

WP1 state of the art

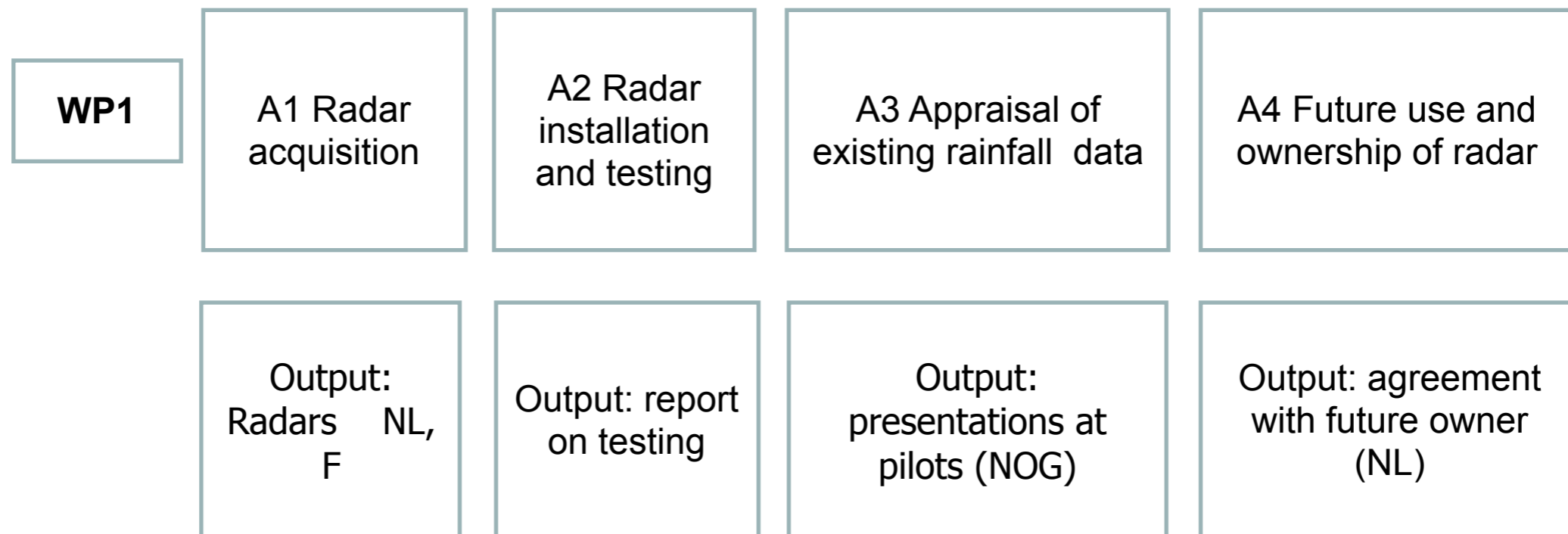
RainGain Project Meeting, Exeter, 6-7 October 2014

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Ecole des Pont ParisTech



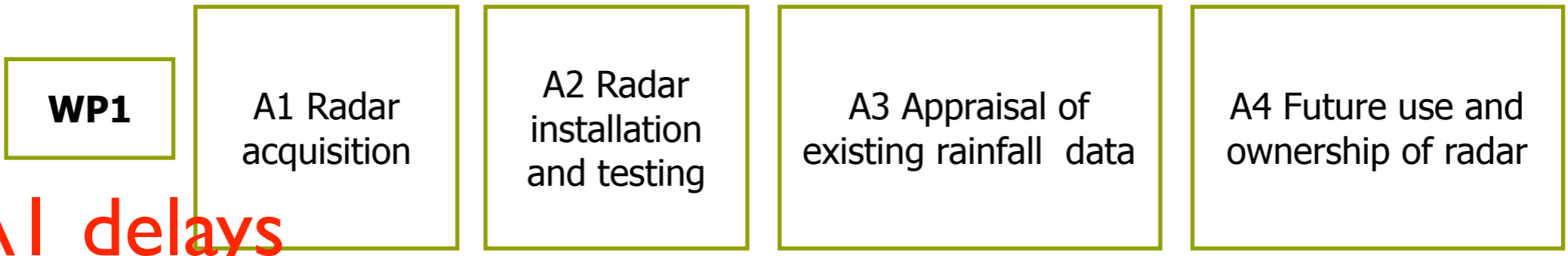
RainGain WP1



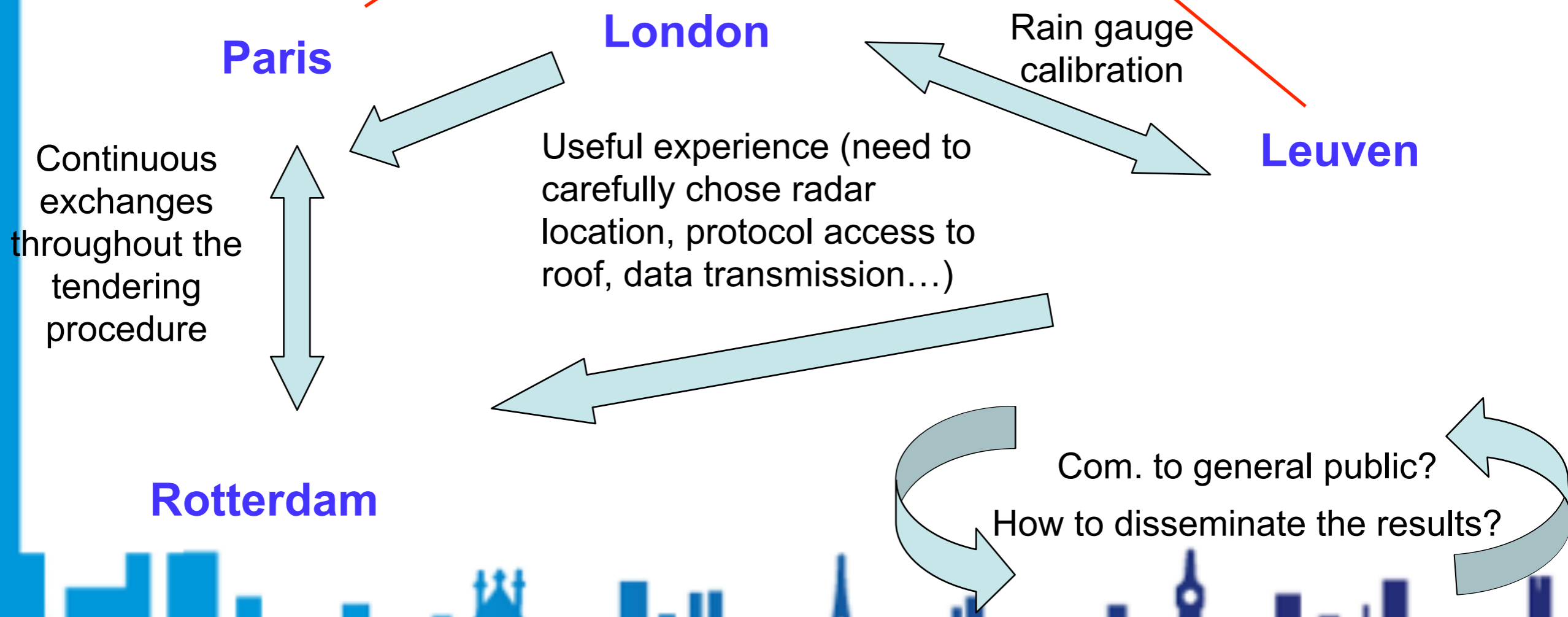
Partners are at various stages

- FR and NL recently acquired new polarimetric radars
 - Public tenders turn out to be complex
- BE had already a radar
- UK borrowed a radar





long AI delays
=> underspending?



- Deriving observed rainfall intensities from radar reflectivity values (Johan Van Assel):
 - Despite continued efforts in the past years, we must conclude that today we are **still far from a reliable Z-R** conversion with our radar : uncertainty about the validity of the attenuation corrections that take place in the –for us inaccessible- conversion from raw to processed data; likelihood of considerable blanking during heavy rainfall in the immediate vicinity of the radar (despite the shelter); high and unstable clutter; ... But above all there seems to be **very little consistency** in the observed temporal rainfall patterns between raingauges and the corresponding pixels (and the same is true when we use C-band data instead of gauges).

- Deriving observed rainfall intensities from radar reflectivity values (follow-up):
 - My personal feeling (based on realtime observations of images) is that there might be a **radial scaling factor in the polar to cartesian conversion**. We have asked DHI to check this, but they say that for that specific resolution they cannot find an error in the calculations. Nevertheless, I tried to verify this assumption on a particular event, and this analysis did certainly not fully contradict my assumption. But it is obviously only one event, and before we could have more certainty on this, a lot more events would need to be analysed.
 - **This uncertainty obviously puts a heavy burden** on the calibration of a Z-R relationship. One of Patrick's masterstudents has tried this in the past months, but without much success.



- Radar shipped to the Netherlands last summer



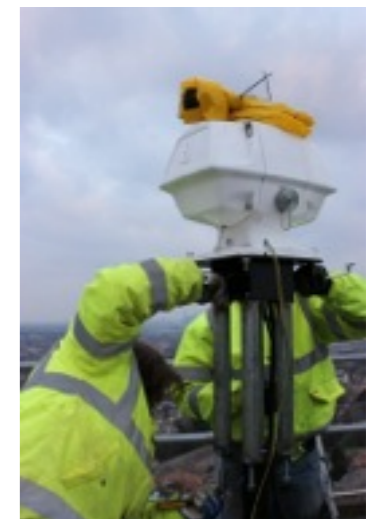
- then installed at SSBV premises for **factory tests**. **Some issues** regarding integration of the radar rotator and positioner are currently being resolved. Then, they will be integrated, validated and tested.
- other tests are conducted as well, especially for the radar interface



- A visit to the Nationale Nederland Building in Rotterdam has been planned next week to sort out transportation of the radar to the roof and final installation.
- SSBV is currently aiming for shipment to Rotterdam in the 3rd week of October.

London's low-cost X-band radar: Selex RainScanner RS90

	Selex RainScanner RS90																									
Radar type	<i>X-band</i>																									
Polarisation	<i>Single-polarisation</i>																									
Doppler (yes/no)	<i>No</i>																									
Antenna	<i>Parabolic, pencil beam antenna</i>																									
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Temporal resolution	<ul style="list-style-type: none"> Light rain: within 35-40 km range ^{1 min} Moderate rain: within 60-70 km range Heavy rain: within 70-100 km range ² 																									
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4. Decommissioning and 'wrap-up' stage

(October 2013 - Present)

- a) Continued data processing and analysis
- b) Documentation
- c) Dissemination

A website for displaying raw as well as processed X-band radar data for selected storm events is being implemented (for the use of the urban hydrology community)



X-band radar monitoring campaign in Central London:

Conclusions

- It is not easy to install a radar in the heart of a dense urban area such as London (**more details on this can be found in the following slides**)
- In general: low cost X-Band radar can effectively capture storm cells and storm movement at high resolution; however, the accuracy of the estimates is rather poor.
- The main reasons for poor accuracy are clutter and attenuation.
- Accuracy can be improved based on complementary data from other sensors (e.g. C-band radar, raingauges); however, the need for data from multiple sensors to produce reliable estimates makes the added value of the low-cost X-band radar questionable, especially in areas such as London where C-band radar coverage and quality is quite good.
- Low cost X-bands could be useful for tracking and forecasting storm movements in areas where no other data area available. For example: in coastal areas.

- **Analysis and mitigation of the risk of radar radiation to people:**
 - Check recommended exclusion distances:
In our case: 64 m in the direction of the radar beam and 1.5 m under the radar beam while the radar is switched on)
 - There is always a possibility that someone is within the recommended exclusion distances and therefore subject to the effects of radiation
 - Stakeholders (e.g. building managers, local authorities, residents, etc.) want to know about the potential consequences of the radiation
 - Risk assessment and risk mitigation plan are required:

$$\text{Risk} = \text{Hazard (likelihood)} \times \text{Exposure(who?)} \times \text{Consequence(what?)}$$

Depends on specific location

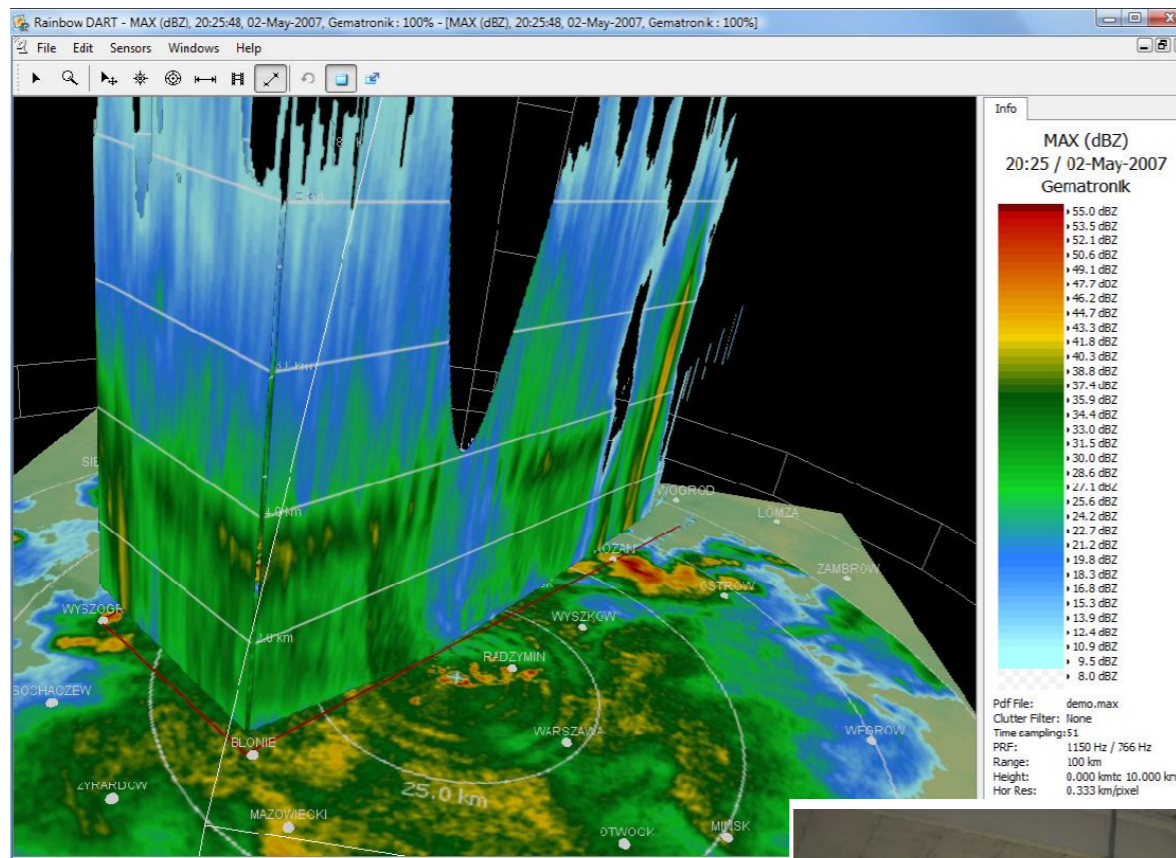
'Same' for all radars, but little info available

Most critical in the case of X-bands installed in urban areas – closer to people!

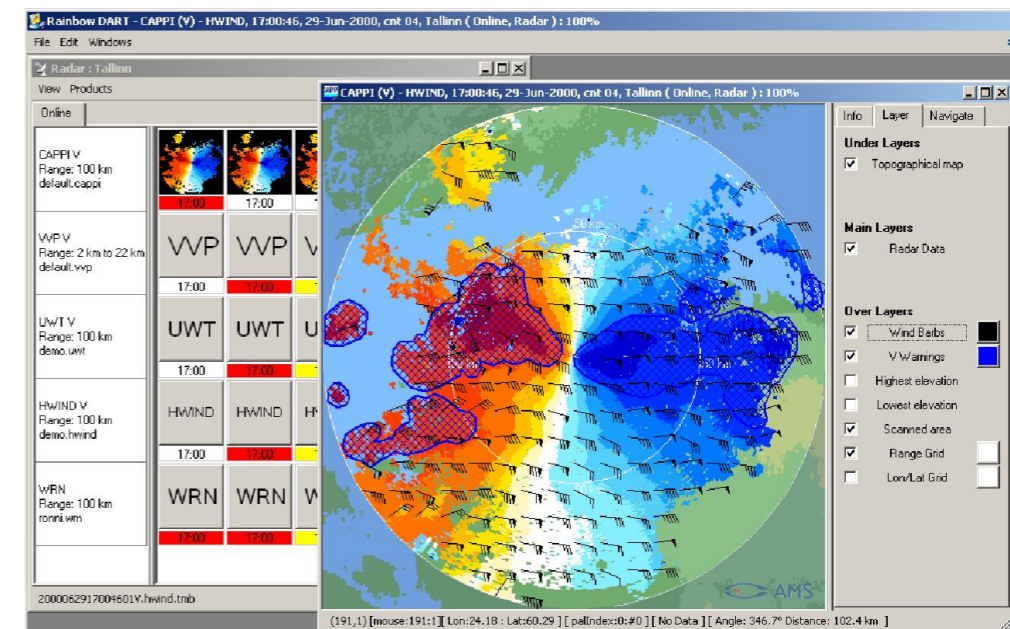
Analysis and mitigation of the risk of radar radiation to humans:

- **Characteristics of radiation:** would be good to summarise them somewhere (e.g. short guidelines)
 - Non-ionising, microwave radiation
 - Wavelength 2.5 - 4 cm
 - Frequency of 9410 ± 30 MHz
 - Mean / Peak radiated power: 25 W / 25 kW
- **Impact of radar radiation on humans:** some info available, but not much and not explicit reference to radar radiation / experiences
 - In general, microwaves cause heating of body tissues from induced currents
 - Relationship between long term exposure to microwave radiation and the risk of developing cancer? – **Typical question!** Until now, not enough evidence to support such a connection





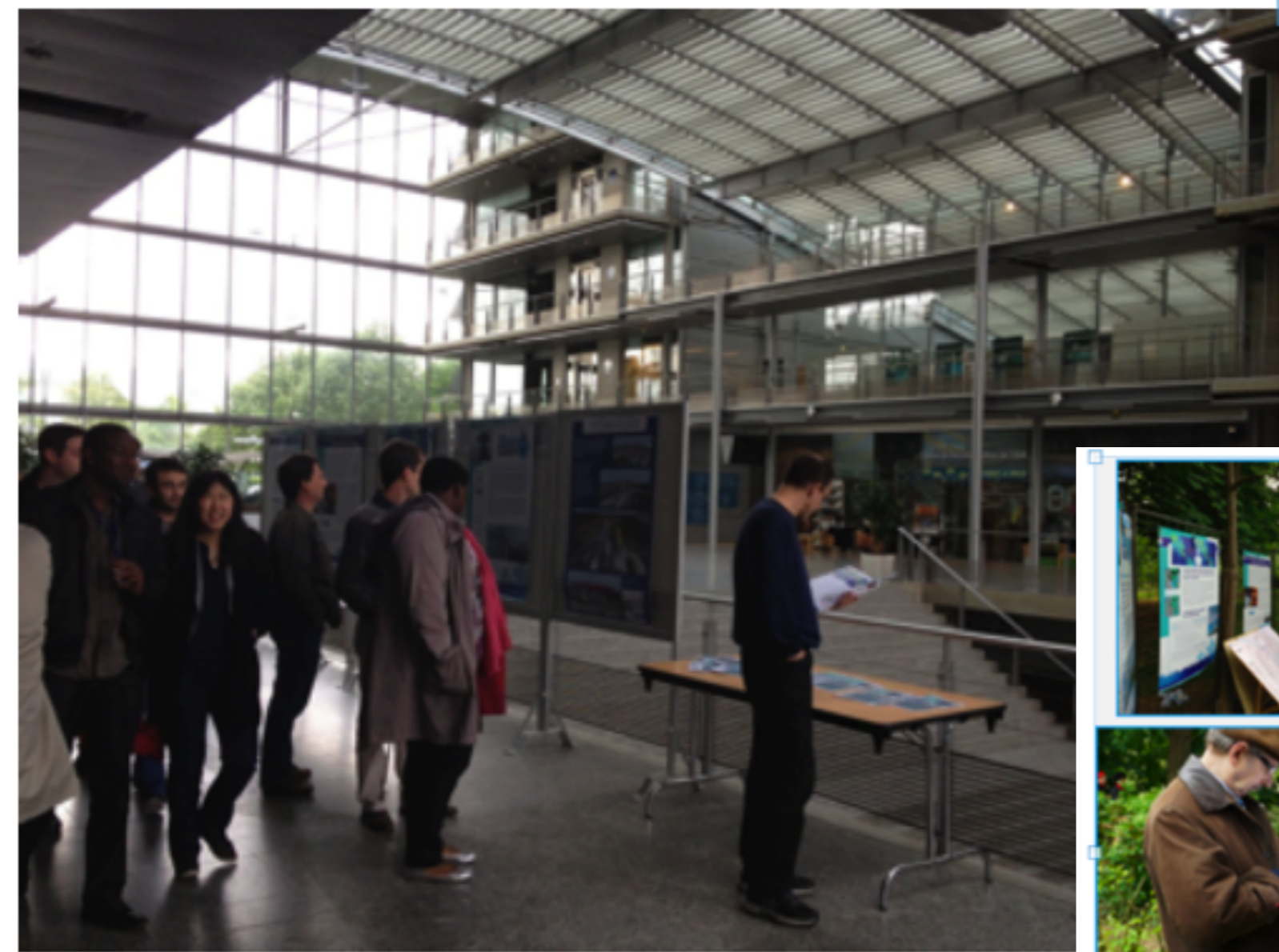
SELEX Meteor 50/60 DX



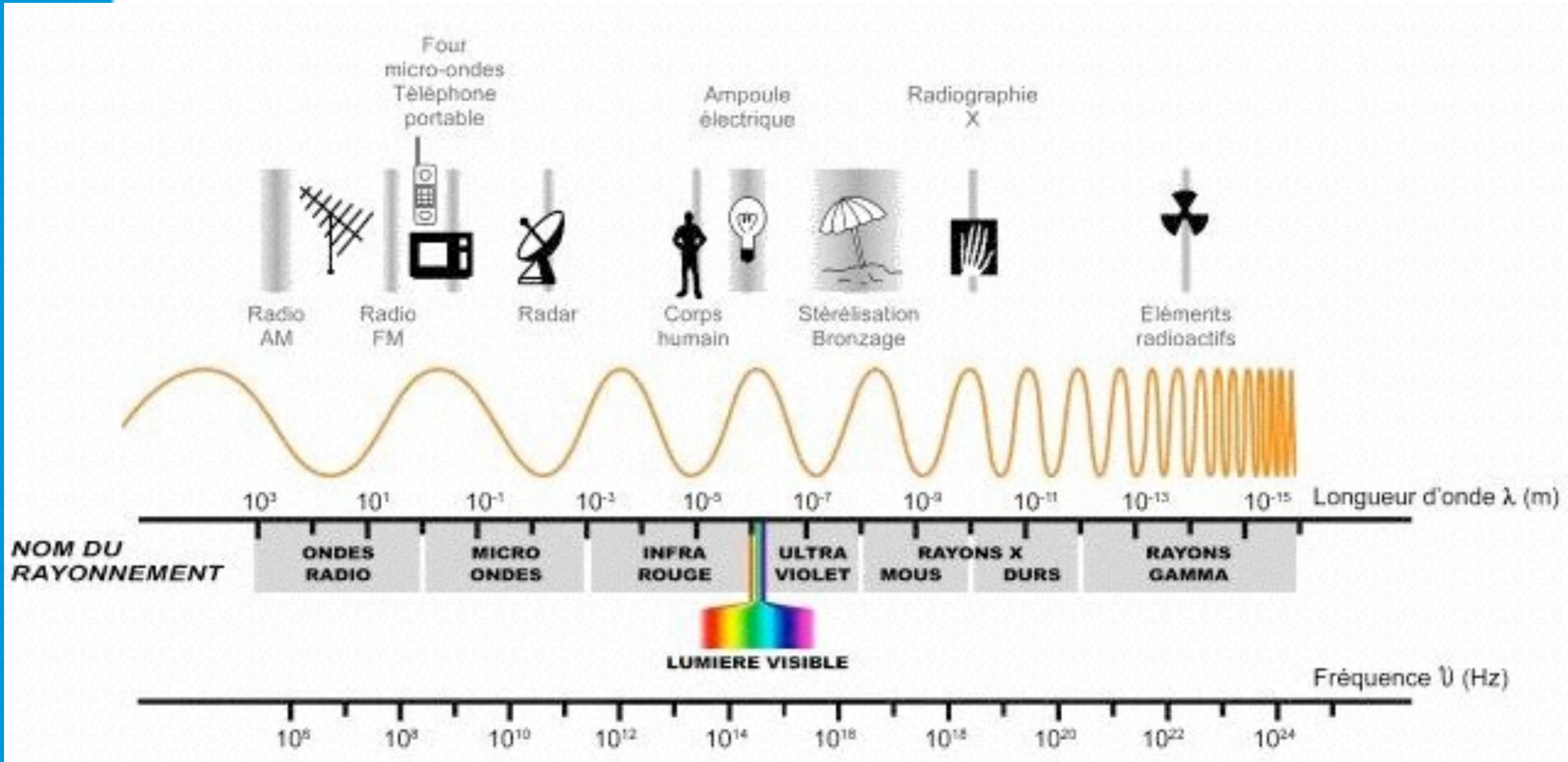
Operating Frequency Range	9.36 – 9.38 GHz or 9.30 – 9.35 GHz
Peak Power (at Magnetron Output)	100 KW
Beam Width (1.8m standard)	1.3°
Antenna Gain	42.5, dB
Pulse Modes	4
Pulse Width (PW), configurable	0,33 – 2.0 μs or
Range Resolution @ Short Pulse	50 - 500 m
Pulse Repetition Frequency (PRF)	250 – 2500 Hz
Operational Range	100 km
Maximum Unambiguous Velocity @ 5:4	+/- 80 m/s
MDS @ Long Pulse	-113 dBm
Sensitivity (dBZ) @ LP& 100km	~ -11 dBZ
Sensitivity (mm/hr) @ LP, 100km	~ 0.002 mm/h

Wide communication:

- institutional safety and health committees
- colleagues
- general public/ citizens
- stakeholders (e.g. mayors)



Safety issues



- Ionization
 - reference photon energy: that required to ionize atomic hydrogen
 - 13.6 eV
- X rays
 - wavelength: 0.01 to 10 nanometers,
 - i.e. frequencies : 30 petahertz to 30 exahertz (3×10^{16} Hz to 3×10^{19} Hz)
 - energies in the range 100 eV to 100 keV
- X- band photon: non ionizing !
 - frequency ≈ 10 GHz
 - 4×10^{-5} eV

Safety norms



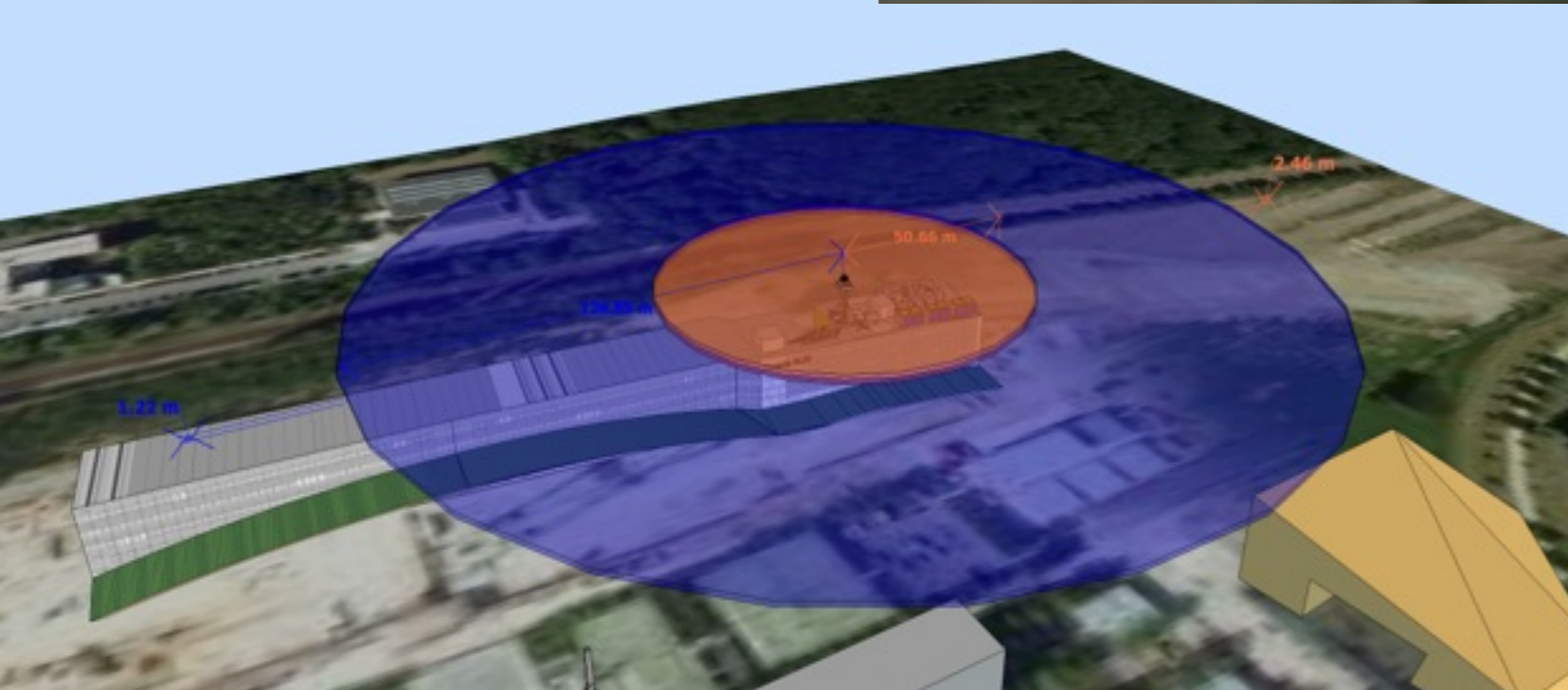
DECRET

Décret n°2002-775 du 3 mai 2002 pris en application du 12° de l'article L. 32 du code des postes et télécommunications et relatif aux valeurs limites d'exposition du public aux champs électromagnétiques émis par les équipements utilisés dans les réseaux de télécommunication ou par les installations radioélectriques

NOR: INDI0220135D
Version consolidée au 05 mai 2002

- Two norms for non-ionizing radiations in the range 10MHz-10GHz:
 - UTE C 18-610, 1995: $<10\text{W}/\text{m}^2$
 - ICNIRP, 1998: $<0,08\text{ W}/\text{kg}$ ($\approx \text{UTE}/2$)
 - Public values -> x 5 for « professionals »

General public
Professionals



News from Paris



- after a somewhat complex process: radar ordered on 19/03/13, notified on 25/03/13

Factory Acceptance Test (Nuess, 22-23/05/14), Chandrasekar (+DS+IT), [see Chandrasekar's interview on the RainGain website](#)

– request for a new parabola test

- **big data** storage : notification of the market (tender deadline: 22/09/14), $\approx 2 \times 2 \times 84 \text{ Tb} \approx \mathbf{1/3 \text{ Pb}}$ to be installed in few weeks)

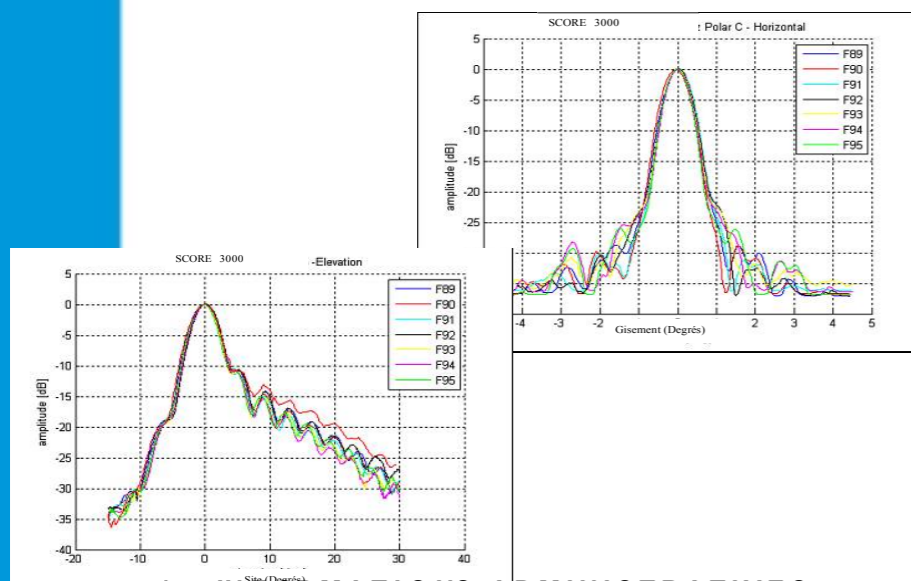


News from Paris



Autorité de régulation
des communications
électroniques et des postes
www.arcep.fr

- emissions authorization
 - first request on 19/08/13
 - who should manage it (discussion at the National Frequency Agency) ?
 - new submission 14/04/14 (with new forms!)
 - should take 6 weeks
 - only 5/6 main users replied (as of today)



1. INFORMATIONS ADMINISTRATIVES

Demandeur (champs obligatoires)

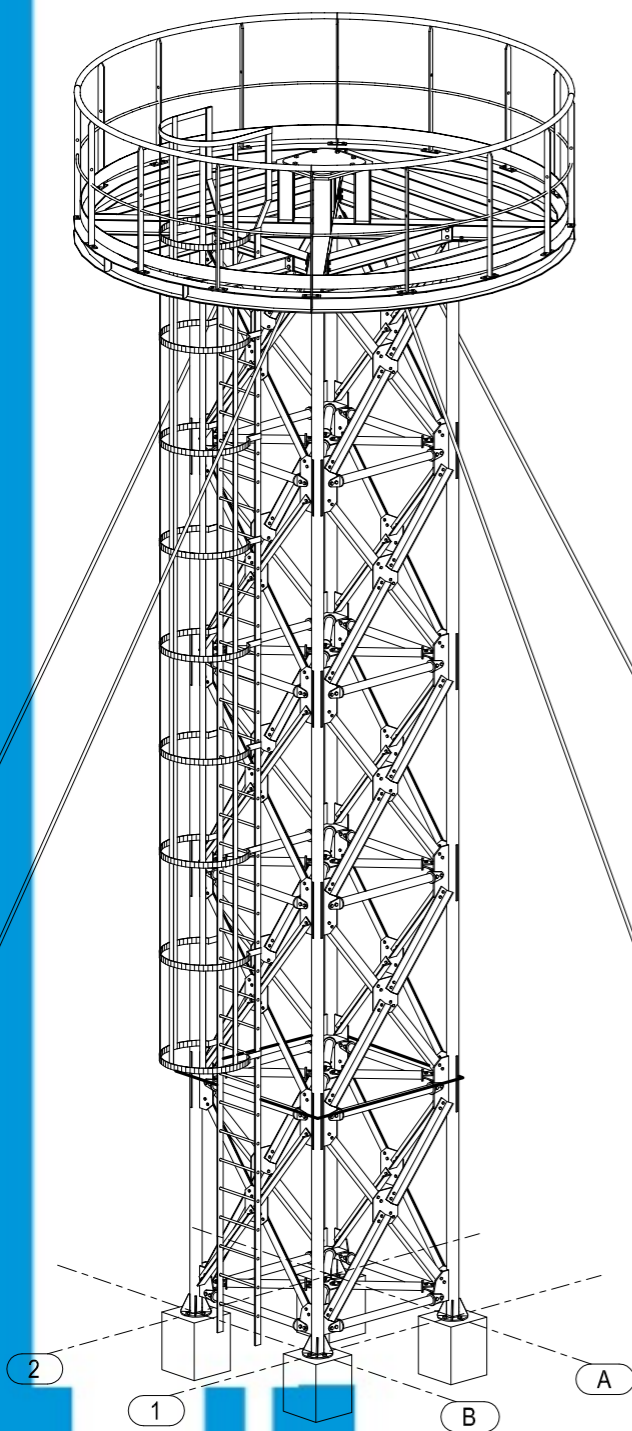
Raison sociale

Adresse

Code postal Commune

News from Paris

- structure design, implementation requirements
 - amazing delays from the (large) engineering consultant firm, did not consider the existing tower supports: ≈ 2 months lost
 - full change of plans and restructuring the ENPC group working on these issues (16/07)
 - 7 responses to the tender (18/09/14)
 - end of selection this week
 - end of works: mid November:
 - Green City 18-19/11/14 ?



- a series of implementation problems were largely underestimated
 - put the project budget at risk !
 - amplified by lack of communication
 - contrary to interreg goals !
 - » national frameworks
 - » heterogeneous partner goals
 - a large set of learnt lessons !
- regulations to be changed?
 - “main users” regulating the bandwidth?
- “extension(s)” of the project?