TV IN A MOBILE WORLD

Can broadcasting make the step into an increasingly mobile world? **ROLAND BEUTLER** discusses technology and business models in the context of public service remits, mobile network operators and the new world of 5G

Broadcasting has played a very important role in society for decades – in particular, public service broadcasting (PSB) has contributed greatly to cultural diversity. The remit of public service broadcasters to serve all social milieus with a huge range of programmes – news, sports, fiction, children's TV, education – has helped to provide social cohesion in Europe for a long time. Pan-European content such as the Eurovision Song Contest or live transmissions of big sports events are still the most popular programmes, while there is also a plethora of regional content targeting particular areas or languages.

However, once societies started to enter the digital era the picture changed. New content providers exploiting completely new technologies are competing with incumbent broadcasting companies to win the public's favour. In a globalised media market becoming dominated by the internet, it is getting harder for public service broadcasters to maintain their market share.

Broadcasters reacted by developing new programme formats. They started offering better quality and new types of services. Today the content offer of broadcasting companies ranges from traditional linear 24/7 radio and TV programmes to all sorts of nonlinear content, ie. time-shifted, on-demand podcasts and social media. Many radio and TV shows of today would not be feasible without social media integration.

The winner of the 2016 Eurovision song contest celebrates – but can you watch her on free-to-air mobile?

Integration of social media has without any doubt lifted the attractiveness of public service broadcasters to a new level. However, social media means new user habits and expectations, as they use new types of devices and want access to any kind of content wherever they are, at all times, under all conceivable receiving conditions and certainly at costs which are affordable.

It is not only content that has changed now that smartphones and tablets are on the scene – indeed, smartphones have turned into an electronic interface to the world. Many people seem to be inseparably tied to their smartphone and broadcasters need to consider getting all their content, linear and nonlinear, on smartphones and tablets as a crucial strategic objective.

MOBILE: A BIG CHALLENGE FOR BROADCASTERS

For broadcasters, smartphones and tablets are both a blessing and a curse. On one hand they offer new opportunities for engaging with the audience. On the other hand, getting all broadcast content, linear and nonlinear, to these devices, lies beyond their control.

This is primarily true for linear content. Smartphones and tablets are making use of wireless IP networks, either mobile networks or WiFi, to access various kinds of content. This also allows streaming of live radio and TV programmes. However, there are severe bottlenecks as current subscriptions to mobile network operators come with data caps which limit the consumption of linear broadcast content to a few hours a month. Beyond that either the data rate is throttled to a level which prevents decent TV watching or alternatively, users have to pay significantly more to extend their data caps.

In the past, distribution of broadcast content was straightforward. To distribute linear radio and

TV programmes, broadcasting networks, ie. terrestrial, cable or satellite networks, were employed. However, nonlinear broadcast content requires interactivity which can only be provided by broadband networks. Therefore, broadcasters have started to use various options such as over the top (OTT) internet distribution and dedicated managed broadband networks. To date, access to content on broadband networks is enabled in terms of unicast communication.

The limitations of mobile subscriptions for mobile devices pose a severe problem to broadcasters – there are fundamental obstacles to reaching these devices with linear content in a way they would like to. Therefore, they have tried to engage with device manufacturers to convince them to incorporate broadcast receivers into smartphones and tablets. From a practical point of view this would be possible as there are chipsets which could be integrated and would enable mobile devices to receive every digital terrestrial broadcasting standard which is used in the world.[1]

Unfortunately, this has not been successful and one can only speculate about why manufacturers have not been receptive. One reason is the huge influence of the mobile network operators. Most of them do not like the idea that through an additional air interface users could access audiovisual content without an operator's tills ringing. An argument has also been put forward that incorporating another chipset would decrease device performance by roughly 3 dB, which would lead to correspondingly higher effort on the network side and, clearly additional operator costs.

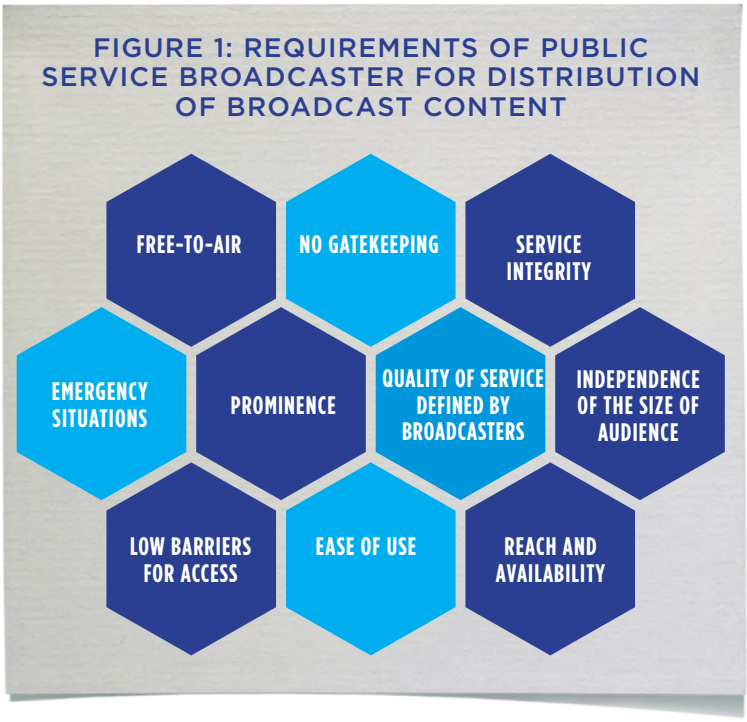
On the other hand, the mobile market is changing. It used to be totally dominated by the mobile network operators, which by subsidising mobile phones had direct control over the features of the devices – only those features made it into phones which were compatible with the business models of operators. But now, in markets such as Germany, about 40% of mobile phones are sold without a contract. Users buy a phone and then decide which contract suits their needs. This could give manufacturers more freedom, as a feature such as a terrestrial broadcast receiver could give them a competitive edge.

3GPP ENHANCEMENTS FOR TV SERVICES

But so far, integration of broadcasting receivers has not happened. Therefore, broadcasters are looking for other opportunities to accomplish their strategic goal to reach smartphone and tablets with all their content. Such an opportunity was seen in 2015 in the work of 3GPP, the international specification organisation of cellular network technologies.

3GPP launched a study item in its SA1 working group that addressed enhancements of 'evolved multimedia broadcast multicast services' (eMBMS, the point-to-multipoint specification for 4G cellular networks) for TV. As broadcasters felt that this work touches on their core interests they started to get engaged. The European Broadcasting Union (EBU) and two of its members, the BBC and IRT (the R&D institute of German public broadcasters) joined 3GPP. This opened the door to contribute to the SA1 work by submitting a list of service requirements which from a broadcasting point of view are essential if mobile networks are to play an important role for the distribution of broadcast content and services, both linear and nonlinear.

FIGURE 1: REQUIREMENTS OF PUBLIC SERVICE BROADCASTER FOR DISTRIBUTION OF BROADCAST CONTENT



Rather than letting the mobile industry define specifications for TV, the EBU felt that it is crucial to inject the requirements of broadcasters into this specification activity from the very beginning. Consequently, the EBU, supported by some manufacturers and even some mobile operators, requested that the future 3GPP system will:

- Allow for free-to-air delivery of broadcast content
- Envisage a receive-only device, ie. no authorisation at the network
- Overcome the limitation that only up to 60% of a carrier can be used for eMBMS
- Provide the mechanism to deploy a standalone eMBMS network without any unicast elements
- Facilitate mixed eMBMS and unicast usage on different carriers or even networks
- Offer the possibility to provide a guaranteed quality of service across the entire envisaged coverage area
- Make possible the establishment of large coverage areas, ranging from regional to national.

> **"Free-to-air distribution is not debatable for public service broadcasters."**

These proposals meet the requirements public service broadcasters must impose on any relevant content distribution technology to fulfill their remit (see Figure 1).

Free-to-air distribution is not debatable for public service broadcasters as it is in most cases a legal

obligation. Also, removing the 60% limit for an eMBMS carrier is needed to use resources in the most efficient manner.

TECHNICAL ISSUES FOR MOBILE TV NETWORKS

Efficient usage of resources is the basis of the proposal to enable standalone eMBMS networks. In most countries there is more than one mobile operator. If the broadcasting community wants to use eMBMS to deliver tens of linear TV channels, for example in high definition (HD) quality, this would require significant spectrum and network resources. To reach the whole population each operator would have to provide all of this content to its own subscribers but they are only a part of the population. So the same content would be distributed several times. This is a waste of resources, let alone leading to prohibitive distribution costs for broadcasters.

Therefore, a dedicated standalone eMBMS network could be established which is exclusively used to deliver the whole set of linear TV programmes. This network could then be shared by all mobile operators by allowing all their subscribers access to it. Who operates such a network becomes a secondary question. It could be a mobile or virtual mobile network operator but could also be a broadcasting network operator that extends its service portfolio to smartphones and tablets. It is important to note that the requirement of a standalone eMBMS network infrastructure does not preclude other configurations which might be relevant for mobile operators, including dynamic switching from unicast to eMBMS.

If a broadcasting network operator runs a standalone eMBMS network it would certainly try to build on existing broadcasting network infrastructure. Terrestrial broadcasting networks provide services across large areas. In the case of digital terrestrial television (DTT) networks this is typically achieved by using a limited number of high-power-high-tower (HPHT) stations. HPHT transmitters operate at output power that can reach 100 kW or more. This gives rise to a large coverage area per transmitter, or in mobile technology language. large cells. Therefore, the distance between next-neighbouring stations, the so-called inter-site distance (ISD), is correspondingly large.

In contrast, mobile networks are based on a low-power-low-tower network topology (LPLT). This results in cells with small radii. To cover a large area many stations with a correspondingly small ISD need to be deployed.

Large area coverage by means of digital terrestrial broadcasting systems is usually accomplished by single frequency networks. This means that all transmitters in the network use the same frequency range to provide the same content. The major issue of single frequency networks is to avoid self-interference. Self-interference free single frequency network operation using OFDM waveforms (a frequency division multiplexing scheme) requires a guard interval or, in 3GPP language, a cyclic prefix, of appropriate length which has to be adapted to the inter-site distances in the network.

> **“The free-to-air issue was not as contentious as might have been expected.”**

The current 3GPP standard provides only cyclic prefixes of up to 33 μs. For a self-interference free single frequency network the next-neighbour distance between two transmitters should therefore not exceed about 10 km. This is not sufficient for a broadcasting network operator that would like to deploy a standalone eMBMS network based on existing HPHT broadcasting sites. In this case, the next-neighbour inter-site distance can reach up to 100 km. As a consequence, the cyclic prefix of the 3GPP system would need to be extended substantially.

It did not come as a big surprise that the proposals of broadcasters for 3GPP were not very welcome by some mobile operators although, surprisingly, the free-to-air issue was not as contentious as might have been expected. It was rather the requests for ‘no authorisation’ and the standalone network which triggered a lot of resistance. The motive seems to be pretty clear. As 3GPP networks have always been end-to-end enterprises under the control of operators, both requests undermine their position. Some claimed that they will never accept any economically viable traffic bypassing their SIM cards. Reception of content without being registered is obviously perceived as a direct assault on their business model.

Nevertheless, after lengthy discussions most of the broadcaster’s requirements made it into normative text on service requirements. This is the first step on the way to a full specification. The results of the above mentioned SA1 study are available in the technical report, TR 22.816.[2] Subsequently, broadcasters’ requirements have been included in the technical specification, TS 22.101.[3]

Clearly, this was only possible by a concerted effort by broadcasters, manufacturers and some mobile operators. The target of the enhancements of eMBMS for TV services is Release 14 which is expected to be out mid-2017. It remains to be seen if this can be achieved or if a delay to Release 15 will have to be accepted. This will be published about 18 months later. However, all this depends on available resources within 3GPP and the interest of members to engage in the specification process.

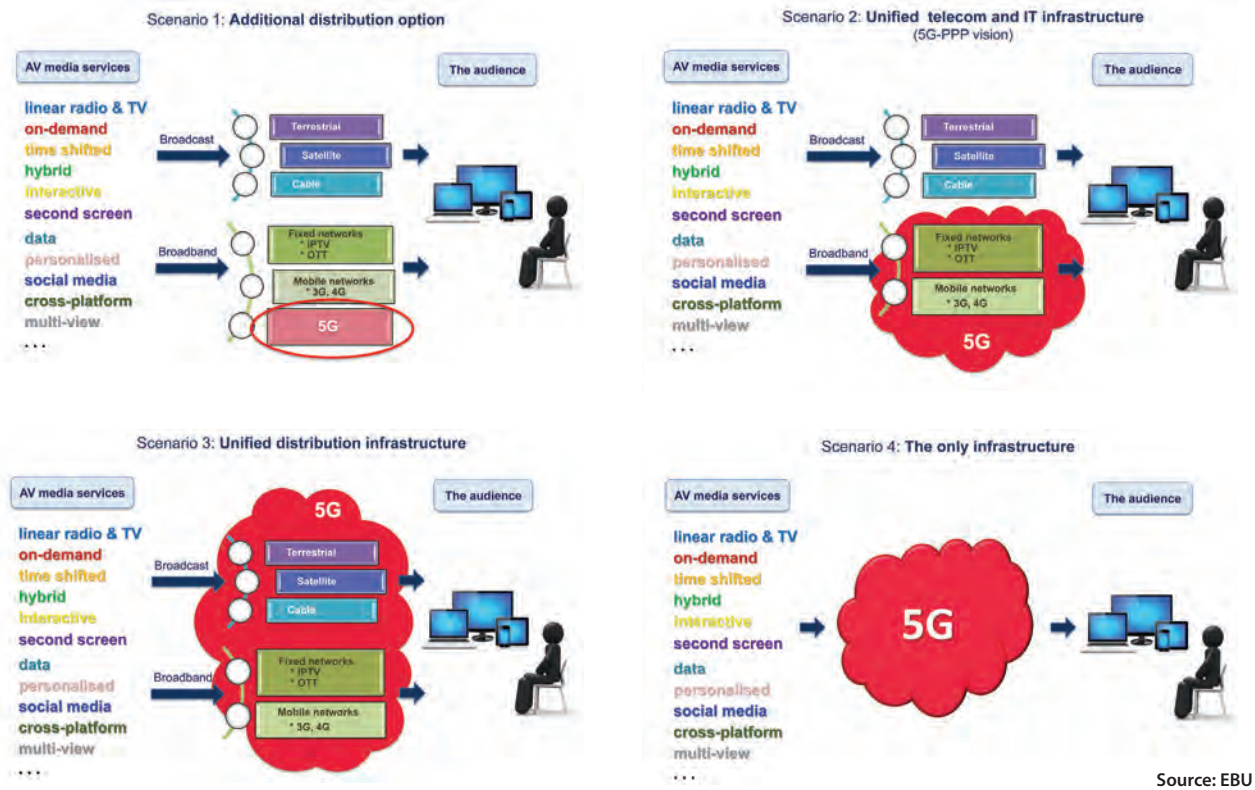
5G: THE PROMISE OF NEXT GENERATION MOBILE NETWORKS

Mobile communication technology was introduced more than 30 years ago. Since then we have seen four generations of mobile networks that has taken us from making voice calls to internet access.

Now, the next generation, 5G, is the focus of various stakeholders around the globe and is fanning the wildest dreams of politicians, manufacturers and researchers. For politicians and regulators in Europe, in particular, 5G seems to be a way to regain global leadership in mobile technology.

The European Commission seems to have high-flying expectations:[4]

FIGURE 2: SCENARIOS FOR 5G IN DISTRIBUTION OF BROADCAST CONTENT



Source: EBU

"5G is a new network technology and infrastructure that will bring the capacities needed to cope with the massive growth in the use of communication – especially wireless – technologies by humans and by machines. 5G won't just be faster, it will bring new functionalities and applications with high social and economic value."

Apart from the expectation that there will be high societal and economic impact the most important issue is that 5G no longer refers to communication between humans only. Rather, machine type communication will dominate telecoms in the future. Indeed, machine-to-machine (M2M) communication may be beneficial in basically every sector of modern societies that rely on computers and automation of some kind.

5G is expected to offer a new level of functionality and performance, not only higher data rates but also significantly lower end-to-end latencies to embrace real-time applications as much as possible. Serving more devices than ever concurrently and being able to offer basically unlimited network capacity are complementary requirements. And at the same time energy efficiency will be reduced by orders of magnitude.

As the European Commission expects 5G to spread out into all economic areas it started to engage with various market sectors such as energy, transport, infrastructure and entertainment and media. These so-called 'verticals' have been invited to collaborate in the definition of the basic features of 5G technology and become part of the technological development process.

Broadcasters are actively engaging at a political level, eg. in the context of the so-called 5G Action Plan[5], as well as in the specification, standardisation and technical development in 3GPP,[6] ITU-R WP5D[7] and 5G-PPP.[8]

In addition to the items on eMBMS enhancements there is a second workstream in 3GPP which is of primary importance to broadcasters. This is the specification of the new radio access technology (RAT) which will be an integral part of 5G technology and network architecture.

> **In any case, 5G development is an activity broadcasters have to follow closely.**

The eMBMS enhancements currently under review in 3GPP are based on 4G LTE. This may impose basic obstacles, such as in extending the cyclic prefixes to values that would suit broadcasters. As 5G is meant to serve a great variety of use cases there is also a need to consider using different waveforms. This may open up an opportunity to pave the way for very large cell radii up to 200 km, which could enable a HPHT network topology. Therefore, broadcasters have contributed to this process by making corresponding inputs in line with the requirements already injected into the eMBMS enhancement process. It remains to be seen whether these ideas will fall on fertile ground.

In any case, 5G development is an activity broadcasters have to follow closely. It may give rise to a new way of distributing broadcast content and the opportunity to offer a greater variety of content

and, hopefully, lower distribution costs. Furthermore, this process is strongly supported by politicians and industry, so it may be successful.

WHO WILL PAY FOR INFRASTRUCTURE?

Without any doubt 5G will have a certain impact on distribution of broadcast content. But will it just be an additional distribution path on the broadband side, will it integrate all broadband networks under one roof or will it finally also cover all the broadcasting distribution options? Is it about integration in the first place or is 5G set to replace all existing technologies by something completely new in the long run (see Figure 2)?

In organisations such as 3GPP or the WP5D of ITU-R, the implicit assumption is that 5G is about wireless communication that is expected to revolutionise our world. This will go hand in hand with a plethora of new services and applications spreading out into every corner of societies around the globe. As a consequence, data traffic volumes to be carried over 5G networks will increase dramatically. But this means that the wired part of the infrastructure of future communication networks has to be adapted correspondingly to be able to cope with this traffic.

As a consequence, the major investment and innovation induced by 5G will quite likely take place in wired infrastructure. This means that fibre networks have to become ubiquitous, reaching out to every household, factory, office and public place. The wireless 5G sector may then just play the role of providing access to the omnipresent fibre network infrastructure for portable and mobile devices.

This raises an important question. Who should bear the necessary investments? It seems doubtful that such fibre penetration can be achieved by relying only on market forces. Fibre rollout may be financeable in urban settings but probably not in rural areas. If, however, broadband connectivity is indeed so important for the future development of western societies as unanimously presented in all the 5G debates and discussions, then its availability is tantamount to that of water and electricity. If this is right, then it is hard to avoid the question that provision of broadband connectivity is a common goal of communities or societies as a whole. This would suggest accomplishing fibre rollout by public funding. However, in times when most development is left to the market this proposal may probably meet with no response.

In addition to the fibre issue there is another aspect of 5G which may stir up the current mobile communication ecosystem. Some of the developments in 5G such as autonomous driving will certainly build on device-to-device communication. Information will be sent directly from one device to another in real-time without routing through a remote base station. Without a doubt there is still a need for traditional base station type communication, for example for those services which have to be made available for all vehicles such as detailed traffic information or road conditions. But it remains to be seen how far future communications will deviate from the classical approach still used today.

> **“Mobile operators need to understand that TV services over 3GPP networks bring new business.”**

It seems evident that all these developments will have a dramatic impact on the role that mobile network operators will play in the future. Their current business models may no longer be sustainable in such an environment. It can be expected that the primary business will be wire-based with a wireless extension depending on the circumstances.

UNLOCKING NEW MARKETS

Against this background it is natural that the incumbent stakeholders in the mobile broadband business will try to unlock new markets which could benefit from 5G technologies. This is the reason why the European Commission, in particular, is so eager to engage with the verticals.

Finding new customers in new markets is certainly welcome. But doing business with new customers requires offering a product or service that suits their needs. This is the crux of the matter, at least regarding mobile network operators, and for the time being it seems they do not understand the signs of the times. In 3GPP they say they want to get hold of new customers but still believe their current business models will also work in the future. Quite likely they may be confronted with a new reality.

With regard to the broadcasting sector, mobile operators need to understand that delivery of TV services over 3GPP networks brings new business opportunities. So far, most operators generate their revenue through user subscriptions – there is a business relationship between the operator and the user while the content provider does not pay for delivery. In a free-to-air delivery context this will be reversed: operators have to ensure access to free-to-air broadcast content for users at no additional costs for them while the business arrangement would be established with the broadcast content provider. In other words, the existing business to consumer (B2C) model would be replaced by a business to business (B2B) one between broadcast company and mobile network operator.

More discussion about these new business opportunities is needed. It may well turn out that finding a win-win business arrangement between broadcasters and mobile operators will leverage future distribution of broadcast content more efficiently than focusing just on the development of sophisticated new technical features.

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REFERENCES **1** Siano Mobile Silicon, a company that pioneered the world's first mobile devices with a digital TV tuner, went into receivership in March 2016. See bit.ly/2bZWx10 **2** See www.3gpp.org/DynaReport/22816.htm **3** See www.3gpp.org/DynaReport/22101.htm **4** Landmark agreement between the European Commission and South Korea on 5G mobile technology. 16 June 2014. bit.ly/1qV5Dvu **5** Towards 5G. European Commission, Digital Single Market. bit.ly/2bDgDgH **6** See www.3gpp.org **7** ITU working party 5D – IMT systems. bit.ly/2bUmSin **8** 5G Infrastructure Public Private Partnership. See 5g-ppp.eu