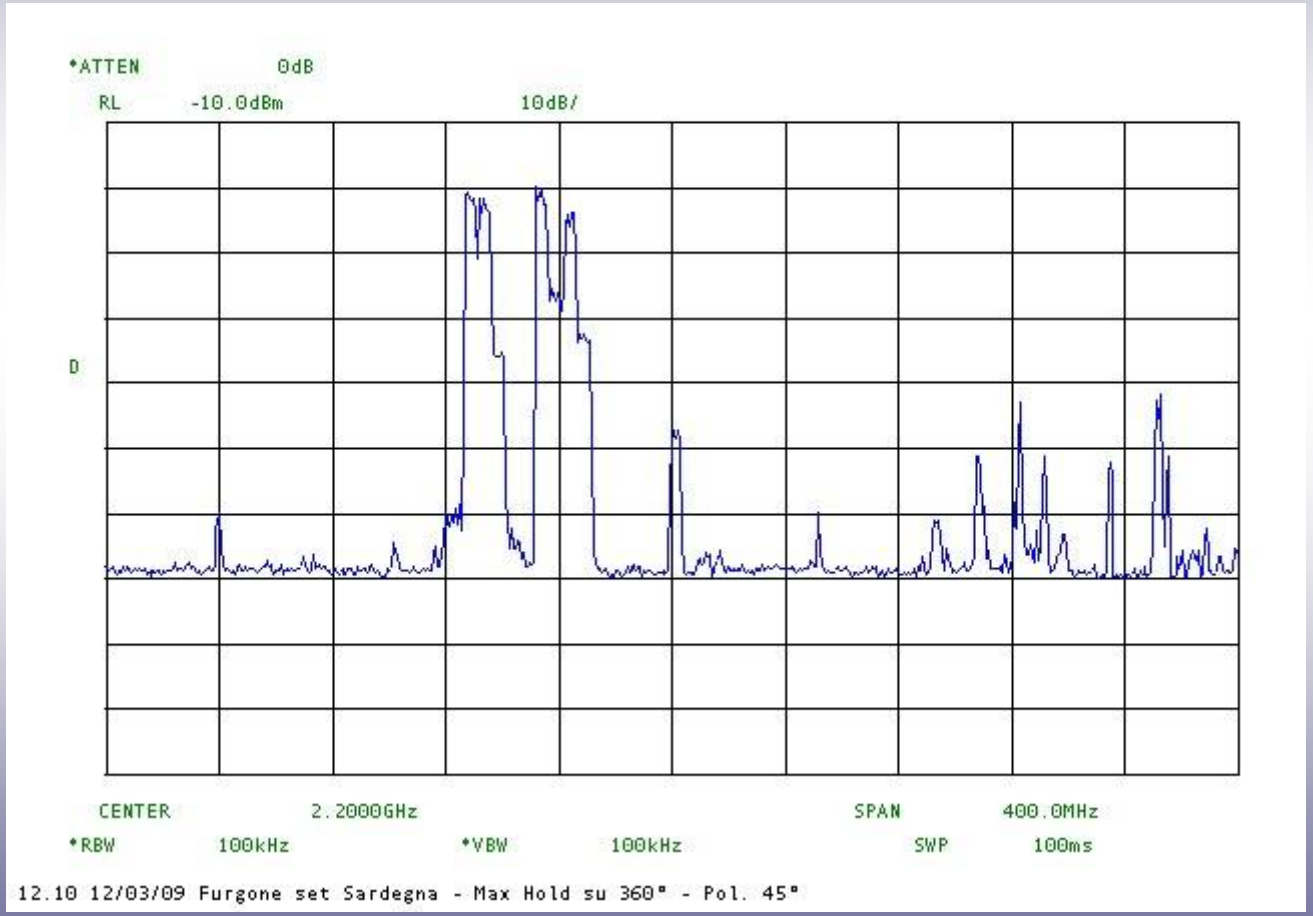
Strategies toward VBLBI2010 Frequency selections

- Strong Signal surveys:
  - There are forbidden bands anyway by RFI
  - Total and Peak power evaluation
  - Very careful receiver design for
    - ***High dynamic range***
    - ***Careful distribution of GAIN and FILTERING across all Rx***
    - ***Cut the unwanted bands***
    - ***TEMPERATURE design is the key factor for long term stab***
    - ***Support CRAF activity toward setting up RQZ at EU Observatories***

Spectrum @ Medicina: 2.0-2.4 GHz

ATTN!!!

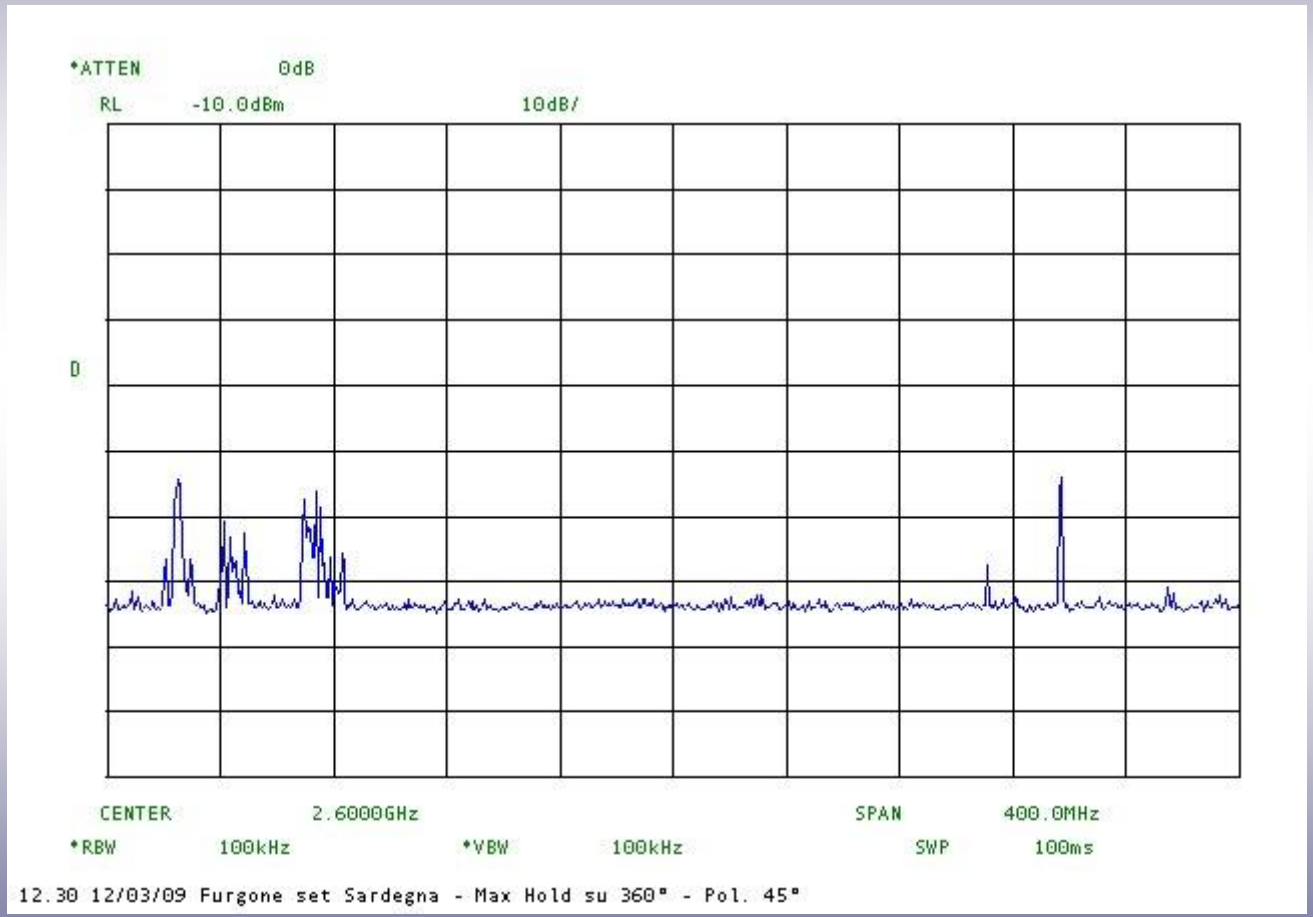
Noise floor
+50dB
Above ITU-769



Spectrum @ Medicina: 2.4-2.8 GHz

ATTN!!!

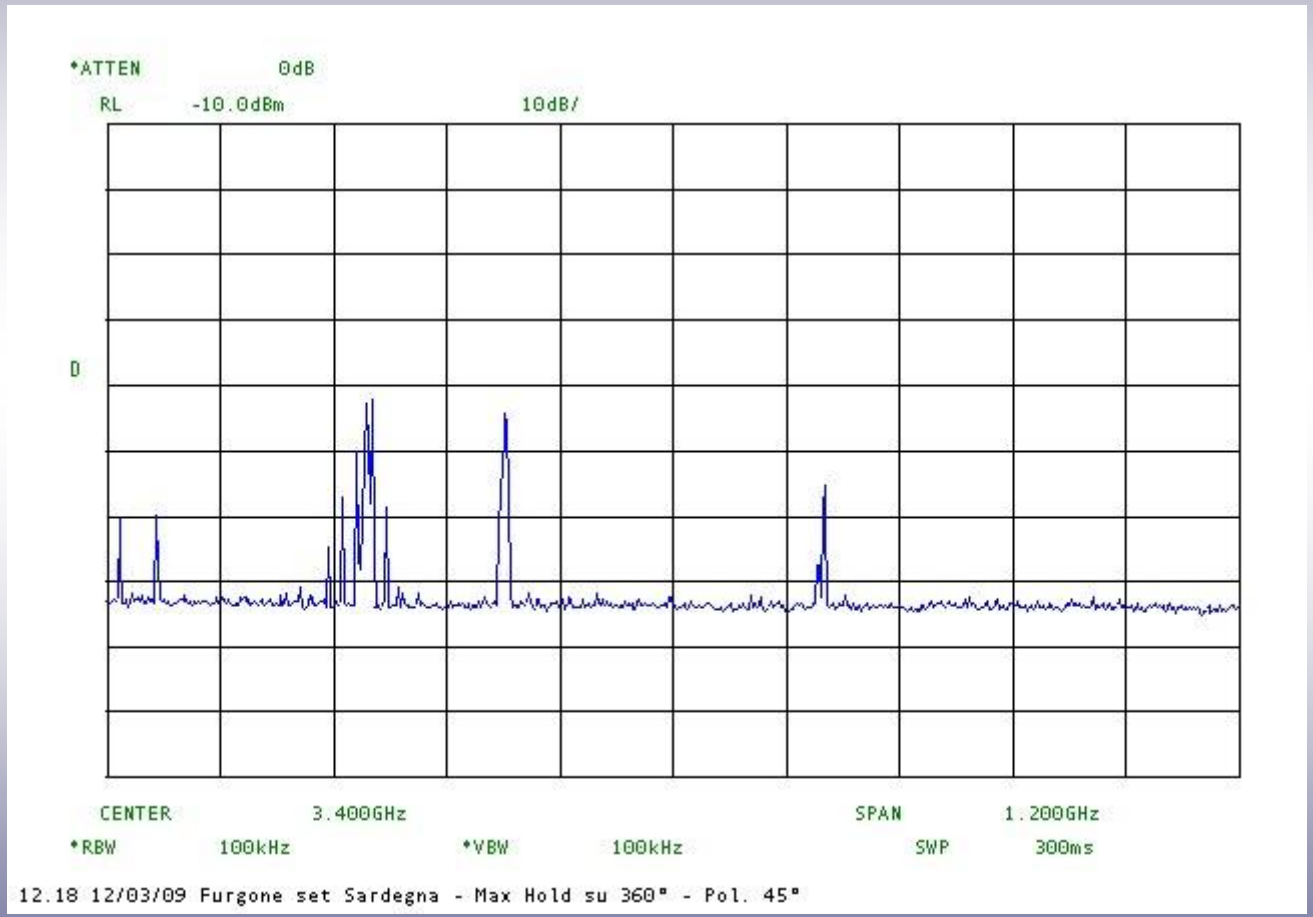
Noise floor
+50dB
Above ITU-769



Spectrum @ Medicina: 2.8-4.0 GHz

ATTN!!!

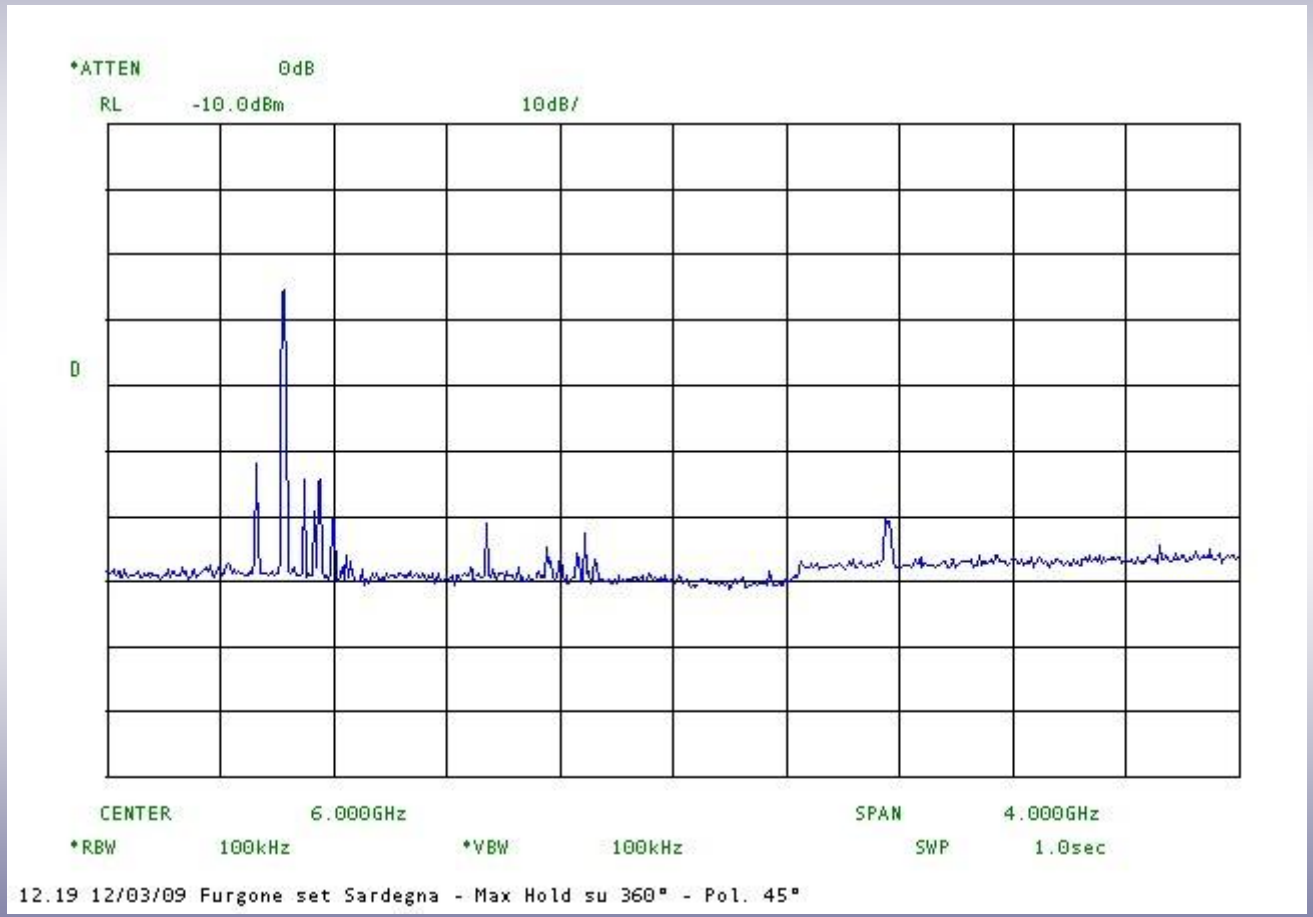
Noise floor
+50dB
Above ITU-769



Spectrum @ Medicina: 4.0-8.0 GHz

ATTN!!!

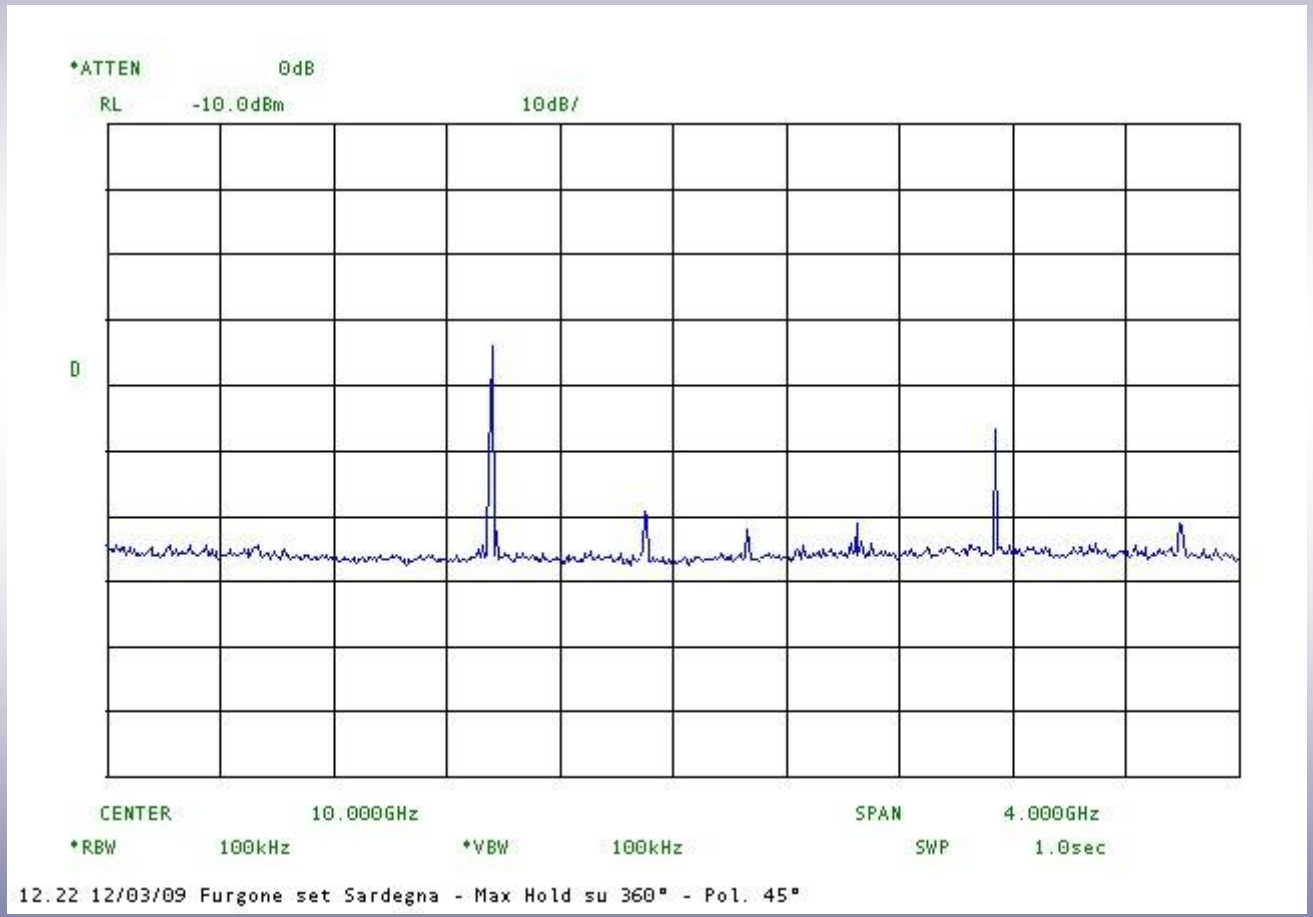
Noise floor
+50dB
Above ITU-769



Spectrum @ Medicina:8.0-12.0 GHz

ATTN!!!

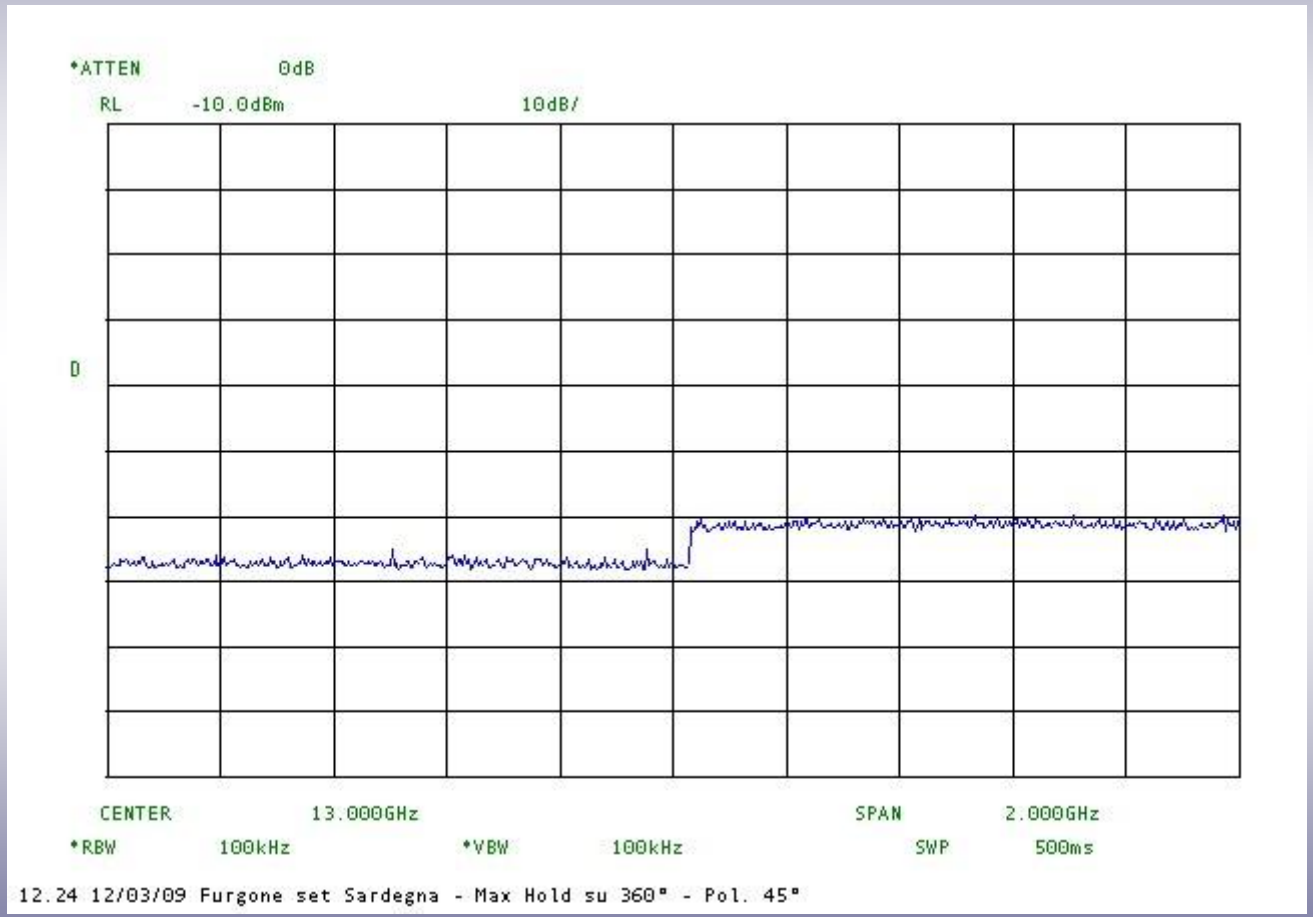
Noise floor
+50dB
Above ITU-769



Spectrum @ Medicina:12.0-14.0 GHz

ATTN!!!

Noise floor
+50dB
Above ITU-769



Conclusions

- ***Spectral occupancy*** at the typical level of sensitivity expected for a VLBI observation is much worse than what you saw here.
- ***Exclusive*, *Primary*** and also *secondary* allocations shall be strenuously defended: accurate calibrations, natural sensitivity limits and mitigation efficiencies can be evaluated only here.
- ***UWB devices*** should be carefully considered as the most dangerous
- ***Radio Quiet Zones*** are the best strategies against them.
- Extremely efficient ***Mitigation techniques*** are the key factors for success: but attention to caveats…..
- Suggestions for Frequency band selection in VBLBI2010 ?
  - Strong Signal surveys for designing high dynamic range receivers;
  - ***Support your national colleagues working also for CRAF***

Is RFI a kind of ambient pollution?

- We think this is not the case.
  - If we would be able to ***switch off all*** the active services, immediately, all RFI would disappear. So the answer is NO
  - More than that, we do not want to mix our difficulties with endless political debates.
    - We ask for keeping present allocations.
    - We ask for good regulatory upgrades toward new devices.
    - We are struggling to have with all future services, at least as well as with the present ones,

COMPATIBILTY

(fighting is not the best strategy)

SRT … a few weeks ago