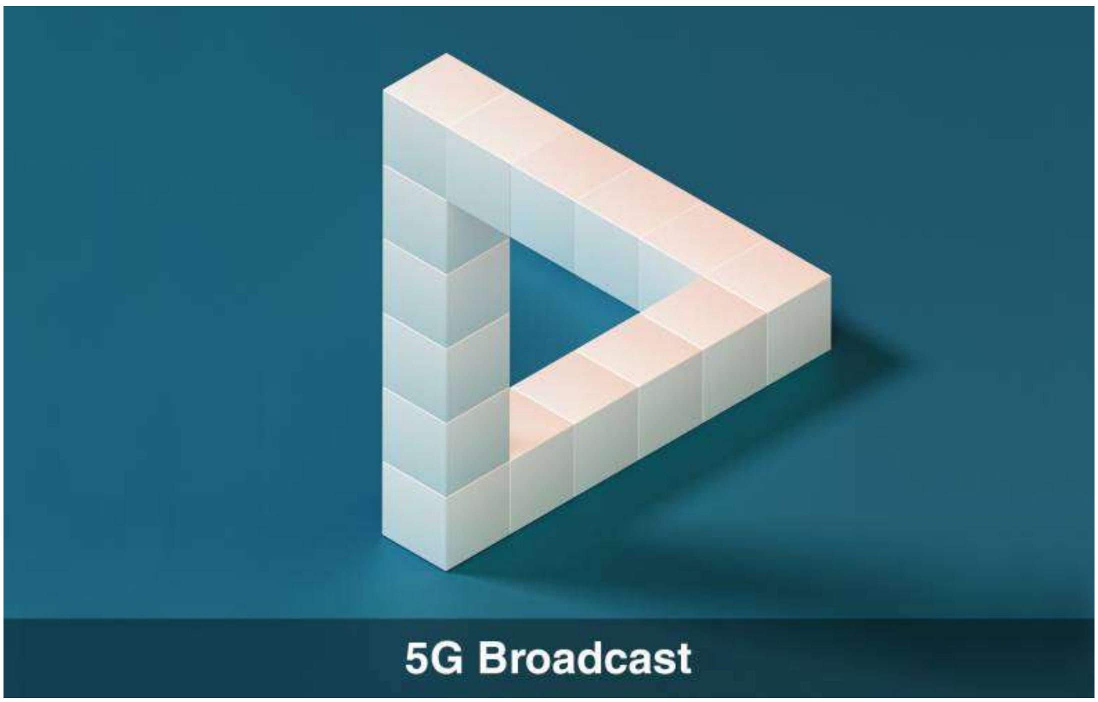
5G Broadcast: Part 1 - A Major Milestone For Mobile Broadcast



We present the first in a series of articles on 5G Broadcast, starting with its history and why it is rising up the agenda for broadcasters. Future articles will delve deeper into the technology and standardization, including interaction with existing digital terrestrial networks, with some examples of early trials and deployments.

Other articles in this series:

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Mobile broadcast is finally gaining ground with content and video service providers with 5G Broadcast, as standards mature and trials show that it can work well over commercial cellular networks. 5G Broadcast also threatens to take over from digital terrestrial transmission with the High Tower High Power (HTHP) cellular overlay model.

The arrival of 5G Broadcast/Multicast marks a major milestone for video transmission over mobile networks, after numerous false or at any rate premature dawns dating back two decades. This builds on the earlier LTE Broadcast technology, or Evolved Multimedia Broadcast Multicast Services (eMBMS), developed by 3GPP, the global body for cellular standards, and introduced progressively through successive releases.

It was initially brought into national mobile services by telcos such as Verizon in the USA around 2014, focused not just on video but also other applications requiring simultaneous transmission to many, or all, devices, such as emergency services and software updates.

Then in 2017 3GPP improved support for transmission of TV services to both mobile devices such as smartphones and stationary TV sets over eMBMS in its Release 14. At this point broadcasters started to take greater interest, with the BBC among others starting trials. Yet at this stage mobile broadcast still remained on the back burner for broadcasters, of interest for research and development but with little immediate prospect of deployment in national services.

That is all changing now as several factors conspire to drive mobile broadcast high up the agenda under 5G. First, more and more TV viewing is now done from wireless devices over mobile networks in any case, which means that broadcasters with public service remits must cater for them as efficiently as possible. The alternative of unicast transmission becomes highly inefficient for popular live or linear content, with each individual user consuming bandwidth in the core and radio network.

Second, under 5G mobile, networks are able for the first time to meet quality expectations for users, with a caveat that cell density must be sufficient to enable the required capacity and bit rate. Third, as the 3GPP standards continue to mature, mobile chip makers such as Qualcomm and MediaTek are starting to incorporate 5G Broadcast/Multicast in their products, in turn leading to implementation by makers of relevant UE (User Equipment), primarily smartphones but also increasingly tablets and laptops. Indeed, the move from legacy physical SIM cards to eSIMs integrated permanently onto device circuit boards will lead to more laptops and tablets, initially at the higher end, being “5G ready” and therefore capable of receiving mobile broadcasts.

There is also prospect of convergence between 5G Broadcast and digital terrestrial transmission at both the infrastructure and protocol level, especially with the most advanced third generation North American version, ATSC 3.0. At the same time, the DVB-I standard, developed to enable transmission of linear services over the internet at full broadcast quality, has been extended to cater for delivery over 5G as well as fixed line broadband networks.

Some analysts even argue that 5G Broadcast will replace ATSC 3.0 in North America for OTA (Over The Air) delivery of TV services, because it is better attuned to the growing population of wireless connected device that account for ever more viewing. They can be seen as almost complementary alternatives, both having been developed for the coming era of High Tower High Power (HTHP) broadcasting. Under ATSC 3.0, this involves adaptation of existing digital terrestrial TV (DTT) infrastructure for interactive IP transmission, even if not necessarily aligned with the internet. Under 5G, it involves overlay of DTT-like HTHP infrastructure over existing cellular 5G networks.

Currently, use of ATSC 3.0 has been almost entirely confined to fixed TV sets in the home, while 5G Broadcast/Multicast has entered the frame for mobile devices, so they have been coming along in parallel. But even TV sets connected to ATSC 3.0 have mostly been accessing content over the internet rather than via linear channels, so could be served well by 5G networks, again providing the coverage and quality are good enough. That admittedly is often not the case yet in North America, as elsewhere.

Still it looks unlikely that 5G Broadcast/Multicast will oust digital terrestrial networks, at least in the short and medium term, because the latter are too well entrenched. It is more likely they will converge towards common protocols and infrastructures, as is already happening to an extent through the 3GPP standards. Consolidation is most likely to occur soonest at the level of the core IT network behind the transmission, where operations and subscriber management occur. This will be discussed further in a future article in this 5G Broadcast series.

A major distinction is that 5G Broadcast has been designed for mobile networks where data capacity for video distribution remains an issue, partly because there is a lot of unicast streaming hogging a significant proportion of over the air bandwidth. This is also of interest for broadcasters, since mobile networks will be part of the overall broadband infrastructure over which users and subscribers will access their services.

Another distinction from digital terrestrial is that 5G Broadcast has been more focused on the challenge of unifying the three modes of delivery, unicast, multicast and broadcast, into a coherent and efficient mechanism entirely transparent to the user. The idea is that the network will switch seamlessly between the three modes on the basis of operational rules relating to congestion, cost, and quality of service.

Unicast transmission is optimal when viewing density is low, that is when only a small number of viewers are accessing a channel at a given time. This may apply to niche linear content, or on demand material accessed at different times. Such content cannot be multicast or broadcast over the air, although if popular can be cached at the edge of Content Delivery Networks (CDNs) to save bandwidth and therefore costs there.

Broadcast at the opposite end of the spectrum is also relatively straightforward in that the content is transmitted to all devices on the network. Multicast is the hardest to implement technically because it involves individual devices, and also whole radio cells, leaving and joining a session on demand. This means that multicast must be interactive so that devices can signal their desire to leave and join, which is not necessary for broadcast.

A particular challenge in the 5G case that does not apply over fixed wire networks is to ensure that multicast sessions are maintained as users move between cells during handover. Then at the application level, broadcasters or mobile operators need to determine the rules that govern movements between the three levels.

To begin with a session might be unicast with just a few users. But as demand ramped up it would make sense to convert to multicast in order to save bandwidth otherwise consumed by multiple streams. This process can be devolved to the level of cells, so that some might stay on unicast, while others with high demand are on multicast. In the event of demand for content becoming high across the whole network, transfer to full broadcast would make sense. This would save on uplink bandwidth because it would no longer be necessary for devices to send signals to the network when they leave or join a multicast session.

The protocols and techniques underlying these processes will be discussed in a future article focusing on the 5G multicast and broadcast processes specifically. The main point of multicast is that it serves all users wanting to receive a service in the most bandwidth-efficient way possible. It prunes transmission back to the last node in a downstream path beyond which nobody has elected for the service, to avoid wasting bandwidth beyond that point. And up to that point each stream is transmitted just as a single stream, only branching towards each user at the final point of the delivery chain. In a mobile network that final point is always the cell, known as a RAN (Radio Access Network).

Multicast was first conceived for fixed networks and over mobile early conceptions were broadcast only, ushered in at the time of the 3G cellular generation when the first consumer handsets could display images and potentially videos. Broadcasters were in fact early to spot the potential, leading to development of the DVB-H (Handheld) technology release in 2004, followed four years later by Qualcomm's proprietary MediaFLO. Both aimed to enhance mobile networks to enable reception of broadcast signals without needing a SIM card for normal service. This entertained the hope of bringing on a new generation of dedicated mobile viewing devices.

In the event both DVB-H and MediaFLO flopped miserably, in large part because they were ahead of their time. Neither the devices nor the mobile networks were yet able to deliver video at acceptable quality even by the expectations of the time. Handsets lacked the graphics capability to display HD video properly, while both technologies would require substantial upgrades to cellular networks that would not be paid off by the prospective meagre added revenues at the time.

It is different now. 5G Broadcast/Multicast supports one-to-many communications far more effectively, enabling broadcasters to issue a single downlink signal without having to worry how that is then delivered most efficiently to all users that want the associated content. The mobile network will take care of routing and deciding when and where to switch between those three modes of delivery.

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5G Broadcast: Part 2 - 5G Broadcast Unites & Divides Different Factions