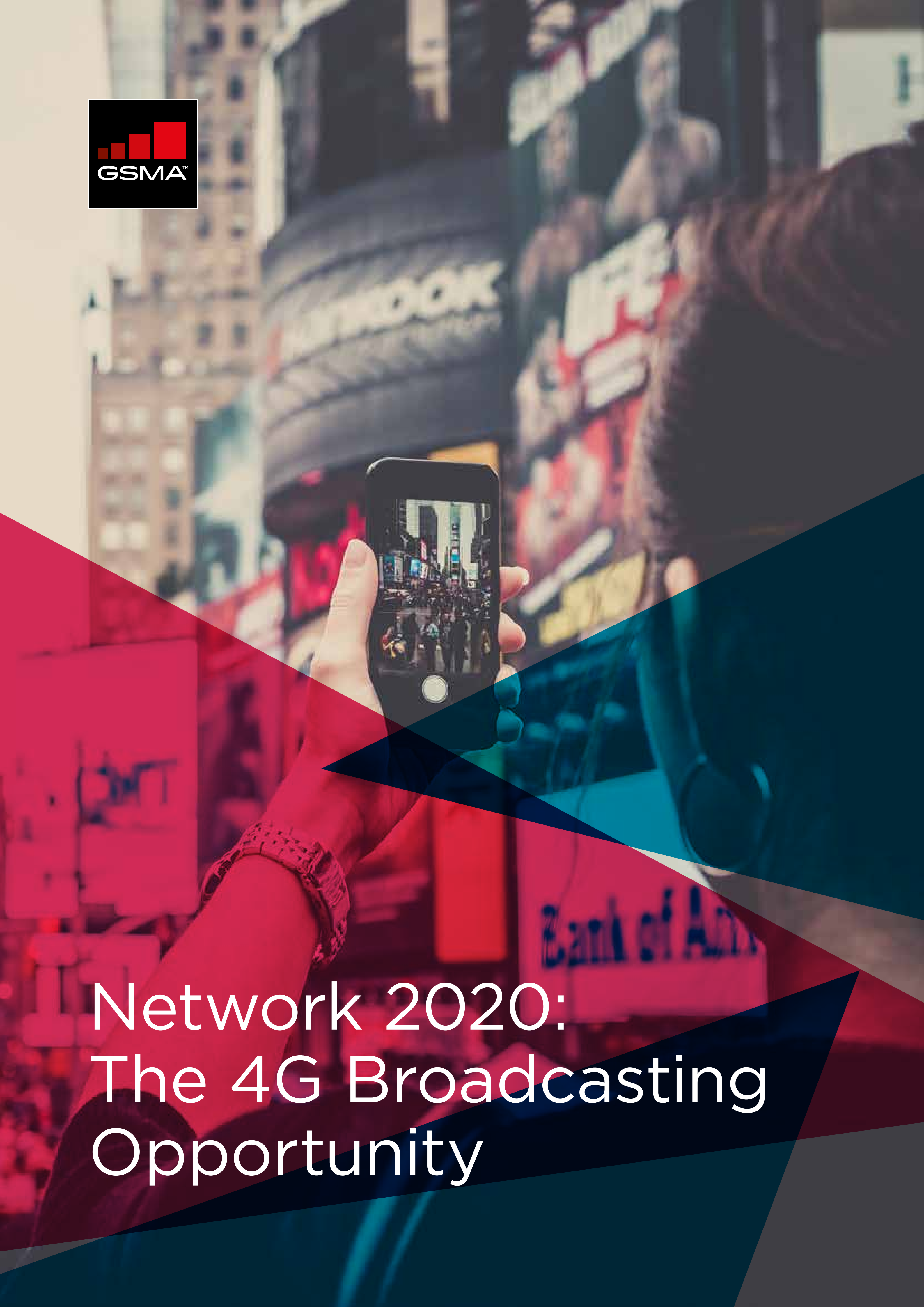


Network 2020: The 4G Broadcasting Opportunity

About the GSMA

The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with almost 300 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of conferences.

For more information, please visit the GSMA corporate website at www.gsma.com. Follow the GSMA on Twitter: @GSMA.

Network 2020

Network 2020

The GSMA's Network 2020 Programme is designed to help operators and the wider mobile industry to deliver all-IP networks so that everyone benefits regardless of where their starting point might be on the journey.

The programme has three key work-streams focused on: The development and deployment of IP services, The evolution of the 4G networks in widespread use today The 5G Journey, developing the next generation of mobile technologies and service.

For more information, please visit the Network 2020 website at: www.gsma.com/network2020 Follow the Network 2020 on Twitter: #Network2020.

With thanks to contributors:
DISH Network Corporation
EE Limited
Ericsson
Gemalto NV
Huawei Technologies Co Ltd
KDDI Corporation
KT Corporation
NEC Corporation
Nokia
Orange
Qualcomm Incorporated
SK Telecom Co., Ltd.
Telecom Italia SpA
TeliaSonera Finland Oyj
Telstra Corporation Limited
United States Cellular Corporation
Verizon Wireless
Vodafone GmbH

Contents

1

Introduction

1.1 Overview

The deployment of LTE and widespread adoption of smartphones have opened up new opportunities in mobile communications for operators to consider. In addition to the traditional business model of providing mobile broadband data access and communication services on the move, Mobile Network Operators (MNOs) can extend the portfolio of services offered by leveraging the enhanced broadcasting capabilities of LTE networks. 3GPP (3rd Generation Partnership Project) has already standardised eMBMS (evolved Multicast Broadcast Multimedia Service) also referred to as LTE-Broadcast (LTE B).

Broadcasting has been conventionally confined to real-time delivery of media content (e.g., mobile TV), however, streaming of video is not the only use case eMBMS can fulfil. This paper will illustrate, for example, the use of eMBMS for non-delay-sensitive applications, such as content pre-positioning and software updates, broadcasting of content relevant only in specific locations and other use cases that together form a compelling business opportunity.

This document will also provide a technical overview of eMBMS for operators considering to deploy the technology including network APIs and the status of readiness of devices.

1.2 Definitions

Term	Description
Head Content	Head content refers to media that is consumed, not necessarily simultaneously, by a large number of users. This popular content is positioned in the head of a statistical distribution ranking the content by popularity.
Long Tail	Long Tail refers to the content (or more generically products) that are not highly popular but are consumed in large numbers. Long tail content forms the tail of a statistical distribution ranking the content by popularity.

1.3 Abbreviations

Term	Description
3GPP	Third Generation Partnership Project
API	Application Programming Interface
ARP	Allocation and Retention Priority
BM-SC	Broadcast Multicast Service Centre
CDN	Content Delivery Network
CoMP	Coordinated Multiple Point transmission
CP	Content Providers
DASH	Dynamic Adaptive Streaming over HTTP
DTT	Digital Terrestrial Television
eMBMS	Enhanced Multimedia Broadcast and Multicast Service
eNB	eNodeB
EPC	Evolved Packet Core
EPS	Evolved Packet System
E-UTRAN	Evolved-Universal Terrestrial Radio Access Network
FTA	Free to Air
FTV	Free to View
GBR	Guaranteed Bit Rate
GUI	Graphic User Interface
ICN	Information Centric Network
LTE-B	Long Term Evolution Broadcast
MBB	Mobile Broadband
MBMS	Multimedia Broadcast Multicast Service
MBMS-GW	MBMS Gateway
MBSFN	Multicast-Broadcast Single Frequency Network
MCE	Multi-cell/multicast Coordination Entity
MEC	Mobile Edge Computing
MNO	Mobile Network Operator
MooD	Multimedia Broadcast Multicast Service on Demand
NDN	Named Data Network
OTT	Over the Top
PLMN	Public Land Mobile Network

RNIS	Radio Network Information Services
RNTI	Radio Network Temporary Identity
RSPG	Radio Spectrum Policy Group
SC-PTM	Single Cell Point to Multipoint
TMGI	Temporary Mobile Group Identity
SDL	Supplemental Downlink
UE	User Equipment
UHD	Ultra-High Definition
UHF	Ultra High Frequency
UMTS	Universal Mobile Terrestrial System
V2I	Vehicle to Infrastructure
V2P	Vehicle to Pedestrian
V2V	Vehicle to Vehicle
V2X	Vehicle to X
VR	Virtual Reality

1.4 References

Ref	Title
[1]	"Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997. Available at http://www.ietf.org/rfc/rfc2119.txt
[2]	Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020
[3]	"The Economic Benefit of Broadcast Offload in Mobile Data Delivery", a study from Rise Conseil & TDF
[4]	"Evaluating the LTE Broadcast Opportunity". Available at http://gsacom.com/download.php?id=1972
[5]	"Multimedia Broadcast/Multicast Service (MBMS); Extensions and profiling"

2

Business value of LTE-Broadcast

2.1 Considerations

While broadcasting technology has been included in the 3GPP specifications for the third generation mobile system (UMTS) this capability failed to gain market traction as the focus of 3G was to provide mobile broadband. The specification of an evolved version of the Mobile Broadcast and Multicast system (eMBMS) as part of 4G specifications, greatly improved both the performance and the features set making the provision of broadcast services over mobile networks more feasible. As of the end of 2016 a number of network operators have developed commercial services and several trials have been conducted in a large number of countries. The main obstacle to a widespread adoption of eMBMS can be attributed to the upfront cost of deployment, device dependency, and more importantly the need for a targeted revenue generating business case rather than maturity of the solution. As eMBMS specifications reach their fifth release (the first being Release 9) it can be safely assumed that the technology is stable and proven.

Regarding the costs of deployment those can be broken down in core network costs and radio network costs. As it will be discussed in section 3 the eMBMS core network infrastructure is overlaid on the existing 4G core network (Evolved Packet Core) and consists of a few new functional elements that are offered by all the main suppliers of infrastructure equipment. In the radio access network eMBMS can be enabled in the radio network simply via software upgrade. The reason for high initial investment is the complexity of synchronising the radio network required to reap the benefits of the Multicast Broadcast Single Frequency Networks as this is a not an insignificant task. However the advantages of deploying a synchronized network go beyond eMBMS. For example, inter eNodeB synchronisation allows an operator to improve the signal quality by means of the Coordinated Multiple Point transmission and reception (CoMP) technology.

If looking for a technology aspect that could have hindered the potential of eMBMS, this is the support of eMBMS in devices (see section 3.3). And yet, the delay in introducing support of eMBMS in devices has often been ascribed to the lack of value in mobile broadcasting rather than the maturity of the technology.

As far as the revenue generating business case is concerned, LTE-B enablement in the operator's network can be justified through a cost-driven business case alone. As Telstra claims, shifting of <1% of busy hour unicast traffic to LTE-B can justify the capital expenditure required for enabling broadcast in the network. While it is fair to recognise that there is no "killer application" for mobile broadcast, this paper shows that there exist a number of applications and services that cannot be easily replicated with technologies other than broadcast and that permit a more efficient use of the network resources. It is believed that their combination creates a positive business model across the value chain and that operators can claim a significant share of the generated value.

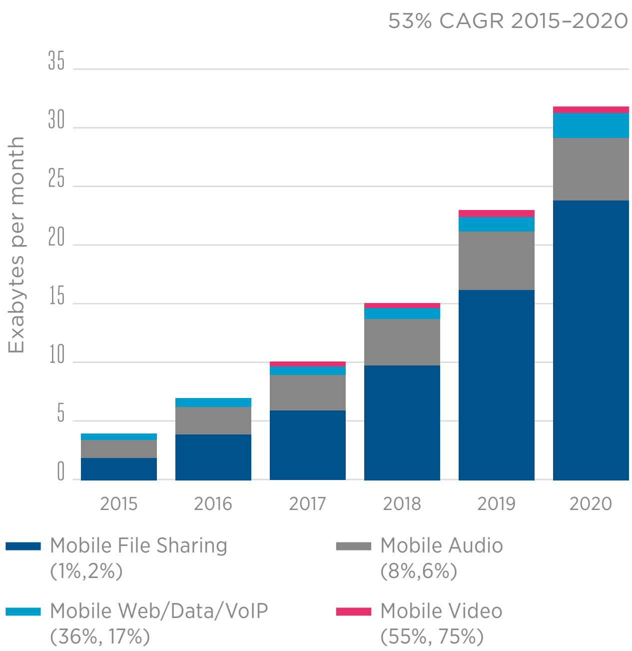
This paper also shows that other stakeholders benefit from enabling broadcasting in mobile networks. In the remainder of this section the business value of eMBMS for a mobile operator will be assessed according to cost savings that can be realised and new revenue opportunities.

2.2 Cost savings

Cost savings can be realised thanks to a more efficient use of the resources that translates in reducing the requirement on infrastructure and spectrum to provide the same level of service.

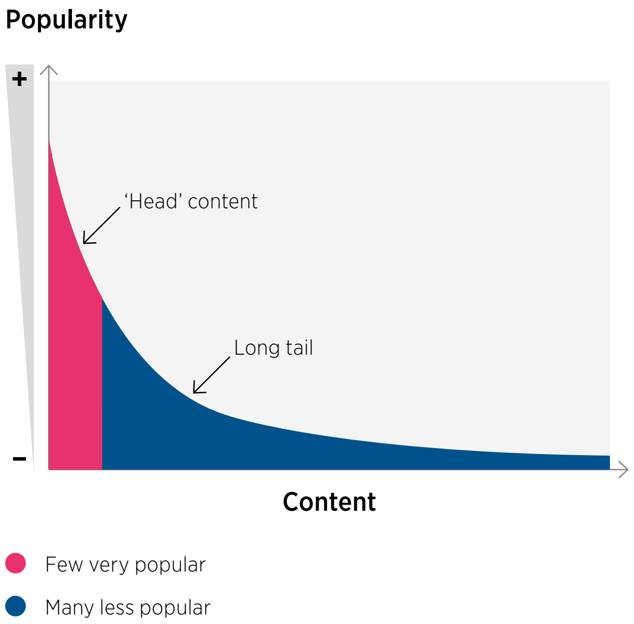
Source: Cisco VNI [3]

Figure 1: Mobile video is set to take a dominant share of the mobile data traffic



Video has experienced an explosive growth in the past few years, Cisco estimates that in 2015 mobile video traffic accounted for 55 percent of total mobile data traffic and it is expected to be 75% of the overall mobile data traffic by year 2020 [3]. A large proportion of this traffic is consumed (not necessarily simultaneously) by a large number of subscribers: this popular content is sometimes referred to as head content in contrast with the content long tail indicating the more numerous but less popular content[1] (see Figure 2). Examples of head content include live TV, time-shifted TV, on demand video and YouTube videos. Software updates, especially operating system updates can also be categorised as head content.

Figure 2: Example of statistical distribution of content popularity illustrating the head content and the long tail



Although the LTE access network can support many simultaneous high data rate streams in each cell, delivering highly popular content using unicast (point to point) transmission is not very efficient and an opportunity exists to optimise the use of the network by deploying eMBMS.

Given that a single transmission of content via eMBMS can be received by all the users in a given broadcast area, three beneficial effects occur:

- Radio resources for delivering head content are used more effectively since a single eMBMS transmission can replace a multitude of unicast transmission. In fact it can be demonstrated that the efficiency gain takes effect even when a small number of unicast transmissions are replaced
- The radio resources saved can be redeployed to provide higher throughput to individual users or simply to reduce energy consumption thus relieving the pressure on spectrum resources
- By delivering the content only once to the eNodeB that is selected for broadcasting it, eMBMS considerably reduces the strain on the transport network.

"The Economic Benefit of Broadcast Offload in Mobile Data Delivery", a study from Rise Conseil & TDF published in 2015 [4] argues that just by making fairly conservative assumptions on the adoption of eMBMS and availability of devices in France, the cumulative saving in the period 2016 – 2025 could amount to €10bn.

A further costs saving directly linked to the better use of the network capacity that eMBMS allows can be found in the lower number of eNodeBs potentially required to serve an area where traffic is shifted from unicast to multicast/broadcast. This could be significant especially in densely populated areas where eMBMS performs at its best and where it is potentially expensive to acquire new sites. For example, KT in South Korea has successfully demonstrated commercial deployment and efficiency of LTE-B for delivery to densely populated areas (http://telecoms.com/217182/koreas-kt-launches-lte-broadcast-service/).

[1] See for example https://en.wikipedia.org/wiki/Long_tail

2.3 New revenues

As discussed in section 4, eMBMS will enable the provision of new types of services (e.g. multi-camera views of a sport event, group communications), that may not be feasible to deliver using unicast, as well as an efficient means for delivering existing services (e.g. maintenance of digital signage, software update of IoT devices, electronic newspaper). eMBMS also opens up new ways for content providers and advertisers to reach mobile users (e.g. access via mobile of premium content, advertising during tourist information carousel).

It is reasonable to assume therefore that new value will be created and mobile operators can access a large part of it.

A further indirect source of revenue that can derive from deploying eMBMS is the potential of reselling the bandwidth that is freed up thanks to the efficiency and scalability of eMBMS.

LTE-B will sustain the technology relevancy and business model as LTE evolves to 5G. Introduction of 5G does not invalidate how LTE-B is deployed or commercialised, rather would support it from the start and take it to a new level by enabling a broad range of IoT, V2X and VR applications using this capability. Improved latency and reliability of 5G compared to today's networks will ensure that LTE-B efficiently distributes content, software and security updates to millions of connected devices. Frequency segmentation along with low latency in a specific frequency (i.e. network slices) in 5G means that LTE-Broadcast could become a network slice for distribution of videos, live streaming, software/firmware updates to mobile devices and connected cars, and 360°/Virtual Reality content and applications.

2.4 New spectrum: Supplemental Downlink in 470-694 MHz

The concept of Supplemental Downlink (SDL) in the context of UHF flexibility consists of allowing Mobile Broadband (MBB) use of available spectrum resources where not used by Digital Terrestrial Television (DTT) for additional downlink capacity provided that such use does not constrain existing and future DTT deployments and DTT installations.

While in the European Radio Spectrum Policy Group (RSPG) opinion on the long-term strategy of UHF conventional DTT distribution is protected until 2030, a flexibility option is also proposed. Frequency gaps in the UHF[2] band not required for DTT distribution can be filled with LTE downlink based on LTE-Advanced carrier aggregation of such downlink resources with standard mobile operator bands such as the 800 or 900 MHz bands.

Supplemental Downlink usage could be envisaged as early as around 2020, in a possible converged scenario, LTE Broadcast (LTE-B) provides access of mobile terminals for broadcast services over LTE networks. There are on-going evolutions in 3GPP to facilitate such service cooperation (see section 3.1.5)

However, LTE-B complements LTE networks and provides an option to enhance the MBB service in the direction where additional capacity is most needed. The SDL of LTE-B would provide large extra bandwidth in mobile broadband networks for unicast audio-visual content in the downlink direction such as VoD and Replay of TV programs

SDL with LTE-B has the potential to provide a win-win for broadcast and mobile broadband: broadcast would gain the delivery path and required capacity to mobile devices in mobile environments, even in difficult to reach locations such as underground public transport. At the same time, mobile broadband would gain valuable spectrum for additional capacity some of which will be needed for unicast of on-demand TV programs[3].

[2] http://rspg-spectrum.eu/wp-content/uploads/2013/05/RSPG15-595_final-RSPG_opinion_UHF.pdf
[3] See Digital Europe white paper on supplemental downlink in the UHF band:
http://www.digitaleurope.org/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=893

3

Technology status

3.1 Infrastructure

LTE Broadcasting is provided by eMBMS (evolved Multimedia Broadcast Multicast Service), a technology standardised by 3GPP. While traditional cellular communications provides point-to-point communication via dedicated bearer serving the two end points, eMBMS enables point-to-multipoint communication via shared bearers allowing the same transmission to reach multiple users. eMBMS, enabling EPS (Evolved Packet System) to provide MBMS bearer services over both UTRAN (UMTS Terrestrial Radio Network) and E-UTRAN (Evolved-UTRAN), has the following advantages for mobile operators.

- eMBMS utilises existing LTE infrastructure and spectrum and provides capability for UE to switch between unicast and multicast
- eMBMS offloads identical content, live content and software updates from unicast and thus enhances network efficiency when several UEs in the same cell receive the same content simultaneously
- eMBMS allows scalability of broadcasting services as a virtually unlimited number of users or UEs can access the same content.

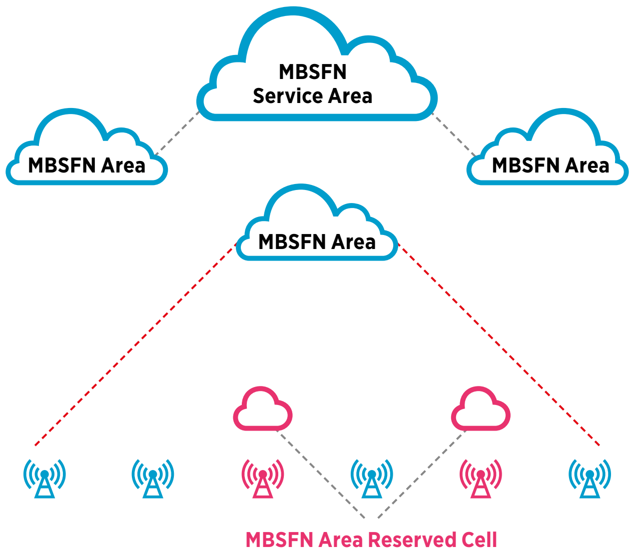
3.1.1 MBSFN hierarchical structure

When the Multicast-Broadcast Single Frequency Network (MBSFN) is used to deliver eMBMS service, different cells of a network are subdivided into the following logical areas as shown in Figure 3:

- MBMS Service Area: The area within which data of a specific MBMS session are sent
- MBSFN Synchronisation Area: An area of the network where all eNBs (eNodeB) can be synchronised and perform MBSFN transmissions. MBSFN Synchronisation Areas are capable of supporting one or more MBSFN Areas. On a given frequency layer, an eNB can only belong to one MBSFN Synchronisation Area. MBSFN Synchronisation Areas are independent from the definition of MBMS Service Areas
- MBSFN Area: An MBSFN Area consists of a group of cells within an MBSFN Synchronisation Area of a network, which are co-ordinated to achieve an MBSFN Transmission (i.e. a technique whereby identical waveforms are transmitted at the same time from multiple cells – which is seen by the UE as a single transmission). All cells within a MBSFN Area (apart from reserved cells) contribute to the MBSFN Transmission and advertise its availability
- MBSFN Area Reserved Cell: A cell within a MBSFN Area that does not contribute to the MBSFN Transmission. The cell may be allowed to transmit other services.

Source: 3GPP, recreated by GSMA

Figure 3: eMBMS hierarchical structure



Therefore, apart from MBSFN Area Reserved Cells, all cells in MBSFN areas that serve the MBMS service area will broadcast/multicast the data provided by the service on the particular frequency block.

3.1.2 Single Cell Point to Multipoint

3GPP Release 13 introduced a new mechanism for delivery of eMBMS in order to improve the efficiency of use of radio resources and flexible deployment of numerous applications: Single Cell Point to Multipoint (SP-PTM). SC-PTM make use of the eMBMS system architecture used for MBSFN, but follows a different approach in the allocation of radio resources aimed at improving the radio efficiency as well as to reducing the latency. The granularity of the broadcast/multicast services is down to a single cell so that the broadcast/ multicast area can be dynamically adjusted cell by cell according to the distribution of users. The SC-PTM transmission is carried over LTE downlink shared channel scheduled using a common Radio Network Temporary Identity (RNTI) for a group of users making it agile in utilising the radio resources dynamically in time and frequency.

3.1.3 eMBMS architecture

The hierarchical structure of eMBMS service is enabled by the architecture of eMBMS as shown in Figure 4. It is worthwhile noting that eMBMS re-uses the Evolve Packet Core (EPC) introducing only a few additional entities to function: MCE (Multi-cell/multicast Coordination Entity), MBMS-GW (MBMS Gateway) and BM-SC (Broadcast Multicast Service Centre). The role of these functions is briefly discussed below.

MCE. When operating using MBSFN, the MCE serves one or more eNodeBs and performs:

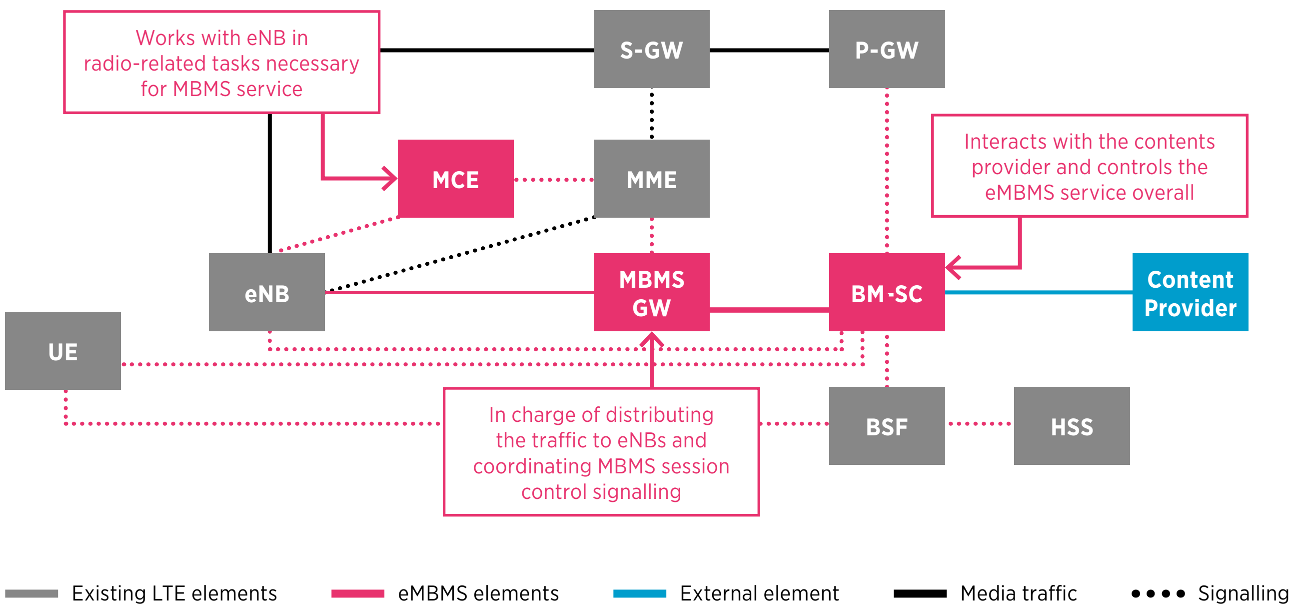
- The admission control and the allocation of the radio resources used by all eNodeBs in the MBSFN area for multi-cell MBMS
- Counting and acquisition of counting results for MBMS service(s)
- Resumption/suspension of MBMS session(s) within MBSFN area(s) based on e.g. ARP (Allocation and Retention Priority) and/or the counting results for the corresponding MBMS service(s).

MBMS-GW. The MBMS-GW sends/broadcasts MBMS packets to each eNodeB transmitting the service. It uses IP Multicast as the means of forwarding MBMS user data to the eNodeBs.

BM-SC. The BM-SC provides functions for eMBMS user service provisioning and delivery of eMBMS transmissions. It may also serve as an entry point into PLMN (Public Land Mobile Network) for content provider's broadcast content eMBMS transmissions.

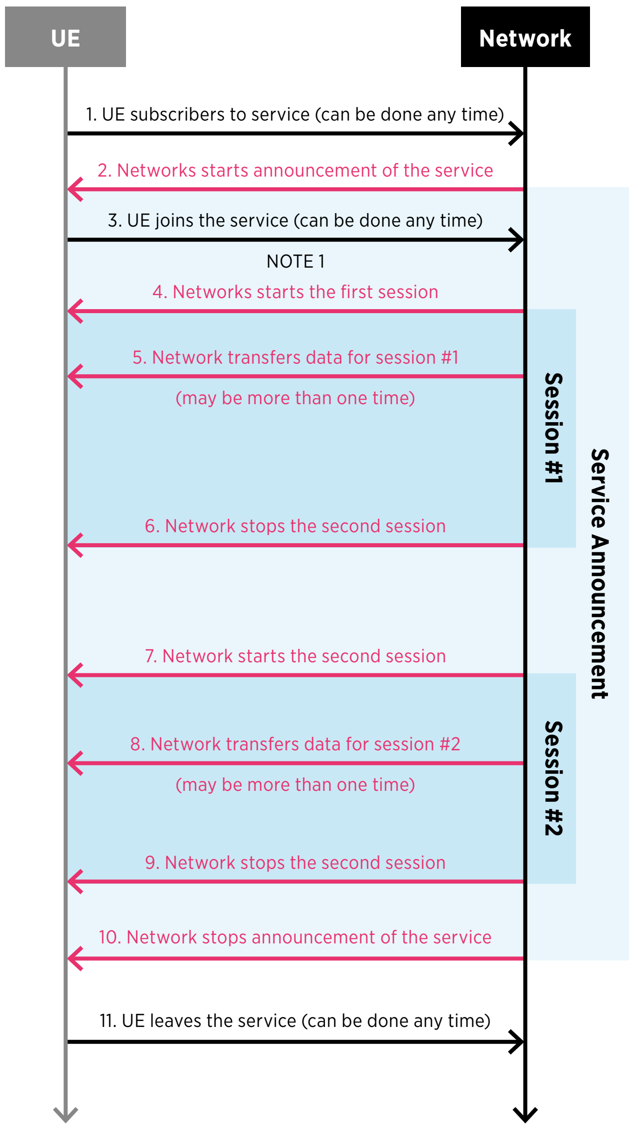
In short, BM-SC is the gateway that interacts with the contents provider and controls the service overall, the MBMS-GW provides the gateway function between the radio and service networks and separates the service layer functions from the core network while the MCE works with eNodeB in radio-related tasks necessary for MBMS service.

Figure 4: eMBMS Architecture



With the eMBMS specific entities implemented in the network, the network provides broadcast/multicast service to eMBMS-enabled UEs. In both cases, the service is announced by the network where interested UEs join the announced service for multicast and UEs with local service activation are listening to the service for broadcast. The actual data transfer can start when MBMS session starts and the subscribed/activated UEs receive data anytime during the session. The above procedures are visualised in the following figure.

Figure 5: eMBMS high-level call flow



NOTE 1: In case of broadcast, step 3 is not applicable and UE activates/deactivates local service in steps 1 and 11 respectively

3.1.4 Advanced capabilities of eMBMS

In addition to the functionalities described in the previous sections, eMBMS provides advanced capabilities such as mobility based Service Continuity (Unicast fallback and Switching for DASH-over-MBMS 3GPP 26.346 release 12) and Release 12 MooD (MBMS operation on Demand). MooD enables dynamic switching between Unicast and Broadcast over LTE, based on configured triggers. The trigger may be demand driven (i.e. through user service consumption or when there is an urgent alert to be broadcasted) or pre-scheduled based on events. MooD leverages the Service Continuity procedures mentioned above to achieve seamless transition unicast-broadcast and vice versa.

eMBMS uses DASH (Dynamic Adaptive Streaming over HTTP), a media format that slices live streams into a sequence of media segments which are then delivered over FLUTE as HTTP independent files. This technology is standardized in MPEG and in 3GPP and therefore is widely accepted in the industry. This makes it attractive since players are natively supporting both unicast and broadcast media delivery, whilst at the same time CDNs are required to only serve a single media format thus reducing operating costs and maximizing infrastructure usage.

Most LTE Broadcast deployments to date use FLUTE (File Delivery over Unidirectional Transport) over UDP both for live media (DASH) and file download (e.g. on device pre-positioning of content). Latency experiments have been undertaken in MPEG and techniques to reduce DASH latency for LTE Broadcast have been researched. Recently (early 2016) Advanced Television Systems Committee (ATSC) 3.0 developed an additional broadcast transport method targeted at enhanced TV services targeting reduced latency named Real-time Object Delivery over Unidirectional Transport (ROUTE)/DASH transported over MPEG media transport (MMT).

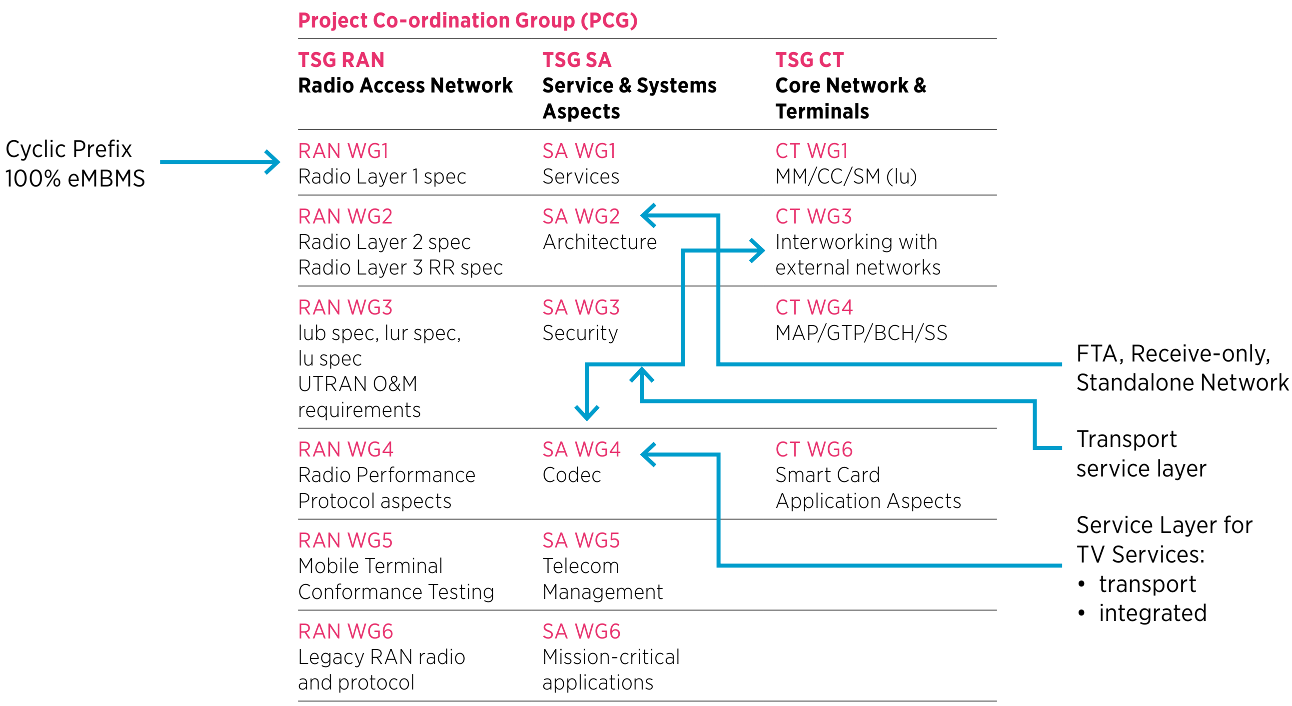
3.1.5 3GPP Enhancements for TV Service

In March 2016, 3GPP issued a technical report on 3GPP enhancements for TV service (TR 22.816). This technical report describes use cases, proposes assumptions and potential requirements and analyses 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 Over the Top (OTT) content.

3GPP is now engaged in Technical Specifications for Release 14 (TS 22.101), including 3GPP enhancement for TV service support, whereby 3GPP networks can provide unicast and broadcast transport, referred to as “TV transport services”, to support distribution of TV programs. TV transport services can support the three types of TV services – Free-to-air (FTA), Free-to-view (FTV), and Subscribed services. Each type of TV service has different requirements in order to meet regulatory obligations and public service and commercial broadcaster’s requirements regarding content distribution, hence many requirements are optional to implement depending on the type of TV transport services a MNO chooses to offer.

This work now impacts several 3GPP workgroups as summarized in the following figure:

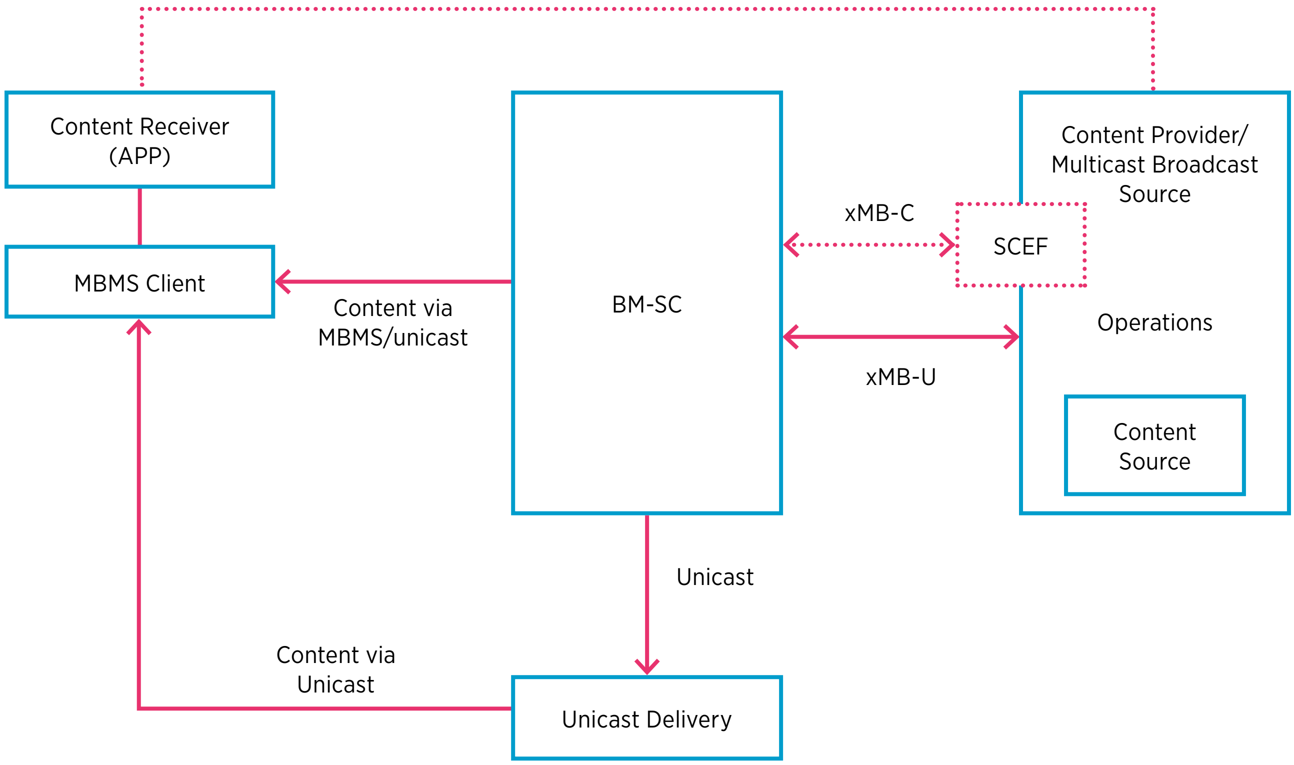
Figure 6: 3GPP groups working on TV enhancements



3.2 Broadcasting API

3GPP Rel.14 26.346 has introduced a new reference point xMB (Broadcasting API) between the Content Provider and the BM-SC.

Figure 7: The xMB reference model



The xMB reference point provides the ability for the content provider to:

- authenticate and authorize BM-SC(s).
- create, modify and terminate a service.
- create, modify and terminate a session.
- query information.
- deliver content to the BM-SC(s)

The xMB reference point provides the ability for the BM-SC to:

- authenticate and authorize a content provider.
- notify the content provider of the status of an MBMS user service usage.
- retrieve content from the content provider

The xMB reference point also includes a security function for confidentiality protection for both control plane and user plane.

3.2.1 Session Management

The API enables session management procedures to allow the content provider to create, modify and terminate sessions. Each session is “time bound” (i.e. has a start and stop time) and is associated with a target broadcast area (which can be used to derive the MBMS Service Area). The stop time may be absent in the case of 24/7 sessions.

The MBMS Bearer is active between the start and stop time of the session independently of whether the content provider is sending data. The BM-SC automatically terminates the MBMS bearer at stop time. The content provider may proactively terminate the session before the stop time.

The Session State diagram is shown in Figure 8. The BM-SC may only allow state transition, when the mandatory session properties according to the service type is configured. The BM-SC may reject modification of properties depending on the session state.

State description of the BM-SC for a session. The BM-SC may reject state transitions when mandatory parameters are missing. The BM-SC may send error notifications to the content provider.

- Session Idle: The Session is under preparation. Typically, the content provider needs multiple session updates in order to configure all session parameters and retrieve the needed information for content provider user-plane entities
- Session Announced: The session parameters are announced and MBMS Client may become aware that the session is about to start
- Session Active: The session is active according to the Session Schedule.

Figure 8: Session State Diagram

Table 1: Devices supporting eMBMS

3.3 Devices

In December 2016, approximately 20 commercially available devices support eMBMS

HTC One M9	LG G Vista	Samsung Galaxy S5
HTC Desire 626	LG K4	Samsung Galaxy Note Edge
LG G5	Motorola Droid Turbo 2	Samsung Galaxy Note 4
LG G4	Motorola Droid Maxx 2	Samsung Galaxy Note 3
LG G3	Motorola Droid Turbo	Samsung A7
LG V10	Samsung Galaxy S7	Samsung A5

All these devices make use of Qualcomm® Snapdragon™ chipset and eMBMS can be enabled via an over the air software upgrade. At present, all devices use the Android operating system.

Additional eMBMS compatible devices area listed in Annex A of the Evaluating the LTE Broadcast Opportunity [4] whitepaper.

3.3.1 Device middleware

The middleware layer plays an important role in delivering eMBMS services. It is required so that developers do not need to understand eMBMS technology in order to develop applications. Relevant APIs are available for application and client developer through middleware.

The main functions of the eMBMS Middleware are:

- Control and interface with the Modem to access eMBMS streams
- Receive and process eMBMS Metadata
- Provide relevant Metadata to the application
- Receive File Download service
- Receive DASH Live services
- Provide a DASH Server API to the application for playing the streams
- Perform File Repair
- Perform Reception Reporting.

The middleware layer is currently not standardised and based on the requirements defined in TR 26.852 [5] specification work is ongoing in 3GPP to standardise the service APIs. The middleware capabilities are evolving and will needed to be updated to support newer features such as broadcast ←→ unicast handover and MooD (MBMS operation on demand).

4

Services using broadcasting capabilities

4.1 Overview

Broadcasting capabilities enable operators to provide business models that would have been inefficient if provided by traditional networks. This section will list seven key examples to illustrate the business potential of LTE broadcasting.

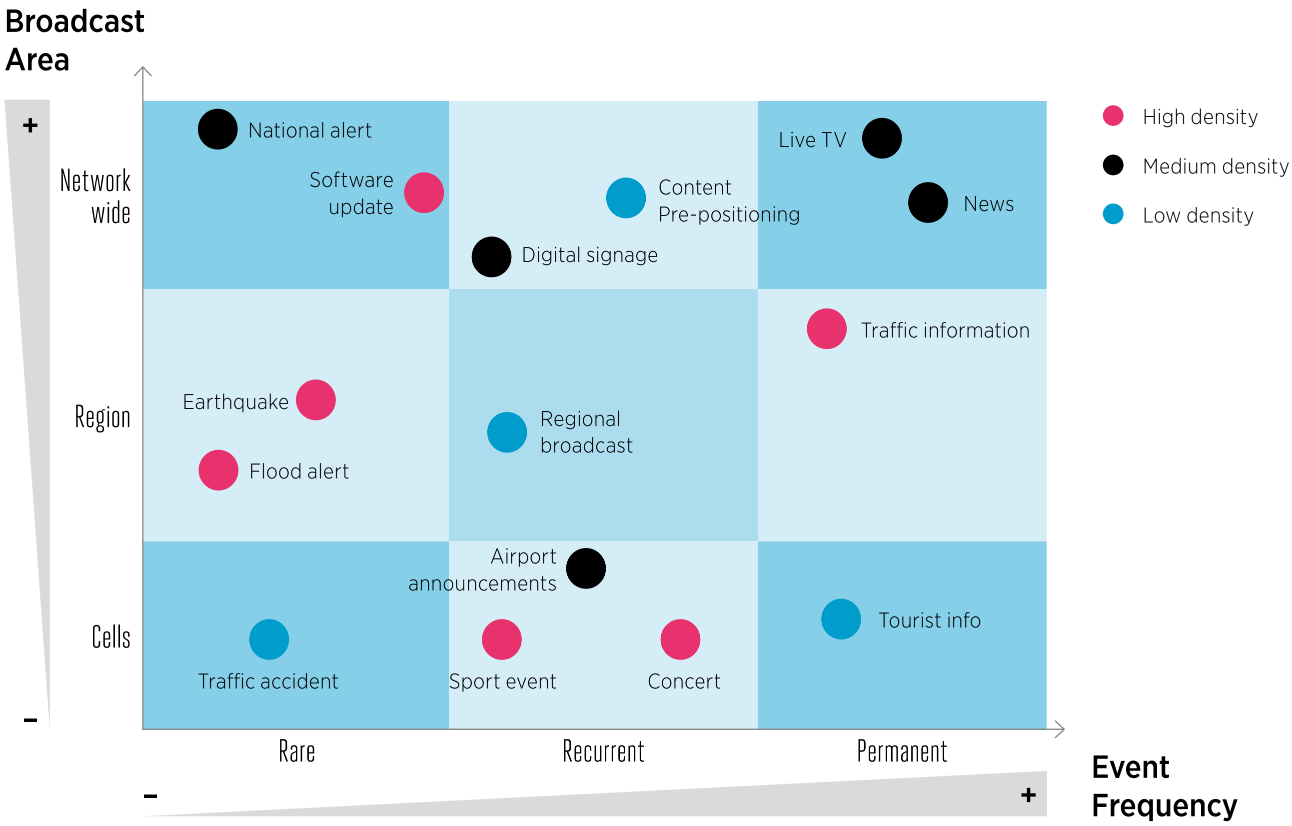
Figure 9 attempts to categorise services that utilise the broadcasting capabilities across three different dimension: how frequently the content is provided (horizontal axis), how wide the broadcast area is (vertical axis) and how many users are likely to require the content simultaneously (colour coded).

Some of the services and their specific requirements are discussed in the rest of this section.

4.2 Localised live broadcast

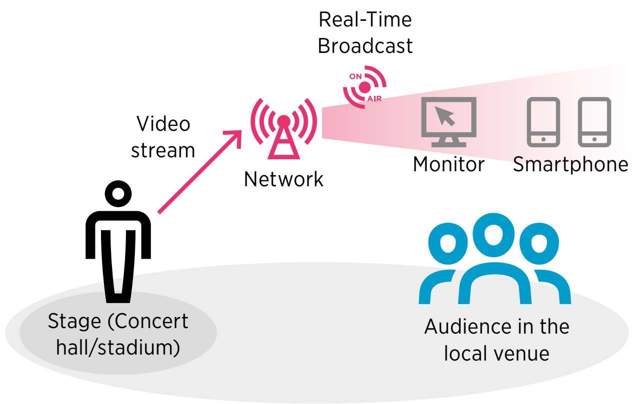
Localised live broadcast refers to broadcasting live events (e.g., sport events and concerts) at the live event venue to provide better sight and additional information that audiences can enjoy. An example would be broadcasting an up-close shot of athletes for audiences in a sports stadium, instant replay from one of the cameras, related statistics of the athletes, audio broadcast from the commentators and other relevant information. Broadcasting can also be used to inform users of venue layout, security announcements and so on.

Figure 9: examples of services using broadcast



On Air icon source: securitycast.net

Figure 10: Localised live broadcast



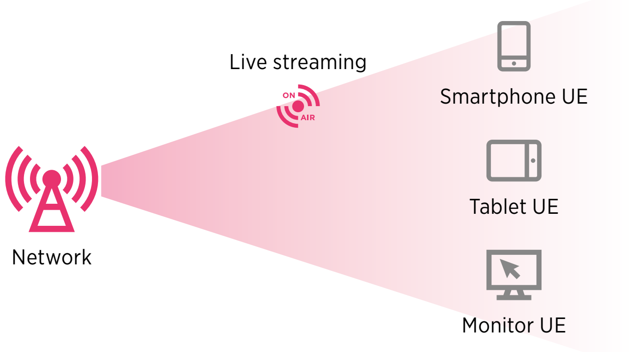
Given the very high density of users, unicast transmission would present a difficult challenge particularly if the video is in high definition or even UHD. Also using IEEE 802.11ac standards could result problematic especially for guaranteeing a sufficient quality of service.

A technology that may be used to complement broadcasting to provide an optimal user experience in these circumstances is Mobile Edge Computing (MEC). As the broadcasted content needs to be streamed and formatted with the appropriate codec, in order to provide a quasi-real time video it is beneficial that the processing takes place in situ: a MEC server connected to all the eNodeB's of the stadium/event area can fulfil this requirement. Furthermore, utilising MEC it is possible to fine tune the usage of the eNodeB resources and adapt the content quality based on the local radio conditions. This also ensures that sufficient capacity for unicast traffic such as voice calls and messaging is available.

Depending on the capability of the device, it may also be possible to provide the user with a multiscreen experience.

On Air icon source: securitycast.net

Figure 11: Live TV streaming



4.3 Live TV streaming

Live TV streaming refers to the use of broadcast technology for streaming of live TV (e.g., news programs).

In terms of the business model, live TV streaming can be offered as a subscription service or pay per view, which is by charging for individual events. Other business models, for example a revenue sharing agreement between the mobile operator and broadcaster, can also be envisaged.

Access to live TV could also be offered as a differentiating factor.

4.4 Audio Streaming

Audio streaming could be best described with traditional FM/AM radio channels. LTE Broadcast offers an opportunity for replacing these radio channels while providing higher quality audio with new types of multimedia content. LTE Broadcast also enables operators to broadcast these high quality multimedia contents even in crowded areas, which would have been technically challenging with existing unicast technology. Furthermore, LTE Broadcast provides capabilities to setup both national and local stations as it leverages LTE networks which are typically deployed nationwide. Instead of replacing existing FM/AM radio channels, operators can also choose to operate their own audio streaming channel. Operators will be able to monetise audio streaming by pursuing three business models:

- Monthly subscription fee per channel(s) paid by listeners
- Transmission fee from radio channel providers
- Fee for broadcasting advertisement.

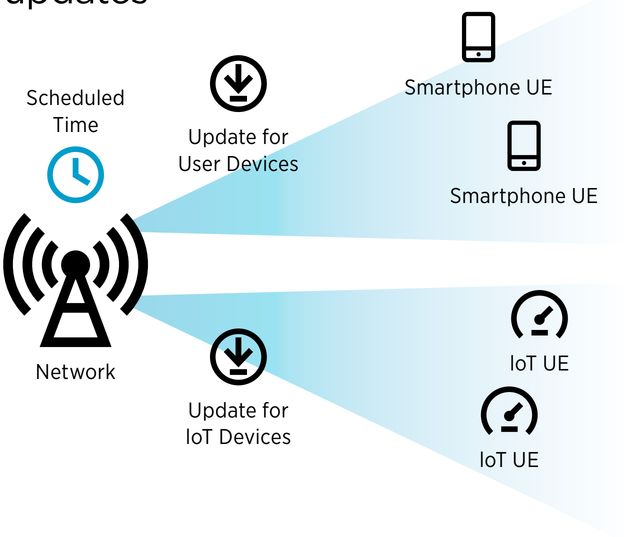
4.5 Software update

Scheduled software updates refers to updates of software/firmware that are scheduled rather than downloaded at the time of request. This allows operators, for example, to perform non-time critical broadcasting (e.g. distribution of a software update) during off-peak times when more resources can be allocated to eMBMS without negatively affecting unicast traffic.

One crucial point on LTE-B software update is that it has to align with the typical software update workflow. In the Android or iOS application update scenarios, the LTE-B software update has to work with Google Playstore and Apple Appstore workflow, having the apps authenticated and the app update initiated by the end-user.

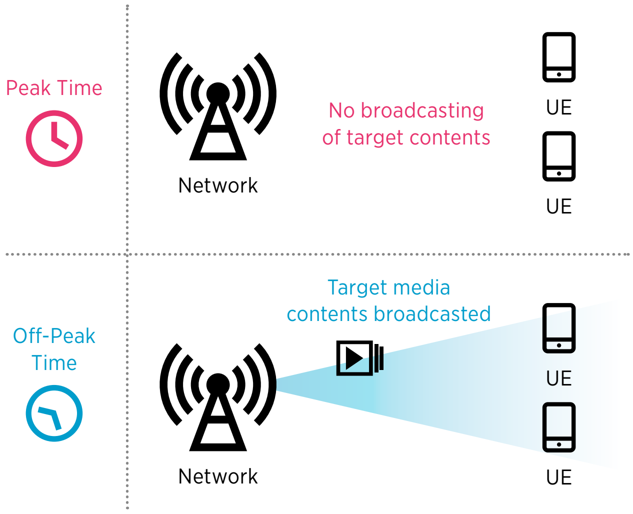
Update icon source: rstinstruments.com

Figure 12: Scheduled software updates



Media icon source: simpleicon.com

Figure 13: Content pre-positioning



4.6 Content pre-positioning

Content pre-positioning refers to the use of broadcast technology to download popular media contents on device before it is consumed. This need is closely associated with the trend of binge viewing (e.g., downloading contents on devices for future viewing in places such as public transport).

This capability proactively and intelligently pushes to mobile devices (i.e. pre-positions) popular videos using LTE-broadcast, instead of the current unicast pull approach. With pre-positioning, video content of interest to the user is delivered to a device using LTE-Broadcast and stored on the device that can make the content available to the user when required. Pre-positioning provides high-impact viewing experience for consumers, while ensuring optimised delivery in a cost-effective manner. Rationale for content providers are:

- More reliable delivery than customer prompted at lower cost
- Resonate with consumers – content promotion and increased user engagement
- Seamless personalised experience – hyper-targeted guaranteed quality viewing
- Unconstrained rich media quality – network offline usage with lower cost
- The data downloaded in broadcast mode does not reduce the subscriber's data allowance.

4.7 Broadcasting for automotive industry

4.7.1 Introduction

There are a number of connected car use cases where LTE-B can play a role. Other than software/app update in the vehicle, broadcasting can be used for network-aware deterministic live streaming, as well as opportunistic push of files such as video, navigation, advertisements etc. In the first use case based on network condition and mobility, a higher quality network stream tailored to the cells along car's path is delivered. In the second use case, network micro-troughs are predicted to push entertainment content, points of interest, maps, advertisements and promotions.

Figure 14: Deterministic network-aware streaming

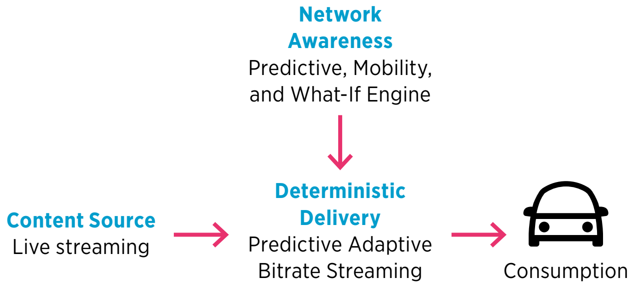
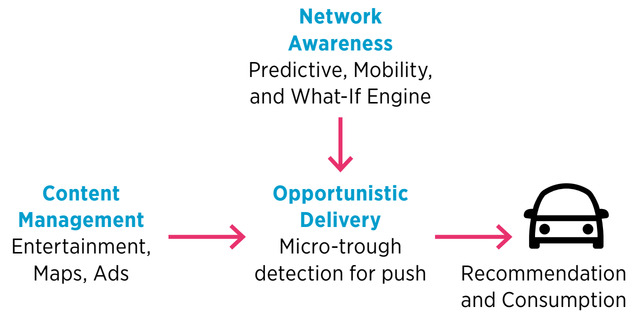
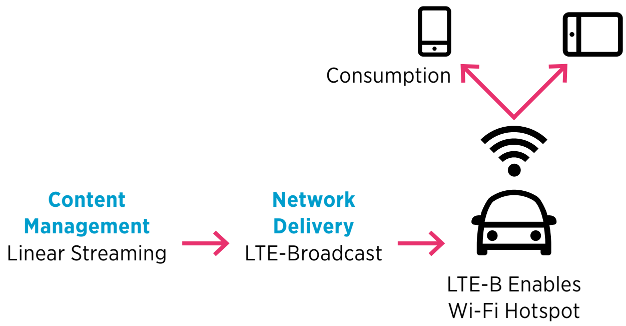


Figure 15: Opportunistic content delivery



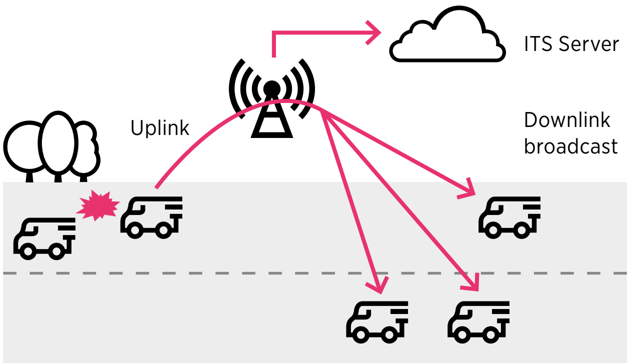
Another use case of interest could be linear streaming to an LTE-B enabled Wi-Fi hotspot in the vehicle and extend the streaming to connected non-LTE-B devices. It needs to ensure seamless LTE-B/Wi-Fi hand-off and viewing experience, as consumption occurs from mobile, tablet and car screen.

Figure 16: Example of linear streaming to a vehicle



Broadcasting for automotive industry refers to the use of broadcast technology to deliver vehicular information (e.g. driving assistance and autonomous driving relevant information) to vehicles in Intelligent Transportation System. This includes V2V (vehicle-to-vehicle), V2I/N (vehicle-to-infrastructure/network) and V2P (vehicle-to-pedestrian). Depending on the scenarios (e.g. urban, freeway), the infrastructure/network may be serving vehicular information to several hundreds of vehicles at a time.

Figure 17: Broadcasting for automotive industry (V2V)



4.8 Location specific broadcasting

Localised broadcasting is where information from local shops/venue is broadcast to devices in proximity. Local shops could broadcast shopping information and offers (i.e. coupons) to the people nearby which could provide an extra push for those people to walk into the shop. Tourist attractions could also leverage LTE broadcasting by sending a short audio/multimedia tour or a short text describing its value. The operators could monetise this use case by:

- Revenue share with a coupon company or local shops/tourist attractions
- Offer of multimedia tours of attractions to visitors
- Distribution fee from local shops/tourist attractions.

4.9 Non-critical notifications

Non-critical notifications are types of information that more conveniently provide services that are also accessible via different means but that are pushed to the device rather than having to be pulled. Examples include news alerts, gate/platform announcements for public transport (e.g., rail and intercity bus), changes in various financial indices (e.g. exchange rate, stock market and interest rates) and weather alerts. The operators could monetise this use case by:

- Subscription fee from the end-user to the notification services
- Transmission fee from the service providers.

Find out more at
www.gsma.com/network2020

GSMA HEAD OFFICE
Floor 2
The Walbrook Building
25 Walbrook
London EC4N 8AF
United Kingdom
Tel: +44 (0)20 7356 0600
Fax: +44 (0)20 7356 0601