Broadcast and Multicast Communication Enablers for the Fifth-Generation of Wireless Systems

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Abstract

This document summarizes the dissemination activity of the 5G-Xcast project during the whole project life (from 01/06/2017 to 31/07/2019). The activities of partners related to deliverables, journal and conference papers are listed with a download links. The dissemination events such keynote talks and presentations are listed with the number of people reached. 5G-Xcast has also organised workshops and tutorials that are listed. Finally, social media activity, public website and videos produced by the partners are discussed.

Keywords

5G-PPP Phase 2, dissemination, IEEE conference, workshop, twitter, public website, YouTube video. Keynote speech, tutorial.

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List of Acronyms and Abbreviations

BMSB	International Symposium on Broadband Multimedia Systems and Broadcasting
CO	Confidential Deliverable
IBC	International Broadcasting Convention
IEEE	Institute of Electrical and Electronics Engineers
PU	Public Deliverable
SFN	Single Frequency Network
3GPP	3rd Generation Partnership Project
5G-PPP	5G Public-Private Partnership

1   Introduction

This deliverable summarises the dissemination activities related to 5G-Xcast performed during the project, e.g. journal and conference papers, keynotes and presentations, workshops or tutorials. In order to ensure open access, and for a maximum diffusion of project results, submitted version of IEEE conference papers and journals have been posted on the project website as per IEEE policy [1]. Author' versions of these papers have been also published in Research Gate and public platforms available in open access, e.g. RiuNet (UPV repository), Zenodo repository and the European Commission portal OpenAIRE.

A table summarizing the targets of the project for different dissemination and communication activities, as well as the objectives reached so far, is given below.

Table 1: Project targets and current number of dissemination activities.

Dissemination activity	Current number	Target
International journals, whitepapers and conference papers Counting the Special issue in Journal IEEE Broadcasting (see Section 3)	39 46	40
Keynotes and panels in major conferences	16	10
Participation in 5G/Broadcast events and forums	19	10
Workshops in major IEEE conferences	8	8
Summer schools, tutorials and training	1	4
Public deliverables	21	21

As shown in Table 1, almost all the objectives related to the number of the dissemination activities have been achieved. The number of dissemination activities related to international journals and conference papers has reached the target of 40 contributions. Regarding the number of keynotes and panels together with the participation in 5G/Broadcast events, dissemination has already reached the required number of activities. The targeted number of workshops in major IEEE conferences and public deliverables has also been reached. Regarding summer schools, tutorials and training events, the number of activities ended far from the initial target. Due to the logistic and organizational efforts that these massive events require, 5G-Xcast did not organise more tutorials. Finally, all the targeted public deliverables were submitted and made available in the project website. Finally, since the project is focused on technical deliverables and scientific contributions, there was less focus on patents. However, the project has filed one patent. The patent was filed in the Netherlands and could be extended internationally.

These dissemination activities have helped to reach a large number of people from academia, industry, civil society, media, etc. In particular, 3564 people from the scientific community, 66446 people from the industry, 91 people from the civil society, 555 people from the general public, 254 policy makers, 409 people from media, 512 customers and 1174 people from others sectors. In total, 72639 people have been reached with the 5G-Xcast dissemination activities.

2 Deliverables

During the project, confidential and public open deliverables have been developed. Deliverables are related to specific tasks and work packages. All documents have been either published in the project website or shared with 5G-PPP projects for inter-project cooperation.

Please note that CO stands for confidential, PU for public and first versions of public deliverables as stated in the proposal are not available in the website. For deliverables with more than one version, first and final release will have names v1.X and v2.X respectively.

Work Package 1:

D1.1 (CO)   I. Alepuz, Ed., "Project Management and Administration Guidelines," Deliverable 1.1, 5G-PPP 5G-Xcast project, Jun. 2017.

D1.2 (CO)   I. Alepuz and D. Gomez-Barquero, Eds., "Mid-Term Management and Administration Activities", Deliverable 1.2, 5G-PPP 5G-Xcast project, May 2018.

D1.3 (CO)   I. Alepuz and D. Gomez-Barquero, "Final Management Report", Deliverable 1.3, 5G-PPP 5G-Xcast project, July 2019.

Work Package 2:

D2.1 (PU)   D. Ratkaj and A. Murphy, Eds., "Definition of Use Cases, Requirements and KPIs," Deliverable 2.1, 5G-PPP 5G-Xcast project, Jun. 2018.

D2.2 (PU)   A. Murphy, C. Kunert and I. Alepuz, Eds., "Analysis of the Technical Developments Against the Use Cases", Deliverable 2.2, 5G-PPP 5G-Xcast project, Jan. 2019

D2.3 (PU)   "Future Work and Longer-Term Use Cases", Deliverable 2.3, 5G-PPP 5G-Xcast project, Jun. 2019.

D2.4 (PU)   "Analysis and Development of Terrestrial Broadcast in 5G-Xcast", Deliverable 2.4, 5G-PPP 5G-Xcast project, May 2019.

D2.5 (PU)   "Analysis and Development of Public Warning in 5G-Xcast", Deliverable 2.5, 5G-PPP 5G-Xcast project, May 2019.

Work Package 3:

D3.1 (PU)   D. Vargas and D. Mi, Eds., "LTE-Advanced Pro Broadcast Radio Access Network Benchmark," Deliverable D3.1, 5G-PPP 5G-Xcast project, Nov. 2017.

D3.2 (PU)   E. Garro, M. Fuentes, J.J. Gimenez and J.L. Carcel. Eds., "Air Interface", Deliverable 3.2, 5G-PPP 5G-Xcast project, Nov. 2018.

D3.3 (PU)   M. Säily and C. Barjau. Eds., "RAN Logical Architecture and Interfaces for 5G-Xcast", Deliverable 3.3, 5G-PPP 5G-Xcast project, Feb. 2019.
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D3.4 (PU)   F. Tesema et. Al Eds., "RAT Protocols and Radio Resource Management", Deliverable 3.4, 5G-PPP 5G-Xcast project, May 2019.

D3.5 (CO)   D. Mi, Ed., "RAN Proof-of-Concept Prototypes", Deliverable D3.5, 5G-PPP 5G-Xcast project, Feb. 2019.

Work Package 4:

D4.1 (PU)   T. Tran, Ed., "Mobile Core Network," Deliverable 4.1, 5G-PPP 5G-Xcast project, May 2018.

D4.2 (PU)   J. Hart, Ed., "Converged Core Network," Deliverable 4.2, 5G-PPP 5G-Xcast projects, Aug. 2018.

D4.3 (PU)   B. Altman, Ed., "Session Control and Management," Deliverable 4.3, 5G-PPP 5G-Xcast project, Nov. 2018.

D4.4 (CO)   P. Sanders, Ed., "5G-Xcast WP4 Core Network PoC Prototype", Deliverable 4.4, 5G-PPP 5G-Xcast project, Feb. 2019.

Work Package 5:

D5.1 (PU)   N. Nouvel, Ed., "Content Delivery Vision," Deliverable 5.1, 5G-PPP 5G-Xcast project, Nov. 2017.

D5.2 (PU)   T. Stevens, Ed., "Key Technologies for the Content Distribution Network", Deliverable 5.2, 5G-PPP 5G-Xcast project, Aug. 2018.

D5.3 (PU)   B. Altman, Ed., "Application Layer Intelligence", Deliverable 5.3, 5G-PPP 5G-Xcast project, Nov. 2018.

D5.4 (CO)   T. Tran, Ed., "5G-Xcast Content Distribution PoC Prototype", Deliverable 5.4, 5G-PPP 5G-Xcast project, Feb. 2019.

Work Package 6:

D6.1 (CO)   T. Jokela, J. Morgade, K. Dushchuluun, Eds., "Initial Planning for Test-Beds, Showcase and Demonstrators," Deliverable 6.1, 5G-PPP 5G-Xcast project, May 2018.

D6.2 (PU)   J. Eyles, A. Murphy, D. Vargas and J. J. Gimenez, Eds., "Development of Showcase and Demonstrators", Deliverable 6.2, 5G-PPP 5G-Xcast project, Feb. 2019.

D6.3 (PU)   D. Mi and J. J. Gimenez, Ed., "Test-Beds Integration and Development", Deliverable 6.3, 5G-PPP 5G-Xcast project, Feb. 2019.

D6.4 (PU)   "Final Evaluation and Validation", Deliverable 6.4, 5G-PPP 5G-Xcast project, May 2019.

D6.5 (PU)   J.J. Gimenez, Ed., "European Championships 2018 Showcase and Demonstrators", Deliverable 6.5, 5G-PPP 5G-Xcast project, Jul. 2018.

D6.6 (PU)   N. Nouvel, Ed., "Optimized Resources Allocation For Live Video Content Demonstrator", Deliverable 6.6, 5G-PPP 5G-Xcast project, Aug. 2018.

D6.7 (PU)   T. Tran, J.J. Gimenez, Eds., "Large Scale Media Delivery powered by MooD and free-to-air distribution to TVs and Smartphones", Deliverable 6.7, 5G-PPP 5G-Xcast project, Feb. 2018.

D6.8 (PU)   H. Kokkinen, Eds., "Spectrum Management Demonstrator EUCNC 2018", Deliverable 6.8, 5G-PPP 5G-Xcast project, Feb. 2019.

D6.9 (PU)   Jordi Gimenez, Eds., "EUCNC 2019 Demonstrator", Deliverable 6.9, 5G-PPP 5G-Xcast project, May 2019.

Work Package 7:

D7.1 (PU)   B. Mouhouche, Ed., "Data Management Plan," Deliverable 7.1, 5G-PPP 5G-Xcast project, June. 2018.

D7.2 (CO)   B. Mouhouche, Ed., "5G-PPP Phase 2 Collaboration, Dissemination and Exploitation Plan," Deliverable 7.2, 5G-PPP 5G-Xcast project, Nov 2017.

D7.3 (PU)   B. Mouhouche, M. Fuentes and J.L. Carcel, Eds., "Dissemination Report," Deliverable 7.3, 5G-PPP 5G-Xcast project, July 2018.

D7.4 (PU)   B. Mouhouche, M. Fuentes, J.L. Carcel, Wei Guo Eds., "Exploitation and Standardisation Report," Deliverable 7.4, 5G-PPP 5G-Xcast project, July 2019.

3   Journal Articles and Magazines

The main results of 5G-Xcast have been published in 5 journal papers and 3 informative magazine, in addition 3 to White papers. The full text can be found in (http://5g-xcast.eu/documents/). 5G-Xcast is also planning 7 Journal papers in special issue of an IEEE Journal on broadcasting.

The joint work between partners is also highlighted.

3.1   Journal Articles

The following journal papers have been **published** during the project life:

1.   J. J. Gimenez, D. Gomez-Barquero, J. Morgade, and E. Stare, "Wideband Broadcasting: A Power-Efficient Approach to 5G Broadcasting," *IEEE Communications Magazine*, vol. 56, no. 3, pp. 119 – 125, Mar. 2018.
    Joint work of UPV and IRT

2.   D. Gomez-Barquero, D. Navratil, S. Appleby, and M. Stagg, "Point-to-Multipoint Communication Enablers for the Fifth-Generation of Wireless Systems," *IEEE Communications Standards Magazine*, vol. 2, no. 1, pp. 53-59, Mar. 2018.
    Joint work of UPV, Nokia and BT

3.   M. Fuentes, D. Mi, H. Chen, E. Garro, J.L.Carcel, D. Vargas, B. Mouhouche and D. Gomez-Barquero, "Physical Layer Performance Evaluation of LTE-Advanced Pro Broadcast and ATSC 3.0 Systems," *IEEE Transactions on Broadcasting*, Early Access. **Joint work of SEUK, UNIS, UPV and BBC.**

4.   J.J. Gimenez, J.L. Carcel, M. Fuentes, E. Garro, S. Elliot, D. Vargas, C. Menzel and D. Gomez-Barquero, "5G New Radio for Terrestrial Broadcast: A Forward-Looking Approach for NR-MBMS" *IEEE Transactions on Broadcasting*, Early Access. **Joint work of IRT, SEUK, UPV and BBC.**

5.   D. Vargas, J.J. Gimenez, T. Ellinor, A. Murphy, B. Lembke, K. Dushchuluun, "Practical performance measurements of LTE Broadcast (eMBMS) for TV applications", SMPTE Motion Imaging Journey, **Joint work of BBC and IRT.**

3.2   Informative Magazines, White Papers and Technical Reports

5G-Xcast has produced one informative magazine, two white papers and one technical report:

1.   D. Ratkaj, "EU-funded research in 5G broadcast – 5G-Xcast," *The EBU magazine Tech-I*, vol. 33, p. 33, Sep. 2017.

2.   F. Tesema and V. Pauli, "2nd Layer of FEC in RAN for Mixed-Mode Broadcast/Multicast Networks. NOMOR Research GmbH White Paper, Aug. 2018.

3.   EBU, IRT and BBC, Technical Report TR 044, "Trials, Tests and Projects Relating to 4G/5G Broadcast Supported by European PSB", Jul. 2018.

4. L. Yu, C. Dietrich, V. Pauli, "IMT-2020 Evaluation: Calibration of NOMOR's System Level Simulator", NOMOR Research GmbH White Paper, Nov. 2018.

5. J. J. Gimenez, "IRT and EBU show the potential of 5G for media distribution", IRT, EBU. The EBU magazine Tech-I, Dec. 2018.

6. F. De Angelis, "New delivery methods bring new measurement challenges", EBU. The EBU magazine Tech-I, June 2019.

7. F. Tesema, V. Pauli, Coordinated Link Adaptation and Higher Layer Error Correction for 5G Broadcast / Multicast, white paper. July 2019.

4 Conference Papers

5G-Xcast partners have published up to 25 conference papers. All of them can be found on the European Commission open access repository (http://openaire.eu/) and the open access repository (http://zenodo.org). A selection of the most relevant conference papers is also available on our public website (http://5g-xcast.eu/documents/). The full list of conference papers, either **published** or **accepted, are listed** below. The joint work between partners is also **highlighted**.

1. J. L. Carcel, J. Gimenez and D. Gomez-Barquero, "Zero-Guard OFDM Operation in SFN with ATSC 3.0 Ultra-Robust Transmission Modes," *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Cagliari, Italy, 2017.

2. J. Kalliovaara, *et al.*, "Designing a Testbed Infrastructure for Experimental Validation and Trialing of 5G Vertical Applications," *Proc. EAI International Conference on Cognitive Radio Oriented Wireless Networks (CROWNCOM),* Lisbon, Portugal, 2017. **Joint work of TUAS, Nokia and Fairspectrum**.

3. B. Mouhouche, L. Christodoulou and M. Fuentes, "Partial HARQ Retransmission for Broadcast in Fading Channels," *Proc. International Conference on Computer Science, Information Technology and Applications (CSITA),* Dubai, UAE, 2017.

4. A. Prasad, M. A. Uusitalo, D. Navrátil, and M. Säily, "Challenges for Enabling Virtual Reality Broadcast Using 5G Small Cell Network," *Proc. EEE Wireless Communications and Networking Conference (WCNC),* Barcelona, Spain, 2018.

5. W. Guo, M. Fuentes, L. Christodoulou and B. Mouhouche, "Roads to Multimedia Broadcast Multicast Services in 5G New Radio," *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Valencia, Spain, 2018.

6. M. Fuentes, L. Christodoulou and B. Mouhouche, "Non-Uniform Constellations for Broadcast and Multicast in 5G New Radio," *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Valencia, Spain, 2018.

7. A. Prasad, P. Lunden, Z. Li and M. Uusitalo, "Enhancements for Enabling Point-to-Multipoint Communication Using Unlicensed Spectrum," *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Valencia, Spain, 2018.

8. T. Jokela, *et al.*, "Trials of Spectrum Sharing in 2.3 GHz band for two types of PMSE Equipment and Mobile Network," *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Valencia, Spain, 2018. **Joint work of TUAS, Fairspectrum**

9. J. Gimenez, S. Elliot, D. Vargas, P. Renka and D. Gomez-Barquero, ""Enhanced TV Delivery with eMBMS: Coverage Evaluation for Roof-Top Reception" *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Valencia, Spain, 2018. **Joint work of IRT, BBC, UPV.**

10. E. Öztürk, W. Zia, V. Pauli and E. Steinbach, "Performance Evaluation of ATSC 3.0 DASH over LTE eMBMS," *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Valencia, Spain, 2018.

11. A. Zafeiropoulos, *et al.*, "Enabling Vertical Industries Adoption of 5G Technologies: a Cartography of evolving solutions," *Proc. European Conference on Networks and Communications (EUCNC)*, Ljubljana, Slovenia, 2018.

12. H. Chen, D. Mi, Z. Chu, P. Xiao and R. Tafazolli, "Rate-Splitting for Multigroup Multicast Beamforming in Multicarrier Systems," *Proc. IEEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Kalamata, Greece, 2018.

13. A. Prasad, A. Maederz, and M. A. Uusitalo, "Optimizing Over-The-Air Virtual Reality Broadcast Transmissions with Low-Latency Feedback," *Proc. IEEE 5G World Forum*, Santa Clara, USA, 2018.

14. H. Chen, *et al.*, "Pioneering Studies on LTE eMBMS: Towards 5G Point-to-Multipoint Transmissions," *Proc. IEEE Sensor Array and Multichannel Signal Processing (SAM) Workshop*, Sheffield, UK, 2018. **Joint work of UNIS, Samsung, BBC and UPV.**

15. D. Vargas, J.J. Gimenez, T. Ellinor, A. Murphy, B. Lembke, K. Dushchuluun, "Practical performance measurements of LTE Broadcast (eMBMS) for TV applications," *Proc. International Broadcasting Conference (IBC) 2018 conference*, Amsterdam, 2018. **Joint work of BBC and IRT.**

16. R. Odarchenko, R. Aguiar, B. Altman, B. Altman, Y. Sulema, "Multilink approach for the content delivery in 5G networks," *Proc. 5th International Scientific-Practical Conference*, *Problems of Infocommunications. Science & Technology 2018*, Kharkiv, Ukraine, 2018. **Joint work of Bundleslab and LiveU.**

17. R. Odarchenko, "Solutions for optimization of mobile broadcasting in 5G Networks", *Proc. 23th International Scientific and Technical Conference, Modern means of Communications,* Minsk, Belarus, 2018.

18. H. Chen, D. Mi, M. Fuentes, D. Vargas, E. Garro, J.L. Carcel, B. Mouhouche, P. Xiao and R. Tafazolli, "On the performance of PDCCH in LTE and 5G New Radio", *Proc. IEEE Globecom 2018,* Abu Dhabi, UAE, 2018. **Joint work of UNIS, Samsung, BBC and UPV.**

19. E. Garro, M. Fuentes, D. Gomez-Barquero and J.L. Carcel, "5G Mixed Mode: An Innovative Point-to-Multipoint Solution for New Radio", *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Jeju, South Korea, 2019. **Joint work of UPV and Samsung.**

20. J.L. Carcel, B. Mouhouche, M. Fuentes, E. Garro and D. Gomez-Barquero, "IMT-2020 Key Performance Indicators: Evaluation and Extension Towards 5G New Radio Point-to-Multipoint", *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Jeju, South Korea, 2019. **Joint work of Samsung and UPV.**

21. C. Barjau, M. Säily and D. Gomez-Barquero, "Enabling SFN Transmissions in 5G Cloud-RAN Deployments", *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Jeju, South Korea, 2019. **Joint work of UPV and Nokia.**

22. J. Hallio, R. Ekman, J. Kalliovaara, T. Lakner, J. Auranen, A. Arajärvi, T. Jokela, J. Paavola, H. Kokkinen, T. Savunen and H. Rantanen, "Rapidly Deployable Network System for Critical Communications in Remote Locations", *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Jeju, South Korea, 2019. **Joint work of TUAS and FS**

23. H. Chen, D. Mi, B. Mouhouche, P. Xiao and R. Tafazolli, "Performance Evaluation of New Radio PDCCH for Point-to-Multipoint scenarios", *Proc. IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB),* Jeju, South Korea, 2019. **Joint work of UNIS and Samsung.**

24. W. Guo and B. Mouhouche, "A Method to Tailor Broadcasting and Multicasting Transmission in 5G New Radio", *Proc. European Conference on Networks and Communications (EUCNC)*, Valencia, Spain, 2019.

25. R. Odarchenko, Y. Sulema, J. Gimenez, B. Altman and S. Petersen, "Multilink solution for 5G: Efficiency Experimental Studies", IEEE AICT 2019, July 2019. . **Joint work of Budleslab, IRT and LiveU.**

5 Keynote Talks, Presentations and Posters

The main results of 5G-Xcast in the first phase of the project have been presented in 50 talks and presentations:

		People reached
1.	D. Gomez-Barquero, "Broadcast and Multicast Communication Enablers for the Fifth-Generation of Wireless Systems," *IEEE BMSB,* Cagliari, Italy, June 2017.	135
2.	D. Gomez-Barquero, A. Prasad and B. Mouhouche, "Broadcast and Multicast Communication Enablers for the Fifth-Generation of Wireless Systems," *EUCNC,* Oulu, Finland, June 2017.	600
3.	L. Christodoulou, "5G-Xcast, Developing Broadcast and Multicast Capabilities for the 5G," *IEEE 5G Summit*, Thessaloniki, Greece, July 2017.	122
4.	D. Gomez-Barquero, "5G-Xcast", FOBTV, Amsterdam, Netherlands, Sep. 2017.	25
5.	M. A. Uusitalo, "Wireless for Verticals", *IEEE 5G-IoT Summit,* Helsinki, Finland, Sep. 2017.	70
6.	B. Mouhouche, "The Challenge of Broadcast Support in 5G Systems," *IEEE 5G Summit,* Montreal, Canada, Oct. 2017.	200
7.	B. Mouhouche, "Role of Unlicensed Spectrum in Next Generation Wireless Systems," *IEEE PIMRC,* Montreal, Canada, Oct. 2017.	60
8.	D. Vargas, "Broadcast and Multicast Communication Enablers for 5G," *DTG Spectrum Access Forum*, London, UK, Oct. 2017.	14
9.	D. Mi, "Xcast Enabler for 5G," *5GIC Standards Sub-Group Meeting*, Guildford, UK, Nov. 2017.	20
10.	S. Appleby, T. Stevens and R. Turnbull, "Unified Content Delivery on Fixed and Mobile Networks: A view of synchronous TV delivery," *EBU Forecast*, Geneva, Switzerland, Nov. 2017.	116
11.	D. Gomez-Barquero, "All you want to know about the 5G-Xcast project," *EBU Forecast*, Geneva, Switzerland, Nov. 2017.	116
12.	J. Morgade, "Next generation of DTT technologies, where are we going?" EBU Forecast, Geneva, Switzerland, Nov. 2017.	116
12.	D. Gomez-Barquero, "The Disruption of 5G in Broadcasting," *BES Expo,* New Delhi, India, Feb. 2018.	240
13.	D. Gomez-Barquero, "Broadcast in 5G," *BES Expo,* New Delhi, India, Feb. 2018.	240

14. M. Fuentes, "The Role of Broadcast in 5G New Radio and Beyond," *IEEE 5G Summit*, Trento, Italy, Mar. 2018.   60

15. R. Turnbull, "Unified Content Delivery on Fixed and Mobile Networks: A view of synchronous TV delivery," *Advanced Spectral Management in 5G+ Networks*, London, UK, Mar. 2018.   54

16. A. Prasad, "5G-Xcast: Enabling Mass Media Delivery & Interconnected Social Experiences in the 5G Era," *WIVE Project Seminar*, Helsinki, Finland, Mar. 2018.   30

17. F. De Angelis, "Rethinking Reliable Multicast Encapsulation Protocols", EBU Broadthinking 2018. Mar. 2018   100

17. A. Prasad, "5G – A Key Enabler for New Verticals and Markets," *NAB Show*, Las Vegas, USA, Apr. 2018.   60

18. R. Tafazolli, "5G, Any Service Any Cast, a Special Generation," *IEEE WCNC,* Barcelona, Spain, Apr. 2018.   30

19. E. Guttman, "5G in 3GPP," *IEEE WCNC,* Barcelona, Spain, Apr. 2018.   30

20. B. Mouhouche, "5G-Xcast Project, Scope and Objectives," *IEEE WCNC,* Barcelona, Spain, Apr. 2018.   30

21. A. Prasad, "Role of Edge Computing in the Mass Delivery of Interconnected Social Experiences in 5G," *IEEE WCNC,* Barcelona, Spain, Apr. 2018.   30

22. D. Gomez-Barquero, "Broadcast and Multicast Communications Enablers for 5G," *IEEE BTS Young Professionals Workshop*, Reggio Calabria, Italy, Apr. 2018.   125

23. N. Cardona, "5G-Xcast", *5G Forum,* Málaga, Spain, Apr. 2018.   150

24. A. Prasad, "5G-Xcast", *WBU IMCG,* Atlanta, USA, Apr. 2018.   95

25. David Gomez-Barquero, "Broadcast and Multicast Communications Enablers for 5G", 5G Virtual Conference, May 2018.   384

26. B. Mouhouche, "Research and Standard Trends in Broadcast for Future 5G Cellular Systems", *5G Summit*, Hammamet, Tunisia, May 2018.   40

27. B. Mouhouche, "5G Broadcast Use Cases and their Impact on Society and Citizens", *5G Summit,* Brasilia, Brazil, May 2018*.*   100

28. A. Prasad, "5G context and the 5G-Xcast project", *World Broadcasting Union-Internet Media Connectivity Group (WBU-IMCG)*, Atlanta, USA, May 2018   90

28. M. Cuevas, "Convergence in 5G", IEEE BMSB 2018, Jun. 2018.   150

29.	Darko Ratkaj, "Future distribution of public service media content and services", *EUCNC 2018 "Verticals Industries and Services for 5G" workshop*, Ljubljana, Slovenia, June 2018.	50
30.	D. Gomez-Barquero, "5G-Xcast for Public Warning Systems", *EUCNC 2018 "Verticals Industries and Services for 5G" workshop*, Ljubljana, Slovenia, June 2018.	50
31.	A. Prasad, "5G-Xcast: Towards inter-connected social experiences through mass delivery of immersive content", IEEE *5G Summit,* Tangiers, Morocco, June 2018.	40
32.	A. Prasad, "Enabling mass media delivery and interconnected social experiences through Xcasting in 5G", IEEE *5G Summit,* Tangiers, Morocco, June 2018.	30
33.	B. Mouhouche, "Media Support in 5G: The 5G-Xcast project", *5G World Forum,* Santa Clara, CA, USA, Jul. 2018.	65
34.	B. Mouhouche, Panel on the "Future of Media in 5G", *5G World Forum,* Santa Clara, CA, USA, Jul. 2018.	90
35.	D. Ratkaj, "Introduction to 5G-Xcast: Broadcast and Multicast Communication Enablers for the Fifth-Generation of Wireless Systems", *DVB Workshop: Smart solutions for next-gen hybrid broadcast-broadband IP convergence,* Delhi, India, Jul. 2018.	55
36.	A. Prasad, "Future of Digital TV – Spectrum Considerations for 5G-Xcast", *SET Expo 2018,* Sao Paulo, Brazil, Aug. 2018.	70
37.	A. Prasad, "TV/5G Convergence", *SET Expo 2018,* Sao Paulo, Brazil, Aug. 2018.	55
38.	J. Hart, "5G Network Slicing and Convergence: Key technologies in Next Generation Networks", *FITCE Congress 2018,* Manchester, UK, Sept. 2018.	50
39.	A. Prasad and D. Gomez-Barquero, Masterclass on "5G-Xcast – A Unified Framework for Common Content Delivery in 5G". *International Broadcasting Conference (IBC),* Amsterdam, Netherlands, Sept. 2018.	70
40.	D. Gomez-Barquero, "5G Broadcast Status in 3GPP", *International Broadcasting Conference (IBC),* Amsterdam, Netherlands, Sept. 2018.	TBD
41.	A. Prasad, "5G Facts, Fiction, and Impacts for the Future of Broadcasting", *IEEE BTS Annual Symposium,* Arlington, Virginia, USA, Oct. 2018.	65
42.	M. Bot, "CAP and mobile multimedia alerts", *2018 Common Alerting Protocol (CAP) Workshop,* Hong Kong, China, Oct. 2018.	60

43.	B. Mouhouche, "5G-Xcast Broadcast/Broadband Convergence", *ATSC-TSDSI Workshop on Convergence,* New Delhi, India, Nov. 2018.	70
44.	T. Tran, "5G-Xcast Bringing Multicast and Broadcast Capabilities to 5G", *EBU Forecast 2018,* Geneva, Switzerland, Nov. 2018.	50
45.	J.J. Gimenez, "The 5G-Xcast Showcase during the European Championships 2018", *EBU Forecast 2018,* Geneva, Switzerland, Nov. 2018.	50
46.	A. Prasad, "5G - A Unique Value Proposition for the Mass Delivery of Immersive Media?" *9th FOKUS FUSECO Forum Berlin*, Germany, Nov. 2018.	40
47.	B. Mouhouche, "The 5G Story, Vision, Research and Standards", *Advances in Wireless Communications Workshop,* Kaust, Thuwal, South Arabia, Dec. 2018.	25
48.	B. Mouhouche, "5G-Xcast – The role of broadcast in 5G networks", *International Cooperation EU-India (5G-IA, TSDSI, BIF) Workshop,* New Delhi, India, Feb. 2019.	70
49.	B. Mouhouche, "Paving the way towards 6G", *IEEE Wireless Communications and Networking Conference,* Marrakech, Morocco, Apr. 2019.	50
50.	D. Gomez-Barquero, "Challenges and Opportunities for Innovation in Broadband Multimedia and Broadcasting", *IEEE BTS Young Professionals Workshop,* Uxbridge, West London, UK, Apr. 2019.	30
51.	D. Gomez-Barquero, "Broadcast and Multicast Communications Enablers for 5G", *IEEE BTS Distinguished Lecturer Program*, Cagliari, Italy, May 2019.	20
52	D. Gomez-Barquero, "5G-Xcast – Enabling Point-to-Multipoint Communication Capabilities in 5G New Radio and the 5G Core", *IEEE BMSB 2019*, Jeju island, South Korea, June 2019	150

The project has also prepared and presented 10 posters/brochures:

1. D. Gomez-Barquero, A. Prasad and B. Mouhouche, "5G-Xcast: Broadcast and Multicast Communication Enablers for the Fifth-Generation of Wireless Systems," *EUCNC,* Oulu, Finland, June 2017.

2. N. Nouvel, "Broadcast and Multicast Communication Enablers for the Fifth Generation of Wireless Systems (5G-Xcast), Mobile World Congress (MWC) 2018, Feb. 2018.

3. N. Nouvel, "Broadcast and Multicast Communication Enablers for the Fifth - Generation of Wireless Systems (5G-Xcast)," *NAB Show,* Las Vegas, USA, Apr. 2018.

4. N. Nouvel, "Towards 5G Broadcasting", International Broadcasting Convention (IBC), Amsterdam, Netherlands, Sep. 2018.

5. M. Fuentes, J. Gimenez, J. Eyles, E. Öztürk, T. Jokela, T. Tran, "5G-Xcast EuCNC brochure", June 2019

6. T. Tran, "5G-Xcast EUCNC 2019 Poster: Converged, autonomous MooD in fixed/mobile networks", June 2019.

7. J. EYles, "5G-Xcast EUCNC 2019 Poster: Forecaster5G: Object-based broadcasting", June 2019.

8. T. Jokela, "5G-Xcast EUCNC 2019 Poster: Multimedia Public Warning", June 2019.

9. E. Öztürk. "5G-Xcast EUCNC 2019 Poster: Reliable Multicast Delivery in 5G Networks", June 2019.

10. J. Gimenez, "5G-Xcast EUCNC 2019 Poster: Hybrid Broadcast Service with Multi-Link", June 2019.

6 Workshops

5G-Xcast has implemented a comprehensive dissemination strategy towards the scientific community with the organisation of workshops. This dissemination strategy is of prime importance to let project's results and findings percolate among academic and industrial research peers and the regulatory community.

The following workshops have been organized so far:

1. Joint Workshop with Speed5G, "Advanced spectrum management in 5G+ networks", *Speed5G Workshop,* London, UK, Mar. 2018.

2. Joint Workshop with ONE5G, "Centimetre and Millimetre Wave based communications for 5G Networks (CmMmW5G)," *IEEE WCNC 2018*, Barcelona, Spain, Apr. 2018.

3. 5G-Xcast Workshop, "Point-to-Multipoint as Key Technology Element for 5G Systems," *IEEE BMSB 2018*, Valencia, Spain, June 2018.

4. Joint Workshop with 5G-PPP Projects, "Delivering Future Media Applications and Services in 5G," *EUCNC Conference,* Ljubljana, Slovenia, June 2018.

5. Joint Workshop with University of Oulu, "Disrupting Media and Entertainment in the 5G Era" *IEEE 5G World Forum,* Santa Clara, USA, July 2018.

6. Joint Workshop with ONE5G, "5G Advanced: The Next Evolution Step of 5G NR," *IEEE Globecom 2018,* Abu Dhabi, UAE, Dec. 2018.

7. Joint Workshop with ONE5G, "Advanced 5G radio access network features and performance" *IEEE Wireless Communications and Networking Conference,* Marrakech, Morocco, Apr. 2019.

8. 5G-Xcast Workshop, *IEEE BMSB 2019*, Jeju, South Korea, Jun. 2019.

7 Tutorials and Training Schools

Tutorials have been organized in conjunction with IEEE conferences. Ph.D. students can find ideas during these events to steer their career in 5G and media industries.

1. "Tutorial 5G-Xcast", IEEE BMSB 2018, Valencia, Spain, June 2018. "Tutorial 5G-Xcast", IEEE BMSB 2018, Valencia, Spain, June 2018.

8   Booth at EUCNC 2018

5G-Xcast partners Turku University of Applied Science and Fairspectrum held a booth at the EUCNC 2018 conference where they presented a demonstration on dynamic spectrum sharing.

5G-XCast provides means to deliver the new audio-visual media, like 4k/8k Ultra-High-Definition Television and Virtual Reality including their consumer interactivity. As a part of media production, wireless links are used between the camera and the Outdoor Broadcasting van or another type of video processing unit. The new audio-visual content requires higher bitrates and more spectrum from the wireless links than the High Definition (HD) video. 2.3 GHz frequency band is used for wireless camera communications in many European countries. ETSI has specified how Licensed Shared Access (LSA) helps mobile operators to use the same spectrum band as a secondary user. A part of the 2.3 GHz Program Making and Special Events (PMSE) users are expected to migrate the camera communication to LTE or 5G.
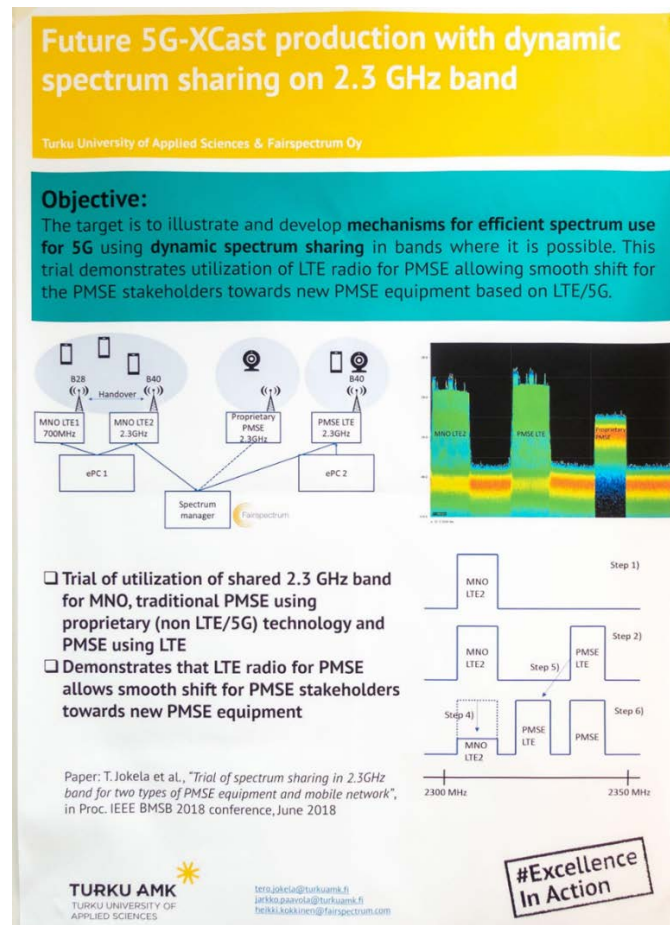
Figure 1. EUCNC 2018 Booth brochure

This demonstration showed how thanks to the dynamic spectrum management, the current license holders, PMSE, can be prioritized and how LSA can be used to manage spectrum sharing between current PMSE use, LTE based PMSE use and commercial LTE operator network. More details are shown in Figure 1. The benefits introduced to the system are: The regulator has the full control of the system, mobile operator gets access bands, which cannot be cleared, military and PPDR get clear benefit from sharing their spectrum bands, and PMSE users have a smooth transition path to LTE and 5G.

9 Demonstrations at IBC 2018

5G-Xcast performed two live demonstrations during the last edition of the International Broadcasting Convention (IBC) 2018, held in Amsterdam (Netherlands). The demonstrations, led by Broadpeak and, IRT together with EBU, helped to pave the way towards 5G Broadcasting, using the 5G-Xcast mobile technology to enable free-to-air distribution of enhanced media services to TVs and smartphones at scale.

Broadpeak performed a practical demonstration on path adaptation for live content delivery of unicast and multicast services. In particular, the demo showed how unicast and multicast live content can be adapted to the delivery path for three different user contexts related to both "at home" and "on the go" situations. The solution was integrated within the 5G-Xcast framework, where a network-agnostic content distribution framework allows to optimise network resources dynamically.
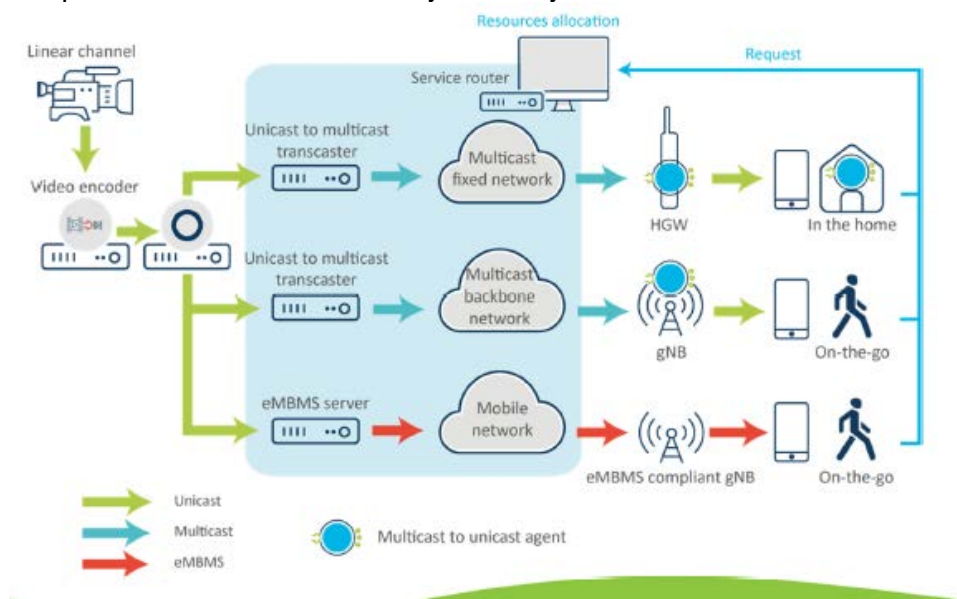
Figure 2. Broadpeak IBC 2018 Brochure

Figure 3. Broadpeak IBC 2018 Demonstration

IRT in collaboration with the EBU performed a demonstration about how audiovisual content produced in the state-of-the-art formats both live and on-demand can be distributed to large audiences in the 5G environment. As part of the 5G-Xcast project, the demonstration was performed using the LTE eMBMS technology to deliver live TV content and signalling for add-on services based on the HbbTV standard. Both services were transmitted in MPEG TV streams to smartphones and virtual set-top-boxes on TV devices.
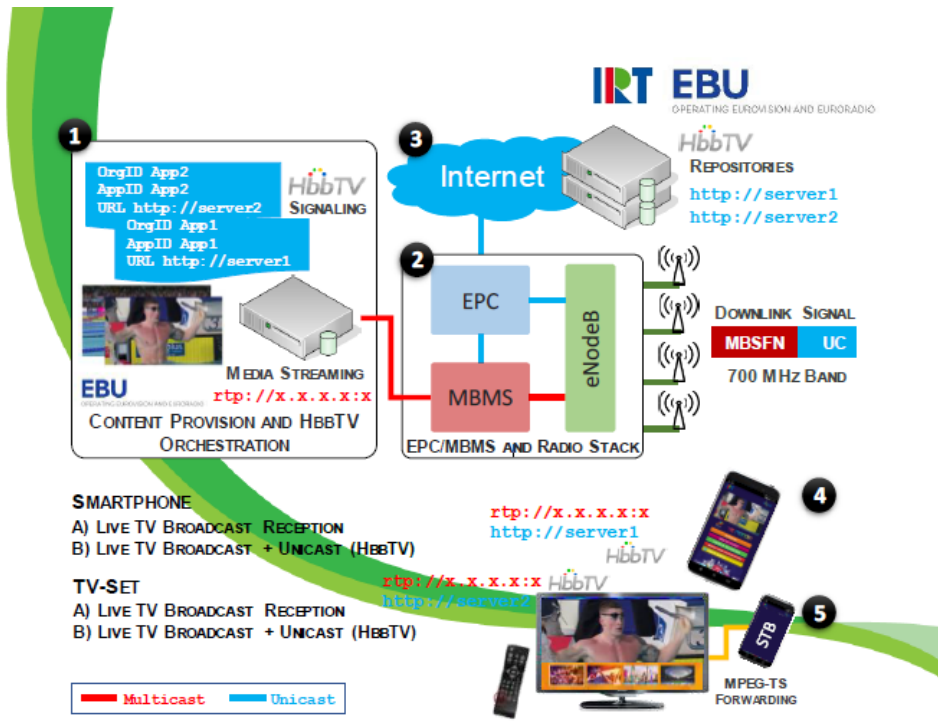

Figure 4. IRT and EBU IBC 2018 Brochure
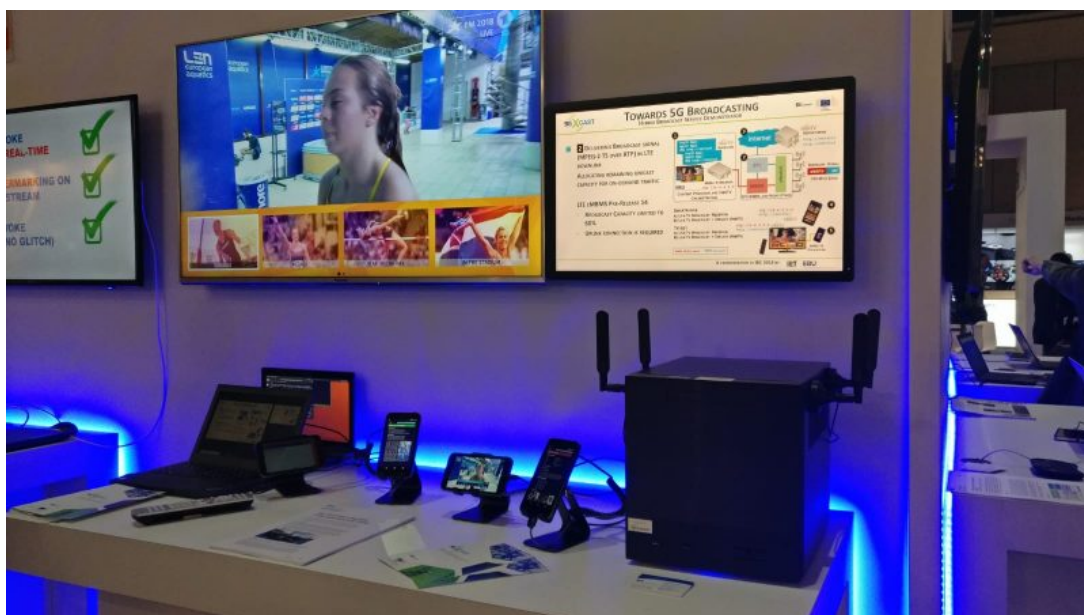
Figure 5. IRT and EBU IBC 2018 Demonstration

10 Demonstration at MWC 2019

5G-Xcast conducted the first live demonstration of video delivery over 5G during the Mobile World Congress' last edition, held 25-28 February in Barcelona. The demonstration, which was jointly performed by IRT, EBU and Enensys-Expway, showed the concept of large scale media delivery in 5G powered by MooD and free-to-air distribution of enhanced media services to TVs and smartphones.

The showcase involved live video transmissions to multiple end-user devices based on 5G-Xcast concepts, enabling the large-scale distribution of audiovisual media services over 5G networks, with maximum scalability, bandwidth efficiency, and sustained video quality on every end-user screen.
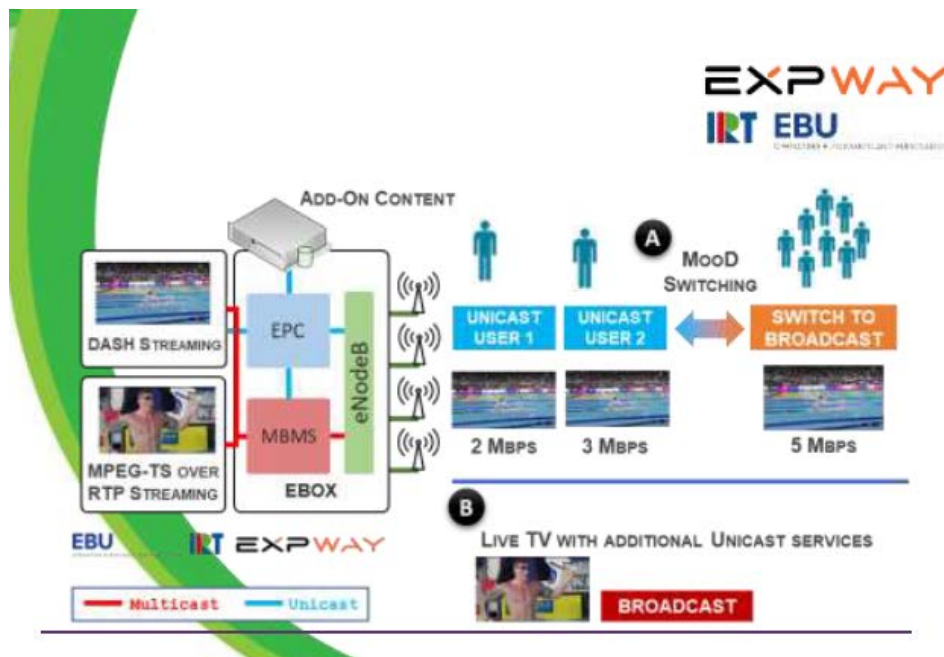
Figure 6. Expway, IRT and EBU MWC 2019 Brochure

Figure 7. Expway, IRT and EBU MWC 2019 Demonstration

11 Demos at EUCNC 2019

5G-Xcast was one of the 5G-PPP Phase-II projects present at the 28th edition of European Conference on Networks and Communications, EuCNC 2019, held 18-21 June in Valencia (Spain). The conference, which gathered large amounts of experts from multiple industries, research centers, universities and business on telecommunications, was the ideal scenario to present our latest demos.

The project performed five demonstrations at the 5G-Xcast booth plus one additional joint demonstration located at the Sat5G booth.

- The demonstration on **"Converged, autonomous MooD in fixed/mobile networks"** performed by BT and Expway showed how the content prepared for unicast distribution can be distributed over both fixed and mobile networks with dynamic switching between multicast/broadcast and unicast delivery depending on the audience size.

- BBC in collaboration with University of Surrey presented the **"Forecaster5G: Object-based broadcasting"** showing how the content is produced as a set of discrete media objects to be rendered by the end device. Common objects were transmitted using the Dynamic Adaptive Streaming over IP Multicast (DASM) system while personalised content was received via unicast.

- The demonstration on **"Multimedia Public Warning"** showcased the use of dynamic spectrum management, LTE broadcast and channel bonding to send public warning multimedia alerts to the user equipment. This demo was performed by One2many, LiveU, Fairspectrum, Turku University of Applied Sciences (TUAS) and Universitat Politecnica de Valencia (UPV)

- Nomor in collaboration with BT, Broadpeak and Bundleslab presented the demo on **"Reliable Multicast Delivery in 5G Networks"** where the gains and trade-offs in resource consumption, spectrum efficiency, service coverage, and quality of experience introduced by multicast when delivering popular content were demonstrated.

- The demonstration on **"Hybrid Broadcast Service with Multi-Link"** performed by Institut Für Rundfunktechnik (IRT), European Broadcasting Union (EBU), Bundleslab and LiveU showed the benefits of splitting and combining content from different networks via LTE and Wi-Fi interfaces, with a seamless switch between them and the ability to increase aggregated throughput via Multi-Link.

- Finally, the **"Low latency mABR live streaming 5G-Xcast SaT5G demo"** joint demonstration showcased the use of satellite multicast capabilities for the delivery of live channels. The 5G-Xcast partners involved in this demonstration were Broadpeak and University of Surrey (UNIS).
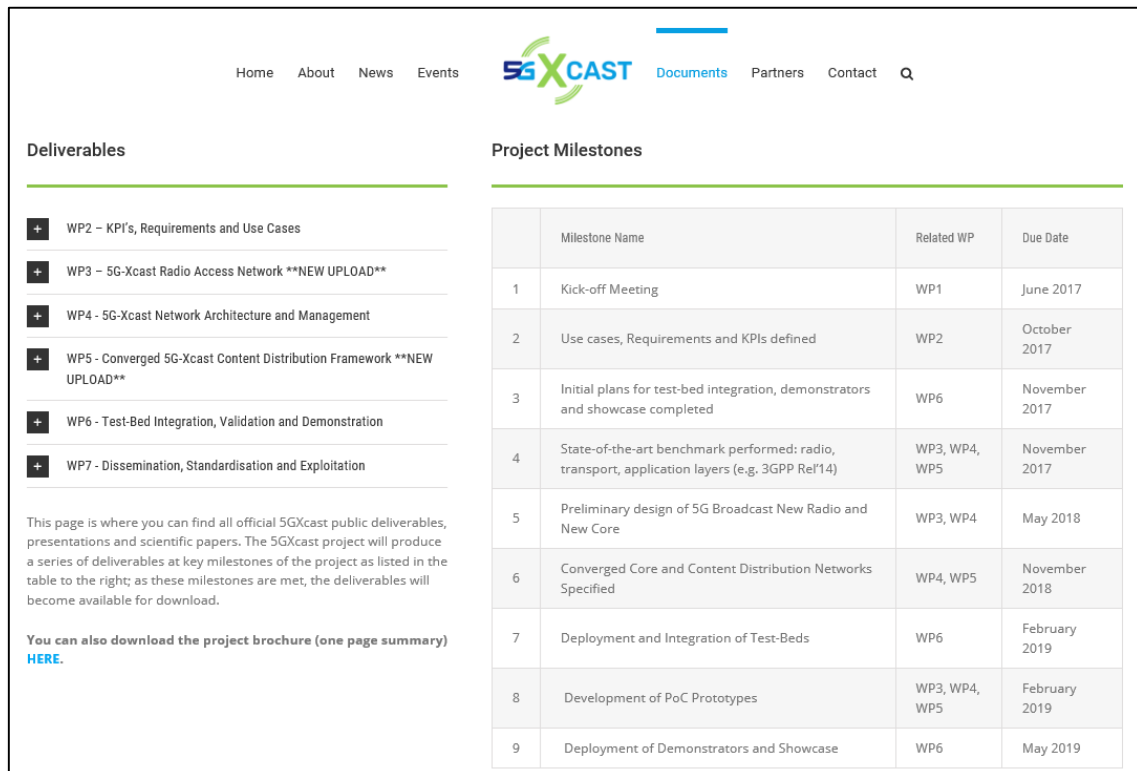
During the conference, videos were filmed to explain the performance of our 5G broadcast demonstrations. The videos of these demonstrations were created and shared via our YouTube channel.

12 Project Website and Social Media

In order to ensure the largest possible exposure of the project, different social media and networking tools have been used. The main dissemination activities have been shared via the project website and twitter.

12.1 Project Website

A public website presents the news, events, description, consortium and public deliverables of the project. The public website is the central hub for the dissemination activities. Open access to scientific publications is being ensured by publishing submitted papers in compliance with IEEE rules. Figure 8 shows as an example part of the documents section, where public deliverables are shared.

Figure 8. 5G-Xcast project website.

12.2 Twitter

The project is using Twitter as a key tool for dissemination. Not only news related to the project or published in the website, but also the main activities related to 5G-PPP or 3GPP are continuously shared through this platform.

Currently, the project has shared 235 tweets reaching more than 320000 impressions in total. This impact has led our Twitter account to have 672 followers and more than 1950 profile visits. The current number of tweets, followers and links on twitter are also observed in Figure 9.
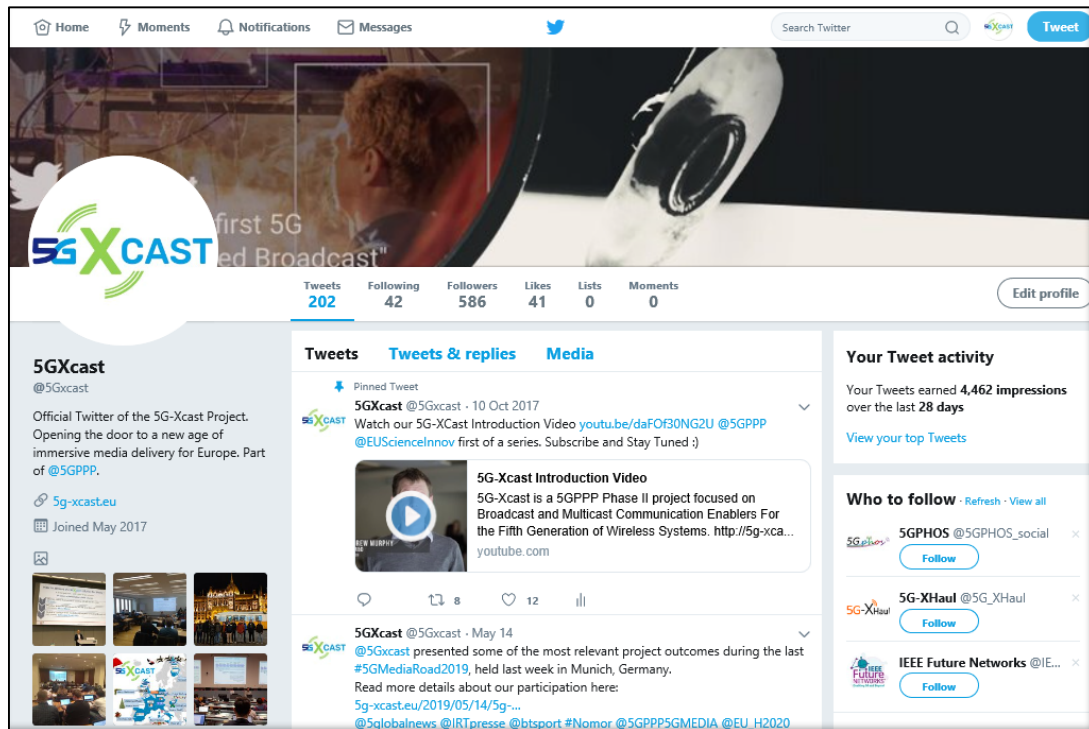
Figure 9. 5G-Xcast twitter profile.

12.3 Linkedin

Linkedin is another social media tool used to promote the 5G-Xcast work. The possibility to share posts and news with longer extension than on Twitter makes of Linkedin an attractive social network to share the project progress with a higher level of detail. The release of new project deliverables, news articles related to project meetings and the participation in 5G-PPP or 3GPP events are continuously shared through this platform.

5G-Xcast is present on Linkedin under the name of '5G-Xcast 5GPPP Project', counting on a total number of 361 followers. 5G-Xcast Linkedin profile has been visited by more than 1850 users and the project posts accumulate more than 52000 impressions.

5G-Xcast profile visitors come from different professional sectors, showing the project impact on different fields:

- Engineering (23.78%)
- Research (18.23%)
- Information Technology (12.77%)
- Business Development (7.23%)
- Education (6.99%)
- Media and Communication (5.06%)
- Sales (3.37%)
- Program and Project Management (3.21%)
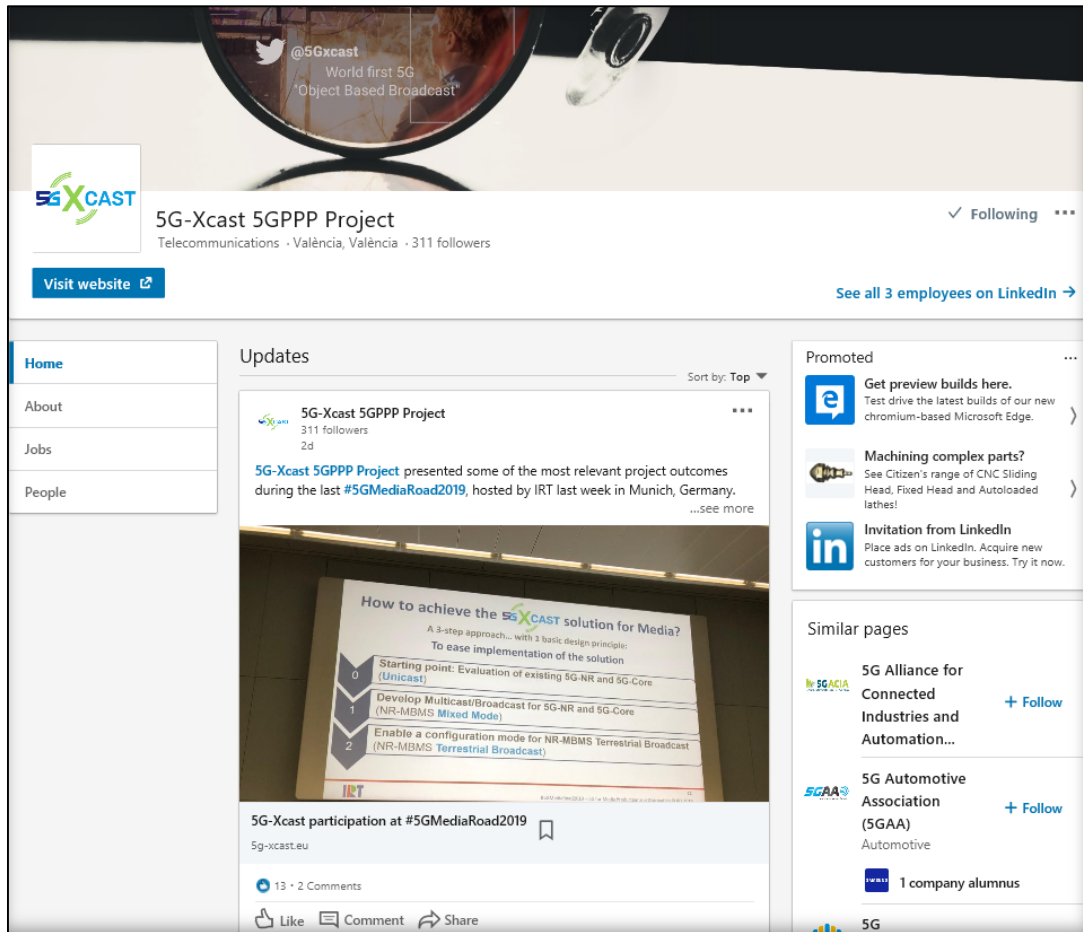- Marketing (2.49%)
- Accounting (2.17%)

Figure 10. 5G-Xcast Linkedin profile.

12.4 YouTube

A YouTube channel has been created to capture presentations from e.g. industry forum demonstrations, workshops, and test-bed trials. Figure 11 presents the project profile.
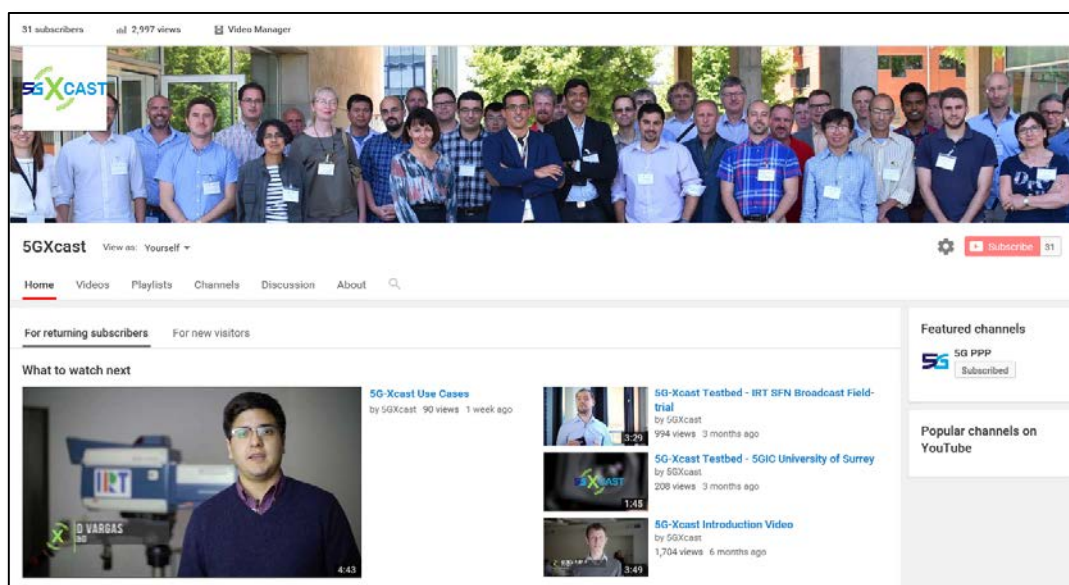

Figure 11. 5G-Xcast YouTube profile.

Up to now, 18 videos have been released:

- 5G-Xcast Introduction Video
- 5G-Xcast Use Cases
- 5G-Xcast Testbed – 5GIC University of Surrey
- 5G-Xcast Testbed - IRT SFN Broadcast Field-trial
- 5G-Xcast: enabling point-to-multipoint transmissions in 5G networks
- 5G-Xcast Turku Testbed Video
- 5G-Xcast Interviews – EuCNC 2018
- 5G-Xcast: TUAS and Fairspectrum Dynamic Spectrum Use Demonstration
- 5G-Xcast: Layer 2 FEC in 5G Broadcast/Multicast Networks.
- The 5G-Xcast Trial of Hybrid Broadcast Service.
- 5G-Xcast Demonstration on 5G Broadcast Video Delivery – Mobile World Congress 2019.
- EuCNC: Content Distribution Framework in 5G converged network (BT)
- EuCNC: Hybrid Broadcast Services with Multi-Link (IRT)
- EuCNC: Forecaster5G: Object-based broadcasting over multicast and unicast (BBC)
- EuCNC: Reliable Multicast Delivery in 5G Networks (Nomor)
- EuCNC: Efficiently delivering Public Warning messages with multimedia contents (One2Many)
- EuCNC: Over-the-Air multicast over satellite for video caching and live content delivery (Broadpeak/ Sat5G)
- 5G-Xcast Final Video

5G-Xcast Youtube channel counts on a total number of 57 followers. The 18 videos accumulate a total number of 8724 views, with 16000 minutes (11 days and 3 hours). 5G-Xcast material has reached audience across Europe, America, Asia, Africa and Oceania, being some the countries with biggest percentage of views:

- Finland (47.3%)
- Germany (13.9%)
- United Kingdom (14.4%)
- Spain (4.3%)
- United States (4.1%)
- India (2.4%)
- South Korea (1%)
- South Africa (0.5%)
- Australia (0.4%)

The videos have reached people with the following age:

- 25-34 years old (11.7%)
- 35-44 years old (56%)
- 45-54 years old (21%)
- 65+ years old (11.7%)

The following devices have been used:

- Computer (72.7%)
- Mobile phone (21.8%)
- Tablet (4.5%)
- TV (1.0%)

- Game console (0.01%)

13 News and Press Releases

Concerning the press, contacts are being established with the relevant trade press in order to extend the reach of the communication activities.

1.	Nomor	"Nomor Research to develop cross-layer optimized solutions for 5G multicast/broadcast as part of the 5G-Xcast project," June 2017.
2.	UPV	"La UPV lidera un proyecto europeo para el diseño de una innovadora arquitectura de red 5G," Jul. 2017.
3.	UPV	"The MCG leads a European project for new 5G communications," July 2017.
4.	Expway	"Expway Extends LTE Broadcast to Multi-media Distribution Over 5G," Sep. 2017.
5.	IRT, Nokia	"5G: Bridging mobile broadband and broadcast networks," Oct. 2017.
6.	BBC	"5G-Xcast: A European-funded research project to develop broadcast and multicast within 5G," Nov. 2017.
7.	Broadpeak	CSI Magazine: 5G to improve
7.	Broadpeak	"Broadpeak Leads Technology Innovation for Content Delivery Over 5G Networks," Feb. 2018.
8.	Nokia	"5G Deemed a "Key Enabler" for New Markets," Interview in Radio World, Apr. 2018.
9.	Nokia	"5 new things I learned about 5G at NAB," Apr. 2018
10.	Nokia, Samsung, UPV, EBU	"Disrupting Media & Entertainment in the 5G Era," July 2018.
11	EBU, IRT	"EBU Members IRT and RAI test 5G for broadcast applications during European Championships 2018," Aug. 2018.
12	EBU	"Collaboration: The buzzword of IBC2018", Sept 2018.
13	Nomor Research	"Nomor Research completed calibration of 5G System Level Simulator as part of the 5G IA's ITU IMT-2020 Evaluation," Nov. 2018
14	Broadpeak	"MWC Barcelona 2019 Tour," Mar. 2019.

The official 5G-Xcast website has periodically released news related to the project or broadcast/multicast activities in 3GPP and other standardization bodies:

1. Keynote Speech at IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2017).

2. EUCNC 2017 Poster Session.

3. EUCNC 2017 5G-PPP Special Session.

4. 5G-Xcast Kick Off Meeting in Valencia (UPV).

5. 5G-Xcast project presented at IEEE 5G Summit Thessaloniki.

6. Joint meeting with 5GPPP Sat-5G project at 5GIC.

7. 5G-Xcast 2nd Face to Face Project Meeting in Surrey University, Guildford UK.

8. 5G-Xcast presented at the 5G C-Tech Forum at IBC 2017.

9. First advisory board meeting of 5G-Xcast at IBC 2017.

10. 5G-Xcast present at the FOBTV Session at IBC 2017.

11. 5G-Xcast project presented at IEEE 5G Summit Helsinki.

12. CrownCom17 invited paper on "Designing a Testbed Infrastructure for Experimental Validation and Trialling of 5G Vertical Applications".

13. 5G-Car & 5G-Xcast Collaboration.

14. 5G-Xcast participates at IEEE 5G Summit Montreal.

15. Presentation of 5G-Xcast at DTG Spectrum Access Forum.

16. PIMRC 2017 Panel on Unlicensed spectrum.

17. Deliverable D2.1 – Definition of Use Cases, Requirements and KPIs – Now Available.

18. 5GPPP Phase II Research & Innovation Projects Brochure.

19. IEEE 5G World Forum 2018 – Disrupting Media and Entertainment in the 5G Era.

20. IEEE BMSB 2018 – Workshop on Point-to-Multipoint as Key Technology Element for 5G Systems.

21. 5G-Xcast at EBU Forecast 2017.

22. Deliverable D5.1 – Content Delivery Vision – Now Available.

23. Deliverable D3.1 – LTE-Advanced Pro Broadcast Radio Access Network Benchmark – Now Available.

24. 5G-Xcast 3rd Face to Face Project Meeting in IRT, Munich, Germany.

25. Point to Multipoint (PTM) will be one of the major items in the next phase of 3GPP work.

26. 5G-Xcast present at BES Expo in India.

27. 5G-Xcast participates at IEEE 5G Summit in Trento.

28. Fairspectrum and Turku University of Applied Sciences demonstrate Licensed Shared Access on 2.3 GHz band.

29. Study on Implications of 5G Deployment on Future Business Models referencing 5G-Xcast.

30. 5G-Xcast presentation at the WIVE project seminar on "The future of media in 5G".

31. DVB publishes draft Multicast-ABR logical reference architecture.

32. 5G-Xcast TM presentation at the 2018 NAB show.

33. One5G and 5G-Xcast workshop at the IEEE WCNC 2018 Conference.

34. 5G-Xcast TM talk at the IEEE WCNC workshop on intelligent computing and caching network edge.

35. 5G-Xcast talk at the IEEE BTS Society Young Professional Workshop 2018.

36. 5G-Xcast 4th Face to Face Meeting hosted by EBU in Geneva.

37. Prof. Narcis Cardona Presentation at the 5G Forum in Malaga.

38. 5G-Xcast talk and panel at the 5G-IoT summit and UNET conference.

39. 5G-Xcast activity at the IEEE BMSB 2018 conference.

40. 5G-Xcast activities at the EUCNC 2018 conference.

41. 5G-Xcast Presentation at the IEEE 5G Summit in Brasilia.

42. 5G-Xcast presentation at the World Broadcasting Union – Internet Media Connectivity Group (WBU-IMCG).

43. Deliverable D4.1 on Mobile Core Networks available.

44. Initial planning in D6.1 for the test-beds development completed.

45. 5G-Xcast Second Advisory Board Meeting.

46. 5G-Xcast participation at the IEEE BMSB 2018.

47. 5G-Xcast 5th Face to Face Meeting hosted by TUAS in Turku.

48. 5G-Xcast presentations at SET Expo 2018.

49. 3GPP to study the enhancement needed for LTE-based eMBMS to meet the 5G requirements.

50. Now available Deliverable D4.2 on Converged Core Network.

51. Deliverable D5.2 on Key Technologies for the Content Distribution Network now available.

52. 5G-Xcast showcase during European Championships 2018.

53. 5G-Xcast participation at IBC 2018.

54. 5G-Xcast participation at FITCE Congress 2018.

55. 5G-Xcast 6th Face to Face Meeting hosted by Nokia in Espoo.

56. 5G-Xcast attendance to the Workshop on 3GPP submission towards IMT-2020.

57. 5G-Xcast participation at IEEE BTS Broadcast Symposium 2018.

58. 5G-Xcast participation at CAP Implementation Workshop 2018.

59. Deliverable D3.2 on Air Interface available!

60. Deliverable D4.3 on Session Control and Management available!

61. Deliverable D5.3 on Application Layer Intelligence available!

62. Joint One5G and 5G-Xcast Workshop at the IEEE Globecom 2018 Conference.

63. 5G-Xcast 7th Face to Face Meeting hosted by Bundleslab in Budapest.

64. Now available Deliverable D2.2 on Analysis of the Technical Developments against the Use Cases.

65. 5G-Xcast participation at EU-India Stakeholders' Workshop on 5G Technology Landscape.

66. 5G-Xcast participation at 5G Vertical User Workshop.

67. Deliverable D3.3 on RAN Logical Architecture and Interfaces for 5G-Xcast now available.

68. 5G-Xcast 8th Face-to-Face Meeting hosted by IRT in Munich.

69. Deliverable D6.2 on Development of Showcases and Demonstrators now available.

70. Deliverable D6.3 on Test-Beds Integration and Deployment now available.

71. 5G-Xcast live demonstration of video delivery over 5G at Mobile World Congress 2019.

72. 5G-Xcast keynote at 2019 IEEE Broadcast Technology Society (BTS) Young Professionals Workshop.

73. 5G-Xcast participation at the IEEE Wireless Communications and Networking Conference (WCNC) 2019.

74. 3GPP to study the architecture enhancements needed to provide 5G multicast/broadcast services.

75. 5G-Xcast lecture at the University of Cagliari.

76. 5G-Xcast participation at #5GMediaRoad2019.

77. 5G-Xcast paper on 5G-NR based Terrestrial Broadcast delivery: A step beyond FeMBMS.

78. 3GPP status on LTE-based 5G Terrestrial Broadcast.

79. 5G-Xcast participation at IEEE BMSB 2019.

80. 5G-Xcast programme at EuCNC 2019.

81. 5G-Xcast participation at EuCNC 2019.

82. New IEEE Transactions on Broadcasting special issue on 5G now available.

14 Meetings with the Advisory Board and other 5G-PPP Projects

Project partners have also participated in two additional meetings with the Advisory Board:

1. IBC 2017, Amsterdam, Netherlands, Sep. 2017.
2. IEEE BMSB 2018, Valencia, Spain, June 2018.

Moreover, two meetings for potential collaboration with other 5G-PPP projects took place:

1. Joint meeting with SAT-5G, University of Surrey, Guildford, UK, Sep. 2017.
2. Joint meeting with Bluespace, UPV, Valencia, Spain, Feb. 2018.

References

[1]   The Institute of Electrical and Electronics Engineers, Inc. "IEEE Policies", 2016.