RF electromagnetic measurements in a rural environment

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Introduction

Pleumeur Bodou Radio Observation

- Association (10 members)
- Main objectives
  - Promote and lead on the previous spatial telecommunication site, activities centered on the observation of radio frequency: radio astronomy, ionosphere, …, etc
  - Rehabilitation and retrofitting of one or more antennas on the site for radio astronomy
  - Installation of special equipment (Galileo, ...)
  - Teaching animation, training, research program, cooperation with institutional laboratory, ..., etc
- To know more about the association and its project: http://www.obsradio.asso.fr

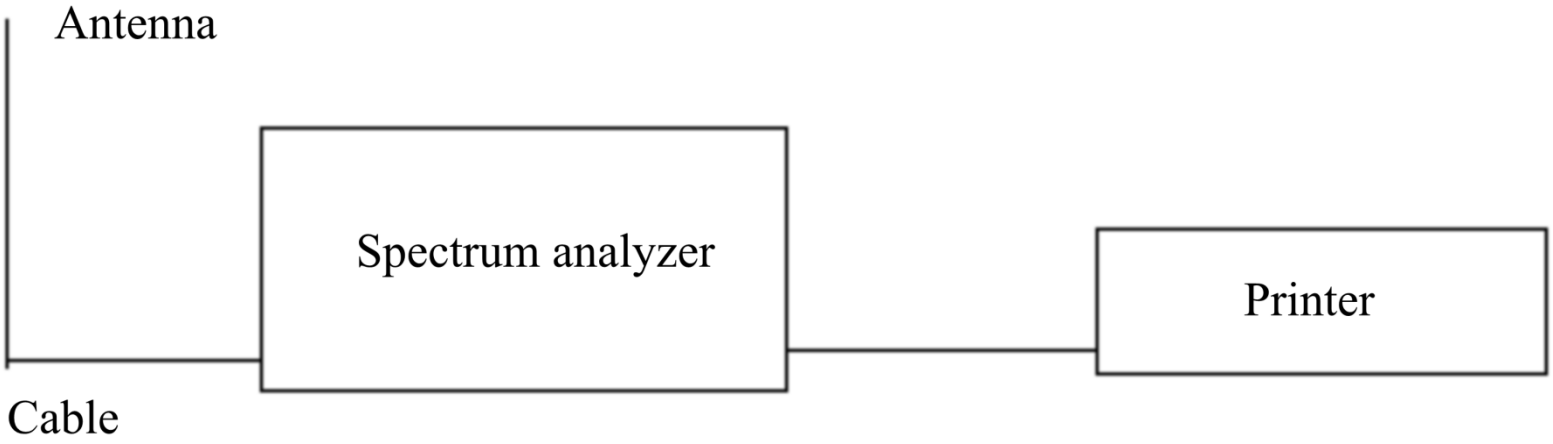
Aim of the experiment

- Determine the electromagnetic spectrum occupation in rural environment
  - Pleumeur Bodou (previous spatial telecommunication center)
    - Lat: 48°47’07’’ North
    - Long: 3°31’05’’ West

Measurement set-up

Schematic view

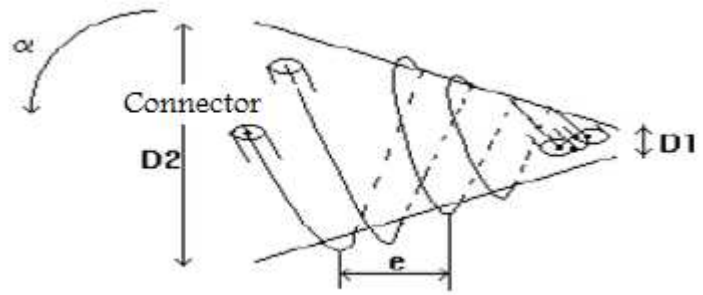
- Antenna
- Cable « RG213 » : 10 m, attenuation: 1dB
- Spectrum analyser (HP 85462A)
- A printer (display results measurements on a graphic)



Used antenna (1)

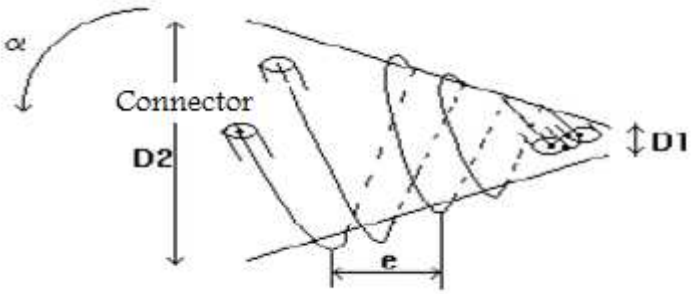
- Biconical antenna
  - Broadband dipole antenna
  - Arrangement of 2 conical conductors
  - Can be used in vertical and horizontal polarization
  - Bandwidth: 20- 220 MHz
  - Antenna factor : 13 dB

Used antenna (2)



- Conical log-spiral antenna
  - Constituted by 2 coaxial feeders wrapped in the same sense
  - On the top of the cone the central core and the wire brainding are reversed
  - One of the end of the cable acts as an connector, the other one stays in the air. So the wire braindind of the coaxial cable acts as an illuminator
  - Polarization is circular in the same sense as the turns winding

Used antenna (2 bis)



- Conical-spiral antenna
  - Weaker is the α angle, more attenuated is the antenna back lobe
  - The progress of « e » identical is identical to that of a log periodical antenna (impedance and radiation patter are repetitive and following a log periodical law)
  - Power gain : 6 dB (α=30°)
  - Bandwidth : 200 -1200 MHz
  - Antenna factor: 28 dB

Used antenna (3)

- Double-ridged waveguide horn antenna
  - Linear polaried broadband directional
  - Bandwidth: 1-18 GHz
  - Can be used in vertival or horizontal polarization according to its fixation
  - Antenna factor : 27 dB

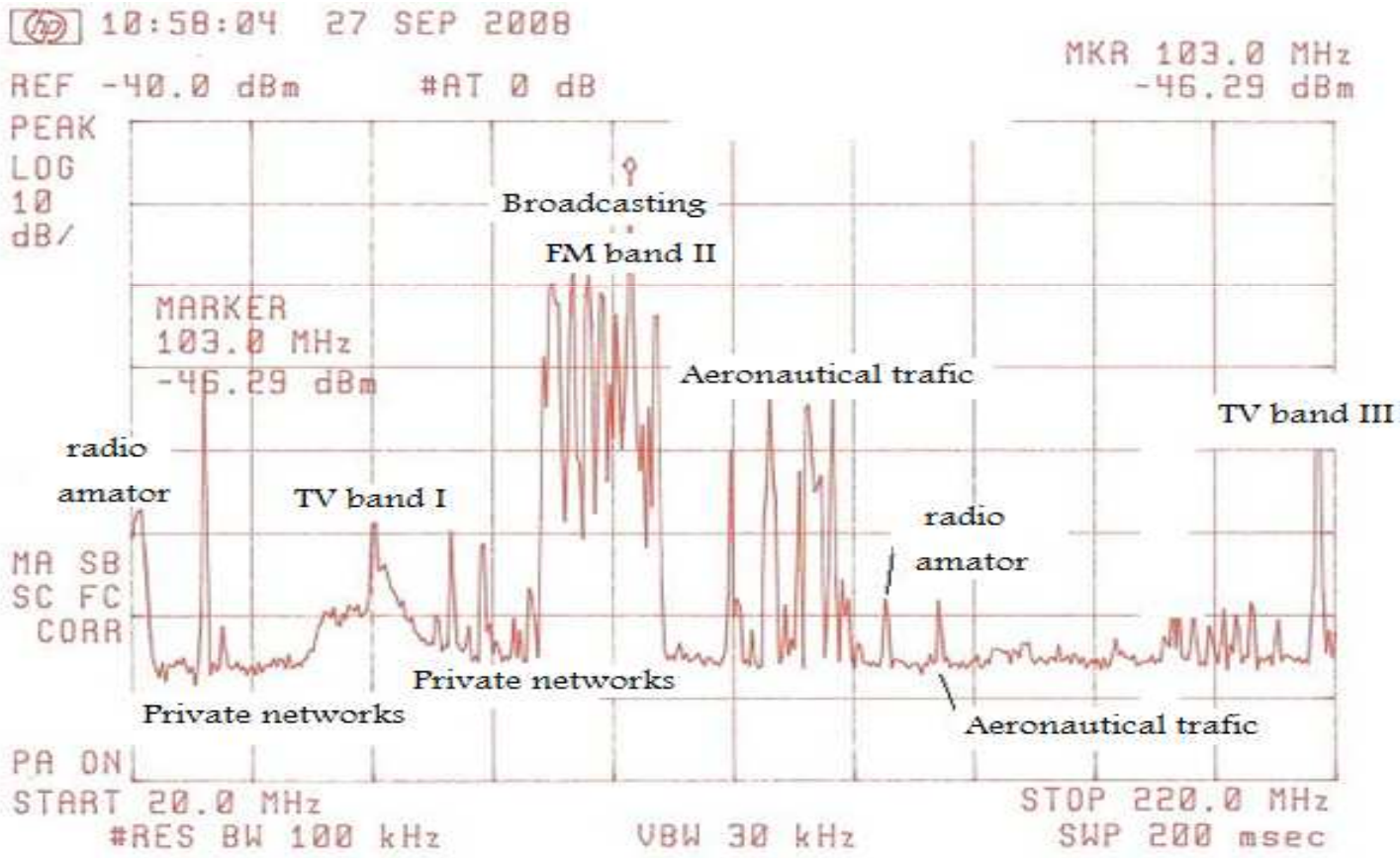
Results

Results

- Radioelectrical power in function of frequency
  - Date
  - Hour
  - Bandwidth
  - Services
    - Broacasting
    - TV
    - Radioamator
    - …
  - Noise threshold : -108 dBm

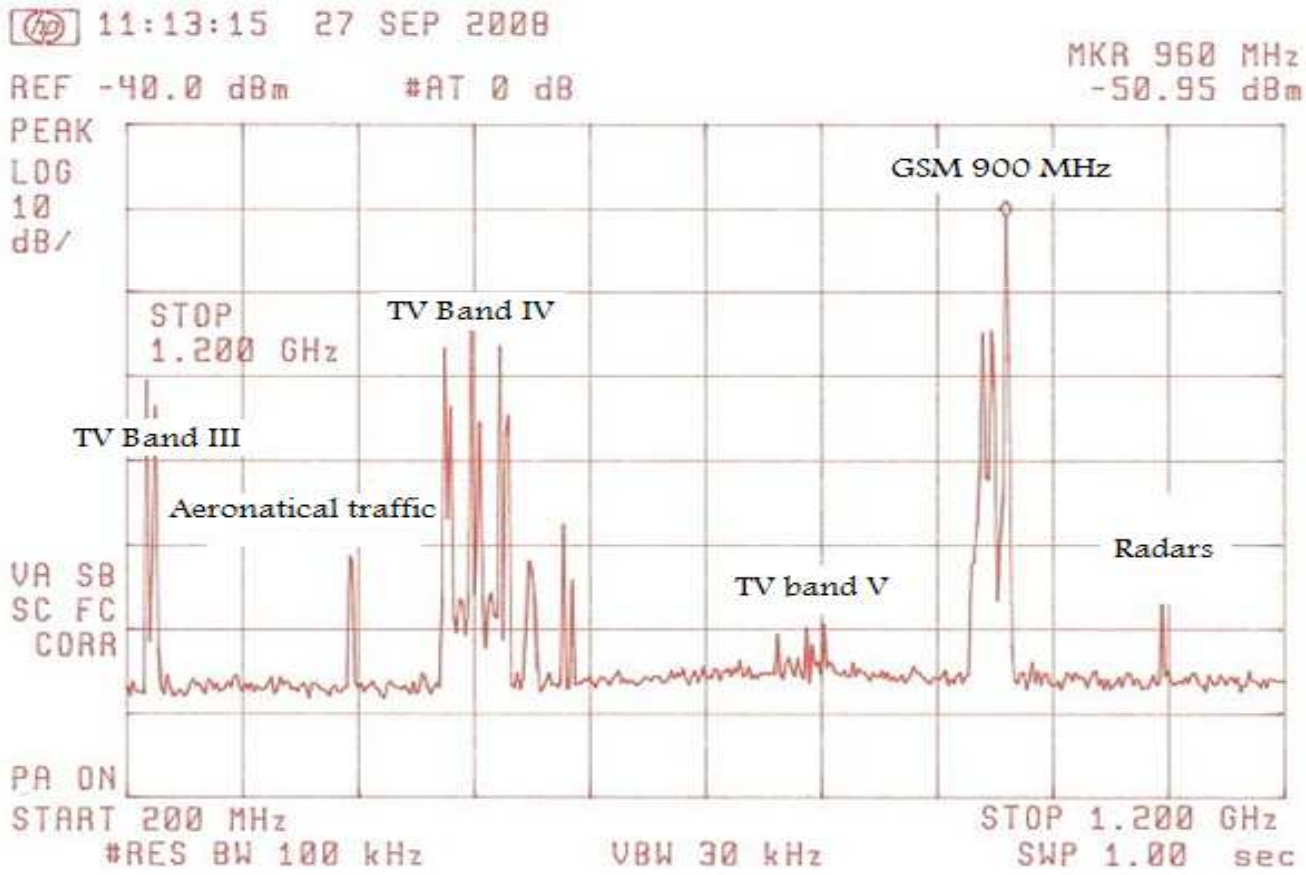
Results in HF frequency band

- 20-220 MHz, horizontal polar, Est-West direction



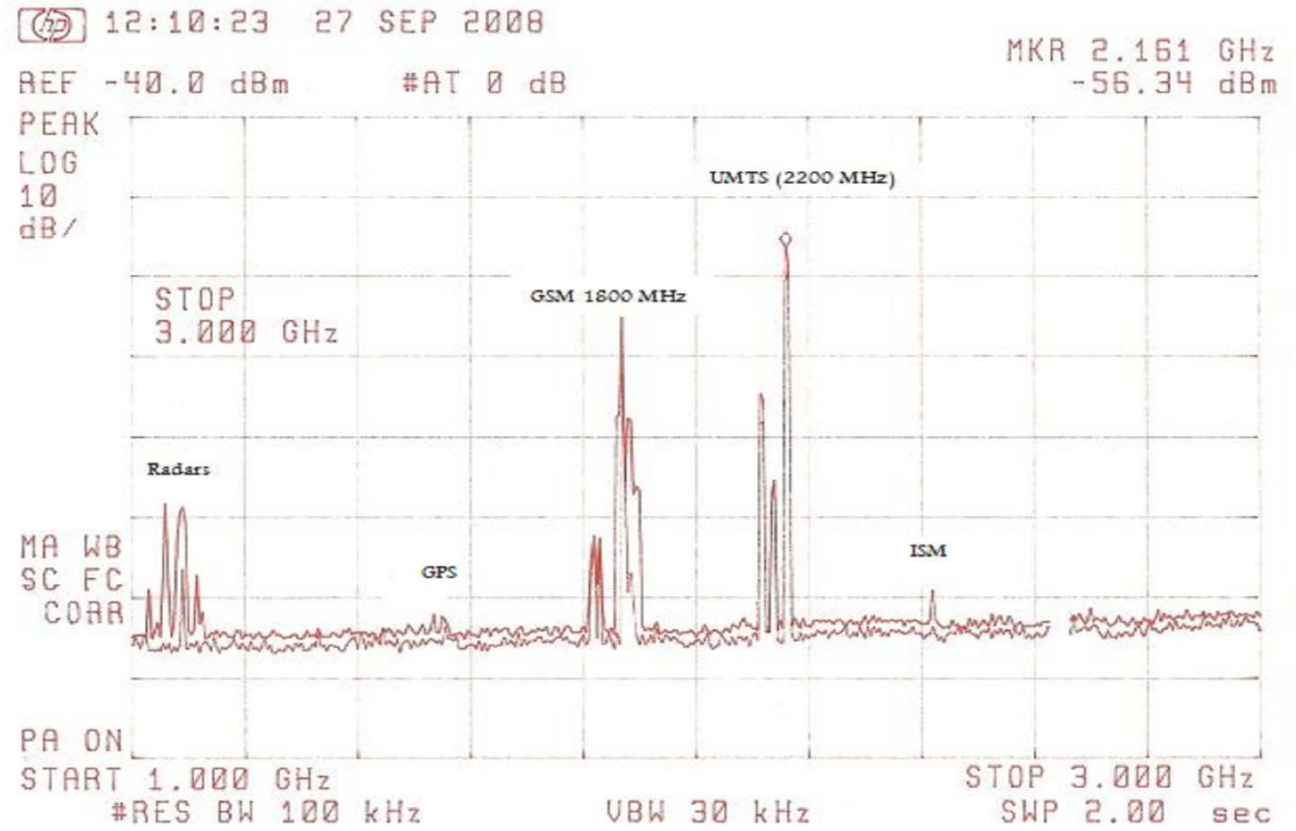
Results in VHF frequency band

- 200-1200 MHz, circular polar, South direction



Results in UHF frequency band

- 1-3 GHz, horizontal polar, Est direction



Conclusion

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- Measurements in the 20 MHz – 3 GHz in a rural environment
- Spectrum clean outside frequency bands allocated to services: land, aeronautical and maritime radio communications and more particularly in frequency bands allocated to: radioastronomy, spatial research, remote sensing, radio navigation, ….

Conclusion

- To compare the measurement radioelectrical power to electrical limits values at the antenna level, conversion are made for different services: we find
  - GSM (900 MHz): 17.8 mV/m
  - UMTS (2.2 MHz): 8.9 mV/m
- Electric fields close to the antenna are weak compared to limit standard values legal in France and in European union (41 V/m)