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Report

5G Broadcast - the Universal Radio and Television Mobility Platform

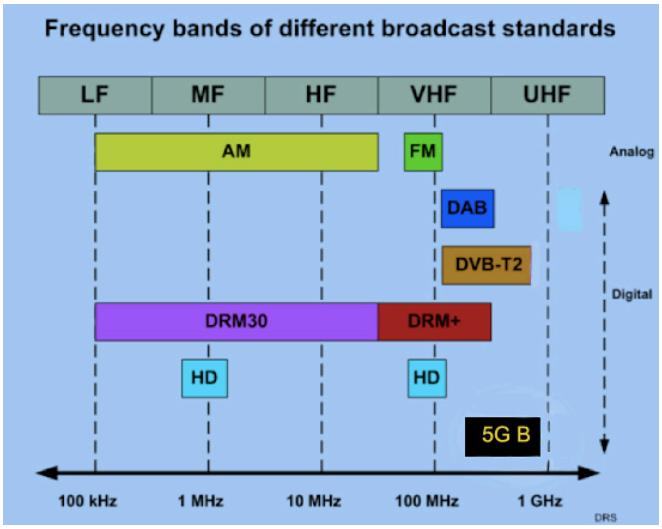
Ready to launch 2024: a universal broadcasting platform

The smartphone is a versatile communication tool. More than previously anticipated it is now being developed into the most important platform for radio and television listening and viewing. 2024 there are 7 billion smartphones in the world. Global 5G mobile subscriptions are projected to reach 1.6 billion by the end of 2023. Global mobile data traffic consumption per smartphone is expected to reach 56 GB per month at the end of 2029 according to Ericsson Mobility Report.

Media content is increasingly being delivered on Internet via fixed line and mobile IP networks. Audiences on the move will consume OTT[1] media on a range of mobile devices (e.g., smartphones and tablets), as well as in connected cars. Video and audio streaming (including radio and television channels) is now taking approximately 75% of the global Internet capacity.

The LTE-based 5G Terrestrial Broadcast System or ”5G Broadcast” might disrupt conventional broadcasting models and replace today’s digital terrestrial transmission systems as DVB-T2 and DAB. This could lead to a fierce competition between broadcast providers and telecom operators, but probably more a road of merging interests.

The UHF frequency band is a battleground for industry stakeholders



Recently, the ITU *World Radiocommunication Conference* (WRC23) in Dubai has deliberated what services should use the radio spectrum. One hot debate was about the use of the lower UHF band in Region 1 (Europe, Africa and the Middle East). Digital terrestrial television (DTT) services is currently located in this band as well as in VHF band III[2] .

The telecom industry values the UHF band as ideal to expand their mobile services. However, this use creates interferences with DTT. While mobile telecom services have several alternative high frequency band, DTT is

[1] OTT = Over-the-top (Broadband media reception)

[2] VHF III 174-230 (DVB-T2+DAB), lower UHF 470-694 MHz (DVB-T2)

more limited.

The EU and CEPT **(**European Conference of Postal and Telecommunications Administrations) supported a *secondary* allocation to the mobile service in the frequency band 470–694 MHz to be made at WRC-23, with a future agenda item 2031 to consider a possible upgrade to a primary allocation. This also became the final decision at the WRC23. Thus, the broadcasting sector is retaining its primary allocation of the UHF band in Region 1 for at least another decade.

5G will merge interests

There are good arguments for 5G terrestrial broadcasting as well as 5G Broadband. Emergency alert systems are crucial elements to reach out to the population before, during and after an emergency, crisis, or catastrophe. In principle, both broadcast and mobile networks can be used to convey messages and relevant information.

In any emergency, terrestrial broadcasting provides a key resilient network to reach out to citizens and support the work of emergency and rescue services, which often operate their own internal communication systems on the DTT infrastructure.

Terrestrial broadcasting services enable a direct connection, without gatekeepers, between broadcasters and citizens. Among all media, especially public broadcasters are a primary source of trusted information, thus greatly contributing to the required public debate to keep democracy healthy.

Broadcast providers point out that DTT's high population and territorial coverage allows broadcasters to play a key role in European societies, preventing leaving anybody behind: DTT brings a free-to-air and easy-to-use linear TV experience to all citizens, regardless of their age, their location or their economic, social and educational conditions.

Broadcasters in Euriope say it is essential to preserve the 'sub 700 band' exclusively for broadcasting, and to secure it well beyond 2030. According to *The Association of European Radios (AER)* a co-allocation, or loss, of these broadcasting frequencies would completely end terrestrial TV broadcasting and also pose an existential threat to terrestrial radio broadcasting via FM and DAB+2[3] in the medium term as the broadcasting costs of transmitters and tower rents for radio would suddenly rise.

However, DTT is losing ground as OTT as a platform for radio and television already is outpacing DTT and DAB-radio via smartphones and Connected Cars via fixed and mobile broadband as well WiFi access. In some European countries DTT household penetration is already low. In Sweden today less than 12 percent of the household receive television via DTT. Switzerland closed its DTT network in 2020. But in several other countries DTT will be retained for at least another decade.

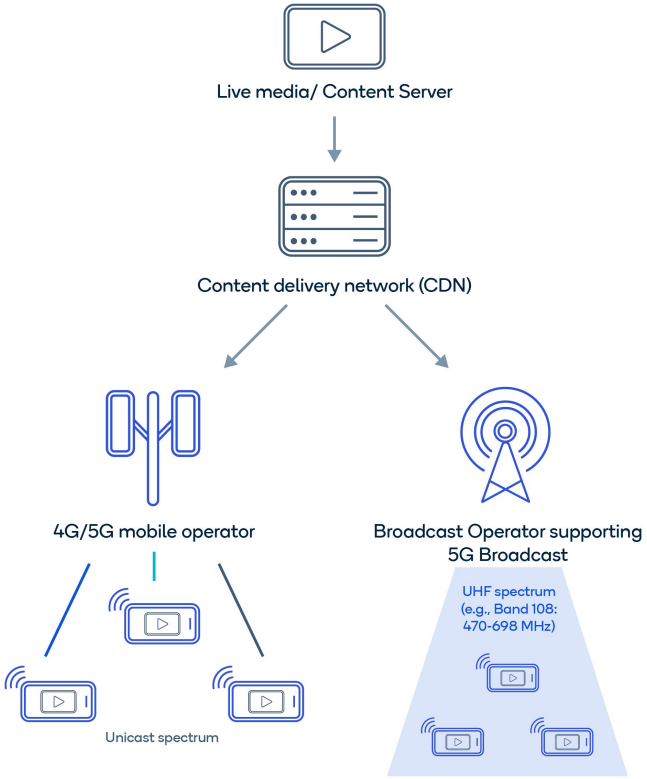
Still, broadcast providers will team with broadcasters to develop 5G Broadcast. This must be done as the smartphone is becoming the major portable device for broadcast television as well as for radio listening. Smartphones are not and will probably never be developed for DVB or DAB reception.

In any case we should anticipate that both broadcast providers and the telecom companies now will invest heavily in the 5G Broadcast technology.

Why 5G Broadcast?

5G Broadcast combines broadcast and unicast technologies, not only promoting a free and better user experience on mobile devices but also a more efficient use of the

[3] FM and DAB is not assigned in the UHF-band rather the lower bands VHFII and VHFIII respectively.



spectrum. 5G Broadcast has the potential to offer several advantages over traditional broadcasting systems when it comes to distribution quality and choice.

Firstly, 5G Broadcast can deliver higher quality video and audio content than traditional broadcasting systems, as it has more available bandwidth to transmit the content. This means that users can experience better picture quality, sound quality, and overall viewing experience.

Secondly, 5G Broadcast can offer more choice to users, as it can support a wider range of content formats, including 4K and 8K Ultra HD, Virtual Reality (VR), and Augmented Reality (AR) content. In addition, 5G Broadcast can also enable personalized and interactive services, such as targeted advertising, recommendation engines, and interactive features.

Thirdly, 5G Broadcast can offer more flexibility and scalability than traditional broadcasting systems, as it can be adapted to different use cases and scenarios. For example, it can be used to deliver live events and sports matches to large audiences, or it can be used to deliver on-demand content to individual users.

What is 5G Broadcast?

The *LTE-based 5G Terrestrial Broadcast System or* 5G Broadcast is a global terrestrial broadcast standard that was completed in 2020 as part of a 3GPP Release specifications. 5G Broadcast has been endorsed as a standalone terrestrial broadcast system via ETSI TS103 720 technical specification and most recently by ITU-R (article 1.38) where it is defined as a worldwide standard within ultra-high frequency (UHF) band. 5G Broadcast meets all 3GPP broadcast requirements. It is offering a downlink-only service intended for direct reception by all members of the general public across the service area, including the capability of free-to-air reception.

5G Broadcast technology enables an unlimited number of users to be reached with a single data stream and without any loss of quality. 5G Broadcast is based on the 3GPP Further evolved Multimedia Broadcast Multicast Service broadcast standard (FeMBMS). It enables the distribution of linear media content via large radio cells with a radius of up to 60

kilometres. A single data stream is broadcast using a high-tower high-power transmitter as well as low power tower ones. This possibility opens the way to new synergies and different collaborative scenarios between the broadcast and mobile ecosystem technologies.

In Europe 5G Broadcast will be operated on the the UHF frequency band 470-698 Mhz assigned for broadcasting as well as a secondary allocation in the ”700 MHz band” (694-790 Mhz) in which mobile communications have primary allocation.

All mobile devices within the coverage area of such a transmitter can receive the programmes distributed via this data stream. Since the signal is distributed only once to all receiving devices there is no excessive network utilization based on the number of receiving devices per cell and, therefore the quality of the programmes will not be reduced due to many devices.

An aim of 5G Broadcast is to give broadcasters the opportunity to provide linear television for mobile devices as well as for conventional televisions using a single chipset. The standard also allows the dynamic use of residual capacity (if available) for the transmission of non-linear content. However, the dynamic use of residual capacities would require some changes on the regulatory side and further developments.

With 5G Broadcast it is possible to use the same media formats for media distribution as for content delivery via the internet (OTT). This enables an easy way for seamless switching between distribution channels - e.g. 5G Broadcast and 5G Broadband - and results in the best media experience for the customers at all times. Furthermore, the linear content distributed with 5G Broadcast can easily be personalized by additional content distributed via internet and merged on user mobile devices. This possibility opens the way to new synergies and different collaborative scenarios between the broadcast and mobile ecosystems.

Another important key feature of FeMBMS is the reception of content without need of an internet connection. This Free-To-Air feature is important for public broadcasters which want to reach their customers without any restriction. However, adapted chipsets are required in mobile devices which enable the broadcast reception from HTHPs (high-tower high-power) with SDO (standalone downlink only) technology.

ATSC 3.0, also known as NextGen TV, is a broadcasting standard (USA) primarily designed for over-the-air (OTA) television broadcasting. It aims to deliver high-quality video and audio content to home televisions and mobile devices via terrestrial broadcasting. However, ATSC 3.0 is not matchable with mobile 5G Broadband and will not enable seamless switching for a channel between terrestrial and mobile transmitter networks.

5G Broadcast Provides High Consumer Value

5G Broadcast can also enable many attractive new use cases that bring considerable value to consumers:

5G Broadcast can bring new network efficiency when it comes to delivering zero-rated media content to the mass public. An example of this is from a livestream of a soccer match or a presidential debate. When this content is watched simultaneously by a large number of viewers over unicast cellular connections, it creates a huge burden on the network, reducing quality of service and increasing delivery costs for network operators. With 5G Broadcast, live content can be delivered to thousands or even millions of users without the same data being sent individually to each user using unicast.

The benefit of dynamically offloading to 5G Broadcast is a more robust, uninterrupted video playback user experience. Additionally, freeing up resources on unicast network benefits other users on the network who are using data for other activities. And for high-

mobility users who may move outside the 5G Broadcast service area, they can continue to receive the same content with their device seamlessly switching to the unicast network for uninterrupted playback of this content.

For seamless switching between unicast and broadcast on a mobile device the media player starts playback of content using unicast network. If player discovers same content is available on the broadcast network, it switches to the broadcast network seamlessly. When broadcast network becomes unavailable, media player goes back to unicast mode without interruption. This intelligent routing of data traffic happens automatically without any user intervention.

With 5G Broadcast, broadcast network operators and mobile network operators could collaborate for a hybrid scheme where highly popular, live content could be delivered through 5G Broadcast when available. In this scenario, content delivered over broadcast network would be classified as zero-rated and it would not count towards the consumer's monthly data cap — another welcomed benefit for consumers.

The broadcast network and mobile network operators can work together to address customers' needs in certain scenarios such as using 5G Broadcast infrastructure instead of unicast when there is broadcast signal and using unicast infrastructure when users moves out of broadcast network coverage.

During public emergencies and disaster events like earthquakes, wildfires, floods and tornados, our smartphone can turn into a life-saving device if it is robustly connected. In the unfortunate scenario that the cellular network becomes disabled from structural damages (e.g., in case of an earthquake), public authorities could still use the broadcast infrastructure to communicate with smartphones that support broadcast services. This is because the high-tower broadcasting sites are more physically resilient. This is a priority for many public safety agencies, and 5G Broadcast has become a prime candidate to enable services that can facilitate invaluable direct communications (e.g., sending emergency information and lifesaving instructions) with the ones who need it the most.

Recently one of the largest television networks in China, Sichuan Radio and Television, successfully showcased broadcast of TV, radio and emergency messages using 5G Broadcast. An emergency alert is generated and sent from broadcast core network using one of their terrestrial broadcast towers located in Chengdu.This demonstration showed how 5G Broadcast could be used by public safety agencies to alert public during major emergencies.

Events such as motorsports racing, Olympic games, football matches and large festivals pose a real challenge for mobile operators since large number of users in close proximity will share nearby limited network resources like a cellular tower simultaneously. For these scenarios 5G Broadcast could fill a much-needed role in ensuring all users in the area can smoothly stream high-definition video content from the event without overloading cellular towers nearby.

What is now going on in the world ?

5G Broadcast is a new technology that is still in stages of deployment. While trials and tests are being conducted in more than 20 countries since 2019, commercial deployments of 5G Broadcast are not yet widely available.

In 2021, the South Korea's three major mobile carriers launched 5G Broadcast services in Seoul, Busan, and other major cities. Broadcasters, including the *Korean Broadcasting System (KBS)* and *Seoul Broadcasting System (SBS),* have conducted trials in partnership with network operators.

In addition to South Korea, trials and tests of 5G Broadcast are being conducted in several

other countries, including *Austria, Czech Republic, Estonia, Germany, France, Italy Spain, the United Kingdom, the United States, Brazil, Colombia, China, India* and *Australia.* Additionally, there are more countries including *India, Malaysia* and *Turkiye t*hat are studying 5G Broadcast for potential trials in near future.

In Germany, for example, the 5G Media Initiative is conducting tests of 5G Broadcast in several cities, including Berlin, Munich, and Cologne. The initiative is a joint project between several industry partners, including broadcasters, network operators, and technology providers.

Similarly, in the United Kingdom, trials of 5G Broadcast are being conducted by the 5G RuralFirst project, which is exploring the use of 5G technology to deliver broadband connectivity and other services in rural areas.

China has been actively exploring 5G Broadcast as part of its efforts to advance digital broadcasting. *The China Media Group* (CMG), in collaboration with major network operators, have conducted several 5G Broadcast trials in various cities.

The national broadcaster, the *Australian Broadcasting Corporation* (ABC), has conducted trials of 5G Broadcast technology. The trials aimed to evaluate the feasibility and potential benefits of 5G Broadcast for delivering media content.

United States: In the United States, several broadcasters and technology companies have shown interest in 5G Broadcast. Trials and demonstrations have been conducted to showcase the capabilities of 5G Broadcast technology in delivering content efficiently and cost-effectively.

In addition to UHF spectrum plans, pan-European strategy and business models, the availability of reception facilities also plays a minor role. Currently, only a few basic prototypes of "smart" mobiles with 5G Broadcast capabilities are available for demonstration purposes, which have been demonstrated at various public events and closed tests.

The Prague tests

In recent days, one of these "smartphones" was also available for experimental 5G Broadcast tests in Prague. The broadcast content on the 700 MHz band in the 8 MHz channel consisted of three television stations - *CT Sport HD, CT 24 HD, CNN Prima News* - and radio station *CRo Radiožurnál.* The set transmission transmission parameters (roughly as a compromise between robustness and data capacity) enabled a data rate of approx. 11.839 Mbit/s.

Apparently, 5G Broadcast is ready for commercial deployment from early 2023. Standardization after the approval of Rel. 17 and the incorporation of 6, 7 and 8 MHZ channel grids into the 470-694/698 MHz TV band is largely complete. The addition of periodic samples for cell acquisition subframes is considered to enable TDM[4] operation for both 5G Broadcast and DTT (eg DVB-T2) frame structures.

Another key requirement for the deployment of 5G Broadcast services is the coexistence of reception in the same receiving device (smartphone) of both LTE-based and unicast 5G broadcasts. This affects both the base station and the end user device. The alpha and omega of 5G Broadcast's success will be its availability in mobile phones. That is also why, after the first smartphone prototypes, we are still waiting for a chip supporting 5G Broadcast according to the latest standards.

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[4] Time-division multiplexing (TDM) is a method of putting multiple data streams in a single signal by separating the signal into many segments, each having a very short duration. Each individual data stream is reassembled at the receiving end based on the timing.

> Overall, while 5G Broadcast is still in the early stages of deployment, it has the potential to revolutionize the way multimedia content is delivered over radio networks. As the technology continues to evolve, we can expect to see more countries exploring its potential and rolling out commercial deployments in the coming years. (televizníweb.cz)

5G Broadcast a game changer for in-car digital radio

Technical development of more modern systems for digital terrestrial broadcasting such as 5G Broadcast will now become a more qualified choice for digital radio in the car together with 4/5G broadband. Besides this, the analogue FM system will remain for several decades because it is a well-established standard in all countries with a robust technology for emergency preparedness with a good transmitter range.

Although 5G Broadcast is primarily developed as a platform for television, the system is equally useful for radio. With this, attempts to establish the DAB system (DAB+) for terrestrial digital radio can now be seriously questioned. DAB+, has a more limited mobility range, limited sound quality range, channel space limiting choice and less robustness. DAB+ is significantly less flexible than 5G Broadcast.

The European Electronic Communications Code (EECC 2021) contains a provision that all radio equipment integrated into a new passenger car (not buses, trucks, etc.) placed on the market for sale or hire in the Union must be able to receive digital terrestrial radio. This provision was seen as an advantage by DAB system stakeholders who have promoted this system since 1995.

Now car manufacturers will be able to choose to deliver new cars with 5G Broadcast instead of DAB+ without at the same time overriding the EECC provision.

Can existing DAB networks be used for 5G Broadcast? The Swedish company *Progira* has investigated whether the DAB network in Denmark can be used to transmit 5G Broadcast. Regarding the capacity provided, it is concluded that it will not be easy to provide high capacity indoor handheld reception using existing broadcast infrastructure.

For handheld indoor reception, the capacity provided would be limited to about 3-4 Mbit/s, which is at least further away from the transmitters. While targeting handheld outdoor or mobile reception it would be possible to provide acceptable reception quality up to around 10-15 Mbit/s. To provide higher capacity, additional infrastructure is required, which will inevitably increase the transmission cost. Broadcasters should carefully consider whether 5G broadcasts via the DAB network can be profitable.

5G Broadcast provides considerable room for more channels by making the bandwidth of 600 MHz 8 MHz compared to DAB's 1.5 MHz on the 200 MHz band. An important experience during the tests carried out in Prague with 5G Broadcast in a car is that the reception of image and sound is significantly more stable and free of so-called drop-outs than for conventional digital terrestrial broadcasting.

Is 5G Broadcast ready to be launched?

The Global LTE/5G Broadcast Market is expected to be valued at USD $1.8 billion by the end of 2029, growing at a compound annual growth rate of 9.9% from 2021 to 2029, according to a recent study by Adroit Market Research.

For broadcasters, 5G Broadcast can unlock access to billions of devices while bringing new experiences and benefits to consumers in both developed and emerging countries. Among broadcast partners, there is significant interest to learn and get started with 5G Broadcast.

Broadcasters from *Germany, France, Ireland, Italy, the Netherlands* and *Austria* have signed a joint declaration of intent on 5G Broadcast. A joint European roadmap defines the further milestones for a possible introduction of 5G broadcast-based services as a supplement to existing DVB-T installations. The goal is to work together on activities to further define broadcast services and opportunities and their validate business models. *Bayrische Rundfunk, France Télévisions, NPO, ORF/ORS, RTÉ, RAI* and *SWR* have signed and are now jointly setting the pace.

Conclusions

5G Broadcast, together with 5G Broadband, will become a major global improvement for digital distribution of radio and television. The gradual transition from today's systems will take quite some time but it is obvious that major broadcasters must be involved and committed from Day 1.

For too long broadcasting and online have been considered in opposition, and not complementary. The option of combining broadcasting and online must be kept to the fore; we must use both broadcast and online technologies in a sustainable and smart way to ensure that PSM (public service media) organizations keep control over future distribution in their own hands, writes Antonio Arcidiacono, EBU Director of Technology & Innovation in a blog essay.

The deployment and adoption of 5G Broadcast is still in early stages, and there are additional technical, regulatory, and commercial challenges that need to be addressed before it can become a mainstream technology for broadcasting. But the system has now been on test in several countries for more than five years and is set for operation quite soon. The challenge at the moment is to achieve the win-win situation; to enable a common technical and economic platform in order to merge the interests of the major stakeholders; the broadcasters, the broadcast providers and the telecom industry.

The market is looking forward to introduction of the chip enabling 5G Broadcast reception of radio and television in mobile devices and in-car receivers. It has been reported that this chip will be introduced in 2024. Then a 5G Broadcast/5G Broadband success will be a significant boost of consumer value for viewers and listeners world wide. This will involve all broadcasting sectors; public, commercial and community radio and television.

(Sources: *EBU, Südwest Rundfunk, ORS Austria, 5-MAG, Qualcomm, Rohde & Schwarz, Televizniweb, RedTech Magazine, TelcoNews India, Ericsson, The Association of European Radios, Swedish Telecom Authority, ITU, Clean Feed*)

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