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ECO european communications office

A European testbed for spectrum sharing studies: the role of simulations

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Spectrum Sharing for the Digital Ecosystem Towards 6G
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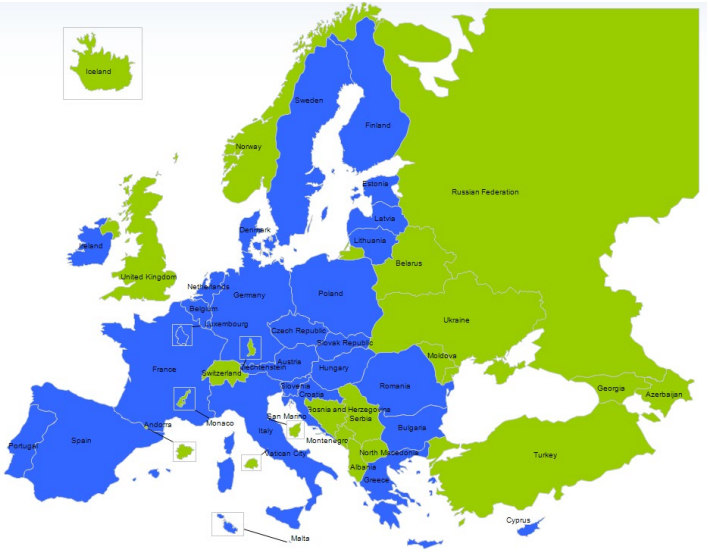
Outline

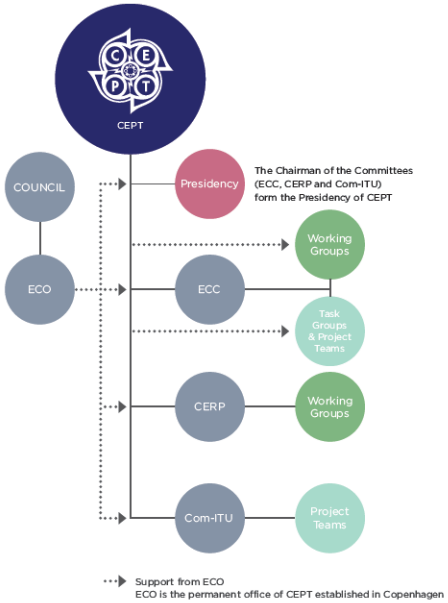

European regulatory framework for radio spectrum
ECC Strategic Plan and CEPT Roadmap to 5G and beyond
Spectrum engineering and spectrum regulation
The SEAMCAT tool for Monte Carlo analysis
Case study: introducing WAS/RLAN in the 6 GHz band
Conclusions

CEPT: European Conference of Postal and Telecommunications Administrations

- **CEPT**: Organisation of regulators and policy makers from 48 European countries
- **ECC**: Electronic Communications Committee – main body with responsibility for spectrum and telecommunications
- **ECO**: European Communications Office – CEPT Permanent Office



EU Member States – blue
Other CEPT members - green



ECC: Electronic Communications Committee

- Primary objective is to harmonise the efficient use of the radio spectrum, satellite orbits and numbering resources across Europe
- Reduce spectrum scarcity and improve sharing and access to spectrum to enable the introduction of new technologies, whilst protecting existing ones
- Develop common policies and regulations in electronic communications and related applications for Europe
- Provide the focal point for information on spectrum use in Europe (EFIS, ECODocDB, etc.)
- Active in representing European interests in the ITU and other international organisations
- Applies expertise in partnership with all stakeholders, the European Commission and ETSI to facilitate the delivery of technologies and services for the benefit of society.

European regulatory framework for radio spectrum

Developing and exploring relationships with universities, scientific institutes and European research programmes is strategic for the ECC

- ECO and JRC have been working together on spectrum matters of common interest.

Joint Research Centre

ECO european communications office

ECC strategic plan for 2020-2025

- The ECC Strategic Plan for 2020-2025 identifies skills and actions to be developed in:
  - Expertise in managing scarce resources
    - Spectrum management
    - Numbering and resources
  - Europe wide forum for the work in ITU
  - Cooperation with the European Commission, ETSI, others…
  - Focal point in Europe for information on electronic communication

- Major spectrum challenges
  - Spectrum sharing
  - Receiver parameters
  - Promote use of higher frequencies

ECC Strategic Principles for 2020-2025

Spectrum Sharing	• Promote innovation, enabling easier and more rapid access to spectrum. New technologies (e.g. cognitive radio) for licensed or unlicensed shared use. Higher frequencies to promote interest in spectrum sharing.
Transmitter and Receiver parameters	• Define appropriate set of parameters in co-channel and adjacent bands. Characterisation of transmitters and receivers, monitoring of implication of increases in the general noise floor.
Balancing the interests of all spectrum users	• Balance the interest of incumbents, who will tend to seek stability and regulatory certainty, and the needs of new entrants who will often seek rapid and straightforward access to spectrum.
Ensuring non-discriminatory access to numbering and network resources	• Develop harmonised policies to promote non-discriminatory and technology neutral access to numbering resources and facilitate the continued evolution to the high capacity networks of the future. Effective numbering plan management is key to promote competition, foster innovation and ensure consumer protection, administering a scarce resource efficiently.

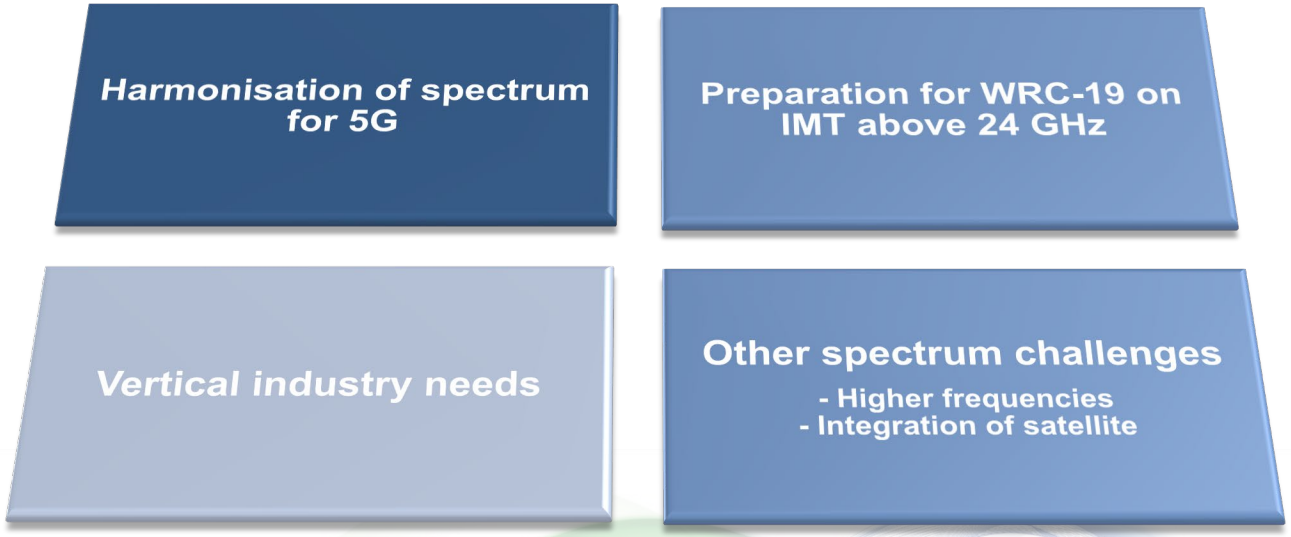
Major topics in 2020-2025

1. Review the 470-960 MHz band
2. Wireless broadband and connectivity
3. General authorisation and licence exempt use of spectrum
4. Next generation satellite systems, including mega NGSO constellations and short duration satellites.
5. New business models and applications, including small cells and backhaul infrastructure
6. Number portability, ease of switching, end-user protection, public safety



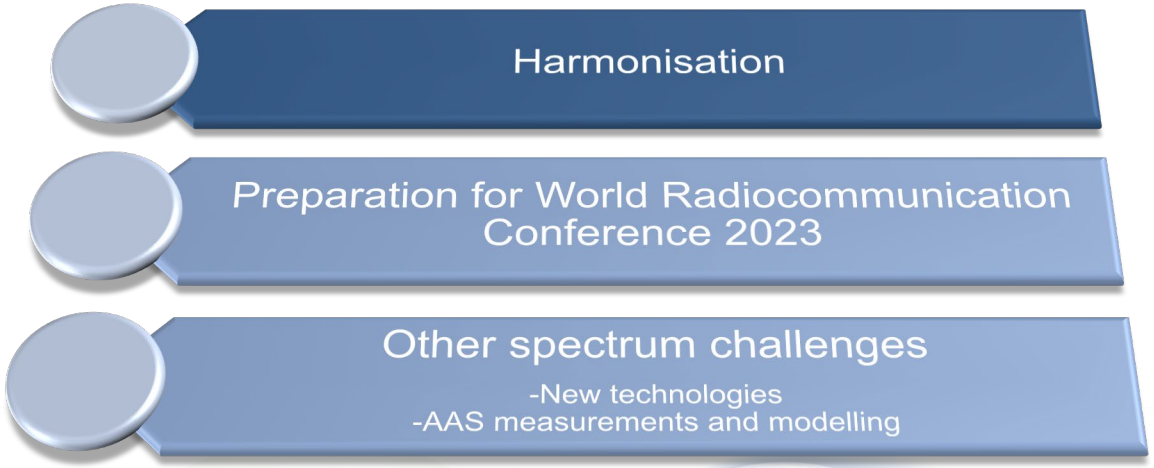

The first CEPT Roadmap for 5G

In 2020 the ECC completed its activities for the **CEPT roadmap for 5G**.



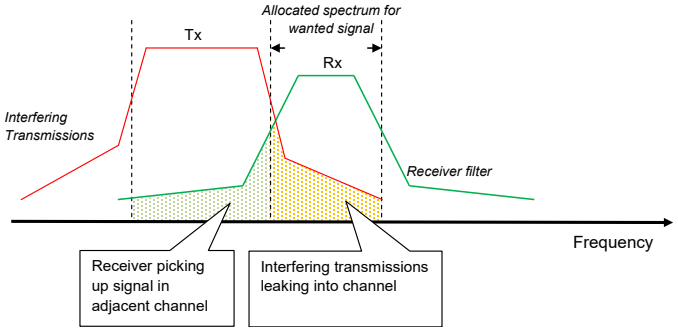
The CEPT Roadmap for 5G and beyond

The new roadmap for 5G and beyond builds on previous and existing activities on spectrum harmonisation for 5G. It looks towards future developments, also addressing techniques such as artificial intelligence and blockchain.



Spectrum engineering as the basis for spectrum regulation

Spectrum engineering is the basis for the development and the continuous update of proper rules, strategies, plans and guidelines for the management of spectrum.



Coexistence studies provide the elements for the **periodic revision** or **the issue of new rules**

- Balance between the facilitating the evolution of new systems and the safeguard of systems already in place

DIFFERENT APPROACHES TO ASSESS COEXISTENCE

Theoretical studies: MCL, Monte Carlo simulations

Measurements

Testbed and trials

Spectrum Engineering Advanced Monte Carlo Analysis Tool

SEAMCAT is the common CEPT software tool for coexistence studies

SEAMCAT
Spectrum Engineering Advanced Monte Carlo Analysis Tool

https://www.seamcat.org/

The tool is **Open Source** and **free of cost**

- Based on the Monte Carlo simulation method for statistical modelling of interference scenarios between radio communication systems

The **SEAMCAT Technical Group** (STG) provides in CEPT technical support on the development of SEAMCAT

ECO organises regular training workshops

Use across the world

Country	Acquisition: Sessions
	3,671 % of Total: 100.00% (3,671)
1. South Korea	366 (9.97%)
2. United States	342 (9.32%)
3. United Kingdom	310 (8.44%)
4. Germany	304 (8.28%)
5. Japan	253 (6.89%)
6. Russia	204 (5.56%)
7. China	148 (4.03%)
8. France	142 (3.87%)
9. Brazil	106 (2.89%)
10. India	89 (2.42%)

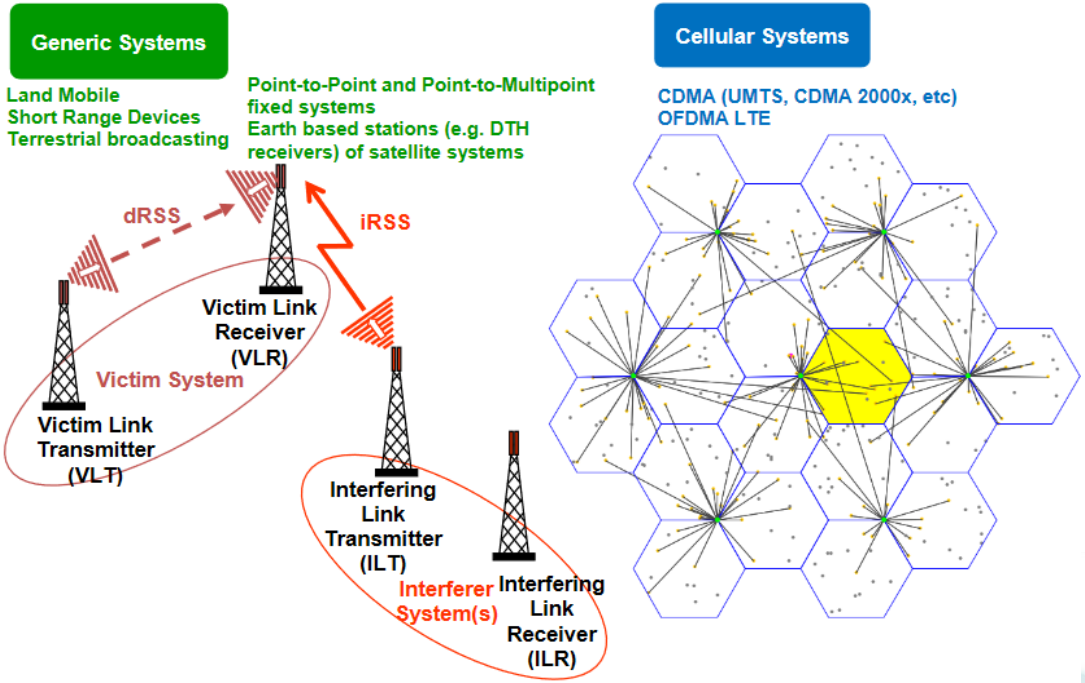
Systems simulated in SEAMCAT

Statistical simulations on a range of system types using the Monte Carlo method.

Simulation of close-to-reality co-existence scenarios

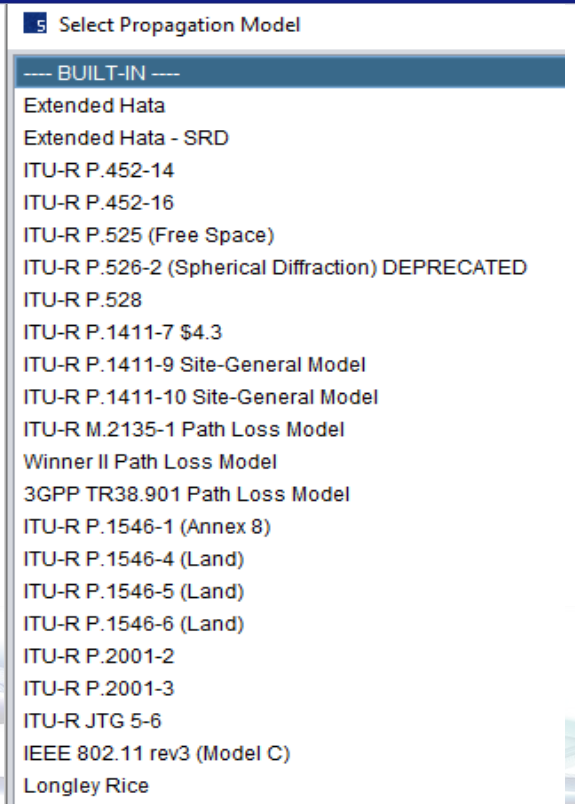
Results provided as:

- Probability of interference based on C/I, I/N, (C+I)/N, (N+I)/N
- Throughput loss for cellular systems



Built-in propagation models in SEAMCAT

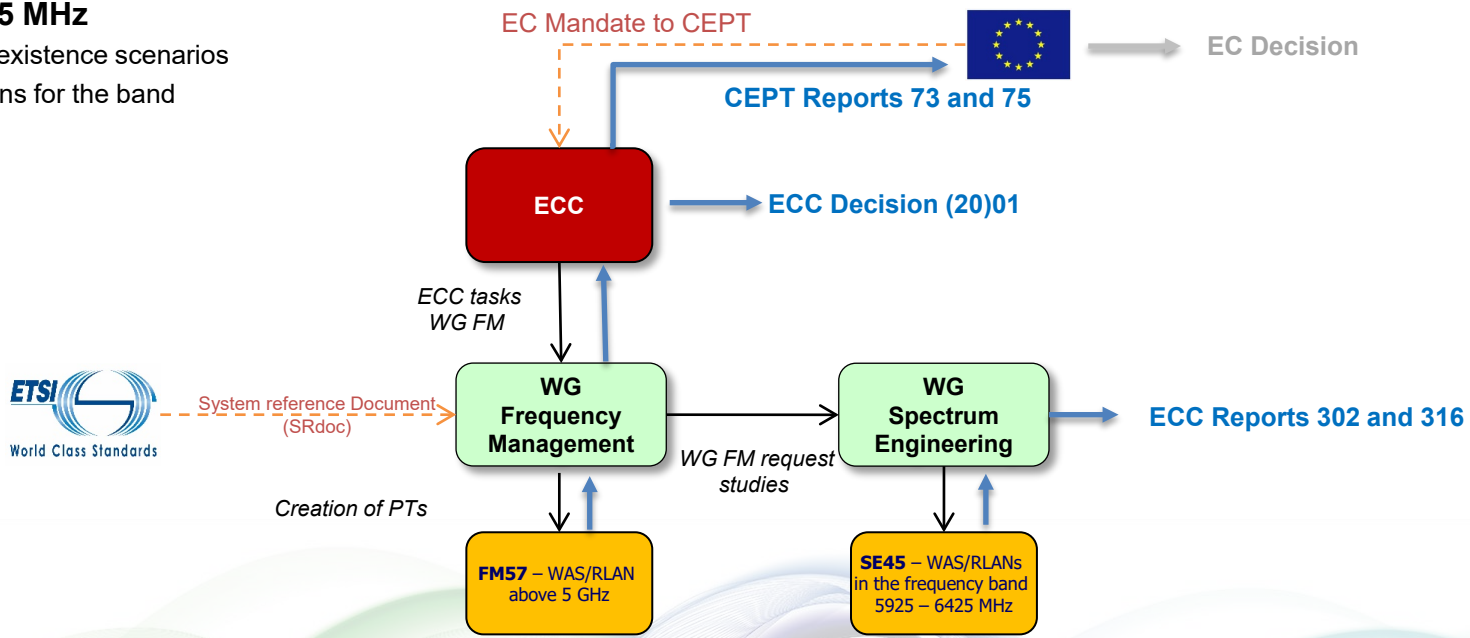
- Several pre-defined propagation models (with some variants) are available in the library
- Users can also develop plugins to be used by SEAMCAT. This provides additional flexibility.
  - For instance, an external Propagation Model Plugin has been recently developed for studies on SRD in the 900 MHz. This extends the site-general propagation models from Recommendation ITU-R P.1411-10 with the statistical functions for LoS probabilities from Report ITU-R M.2135-1



Introducing WAS/RLAN in the 6 GHz Band

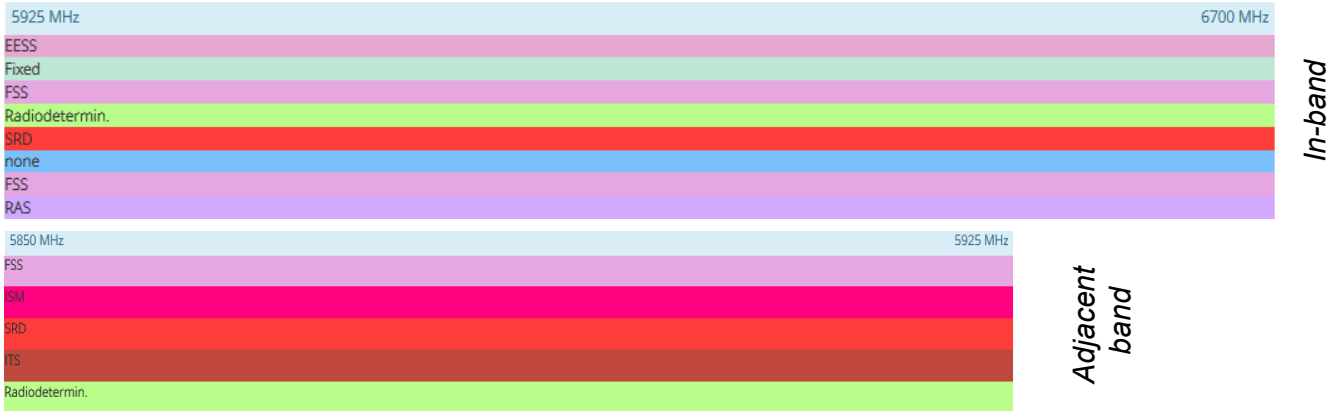
Wireless access systems (including RLAN) in the band 5925-6425 MHz

- Compatibility and coexistence scenarios
- Harmonised conditions for the band



Identification of the required coexistence studies

Applications in the European Common Allocation (ECA) Table: efis.cept.org



Note: some applications only operate in a sub-range of th indicated frequency bands

Additional studies requested in relation to the ITS Mandate to CEPT

- Urban rail – ITS in the 5915-5935 MHz

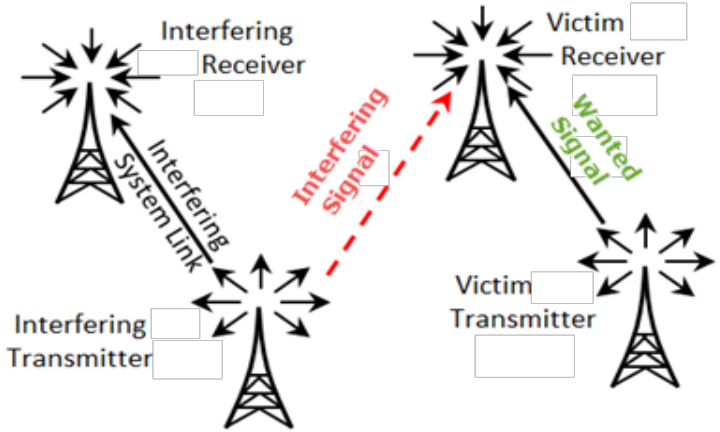
WAS/RLAN parameters: assessment of Duty Cycle via measurements

- The 6 GHz band is expected to be used for high data-rate applications. At the time of the studies the 6 GHz was greenfield for the operation of most RLAN systems
- Although conditions for the use of the 6 GHz band for RLANs are **technology neutral**, evidence-based assessment needs to rely on existing technologies
- There was a need to assess duty cycle of WAS/RLANs in the 6 GHz band, which is a key parameter for co-existence studies
- A measurement campaign on WAS/RLAN duty cycle was performed jointly by JRC and HPE, based on well-defined, well-controlled, and repeatable measurement methodologies.
  - Evidence from IEEE 802.11ac has been used to extrapolate the behaviour of future IEEE 802.11ax access points as a candidate technology

Monte Carlo analysis on RLAN vs Fixed Service

Two systems composed each of **one transmitter** and **one receiver**:

- **Victim** System: Fixed Service
- **Interfering** System: RLAN



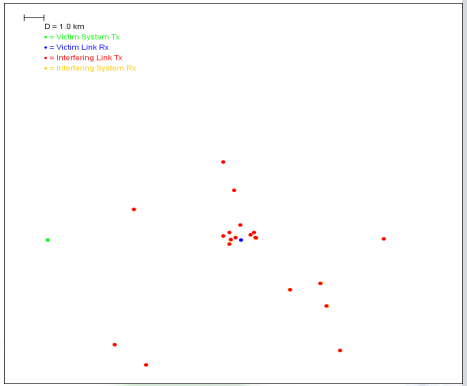
The **victim receiver** receives two types of signals in the simulation:

- **wanted signal** from its corresponding transmitter.
- **interfering signal(s)** originated at the interfering transmitter

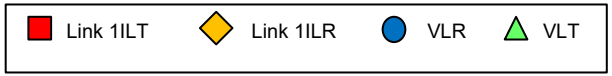
RLAN vs FS analysis based on SEAMCAT

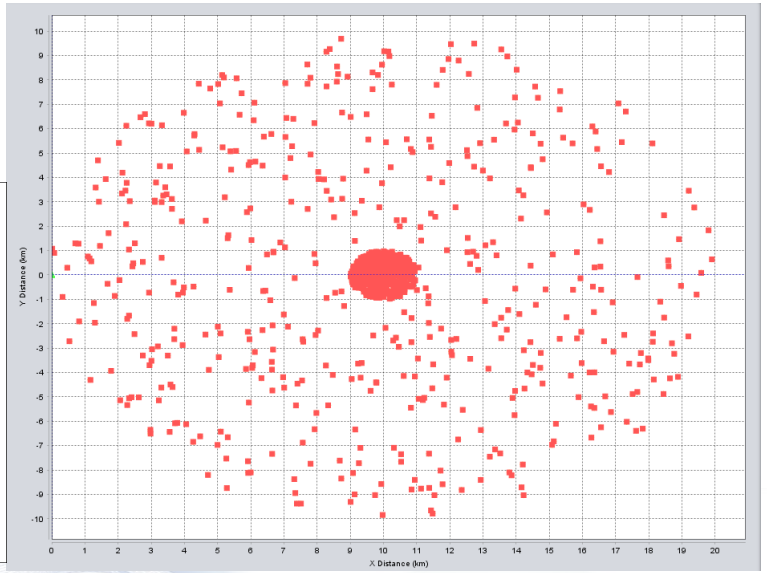
RLAN (**interfering link**) onto a Fixed Service (FS) 10 km link (**victim link**).

- Co-channel interference
- 20 RLAN APs, placed around the FS receiver: 10 placed within 1 km the others placed in a 10 km radius, excluding the inner circle of 1 km.
- 100000 runs



Snapshot of a single run





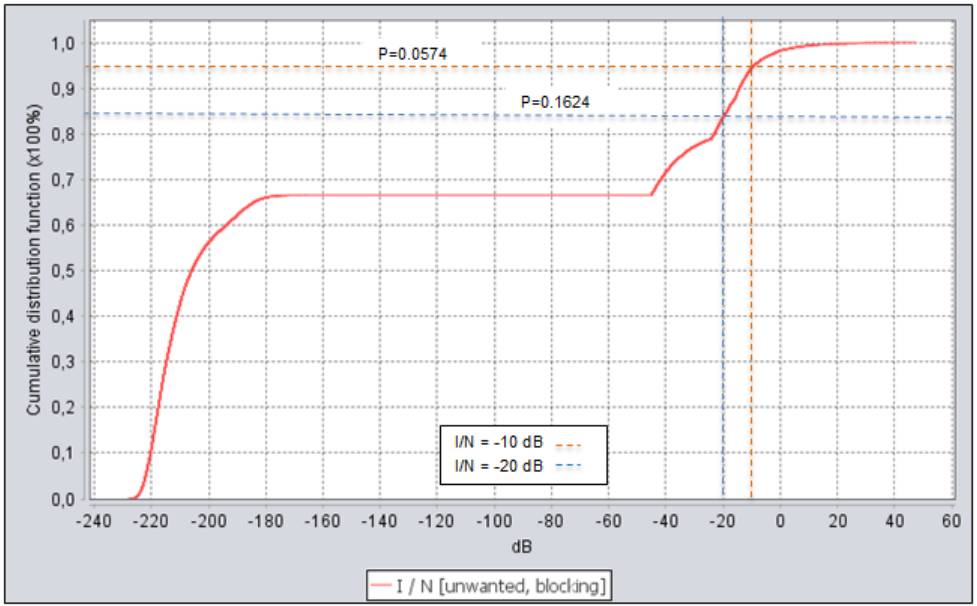
Overlay of multiple runs

Note: The presented case study was part of the preparatory studies for the introduction of WAS/RLAN in the 6 GHz band and does not necessarily reflect the conclusions of that work.

System Parameters

Parameters	RLAN	FS
Tx Conducted Power	18.6 dBm	17 dBm
Tx/Rx Antenna Gain	11.3 dBi	38.1 dBi
Tx/Rx Antenna Height	2 m	15 m
Duty Cycle	1.97%	N/A
Antenna Pattern	Omnidirectional	ITU-R F.1245-2
Tx Conducted Power	18.6 dBm	17 dBm (By compensating Rx and Tx feeder loss)
Propagation model	RLAN-FS: WINNER-II (≤ 1km) + ITU-R P.452-16 (>1km) FS-FS: ITU-R P.452-16	
Noise Floor	--	-93 dBm
Receiver Sensitivity	--	-66.5 dBm
Reception Bandwidth	80 MHz	40 MHz

Results



Protection criterion:

- I/N = -10 dB
- I/N = -20 dB

Interference probability % = (1-CDF) x 100

Conclusions

- The ECC Strategic Plan for 2020-2025 identifies principles and topics and set actions for the efficient management of scarce resources, including spectrum and orbits.
- Sharing is a key challenge for the efficient use of the radio spectrum
- Collaboration on spectrum matters with universities, scientific institutes and European research Programmes is consolidated and enhanced, in support of the ECC Strategic Plan.
- The use and development of SEAMCAT is promoted as a common tool at disposal for coexistence studies.
  - Contribute to the SEAMCAT Technical Group (STG) in ECC
  - Additional flexibility offered to develop software plugins in SEAMCAT (e.g. for propagation models)
- SEAMCAT is available to be part and support the ongoing development of the European Testbed for Spectrum Sharing Studies
  - Simulations as on of the approaches to assess coexistence and support the development of spectrum regulation

Questions?

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ECC webpage

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