TR 044

TRIALS TESTS AND PROJECTS RELATING TO 4G/5G BROADCAST SUPPORTED BY EUROPEAN PSB

TECHNICAL REPORT

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1. Introduction

In 2015, European public service broadcasters became aware of a study in 3GPP, the global standardization organisation of mobile telecommunication technologies, aiming to enhance the 3GPP system to support and accommodate TV services. The so-called EnTV study [1] focussed on enhancements to the existing broadcast mode of the 3GPP system, i.e. eMBMS1.

In order to influence the standardization process European public service broadcasters started engaging in 3GPP. The process was coordinated by EBU’s Strategic Programme “Future Distribution” (FD)2, which set up the project team “Mobile Technologies and Standards” (MTS)3 to carry out the required detailed technical work.

The EBU produced a set of high-level requirements such as the possibility to enable free-to-air distribution of linear TV services for smartphones and tablets without the need to use a SIM card. Standalone operation of an eMBMS network using the entire capacity of a given carrier was another very important element. Efficient usage of infrastructure and spectrum resources, with the possibility to share these to allow users who have contracts with different network operators access to linear broadcast programmes complemented the requirements. Figure 1 sketches these requirements.

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1 eMBMS: evolved Multimedia Broadcast and Multicast Services.
2 EBU Strategic Programme on Future Distribution, https://tech.ebu.ch/groups/fd.
3 EBU Project team Mobile Technologies and Standards, https://tech.ebu.ch/groups/mts.
Broadcasters’ proposals were supported by several infrastructure and device manufacturers and some network operators from around the world. Indeed, it turned out that the time was right to further develop the 3GPP broadcast mode. Obviously, it was not only the broadcast industry seeing value in employing a broadcast mode to deliver content from one source to many recipients at the same time throughout a given area. In other areas such as public safety services it is necessary to distribute the same information to a large group of users at the same time. Last but not least, mobile network operators also realised that eMBMS is a potent tool to optimise the use of network resources. In summer 2017, Release 14 of 3GPP was published. Against the odds, all the high-level requirements of public broadcasters made it into the 3GPP specification. The modifications of the existing eMBMS standard contained in Release 14 are now addressed as FeMBMS, i.e. “Further evolved Multimedia Broadcast and Multicast Services”.

Since the publication of Release 14, there has been significant work by broadcasters building on EnTV. The present report outlines some of this work relating to eMBMS / FeMBMS and, in particular, details a number of the trials, tests and projects that are of relevance to this topic. The document features stakeholders from across the value chain including not only public service broadcasters, but also national and regional governments, regulators, mobile network operators and equipment manufacturers.

All of these trials have the objective to better understand eMBMS and Rel-14 with the aim of identifying any gaps or limitations in the existing specifications in order to propose potential enhancements. Taken together, these developments illustrate the considerable industry interest regarding the potential of 3GPP technologies to deliver broadcaster services.

3GPP Release 14 still refers to 4G, i.e. LTE. Release 15 which has been finalized in June 2018 is the first 3GPP Release which includes some 5G features and a new radio interface called ‘5G New Radio’ (5G-NR). Release 15 takes forward all LTE eMBMS features from Release 14 but does not contain a broadcast mode in 5G-NR. However, joint effort of broadcasters and members of the mobile industry have safeguarded studies for Release 16 to further develop LTE MBMS features to meet the 5G requirements of 3GPP Technical Report TR 38.913 [2]. Further normative work on 5G broadcast would be considered in future releases, i.e. Release 17 or later.

As a matter of fact, the trials and projects featured in this report constitute a snapshot in time. More trials and eventually deployment of commercial networks can be expected in the time to come. This report will be updated as required to reflect the ongoing developments.

2. Trials, Tests and Projects

This section outlines a number of trials, tests and projects based on a mixture of technologies including Rel-14 FeMBMS & EnTV, eMBMS from 3GPP releases prior to Rel-14 and technologies that are pre-standardisation.

2.1 Germany: ‘5G Today’

Summary

The 5G Today Project focuses on the distribution of media content in broadcast mode based on mobile technology. The main tasks within the project are:

- Implementation of FeMBMS transmitter as well as FeMBMS receiver;
- Broadcast network based on FeMBMS in the higher Bavarian region; and
- Novel insights into network parameters, antenna design and propagation models.
The project consists of several work packages (WP) as follows:

WP1: Requirements and system architecture including use case definition, performance indicator and regulatory aspects

WP2: Theoretical investigations and simulations including coverage prediction, propagation models and antenna diversity investigations

WP3: Prototype development including implementation of a FeMBMS transmitter and of an FeMBMS receiver based on SDR technology with Open Air Interface Toolkit

WP4: Test field implementation and result analysis including set-up of the play-out centre, launching of the FeMBMS test environment, field tests for the validation of the coverage prediction, result analysis and utilization planning

The FeMBMS method was specified in 3GPP within Release 14 in the summer of 2017 and enables the following features: support of larger inter-site distance (cyclic prefix 200 µs), mixed MBMS/unicast transmission, dedicated MBMS transmission, new subframe type, receive-only mode and free-to-air capability.

The project is funded by the Bavarian Research Foundation and the duration is 28 months (1st July 2017 to 31st October 2019).

Key Partners
Institut für Rundfunktechnik GmbH, Kathrein, Rohde & Schwarz, Telefonica O2, Bayerischer Rundfunk.

References
2.2 United Kingdom: ‘5G RuralFirst’

Summary
5G RuralFirst is a project funded under the UK government’s 5G Trials and Testbeds scheme. Led by Cisco and lead partner University of Strathclyde, it will deliver testbeds and trials to exploit 5G benefits for rural communities and industries like agriculture, broadcasting, and utilities to address the challenges of and build the business case for 5G rural deployment.

Based primarily on the Orkney Islands and in the farmlands of Shropshire and Somerset, the project will integrate spectrum sharing strategies for 5G; bringing connectivity to rural communities, enabling smart farming in partnership with Agri-Epi Centre (including drones, autonomous farm vehicles and remote veterinary inspections); innovative methods of delivering broadcast radio over 5G working with the BBC, alongside the delivery of 5G connectivity for IoT in utility and other industries in rural areas.

Amongst other key use cases, one is broadcast radio delivered over 5G with the BBC. The BBC believes internet-based delivery will become increasingly important to broadcasting. It will use the 5G testbed on Orkney to trial the capabilities of 5G to deliver traditional radio and new forms of BBC audio content over these new technologies.

Key Partners
BBC, BT, Cisco, Microsoft, University of Strathclyde, Harper Adams University, The University of Edinburgh, Heriot-Watt University, University of Surrey 5G Innovation Centre, Orkney Islands Council, Power Networks Demonstration Centre, Parallel Wireless, Nominet, Lime Microsystems, Scottish Futures Trust, Datavita, Agri-EPI Centre, CloudNet, Fairspectrum, Censis, Soil Essentials, Faroese Telecom/SHEFA, Hyperceptions, Precision Decisions, Zeetta Networks, Afimilk, pure LiFi, Broadway Partners, Kingshay, Milkalyser, Telint.

References

2.3 Finland: ‘Wireless for Verticals – WIVE’

Summary
- Aim: increase competitiveness of automated transport, smart grids, massive machine connectivity as well as media delivery via 5G
- Work Package 1: Business aspects analysed
- Work Package 7: Media & Entertainment
  - Use Case pilot defined: “TV & Radio broadcasting”
  - Use Case pilot defined: “National authority broadcast delivery”

The main idea is to use the cellular network to transmit the TV & radio content that is currently transmitted in a dedicated broadcasting network. The objective from the technology perspective is to study the performance of the main elements of network that allow for nationwide coverage. Such elements at this stage are considered to be the SFN operation of the network, robustness and throughput trade-off of the signal using different MCS and mobility management to allow seamless handover from cell to cell.
The transmission of authority broadcasts such as Public Warning messages containing multimedia information to users using multicasting is trialled. These trials are anticipated to be performed in similar settings to those for “TV & Radio broadcasting”. In addition, it should be possible even for users without SIM cards to receive the content. Further functionalities to be trialled are the mechanism to allow for cell site granularity selection of the area to which the authority broadcast is transmitted and forced control of the user terminal to receive the content.

The aim is to test and analyse these Use Cases in Autumn 2018 while the eMBMS test environment available.

**Key Partners**
Yle, VTT, Nokia Bell labs, Digita, Teleste, Aalto University, Turku University of Applied Sciences, Tampere University of Technology, University of Turku

**References**
- [https://www.vttresearch.com/media/news/wive-project-uses-5g-to-increase-the-business-value](https://www.vttresearch.com/media/news/wive-project-uses-5g-to-increase-the-business-value)
2.4 Finland: ‘5GTN+ Project’

Summary

- Aim: Make agile TV and Radio production and distribution using 5G and test eMBMS delivery to end user terminals
- Achievement: light path backbone network, connection of all 5G Test Network Finland projects
- Projects involved: 5GTN+ - WIVE - TAKE5 - Cornet, 2016
- Uplink using 5G radio in Oulu and transfer via light path to Espoo, 11/2017
- 2x unicast 4K H.264 UDP & MPEG-TS throughput ~ 100-130 Mbps, low latency eMBMS broadcast 5G in Oulu 03/2018

Key Partners
Expway eMBMS solution, Bittium Tough mobile, Nokia network devices and VTT.

References
- http://5gtnf.fi/projects/5gtnplus/

2.5 Finland: ‘5G eMBMS Demo’

Summary

- 16.5.2018 in Nokia, Karaportti Finland (Audio and Video)
- Main goal promoting broadcast-like services in 5G network
- Participants from media, press, ministerial, telco, EBU etc.
- Multiple mobile devices receiving broadcast quality DASH streams via 5G network in the 2.9 GHz band.

Key Partners
Technology partners: Nokia, Qualcomm, Enensys
Media and telcos: Yle, MTV and Elisa

References
- Press release, “Yle, MTV, Elisa, Nokia, ENENSYS, Bittium and Qualcomm Showcase the Future of TV, Paving the Way to 5G Broadcast”

2.6 Norway: Trial of LTE-B in rural Norway

Summary

Is LTE Broadcast (LTE-B) a technology that is well-suited for distribution of linear TV to big screen TVs, via 4G or 5G? We are in particular testing this in rural areas of Norway, where a dedicated “shadow network” has been set up to provide TV services to the 0.26% of households that live in areas without possibilities for satellite and DTT reception (as they live in the satellite “shadow” or the DTT “shadow” due to e.g. mountains). 552 small DTT transmitters are currently needed to cover
these areas and the shadow network take up 1/3 of NRK’s TV distribution costs (it is 240 times more expensive to reach a household in the shadow areas than a household in the remaining 99.74% of Norway).

The project also tries to find out if cooperation may result in benefits for society by providing broadband access, expanding emergency network coverage or introducing other functionalities in areas that currently lack such capabilities.

**The TV via LTE-B project at a glance:**

**What:** 4 NRK channels in HD, 4 - 5 Mbit/s per channel

**Frequencies:** 758 - 778 MHz downlink; 708 - 718 MHz uplink

**Transmitters:** 1 x 40 W

**Where:** Selje in Sogn og Fjordane county on the Norwegian West Coast

**Signal to site:** Primarily DVB-T, although internet is also tested

**Timeline:**

- **Q4, 2017:** Network first deployed, adjustments have been ongoing ever since
- **Q2/Q3, 2018:** Technical test, 3 - 4 receivers
- **Q3/Q4, 2018:** Live demonstrations in Selje for participants and media
- **Q4, 2018:** Project report due

![Figure 5: Test site (photo credit NRK)](image)

**Key partners**

NRK has partnered with Nokia, NTV (Norwegian Television), Paneda, Norkring and mobile network operator Ice to find out whether it is commercially realistic to replace the DVB-T network by LTE-B in a cooperation with mobile network owners, the government or others, and whether it can reduce costs or provide synergies. IRT, Qualcomm and BBC are also indirectly taking part in the project, whereas NKOM (the Norwegian Post and Tele Authority) and The Norwegian Media Authority take part as (keen) observers.
2.7 Italy: Stand-alone 4G/LTE broadcast network in Aosta Valley

Summary
RAI Research in cooperation with the EBU and the Technische Universitaet Braunschweig (TUB) is implementing a stand-alone 4G/LTE broadcast network, by means of broadcast towers in a single-frequency-network (SFN) configuration. The trial will also show how state-of-the-art mobile technologies such as 4G/LTE and, in the future, 5G, deployed on a conventional terrestrial broadcast network infrastructure, could be used for the distribution of public service media content and services.

The demonstration, realized in cooperation with the Eurovision Media Services, will take place during the European Championship in August 2018 at the RAI’s open test network in Aosta Valley. The network allows up to five transmitters to be made available at the same time on channel 53 (730 MHz) for a suitable network configuration and different transmission technologies such as DVB-T2 and/or 3GPP Release 14 FeMBMS. The SFN is operating on two transmitting sites. The 3GPP Rel-14 FeMBMS signal is generated at the RAI Aosta SR premises and is delivered to the transmitting sites via analogue microwave links.

The maximum payload delivered from the Head-end at Aosta SR premises is 10 Mbit/s. In order to guarantee the SFN constraint without using any SFN adapter, the signal is delivered through the network using the “mirroring technique”. At the transmitting site the correct time synchronization has been realized by means the insertion of a local delay, using a digital delay line.

The demonstration scheme is shown below. In Figure 6 is reported the reference demonstration scheme. TUB provides the modulator and demodulator that implement the FeMBMS physical layer.

The key elements of the demonstration include:

- stand-alone LTE eMBMS network deployed on terrestrial broadcast infrastructure;
- distribution of live TV broadcast from the European Championships (Berlin and/or Glasgow) over an LTE eMBMS (broadcast) network to mobile devices;
- free-to-air reception; and
- mobile reception (in the vehicles).
Key Partners
RAI, TUB, EBU.

References

2.8 5G-Xcast project

Summary
5G-XCast is a 5G-PPP Phase 2 project focused on Broadcast and Multicast Communications Enablers for 5G Systems. The project is developing point-to-multipoint (PTM) communication capabilities for 5G primarily targeting the technical requirements of the Media & Entertainment (M&E) vertical. 5G-Xcast is devising and assessing a conceptually novel and forward-looking 5G network architecture for large scale immersive media delivery. The project focuses on a holistic implementation of multicast and broadcast functionalities a critical technology element in 5G systems in addition and as a complement to unicast. 5G-Xcast technologies will be also fundamental to progress towards the vision of a converged 5G infrastructure for fixed and mobile accesses, including terrestrial broadcast. 5G-Xcast harmonizes the media delivery among the three considered types of networks and to provide an optimised and seamless media user experience.

The media industry is represented by the EBU, BBC and IRT, among other partners. Their experience in broadcast technologies is key to evaluating the different alternatives for media distribution in 5G. The project has already assessed state-of-the-art eMBMS technology against requirements and KPIs for audio-visual media delivery. 5G-Xcast also leverages the latest characteristics in eMBMS Release 14 to explore the design and performance of the 5G RAN and core architectures for media delivery for mobile and terrestrial broadcasting.

The project will also focus on demonstrators and trials of the concepts and features developed in 5G-Xcast. eMBMS plays a prominent role in the trials as the most recent and commercial available technology to be employed for media distribution. The trials are devised as the necessary tools to
evaluate the performance and capability of state-of-the-art technology to meet broadcast requirements in environments close to real deployments. Three different test-beds are made available for trials located in Munich (Institut für Rundfunktechnik), United Kingdom (5GIC at the University of Surrey) and Finland (Turku University of Applied Sciences). Novel use cases for 5G media delivery will be demonstrated, such as:

- **Hybrid Broadcast Service.** Consisting of both linear TV and on-demand elements. They complement each other in the sense of enriching the linear TV offering but also in order to interrelate both types of services;
- **Object Based Broadcasting.** With object-based broadcasting the programme is captured in the conventional way but stored as a set of its component parts, be they audio, video, captions or other material along with detailed metadata that describes how these should be assembled at the receiver.

Among other public demonstrations, the European Championships 2018 will be the context to showcase the concept in which both the linear TV services and on-demand video are offered by eMBMS to reach both smartphones and TV-sets at the same time, thus demonstrating a unified network framework to reach users both at home and on-the-move.

**Key Partners**
UPV, Nokia, BBC, BT, Broadpeak, Bundleslab, Expway, Fairspectrum, IRT, LiveU, Nomor, One2Many, Samsung, TIM, TUAS, EBU, University of Surrey 5GIC.

**References**
The 5G-Xcast project website, including deliverables, [www.5g-xcast.eu](http://www.5g-xcast.eu)

### 2.9 Germany: ‘IMB5’

**Summary**
Objectives of the project:

- Testing the capabilities and limitations of current LTE eMBMS for nationwide broadcast coverage;
- Creating an optimised system architecture for eMBMS based networks; and
- Defining input for modifications of the 3GPPP standardization of eMBMS.

The project “Integration of Broadcast and Broadband in LTE/5G” (IMB5), funded by the Bavarian Research Foundation, explored the LTE-broadcast mode eMBMS within two detailed SFN field trial networks in Erlangen and Munich, Germany and identified potential improvements of the existing broadcasting feature towards 4G/5G. On the User Equipment (UE) side terminals from Qualcomm and Samsung, based on commercial chipsets, have been used mainly for application layer tests.

For detailed physical layer tests, two different LTE SDR platforms from OpenAir Interface and National Instruments have been set-up to support detailed field experiments with the existing and future extended eMBMS waveforms beyond the existing standardized waveform in 3GPP Rel 12.

On the application layer, it was shown in the project, that using LTE eMBMS, a flexible service mix of unicast MBB and broadcast linear TV could be delivered. For country-wide deployment of eMBMS SFN networks, physical layer waveform extensions like an increased cyclic prefix of the currently standardized LTE signals were recommended. Another project result was the successful demonstration of the coexistence of LTE eMBMS with spectrally adjacent DTT.
The consortium is based in Munich, Germany.

**Key Partners**
Institut für Rundfunktechnik GmbH, Fraunhofer-Institut für Integrierte Schaltungen, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nokia Solutions and Networks Management International GmbH, Rohde&Schwarz GmbH & Co. KG; Associated Partners: Bayerischer Rundfunk, BMW Group

**References**
- Press release, 14.01.2016,'IMB5 - Fernsehübertragung mit LTE/5G'
- [www.golem.de](http://www.golem.de), 14.01.2016, ‘TV-Übertragung im Modus eMBMS mit LTE möglich’
- EuCNC Workshop, 04.02.2016, Athens, “IMB5: Experimental Results from the eMBMS Testbeds”

### 2.10 France: ‘Tower Overlay’

**Summary**
In April 2015 TDF and Rai launched the first field trials of LTE-Advanced+ (LTE-A+) Broadcast from high-power television stations, in Paris and Aosta. LTE-A+ is an experimental enhancement of LTE-Advanced eMBMS, which already implemented in 2015 key features later standardized in EnTV 3GPP Rel 14, e.g. larger Cyclic Prefix (CP) enabling High Tower / High Power transmission of an eMBMS signal. The joint project was based on the original “Tower Overlay” idea developed and implemented by Technische Universität Braunschweig (Germany) in 2013. Unlike Rel-14 FeMBMS, the LTE A+ system uses the same OFDM numerology for the distribution payload data and the synchronization/basic signalling information of broadcast services.

The trials intended to evidence the concrete possibility of a true convergence between the LTE technology ecosystem on one side and the traditional broadcast infrastructure on the other side. Adapting LTE Broadcast to traditional high broadcasting towers creates the possibility of cooperation between the cellular and broadcasting networks, towards reducing network load, energy consumption and network costs as mobile data including video/TV consumption grow rapidly. In addition, the Tower Overlay system allows the additional flexibility to share in time-division the radio channel resource between LTE A+ and a fully standard DVB-T2 signal.
Conversely, using an LTE-based technology opens the possibility to reach all mobile devices without the need to add a specific broadcast receiver in the devices.

In Paris, one transmitter (Eiffel Tower) was used, operating on an experimental UHF frequency in the 700 MHz band. The LTE A+ stream intended for mobile devices aggregated a large range of digital media content (live TV, video on demand, catch-up TV, live radio, podcasts, magazines, newspapers, software updates) that was received on the mobile device and stored until the end-user wants to view it, anytime, and without loading the LTE unicast network. Optionally, a DVB-T2 stream conveyed conventional digital HDTV programmes which could be viewed on standard domestic DVB-T2 TV sets.

The trial was successful, and also performed an extensive field measurement campaign to evaluate the waveform performance in detail. The results have been used to enhance LTE-A+ and the Tower Overlay towards an efficient mobile broadcasting system.

![Figure 9: Mobile measurement results](image)

**Key Partners**
Technische Universität Braunschweig (Germany), Radiotelevisione Italiana (Italy), TDF (France), GatesAir (USA).

**References**

**2.11 Germany: ‘Tower Overlay improving mobile network’**

**Summary**
During the NGMN Industry Conference & Exhibition in Frankfurt in October 2016 a demo evidencing the benefit of High Tower LTE Broadcast to improve mobile network performance was performed.

The demo provides a simulation of a mobile network (based on a realistic network scenario in
Hannover, Germany) where any given user can be served by three different network options (or layers):

- a standard LTE unicast layer,
- a classical LTE Broadcast layer, which is transmitted from the normal cellular LTE A transmission sites using Rel-9 eMBMS;
- a Tower Overlay layer using a High Tower extension of LTE Broadcast (LTE A+), where the signal can be transmitted from a high tower with a much larger coverage area, and still being received on an LTE device.

In the demonstration scenario, a high usage of live video is creating stress and pressure on the network. As the network load rises, a growing proportion of mobile users wish to watch a live video feed. At a certain point, the eMBMS layer is activated on network cells serving multiple viewers of the live feed and some load reduction in the cellular network can be observed. When the number of users grows further, the Tower Overlay layer is activated, and a massive reduction of network load can be observed in the cellular network, as the vast majority of LTE sites hand off the video service to the Tower Overlay layer. The demo therefore creates a compelling evidence of the effect of eMBMS on the network load and the significant additional load reduction through the Tower Overlay layer.

The demo also included a live physical transmission of the LTE unicast, eMBMS and Tower Overlay signals to a tablet PC supplying an HD video service. The tablet switches in real time between the three different network layers in a seamless manner, providing a fluid viewing experience to the end user under all network conditions (a “best network” approach).

**Figure 10: Project Demonstration**

**Key Partners**
Technische Universität Braunschweig (Germany), Radiotelevisione Italiana (Italy), TDF (France)

**References**

### 2.10 Italy: ‘Tower Overlay’

In April 2015 Rai CRIT launched an experimental trial in Aosta Valley to investigate the performance of TOoL+ (reference below), a solution based on an evolution of the LTE-A (4G) technology, called LTE-A+, to broadcast data to mobile devices using the cost-efficient HTHP infrastructure.

The selection between the layers Unicast/eMBMS/TOoL+ can be decided by means of a load distribution algorithm. The new layer spans several LTE cells and thereby reduces backhauling capacity and network cost.

The main goal of the field trial was to evaluate the TOoL+ system performance in a real scenario, and to measure the influence of different LTE-A+ transmission parameters, offering insights towards a realistic TOoL+ network planning.

Both the TOoL+ signal creation and reception are realized by means of a Software Defined Radio (SDR) approach due to its high flexibility and short development time. The transmitter and the receiver used for the field trials are both based on the first TOoL+ live demonstrator [2]. In contrast to the lab demonstrator, the LTE-A+ modulator has been linked to an enhanced version of a GatesAir M2X DVB-T2 exciter to multiplex the DVB-T2 and LTE-A+ signal and to monitor and improve both signal quality and out of band emissions.

TOoL+ data streams consist of two components: the DVB-T2 signals and the LTE-A+ signals embedded into FEFs. For LTE-A+, a similar SDR-based measurement receiver was implemented based on the TOoL+ lab demonstrator receiver [2], though providing more sophisticated algorithms, e.g. for channel estimation.

The main advantage of the SDR approach in this context is the flexible access to data along the decoding process to analyse the system performance in detail, i.e. the possibility to output various performance figures and signal characteristics at different stages of the decoding process. The collection of raw I/Q data combined with an offline signal analysis furthermore allows for continuous improvements of the receiver itself and the evaluation of different decoding strategies and algorithms. Measurements were performed in urban, suburban and rural areas and motorway mobile environment.

The network allows up to five transmitters to be made available at the same time on channel 53 (730 MHz) for a suitable network configuration and different transmission technologies such as DVB-T2 and / or 3GPP Release 14 FeMBMS.

The receiver input power levels during measurements in the Aosta Valley and the architecture of the LTE-A+ measurement receiver are depicted in Figure 11a & b.

**Key partners**

RAI, TUB, EBU.

**References**

- Ilsen S., Rother D., Juretzek F., Bretillon P., Seccia J., Ripamonti S., “Tower Overlay over LTE-Advanced+ (TOoL+) - Field Trial Results”, IEEE 2015 ICCE-Berlin conference
Figure 11a: Aosta Valley measurement results

Figure 11b: Architecture of measurement receiver
3. Relevant Initiatives

3.1 EBU Project Team MTS

Summary
European Broadcasting Union (EBU) members have identified the need to contribute to the ongoing standardisation work in the domain of mobile technologies as one of the current priorities. Activities of broadcasters resulting thereof were coordinated by the EBU Strategic Programme “Future Distribution” (FD). In order to carry out detailed technical work FD created a Project Team called “Mobile Technologies and Standards” (MTS) that seeks to build technical competence within the EBU community in the domain of the current and future mobile technologies, including both 4G/LTE and 5G. To do so, the Project Group

- undertakes detailed technical studies of 4G and 5G and their respective standardisation roadmaps;
- monitors the work in the relevant standards developing organizations (SDOs) and prepare contributions to their work on the issues of relevance for public service media;
- formulates and coordinates EBU positions on relevant mobile standardisation issues;
- shares knowledge and relevant information to EBU Members, including on the potential impacts of standardisation developments; and
- provides expert advice on mobile technologies to the EBU Members.

In particular, MTS has been carrying out a 3GPP “Gap Analysis” in conjunction with a representative company from the mobile industry with the aim of identifying gaps in order to

- verify what requirements from 3GPP TS 22.101 [3] have been accommodated in Rel-15, understand in which way this has been accomplished and what are the relevant specifications;
- identify what requirements from 3GPP TS 22.101 [3] have not been included in Rel-14, if any; and
- identify if any of the relevant requirements from 3GPP TR 38.913 [2] have effectively been covered already in Rel-14.

Members
Participants are drawn from across the EBU membership.

References
- EBU, www.ebu.ch
- EBU FD, https://tech.ebu.ch/groups/fd
- EBU MTS Group, https://tech.ebu.ch/groups/mts

3.2 ETSI ISG MBC

Summary
In May 2016 ETSI created a new Industry Specification Group (ISG) on Mobile Broadcast Convergence (MBC). Since then the ISG MBC has explored the deployment and business models of converged networks from the perspectives of all interested parties including broadcasters, satellite, mobile &
terrestrial broadcast network operators, content owners & providers, network infrastructure vendors, manufacturers of consumer equipment and consumers. The group studied the means to support delivery of audio-visual (AV) media including linear and nonlinear elements over converged networks, taking into account the potential benefits and challenges from a commercial and technical perspective.

TV delivery has traditionally been dependent on unidirectional, one-to-many delivery networks to fixed TV sets (i.e. broadcasting). Nowadays, an increasing number of consumers watch linear or nonlinear content on their traditional home screens as well as on their smartphones and tablets. Although much of this content is currently delivered via WiFi networks, these new forms of media consumption dramatically increase the load on mobile networks. This situation may require new solutions, such as the leveraging of a one-to-many broadcasting approach.

While the ISG was not to make recommendations about spectrum allocation, spectrum authorization models which impact the regulatory framework and/or business model have been considered in the ISG work.

Participation in the Mobile and Broadcast Convergence Industry Specification Group was open to all ETSI members as well as organizations who are not members, subject to signing ISG Agreements.

The chairman of the MBC ISG was Simon Fell (EBU), the vice-chair was Philip Kelley from Nokia Germany. Currently (as of May 2018). The final report has been approved in June 2018.

Members

ETSI MBC Members:


Non-ETSI MBC Participants:

Andrew Dumbreck Media Ltd, Gradiant, iTEAM Research Institute, Panasonic Europe Limited, RAI, Sky UK Ltd.

References

- [http://www.etsi.org/deliver/etsi_gr/MBC/001_099/001/01.01.01_60/gr_mbc001v010101p.pdf](http://www.etsi.org/deliver/etsi_gr/MBC/001_099/001/01.01.01_60/gr_mbc001v010101p.pdf)

4. References

[1] 3GPP Work Item = 700032 (EnTV) “Enhancement for TV Service” [Rel-14]

[2] 3GPP “Study on scenarios and requirements for next generation access technologies”, TR 38.913 v14.3.0

[3] 3GPP Specification TS 22.101 ‘Service Aspects; Service Principles’

21
5. **List of acronyms**

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<th>Acronym</th>
<th>Full description</th>
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<tbody>
<tr>
<td>3GPP</td>
<td>3rd Generation Partnership Project</td>
</tr>
<tr>
<td>5G-NR</td>
<td>5G New Radio - a new radio interface in 5G</td>
</tr>
<tr>
<td>eMBMS</td>
<td>evolved Multimedia Broadcast and Multicast Services</td>
</tr>
<tr>
<td>DTT</td>
<td>Digital Terrestrial Television</td>
</tr>
<tr>
<td>EnTV</td>
<td>a 3GPP study on Enhancement for TV service</td>
</tr>
<tr>
<td>FD</td>
<td>EBU Strategic Programme on Future Distribution</td>
</tr>
<tr>
<td>FeMBMS</td>
<td>Further evolved Multimedia Broadcast and Multicast Services</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>LTE</td>
<td>Long Term Evolution, the fourth generation of mobile technology</td>
</tr>
<tr>
<td>LTE-B</td>
<td>LTE Broadcast</td>
</tr>
<tr>
<td>MBB</td>
<td>Mobile Broadband</td>
</tr>
<tr>
<td>MCS</td>
<td>Modulation and Coding Scheme</td>
</tr>
<tr>
<td>MTS</td>
<td>EBU project group on Mobile Technologies and Standards</td>
</tr>
<tr>
<td>NGMN</td>
<td>Next Generation Mobile Networks</td>
</tr>
<tr>
<td>PTM</td>
<td>Point-to-multipoint</td>
</tr>
<tr>
<td>QoS</td>
<td>Quality of Service</td>
</tr>
<tr>
<td>RAN</td>
<td>Radio Access Network</td>
</tr>
<tr>
<td>SDR</td>
<td>Software Defined Radio</td>
</tr>
<tr>
<td>SFN</td>
<td>Single Frequency Network</td>
</tr>
<tr>
<td>SIM</td>
<td>Subscriber Identity Module (SIM)</td>
</tr>
</tbody>
</table>