

5G SPECTRUM AWARD AND NETWORK DEVELOPMENT IN MONTENEGRO

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CONTENT

- ❑ TECHNOLOGY OVERVIEW
- ❑ NETWORK COVERAGE
- ❑ SPECTRUM ALLOCATIONS (AUCTIONS 2016/2021)
- ❑ OBJECTIVES OF 5G SPECTRUM AWARD
- ❑ SUBJECT OF PUBLIC BIDDING
- ❑ RESERVE PRICE
- ❑ OVERVIEW OF THE PUBLIC BIDDING PROCEDURE
- ❑ FORMAT OF THE SPECTRUM AUCTION
- ❑ SPECTRUM ALLOCATIONS (AUCTION 2023)
- ❑ SPECTRUM AUCTION RESULTS AND REVENUES
- ❑ COVERAGE REQUIREMENTS AND 5G NETWORK DEPLOYMENT OBLIGATIONS
- ❑ INTERFERENCE IN 700 MHZ BAND FROM DTT ALB
- ❑ CONCLUSIONS

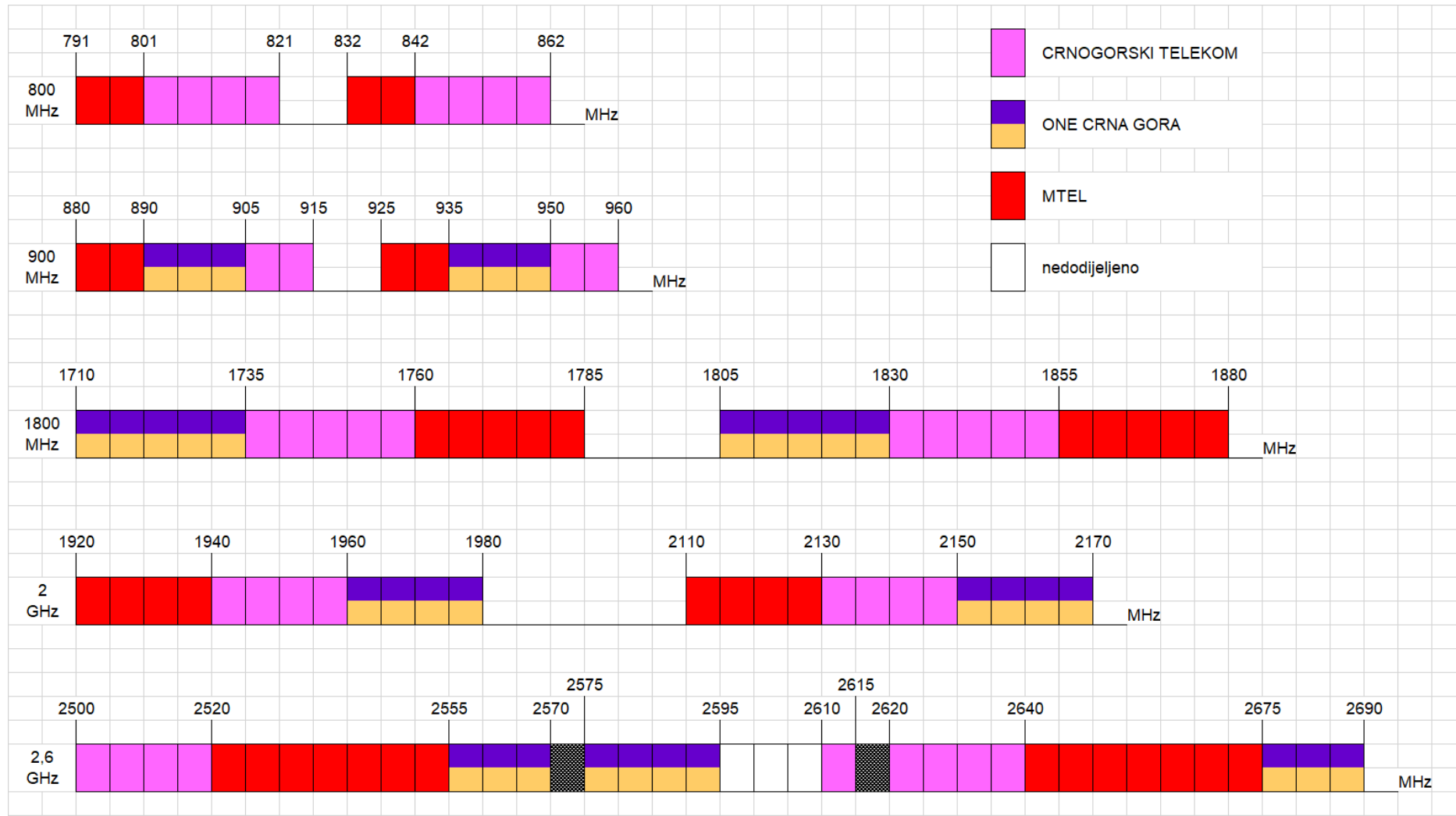
TECHNOLOGY OVERVIEW

- Three MNOs: T-Mobile (35,2%), One (29,2%), Mtel (35,6%)
- Seven bands in use: 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2 GHz, 2.6 GHz and 3.6 GHz
- Technologies: 2G (GSM/GPRS/EDGE)
 - 3G (UMTS/HSPA+/DC-HSDPA) – significantly reduced
 - 4G (LTE/LTE-Advanced – up to 3GPP Release 13)
 - 2x2 MIMO, 4x4 MIMO and 8x8 MIMO on few sites
 - 2CA, 3CA, 4CA on many urban sites
 - no VoLTE, NB-IoT in few sites
 - 5G (NR - 3GPP Release 15)
 - NR (DSS) in 1800 MHz, 2 GHz and 2.6 GHz
 - NR (NSA) in 3.6 GHz
- Voice traffic in cities: <5% by GSM, >95% by UMTS
- Data traffic in cities: 100% by LTE

NETWORK COVERAGE (APRIL 2023)

Techology	Criterion	Network coverage
GSM population	RxLev \geq -99 dBm	98,38%
GSM territory	RxLev \geq -99 dBm	84,12%
UMTS population	RSCP \geq -99 dBm	97,98%
UMTS territory	RSCP \geq -99 dBm	81,34%
GSM/UMTS composite population	RxLev \geq -99 dBm & RSCP \geq -99 dBm	98,43%
GSM/UMTS composite territory	RxLev \geq -99 dBm & RSCP \geq -99 dBm	84,41%
LTE (base) population	RSRP \geq -120 dBm	97,87%
LTE (base) composite territory	RSRP \geq -120 dBm	80,47%
LTE (10 Mb/s DL) composite population	RSRP \geq -106 dBm@10 MHz & RSRP \geq -112 dBm@20 MHz	97,47%
LTE (10 Mb/s DL) composite territory	RSRP \geq -106 dBm@10 MHz & RSRP \geq -112 dBm@20 MHz	77,93%

SPECTRUM ALLOCATIONS (AUCTIONS 2016/2021)



OBJECTIVES OF 5G SPECTRUM AWARD

- Preparations for the spectrum auction in the 700 MHz, 3.6 GHz and 26 GHz - beginning of 2022 (as soon as the previous auction at the end of 2021 was finalised: renewal of licences for MNO MTEL in 900 MHz, 1800 MHz, 2GHz + available block 2x5 MHz in 1800 MHz, 2x5 MHz in 2 GHz, 2x40 MHz and 40 MHz in 2.6 GHz)
- The strategy for RF award was designed to achieve several objectives simultaneously:
 - preserving and encouraging the effective competition into the market of mobile electronic communication services;
 - providing a stable business environment for mobile operators and other investors;
 - creating conditions for further development of mobile electronic communications networks and services and enabling the implementation and development of advanced technologies (eg 5G NR) through the timely allocation of adequate frequency resources;
 - enabling the availability of broadband data transmission services of appropriate quality over as much of the territory of Montenegro as possible;
 - ensuring the development of electronic communications services and infrastructure to support the social and economic progress of Montenegro;
 - generating the revenues for the budget of Montenegro from the award of radio-frequencies that reflect the market value of the spectrum.
- Multiband spectrum auction in 700 MHz, 3.6 GHz and 26 GHz band
- Full application of the principle of technological neutrality - maximum spectrum valorization

SUBJECT OF PUBLIC BIDDING

Band	Lot category	Block width	Number of blocks for award	Period of approval validity	Description	Reserve price per block [EUR]
700 MHz	PA1	2x5 MHz	2	15 years as of the date of the approval issuance	Frequency generic blocks from the range H1 to H6 (reserved spectrum for the new entrants into the market, subject to the award in the pre-auction phase)	690,000.00
	GA1	2x5 MHz	4 (5 or 6 if one or both of blocks in lot category PA1 are not awarded in the pre-auction phase)	15 years as of the date of the approval issuance	Frequency generic blocks from the range H1 to H6 (unreserved spectrum, subject to the award in the main auction phase)	690,000.00
	GA2	5 MHz	2	15 years as of the date of the approval issuance	Frequency generic unpaired blocks from the range I2 to I3 (unreserved spectrum, subject to the award in the main auction phase)	70,000.00
3,6 GHz	PA2	10 MHz	10	15 years as of the date of the approval issuance	Frequency generic unpaired blocks from the range L5-L6 to L79-L80 (reserved spectrum for the new entrants into the market, subject to the award in the pre-auction phase)	95,000.00
	GA3	10 MHz	28 (29 to 38 if one or more blocks in lot category PA2 are not awarded in the pre-auction phase)	15 years as of the date of the approval issuance	Frequency generic unpaired blocks from the range L5-L6 to L79-L80 (unreserved spectrum, subject to the award in the main auction phase)	95,000.00
26 GHz	PA3	200 MHz	1	15 years as of the date of the approval issuance	Frequency generic unpaired blocks from the range M12 to M16 (reserved spectrum for the new entrants into the market, subject to the award in the pre-auction phase)	100,000.00
	GA4	200 MHz	4 (5 if a block in lot category PA3 is not awarded in the pre-auction phase)	15 years as of the date of the approval issuance	Frequency generic unpaired blocks from the range M12 to M16 (unreserved spectrum, subject to the award in the main auction phase)	100,000.00

RESERVED PRICES

- The minimum amount of the one-off fees for the awarding of approvals for the use of radio-frequencies (reserve price) according to the LEC are determined by Ministry of Economic Development and Tourism
- External expert consultancy company hired to prepare the study on reserve prices
- Spectrum evaluation methodology based on:
 - Benchmark analysis of reserve and achieved prices for RF in specific bands in spectrum auctions of CEPT member states in the last 5 years
 - RF prices achieved in previous award procedures in Montenegro
 - The amount of the annual fees for the use of RF
 - Coverage requirements and 5G network deployment obligations
 - Adjustments to general demographic and macro economic parameters of Montenegro
- Usually, the reserve price should be set at a slightly lower value than the estimated value in order to achieve the realistic market value in the process of competitive bidding
- Reduction of the estimated price value by 20% in order to stimulate the fastest possible development of 5G networks

OVERVIEW OF THE PUBLIC BIDDING PROCEDURE

	Phase description	Date of execution
1.	Issuance of the Decision on the initiation of the public bidding procedure	26 October 2022
2.	Deadline for the submission of applications for participation in the spectrum auction	28 November 2022
3.	Issuance of the Decision on eligibility of the applicant	30 November 2022
4.	Training of bidders for the use EAS	12-14 December 2022
5.	Trial (MOCK) auction	16 December 2022
6.	Spectrum auction	20-27 December 2022
7.	Issuance of the Decision on the selection of bidders	12 January 2023
8.	Issuance of the approvals for the use of radio-frequencies	9 February 2023

FORMAT OF THE SPECTRUM AUCTION

ELECTRONIC SPECTRUM AUCTION (supported by Specure)

Stages: Principal and Assignment

Principal stage determined how many frequency generic blocks of a certain category have been awarded to each winner of the auction:

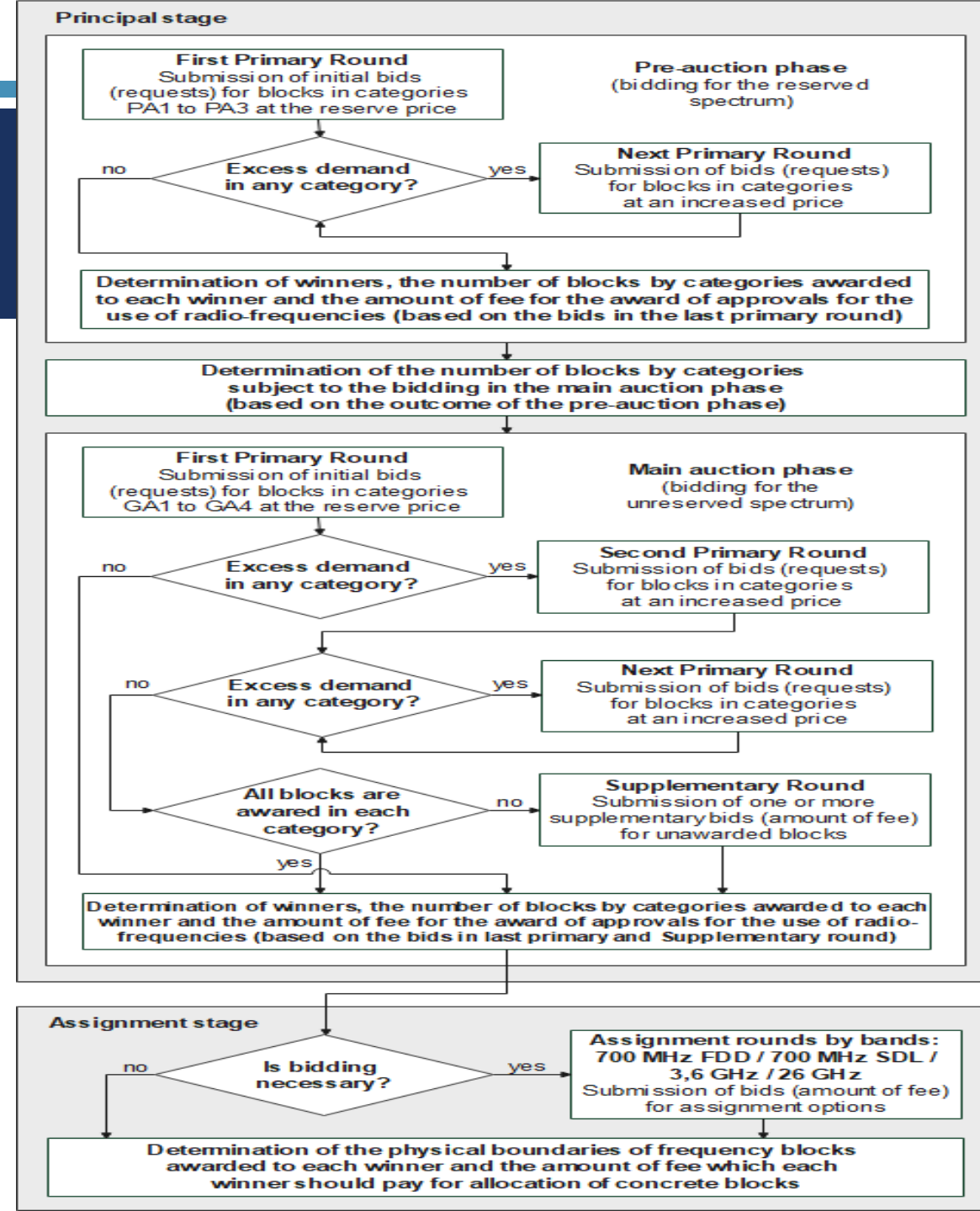
- ❑ bidding for the reserved spectrum (the pre-auction phase) envisaged for new entrants and
- ❑ bidding for the unreserved spectrum (the main auction phase) – all qualified bidders.

Pre-auction phase omitted (no new entrants)

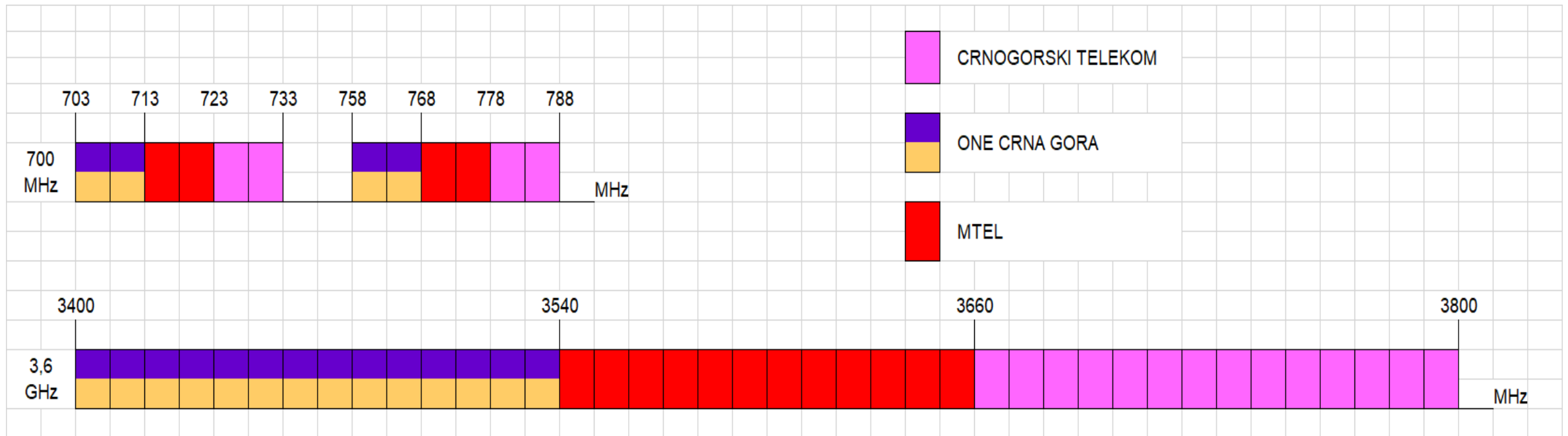
Main auction: combined format of a simple "clock" bidding (5 primary rounds were executed) in clock format and 1 supplementary bidding round in sealed bid format, conducted for the blocks unwarded after the last primary round of the main auction

Assignment stage determined which specific frequency blocks have been awarded in each band to each winner of the auction, one seal bid round for each band

167 AUCTION RULES



SPECTRUM ALLOCATIONS - AUCTION 2022



SPECTRUM AUCTION RESULTS AND REVENUES

Band	RF blocks awarded and revenues generated		
	ONE CRNA GORA	MTEL	CRNOGORSKI TELEKOM
700 MHz	2x10 MHz	2x10 MHz	2x10 MHz
	H1-H2 [703-713/758-768 MHz]	H3-H4 [713-723/768-778 MHz]	H5-H6 [723-733/778-788 MHz]
3.6 MHz	120 MHz	120 MHz	140 MHz
	L5-L28 [3420-3540 MHz]	L29-L52 [3540-3660 MHz]	L53-L80 [3660-3800 MHz]
Total amount of one-off fees [€]	2,977,998.00	2,750,148.00	3,108,000.00
Total amount of revenues generated for the Budget of Montenegro [€]	8,836,146.00		
Increase of the one-off fees in relation to reserve prices [€] / %	1,086,146.00 / 14%		

COVERAGE REQUIREMENTS AND 5G NETWORK DEPLOYMENT OBLIGATIONS

700 MHz band

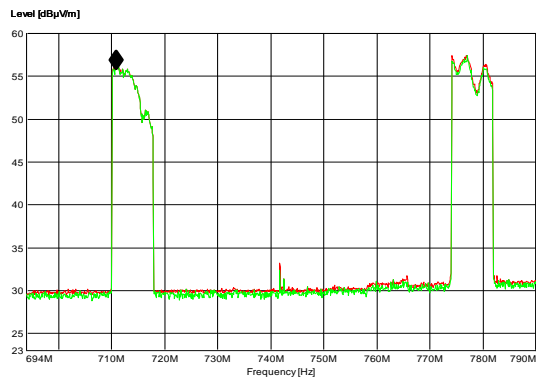
- at least 97% of the population (10/3 Mb/s) by the end of 2024
- at least 98% of the population (10/3 Mb/s) by the end of 2026
- five selected uncovered rural areas by the end of 2026
- all highways and intercity roads by the end of 2026
- all regional roads by the end of 2030
- aquatorium of Skadar Lake (Montenegrin part), Bokakotorska Bay and part of the territorial waters of Montenegro up to 1 nm from the coast by the end of 2026
- parts of national parks in Montenegro where the tourist infrastructure is located by the end of 2030

3.6 GHz band

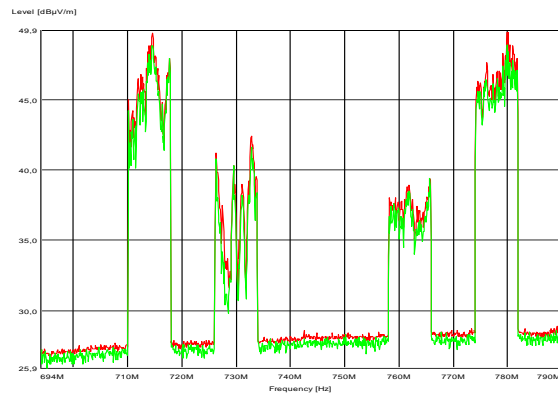
- at least 75% of the population (30/10 Mb/s) by the end of 2026
- at least 75% of the population (100/30 Mb/s) by the end of 2030
- 5G based on 3.6 GHz band in all cities by the end of 2024; 50% population by the end of 2026, all populated areas by the end of 2030

INTERFERENCE IN 700 MHz BAND FROM DTT ALB

Azimuth: 150,00 deg Polarization: HORIZONTAL
 Elevation: 0,000 deg Height: 50,00 m
 Marker: 711 MHz 55,9 dBµV/m

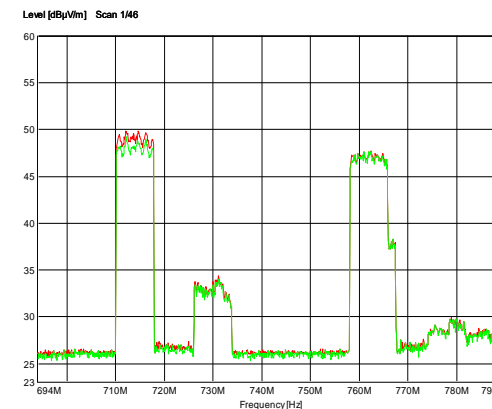


Podgorica - 2022



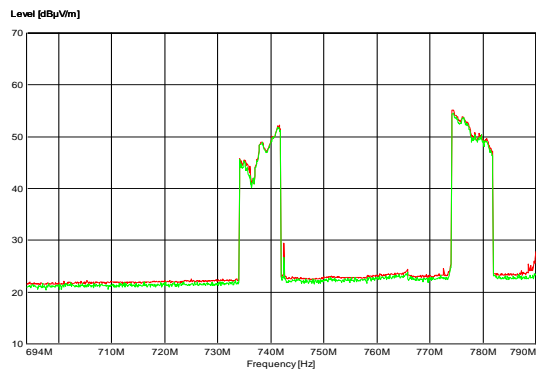
Bar - 2022

Azimuth: 181,00 deg Polarization: Horizontal
 Elevation: 0,000 deg Height: 30,00 m



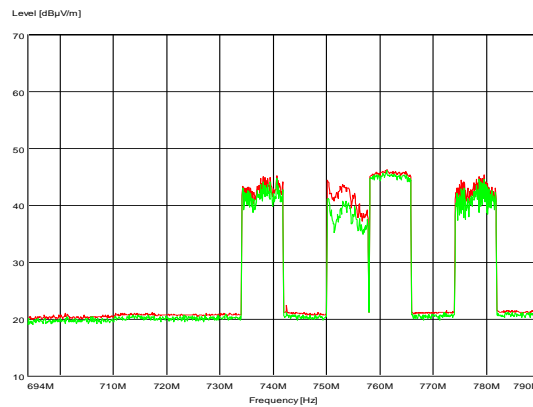
Ulcinj - 2022

Azimuth: 156,00 deg Polarization: HORIZONTAL
 Elevation: 0,000 deg Height: 50,00 m



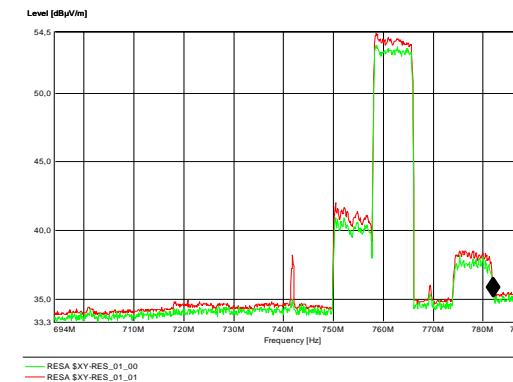
Podgorica - 2023

Azimuth: 150,00 deg Polarization: HORIZONTAL
 Elevation: 0,000 deg Height: 24,00 m



Bar - 2023

Azimuth: 117,00 deg Polarization: Horizontal
 Elevation: 0,000 deg Height: 10,00 m
 Marker: 782,1 MHz 35,2 dBµV/m



Ulcinj - 2023

CONCLUSIONS

- Award of licences for 5G pioneer bands by the means of spectrum auction is a complex process and requires a careful design of the RF allocation strategy in order to achieve expected objectives.
- Timely award of licences for RF use conducted in 2021 and 2022, enabled all MNOs in Montenegro to start the implementation of 5G mobile communication networks and service provision.
- Revenues for the budget of Montenegro generated as a result of the auction reflect the real market value of the spectrum.
- Substantial investments are expected from licence holders in order to fulfill coverage requirements and 5G network deployment obligations, which in the long term represents significant support for social and economic benefits.

5G SPECTRUM AWARD AND NETWORK DEVELOPMENT IN MONTENEGRO

Struga, North Macedonia, 30 May 2023



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THANK YOU FOR YOUR ATTENTION