

Ultra Wide Band *compatibility issues*

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Compatibility Studies within CEPT

- Studies within CEPT are carried out in Working Group Spectrum Engineering and by Project Team SE24
- Priority had been given to the issue of Short Range Radar :
 - ECC Report 23 “sharing and compatibility between 24 GHz SRR and fixed service, EESS and radio astronomy”
 - Further activities :
 - Compatibility with speed radar at 24 GHz
 - Immunity of SRR against other services at 24 GHz
 - Compatibility studies at 79 GHz

Compatibility Studies within CEPT (2)

- Studies are ongoing on the feasibility of coexistence of UWB below 10.6 GHz with other services :
 - Preliminary results in January 2004
 - Final report in October 2004
 - Timing in line with TG1/8 schedule (Nov.2004)
 - ECC/PT1 is dealing with the protection of IMT-2000/UMTS
- No particular focus on the compatibility studies concerning imaging systems (as the third category defined by FCC)

Protection of other services from SRR at 24 GHz

- ECC report 23 includes sharing studies with 3 services :
 - Fixed Service (FS)
 - Radio astronomy (RAS)
 - Earth Exploration Satellite Service (EESS)
- Other services are assumed to be « covered » by the protection of these three services. Ex : BSS earth stations in the 21.4-22 GHz compared to FS.
- One exception : speed radars operating in the ISM band

Protection of other services from SRR at 24 GHz (2)

SRR e.i.r.p. levels (dBm/MHz)	RAS	EESS	Fixed
-30	No, see note 1	No	No
-41.3	No, see note 1	No	No
-50	No, see note 1	No	See note 2A
-60	No, see note 1	Yes	Yes

Table 1A: Summary of co-existence (assuming 100% of vehicles within visibility of the victim service are equipped with SRR)

Note 1: If all of the possible mitigation factors such as local terrain, clutter loss, car density are applicable and if this leads to sufficient reduction in interference level, then sharing between the SRR at 24 GHz and radio astronomy could be possible in some cases.

Note 2A: If the protection criteria of -20 dB I/N is to be met in all cases, sharing is not feasible. However, sharing is considered to be feasible if an excess of the protection criteria by 10 dB (up to -10 dB I/N) in worst case scenarios can be accepted.

Protection of other services from SRR at 24 GHz (3)

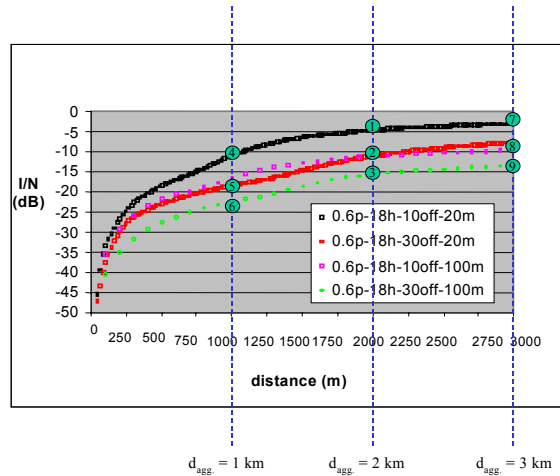
SRR e.i.r.p. levels (dBm/MHz)	RAS	EESS	Fixed
-30	No, see note 1	No	No
-41.3	No, see note 1	Yes	See note 2B
-50	No, see note 1	Yes	Yes

Table 1B: Summary of co-existence (assuming 10%, or less, of vehicles within visibility of the victim service are equipped with SRR)

Note 1: If all of the possible mitigation factors such as local terrain, clutter loss, car density are applicable and if this leads to sufficient reduction in interference level, then sharing between the SRR at 24 GHz and radio astronomy could be possible in some cases.

Note 2B: If the protection criteria of -20 dB I/N is to be met in all cases, sharing is not feasible. However, sharing is considered to be feasible if an excess of the protection criteria by 10 dB (up to -10 dB I/N) in worst case scenarios can be accepted.

Protection of Fixed Service from SRR 24 GHz (1)



Protection of Fixed Service from SRR 24 GHz (2)

- Interference is « long-term »
 - Discussions occurred on the agreed $I/N = -20 \text{ dB}$ interference criteria. Should FS be protected with $I/N = -20 \text{ dB}$ in all scenarios or could this criteria be exceeded in some cases ?
 - In practice, the calculation shows that, with -50 dBm , I/N can exceed the -20 dB I/N by up to 10 dB in a scenario such as :
 - Fixed link aligned with the direction of a road or highway
 - Up to 2 or 3 km of the road visible from the receiving fixed station
 - The receiving fixed station is located less than 10 m offset from the road
- The receiving fixed station has an antenna height of less than 18 m.

Protection of EESS from SRR 24 GHz (2)

- Requirement for 35 dB discrimination in the direction of the satellite
- Increasing sensitivity of the EESS receiver (additional 7 dB in 20 years)
- Issue of the RR n°5.340 « all emissions are prohibited... »

Protection of radioastronomy from SRR 24 GHz

- Compatibility requires special on-site measures which can extend to large areas
- Difficulty of radio astronomy stations visible from roads or located in non-rural areas
- Issue of the RR n°5.340 « all emissions are prohibited... »

Protection of speed radar from SRR 24 GHz

- Several CEPT countries have implemented speed radar in this band.
- Studies have demonstrated that there are some probabilities of interference from the SRR residual or unmodulated carrier used for doppler measurement
- Key Question : would the interference cause no speed measurement or wrong speed measurement ?
- Proposed solution : shift of frequency and reduction of frequency uncertainty from 100 MHz to 70 MHz
- Ongoing studies to respond to the key question and examine whether the proposed solution is necessary

Immunity of SRR from other services

- This is linked to the perception that SRR has safety-related aspect
 - What would happen in cases where the operation of SRR would have been interrupted because of interference from other services ?
- ⇒ It is necessary to investigate the real impairment to SRR
- Work is currently focusing on the impact from fixed service
 - Preliminary results, to be confirmed show that SRR would have to operate in high interference potential (I/N above 25 dB) in the vicinity of FS stations and hence would have to implement high rate processing gain to overpass this interference (60 dB rather than 40 dB ?).
 - Preliminary conclusions are expected in December 03

Compatibility studies at 79 GHz

The work is ongoing within SE24 :

- Radio astronomy : Sharing easier than at 24 GHz still requesting however on-site measures
- No defence systems deployed by NATO. No information about national defence applications.
- Potential difficulties relating to Amateur and Amateur-Satellite in portion of the band (77.5-78 GHz)

Coexistence with UWB below 10 GHz

List of services/systems considered by SE24 :

- 1 Fixed Service (FS)
- 2 Mobile Satellite Service (inc. Search and Rescue)
- 3 Earth exploration satellite Service (EESS)
- 4 Radio Astronomy Service (1 - 6 GHz)
- 5 DVB-T
- 6 T-DAB
- 7 Bluetooth
- 8 Radio LAN
- 9 Cellular systems : GSM and IMT-2000/UMTS

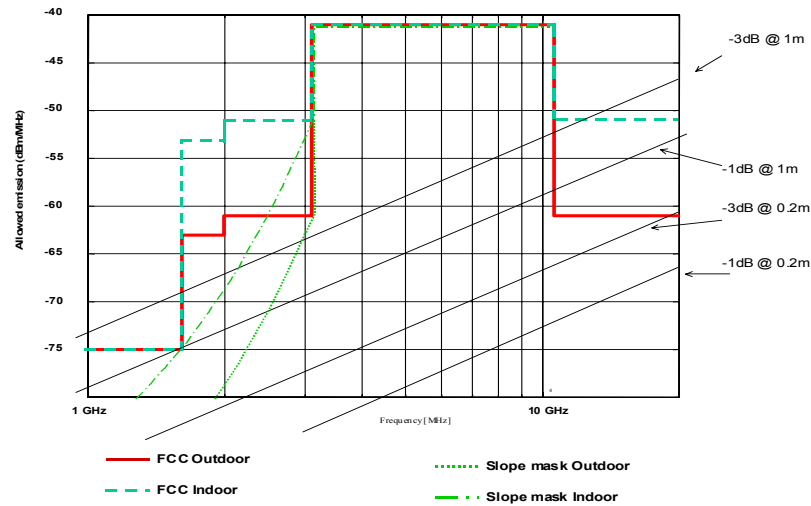
Indoor/Outdoor issue

- Several compatibility studies are differentiating environment
- For FCC : « *Devices operating under this category must demonstrate that the system units will fail to operate if they are removed from the indoor environment. One acceptable procedure may be to show that the transmitting unit requires AC power to function* »
- CEPT did not decide whether there is a need/possibility to differentiate between environments

Power definition issue

- Basic assumption that the limit will be based on mean power in 1 MHz
- FCC additional requirement for CW (1 kHz RBW) for the protection of RNSS systems (10 dB lower limit)
- FCC peak power additional requirement based on 0 dBm :
 - In 50 MHz as representing the widest receiver bandwidth
 - With $20\log(50/\text{RBW})$ rules in measurement with narrower RBW (e.g. 3 MHz)

FCC and Slope masks



Methodology

- Single-entry or aggregate scenario depending on the interfered system
- In both cases, a « critical » assumption : the density of simultaneously transmitting UWB
- Different propagation models depending on the scenario
- In many cases, measurement have been carried out to assess the sensitivity of the service/system to UWB interference (e.g. min. C/I)

Preliminary results of studies below 10.6 GHz

- RNSS (Galileo) : initial study
 - -75.3 dBm / MHz is OK with single-entry and aggregate scenarios. But cares required with low prf
 - Particular issue with imaging systems
- Cospas/Sarsat (400 MHz / 1.5 GHz) : Compatible with the slope mask but not with the FCC mask
- MSS (service links / feeder links) : Concerns for earth stations in cases of low PRF UWB and Issue of C band satellite receiver
- Radioastronomy : not compatible, on-site solutions may be envisaged depending on frequency and site location

Preliminary results of studies below 10.6 GHz (2)

- EESS :
 - 5 GHz : compatible
 - 1.4 GHz : not compatible, including with « slope mask » (few hundred of device/km² will interfere)
- T-DAB and DVB-T : compatible with slope mask but not with FCC mask (at least for DVB-T).
- Bluetooth : compatible with slope mask but not with FCC mask
- RLANs : not compatible, several meters of interfering distance in « realistic » case (propagation, wanted signal level)

Preliminary results of studies below 10.6 GHz (3)

- Fixed service
 - Negative margin of 20/35 dB in indoor/outdoor scenario compared to the value of -41 dBm/MHz
 - Peak level limit particularly required (same negative margin)
- Cellular systems
 - Different scenarios (single-entry, aggregate...)
 - Based on single entry, few dBs missing from the slope mask

Conclusion

- UWB is a challenge for spectrum managers and for CEPT :
 - unknown future development of UWB technologies
 - number of systems/services potentially impacted
- This require special cares in the compatibility studies

Things are moving quickly ! CEPT is to make up his mind rapidly on the limits which will ensure the protection of other service !