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5G FOR THE DISTRIBUTION OF AUDIOVISUAL MEDIA CONTENT AND SERVICES

TECHNICAL REPORT

Geneva – Parte V

EBU
5G for the Distribution of Audiovisual Media Content and Services

Contents

References

This report elaborates on the potential of 5G to facilitate the distribution of the whole range of PSM services to portable and mobile devices. It is a result of collaboration between stakeholders in the media sector, including public and commercial broadcasters, broadcast and telecom network operators, equipment manufacturers, and technology providers. Hence, the views presented in the report do not necessarily reflect a formal position of the EBU or any of the contributing parties.

The report addresses 5G network deployment opportunities for the distribution of media services. Even though the media industry, led by the EBU, successfully engaged in the standardization of 5G, in particular 5G Broadcast, this does not guarantee that all standardised features will inevitably be implemented in 5G networks and devices. The scope and timing of market deployment of a particular feature are largely driven by the existing or expected market demand.

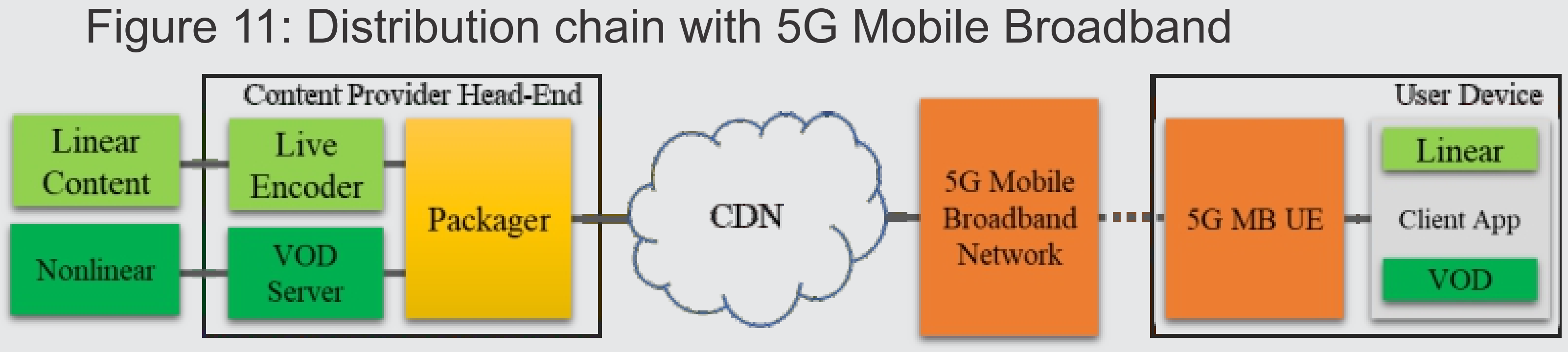
5.25G Mobile Broadband Distribution

This section investigates how 5G Mobile Broadband (i.e. the architectures and features of 5G outlined in § 3.2 that are applicable to media distribution) may deliver both linear and nonlinear content. In the first instance the OTT delivery model has been assumed, in which media traffic is treated in the same way as any other data on the network.

However, compared with OTT, the 5G media streaming architectures, or the inclusion of multicast / broadcast mechanisms may improve the distribution of media content to meet more of the requirements in § 2.4.

Figure 11 depicts the distribution chain to model 5G Mobile Broadband for OTT. Note that differences may exist when referring to architectures which can expose interfaces to CDN operators or directly to service providers as, for instance, for Figure 3.2.

Figure 11: Distribution chain with 5G Mobile Broadband



5.2.1 Universal Coverage and Universal Access

5G Mobile Broadband connectivity is provided within a given 'home' country by a specific mobile network. Within the home country it is usually not possible to access data from a network for which the user has no subscription, i.e. intra-country roaming is usually not possible. In situations where not all mobile networks provide near-universal coverage, which is common throughout Europe, subscribers of networks with low geographic coverage may not be able to receive an adequate service throughout their journeys. Figure 12 illustrates the situation in which, out of three networks, only MNO C provides near-universal coverage. In this example, subscribers to MNO A would not be able to receive a service throughout their journey, while it would be possible for subscribers of MNO C. This situation may not be suitable for many PSM organisations who are often tasked with providing universal coverage.

Figure 12: Conventional mobile network operation showing different coverage per operator

Options for providing universal coverage regardless of operator are:

a) Extend all networks to provide near-universal coverage. Extending all networks would require additional investment by all operators. Additionally, under this model, content concurrently requested by multiple users in the same cell, but from different home networks, would need to be replicated and transmitted across different networks, using radio spectrum inefficiently.

b) RAN sharing so that one network (e.g. MNO C) could provide coverage to all subscribers when outside the coverage area of their home network. RAN sharing may significantly reduce any additional investment compared with option I as it may not be directly necessary to extend the coverage of each network. However, RAN sharing would require at least the following aspects to be in place:

. A supportive regulatory environment, potentially including the ability to share spectrum across operators.

II. Network sharing agreements between all operators in a country.

III. A governance model, potentially including a third party or joint venture to manage the shared parts of the network.

c) Use of Roaming within the 5G Media Streaming architecture. A reference architecture for roaming with local break out and home-routed scenarios is defined in . Different RAN sharing and roaming models may require different degrees of cooperation between MNOs and regulatory frameworks. It is also unclear whether the technical characteristics of roaming could enable the delivery of an uninterrupted stream should a mobile device quickly need to roam from one network to another in areas of patchy coverage. Buffering content on the user device – as is now commonplace – may help overcome some of these difficulties.

The situation illustrated in Figure 12 would apply to services consumed via unicast, multicast or broadcast transmissions (except FTA broadcast). All cases call for cooperation between MNOs, which is not yet in place.

In the current situation it is unclear whether 5G Mobile Broadband could adequately provide universal coverage and/or universal access for either linear or nonlinear services.

5.2.2 Free-to-air (FTA) Access

5G Mobile Broadband requires the use of SIM cards for authentication to a network and to get access to services such as voice, text and data. Under these conditions there is typically no free-to-air access to AV services.

However, services can be made free at the point of access based on flat rate tariffs, packages with a limited cost on top of the tariff, and with zero-rating arrangements between service providers and network operators, as described in Annex B.

5.2.3 Defined Quality of Service (QoS)

At times of peak traffic, it is difficult to guarantee a defined QoS in general purpose data networks. 5G Mobile Broadband using unicast will face the same problem. The use of multicast / broadcast in the core network may decrease congestion in the case of concurrent demand of the same content. Therefore, multicast / broadcast may be useful techniques for the distribution of linear services but would be of limited help for nonlinear content. 5G Network Slicing, as described in § 3.2, may allow different QoS rules so that certain traffic receives favourable treatment (e.g. forwarding, scheduling, …) across the core network to improve its distribution.

However, in the radio access network it is unclear whether it is possible to guarantee the allocation of radio resources to maintain the QoS across nationwide coverage, especially for nonlinear content for which consumption is often non-concurrent.

5.2.4 Scalability

5G Mobile Broadband using unicast faces traffic scaling commensurately with the number of users. Meeting higher demand for unicast traffic would therefore necessarily require investing in network infrastructure to support the greater traffic. Content that is consumed concurrently may be delivered more efficiently by the provision of multicast / broadcast modes.

Unicast to broadcast switching may be provided by means of MooD in eMBMS. New approaches in Release 17 for 5G Multicast / Broadcast may also support the provision of multicast and broadcast in a dynamic fashion. Alternatively, the support of multicast within the 5G Media Streaming architecture might also be considered, as explained in § 3.2.2. Note that the use of multicast or broadcast has an impact on network protocols, architectures and the content source, which may differ from the OTT model. The integration of multicast / broadcast capabilities as a network function optimization as suggested in § 4.5.1 would allow for scalability with minimal impact on the content servers and end device applications.

Issues at the radio access network may still involve the impossibility to deploy large area SFNs (as this may not be supported in 5G Multicast / Broadcast) which may call for the need of skilful scheduling and interference coordination (frequency reuse).

5.2.5 Service Integrity

5G Mobile Broadband may not be able to guarantee service integrity for content delivered over best effort unicast as the content or its presentation may suffer modification within the network (e.g. filtering may be applied to specific content). Transcoding would also be needed at some network nodes (see § 3.2.2). Although the use of secure protocols may enhance the abstraction of content in the network, the final experience is highly dependent on the network conditions.

The deployment of specific architectures that differentiate media traffic may provide better control on the distribution chain granting a high degree of control to service providers.

5.2.6 Prominence

5G Mobile Broadband would allow the prominence of media services with the design of an application. Due prominence may require additional measures when the app is part of an app store managed by a third party.

5.2.7 Ease of Use

5G Mobile Broadband would allow the 'ease of use' of media services for consumers to be defined by the design of applications running on the user device. These applications generally require download and regular updates. Specific APIs may need to be provided to developers to integrate functionalities beyond the generic apps for OTT distribution.

5.2.8 Accessibility

5G Mobile Broadband using unicast grants access to a wide range of customization regarding accessibility. This is already applied in HbbTV applications which may allow changes to font size, position, background of subtitles, the introduction of customizable sign language presenter, clean audio and slowed down speech for greater audibility, etc. The integration of these options in apps is possible through implementation.

5.2.9 Public Warning

The availability of services under emergency situations mainly depends on the network availability as well as audience size. The OTT model suffers from the lack of resources in the network when networks become congested. The use of multicast / broadcast technologies may alleviate network congestion. However, without the establishment of dedicated resources, independent from other type of traffic, both at the core and radio access networks for the provision of media services, its availability may be prioritized but not guaranteed.

For example, Finnish national law (compliant with EU Net Neutrality rules ,)allows IP-packet prioritization in fixed and mobile broadband networks for PPDR (Public Protection and Disaster Relief) traffic between authorities. It would be compliant with EU Net Neutrality for Finnish national law to allow IP-packet prioritization for emergency warnings to a large audience through PSM internet publishing platforms.

5.2.10 Encryption and Copy Protection

OTT platform or content providers can use market-standard technologies to ensure that the streaming of their channels is always encrypted and protected. OTT content is typically encrypted with minimum AES 128 and protected by the usage of a DRM-system. These DRM-systems protect the content end-to-end along the complete transmission-chain to the user's display against unauthorized usage.

Common DRM systems are Google Widevine (for MPEG DASH), Apple Fairplay (for HLS) or Microsoft PlayReady (for MPEG DASH, smooth streaming), separate Security Levels must be considered. All DRM systems require a return channel. Copy protection systems can prohibit recordings, limit the outputs of devices to lower resolutions or activate “Copy never” settings on digital outputs.

Note that DRM is supported, in particular, in the architectures described in §§ 3.2.2 and 3.2.3.

5.2.11 Targeted Advertising and Personalization

5G Mobile Broadband using bi-directional communication and the use of unicast allow for the application of server-side technologies for content personalization and targeted advertising including, but not limited to, means for dynamic ad substitution (DAS).

5.2.12 Gatekeeping

The delivery chain of 5G Mobile Broadband for both linear and nonlinear services (see Figure 11) shows several areas in which gatekeeping may appear. Some examples are provided below.

Content Delivery Network (CDN)

Third-party CDNs may become gatekeepers as the intermediate point between a service provider and the MNO. Depending on the functionalities required from the CDN this may have a different impact. Content served using unicast would experience the same degree of gatekeeping as per the current OTT model. The unavailability of multicast enabled CDNs may result in the need of establishing multiple independent connections to different MNOs to provision content served as multicast. Note that the 5G Media Streaming architecture offers the possibility to by-pass the CDN as the functionality can be offered within the MNO domain.

Mobile Network Operator (MNO)

Mobile Network Operators would have control over the delivery of media towards the user. This currently involves the possibility to transcode and filter the content. Service level agreements (SLAs) could, in principle, be established between service providers, CDN operators and MNOs to agree the distribution of content with specific QoS parameters. The introduction of specific functionalities in MNO networks such as the use of multicast / broadcast or the 5G Media Streaming architecture would require corresponding business models.

Device manufacturers

Device Manufactures have the main role in integrating and requesting from chipset manufacturers the implementation of certain features in devices. For the traditional model of OTT using unicast this may not result a problem. However, the integration of additional features will need to be justified and requested to be implemented.

Client Applications

Considerations in terms of prominence of ease of use apply when the applications require to be downloaded by users. Applications currently supported under an OTT model would not require changes unless advanced functionalities of the 5G Mobile Broadband system are integrated (e.g. 5G Media Streaming Player).

5.2.13 Costs

Content Delivery Network (CDN) Costs

CDN cost is dependent on audience size and required bandwidth, what makes it difficult to predict in advance. As a rule of thumb, CDN costs scale linearly with the number of requests. Economies of scale cannot fully compensate rising costs with increasing audience. On the other hand, dimensioning CDNs for peak demand reduces the possibility for financial benefits. CDN costs are not regulated and need to be negotiated independently with the content provider.

Costs between Service Providers and MNOs

No direct cost related to mobile networks is in the OTT model although indirect cost may be passed on to users and CDN providers. The use of architectures and features that enable the establishment of special business arrangements between service providers and MNOs need to be evaluated. This may consist of costs for integrating functionalities inside MNO networks (network functions such as those described for the 5G Media Streaming architecture), for establishing SLAs or for traffic injection via specific media-related interfaces exposed from the MNO to the service provider.

It may be interesting to investigate how joint use of spectrum and infrastructure between broadcasters and MNOs can reduce the overall cost for additional broadcast and unicast DL capacity.

Cost for Users

This mainly involves a data subscription plan with potential add-ons such as tariffs including zero rating (see Annex B). Cost for using applications in their smartphones, tablets or car infotainment systems are typically free for applications of PSM organisations. Applications from aggregators or commercial service providers may be purchased (on-time payment) or offered with a subscription.

Royalty fees

Royalty fees for rights holders may be dependent on the distribution path. In general royalty fees for unicast streams may be more expensive than for broadcast distribution and increase if some sort of personalization or off-line availability is added.

5.3Delivery of Linear, Nonlinear and Enhanced Media Services

Linear services can be distributed using either 5G Broadcast or 5G Mobile Broadband. 5G Broadcast would allow the distribution of linear content in essentially the same way as it is delivered over conventional broadcast networks today while essentially meeting all the requirements of PSM organisations and commercial broadcasters for linear service distribution.

5G Mobile Broadband may also be used to deliver linear services, however 5G Mobile Broadband would not meet all the requirements outlined in § 2.4. Universal access and guaranteed QoS, in particular, do not yet appear to be possible to achieve.

Nonlinear services can only be delivered by unicast connections as they offer bi-directional communication, which is the basis for interactivity. Additional to the challenges outlined in previous sections, nonlinear cannot benefit from multicast / broadcast modes as users do not generally request content concurrently. Scalability is therefore major problem.

Enhanced media services – which have both a linear and nonlinear component – may make best use of all the delivery methods of 5G mobile broadband. For example, 5G Broadcast could be used to deliver linear services, free-to-air and at a national scale with defined QoS. The linear component may fulfil a minimum PSM requirement of providing free access to services for all.

Nonlinear and catch-up content could be delivered over unicast and multicast as requested through a separate unicast connection with an MNO, although content delivered in this way may only be free at the point of access and may not have guaranteed QoS. Targeted advertising and regional content could also be achieved with this model. Such functionality is enabled by the 3GPP standards and is illustrated by Figure 13.

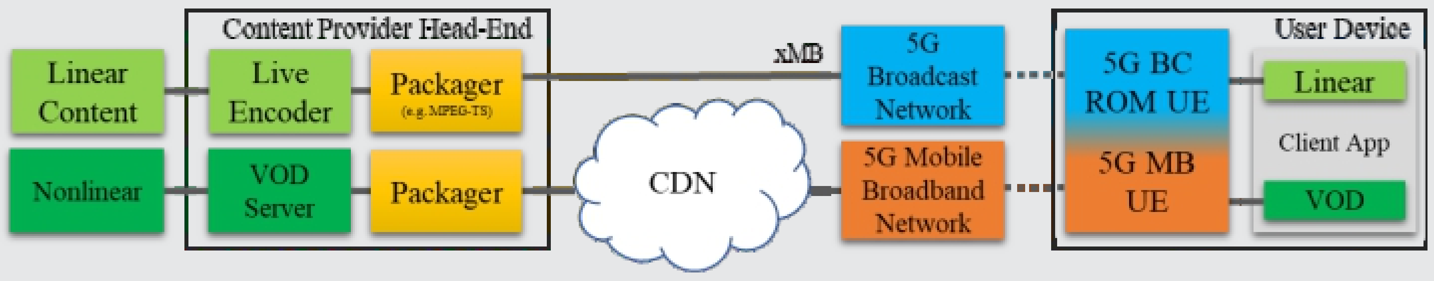


Figure 13: Combination of ROM receiver with unicast capabilities at the UE

Service Description	Enhanced Media Service = Linear + Nonlinear		
	Linear		Nonlinear
Requirements/5G Mode	5G Broadcast	5G Mobile Broadband	
Universal Coverage & Access	Network Dependent	Network Dependent / RAN Sharing / Roaming	
Free to Air Access	Receive-only mode, SIM-free	No FTA / Subscription Required / Flat Rates / Zero-Rating	
Defined QoS	Provider-defined & Guaranteed	Network/RAN Slicing	
Scalability	Unlimited Users	MooD/Multicast/Broadcast	RAN capacity constraints
Service Integrity	Transport-Only Mode & App	Not Guaranteed / May be defined	
Prominence	Defined by App / App Store	Defined by App / App Store	
Ease of Use	Defined by App	Defined by App	
Accessibility	Defined by App	Defined by App	
Public Warning	Dedicated Resources	No guaranteed end-to-end dedicated resources	
Encryption / Copy Protection	CAS-based / To be defined	DRM-based	
Targeted Advertising	Requires Unicast / On-Demand	5GMSA / On-Demand	Possible
Gatekeeping	UE Manufacturers / Network Operators / App Stores	CDN Providers / Network Operators / App Stores	
Costs	Potential network densification / Fixed OPEX / Free for users	Variable OPEX / Tariffs for users	

Supported | Not Supported | Requires further action / relevant 3GPP technology

Figure 14: Media distribution requirements using 5G Broadcast or 5G Mobile Broadband

Analysis and Conclusions

Public and commercial media organizations offer a wide range of content and services across several distribution platforms. The opportunities of reaching a variety of user devices (e.g. smartphones, tablets, car infotainment systems) are limited with conventional broadcast systems. To distribute content and services to these devices, an IP delivery mechanism is required. Out of the home – where Wi-Fi is not generally available – 5G would be an obvious candidate technology.

Recent enhancements to 5G include several features which improve its ability to distribute media content and services. These has been categorized under 5G Broadcast and 5G Mobile Broadband and analysed in the context of distributing linear, nonlinear and enhanced media services. Several benefits and challenges are highlighted here.

6.1 Distribution of Linear Services

Linear services could be distributed by either 5G Broadcast or 5G Mobile Broadband.

5G Broadcast fulfils many of the requirements of media organisations for the distribution of linear services to mobile and portable devices. 5G Broadcast would also allow media organisations to operate dedicated networks (independent of MNOs) with reserved capacity for the transmission of linear services, as they do today with conventional broadcast networks, with similar operational models. Furthermore, SIM-Free FTA transmission would make linear services available to all mobile devices, regardless of the network to which they subscribe for data. The duplication of the same services by across all MNOs in parallel could thus be avoided.

However, several challenges must be overcome before this technology could be actively deployed. The most salient are summarised below:

No 5G networks nor 5G user devices today support 5G Broadcast. Now (Q2/2020) there are no signs that the operating models of MNOs and handset manufacturers will lead to support for 5G Broadcast in the future. This is most likely because user devices would require hardware modifications to be 5G Broadcast compatible – modifications that entail substantial development investments. Should broadcasters wish to make use of 5G Broadcast, they will need to actively take the steps necessary to introduce it, for example by creating a convincing business perspective for all involved market partners, ideally in large / global markets.

Furthermore, due to the challenging link budgets involved, providing near-universal coverage to portable and mobile devices would require networks with an element of LPLT transmitters. Conventional HPHT and MPMT networks alone would not be adequate. The affordability of such networks would need to be considered carefully. Models for the integration of such topologies could be further considered and would require commercial and technical cooperation with MNOs and relevant infrastructure providers.

Standalone downlink only (SDO) bands have not been defined in 3GPP, nor has spectrum been identified by the ITU. 5G Broadcast could be deployed in FDD bands defined in 3GPP. However, this would not use uplink resources, and would therefore be inefficient. Two further options are the L-Band (3GPP band 32: 1452 – 1496 MHz) and the sub-700 MHz UHF band (470 – 694 MHz). Where not assigned to MNOs, the L-Band could be used for SDO in Europe, but a request for such use would likely require wide support from many countries. The sub-700 MHz UHF band is currently heavily used by DTT and PMSE in Europe.

The sub-700 MHz band would be a candidate band for the introduction of 5G Broadcast, as it is allocated to the broadcast service. An introduction of 5G Broadcast in this band would require coexistence with the 8 MHz channel raster of DTT. This may entail the use of 5 MHz carriers within 8 MHz channels, 15 MHz carriers in a contiguous pair of 8 MHz channels or the definition of a new 8 MHz bandwidth for 5G Broadcast. Usage of 10 MHz carrier bandwidths may not be feasible because of severe adjacent channel interference issues. In all cases, ensuring compatibility with the GE06 framework in ITU Region 1 and other Regions that use 8 MHz rasters for DTT.

To create a sufficiently large device and infrastructure ecosystem for 5G Broadcast in sub-700 MHz, it is crucial that a joint effort is made globally with all stakeholders. Here, China and possibly India may deserve specific attention to align these markets with huge populations with the needs of the EBU members.

5G Mobile Broadband unicast capabilities are being deployed in networks and user devices. Unicast supports over-the-top (OTT) distribution of linear services. OTT over unicast is being increasingly used by media organizations to provide services via applications on smartphones, tables or car infotainment systems. Although OTT is very convenient and is the principle way for media organisations access to mobile devices out of the home, unicast OTT does not fulfil all the requirements of media organizations. The most relevant shortfalls are summarized below.

To date, mobile networks do not provide near-universal coverage. Furthermore, unicast coverage is dependent on the user's home network, meaning that subscribers to networks with comparatively low geographic coverage may not be able to enjoy media service throughout their travels. Universal coverage and access may therefore not be practically achievable with unicast OTT. Intra-country roaming or RAN sharing may improve the situation, but several technical and commercial hurdles would first need to be overcome. Flat-rates and/or zero-rating could enable services to be received free at the point of access, but full free-to-air access with no gatekeeping is not possible with OTT unicast.

Defining quality of service (QoS) and service integrity with unicast OTT may prove to be impractical. 5G architectures being developed in 3GPP Rel-16 such as 5G Media Streaming Architecture may improve QoS, particularly in the core network. The 5G System in Rel-17 will support multicast and broadcast capabilities, mainly driven by safety services and IoT use cases. Dynamic switching between unicast, multicast/broadcast may then more efficiently use network resources to improve the QoS of associated services.

If media may also make use of these features, multicast / broadcast could reduce traffic peaks in the core network for concurrently consumed linear and live services. Such an outcome would be particularly attractive should it be possible to implement with no hardware changes to UEs. Treating multicast as a network optimization feature (as opposed to 'as a service') would limit the impact on service providers and UEs, thus making it attractive for both MNOs and handset manufacturers. However, QoS at scale over a large coverage area may remain unguaranteed on the RAN, which would still be subject to resource contention.

Nevertheless, solutions with limited implementation impact and UE complexity and targeting requirements from different stakeholders would facilitate adoption in networks and devices.

Media distribution over 5G Mobile Broadband would imply a degree of gatekeeping given that content and services would be delivered via third party networks. CDN costs which scale commensurately with audience size would need to be further considered.

6.2Distribution of Nonlinear Services

5G Mobile Broadband is essential to provide connectivity for nonlinear services. This makes it possible to provision on-demand services and create commercial propositions enabling monetization, targeted advertising, personalization, etc. The same considerations given in § 6.1 generally apply. However, the main challenge is to scale network resources as multicast / broadcast could not be applied to unsynchronized content consumption.

6.3Distribution of Enhanced Media Services

5G allows for the distribution of enhanced media services, including those that integrate both linear and nonlinear components. 5G Broadcast could deliver the linear component free-to-air at a national scale with defined QoS. 5G Mobile Broadband would be used for nonlinear and catch-up content, although this may or may not be free at the point of access and may not have guaranteed QoS. The combination of 5G Broadcast and 5G Mobile Broadband would fulfil the essential requirements of PSM organisations while providing enhanced services for those with a mobile broadband connection. Commercial media organizations could also fulfil their requirements. 5G supports Fixed Wireless Access (FWA) to stationary devices in a similar way to fibre. It may thus provide linear, nonlinear and enhanced media services for stationary consumption.

In summary, the full set of requirements of PSM and private media organisations regarding enhanced media services could be met only with a combined 5G Broadcast and Broadband network.
To achieve this, further investigations into cooperative models between broadcasters and mobile network operators in term of joint use of spectrum and site assets would be useful. Such cooperation may deliver the cost benefits and the economies of scales required to trigger the device and infrastructure ecosystem for 5G broadcast.

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