WIRELESS DISTRIBUTION OF AUDIOVISUAL MEDIA SERVICES

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ABSTRACT

Audiovisual media services comprise a broad range of content and business models and are often subject to content regulation. The users' expectations are based on quality, choice, convenience, and costs.

Content and service providers use multiple means of distribution to reach their audiences. Different distribution options are assessed in terms of their technical capabilities and reach, the associated costs for the provider, and the ability to ensure prominence of the content and services.

Public Service Media (PSM) organisations have additional requirements consistent with their remit which apply to all distribution options.

The market for audiovisual services is evolving to embrace innovative business models, the expansion of the traditional players into other parts of the value chain, consolidation, and increasingly global competition.

Wireless delivery of audiovisual services will continue to be important. The EBU cooperates with the mobile industry to ensure that cellular mobile networks, in particular LTE eMBMS, become a viable distribution option for PSM content and services.

INTRODUCTION

There has never been more content available and consumed then there is today. The huge popularity of media is not new. Storytelling has always been essential to our social interaction and culture. As viewers and listeners we derive value from content and the way we experience it. Technology is a key enabler but never a substitute for the narrative.

Media content is normally offered to the audience in a package. Examples of such package include a *'TV channel*' - a stream of programmes that reach the viewer according to a pre-defined schedule - and a library of films available to users upon demand. The business of packaging and delivering media content is called *'media service'*. Audiovisual media services usually involve some degree of editorial responsibility of the service provider and are subject to content regulation. Other forms of audiovisual content such as the user-generated content or video-games that are not regulated.

Media service providers offer a wide range of services including not only the traditional linear radio and TV but also time-shifted, on-demand, hybrid, and data services. Different services allow different level of user engagement and interaction, and may be tailored to different segments of the audience, user context, or a particular distribution platform.

At the same time, viewers and listeners have at their disposal an increasing range of devices, such as stationary and portable radio and TV sets but also personal computers, smartphones and tablets, and a host of streaming devices that can connect to a TV set.

The growing capabilities of user devices coupled with an increasing choice of high quality content and services continue to drive user expectations, in particular in terms of quality, choice, convenience, and costs. Users expect the content to be available across different devices and access networks. They enjoy both the shared experience of the living room and the convenience of portable devices, whether in the home or on the move.

DISTRIBUTION OF AUDIOVISUAL MEDIA SERVICES

Content and service providers naturally seek to reach all interested users irrespective of where they are and which device they use. This can only be achieved by using multiple means of distribution, including both the traditional broadcasting platforms (terrestrial, cable and satellite) as well as fixed and mobile broadband IP networks (Figure 1).

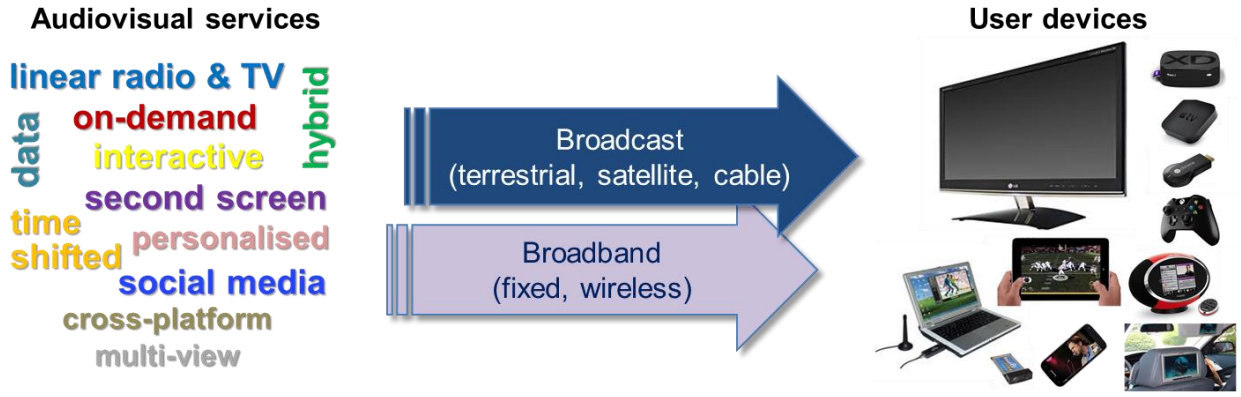

Figure 1 - Distribution options for audiovisual services

All else being equal the user will always prefer higher quality, wider choice, lower costs, and a more convenient use, which together contribute to her experience of the content. Better user experience leads to higher engagement and loyalty to the provider or service.

This is why service providers seek to deliver the best possible user experience. The challenge is to do so in a sustainable way. They have at their disposal several different distribution options and the choice of a particular option largely depends on its technical capabilities, reach, costs, and the ability to ensure prominence of the content and services.

Technical capabilities	Is the technology fit for the purpose? Can it achieve the required quality of service, capacity, content integrity and protection? Does is scale well?
Reach	What geographical coverage can be achieved? What access mode (e.g. free-to-air, conditional access)? Is indoor or outdoor reception possible? Which user devices can be targeted (e.g. TV sets or mobile devices)? Can a specific demographic be reached (e.g. young audiences)? Can a desired audience size be served?
Costs	What are the total costs of delivery for the provider (This can be expressed for example, as the unit costs per household or per viewing hour)? How the costs scale with the number of users?
Prominence	Are the services easy to find and use? Who else is competing for the user's attention? Who are the gatekeepers? What strategic market position can be attained? What is the potential for brand promotion?

Table 1 - Elements for assessment of the distribution options

Different distribution options will score differently, depending on the provider's objectives, a particular market context, and the use case being considered. Broadcast networks are purpose-built for the distribution of linear services while broadband networks are generally not optimised for any particular type of content or service.

PSM Requirements in Distribution

PSM organisations have some additional requirements which stem from their public service remit and apply across all distribution options. They address technical but also regulatory, market, and business issues that are important for PSM organisations, such as:

- The ability to provide content free-to-air and, when on-line, without blocking or filtering
- PSM services shall not be subject to discrimination compared to equivalent services.
- Content and service integrity - the PSM content or service must be played out and displayed on the screen unaltered and without modification or unauthorised overlays.
- Quality of service (QoS) but also network availability, robustness, the required up-time, and reliability to be defined by the PSM providers.
- QoS for each user shall be independent of the size of the audience
- Geographical availability of the service should be defined by the PSM providers.
- A distribution method needs to support at least a minimum service offer (e.g. a minimum number of programmes) as defined by the PSM provider.
- Prominence and ease of use - straightforward access to the PSM content and service,
- Low barrier for access to PSM content and services for people with disabilities.
- Access to the audiences in emergency situations

Depending on the service, user device, and distribution method a set of specific requirements may need to be defined such as the required minimum data rates, bit error rate, latency, or a peak size of the concurrent audience. These specific requirements should be fulfilled in addition to the above listed requirements.

The above mentioned requirements serve as a benchmark for evaluating the available distribution options. In reality though, it is often the case that some of the requirements cannot be met because of technical, commercial, operational, or other reasons. In such cases PSM providers may take a pragmatic approach and try to make the best use of the distribution options at their disposal. Nevertheless, this should not lead to lowering the standards that aim to fulfil the public service remit and meet the user expectations.

The Available Options for the Distribution of Broadcast Services

In a recent EBU study the available distribution options were identified and assessed in terms of their ability to meet the PSM requirements (1). Three broadcast distribution options - terrestrial, satellite, and cable - and three broadband options - fixed broadband (both managed and best effort) and mobile broadband (best effort) have been considered. Some of the main insights from that study are:

- The overall consumption of audiovisual services is increasing. Linear viewing remains is the primary way of watching TV content. Time-shifted and on-demand viewing continue to grow but remain additional to linear, not a substitute.
- Portable and mobile devices are increasingly popular for audiovisual services. However, the majority of TV viewing remains on the large screen and in the home.
- The use of hybrid services (e.g. HBBTV, YouView) is increasing. These services are currently delivered over broadcast and fixed broadband infrastructure.

- Broadcast networks are a cost-effective way to deliver linear services to large audiences. However, they cannot deliver on-demand services nor can they can reach personal devices, such as smartphones and tablets.
- On-demand services can only be delivered via broadband networks. However the unmanaged broadband networks typically operate in a unicast mode and are not well suited for the content that attracts large concurrent audiences (e.g. live sport). In a unicast network the available network resource is shared amongst the active users and, if the number of concurrent users increases beyond a certain level, the individual user experience is degraded because the service quality requirements can no longer be met. This limitation is more pronounced on the mobile networks than on the fixed.
- TV sets in the home can be reached via multiple distribution platforms whereas smartphones and tablets can only be reached by wireless broadband.
- No single distribution option can provide for all relevant use cases. Multiple distribution options need to be used simultaneously to enable the whole range of use cases.
- Delivery of linear TV to smartphones and tablets is a challenge especially outside the home. The main issues are related to network capacity and coverage, data caps, and the inherently high costs of mobile broadband.

Audiovisual Markets in the Flux

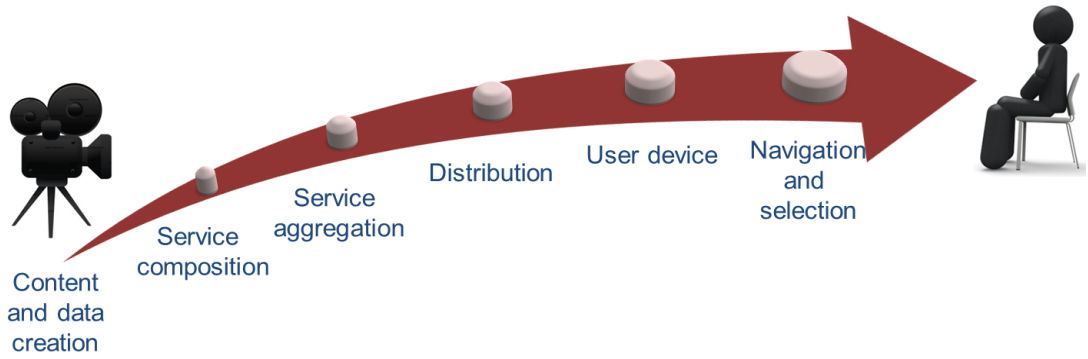

Figure 2 - Media distribution chain

The above mentioned observations are illustrative of the present situation. However, the environment in which PSM organisations and other audiovisual service providers operate continues to change and their distribution requirements may be different in the future. Many uncertainties remain and here are some of the important questions to consider:

- How will the audience behaviour change? Where will the current growth of on-demand viewing stabilise, if at all? Will the linear viewing remain dominant and the on-demand complementary or will the opposite happen? In which time frame?
- Will the TV set retain its primacy as the central screen in the home or will it be replaced by personal devices?
- How will the on-line delivery evolve? Unicast delivery is not particularly cost-effective[1] and hence cannot absorb a significant share of the total viewing. Would the cost basis of the on-line delivery significantly change if multicast were to be implemented?

[1] According to the recently reported figures from the Swedish TV, on-line delivery accounts for about 3% of the total viewing of STV programmes and carries 15% of the distribution costs. At the same time 97% of the viewing is provided over broadcast networks and it corresponds to 85% of the total distribution costs. Similar figures have been published for the BBC in 2013.

- What will the market place look like in the future? What impact will the ongoing consolidation have in the long term as the big market players seek to extend their domain up- and downstream from their traditional roles[2]?
- In the on-line space a new breed of platform operators has emerged that have successfully established a multisided market model and now act as intermediaries between the content providers, the advertisers, and the audiences on a global scale. In addition, new and highly focussed business models are adopted that can scale up quickly and globally (e.g. Netflix). What impact will this have on the traditional and, in particular, the local market players as content and audiences continue to move on-line?

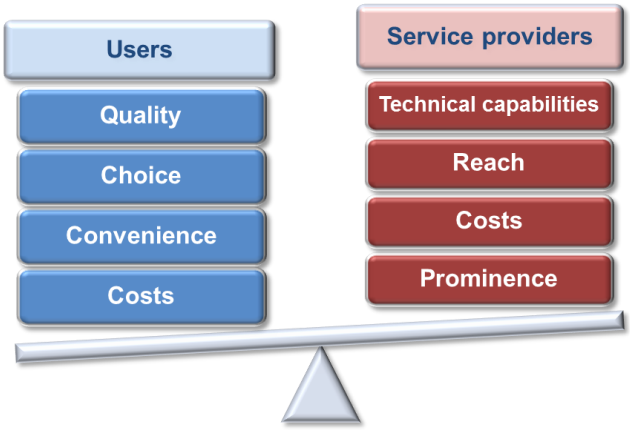

Figure 3 - Service provider's requirements and user expectations

- Technological developments are accelerating. What future capabilities can be expected of different distribution platforms? Will all media production and distribution eventually be IP-based? What will be the impact of the new coding standards such as HEVC?
- When will high resolution services such as UHDTV become widely adopted and which distribution infrastructure will be able to support it? What kind of other innovative services and applications will appear in the future?
- What will be the impact of the global competition for content and talent?

The above list of questions is by no means exhaustive. As the market conditions continue to change, this will affect the technical, commercial, and regulatory environment in which media service providers operate. They will need to carefully balance their own objectives with the user expectations and the regulatory requirements.

WIRELESS DISTRIBUTION OF AUDIOVISUAL MEDIA SERVICES

Wireless distribution platforms are indispensable for the provision of audiovisual media services because they can be effective in many situations where fixed networks cannot.

Audiovisual services have been distributed wirelessly for more than a century. Radio broadcasts began in the early 1900s, followed by terrestrial TV in the 1930s and satellite TV in the 1960s. The latest addition is wireless broadband which really took off after 2000.

Both satellite and terrestrial broadcast networks are purpose-built for the delivery of linear services to large audiences across large geographical areas in a cost-effective way. Satellite networks have a very large capacity but, generally, can only reach stationary receivers with an outdoor antenna. They are particularly suitable for linear services with national or international footprint.

[2] For example, equipment manufacturers seek to control the user interface and also act as content aggregators. Network operators provide, in addition to broadband connectivity, a range of audiovisual media services bundled with voice and data services. A number of recent mergers with between network operators and pay-TV provides illustrate their ambition to gain access to premium content and subscribers.

Terrestrial networks have the flexibility to provide national, regional, and local services. If so designed, they can provide coverage both indoor and outdoor and can deliver not only to stationary but also portable and mobile receivers. In addition, terrestrial broadcasting is the only platform that everywhere provides free-to-air services which is particularly important for Public Service Media organisations.

However, broadcast networks currently cannot deliver on-demand services.

The opposite is true for broadband networks which are currently the only available option for the delivery of on-demand services. They are designed as the general purpose networks which support many different services and applications but are not optimised for any one of them. However, as their capabilities and reach continue to improve their importance for the distribution of audiovisual content and services will further increase.

Wireless broadband networks are essential for reaching mobile devices, in particular smartphones and tablets. Most of the traffic to mobile devices goes over Wi-Fi which provides larger capacity and lower costs than the cellular networks. Furthermore, Wi-Fi is available indoors where most viewing and listening occurs, and the quality is, in general, satisfactory. Even though the cellular mobile networks, in particular 4G/LTE, might be able to provide better user experience in some cases, the high prices of mobile data and the low data allowances are often prohibitive.

The Case for Cooperation between Broadcast and Broadband

Each of the above mentioned distribution platform serves a substantial part of the audience. Whilst there may be some commonalities between them they cannot substitute each other in practice. However, it is evident that broadcast and broadband networks are complementary as the strengths of one broadcast correspond to shortcomings of broadband and vice versa. Hence there may be synergies that are yet to be explored.(2)

The current hybrid solutions (e.g. HbbTV) rely on receivers capable of connecting to both a broadcast and a broadband networks. Nonetheless, further integration of the two approaches at the network level and in the user devices would be desirable.

Cooperative use of terrestrial broadcast and wireless broadband networks could potentially be beneficial to many stakeholders in the media value chain. Content providers would have a better opportunity to provide their content and services to the audiences. Mobile network operators could offload a significant portion of the traffic onto broadcast networks and consequently reduce the need for capital investments. At the same time they would be able to cost-effectively provide an extended range of services with improved quality and coverage. Broadcast network operators could expand their business models beyond the mere transport of linear services. The users would benefit from better services but without increase of the costs. The precious radio spectrum would be used more efficiently.

The broadcast and the mobile industry need to work together in order to find sustainable delivery mechanisms that will be able to meet the future needs of consumers, content providers, and network operators, as well as the relevant regulatory requirements. Despite many obstacles that currently hinder such cooperation the EBU has reached out to the mobile industry in an attempt to establish a constructive forum where the EBU Members and the mobile industry can exchange views and build mutual understanding and trust. Some of the results of this initiative are described below.

Capabilities of LTE in comparison with digital terrestrial TV (DTT) networks

DTT is indispensable to the European PSM organisations for the distribution of linear TV services. DVB-T2[3] is state-of-the-art DTT transmission standard and the EBU has done a substantial amount of work on DVB-T2 network planning, performance, and spectral efficiency, as demonstrated in (3) and (4) and its features are well know to broadcasters.

The capabilities of LTE are less well known. LTE can provide substantially higher unicast bandwidth and head speed than its predecessors but the inherent limitations of the unicast mode remain. However, the LTE standard also includes a broadcast mode of operation, know as eMBMS[4].

The EBU undertook to study the capabilities of LTE, including eMBMS, for a large scale distribution of audiovisual content and services with a particular focus on:

- System performance, including the ability to provide the required capacity and quality of service, and a combined use of unicast and eMBMS,
- Network performance, coverage assessment, spectrum use, and network topologies,
- Operational scenarios, including multi-operator deployments and the possibility to provide free-to-air services.

The work is carried out jointly between the EBU Members and the representatives of both the broadcast and the mobile industry. Some preliminary findings have been published in (4) and the main conclusion is that, from the technical point of view, LTE could in principle meet the broadcasters' requirements, although further developments are needed[5]. However, a number of issues remain to be addressed in particular in relation to network performance, market rollout, business models, regulation, and costs.

As eMBMS has not yet been deployed on commercial LTE networks and the results of various trials are rather scarce, the actual performance could only be assessed on the basis of theoretical studies. A number of issues have a significant impact on the network performance, such as:

- Network topology, including density and height of antenna sites
- Location of terminals (e.g. indoor or indoor) and their antenna gain
- The required coverage (e.g. specific venues, small areas, or country wide)
- Terrain, land usage, and buildings

Concerning the eMBMS spectral efficiency, studies have indicated that values between 1 and 2 bit/s/Hz could be achieved in a regular network configuration with an inter-site distance of about 5 km. Higher spectrum efficiency may be possible with smaller inter-site distances which are common in the existing cellular networks in urban areas. Therefore, a value of 1.5 bit/s/Hz was chosen to assess spectrum requirements in the simulations.

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[3] According the DVB Project '*DVB-T2 is the world's most advanced digital terrestrial television (DTT) system, offering more robustness, flexibility and 50% more efficiency than any other DTT system. It supports SD, HD, UHD, mobile TV, radio, or any combination thereof*'.

[4] eMBMS stands for Evolved Multimedia Broadcast Multicast Services.

[5] Subsequently, some important developments occurred in both the ITU and the 3GPP. The ITU has adopted a new report on *Audio-visual capabilities and applications supported by terrestrial IMT systems* (6). These capabilities would be part of the IMT-2020. The 3GPP has initiated a study that aims to '*describe use cases, propose assumptions and potential requirements and analyse the gap in order to enhance 3GPP system for TV service support. The supported TV service includes linear TV, Live, Video on Demand, smart TV, and OTT content.'* The resulting enhancements would be included in the 3GPP Release 14.

However, in real LTE networks the spectral efficiency ranges from as low as some 0.1 bit/s/Hz to more than 3 bit/s/Hz depending on the above mentioned parameters.

It should be noted that the above mentioned values are relevant for mobile or portable reception on a handheld device from a cellular mobile network. This must be distinguished from the DVB-T2 spectral efficiency of up to 5 bit/s/Hz or more that is achieved in DTT networks for fixed roof-top reception. Further treatment of spectral efficiency of cellular networks in comparison with DVB-T2 is provided by Brugger and Schertz in (7).

The work at EBU continues and the following technical issues are currently in focus:

- Methodology for calculation of LTE eMBMS radio access network coverage, including a detailed list of technical parameters to be used in simulations and their typical values, the recommended wave propagation models, and the coverage criteria. The objective is to enable comparison between different coverage studies. It is understood that this methodology may need to be refined for the purpose of planning real networks.
- Identifying those use cases that are particularly important for PSM organisations and could realistically be addressed by LTE eMBMS.
- Establishing a QoS criterion for the distribution of TV content and services via eMBMS.

CONCLUSIONS

Wireless distribution platforms both broadcast and broadband are indispensable for the provision of audiovisual media services. As their capabilities and reach continue to improve their importance will further increase.

LTE can potentially enable a large scale distribution of audiovisual services which may provide new opportunities to both PSM and commercial providers. At the same time broadcast distribution technologies and networks continue to evolve.

PSM providers are interested in using the new features as they become available on broadcast and broadband networks, provided that they pass the four-criteria test of technical performance, reach, costs, and prominence. At the same time they should meet user expectations on quality, choice, convenience, and costs and gain their acceptance.

EBU continues its efforts to ensure that the future networks will be capable of meeting PSM requirements. Many technical, operational, and cost issues remain to be addressed.

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