Nemzeti Média- és Hírközlési Hatóság

Frequency co-ordination: MFCN Agreements in Hungary

Tasks and Challenges in the Present and for the Future

Tamás István Unger, Expert on frequency co-ordination, NMHH (Hungary)

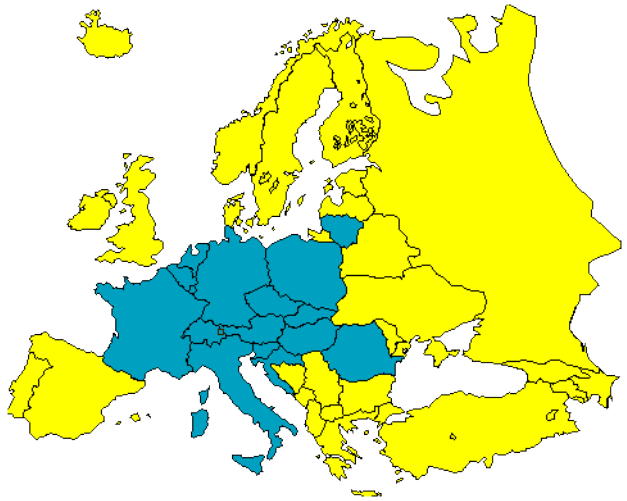
2 July 2020

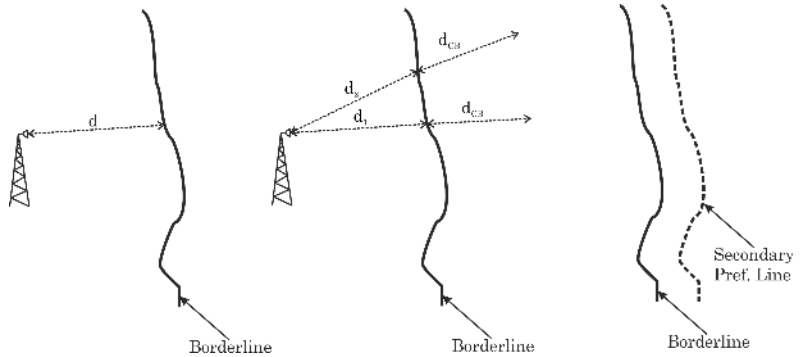
Basic principles: HCM Agreement and more

Harmonized Calculation Methods and Administration Principles in Frequency Co-ordination

Harmonized Calculation Method (HCM Agreement)

- Operation of stations without harmful interference based on bi- or multilateral co-ordination;
- Well-defined processes in the Land Mobile Service and Fixed Service (29.7 MHz – 43.5 GHz);
- Every single station (or microwave link) should be co-ordinated in the border areas, if there is no bi- or multilateral agreement;
- Harmonized calculations based on the same algorithm and topographical data in every country → same results → easy to plan;
- Easy to apply for smaller networks, but not feasible for complex MFCN networks (lot of BTs, constantly changing network parameters, etc.) → need for extensive agreements/arrangements between countries and operators.





Special Agreements besides the HCM Agreement

Aims

- To guarantee equal access to the spectrum irrespectively to the implementation of new technologies;
- Harmonized usage based on agreements with as many countries as possible;
- Clarification of condition in the border zones, where three (or more) county should be involved;
- Signing agreements before bringing the frequencies into use;
- Reducing administrative procedures;
- Higher DoF for operators in frequency allocations.

Influencing Factors, Challenges

- The regulations are not synchronized on national level;
- Different spectrum usage for uncertain period of time in different countries;
- Problems with differences in services at the border of EU;
- Applicable protection criteria are not available.

Special Agreements: Structure and Content

Basics

- Relevant regulations – decisions, recommendations and reports;
- Regulated band: usage, technology;
- Propagation model, FS calc. model;
- Technical provisions, trigger FS values;
- Geo. zones, where it should be applied;
- Procedure in case of harmful interference;
- Definition of administrative procedures.

Optional

- Protection criteria of other services;
- List of stations to be protected;
- Co-ordination procedure;
- Measurement procedure;
- Regulation of transition period;
- Preferential frequency distribution;
- Table of preferential codes.

Technical criteria in general

- Field strength calculations according to the HCM Agreement. Time probability for electronic communications services is 10%;
- Bandwidth correction factor should be added to the trigger value: 10 * log (Cs/5 MHz) [dB], where Cs=nominal channel spacing;
- Aggregated power correction factor decreases the trigger value: 10 * log n [dB], where n=number of the transmitters in the respective antenna sector.

FS triggers

SITUATION	MEAN FIELD STRENGTH (E)
• centre frequencies not aligned or • centre frequencies aligned using preferential PCI codes	at the border, 3 m above ground E ≤ A dBμV/m/5MHz at and at the 6 km line beyond the border E ≤ B dBμV/m/5MHz at 3 m above ground
• centre frequencies aligned using non-preferential PCI codes	at the border 3 m above ground E ≤ B dBμV/m/5MHz

MFCN frequency bands in Hungary

Current situation, Agreements and Rights of Use

700 MHz: MFCN Agreements in Hungary

700 MHz LTE, NR	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
694-790 MHz	LTE vs LTE	Budapest, 15 February 2018					Budapest, 15 February 2018	
	LTE vs. ARNS							Budapest, 6 October 2015

- Agreement (2018): A good example how to protect other services (eg. LTE → DVB-T; Besides the protection criteria the operating DVB-T transmitters of HRV and HNG are also included);
- Preparing to switch off the DVB-T transmitters was a task of NEDDIF and SEDDIF working groups: 31 December 2019. (cca. 75% completed);
- ECC/REC/(15)01 was extended to NR (14 February 2020);

  - HNG has the intention the extend the currently applied Agreements with NR in as much relations as it is possible.

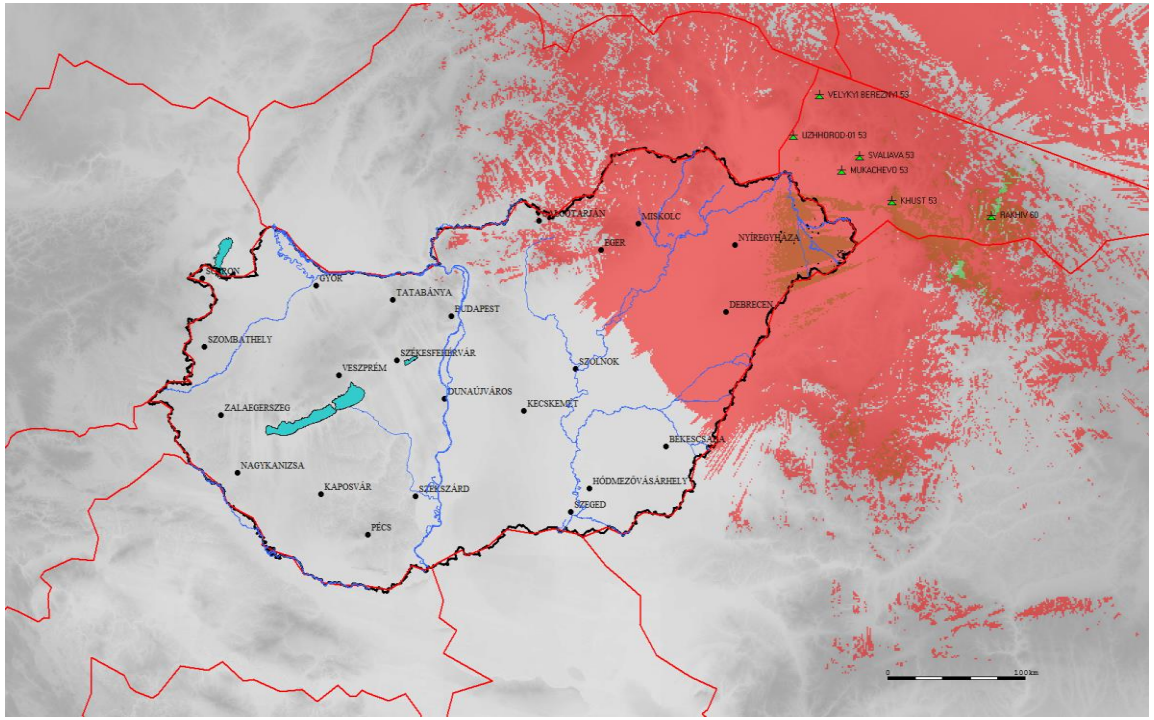
700 MHz: Rights of Use in Hungary

Service provider	Frequency range	Spectrum
Magyar Telekom Nyrt.	708-718 / 763-773 MHz	2 x 10 MHz
Vodafone Magyarország Zrt.	718-728 / 773-783 MHz	2 x 10 MHz
Telenor Magyarország Zrt.	728-733 / 783-788 MHz	2 x 5 MHz

- Spectrum auction was successful in March 2020;
- DVB-T: HNG is in a transition period (ends until 5 September 2020);
- Winners of the auction can use the FDD blocks after 5 September 2020;
- Operators have the rights of use for 15 years (can be extended).

700 MHz: Calculations between DVB-T and LTE

	Duplex Ch. 6.	
	Uplink	Downlink
Duplex channel	728-733 MHz	783-788 MHz
Interfering DVB-T channel	CH 53 (726-734 MHz)	CH 60 (782-790 MHz)
Number of interfering DVB-T transmitters	5	1
Max. FS.	19,297 dBµV/m/20 m	41,940 dBµV/m/1,5 m
Area of interference		



800 MHz: MFCN Agreements in Hungary

800 MHz LTE, UMTS, WiMAX, NR	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
790-862 MHz	LTE/UMTS/WiMAX vs. LTE/UMTS/WiMAX	Budapest, 15 February 2018						
	LTE vs. ARNS							Kiev, 8 July 2011

- Agreement with 6 countries in 2018;
- The 800 MHz is not available for MFCN in UKR;
- There is no ECC recommendation for NR yet.

800 MHz: Rights of Use

Service provider	Frequency range	Spectrum
Vodafone Magyarország Zrt.	791-801 / 832-842 MHz	2 x 10 MHz
Magyar Telekom Nyrt.	801-811 / 842-852 MHz	2 x 10 MHz
Telenor Magyarország Zrt.	811-821 / 852-862 MHz	2 x 10 MHz

- LTE technology;
- Rights of use until 15 June 2019 (can be extended by 5 years).

900 MHz: MFCN Agreements in Hungary

900 MHz GSM, LTE, UMTS, WiMAX, NR	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
880-890/925-935 MHz	GSM vs. GSM	Bratislava, 12 Dec. 2001		Vienna, 5 Feb. 2002	24 July 2007	7 June 2010	Budapest, 27 October 2010	Kijev, 2009
890-914/935-959 MHz	GSM vs. GSM	Vienna, 30 September 1994			Pécs, 2003	Szeged, 16 Nov 2000	Budapest, 22 October 1999	
880-915/925-960 MHz	LTE/UMTS/WiMAX vs. LTE/UMTS/WiMAX	Budapest, 28 May 2014						
	UMTS vs. UMTS							UMTS Budapest, 28 October 2010

- Rule (2014): GSM has priority against other technologies, the condition of technological neutrality can be ensured by operator arrangements;
- New version of co-ordination recommendation ECC/REC/(08)02 valid also for NR since 8 February 2019;
    - Task: Include the NR into the existing agreements if needed.

900 MHz: Rights of Use in Hungary

Service provider	Frequency range	Spectrum	Date of expiry
Telenor Magyarország Zrt.	880,1-889,9 / 925,1-934,9	2 x 9,8 MHz	2022-04
	889,9-891,9 / 934,9-936,9	2 x 2 MHz	2029-06*
Vodafone Magyarország Zrt.	891,9-901,9 / 936,9-946,9	2 x 10 MHz	2022-04
	901,9-902,9 / 946,9-947,9	2 x 1 MHz	2029-06*
Magyar Telekom Nyrt.	902,9-904,9 / 947,9-949,9	2 x 2 MHz	2029-06*
	904,9-914,9 / 949,9-959,9	2 x 10 MHz	2022-04

- Technologies: GMS, UMTS and LTE;
- *: licences can be extended with 5 years;
- Preparation started for expiry in 2022.

1500 MHz SDL: MFCN Agreements in Hungary

1500 MHz LTE, NR	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
1452-1492 MHz	LTE vs. LTE	Budapest, 14 February 2018					Budapest, 14 February 2018	
1427-1518 MHz	LTE vs. ATS							Sharm-El-Sheikh 20 November 2019

- The agreement between six countries (14.02.2018, Budapest) covers only 40 MHz (1452-1492 MHz) of spectrum;
- Recommendation extended also for NR (NR/non-AAS) ECC/REC/(15)01 is available for the whole 1427-1518 MHz band since 14 February 2020;
- According to the decision of EU: if needed, the Agreement can be extended for NR and also for the whole band, involving SRB;
- The whole band is not used in HNG at the moment;
- According to surveys there is no priority to use the band for MFCN.

1800 MHz: MFCN Agreements in Hungary

<table>
<tr><td>1800 MHz
GSM, LTE, UMTS, WiMAX, NR</td><td>Technology</td><td>SVK</td><td>AUT</td><td>SVN</td><td>HRV</td><td>SRB</td><td>ROU</td><td>UKR</td></tr>
<tr><td rowspan="3">1710-1785/1805-1880 MHz</td><td>GSM vs GSM</td><td colspan="3">Vienna, 30 September 1994
Amendment (03 August 2004)</td><td colspan="2">03 December 2018</td><td>Szeged,
16 November 2000</td><td>Budapest,
22 October 1999</td></tr>
<tr><td>UMTS/LTE/WiMAX vs.
UMTS/LTE/WiMAX</td><td colspan="6">Budapest, 28 May 2014</td><td></td></tr>
<tr><td>UMTS vs. UMTS</td><td colspan="6"></td><td>Budapest,
28 October 2010</td></tr>
</table>

- Rule (2014): GSM has priority against other technologies, the condition of technological neutrality can be ensured by operator arrangements;
- New version of co-ordination recommendation ECC/REC/(08)02 valid also for NR since 8 February 2019;
    - Task: Include the NR into the existing agreements if needed.
- UKR is interested in LTE technology: revision of the agreement (2010) is needed.

1800 MHz: Rights of Use in Hungary

Service provider	Frequency range	Spectrum	Date of ex.
Vodafone Magyarország Zrt.	1710,1-1725,1/1805,1-1820,1 MHz	2 x 15 MHz	2022-04
DIGI Távközlési és Szolgáltató Kft.	1725.1-1730 / 1820.1-1825 MHz	2 x 4.9 MHz	2029-06*
Magyar Telekom Nyrt.	1730-1740 / 1825-1835 MHz	2 x 10 MHz	2029-06*
	1740-1755 / 1835-1850 MHz	2 X 15 MHz	2022-04
Telenor Magyarország Zrt.	1755-1785 / 1850-1880 MHz	2 x 30 MHz	2022-04

- Technologies: GMS, UMTS and LTE;
- *: can be extended with 5 years;
- Preparing for expiry in 2022 is in progress.

2100 MHz: MFCN Agreements in Hungary

2100 MHz LTE, UMTS, WiMAX NR	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
1920-1980 MHz, 2110-2170 MHz	LTE/UMTS vs. LTE/UMTS	Budapest, 14 February 2018						
1900-1980 MHz, 2010-2025 MHz, 2110-2170 MHz	UMTS vs. UMTS							Bratislava, 05 September 2002

- The agreement signed in 2002 is in force only in the relation of UKR;
- 8 March 2019: modified ECC DEC (06)01 (no recommendation for NR);
  - Intention to involve UKR to the multilateral agreement.

2100 MHz: A Solution for the Distribution of PCI codes

- UMTS and LTE PCI codes from the annex of the agreement (2018)

Country 1: SRB, SVN

	Set A	Set B	Set C	Set D	Set E	Set F
UMTS Codes	0..10	11..20	21..31	32..42	43..52	53..63
PCI for LTE	0..83	84..167	168..251	252..335	336..419	420..503
Border 1-2						
Zone 1-2-3						
Border 1-3						
Zone 1-2-4						
Border 1-4						
Zone 1-3-4						

Country 2: HNG

	Set A	Set B	Set C	Set D	Set E	Set F
UMTS Codes	0..10	11..20	21..31	32..42	43..52	53..63
PCI for LTE	0..83	84..167	168..251	252..335	336..419	420..503
Border 2-1						
Zone 2-3-1						
Border 2-3						
Zone 2-1-4						
Border 2-4						
Zone 2-3-4						

2100 MHz: Rights of Use in Hungary

Service provider	Frequency range	Spectrum	Date of exp.
Magyar Telekom Nyrt.	1920-1935 /2110-2125 MHz	2 x 15 MHz	2027-06
	1970-1980 /2160-2170 MHz	2 x 10 MHz	2035*
Vodafone Magyarország Zrt	1935-1950 /2125-2140 MHz	2 x 15 MHz	2027-06
	1965-1970 /2155-2160 MHz	2 x 5 MHz	2035*
Telenor Magyarország Zrt	1950-1965 /2140-2155 MHz	2 x 15 MHz	2027-06

- Technology: neutral;
- *: Date of expiry can be extended.

2600 MHz: MFCN Agreements in Hungary

2600 MHz	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
2500-2690 MHz LTE, UMTS, WiMAX, NR	LTE/UMTS/WiMAX vs. LTE/UMTS/WiMAX		Budapest, 15 February 2018					
	LTE/UMTS/WiMAX vs. LTE/UMTS/WiMAX	Wien, 12 October 2011					03 July 2013, by correspondence	

- 2018: Agreement was signed only by 4 countries;
- ROU and SVK has the intention to sign, but the revision of the agreement and the national opportunities is still in progress;
- UKR has strong intention to sign;
- In SRB it depends on the modification of the National Frequency Allocation Table;
- Modified ECC DEC (05)05: 5 July 2019;
- NR: no recommendation for co-ordination yet.

2600 MHz: Different Systems, Complex Regulations (1)

Systems FDD/TDD/SDL & paired / unpaired bands → Complicated regulation

NO INFORMATION on neighbouring country's network		
	Paired band	**Unpaired band**
System	Home network	Home network
FDD	Preferential PCI codes **A** (--) NON-Preferential PCI codes **B** (--)	FDD may not be used (2.2 and 3.2)
TDD	All PCI codes **C** (4.4)	All PCI codes **D** (--)
Supplement. Downlink	--	All PCI codes **C**(4.5.a)

Sets of trigger values	**A** 65 dBµV/m/5 MHz@0 km and 49 dBµV/m/5 MHz@6 km at a height of 3 m above ground **B** 49 dBµV/m/5 MHz@0 km at a height of 3 m above ground **C** 10.5 dBµV/m/5 MHz@0 km at a height of 3 m above ground **D** 30 dBµV/m/5 MHz@0 km at a height of 3 m

2600 MHz: Different Systems, Complex Regulations (2)

<table>
<tr><th colspan="6">OTHER CASES</th></tr>
<tr><td></td><td>Home network</td><td>Neighbour's network</td><td></td><td>Home network</td><td>Neighbour's network</td></tr>
<tr><td></td><td>FDD</td><td>FDD</td><td></td><td>TDD</td><td>TDD</td></tr>
<tr><td>centre frequencies aligned</td><td colspan="2">Preferential PCI codes
<u>A</u>
(4.2.a)
NON-Preferential PCI codes
<u>B</u>
(4.2.b)</td><td>Synchronised

NON-synchronised
(4.3.1)</td><td colspan="2">Preferential PCI codes
<u>A</u>
(4.3.2a)
NON-Preferential PCI codes
<u>B</u>
(4.3.2b)

ALL PCI codes
<u>D</u></td></tr>
<tr><td>centre frequencies NOT aligned</td><td colspan="2">All PCI codes
<u>A</u>
(4.2.a)</td><td>Synchronised

NON-synchronised</td><td colspan="2">All PCI codes
<u>A</u>

ALL PCI codes
<u>D</u>
(4.3.1)</td></tr>
<tr><td>--</td><td>FDD</td><td>TDD</td><td>--</td><td>SDL</td><td>SDL</td></tr>
<tr><td>--</td><td>Preferential PCI codes
<u>A</u>
(4.2.a)

NON-Preferential PCI codes
<u>B</u>
(4.2.b)</td><td>ALL PCI codes
<u>C</u>
(4.4)</td><td>--</td><td colspan="2"><u>Centre frequencies aligned</u>
Preferential PCI codes
<u>A</u>
(4.5.b and 4.2.a)
NON-Preferential PCI codes
<u>B</u>
(4.5.b and 4.2.b)

<u>Centre frequencies NOT aligned</u>
All PCI codes
<u>A</u>
(4.5.b and 4.2.a)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>TDD</td><td>SDL</td></tr>
<tr><td></td><td></td><td></td><td></td><td>All PCI codes
<u>D</u>
(--)</td><td>All PCI codes
<u>C</u>
(4.5.a)</td></tr>
</table>

2600 MHz: Rights of Use in Hungary

- The operators were not interested about the last 15 MHz (green);
- Technology: neutral;
- Rights until 2034.

3400-3800 MHz: MFCN Agreements in Hungary

3400-3800 MHz LTE, UMTS, WiMAX, NR	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
3400-3600 MHz 3600-3800 MHz	LTE/UMTS/WiMAX vs LTE/UMTS/WiMAX	Geneva, 24 November 2015						

- ROU: has intention to join;
- UKR: protection criteria for the stations of their special users should be defined;
- ECC/REC/(15)01: extended with NR (14 February 2020);
- The development of a new recommendation to help the co-ordination in this frequency band is in progress, because applying the recommendation ECC/REC/(15)01 can cause problems in the QoS in the border areas (until the end of 2020) – handling of TDD sync.;
- After this, the agreement could be revised and extended with NR (and with more relations).

3400-3800 MHz: Rights of Use in Hungary

Service provider	Frequency range	Spectrum	Date of exp.
Vodafone Magyarország Zrt.	3 410 – 3 470 MHz	60 MHz	2035*
	3 490 – 3 540 MHz	50 MHz	
DIGI Távközlési és Szolgáltató Kft.	3 470 – 3 490 MHz	20 MHz	
Magyar Telekom Nyrt.	3 540 – 3 660 MHz	120 MHz	
Telenor Magyarország Zrt.	3 660 – 3 800 MHz	140 MHz	

- TDD blocks have been sold on the spectrum auction (March 2020);
- *: Date of expiry can be extended.

26 GHz: MFCN Agreements in Hungary

26 GHz	Technology	SVK	AUT	SVN	HRV	SRB	ROU	UKR
24549 - 25053/ 25557 - 26061 MHz	FWA FDD (p-p, p-mp)	Bratislava, 05 Sept. 2002	Wien, 28 November 2000		Budapest, 21 October 2005	Budapest 27 Oct. 2006	Budapest, 21 Oct. 2005	Bratislava, 05 Sept. 2002 Mod.20 Oct. 2006

- Agreements between 2000-2006 for PP and PmP systems;
- Expiry of licences: April 2027 (cannot be extended);
- The development of a recommendation for co-ordination of MCFN TDD systems (24,25-27,5 GHz) is in progress (planned to 2021);
- EU: Harmonized regulation is available, but there is no demand at the moment.

Summary

Frequency band	Agreed relations (max. 7)	Recommendation for NR	
700 MHz	5 + 1	ECC/REC/(15)01	2020-02-14
800 MHz	6 + 1	No	
900 MHz	6 + 1	ECC/REC/(08)02	2019-02-08
1500 MHz	5 + 1	ECC/REC/(15)01	2020-02-14
1800 MHz	6 + 1	ECC/REC/(08)02	2019-02-08
2100 MHz	6 + 1	No	
2300-2400 MHz	-		
2600 MHz	3 + 2	No	
3400-3800 MHz	5	ECC/REC/(15)01	2020-02-14
26 GHz	-	under development	

Thank you for your attention

Tamás István Unger unger.tamas@nmhh.hu

Nemzeti Média- és Hírközlési Hatóság

2 July 2020