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5G Spectrum Management Workshop

Regional Cross-Border Coordination for 5G and its impact on network deployment costs

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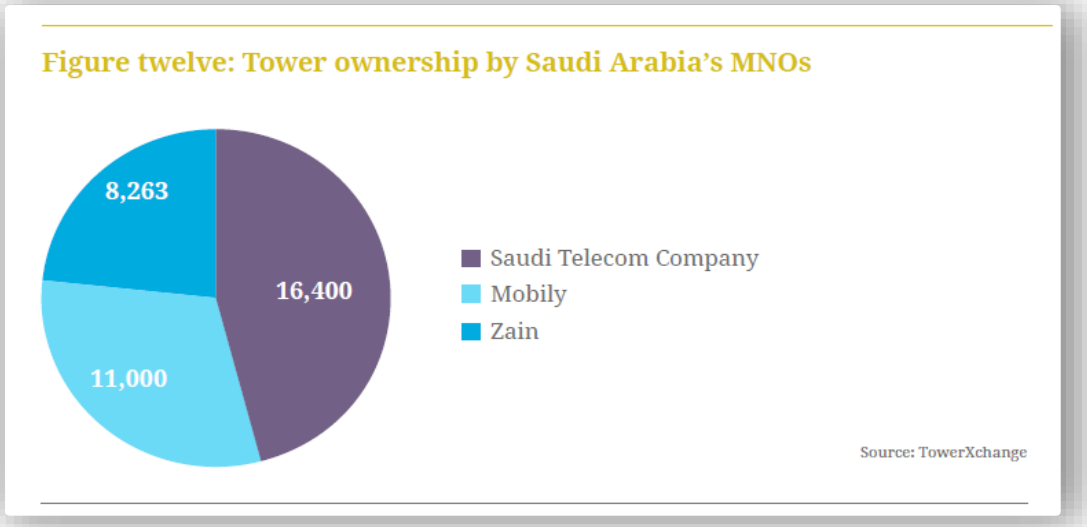
What is the Impact of Cross-Border Coordination (XBC)

- It sets the rules on how operators can deploy their networks near international borders;
- Such rules can either by agreed
  - Regionally (GCC/ASMG/CEPT etc) or bi/multilaterally; or
  - Under ITU Radio Regulation rules
- Typically it will define either a Power Flux Density (PFD) or an Electric Field Strength;
- This could limits where 5G base stations can be placed, their maximum power (EIRP) or the configuration;
- This can add significant cost to network deployment, and can also add a great deal of uncertainty if there is no clear regime in place; *Worst case can prevent deployment in certain areas. Could it reduce spectrum value by 30%? Could increase payback period.*
- The current bands under consideration have two bands that could be affected by this issue:
  - 3.3-3.8 GHz (C Band) and 2.6 GHz;

Why are such agreements needed?

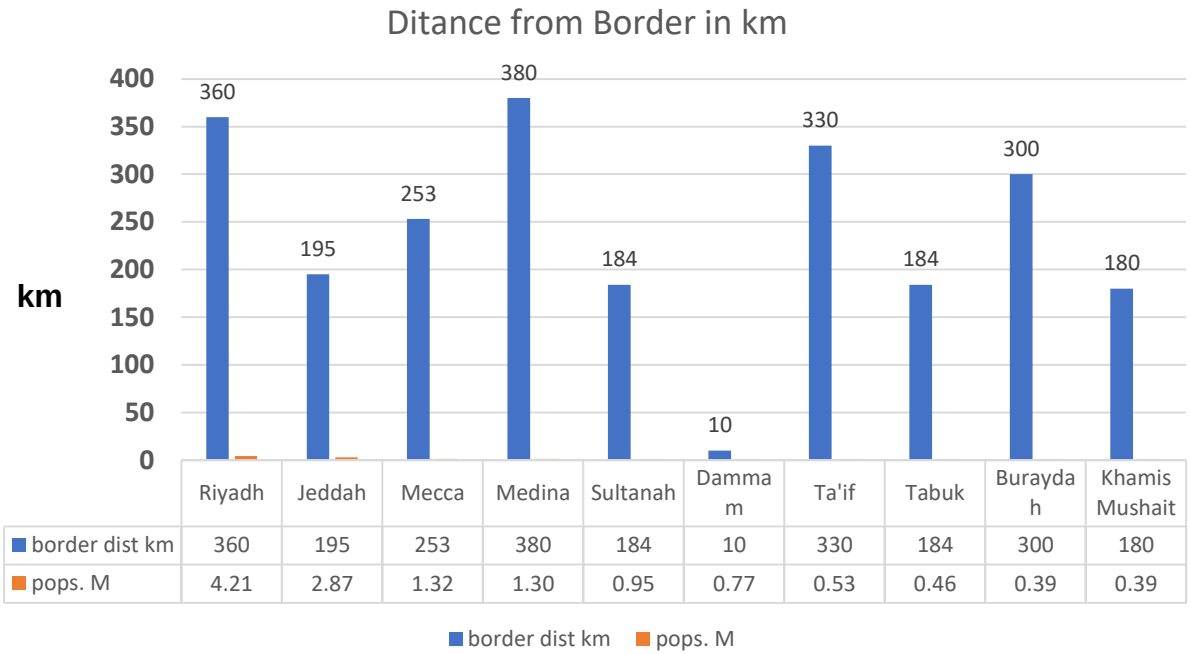
- 1600 km N/S
- 1600 km E/W
- KSA East coast 200km from Iran



Saudi Arabia
Subscribers: 44.0mn
Tower count: 35,663
MNOs: Three
Towerco activity: IHS Towers (exclusive negotiations to acquire Zain's towers) plus modest portfolios held by tower builders including Al Babtain and ACES

Scale of Issue?

Depends on how far potential customers live from borders with neighbour countries.
Top ten cities have population of @13.2 m (40% of total population)



	Riyadh	Jeddah	Mecca	Medina	Sultanah	Damma m	Ta'if	Tabuk	Burayda h	Khamis Mushait
border dist km	360	195	253	380	184	10	330	184	300	180
pops. M	4.21	2.87	1.32	1.30	0.95	0.77	0.53	0.46	0.39	0.39

Anyone living within 200 km of border might have a problem based on analysis for C band.
Suggests 5-6 million people affected based on top ten cities
or just under 20% total population.

ECC Recommendation 11/05

For 2500-2690 MHz

Table 2: Trigger values at a height of 3 m above ground between TDD systems

Non-Preferential frequency usage					Preferential frequency usage
Centre frequencies aligned			Centre frequencies not aligned		
Synchronised TDD, or DL only		Unsynchronised TDD	Synchronised TDD, or DL only	Unsynchronised TDD	Based on bi-or multilateral agreements (Annex 1 paragraph 3)
Preferential PCI codes	Non-preferential PCI codes	All PCI codes	All PCI codes		
65 dBµV/m/5 MHz@0 km and 49 dBµV/m/5 MHz@6 km (paragraph 2)	49 dBµV/m/5 MHz@0 km (paragraph 2)	30 dBµV/m/5 MHz@0 km (paragraph 1)	65 dBµV/m/5 MHz@0 km and 49 dBµV/m/5 MHz@6 km (paragraph 2)	30 dBµV/m/5 MHz@0 km (paragraph 1)	

@ stands for "at a distance inside the neighbouring country"

2.6 GHz Issues – all TDD (B41), or FDD (B7)

- SAMENA understands intention is to licence all TDD (Band 41)
- Bahrain and Iraq intend to go FDD B7 – this will create cross border problems;
- Makes cross-border more complex because of high sites and base tx to base rx;
- Means E field goes from 68 dBuV/m to 33 dBuV/m – extra 35 dB path loss required;
- 35 dB voltage reduction means reduction of power by 30 (i.e. 300 w to 10 w);
- Ideally all KSA neighbours would be approached to try and harmonise a band plan and agree a XBC – perhaps via bilateral meetings or ASMG to develop an ASMG recommendation on XBC;
- More detail in SAMENA submission to Bahrain consultation https://image.slidesharecdn.com/samenareptrabahoct18post1-181104105652/95/45g-crossborder-coordination-in-bahrain-e-field-trigger-levels-1-638.jpg?cb=1541329803

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3.6 to 3.8 GHz – the issue

- No primary allocation to MOBILE in ITU Radio Regulations;
- Fixed satellite service (FSS) uses the band and has a primary allocation in ITU-RR – so must be protected.
- This means mobile has no status in terms of ITU Master International Frequency Register to other primary services like FSS.
- This is unlike 3.4-3.6 GHz has a MOBILE co-primary and a regulatory level for cross border (power flux density – PFD) to protect satellite earth stations.
- This means that 5G deployment cannot claim protection from or cause interference to another primary service. This applies not only to existing FSS, but future deployments.
- If no 5G above 3.6 GHz not an issue – but is 3.6-3.8 GHz to be used there may be an issue.

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WRC-15 Studies for 3.4-4.2 GHz

From CPM-15 Report to prevent interference from Mobile/IMT to Fixed Satellite earth stations

"In the case of IMT-Advanced suburban/urban macro-cell deployment scenarios:

– For the long-term interference criterion, the required separation distances are at least in the tens of km. For the short-term interference criterion, the required separation distances, including when the effects of terrain are taken into account, exceed 100 km for most of the cases. Both the long-term and short-term interference criteria would have to be met.

– **In some cases, the required separation distances are larger, up to 525 km.** In other cases, the required separation distances could be reduced by taking into account additional effects of natural and artificial shielding. However these effects are site specific. "

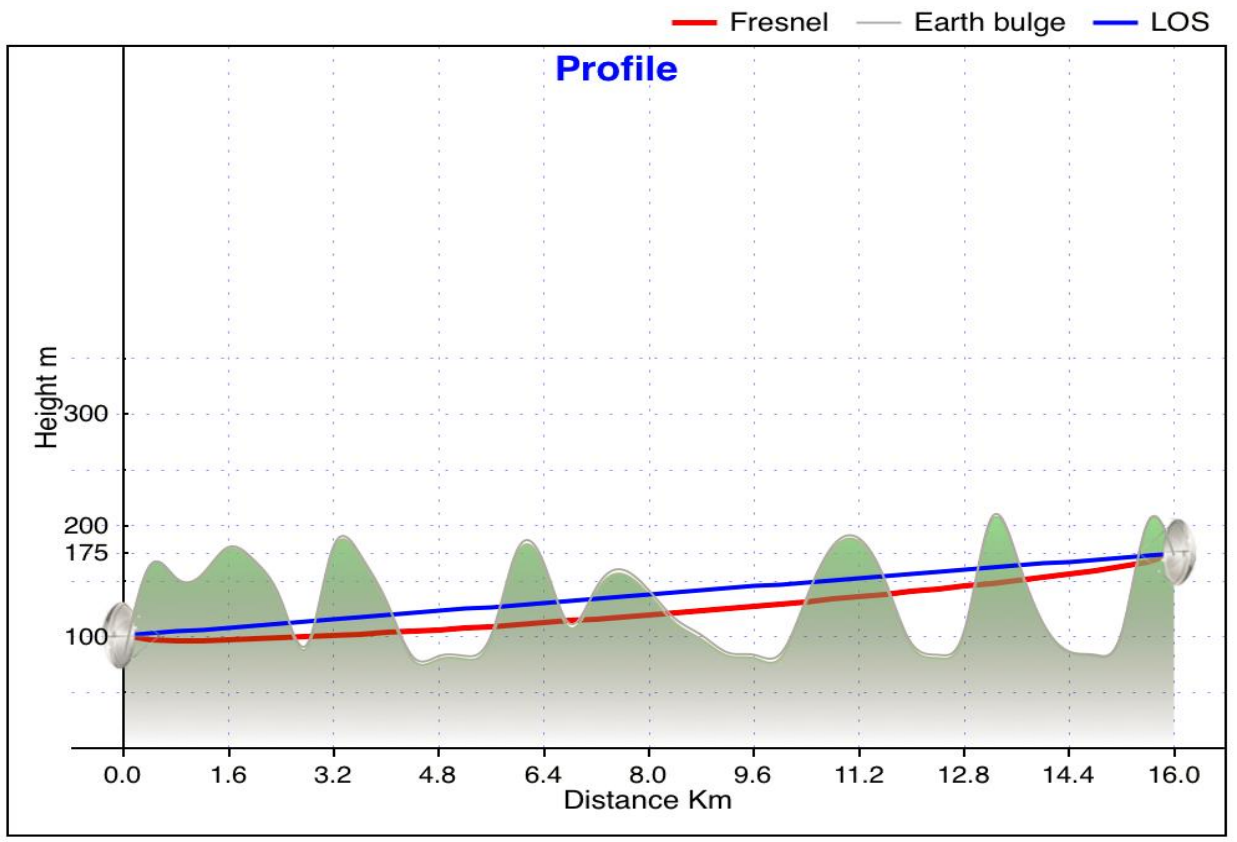
In reality perhaps 200 km is more realistic coordination distance (see SAMENA ASMG 22 input).

C band Sharing – to meet limit in 3.4-3.6 GHz

I.e. protect satellite earth stations

22° 38' 39.4" N	Latitude	22° 47' 17.5" N
53° 51' 45.3" E	Longitude	53° 52' 16.6" E
81.59 m	Elevation (ASL)	172.64 m
3.19	Azimut	183.19
Distance	16.03 Km	Distance
20 m	H antenna	3 m

Free Space Loss	127.7 dB	Free Space Loss
Min. Diffraction L...	30.48 dB	Min. Diffraction Loss



Clearence / Obstruction: at 1.6Km fresnel radius 11.0m and clearance: -82.9m!
Clearence / Obstruction: at 3.2Km fresnel radius 14.6m and clearance: -79.2m!
Clearence / Obstruction: at 3.6Km fresnel radius 15.2m and clearance: -70.5m!

Finland : 3.4-3.8 GHz

October 18 auction

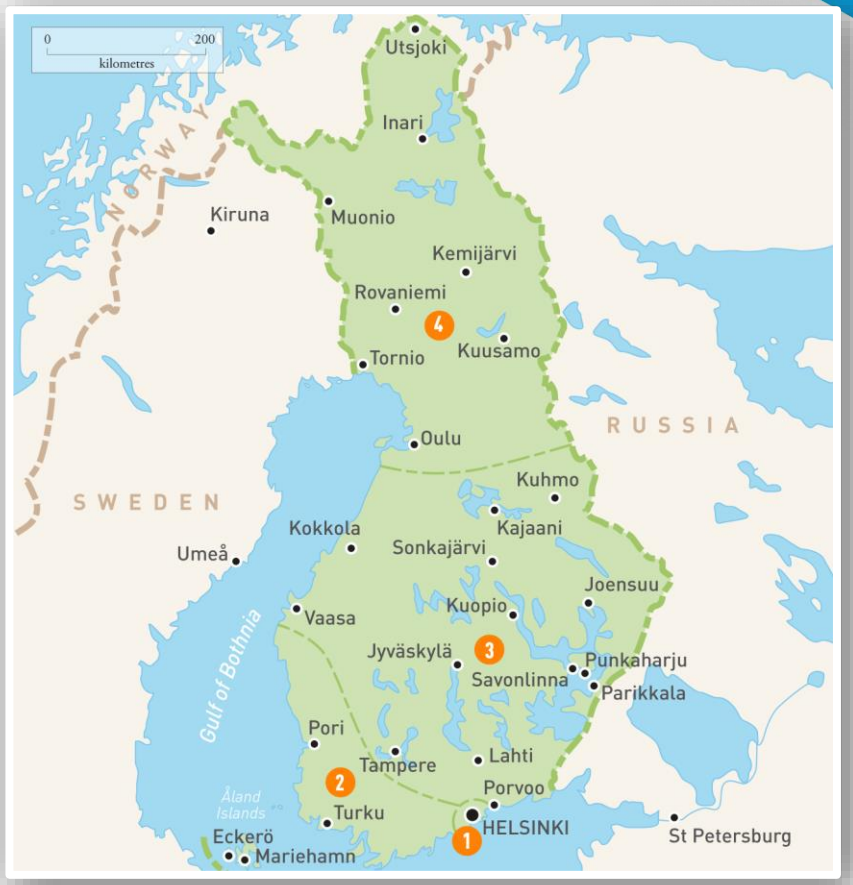
- 1000 km N/S
- 500 km E/W (max.)

3.4-3.6 GHz has IMT designation in ITU

Radio Regs. 3.6 – 3.8 does not.

Recent auction suggested lack of cross-border agreement might have changed operator valuations for “same” spectrum by 30%

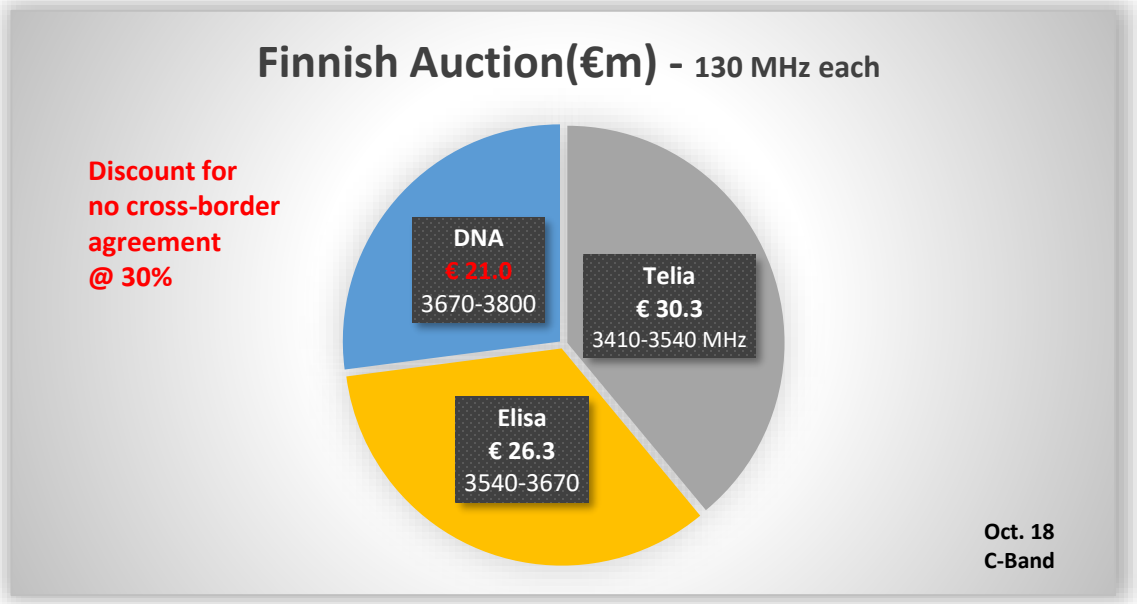
Studies in ITU and Samena submission To ASMG suggest 200 km may be a trigger distance for protecting Russian fixed satellite receivers.
https://image.slidesharecdn.com/samenaasmg22cbandpaperfinal-181106155359/95/samena-c-band-paper-input-asmg22-may-2017-satellite-and-4g-sharing-pfd-limits-1-638.jpg?cb=1541586381



What happened in Finland on C band – 3.4 to 3.8 GHz

3.4-3.6 has CO-PRIMARY

3.6-3.8 does not



elisa analys	MHz	use Telia and DNA € per MHz
with pfd	60	€13,965,231
no pfd	70	€11,307,692
	total	€25,272,923
	actual pay	€ 26,347,000
	diff	€ 1,074,077
	%	**4.08%**

At least 27% of population live Within 200km of Russian Border

Conclusion/suggestions for further work

- Seeking multilateral XBC agreements on potential problem bands such as C band and 2.6 could have a major impact on economic benefit in reducing operator deployment costs and delays;
- For 2.6 this can be via multilateral approach or ASMG;
- For C band it probably means an attempt to get a MOBILE co-primary at WRC19;
- Not formally on WRC agenda but perhaps via Agenda Item 8 and Res 26 to align R1 with R2 and 3 with a MOBILE allocation

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Thank you for your attention

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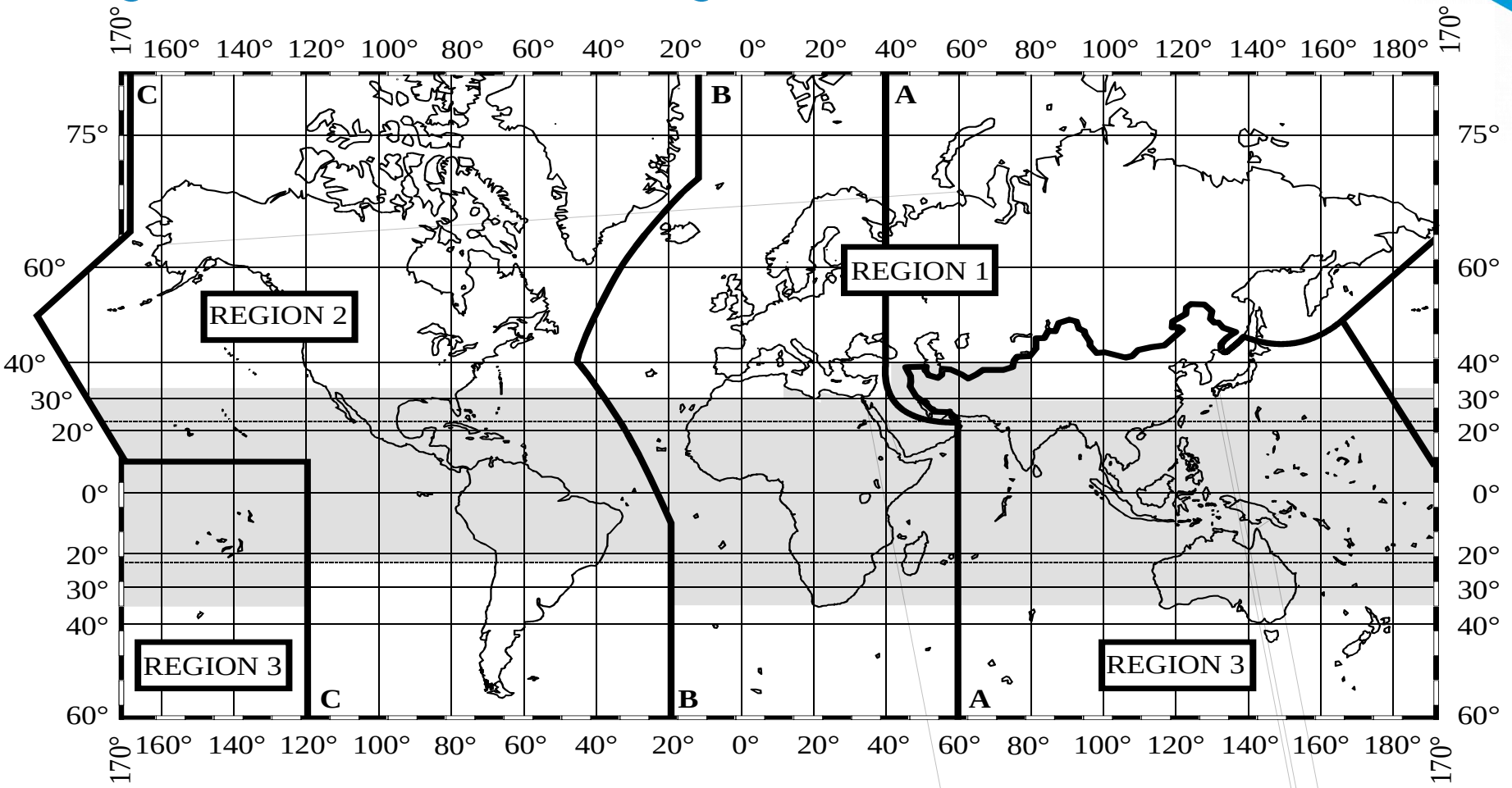
Background Slides

World Regions Defined in the Radio Regulations (Art.5)



The shaded part represents the Tropical Zones as defined in Nos. **5.16** to **5.20** and **5.21**.

Technical details - 2.6 GHz

The following table gives overview of the trigger values of the field strength and the relevant sections of this Annex.

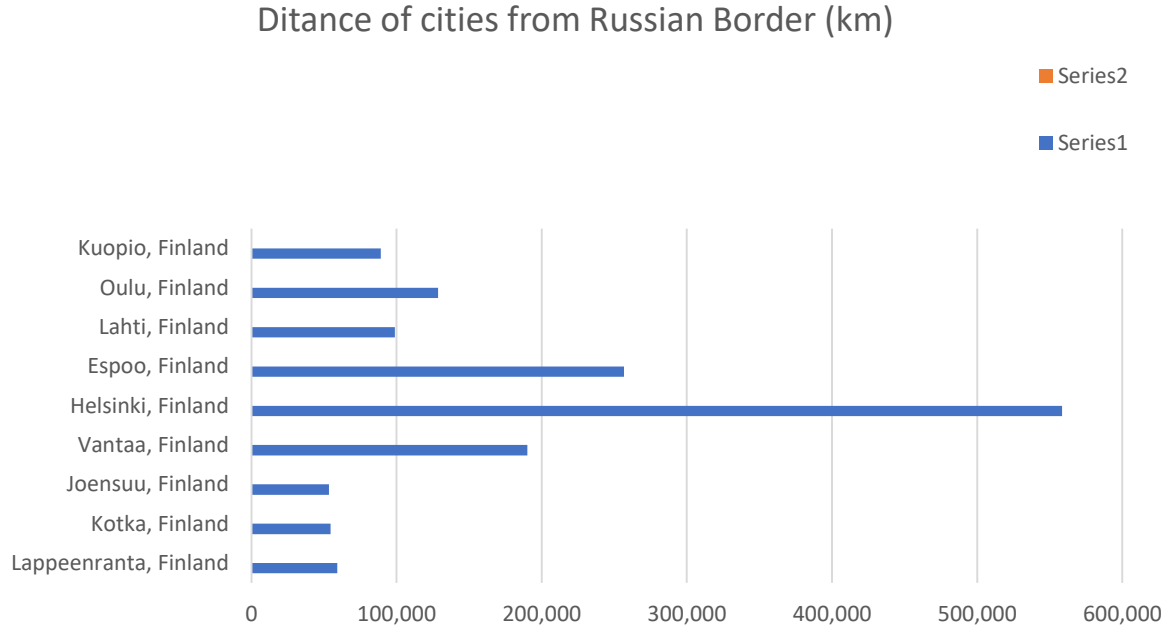
Table 1: Trigger values at a height of 3 m above ground for MFCN FDD systems

Non-Preferential frequency usage			Preferential frequency usage
Centre frequencies aligned		Centre frequencies not aligned	
Using preferential PCI codes	Using non-preferential PCI codes	Using all PCI codes	Based on bi-or multilateral agreements/ arrangement (paragraph 3)
65 dBm/m/5 MHz@0 km and 49 dBm/m/5 MHz@6 km (paragraph 1)	49 dBμV/m/5 MHz@0 km (paragraph 2)	65 dBm/m/5 MHz@0 km and 49 dBm/m/5 MHz@6 km (paragraph 1)	

@ stands for "at a distance inside the neighbouring country"

For field strength predictions the calculations should be made according to Annex 3. In cases of channel bandwidth other than 5 MHz, a factor of 10 x Log_{10} (channel bandwidth[1] /5MHz) should be added to the field strength values.

Technical details - 2.6 GHz



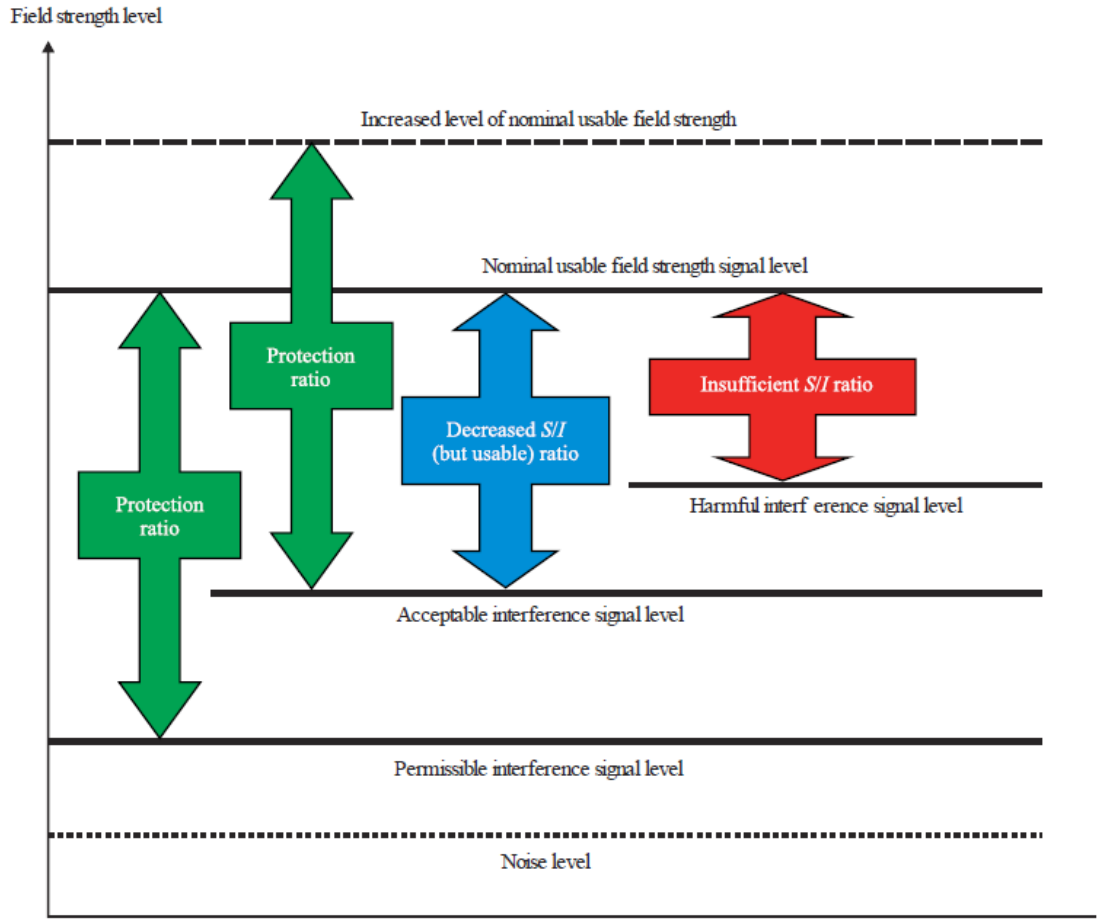
	Lappeenranta, Finland	Kotka, Finland	Joensuu, Finland	Vantaa, Finland	Helsinki, Finland	Espoo, Finland	Lahti, Finland	Oulu, Finland	Kuopio, Finland
Series2	30	45	145	155	165	165	165	190	195
Series1	59,276	54,616	53,388	190,058	558,457	256,760	98,826	128,618	89,104

pops top 14 cities	1,919,267	
total pops	34.9%	
under 200 km	**1,489,103**	**27.1%**

What is Harmful Interference?

To what level should a service be protected?

- What impact does the interference have on the end user?

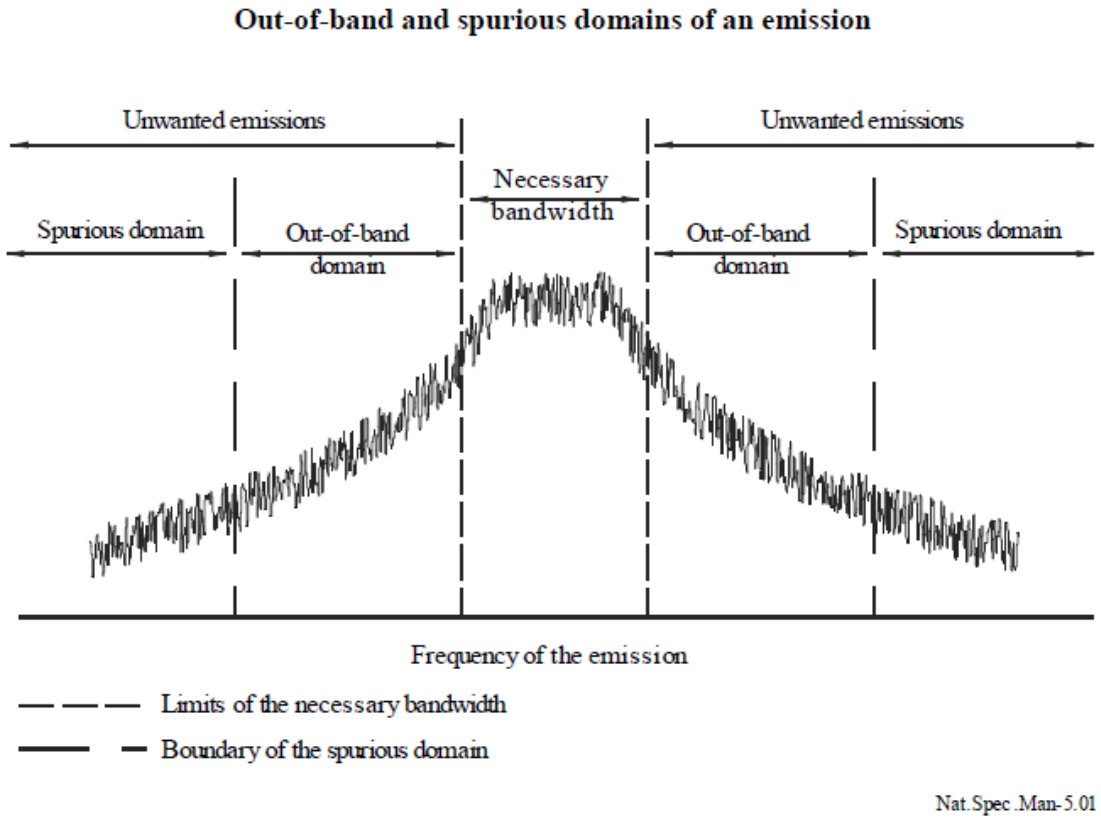


Nat.Spec Man- 3.03

What do we monitor for spectrum

- Does the signal comply with the licence conditions?

Spectrum analyser output



Source: ITU – National Spectrum Management Handbook