Qualcomm

Spectrum sharing and standardization challenges

Marco Papaleo
Director, Technical Standards

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High level classifications of sharing scenarios

	Examples	Sharing methods	Standards aspects
Horizontal Sharing (i.e. intra-service* sharing)	RLAN/IMT sharing UWB/IMT coexistence	Variety of techniques, including detection based and database drive solutions	Depending on solution, it could have major standards aspects, including PHY/MAC
Vertical Sharing (i.e. inter-service* sharing)	Coex between terrestrial and satellite, including FSS DL/UL, EESS, metsat, milsat	Coordination zone, indoor restrictions, data base, Base Station scheduling restrictions, etc.	RF impact, especially gNB (power restriction, OOBE) Newly introduced mechanism (e.g. EIRP mask)

Sharing techniques depend directly on coexistence needs

* Services according to ITU-R definitions

Why horizontal sharing is more challenging

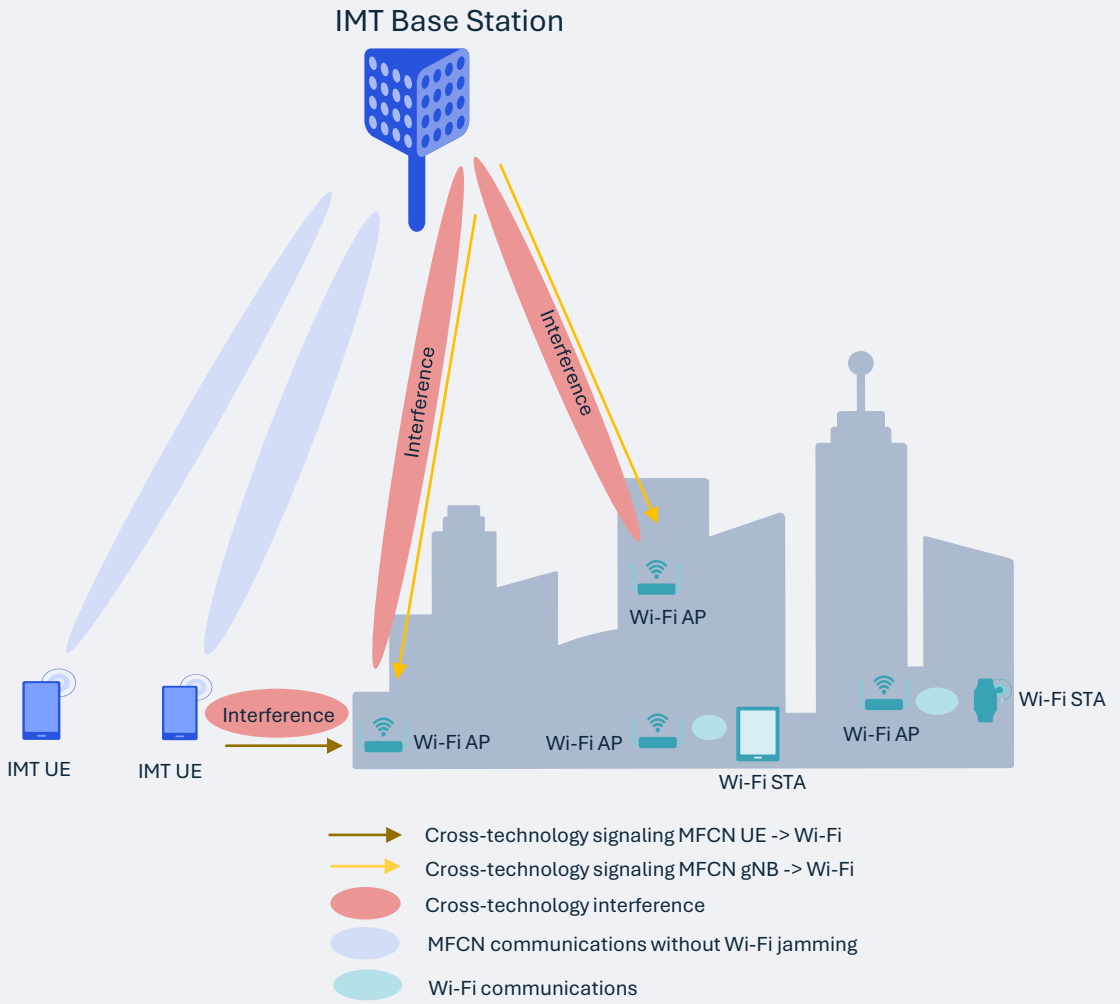
DISCLAIMER:
High level trends

	Regulation e.g. CEPT	Standards e.g. ETSI (and 3GPP, IEEE)
Horizontal Sharing (i.e. intra-service* sharing)	regulation defines high level principles which (depending on specific solutions) should be implemented in standards	Technical standards study and implement technical solutions which follows regulation guidelines
Vertical Sharing (i.e. inter-service* sharing)	spectrum engineering studies for compatibility and regulations implementing technical requirements	Technical Standards implement regulatory requirements

* Services according to ITU-R definitions

Recap: Qualcomm's proposal for RLAN/IMT sharing

- We proposed – as one possible option for further investigation – cross technology signaling (XTS) based on IEEE 802.11bc
- IMT devices broadcast waveform that RLAN devices can decode to identify potential co-existence issues and take mitigation measures (e.g. vacate the channel)
- Among different options in terms of waveform (IEEE-based, 3GPP based, standard agnostic) we selected IEEE based waveform considering the relative added cost compared to other solutions
- In theory, several policies can be implemented, but simplest one to minimize risk of interference is detect and vacate



DSIT Sandbox project on Upper 6GHz: objectives

- Partners (Qualcomm, Real Wireless)

Work Package 1

Field trials in a sandbox environment to assess the feasibility of intensive spectrum sharing between different technology pairs.

Work Package 2

Simulation and modelling to assess the applicability of the sharing solutions to a wider range of technical parameters, locations, frequencies and technologies.

Work Package 3

Economic and regulatory assessment aiming to assess the economic value of sharing solutions and suggest options for exploring potential regulatory mechanisms and tools.

Field Testing

Scenarios evaluated

Scenario 1

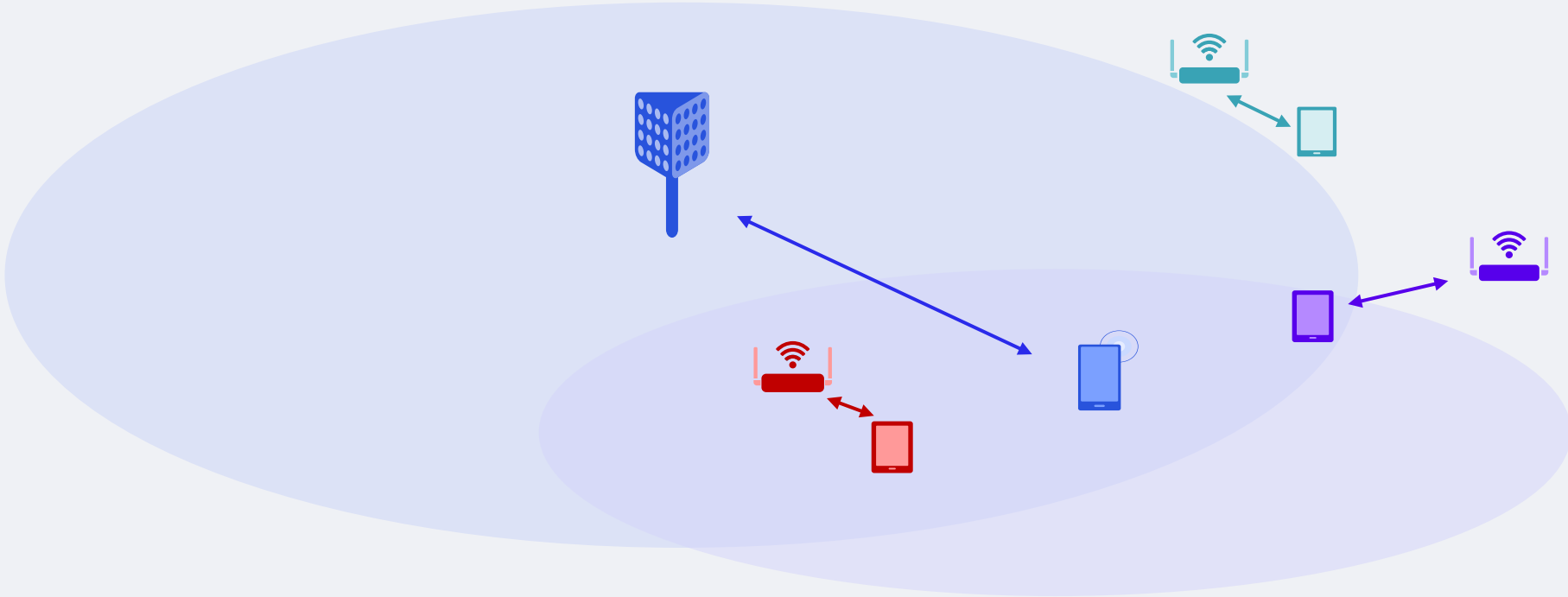
Wi-Fi system deployed at the edge of IMT cross-technology signaling coverage transmitted by 5G BS and UE.

Scenario 2

Wi-Fi AP deployed at the edge of IMT cross technology signaling coverage, while Wi-Fi STA is located within the cross-technology signaling coverage.

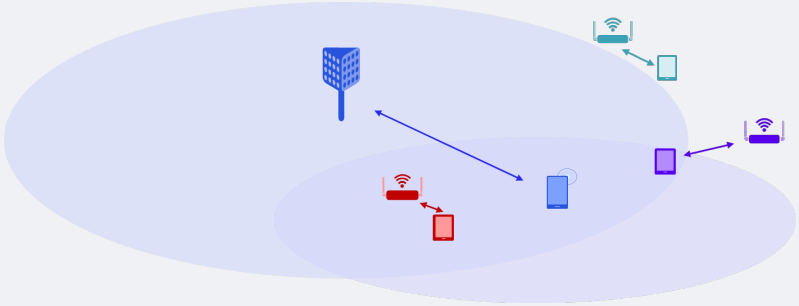
Scenario 3

Wi-Fi system is deployed within IMT cross-technology signaling coverage.



- For each test scenario, a baseline “clean channel” performance without interference is evaluated for both IMT and Wi-Fi systems
- Different scenarios have different level of baseline (due to different node placements)

Sandbox results and insights



Scenario	Wi-Fi Traffic Type	5G SSB RSSI [dBm]	5G DL TP baseline [Mbps]	5G DL TP loss without XTS [%]	Wi-Fi baseline [Mbps]	Wi-Fi TP loss without XTS [%]
1	DL (AP to STA)	-112	130	6%	502	3%
1	UL (STA to AP)	-112	130	0%	477	5%
2	DL (AP to STA)	-104	196	73%	365	15%
2	UL (STA to AP)	-104	196	13%	320	0%
3	DL (AP to STA)	-84	217	84%	480	54%
3	UL (STA to AP)	-84	217	72%	450	63%

- Large performance degradation observed on both licensed and unlicensed systems when Wi-Fi is within XTS range and no mitigation is adopted
- 5G system is more impacted in terms of relative throughput degradation: challenges with handling Wi-Fi bursty interference (both at UE and BS side)
- Larger degradation observed for Wi-Fi DL traffic (e.g. bursty interference due to ACK transmitted from STA impacting UE Rx and gNB rate control)

From paper to reality: what needs to be done to make this work …

- The current studies performed in CEPT on XTS do not consider design details about the overall technical solution
- Those technical aspects cannot be fully handled at regulatory level; it also requires specific work at standardization level:
  - Overall IMT and Wi-Fi equipment sharing behavior needs to be standardized
  - ETSI needs to be involved: ETSI BRAN is typically in charge of specification of RLAN harmonized standard, while ETSI TFES oversees IMT harmonized standards
  - Certain solution specific aspects of the sharing approach may require 3GPP and IEEE standardization updates
- Compliance testing framework to ensure sharing is implemented according to regulations and standards

XTS: what is currently missing and could be studied/defined in ETSI

Detection Threshold	Define XTS detection threshold based on target performance and associated min requirements (e.g. missed detection, false alarm, etc.)
Policy	Wi-Fi behavior in case of XTS detection. The policy should be testable and enforceable (e.g. “detect and vacate” policy the least complex)
Timing	Impacting both IMT (XTS tx periodicity) and Wi-Fi (how often to listen, how long to vacate upon detection, how soon to re-attempt accessing, etc.)
Frequency Raster	frequency location at which the XTS should be sent. This needs to be robust to different IMT channelization
Security	XTS method is based on messages which are broadcasted, authenticity of the sender should be verified

user access restriction (orthogonal aspect): the functionalities related to coexistence shall not be altered nor disabled by the end user (harmonized standards implementation vs market surveillance)

Key take away

- Our sandbox results show that, to enable co-channel sharing, some mitigation techniques need to be implemented at the outset, i.e., LPI cannot be allowed in the band before proper mitigation/coexistence techniques are implemented and verified; this is why Qualcomm is against the phased-approach, as currently proposed
- Mitigation techniques need be friendly to both 3GPP and Wi-Fi design: latest releases of 3GPP and Wi-Fi technologies are built on top of 20 years design direction, it is not likely to see a completely change of direction (XTS is one of the possible solutions)
- Solutions must be standardized: while standardization introduces more complexity, it is the only option to provide enough confidence for all stakeholders to invest in the band
- Reaching industry consensus on this topic is necessary to both standardize and get ecosystem support for deployment: administrations should get a sense of what could be achievable from industry and provide high level direction

Thank you

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