Beyond 2020 Heterogeneous Wireless Network with Millimeter-Wave Small-Cell Access and Backhauling

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Year 2 dissemination activities report

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Abstract: This deliverable provides a detailed list of the dissemination activities performed by MiWaveS partners during the second year of the project. It includes the communication activities (web site, social networks, newsletter, white paper, press release, etc.), which provides general informations about the project and the activities of the consortium, as well as the scientific publications (journals, conferences, workshops, panels, short courses), which communicate the latest technical results toward the scientific community. For each dissemination activity, the achievements of the second year of the project are reported, as well as the plan for the third year.

Keywords: dissemination, publication, communication.

Executive Summary

This document reports the dissemination activities performed or undertaken during the second year of the MiWaveS project, with the objective to ensure that the MiWaveS vision and achievements are widely advertised toward several audiences such as research communities, industrials, standardisation and regulation bodies, and funding agencies. The visibility of the project results is a key for a successful impact in the academia and industrial ecosystem, currently defining and developing the future 5G wireless communication networks.

An overview of MiWaveS is presented to explain the vision and scope of the research activities undertaken by the consortium, as well as the objectives and the technical approach. Next, the dissemination activities are reported, starting with the communication activities (web site, social networks, newsletter, white paper, press release, etc.) targeting a wide audience and providing information of general interest and about the most recent activities, followed by the scientific publications (journals, conferences, workshops, panels, short courses) produced by the partners to disseminate their latest technical results toward the scientific community. For each dissemination activity, the achievements of the second year of the project are reported, as well as the plan for the remaining final year.

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List of Acronyms and Abbreviations

Term	Description
5G	5th Generation
AP	Access Points
CMOS	Complementary Metal Oxide Semiconductor
EC	European Commission
EU	European Union
EMF	ElectroMagnetic Field
FP7	Seventh Framework Program
Gbps	Gigabit per second
IAB	Industrial Advisory Board
ICT	Information and Communication Technologies
mmW	Millimeter Waves
QoS	Quality of Service

1. Introduction

The MiWaveS project targets the development of key enabling technologies for mmW wireless access and backhaul in the future 5th Generation (5G) heterogeneous cellular mobile networks, in particular at the level of networking functions and algorithms, and integrated radio and antenna technologies. This is an industry-driven large-scale integrating project bringing together world-leading European industries, universities and research institutes in the domain of wireless communications. It intends to help the European ICT industry to be at the forefront of innovation and R&D on key enabling technologies for future broadband mobile networks and secure a competitive position on this strategic market.

This document reports the dissemination activities performed or undertaken during the first year of the project, with the objective to ensure that the MiWaveS vision and achievements are widely advertised toward several audiences such as research communities, industrials, standardisation and regulation bodies, and funding agencies. The visibility of the project results is a key for a successful impact in the academia and industrial ecosystem, currently defining and developing the future 5G wireless communication networks.

Section 2 of this report presents a general overview of MiWaveS to explain the vision and scope of the research activities undertaken by the consortium, as well as the objectives and the technical approach.

Next, the dissemination activities are organized in two categories: the first one gathers all the communication activities (**Section 3**) targeting a wide audience and providing information of general interest and about the most recent activities; the second one (**Section 4**) reports the scientific publications produced by the partners to disseminate their latest technical results toward the scientific community. For each dissemination activity, the achievements of the second year of the project are reported, as well as the plan for the final years.

It is important to note that the consortium has also developed a significant activity toward impacting standardisation and regulation bodies, as well as exploitation activities, which are reported in dedicated deliverables [1][2].

2. Project overview

2.1 About MiWaveS

MiWaveS (Beyond 2020 heterogeneous wireless network with Millimetre Wave Small cell access and backhauling) [3][4] is a collaborative research project, partially funded by the EU FP7 (European Union Framework Programme 7), aiming at developing key enabling technologies for millimetre-wave (mmW) wireless access and backhaul, that will play a key role in the future 5th Generation of cellular mobile networks. While mmW is defined as the frequency band between 30 and 300 GHz, the MiWaveS project focuses on the unlicensed 60-GHz band (57–66 GHz) and the light-licensed E band (71–76 GHz, 81–86 GHz).

The MiWaveS project started in January 2014 and will terminate in December 2016.

2.2 MiwaveS consortium

The MiWaveS project is run by a consortium strategically positioned to address its research challenges that need the multi-disciplinary expertise of the most innovative companies, research centres and academic institutions of the European landscape. The strong presence of industrial partners will maximize the impact of the key project outcomes in shaping standards and influencing regulatory bodies, as well as guaranteeing a sound and concrete demonstration of the project results.

The consortium is spread among eight European countries (Finland, France, Germany, Italy, Spain, Sweden, Switzerland and United Kingdom) and comprises fifteen different legal entities, namely three universities (University of Surrey, Technische Universitaet Dresden and Université de Rennes 1), two research institutes (CEA-Leti and VTT), and nine industrial partners: two telecom operators (France Telecom / Orange and Telecom Italia), two user terminal / semiconductor providers (Intel and ST Microelectronics), one PCB substrate technology provider (Optiprint), and finally four network subsystems, equipment and test platform providers (Nokia, Sivers IMA, TST and National Instruments).

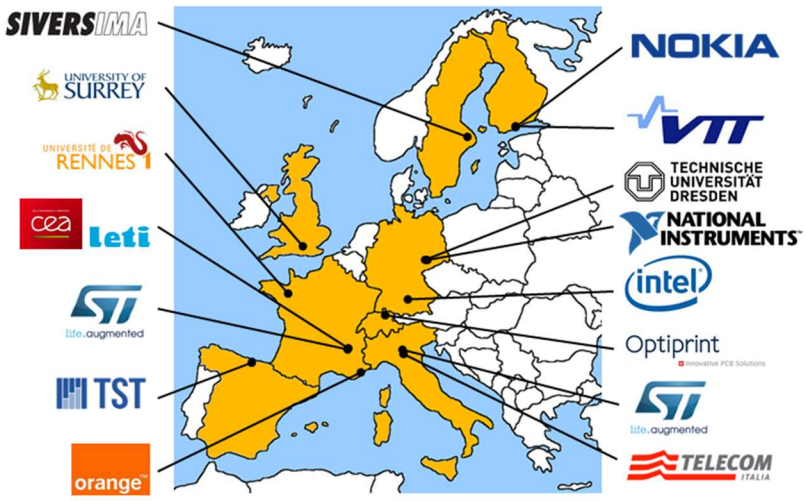


Figure 2-1: European locations of the consortium partners.

2.3 Project vision and use-cases

The MiWaveS project aims to contribute key aspects of the ongoing 5G definition, i.e. the next generation of wireless telecommunications. Specifically, it will show how high-throughput and low-latency heterogeneous mobile networks, based on flexible spectrum usage of the mmW frequency bands at 57–66 GHz and 71–86 GHz, should work. This will be done by proposing new key technology enablers in the mmW domain that focus on providing unprecedented connection speed to mobile terminals and an increased traffic capacity to network operators, the target being to offer a much better user experience than the one achievable in currently deployed networks.

The MiWaveS proposition envisages a system architecture comprising a heterogeneous network of mmW small cells with high data rate APs (Access Points and a peak capacity of 2–5 Gbps near the AP and 250 Mbps at the cell edge). The system, linked together with mmW wireless backhaul with a peak capacity of 10 Gbps, wireless backhaul systems and APs will typically be installed close together on urban utility poles, street lamps or buildings. Whenever a mobile device connected to a 3G/4G/5G network is within radio coverage of an AP, it will be able to request very high-rate data exchanges. A suitable allocation of resources shall be provided by the cellular network in the small cell in order to fulfil the request. The aggregated data from multiple users shall be routed with low latency from the AP to the network through multi-hop mmW wireless or optical fibre backhaul link.

With the aim of favouring an early and smoother adoption of the newly developed mmW technologies, societal aspects will also be addressed by the project, namely with the reduction of the electro-magnetic field (EMF) exposure of the public through the design of highly-directive beam-steering antennas. These will optimize the radiated power density, focusing the energy only in the desired direction and therefore reducing the radiated power density in unintended areas.

In order to provide a solid implementation of the MiWaveS vision, the project works on the following use-cases as a basis to derive suitable system requirements and key performance indicators, which will be needed to finally assess the project results:

- *Urban street-level outdoor mobile access and backhaul system*, in which 1000-times higher data volume per area is expected by 2020, and users expect to have high capacity seamless connections almost anywhere and for area-specific network uses,
- *Large public events and gatherings*, covering massive crowd events (e.g. a Pope visit), sport events or vacation resorts. A great amount of users must be covered by the network but just in some periods and in small areas,
- *Indoor wireless networking and coverage from outdoor*, covering the evolution of indoor networks toward an increase of transmission capacity and versatility, either installing antennas inside the building or outside, and connecting to the operator network by quasi-fixed links,
- *Rural detached small-cell zones and villages*, using mmW wireless backhaul technologies (standalone or combined with wired line connection to enhance the bandwidth) to overcome the deployment difficulties related to traditional wired line based infrastructure installations,
- *Hotspot in shopping malls*, considering ad-hoc deployment of small cells and mmW backhaul as a cost efficient solution to enable high data rate services inside the malls.

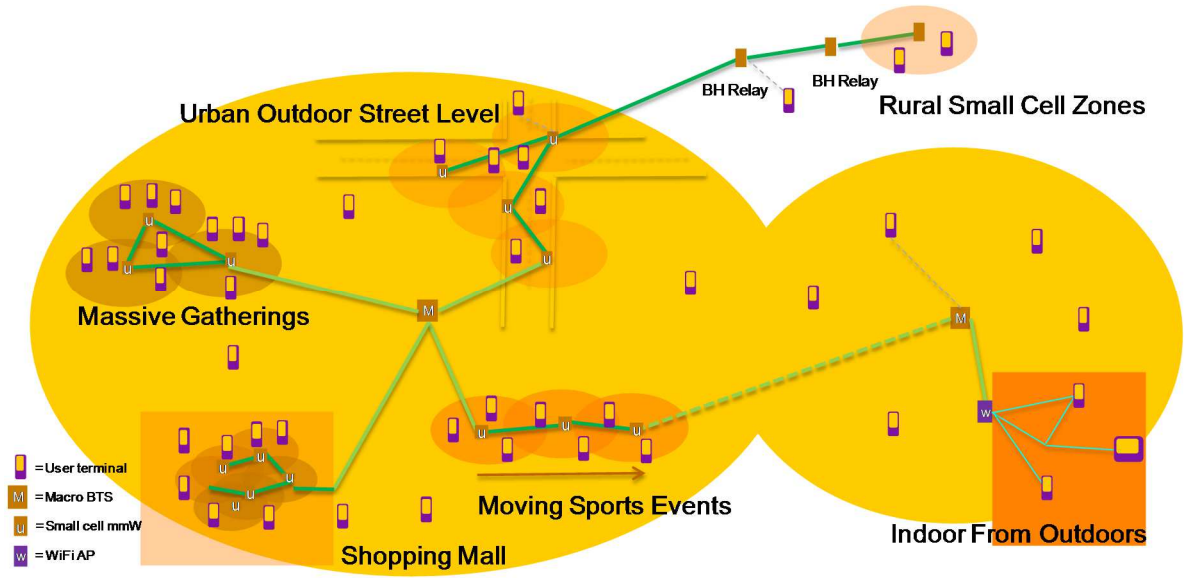


Figure 2-2: MiWaveS use cases combined on a single topology.

2.4 Main technical objectives

The system requirements, derived out of the above mentioned use-cases, and the remaining project work focus on new development and/or enhancement of selected parts of the mobile network, so that the following main objectives can be fulfilled:

- Provide mobile access to content-rich data using a fast and broadband link,
- Reduction of the overall network EMF density (blue radio),
- Reduction of the power consumption of the access and small cell backhaul links (green radio),
- Increase the flexibility and the QoS of operator networks.

The main technical challenges posed by the above mentioned objectives compose the core of the innovation content of the project, which can be split in the following streams of activities:

1. Integrate a 60-GHz low-power chipset in mobile phones and tablets, whose performance allow high data rate access links beyond 10 meters transmission range,
2. Raise the performance of mmW CMOS or BiCMOS chipsets to the requirements of backhauling applications at 57–66 GHz and 71–76 GHz, while lowering their cost for the massive deployment of small cells in urban environments,
3. Design a 60-GHz AP capable of linking multiple users to the network, covering many channels over the 9-GHz frequency band (57–66 GHz), and managing efficiently the near/far dynamics at the same time,
4. Relay information (data routing) in a fast and optimized way, by a cross-layer optimization of the heterogeneous network,
5. Design high gain beam-steered planar antennas for APs and backhauling and tiny fixed beam antennas for user terminal, achieving efficient and cost-effective solutions, while reducing the human body exposure to EMF.

2.5 Project structure

The project is structured in eight work packages, so as to maximize the synergies of the consortium partners and at the same time proceed, when possible, in parallel in order to obtain

in the most efficient and aligned way results that can show the effectiveness of the new key technology enablers proposed by the project.

The structure and the number of work packages are described in **Figure 2-3**.

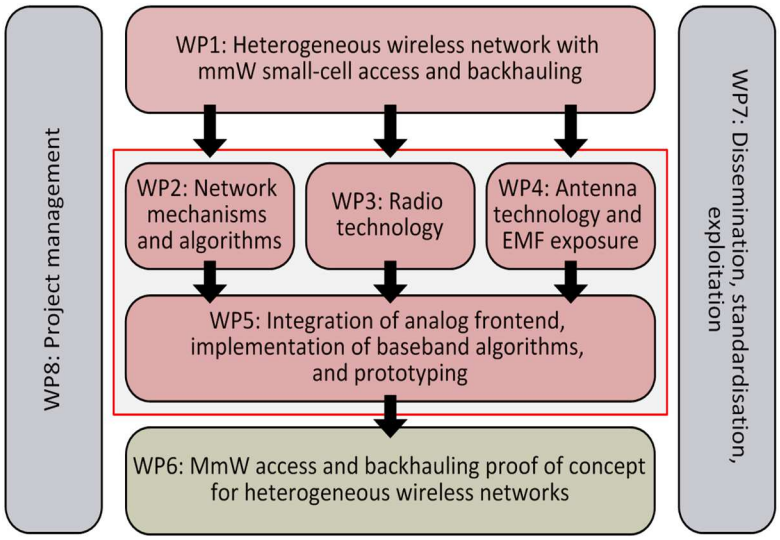


Figure 2-3: Work packages of the MiWaveS project.

2.6 Industrial Advisory Board

The Industrial Advisory Board (IAB) of MiWaveS is composed of the following experts:

- Dr Guillaume Vivier, Sequans, director of advanced technology.
- Dr Ralf Imer, Vodafone, senior manager wireless access innovation.
- Dr Evangelia Georgiadou, OTE, telecommunication engineer.
- Dr Maziar Nekovee, Samsung Electronics UK, chief engineer 5G.
- Dr Hermann Brand, ETSI, director of innovation.
- Dr Mythri Hunukumbure, Samsung Electronics UK, principal researcher.

The second IAB meeting took place on Oct. 15th 2015, co-located with the 6th plenary meeting in Crolles, France. It was the opportunity to present and discuss the work performed over the first half of the project and the first outcomes, especially focusing on the networking functions of future heterogeneous networks based on mmW access and backhauling technologies, beamsteering algorithms, latest mmW transceiver and beamsteering antennas results, and on-going demonstration activities. Dissemination and activities related to standardization and regulation bodies have been discussed as well.

The IAB will meet at least once again in 2016 in order to further discuss the outcomes of the project and advise the consortium about the main conclusions, future exploitation of these results or opportunities to be seized. In order to re-inforce this board and get additional feedbacks, an action has been undertaken to recruit a couple of additional experts for the final year.

3. Communication activities

This section presents the communication activities undertaken to advertise the existence of MiWaveS, its vision about the use of mmW technologies in 5G, and its progresses toward its objectives. This communication targets a wide audience composed of experts and non-experts.

3.1 Project web site

The MiWaveS web site (www.miwaves.eu) was first published online on May 1st 2014 (**Figure 3-1**). It includes a detailed presentation of the project work programme, an up-to-date list of publications and deliverables, and the latest news about the project activity (meetings, presentations, workshops, etc.). Public documents (public deliverables, newsletter, white paper, etc.) can be downloaded from the web site. This web site will be maintained and updated until one year after the end of the project to ensure the widest dissemination of its outcomes.

The audience of the web site is followed with Google Analytics (**Figure 3-2**). Some spikes are clearly visible at the time of important communications. Over the period, more than 29 000 pages were visited and more than 18 000 visitors were registered. Except for the period Aug.-Oct 2015, the average visit rate is about 60 sessions/day.

Figure 3-1: Snapshot of the MiWaveS web site.

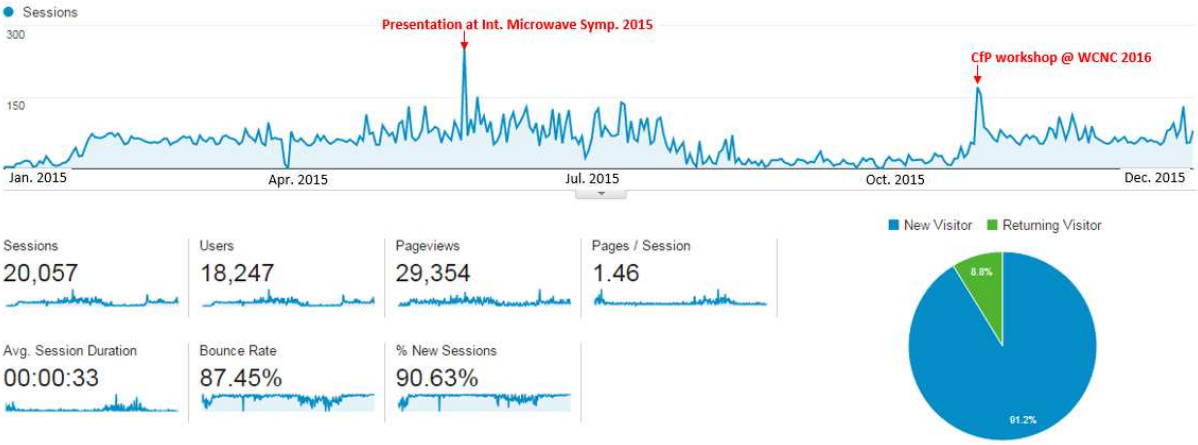


Figure 3-2: Audience of the MiWaveS web site over the period Jan 1st to Dec. 31st, 2015.

3.2 Social networks

The Twitter group (@FP7_MiWaveS) counts 63 followers. More than 40 tweets were posted to date to announce the consortium meetings, publications, workshops, panel sessions, press release, etc.

3.3 Flyer

A one-page flyer to present the project and provide basic information (consortium, web site, LinkedIn and Twitter links) is available for download on our web site (**Figure 3-3**). It was distributed at the EuCNC and Globecom conferences.

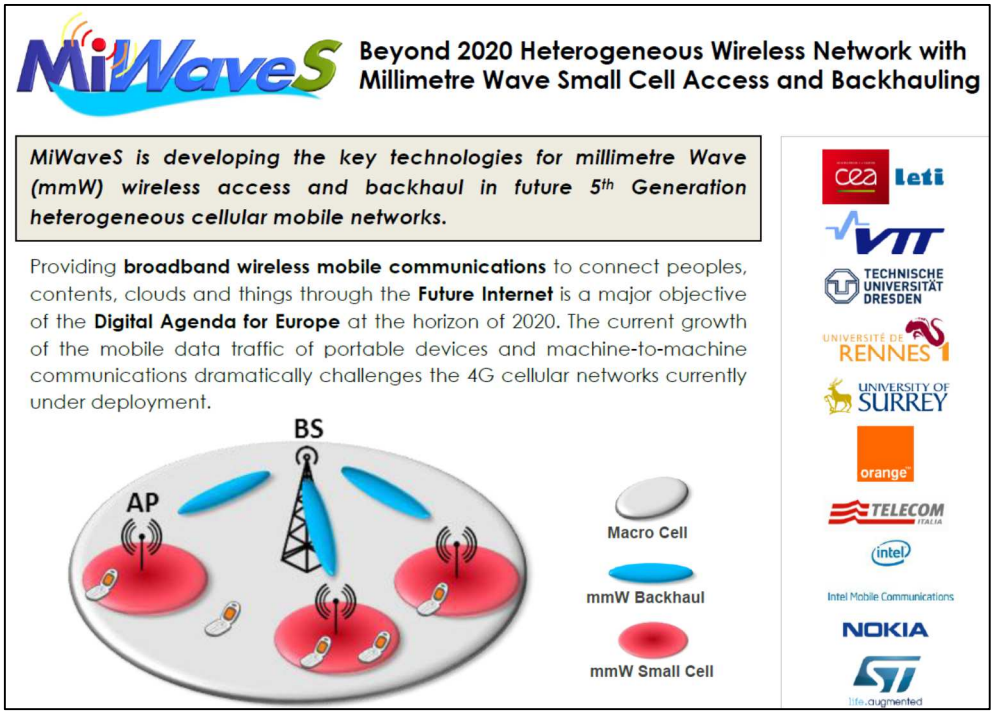
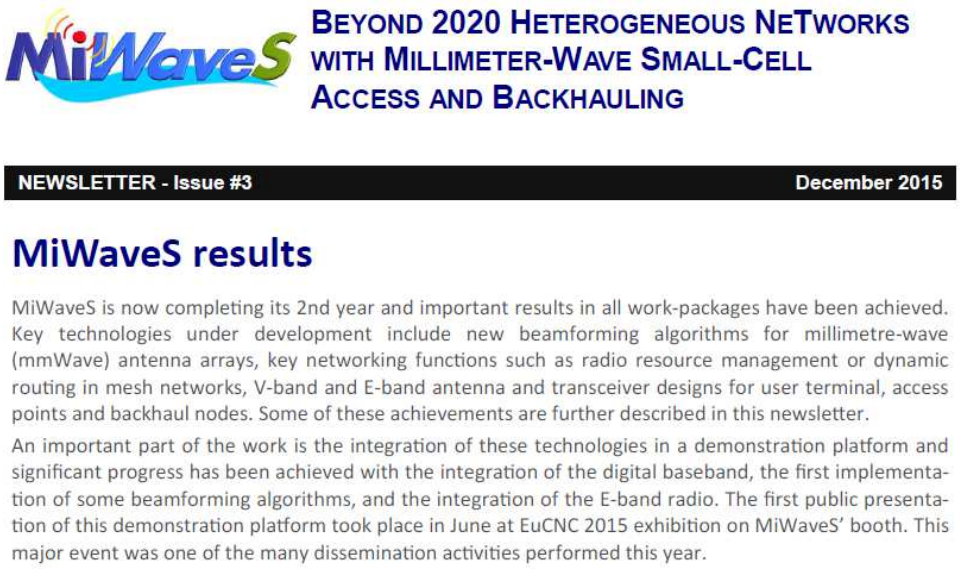


Figure 3-3: Snapshot of the MiWaveS flyer.

3.4 Newsletter

A series of biannual newsletters was started last year in order to communicate on the project advances and the main events. The second and third issues were published in April 2015 and December 2015 (**Figure 3-4**). These newsletters are posted on the web site, announced on Twitter, and sent by email to a selection of industrial and academic contacts including other funded project coordinators, EC members, or Industrial Advisory Board members.


BEYOND 2020 HETEROGENEOUS NETWORKS WITH MILLIMETER-WAVE SMALL-CELL ACCESS AND BACKHAULING

NEWSLETTER - Issue #3 December 2015

MiWaveS results

MiWaveS is now completing its 2nd year and important results in all work-packages have been achieved. Key technologies under development include new beamforming algorithms for millimetre-wave (mmWave) antenna arrays, key networking functions such as radio resource management or dynamic routing in mesh networks, V-band and E-band antenna and transceiver designs for user terminal, access points and backhaul nodes. Some of these achievements are further described in this newsletter.

An important part of the work is the integration of these technologies in a demonstration platform and significant progress has been achieved with the integration of the digital baseband, the first implementation of some beamforming algorithms, and the integration of the E-band radio. The first public presentation of this demonstration platform took place in June at EuCNC 2015 exhibition on MiWaveS' booth. This major event was one of the many dissemination activities performed this year.

Figure 3-4: Snapshot of the first issue of the biannual MiWaveS newsletter.

3.5 White papers

A first white paper was published in January 2015 to present the project vision and activities. A second white paper is being prepared for Q1 2016. This white paper shall summarize the technical key results achieved in the different work packages throughout the second project year and point the reader to respective resources providing more in-depth information about the different solutions.

3.6 Press releases

The following press release was published to announce the presentation of MiWaveS project at the Mobile World Congress 2015:

- "Leading European wireless communications companies to demonstrate millimeter-wave technologies for 5G at Mobile World Congress", 3 March 2015.

This press release was sent to more than 250 medias in the semiconductor sector, wireless and telecom sectors, as well as analyst and research firms.

3.7 Exhibitions

MiWaveS partners presented the project and its first outcomes in a booth in the exhibition of EuCNC 2015 (Paris, France; **Figure 3-5**). The booth displayed posters, hardware prototypes of antennas and transceivers, and a demo of an E-band high-data rate transmission based on baseband and RF hardware and software developed in the project. This booth received a lot of visitors and an interview was requested by the organizers; this interview is available at https://www.youtube.com/watch?v=pJ4dHFWssTA.

Figure 3-5: MiWaveS booth at EuCNC 2015 and zoom on the demonstration.

MiWaveS technology as well as benefits of EU-Public-Private-Partnership was presented at Nokia booth in Mobile World Congress in Barcelona 2.-5. March.

MiWaveS was taken into 5G PPP projects' common video presentation booth in IEEE Globecom 2015 in San Diego, USA 7-9 December. Nokia and NI prepared the video presentation and were present at the booth to represent the project. NI and Nokia also submitted project presentations (poster) to Globecom Interactive Poster session and presented them.

4. Scientific publications

An important objective of MiWaveS is the dissemination of its research results to the scientific community, targeting the scientific journals, conferences or workshops with the highest impact. This section lists the scientific publications performed during the second year as well as the targeted media for the rest of the project.

4.1 Books

One book chapter on EMF issues at mmW has been submitted by University of Rennes 1 (**Table 4-1**).

Table 4-1: List of book chapters.

Partners	Authors / Title / Book	Status
UR1	M. Zhadobov, C. Leduc, A. Guraliuc, N. Chahat, and R. Sauleau "Antenna / human body interactions in the 60 GHz band: state of knowledge and recent advances" *State-of-the-art in Body-Centric Wireless Communications and Associated Applications*, Ed. Q. H. Abbasi, M. U. Rehman and A. Alomainy, IET, to appear summer 2016.	Submitted

4.2 Journals

Five journal papers were written during year 2 (**Table 4-2**). Two of the papers listed in **Table 4-2** present the first results obtained in WP4 by the University of Rennes 1 on a novel architecture of high-directivity antenna arrays, the so-called CTS antennas. Two additional papers have been submitted by UNIS to IEEE Transactions on Communications.

Table 4-2: List of journal papers.

Partners	Authors / Title / Journal	Status
CEA	L. Dussopt "Advanced radio technology to support mobile traffic growth" *EU Research*, vol. 2015, Issue 1, pp. 66-67.	Published
UR1	F. Foglia Manzillo, M. Ettorre, M. Casaletti, N. Capet, and R. Sauleau "Active impedance of infinite parallel-fed continuous transverse stub arrays" *IEEE Transactions on Antennas and Propagation*, vol.63, no.7, pp.3291-3297, Jul. 2015.	Published
UR1, VTT, ORA	F. Foglia Manzillo, M. Ettorre, M. S. Lahti, K. T. Kautio, D. Lelaidier, E. Seguenot, and R. Sauleau "A multilayer LTCC solution for integrating 5G access point antenna modules" *submitted to IEEE Transactions on Microwave Theory and Technique*, Sept. 2015.	Submitted
UNIS	D. Mi, M. Dianati, L. Zhang, S. Muhaidat, "Performance Analysis of Linear Precoding Algorithms in TDD Large Antenna Array Systems with Imperfect Channel Reciprocity" *submitted to IEEE Transactions on Wireless Communications.*	Submitted
UNIS	S. Payami, M. Ghoraishid, M. Dianati, "Optimal Hybrid Beamforming for Large Antenna Arrays with Phase Shifter Selection" *submitted to IEEE Transactions on Communications.*	Submitted

We can anticipate that more journal papers will be prepared and submitted during year 3 since the technical work packages WP2, WP3 and WP4 are now close to their end and more experimental results become available, which is mandatory in high-quality journals on RF hardware research.

The activities of MiWaveS span across a broad range of research domains that are covered by a large number of journals. The main targeted journals are:

- Wireless communications: IEEE Communication Mag., IEEE Communications Letters, IEEE Journal on Selected Areas in Communications, IEEE Trans. Communications, IEEE Trans. Vehicular Technology, IEEE Trans. Wireless Communications, IEEE Wireless Communications, IET Communications.

- RF and integration technologies: IEEE Trans. Microwave Theory and Techniques, IEEE Journal of Solid-State Circuits, IEEE Trans. Components, Packaging and Manufacturing Technologies, IET Electronics Letters.
- Antennas: IEEE Trans. Antennas and Propagation, IEEE Antennas and Wireless Propagation Letters, IET Microwave, Antennas and Propagation.

4.3 Conferences

16 conference papers have been presented in 2015 (**Table 4-3**). As for journal papers, more conferences are expected to be submitted in 2016. MiWaveS partners intend to disseminate the project results in the main conferences of their fields, both in Europe and in the rest of the world:

- Wireless communications: European Conf. on Networks and Communications (EuCNC), Future Internet Assembly, IEEE GLOBECOM, IEEE Vehicular Technology Conf. (VTC), IEEE Int. Conf. on Communications (ICC), IEEE Int. Symp. on Personal, Indoor and Mobile Radio Communications (PIMRC), IEEE International Conference on Ultra-Wideband (ICUWB), IEEE Int. Wireless Symposium (IWS), Int. Conf. on Cognitive Radio Oriented Wireless Networks (CROWNCOM).
- RF and integration technologies: European Solid-State Circuit Conference (ESSCIRC), European Microwave Week (EuMW), IEEE Int. New Circuits and Systems Conference (NEWCAS), IEEE Int. Solid-State Circuits Conference (ISSC), IEEE Radio Frequency Integrated Circuit (RFIC).
- Antennas: European Conf. on Antennas and Propagation (EuCAP), Journées Nationales Microondes, Int. Workshop on Antenna Technology (iWAT), IEEE Antennas and Propagation Society Int. Symposium (APS-URSI).

Table 4-3: List of conference papers.

Partners	Authors / Title / Conference	Status
CEA	L. Dussopt, O. El Bouayadi, J. A. Zevallos Luna, C. Dehos, Y. Lamy "Millimeter-Wave Antennas for Radio Access and Backhaul in 5G Heterogeneous Mobile Networks" *9th European Conference on Antennas and Propagation*, Lisbon, Portugal, 12-17 April 2015.	Published
UR1	F. Foglia Manzillo, M. Ettorre, M. Casaletti, R. Sauleau, N. Capet "Modeling and Design of Parallel-Fed Continuous Transverse Stub (CTS) Arrays" *9th European Conference on Antennas and Propagation*, Lisbon, Portugal, 12-17 April 2015.	Published
CEA	V. Puyal, A. Siligaris, J-L. Gonzalez, C. Dehos, L. Dussopt, P. Vincent "Conception d'un commutateur SPDT TX/RX en technologie BiCMOS 55 nm en bande V pour la 5G" *19èmes Journées Nationales Microondes (JNM 2015)*, 2-5 Juin 2015, Bordeaux, France.	Published
CEA	L. Dussopt "Communications en bande millimétrique pour les futurs réseaux mobiles (5G)" (invited presentation) *19èmes Journées Nationales Microondes (JNM 2015)*, 2-5 Juin 2015, Bordeaux, France.	Published
UR1	M. Ettorre, F. Foglia Manzillo, M. Casaletti, R. Sauleau, N. Capet "A compact and high-gain Ka-band multibeam continuous transverse stub antenna" *2015 IEEE AP-S Symp. on Antennas and Propagation*, 19-25 July 2015, Vancouver, B.C., Canada.	Published
CEA, TI	L. Dussopt, V. Palestini "Millimeter-Wave Communications in 5G Mobile Networks for Wireless Access and Backhaul" *RTSI 2015*, Torino, Sept. 17, 2015.	Published
UNIS	S. Payami, M. Shariat, M. Ghoraishi, M. Dianati, "Effective RF Codebook Design and Channel Estimation for Millimeter Wave Communication Systems" *2015 IEEE Int. Communication Workshop (ICC 2015)*, 8-12 June 2015, London, UK, pp. 1226 - 1231.	Published

UNIS, Nokia, VTT, Intel	M. Shariat, M. Dianati, J. Putkonen, K. Seppänen, T. Suihko, V. Frascolla "Enabling wireless backhauling for next generation mmWave networks" *European Conference on Networks and Communications (EuCNC 2015),* Paris, France, June 29 – July 2, 2015.	Published
CEA	L. Dussopt "Millimeter-Wave Technologies for 5G: Opportunities, Challenges and path toward Standards" Invited presentation *European Conference on Networks and Communications (EuCNC 2015)*, Paris, France, June 29 – July 2, 2015.	Published
Intel, CEA, NI, UNIS, NOKIA, TI	V. Frascolla, M. Faerber, E. Calvanese-Strinati, L. Dussopt, V. Kotzsch, E. Ohlmer, M. Shariat, J. Putkonen, G. Romano "mmWave Use cases and Prototyping: a way towards 5G Standardization" *European Conference on Networks and Communications (EuCNC 2015)*, Paris, France, June 29 – July 2, 2015.	Published
NI	E. Ohlmer, V.Kotzsch "From Use Cases to Prototyping Multi-Gbit/s mmWave Links in MiWaveS" *European Conference on Networks and Communications (EuCNC 2015)*, Paris, France, June 29 – July 2, 2015.	Published
UNIS, Intel	H. Miao, M. Faerber "Self-organized Multi-hop Millimeter-wave Backhaul Network: Beam Alignment and Dynamic Routing" *European Conference on Networks and Communications (EuCNC 2015)*, Paris, France, June 29 – July 2, 2015.	Published
UR1, CEA	A.R. Guraliuc, M. Zhadobov, R. Sauleau, L. Marnat, L. Dussopt Millimeter-Wave Exposure from Mobile Terminals *European Conference on Networks and Communications (EuCNC 2015)*, Paris, France, June 29 – July 2, 2015.	Published
CEA, Nokia	E. Calvanese-Strinati, J. Putkonen "Beyond 2020 Heterogeneous Wireless Networks with Millimeter Wave Small Cell Access and Backhauling" *Brooklyn 5G Summit*, Brooklyn, NY, 8-10 April 2015.	Published
Intel, UNIS, NI, TUD, CEA, UR1, Nokia	V. Frascolla, H. Miao, M. Shariat, E. Ohlmer, V. Kotzsch, L. Dussopt, E. Calvanese Strinati, R. Sauleau, K. Ranta-Aho, J. Putkonen "A strategy for research projects to impact standards and regula–ory bodies - The approach of the EU-funded project MiWaveS" *IEEE Conf. on Standards for Communications and Networking (CSCN 2015)*, Tokyo, Japan, 28-30 Oct. 2015.	Published
TUD	J. Bartelt, L. Landau and G. Fettweis "Improved Uplink I/Q-Signal Forwarding for Cloud-Based Radio Access Networks with Millimeter Wave Fronthaul" *12th Int. Symp. on Wireless Communication Systems (ISWCS 2015)*, 25–28 August 2015, Brussels, Belgium.	Published
UR1, VTT, ORA	F. Foglia Manzillo, M. Ettorre, M. S. Lahti, K. T. Kautio, D. Lelaidier, E. Seguenot, and R. Sauleau "A long slot array fed by a multilayer true-time delay network in LTCC for 60 GHz communications," *submitted to 10th European Conference on Antennas and Propagation*, Davos, Switzerland, 10-15 April 2016.	Accepted
CEA, VTT, OPT	A Moknache, L. Dussopt, J. Säily, A. Lamminen, M. Kaunisto, J. Aurinsalo, T. Bateman, J. Francey "A switched-beam linearly polarized transmitarray antenna for V- band backhaul applications" *submitted to 10th European Conference on Antennas and Propagation*, Davos, Switzerland, 10-15 April 2016.	Accepted
VTT, Univ. Brno	J. Säily, M. Pokorny, M. Kaunisto, A. Lamminen, J. Aurinsalo, Z. Raida "Millimetre-wave beam-switching Rotman lens antenna designs on multi-layered LCP substrates" *submitted to 10th European Conference on Antennas and Propagation*, Davos, Switzerland, 10-15 April 2016.	Accepted

4.4 Workshops and special sessions

MiWaveS partners have presented various aspects of the project work in 10 workshop presentations during the second year (**Table 4-4**) and several presentations are already planned in the next year.

The consortium is also committed to the organization of workshops to enhance the visibility of European projects activity and strengthen the exchanges with academic and industrial actors in the fields. During this second year, MiWaveS contributed to the organization of two workshops:

- IEEE VTC-Spring (11 May 2015, Glasgow): "Emerging MIMO Technologies and Millimeter-waves for 5G Networks" (co-organized with MiWEBA and HARP projects); more information on http://www.miwaves.eu/VTC2015_mmW5G-WS.html.
- European Microwave Week (7 Sept. 2015, Paris): "Millimeter-wave technologies for 5G mobile networks" was held and received more than 60 attendees; more information on http://www.miwaves.eu/EuMW2015_MiWaveS%20workshop%20program.pdf.

In addition a special session was organised at EuCNC 2015, (June 29-July 2, 2015, Paris, France) entitled "5G scenarios and use cases: how new mmWaves technologies can lead to an immersive user experience".

For the third year, MiWaveS has already issued two workshop and one special session proposals:

- "Millimeter Wave-Based Integrated Mobile Communications for 5G Networks" workshop (accepted) at the IEEE Wireless Communications and Networking Conf. (WCNC) in Doha, Qatar (co-organized with mmMAGIC project); more information on http://www.miwaves.eu/WCNC2016_mmW5G.html.
- "Millimeter-Wave Technologies for 5G Mobile Networks and Short-Range Communications" workshop at the 2016 European Microwave Week (EuMW 2015).
- "Millimeter wave antenna systems for future broadband communication networks" convened session (accepted) at the 2016 European Conference on Antennas and Propagation, Davos, Switzerland. More information on http://www.eucap.org/conference/convened-sessions.

Table 4-4: List of workshop presentations.

Partners	Authors / Title / Workshop	Status
CEA	L. Dussopt "MiWaveS - Beyond 2020 Heterogeneous Wireless Network with Millimeter Wave Small Cell Access and Backhauling" *RAN WORLD 2015*, Dusseldorf, Germany, Jan. 20-21, 2015.	Published
CEA	C. Dehos "Towards the integration of millimeter wave access points in future 5G heterogeneous networks: stakes, challenges, and key enabling technologies" *2015 IEEE Radio Frequency Integrated Circuits Symposium (RFIC 2015", workshop "mmW to THz, which applications with whic" technology"*, Phoenix, AZ, 17-19 May 2015.	Published
ST-Fr	F. Gianesello "Low cost mmW antenna: a key enabler for backhaul CMOS/BiCMOS chipset solution up to 120 GHz" *European Microwave Week 2015, workshop on Millimeter-Wave Technologies for 5G Mobile Networks, Sept. 6-11, 2015, Paris, France.*	Published

CEA	C. Dehos, A. Siligaris "Towards the integration of millimeter wave access points in future 5G heterogeneous networks: stakes, challenges, and key enabling technologies" *European Microwave Week 2015*, workshop on Millimeter-Wave Technologies for 5G Mobile Networks, Sept. 6-11, 2015, Paris, France.	Published
ST-Fr	F. Gianesello, R. Pilard, A. Bisognin, D. Titz, C. A. Fernandes, J. R. Costa, C. Luxey & D. Gloria "Industrial mmW chipset enablement using Low Loss BGA package and 3D printed plastic lens" *"Antenna and Packaging Technologies for mmWave Front-End Integration" workshop, IEEE Microwave Week*, Phoenix, AZ, USA, 17-22 May 2015.	Published
ST-Fr	P. Chevalier "SiGe Technologies for mmW and THz Applications" *"MmW to THz, which Applications with which Technology" workshop, IEEE Microwave Week*, Phoenix, AZ, USA, 17-22 May 2015.	Published
CEA	L. Dussopt, I. Velez "Millimeter-Wave Small Cell Access and Backhauling for 5G" *Radio Access and Spectrum Cluster Workshop, 2015 European Conference on Networks and Communications (EuCNC 2015)*, Paris, France, June 29-July 2, 2015.	Published
CEA	L. Dussopt "Beyond 2020 Heterogeneous Wireless Networks with Millimeter-Wave Small Cell Access and Backhauling" *Workshop on millimetre-wave technology for high-speed broadband wireless networks*, Valencia, Spain, 20th Nov. 2015.	Published
NID	E. Ohlmer, V. Kotzsch "mmWave Prototyping" *RF Roundtable*, TU Vienna, 11.-12. Nov 2015.	
NID	E. Ohlmer, V. Kotzsch "Prototyping Adaptive Multi GBit/s Access and Backhaul Links for for 5G mmWave Small Cells" *Globecom 2015, Industry Forum*, San Diego, CA, 6-10 Dec. 2015.	published

4.5 Panels

MiWaveS partners organized and contributed to two panel sessions in international conferences during the second year (**Table 4-5**). Our plan is to pursue the organization of such panel sessions in the main conferences of interest for the project.

Table 4-5: List of panel sessions.

Organizers	Contributors / Title / Conference
V. Frascolla (IMC)	L. Dussopt (CEA), Z. Ying (Sony Mobile), M. Beach (Bristol Univ.), A. Bourdoux (IMEC), M. Nekovee (Samsung), F. Boccardi (OFCOM). "mmWave Technology for Telecommunications: Scope, Status & Way Forward in Pre-development & Standards" *IEEE Vehicular Technology Conf. (VTC-S) 2015,* Glasgow, Scotland, 11-14 May 2015.
V. Frascolla (IMC)	L. Dussopt (CEA), E. Calvanese-Strinati (CEA), R.J. Weiler (Fraunhofer HHI), C. Paoloni (Lancaster Univ.), E. Ohlmer (National Instruments). "5G scenarios and use cases: how new mmWaves technologies can lead to an immersive user experience" *2015 European Conference on Networks and Communications (EuCNC 2015)*, Paris, France, June 29-July 2, 2015.

4.6 Short courses

The organization and contribution to short courses is an important dissemination objective of an Integrating Project such as MiWaveS; besides technical teaching, they are an opportunity to communicate the broad vision of MiWaveS on 5G mobile networks to the younger scientists. Two courses have been organized in 2015, one by TUD, and one by UNIS (**Table 4-6**).

The University of Rennes 1 will organize a one-week school on “Millimeter-wave antennas and technologies” in 2016 (year 3 of MiWaveS).

Table 4-6: List of short courses.

Partners	Contributors / Title
TUD	W. Rave “Algorithmen für Mehrantennensysteme (Antenna array algorithms)”, course in winter semester, Oct. 2015-Feb. 2016.
UNIS	M. Dianati UNIS organized a short course in 5G Communications and Technologies in March 2015. A part of this short course is dedicated to mmWave systems. This course is planned to be repeated every March in the coming years.

5. Conclusion

Communication activities toward a public audience are an important piece of the dissemination activities of an integrating project such as MiWaveS, in order to efficiently impact the community with its vision, strategy and results.

The MiWaveS web site is a central piece of the communication tools as it provides the adequate platform to gather all the information publicly available on the project, from the general ones to the most technical ones. Social medias, such as Twitter, are also useful to timely inform interested parties about important events and stimulate discussions or interactions. These tools should be used more intensively in the remaining of the project as more results are becoming available.

Three issues of the newsletter have been published so far and this series will be pursued with a periodicity of six months to provide a regular update about the project progresses. A 2nd white paper is in preparation and will be published soon. Live exhibitions and demonstrations in major conferences have been done already and are expected in the coming year as the demonstration capabilities increase as an outcome of work-packages 5 and 6.

These communication activities already led to several contacts and proposals for collaborations from companies and forums in Europe and outside Europe. They will be pursued at least for six months after the end of the project in order to adequately disseminate the latest results, and up to one year after the end of the project regarding the maintenance and updates of the project web site.

Scientific publications are probably the most measurable outcomes of a collaborative research project and MiWaveS partners are committed to disseminate their technical results to the scientific community through publications and communications in journals, conferences and workshops. More than 37 contributions have been produced during the second year of the project and are listed in this document. It is expected that this publication activity will continue to increase in the third year of the project as more technical results, including experimental ones, become available.

MiWaveS partners are eager to collaborate with other European research projects in order to leverage the technical results and amplify their impact; dissemination activities are a good way to trigger such collaboration and several actions already took place:

- A joint presentation with E3Network was performed at EuCNC 2015.
- The joint organization of workshops was undertaken with mmMAGIC and MiWEBA.

6. References

[1] MiWaveS deliverable D7.2.1, “Intermediate standardization and regulation activities report”, 30 June 2015.

[2] MiWaveS deliverable D7.2.2, “Intermediate exploitation plan report”, 30 June 2015.

[3] MiWaveS project, Description of work – v19, October 9, 2013.

[4] MiWaveS project website [online]. Available: http://www.miwaves.eu.