LINEAR TELEVISION BROADCASTING OVER 5G NETWORKS, PART 2: REGULATORY AND BUSINESS CONSIDERATIONS

ABSTRACT

This article addresses having a supporting regulatory and licensing framework, as well as having a viable business case for 5G based broadcasting.

It is important to note that this article focusses on the terrestrial delivery of *linear television services* over 5G networks. These linear television services are typically delivered by High-Power High-Tower (HPHT) networks, commonly referred to as terrestrial broadcasting networks, and are often Free-To-Air (FTA). The delivery of Video-On-Demand (VOD) services are not addressed in this article.

In an associated article of both authors, titled *Linear Television Broadcasting over 5G Networks, Part 1: Spectrum Considerations*, the spectrum demands for carrying linear TV services over 5G are addressed separately.

INTRODUCTION

Renewed efforts from the telecom and broadcasting industry to deliver linear television services using mobile cellular technology networks have recently gained traction again. Dating back as far as the early 2000s, technologies such as DVB-H, MediaFlow, T-DMB and ATSC-M/H had limited business success. The capability to deliver linear television services over FeMBMS enabled LTE/5G networks, as defined in 3GPP releases 14/16 and labelled 5G Broadcast (5G BC), may be more promising. The definition of FeMBMS now includes additional 5G numerologies and significantly larger OFDM Guard Intervals to allow networks to operate in Single Frequency Network (SFN) modes.

Current activities within the Release 17 specifications include some new system features which can operate in parallel with 5G BC features. One prominent new feature is the Multicast and Broadcast Service (MBS). MBS provides switching the available carrier capacity automatically from unicast to broadcast or multicast mode. MBS minimizes the required capacity for serving users who are simultaneously streaming the same video or rich media content, including linear television services.

Preparations for the World Radio Conference of 2023 (WRC-23) are now well underway as the industry currently debates the possibility of migrating large parts of terrestrial television services to 5G networks. WRC-23 Agenda Item 1.5 addresses possible changes to the use of the 470 - 694 MHz band in ITU Region 1 to allow 5G service operation. The USA, in ITU Region 2, has cleared 84 MHz of digital television (DTV) spectrum in the UHF 600 MHz band for mobile use. It is noted that for ITU Region 3, the 600 MHz band is not being considered in the forthcoming WRC-23.

Given this background of new 5G technology developments and the global spectrum management agenda of WRC-23, this article addresses having a supporting regulatory and licensing framework, as well as having a viable business case for 5G based broadcasting.

REGULATIONS FOR TV OVER 5G NETWORKS

Traditionally regulations of telecommunication markets address technical and market-related issues. Content carried over telecommunications networks has been considered a private matter: operators are supposed (also by their customers) to only carry traffic. In regulatory terms, this is known as *"mere conduit"* principle. Consequently, MNOs are unfamiliar with content requirements in their licensing and regulatory framework.

With the convergence trend of telecommunication networks, also carrying broadcasting services, additional FTA regulations will have to be included in the licensing and regulations of MNOs. This would especially apply under a scenario where the traditional broadcasting networks would be (partly) replaced by 5G networks.

It is important to note that we stress that regulations for FTA services are additional from the perspective of the MNO. MNOs will primarily deploy 5G networks for facilitating the unicast traffic growth as well as new Internet-of-Things applications. These additional regulations would have to address protecting the *distribution* of FTA services.

FTA services are often defined in a Broadcasting or Media Act (and Code of Conducts), stipulating the number of national/regional services, editorial content requirements per service, and advertising limits. Depending on the applied licensing framework, such content requirements are enforced through the terms and conditions of the

broadcasting or *service* licence for the broadcaster or service provider.

However, FTA services are also regulated in terms of their *distribution*, including must-carry rules, their population coverage, service availability, picture quality and transmission/encoding/ encryption standards. These FTA network requirements are not common for MNOs.

MUST-CARRY OF FTA

In its day-to-day operations the MNO is constantly balancing its traffic over its networks and available spectrum. MNOs also having 5G BC will also balance their traffic between unicast and broadcasting mode. Regardless of whether this rebalancing between unicast and broadcast traffic is automated (MBS), for broadcasting mode the MNO will allocate a part of the available capacity to the broadcasting service. Consequently, the MNO will have less capacity available for unicast traffic.

Unregulated, such traffic balancing will be driven by the profitability of both services. However, for FTA services, which must be carried on a 24/7 basis, such capacity allocation to broadcasting mode would be permanent.

In addition, MNOs offer access to their services through their customer management system and SIM card. Although FTA services can be made available without payment through any customer management system, it should be checked if such system solutions legally comply with the definition of FTA in the relevant Act.

As mentioned in the Introduction, in the past MNOs have experimented with the delivery of linear television services over their mobile networks (for example LTE/eMBMS). These broadcasting services were primarily intended for delivery at handheld devices with relatively small screens. As demonstrated in the authors' associated Part 1 article [*see ABU Technical Review, Issue 289, pp. 7-10, https://www.abu.org.my/TR289MAR2022*] , the delivery of UHD services to large screens over 5G unicast is not feasible. Hence, any FTA must-carry rule including (U)HD services, will need to be delivered over 5G BC, again limiting the MNO's traffic management options.

Hence, National Regulatory Authorities (NRAs) considering 5G based FTA broadcasting, will have to take these must-carry and FTA requirements into account and arrange for it. Clearly such regulatory interventions are intrusive on the current MNO's business operations, especially when licences are already running.

FTA SERVICE AVAILABILITY

FTA services delivered over 5G networks need extra safeguards for having these services available in time of national emergencies or disasters. As the 2011 tsunami in Japan demonstrated, during these times of national distress, the mobile network services were not available, mainly due to traffic overloading.

Consequently, the NRA should regulate how the FTA services, needed to disseminate critical news and information, are facilitated in 5G networks. A 5G network balancing traffic between unicast and broadcasting mode will not suffice as the whole system would still be exposed to traffic overloading. Hence, the FTA services should be permanently allocated to broadcasting mode and traffic balancing between unicast and broadcasting mode should be excluded.

Whether such a permanent allocation of FTA services to broadcasting mode is sufficient to warrant enough services availability during national disasters, needs to be technically investigated.

FTA PICTURE QUALITY

For the different picture resolutions, a minimum bitrate is required. FTA services carried over 5G networks will need to meet these minimum bitrates. It is important to note that when FTA services are carried over 5G networks (or any other broadband network) in unicast mode, two market roles or parties are involved: the broadcaster/service provider and the network operator. The broadcaster may deliver its services in UHD quality to the network operator. However, the network operator may not guarantee sufficient network capacity for delivering this UHD quality at the viewer's premises or device.

Managing the Quality-of-Service (QoS) for video services is more challenging, considering that several parties are involved, such as international Tier-1 network operators, Content Delivery Network (CDN) providers and local Internet Service Providers (ISPs). ISPs tend to guarantee the availability of a defined transport capacity, shared between the different services carried over the 'data pipe', but they do not guarantee this QoS per service.

Recent developments show however that video service providers agree with ISPs that their services have priority over other traffic, so as to ensure a minimum broadband speed is made available to their subscribers.

In many countries, prioritising internet traffic, including over mobile networks, is regulated under *net neutrality* rules. Under these regulations network operators should manage all data-streams according to the same rules. Deliberate blocking or throttling of (audiovisual) streams of third parties is not acceptable.

Hence, MNOs carrying FTA services over 5G unicast, will have to comply with net neutrality regulations, as this FTA traffic would be defined as internet traffic. MNOs managing traffic in such a way that HD or UHD quality would be guaranteed, for example by throttling other traffic, may well conflict with the net neutrality rules in their jurisdiction.

MNOs carrying FTA services over 5G BC seem to be exempt from these net neutrality regulations. However, (automatic) traffic balancing between unicast and broadcasting mode (MBS), may need to be restricted as this traffic balancing would constantly change the traffic type between broadcasting and internet traffic. Alternatively, the net neutrality regulations should be adjusted to facilitate 5G MBS.

FTA TRANSMISSION AND ENCRYPTION

Viewers can access FTA services without a service charge as these services are commonly financed by advertising income. Under such a business model viewers are also able to purchase receivers independently from the service or network provider. To protect consumers from purchasing non-compatible receivers, both the transmission and receiver side are regulated.

The broadcasting network operator needs to deploy a network in compliance with a stipulated transmission standard, like DVB-T2 or ATSC 3.0, and encoding method, like AVC (H.264) or HEVC (H.265). By means of equipment type approval, possibly in combination with import regulations, the NRA facilitates that standard-compliant receivers are sold in the various retail channels.

For FTA services delivered over 5G unicast the transmission standards are IP-based standards. A wide range of IP-based streaming solutions are applied in the market, like HLS ABR (Apple) and MPEG-DASH, which can be combined with various encoding methods such AVC, HEVC and proprietary encoding methods. These different streaming solutions tend to lock-in the viewer to specific receiver devices (such as Apple TV) and/or service providers (such as downloadable software applications from Netflix or Spotify).

IP-based viewing of audio-visual content is mostly paid-for or subscription-based by which the service provider ensures that the correct app and drivers are installed on the viewing device. In this way, the viewer is protected from having a non-compatible device.

Delivering FTA services over IP-based systems may still need additional regulations for protecting the viewer from device/service provider lock-in. For example, smart-TV manufacturers tend to limit the apps that can run on their sets. Stipulating standardisation and having an open platform for TV-apps will reduce the risk of customer lock-in.

From a regulatory stance, FTA services delivered over 5G BC is no different from having these services delivered over a DTTB platform. Consequently, the 5G BC standard and video coding should be stipulated for TV manufacturers to incorporate in the TV set. In addition, the NRA needs to decide if it would stipulate the 5G BC as an additional standard to any incumbent transmission standards (such as DVB-T2 or ATSC 3.0) in the market. Obviously, 5G BC, as an additional standard, would increase the cost of any television receiver.

Finally, the NRA should consider the situation of delivering Pay-TV services next to FTA services over 5G BC. Like for DTTB enabled smart-TV sets the regulator often stipulates that the Conditional Access (CA) system cannot be embedded in the smart-TV set as to prevent the situation where the smart-TV set is dependent on the applied CA system and hence the service provider. Similarly, the NRA should avoid the situation for 5G based broadcasting, that the smart-TV set will be MNO dependent.

BUSINESS CASE FOR TV OVER 5G NETWORKS

The advantage of a global standard (5G) for both unicast and broadcasting services, would be of having cheaper networks and receivers due to larger economies of scale. However, as MNOs and device manufacturers are free to select what part of the 3GPP standards they will implement, it is not a given that 5G BC (and MBS) will be implemented. Hence the marginal costs of having 5G BC (and MBS) in mobile networks and devices should be considered, against the added value of having an FTA service bundle. It should also be considered if a 5G based implementation would result in cheaper TV sets and STBs as compared to DTTB sets and STBs.

5G BC FOR CONNECTED DEVICES

For delivering 5G BC to mobile devices, several studies have been conducted for the optimal network topology. These studies have shown that broadcasting networks (with their main sites being HPHT sites) are important to reduce the overall number of sites that are needed. The mobile network sites (LPLT sites) are important to cover urban areas. In other words, any 5G BC deployment would result in a mixed deployment of broadcasting and MNO sites.

For the broadcasting sites a 5G BC introduction would result in a replacement of some broadcasting equipment, mainly the exciter part of the transmitter. Such replacement costs are considered minimal. Hence, the number of MNO sites needed in the urban areas is critical in establishing the marginal costs. Every cell (gNB) will need to include equipment that can transmit the appropriate 5G BC signals. This will require CAPEX to implement at both the gNB and core network levels. However, many of the required functions will be software based and should not require significant additional costs over non-BC capable systems.

We assess that the key CAPEX driver will be number of additional transmitters to generate the 5G BC signals. As this 5G BC transmitter equipment is also OFDM based equipment, it can be assumed that 5G equipment will be comparable to low power DTTB transmitter equipment. CAPEX for low power OFDM DTTB transmitters range between USD 10k to 30k. Assuming the USD 30k figure and having a redundant transmitter, this would result in additional CAPEX for 1,000 cells (for covering a large city of 5m people) of approximately USD 60 million. Assuming a 10-year linear depreciation method and cost of capital (WACC) of 15% this would result a required annual revenue above USD 12m for a single MNO.

These required additional revenues should be generated by offering linear television services, including FTA and any pay-tv services, next to VOD unicast services. Market surveys show that most content consumed with internet connected devices is short-form video content. Longer form content, such as linear FTA content, is relatively small. **Table 1** shows the share of video views by length when consumed on internet connected devices.

Hence, without a fundamental change of viewing behaviour, the additional revenues to be expected from offering linear FTA services is expected to be small. If the various television broadcasters would select different MNOs

Table 1: Share of video views by length (Q4 2020). *Source: Brightcove*

Content type	0-5 min	6-20 min	21-40 min	41+ min
Corporate Communications	71%	22%	4%	3%
Entertainment	71%	7%	8%	15%
Marketing and Sales	82%	8%	4%	6%
News	90%	3%	2%	4%
Retail	97%	2%	1%	1%
Sports	89%	4%	1%	6%

to carry their services and with 3 MNOs in a market, at least USD 36 additional revenues from linear FTA services would need to be generated. Given the current viewing behaviour this seems doubtful for a city of 5m people.

At this point, we have not even considered the additional costs of having 5G BC (and MBS) enabled handsets. Experiences in the past with DVB-H, MediaFlow and (F) eMBMS have shown this to be extremely challenging, even with a marginal cost of only a few dollars per device. In other words, given that current video viewing on mobile devices is all unicast delivered and that any future growth can still be facilitated with additional spectrum, there seems to be little business incentive for MNOs to introduce 5G based broadcasting at a large scale.

5G BC FOR TV SETS AND STBS

The markets for smart TV sets and STBs are very mature and global markets, with highly efficient production lines, delivering cost effective implementations of DTTB standards. 5G BC is not fundamentally different from 2nd generation DTTB standards and therefore their implementation in smart TV sets and STBs will be at best similar in cost terms. A 5G BC implementation in smart TV sets and STBs is likely to require system changes as the 5G unicast traffic is absent or managed differently as compared to a mobile device.

As with any migration to a new transmission standard, such was the case from analogue TV to DTTB and from 1st to 2nd generation DTTB, a 5G BC introduction would require a transition period in which both the DTTB and 5G BC standards are supported in smart TV sets. This seems unlikely as there is no technical gain for having the new 5G transmission standard, in contrast with the migration from analogue TV to DTTB and from 1st to 2nd generation DTTB.

CONCLUSIONS

Having 5G based broadcasting as an alternative to DTTB for delivery of FTA services, would require NRAs to impose additional regulations on MNOs, requiring MNOs to permanently allocate a part of their network capacity to 5G BC. In addition, other regulatory measures would be required to protect viewers from customer lock-in and purchasing non-compatible receivers. The business case for delivering FTA services over 5G BC, as an additional business to delivering VOD services over 5G unicast, seems feeble because the additional FTA revenues for MNOs are deemed to be relatively small as most video consumption on connected devices is viewing of short-form video content (delivered over unicast). This viewing behaviour has not changed since the introduction of LTE based MBMS services and therefore there is little reason to assume 5G based broadcasting would prove a better business case this time.

Hence, 5G based broadcasting should not be viewed as a DTTB replacement. A better model would be to combine DTTB broadcasting with 5G network services, whereby DTTB would focus on FTA service delivery, albeit with a smaller number of services in UHD quality. 5G networks would continue to deliver VOD services, whereby 5G BC/MBS can be deployed as an advanced traffic management tool to further increase the capacity of mobile networks.

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