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Electronic Communications Committee **CPG PTD**

PTD-3

Virtual meeting, 22-24 June 2021

Date issued: **14 June 2021**

Source: **Austrian Broadcasting Services (ORS)**

Subject: **Technical implementation status of 5G Broadcast: Vienna Field Trial**

Group membership required to read? (Y/N)

N

Summary:

This report presents results from the first phase of the 5G Broadcast field trial in Austria. It summarizes main results from simulation and measurements and compares the existing technology DVB-T2 with 5G Broadcast. The results show that

(i) 5G Broadcast enabled devices can be used for portable outdoor reception and dramatically extend the reach of terrestrial broadcasting,

(ii) 5G Broadcast compared to DVB-T2 can achieve a comparable performance and

(iii) 5G Broadcast enables innovation and new business models in the space of terrestrial broadcasting.

In the second phase, the 5G Broadcast field trial will focus on the ecosystem and new business models in the space of terrestrial broadcasting.

Even though 5G Broadcast is only at an early stage and improvements have to be made for a full operational use it will enable reception on mobile devices and thus dramatically extend the number of accessible users for broadcasters. This additional perspective – supplementary to existing DVB-T2 HTHP networks for fixed reception and portable indoor - clearly supports justification for a further use of the full sub 700 MHz spectrum for existing broadcast technologies until 2030 and beyond.

Note: This information will also be made available to EBU and other relevant European Standardisation Organisations in order to develop relevant standards for an ecosystem and respective consumer products.

Proposal:

The Austrian Broadcasting Services (ORS) invites PTD to

- Consider the information provided in this document
- Include the proposed text in Annex 1 in section 3.8 “Technical implementation of 5G Broadcast“ (or at another appropriate place) of the Draft CEPT Brief on WRC-23 on AI 1.5
- Include the information about the ongoing 5G broadcast trial in Vienna/Austria in Annex 2 as an Annex to the Draft Brief
- To consider our support of “no change” to AI 1.5 of WRC-23 based on the information proving the necessity of the band 470-694 MHz for further development of the terrestrial broadcasting service

Background:

Austrian Broadcasting Services (ORS), a subsidiary of the public service broadcaster ORF in Austria, decided 2019 to launch a field trial in Vienna, funded by the Austrian Digitization Fund and supported by the Vienna University of Technology. In the first phase until Q2/2021, the mobile transmission technology 5G Broadcast (i.e., FeMBMS and LTE-based 5G Terrestrial Broadcast) was compared with the current transmission standard for terrestrial television, DVB-T2.

ANNEX 1: CONSIDERATIONS AND CONCLUSIONS FROM THE VIENNA FIELD TRIAL

Austrian Broadcasting Services (ORS), a subsidiary of the public broadcaster in Austria (ORF), decided 2019 to launch a field trial in Vienna, funded by the Austrian Digitization Fund and supported by the Vienna University of Technology. In the first phase until Q2/2021, the mobile transmission technology 5G Broadcast (i.e., FeMBMS and LTE-based 5G Terrestrial Broadcast) was compared with the current transmission standard for terrestrial television, DVB-T2.

5G Broadcast will enable innovation and new business models in the space of terrestrial broadcasting.[1] Due to the IP-based character and its transparent payload approach with the capability of transporting common OTT streaming packets 5G Broadcast is a promising candidate to innovate linear terrestrial broadcasting. By using the same streaming technology via OTT and terrestrial broadcast it is possible to seamless switch between 5G Broadcast and OTT enabling new hybrid distribution scenarios for broadcasters.

Convergence between 5G Broadcast networks and 5G mobile broadband networks will **lead to new business models** and a **future-proof terrestrial distribution platform** for enhanced media services (linear and non-linear).

Within the first phase of the 5G Broadcast field trial in Austria the following **observations** have been made regarding the **technical implementation status of 5G Broadcast**:

1. **5G Broadcast enabled devices can be used for portable outdoor reception and extend the reach of terrestrial broadcasting.** The following conclusions could be made:
   - 5G Broadcast enabled devices can be used **for portable outdoor reception** and extend the number of accessible users for terrestrial broadcasting.
   - 5G Broadcast HTHP Networks are **a supplement for existing DVB-T2 HTHP networks** for fixed and portable indoor reception and **can coexist** with DVB-T2 in the sub 700 MHz UHF band.
2. **5G Broadcast can achieve a comparable performance as DVB-T2 in future.** 5G Broadcast is still under development, further improvements have to be made, and specifications should be studied under real conditions. Enhancements might include improvements of the C/N ratio (for example by introducing time-interleaving) and a higher signal robustness or data rate improvements by evaluating further approaches such as MIMO for standalone broadcast.

In a second phase, planned until 2023 the 5G Broadcast field trial in Austria will focus on the ecosystem and new business models in the space of terrestrial broadcasting.

Even though 5G Broadcast is only at an early stage and improvements have to be made for a full operational use it will enable reception on mobile devices and thus dramatically extend the number of accessible users for broadcasters. This additional perspective – supplementary to existing DVB-T2 HTHP networks for fixed reception and portable indoor - clearly supports justification for a **further use of the full sub 700 MHz spectrum for existing broadcast technologies until 2030 and beyond** to enable innovation and new business models for 5G broadcast in the space of terrestrial broadcasting.

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[1] REFERENCE TO THE ANNEX 2 IN THE DRAFT DOCUMENT

ANNEX 2: 5G BROADCAST VIENNA FIELD TRIAL

This annex presents the test setup in Vienna, summarizes main results from simulation and measurements, and compares the existing technology DVB-T2 with 5G Broadcast[2]. It further provides an outlook on developments in the testbed and necessary upcoming activities.

1.1 TEST SETUP

Table 1 shows key parameters of the Vienna test setup for 5G Broadcast. The test setup in Vienna consists of two different inputs for payload formats (RTP and HLS), two 5G Broadcast cores from different vendors and two transmitter sites (one HTHP and one MTMP site) with a site distance of approx. 16 km. The IP connection between the transmitters and the 5G Broadcast cores is realized via microwave systems (Figure 1).

Basis of the 5G Broadcast trial network in Vienna are two existing HTHP and MTMP broadcast transmitter sites operated by the ORS, which are also mainly used for FM, DAB+ and DVB-T2 transmissions.

Table 1: Test setup for 5G Broadcast trial Vienna – key parameters

Testing frequency range	734 - 744 MHz [3] 662 – 670/672 MHz [4]
Carrier bandwidths	5, 6, 7, 8, 10 MHz [5,6]
System	FeMBMS / LTE-based 5G terrestrial broadcast
Modulation mode	COFDM – QPSK / QAM
MCS	0 - 26
Payload format	RTP, HLS

Table 2 presents key parameters of the transmitter sites. Table 3 presents measurement setup information and Figure 1: Block diagram of the main components of the test setup

[2] LTE-based 5G terrestrial broadcast according to ETSI TS 103 720
[3] from January 2020 to June 2020 (license from 01.12.2019 to 30.06.2020)
[4] frequency change due to clearance of 700 MHz band from June 2020 up to end of test period (license from 01.07.2020 to 30.06.2021).
[5] 6, 7, 8 MHz as suggested in 3GPP WID RP-210835
[6] Based on coordination restrictions Wien 1 may use up to 8 MHz bandwidth only

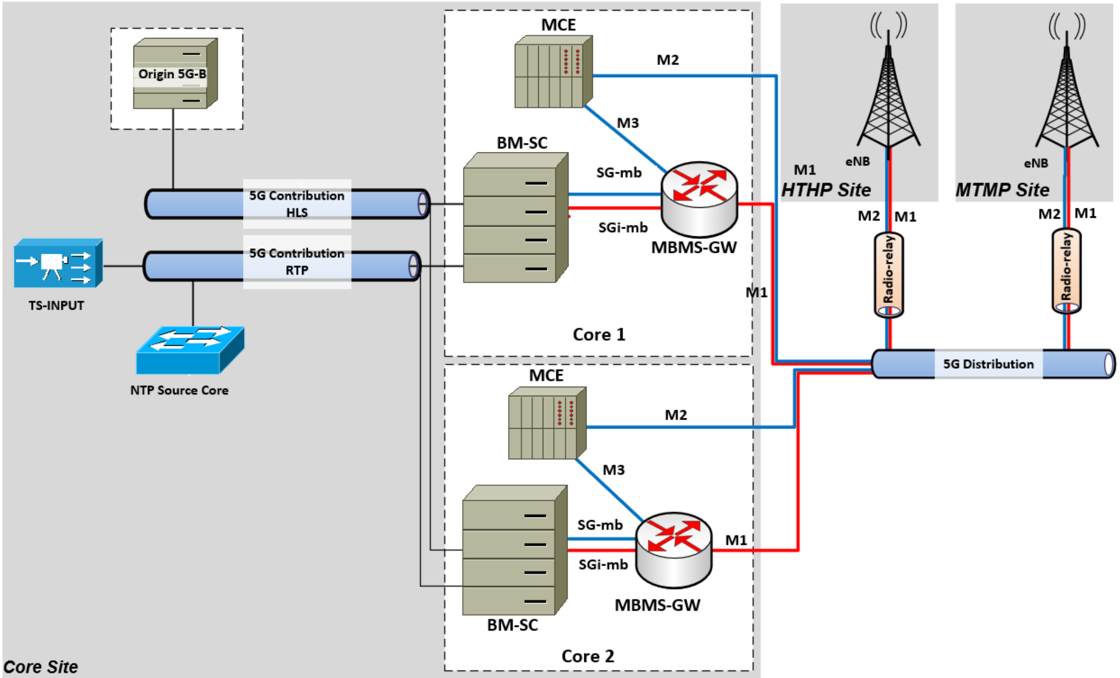


Figure 2 shows the trial area including transmitter stations, core locations and location of measurement points for stationary measurements.

Table 2: Test setup for 5G Broadcast trial Vienna – transmitter sites

Site name	WIEN 1 - KAHLENBERG	WIEN 8 - LIESING
Coordinates (WGS84)	016E20 02 / 48N16 36	016E17 48 / 48N08 11
Hight asl	485 m	217 m
Transmitter type	Rohde & Schwarz THU9	Rohde & Schwarz THU9
Transmitter output Power	3.400 W	1.000 W
ERP	40,0 kW	20,0 kW
Antenna hight	118 m	42 m
Antenna type	Kathrein 2 panels, 4 bays	Kathrein 1 panel, 2 bays
Polarization	vertical	vertical
Main direction	135 deg	10 deg
Beam tilt	4 deg	0 deg

Figure 1: Block diagram of the main components of the test setup

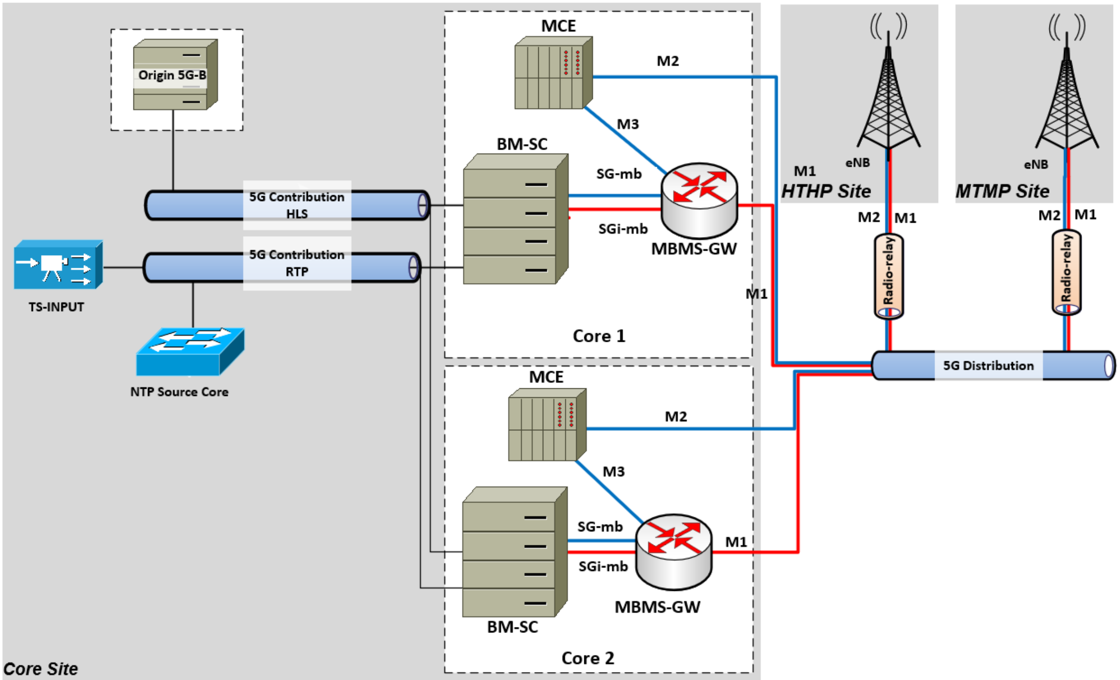


Figure 2: Trial area including transmitter stations, core locations and location of measurement points for stationary measurements

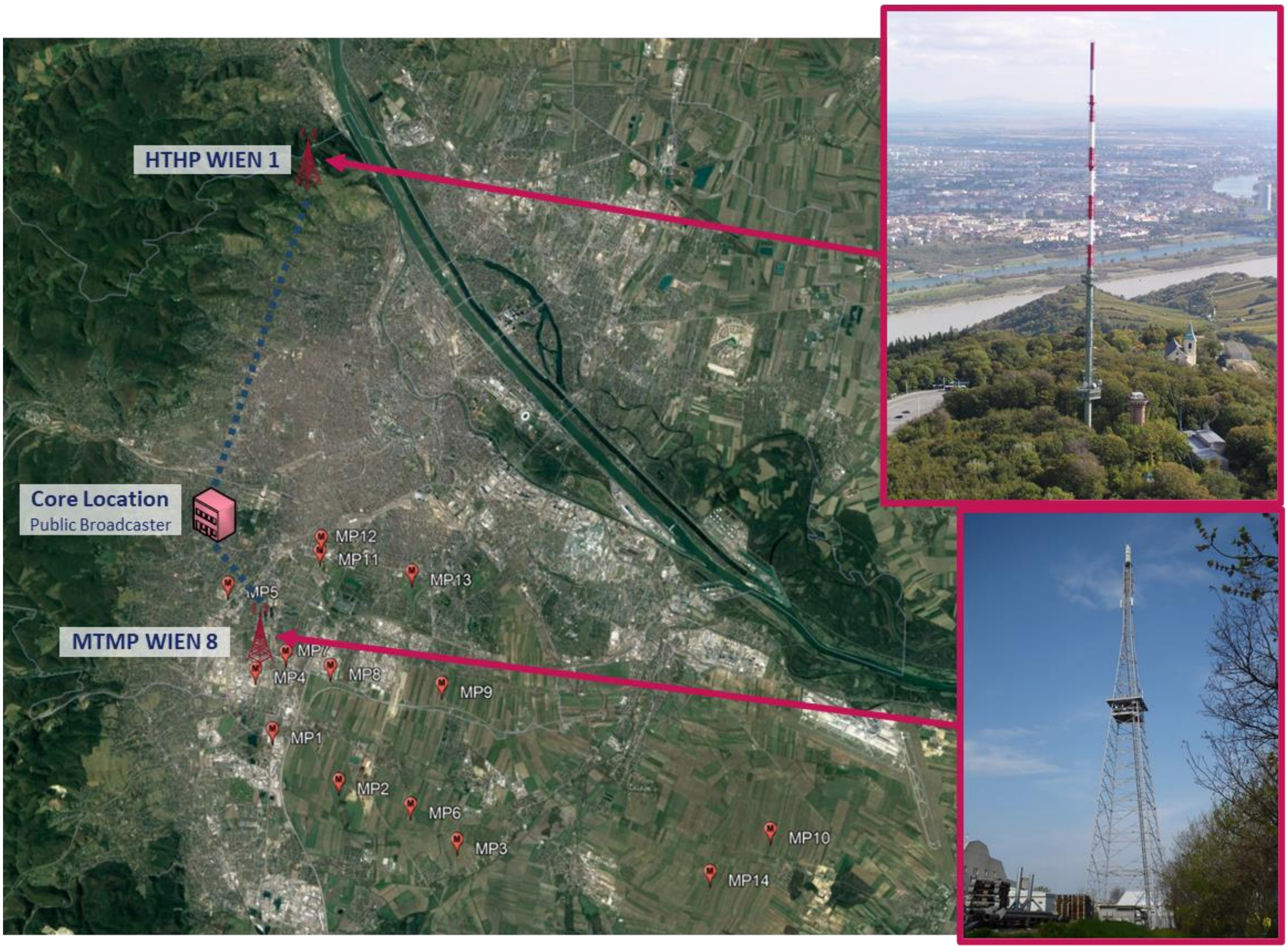


Table 3: Test setup for 5G Broadcast trial Vienna – receiver and measurements

Receiver for applications	TU-Braunschweig receiver
Receiver for measurements	Rohde & Schwarz TSMW Digital Receiver
Software for measurements	Kathrein LTE Scanner (Precision Wave)
Calibrated Measurement Antennas	Rooftop antenna Wisi EB22 (stationary measurements) Omni-directional antenna Schwarzbeck RE4590 (mobile measurements)
Receiving conditions	Stationary, mobile, and portable
Testing date	Phase 1 from January 2020 to March 2021

1.2 SIMULATIONS AND MEASUREMENTS

In cooperation with ORS, the Vienna University of Technology expanded their link-level simulator for FeMBMS and LTE-based 5G Terrestrial Broadcast capabilities. Simulations with a multitude of parameters were performed to calculate data rates and reception quality for different coverage situations. Table 4 shows relevant simulation parameters.

Table 4: Simulation parameters

Bandwidth	10 MHz
F	1.25 kHz
Carrier frequency	739 MHz
MCS	0, 9, 13, 16, 26[7]

ORS performed several measurement campaigns in Vienna with different MCS values under three types of channel conditions: Direct line of sight with (Rician) and without reflections (AWGN), Indirect line of sight (Rayleigh). The following parameters were recorded for all measurement campaigns: Signal power, Carrier interference plus noise ratio (CINR), PMCH BER.

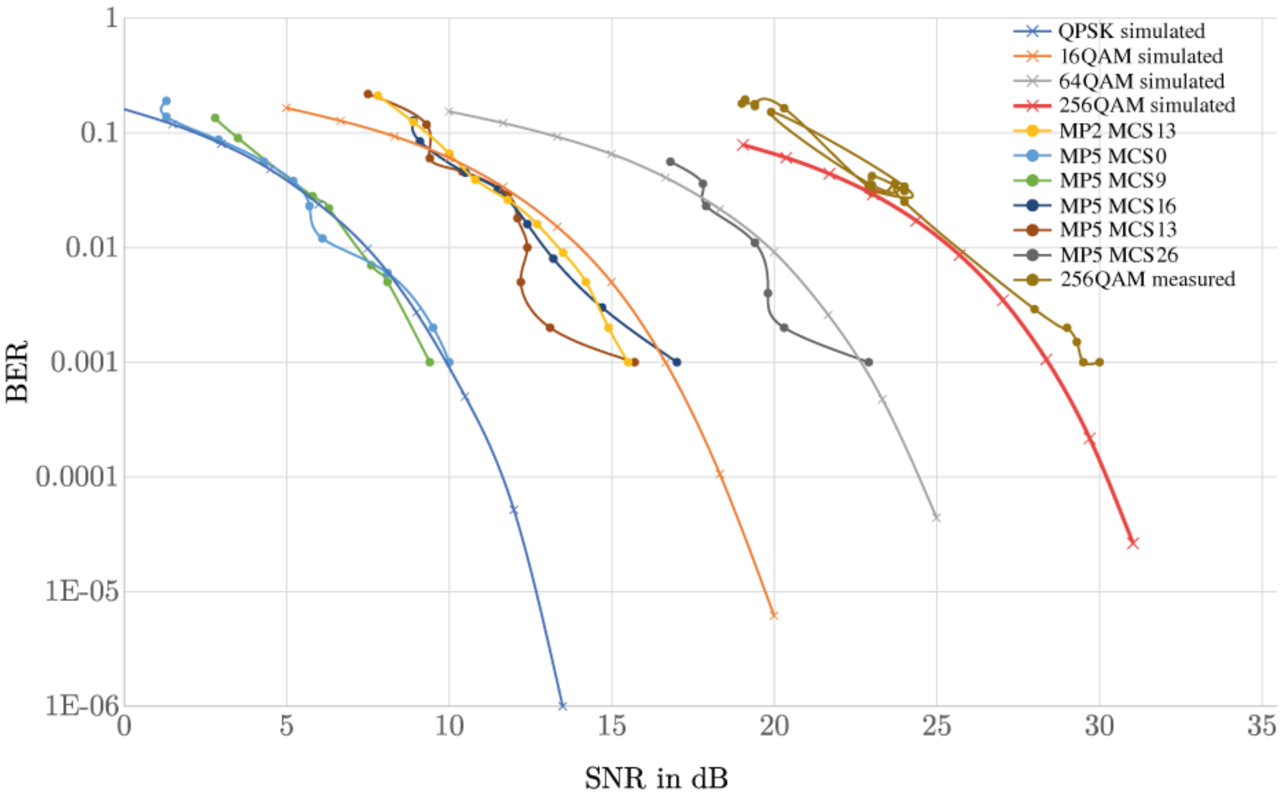
1.3 STATIONARY MEASUREMENTS

During the measurement, the CINR was artificially worsened with a noise source until the receivers lose the synchronization.

For a comparison with the link-level simulations, two representative measurement points MP2 and MP5 were chosen for further stationary measurements and the results compared with the simulations of the Vienna University of Technology (Figure 3). These two measurement points represents AWGN condition.

[7] Corresponding to 7.1.7.1-1 3GPP TS 36.213 Rel.14

Figure 3: Link level simulations compared to stationary measurements.



1.4 MOBILE MEASUREMENTS

Mobile measurements were performed with two different 5G Broadcast measurement vehicles and omni directional antennas to get an overview of PMCH BER in the field in mobile conditions (Figure 4). Figure 5 highlights the difference between MCS9 and MCS16 based on the same measurement track in Vienna.

Figure 4: Vehicles for stationary, high and low velocities for 5G Broadcast measurements

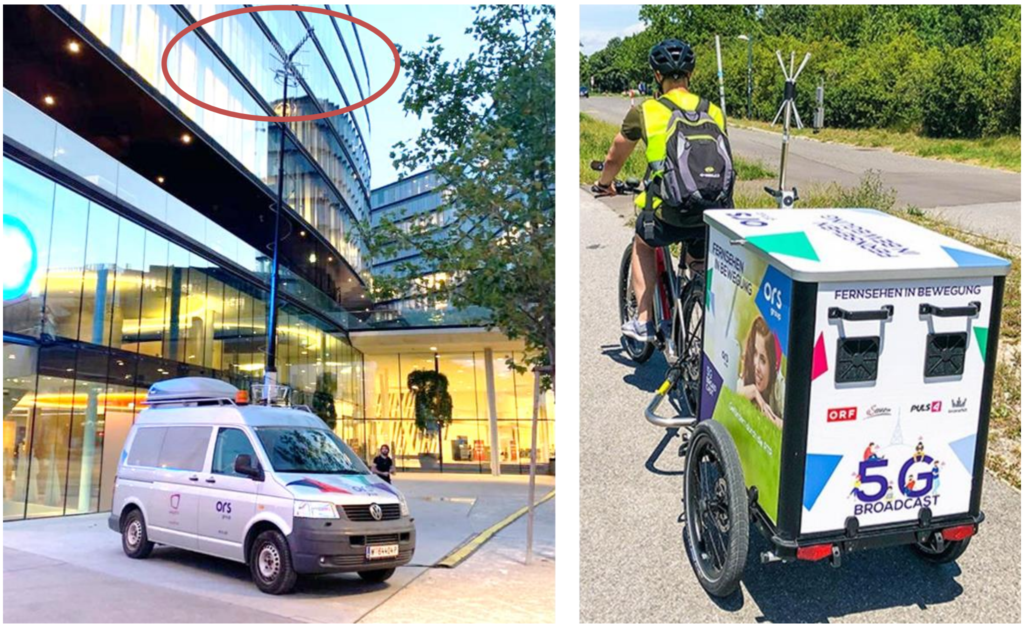
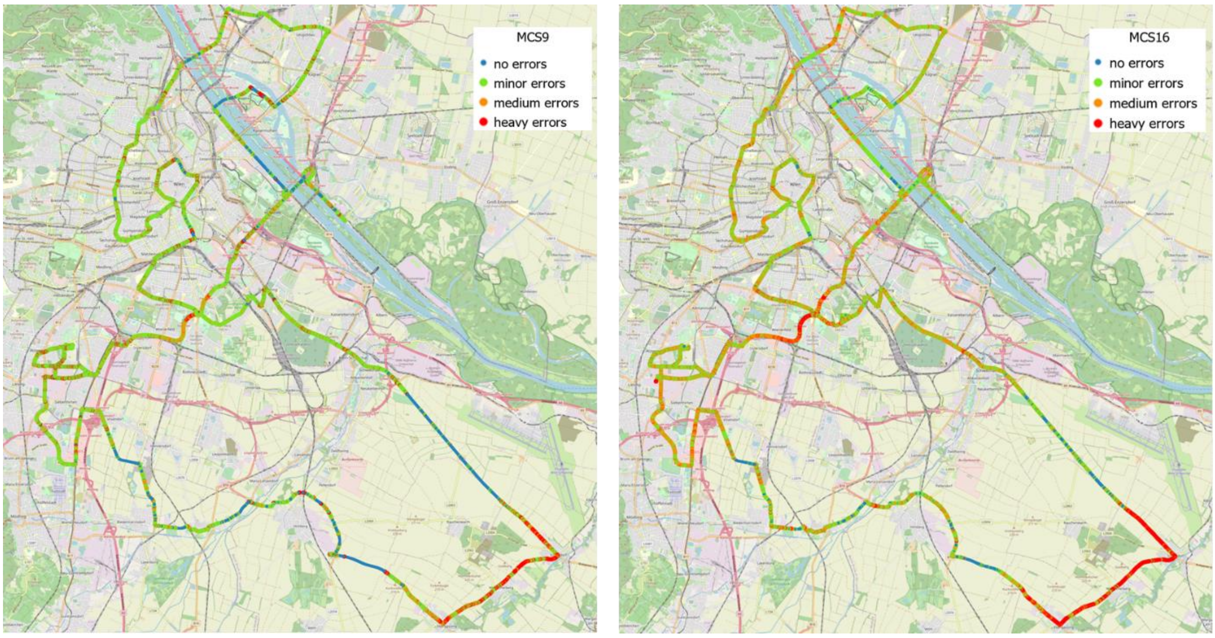


Figure 5: Difference between MCS9 and MCS16 based on the same measurement track in Vienna (Transmitter Wien 1 in operation)



1.5 DVB-T2 AND 5G BROADCAST

To get a first indication about the reception quality and efficiency of FeMBMS compared to the broadcast standard DVB-T2, stationary field measurements in the field were performed to determine the minimum C/N, carrier-to-noise ratio, for DVB-T2 and 5G Broadcast receivers. The same transmitter antenna for equal signal spreading was used for DVB-T2[8] and 5G Broadcast[9].

Table 5: Comparison of DVB-T2 and 5G Broadcast efficiency (data rate and min. C/N or CINR)

System	net data rate [Mbit/s]	net data rate per MHz [Mbit/s /MHz]	min. C/N or CINR [dB]
DVB-T2	27.7	3.5	18.1
5G BC MCS16	15.4	1.5	17.4
5G BC MCS26	30.7	3.1	24.1

1.6 CONCLUSION OF THE TRIAL VIENNA

Within the **first phase** of the 5G Broadcast field trial in Austria the following **three main results** were obtained:

1. **5G Broadcast enabled devices can be used for portable outdoor reception and extend the reach of terrestrial broadcasting.** The different simulations and measurements show that at different speeds

[8] DVB-T2 settings: modulation 64QAM, FFT 32k-ext, code rate 2/3, Guard-Interval 1/16, bandwidth 8 MHz, channel 41.

[9] 5G Broadcast settings: MCS16 and MCS26, 10 MHz bandwidth, center frequency 667 MHz.

(pedestrian, slow velocities up to 30 km/h as well as inner city traffic up to 110 km/h), reception of the linear terrestrial broadcasting in the urban Vienna area is very well possible for mobile devices. The following conclusions can be made:

- 5G Broadcast enabled devices can be used **for portable outdoor reception** and extend the number of accessible users for terrestrial broadcasting.
- 5G Broadcast HTHP Networks are **a supplement for existing DVB-T2 HTHP networks** for fixed and portable indoor reception and **can coexist** with DVB-T2 in the sub 700 MHz UHF band.

2. **5G Broadcast can achieve a comparable performance as DVB-T2 in future.** 5G Broadcast is still under development, further improvements have to be made, and specifications should be studied under real conditions. Enhancements might include improvements of the C/N ratio (for example by introducing time-interleaving) and a higher signal robustness or data rate improvements by evaluating further approaches such as MIMO for standalone broadcast.
3. **5G Broadcast enables innovation and new business models in the space of terrestrial broadcasting.** Due to the IP-based character and its transparent payload approach with the capability of transporting common OTT streaming packets 5G Broadcast is a promising candidate to innovate linear terrestrial broadcasting. By using the same streaming technology via OTT and terrestrial broadcast it is possible to seamless switch between 5G Broadcast and OTT enabling new hybrid distribution scenarios for broadcasters.

1.7 NEXT STEPS OF THE TEST TRANSMISSIONS

The **second phase** (planned until 2023) of the 5G Broadcast field trial in Austria will focus on the **ecosystem** and **new business models** in the space of terrestrial broadcasting:

1. Future **hybrid applications** of broadcasters with **interaction between 5G Broadcast and broadband** will be investigated to ensure that future needs of broadcasters are considered. **Convergence** between 5G Broadcast networks and 5G mobile broadband networks will **lead to new business models** and a **future-proof terrestrial distribution platform** for enhanced media services (linear and non-linear).
2. Currently, the development of the **5G Broadcast ecosystem** is mainly **prevented by the lack of** enabled 5G Broadcast **mobile devices** (i.e. updated firmware in modems and activated functionality in OEM devices). On the other hand, the infrastructure (core and RAN components) required for operational use is already available. Within the last months, ORS has taken a **first step** with the initiative of developing an **open source 5G Broadcast reception platform** (OBECA[10]) for the developer community and as **reference platform for** upcoming **mobile devices**.

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[10] https://github.com/Austrian-Broadcasting-Services/obeca-info

ABBREVIATIONS

5G BC	LTE-based 5G terrestrial broadcast (ETSI TS 103 720)
C/N	Carrier to Noise Ratio
FeMBMS	Further evolved Multimedia Broadcast Multicast Service
HTHP	High Tower High Power
LTE	Long Term Evolution
MTMP	Medium Tower Medium Power
MCS	Modulation Coding Scheme
MIMO	Multiple Input Multiple Output
OBECA	Open Broadcast Edge Cache Appliance
PMCH	Physical Multicast Channel