Installation of X-band radars in urban environments

Lessons learned (and worth sharing) from the London experiment

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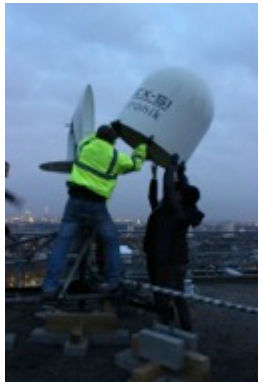


We are not radar experts…

- Didn't really envisage the effort and time required to simply get the radar going (not to mention to get good data out of it)
- Many 'not-so-obvious' issues needed to be dealt with which actually jeopardised the completion of the radar experiment
- Steep learning curve!

- We would have benefited from some advice in this process

Obvious activities / issues

(although obvious, advice for them could also be useful)

- Find an appropriate location for the radar in terms of coverage and ‘visibility’
- Plan transport of radar to chosen location (depending on size of radar and characteristics of access routes)
- Obtain radiation licence from the relevant authority (OFCOM in the UK) in order to ensure that there is not risk of interference with other important communication (radiation) devices
- Find way of supplying power to radar
- Find way of providing data (internet) connection to radar

Less obvious activities / issues

- Analysis and mitigation of the risk of radar radiation to people – beyond simple checking of exclusion zones
- Analysis and mitigation of the risk of direct radar radiation to other communication devices (e.g. antennas)
- Securing the radar and ensuring its stability and integrity at design wind speeds
- Ensuring that the structure upon which the radar will be installed can support the extra-weight (and point loads) imposed by the radar
- Other operational issues – what if?
  - E.g. what if the motor gets stuck and the radar radiates in a fixed direction for a longed period? – intrinsically safe switch off?

Less obvious activities / issues

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:

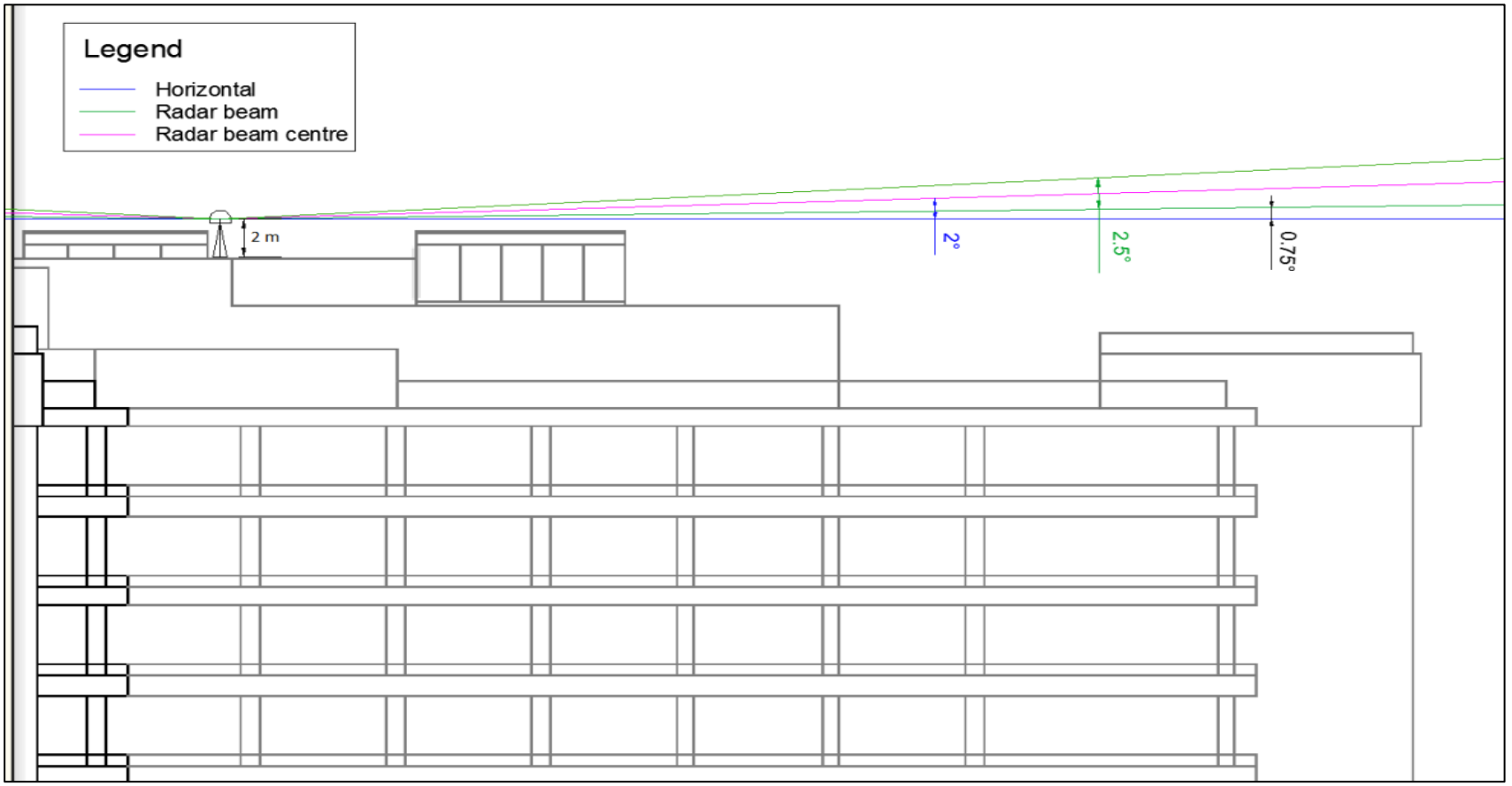
$$Risk = Hazard\ (likelihood) \times Exposure(who?) \times Consequence(what?)$$

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!

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB



Less obvious activities / issues

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

Less obvious activities / issues

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

Relevant sources:

- ICNRP. (1998). Guidelines for public exposure to electric and magnetic fields. International Commission on Non-Ionizing Radiation Protection. See: http://www.icnirp.de/PubEMF.htm
- NRPB. (2003). *Review of the scientific evidence for limiting exposure to electromagnetic fields (0-300 GHz)*. National Radiological Protection Board in partnership with the Health Protection Agency, UK.
- American Cancer Society. (2010). *Radiation Exposure and Cancer*. Available online: http://www.cancer.org/cancer/cancercauses/othercarcinogens/medicaltreatments/radiation-exposure-and-cancer Accessed 13.03.2013.
- US Environmental Protection Agency. (2012). *Radiation Protection*. Available online: http://www.epa.gov/radiation/understand/index.html Accessed 13.03.2013.
- Kwan-Hoong, N. (2003). Non-Ionizing Radiations - Sources, Biological Effects, Emissions and Exposures. In *Proceedings of the International Conference on Non-Ionizing Radiation: Electromagnetic Fields and Our Health*, Malaysia.

Less obvious activities / issues

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

- **Risk mitigation plan:**
  - Implementation of safety protocols to ensure that the radar is switch off when anyone access the ‘exclusion area’
  - Warning signs
  - Dissemination and enforcement of safety protocols

Less obvious activities / issues

Analysis and mitigation of the risk of direct radar radiation to other communication devices (e.g. antennas):

- In urban areas it is likely that there are antennas in close vicinity of the radar
- The nearby antennas may be directly hit by the radar beam and **the energy of the radar pulses may cause interference**.
- There is no evidence to demonstrate the effect of direct radar radiation on communication equipment – this was of great concern in our case

Radar experts present during the installation of the radar indicated that the risk of interference with these antennas is expected to be very low and, if any interference is caused, this will be most likely dissipate through the cable of the antennas and will disappear before the cables reach the receive


Ambulance
Legend
Radar Site
Antennas
North/East Coord
Blanking

Less obvious activities / issues

- **What if the motor gets stuck and there is fixed radiation in one direction? -** Intrinsically safe (switch off) mechanisms
- **Securing the radar and ensuring its stability and integrity at design wind speeds**
  - Recommendations about where to find info about design wind speed would be desirable (e.g. Eurocode for design wind speeds, EN 1991-1-4:2005)
  - Info about highest recorded speeds in main EU cities would be useful
  - Find out no-damage and destruction speed from radar manufacturer
  - Weight may be required at support points of radar in order to ensure that it wont overturn
- **Ensuring that the structure upon which the radar will be installed can support the extra-weight (and point loads) imposed by the radar**
  - Recommendations regarding normal design loads for concrete slabs could be useful: This gives an initial idea of whether the weight of the radar can be supported by building/structure, whether a secondary structure to distribute the weight in a bigger area is needed, etc.
  - A structural engineer may need to be engaged in this process