AGENCY FOR ELECTRONIC COMMUNICATIONS AND POSTAL SERVICES

RF SPECTRUM RELATED ISSUES REGARDING 5G IN MONTENEGRO

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- **Content:**
  - **Overview of mobile networks in Montenegro**
  - **Harmonized bands for MFCN on CEPT and national MNE level**
  - **Available frequencies for LTE/LTE-A/LTE-A Pro**
  - **Frequencies for initial 5G implementation**
  - **Conclusions**

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- **Overview of mobile networks in Montenegro:**
  - **Three MNOs (Telenor, Crnogorski Telekom, Mtel)**
  - **Five bands in use: 800 MHz, 900 MHz, 1800 MHz, 2 GHz and 2.6 GHz**
  - **Technology**
    - **2G (GSM/GPRS/EDGE), coverage: >98% of population**
    - **3G (UMTS/HSPA+/DC-HSDPA), coverage: >95% of population**
    - **4G (LTE/LTE-*Advanced* (2CA/3CA), no VoLTE), coverage:**
      >95% of population (basic)
      >92% of population (10 Mbps DL) - now
      >95% of population (10 Mbps DL) - until Sept. 2019 by CT
  - **Average FTP down/uplink data rate in cities (end of 2017):**
    31 Mbps / 22 Mbps (Mtel)
    44 Mbps / 38 Mbps (Crnogorski Telekom)
    56 Mbps / 42 Mbps (Telenor)
  - **Voice traffic in cities: in two networks <5% by GSM, >95% by UMTS**
  - **Data traffic in cities: in two networks <1% by UMTS, >99% by LTE**

Harmonized bands for MFCN (< 1 GHz)

Band	CEPT level	National level - MNE
700 MHz (2x30 MHz FDD + up to 20 MHz TDD)	▪ at the moment mainly used for DTV ▪ licenced for MFCN only in few countries, used for LTE ▪ available for MFCN in most countries after mid 2020 or mid 2022	▪ allocated for MFCN, not licenced yet ▪ free from DTV transmissions in MNE ▪ DTV signals from ALB, I and HRV present on territory where ½ of population live
800 MHz (2x30 MHz FDD)	▪ licenced for MFCN in almost all European countries, used by LTE	▪ whole band is licenced for MFCN, used for LTE
900 MHz (2x35 MHz FDD)	▪ traditional GSM band, refarmed for UMTS and LTE ▪ GSM in reduction, in future for IoT applications	▪ whole band licenced for GSM and MFCN, used for GSM, UMTS and LTE ▪ GSM in reduction

Harmonized bands for MFCN (1 - 6 GHz)

Band	CEPT level	National level - MNE
1500 MHz (90 MHz SDL)	▪ 40 MHz (1452-1492 MHz) licenced for MFCN only in few countries, used for LTE SDL	▪ band 1452-1492 MHz allocated for MFCN, not licenced yet ▪ bands 1427-1452 MHz and 1492-1518 MHz not allocated for MFCN ▪ whole band 1427-1518 MHz is free for MFCN
1800 MHz (2x75 MHz FDD)	▪ traditional GSM band, refarmed for LTE ▪ GSM in reduction	▪ whole band licenced for GSM and MFCN, used for GSM and LTE ▪ GSM in reduction

Harmonized bands for MFCN (1 - 6 GHz)

Band	CEPT level	National level - MNE
2 GHz (2x60 MHz FDD)	▪ traditional UMTS band, in several countries refarmed for LTE	▪ 2x55 MHz licenced for MFCN, used for UMTS and LTE (test only)
2.3 GHz (100 MHz TDD)	▪ limited use for MFCN through LSA	▪ allocated for MFCN, not licenced yet ▪ whole band free for MFCN
2.6 GHz (2x70 MHz FDD +50 MHz TDD)	▪ licenced for MFCN in many countries ▪ used mainly for LTE	▪ 2x30 MHz FDD + 5 MHz TDD licenced for MFCN ▪ 2x40 MHz FDD + 40 MHz TDD free for MFCN

Harmonized bands for MFCN (1 - 6 GHz)

Band	CEPT level	National level - MNE
3.5 GHz (200 MHz TDD or 2x60 MHz FDD)	▪ in many countries licenced for BWA	▪ allocated for MFCN, not licenced yet ▪ 2x25 MHz FDD licenced for BWA (WiMAX) until April 2022 ▪ 150 MHz free for MFCN
3.7 GHz (200 MHz TDD)	▪ in several countries licenced for BWA	▪ allocated for MFCN, not licenced yet ▪ whole band free for MFCN

Harmonized bands for MFCN (> 6 GHz)

26 GHz (3250 MHz TDD)	▪ harmonized for MFCN in July 2018 ▪ in many countries used for fixed links	▪ not allocated for MFCN ▪ allocation after WRC-19 ▪ band 24.5-26.5 GHz currently used for fixed links

Harmonized bands for MFCN (total)

Designated for MFCN on CEPT level	< 1 GHz	2x95 MHz FDD + up to 20 MHz TDD
	1-6 GHz	2x205 MHz FDD + 640 TDD
	> 6 GHz	3250 MHz TDD
	Total	**2x300 MHz FDD + 3910 MHz TDD**
Allocated for MFCN in MNE	< 1 GHz	2x95 MHz FDD + up to 20 MHz TDD
	1-6 GHz	2x205 MHz FDD + 590 TDD
	> 6 GHz	/
	Total	**2x300 MHz FDD + 610 MHz TDD**
Licenced for MFCN in MNE	< 1 GHz	2x65 MHz FDD
	1-6 GHz	2x160 MHz FDD + 5 MHz TDD
	> 6 GHz	/
	Total	**2x225 MHz FDD + 5 MHz TDD**

Available frequencies for LTE/LTE-A/LTE-A Pro

Band	Amount	Comment
900 MHz	up to 2x15 MHz FDD	Potential use for LTE due to GSM reduction and in case of UMTS shot down
1500 MHz	40 MHz SDL	Free. Potential use for LTE
1800 MHz	up to 2x15 MHz FDD	Potential use for LTE in case of GSM shot down in this band
2 GHz	up to 2x60 MHz FDD	Potential use for LTE due to UMTS reduction or in case of UMTS shot down
2.3 GHz	100 MHz TDD	Free band. Potential use for LTE
2.6 GHz	2x40 MHz FDD + 40 MHz TDD	Free. Potential use for LTE
1500 MHz	Additional 50 MHz	To be allocated. Potential use for LTE
700 MHz 3.4-3.8 GHz	2x30 MHz FDD + up 400-420 MHz TDD	Free. Potential use for LTE and/or 5G NR
Unlicenced		5 GHz potential use for LTE-A Pro (LWA)

Frequencies for initial 5G implementation

"Coverage layer" (< 1 GHz bands)

- suitable for mMTC, eMBB, URLLC
- wide area and deep indoor coverage
- enable operators to roll out 5G quickly and more cost-effectively
- up to 20 MHz FDD/TDD assignments

Band 694-790 MHz

- allocated for MFCN in Montenegro
- free from DTV transmissions in Montenegro
- DTV signals from Albania, Italy and Croatia present on territory where ½ of population live (Podgorica region, Danilovgrad, part of Nikšić and whole coastal region-cities of Ulcinj, Bar, Budva, Kotor, Tivat and Herceg Novi) making band unusable for MFCN
- usage for MFCN, icluding 5G NR before June 2020/2022 possible only on part of territory (nortern region)

Frequencies for initial 5G implementation

"Coverage & capacity layer" (bands in range 1-6 GHz)

- suitable for eMBB, URLLC, mMTC
- wide area but no deep indoor coverage
- the best compromise between capacity and coverage
- 100 MHz contiguous assignments

Band 3400-3800 MHz

- allocated for MFCN in Montenegro
- 2x25 MHz in 3400-3600 MHz band licenced for BWA until April 2022
- free 150 MHz (no-contiguous) in the band 3400-3600 MHz
- free 200 MHz (contiguous) in the band 3600-3800 MHz
- usage for MFCN, icluding 5G NR possible now

Frequencies for initial 5G implementation

"Super data layer" (bands above 6 GHz)

- suitable for eMBB
- addressing specific use cases requiring extremely high data rates
- 800 MHz contiguous assignments

Band 24,25-27,5 GHz

- not allocated for MFCN in Montenegro
- allocation after WRC-19 (in 2020)
- band 24,5-26,5 GHz currently used for fixed links (a number of links authorized until 2023)
- band 26,5-27,5 GHz (1 GHz) free
- planed to migrate fixed links in other bands (23 GHz, 28 GHz) gradualy, depending of market demand for spectrum for 5G

Conclusions

- Allocations of spectrum for MFCN systems in Montenegro are in lice with CEPT, except of the bands 1500 MHz and 26 GHz
- Allocation of additional 50 MHz in band 1500 MHz for MFCN planned in 2020 (possible even before)
- Allocation of the band 26 GHz for MFCN possible after WRC-19 (in 2020), 1 GHz contiguous clear
- For increasing LTE capacity additional frequencies in several bands are available (free frequencies in bands 1500 MHz, 2.3 GHz and 2.6 GHz + refarming in bands 900 MHz, 1800 MHz and 2 GHz)
- Usage of the band 700 MHz for MFCN, including 5G NR before June 2020/2022 is limited by interference from DTV transmitters in neighbouring countries
- Usage of the band 3400-3600 MHz for 5G NR before April 2022 is limited - free blocks are not contiguous
- **Usage of the band 3600-3800 MHz (200 MHz TDD contiguous) for 5G NR (including 5G pilots) is possible now**

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Thank you.

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