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

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Year 1 dissemination activities report

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Abstract: This deliverable provides a detailed list of the dissemination activities performed by MiWaveS partners during the first 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 first year of the project are reported, as well as the plan for the remaining two years.

Keywords: dissemination, publication, communication.

Executive Summary

This document reports the dissemination activities performed or undertaken during the first 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 first year of the project are reported, as well as the plan for the remaining two years.

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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 first year of the project are reported, as well as the plan for the remaining two years.

It is important to note that the consortium has also developed a significant activity toward impacting standardisation and regulation bodies, which is not reported here as it will be reported in the dedicated deliverables D7.2.1 and D7.2.3, as well as exploitation activities.

2. Project overview

2.1 About MiWaveS

MiWaveS (Beyond 2020 heterogeneous wireless network with Millimetre Wave Small cell access and backhauling) [1][2] 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 around 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 Mobile Communications and ST Microelectronics), one PCB substrate technology provider (Optiprint), and finally four network subsystems, equipment and test platform providers (Nokia Solutions and Networks, Sivers IMA, TST and Signalion / National Instruments).

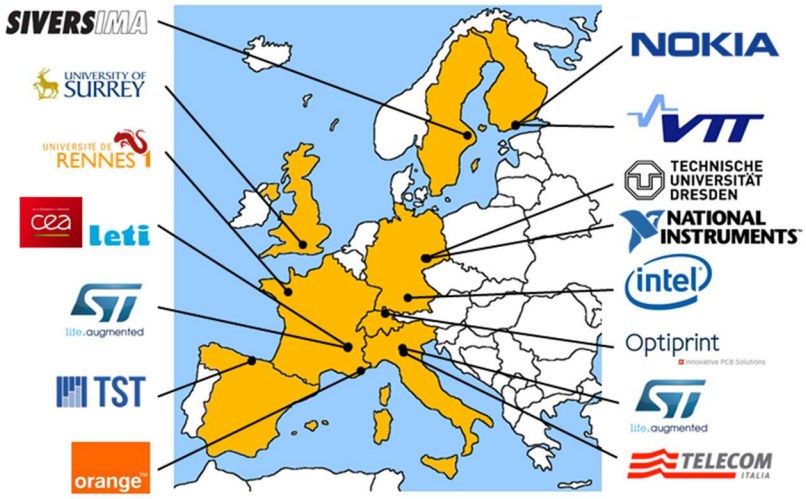

Figure 2-1: European locations of the consortium partners.

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 will work on the following use-cases that will be refined 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.

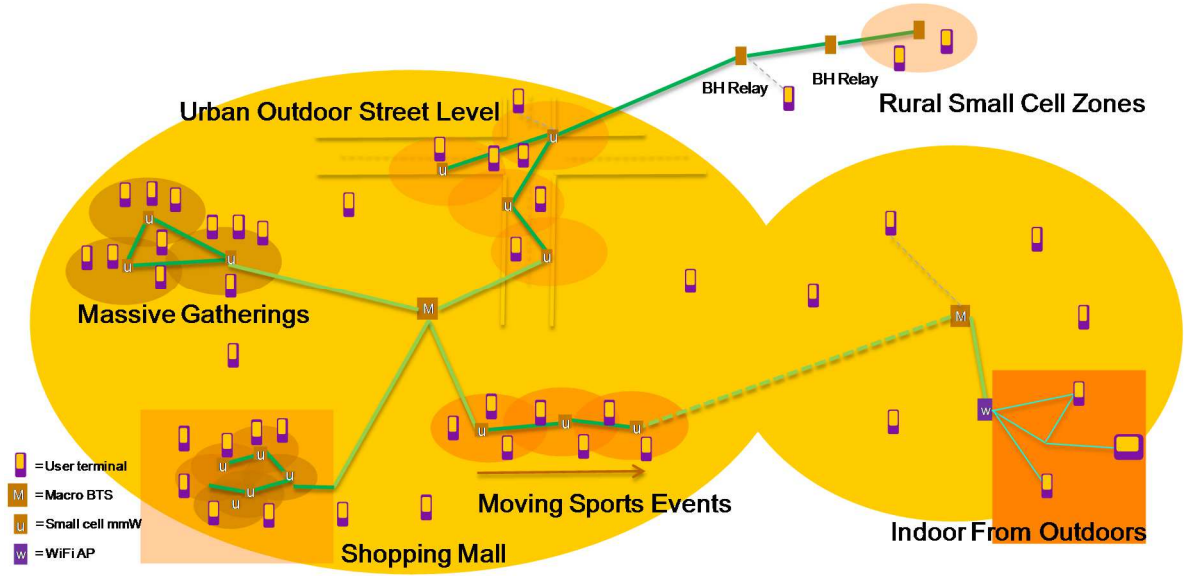

Figure 2-2: MiWaveS use cases combined on a single topology.

2.4 Main technical objectives

The system requirements, derived out of the above mentioned use-cases, and the remaining project work will 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 will 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**.

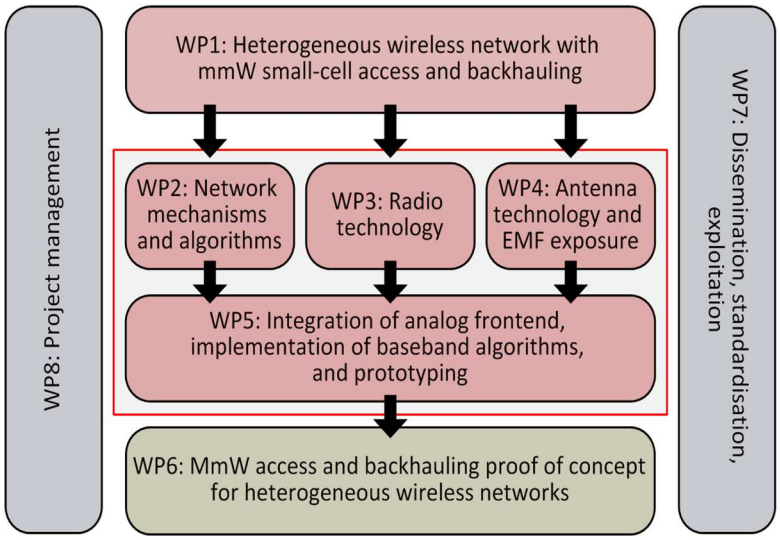

Figure 2-3: Work packages of the MiWaveS project.

2.6 Industrial Advisory Board

During this first year, the Industrial Advisory Board (IAB) of MiWaveS has been installed; it 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.

The first IAB meeting took place on Oct. 1st 2014, co-located with the 3rd plenary meeting in Espoo, Finland. It was the opportunity to present and discuss the work performed over the first three quarters of the project and the outcomes of the first deliverables, especially focusing on the use cases, scenarios and system definition of the heterogeneous network concept using mmW access and backhauling technologies.

The IAB will meet at least twice again, once a year, in order to further discuss the progress of the project and advise the consortium about strategic directions or opportunities to be seized.

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, 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 the web site announcement and press release publication. Over the May 2014 to January 2015 period (8.5 months), more than 11 000 pages were visited, more than 1700 visitors were registered with about 40% of returning visitors.

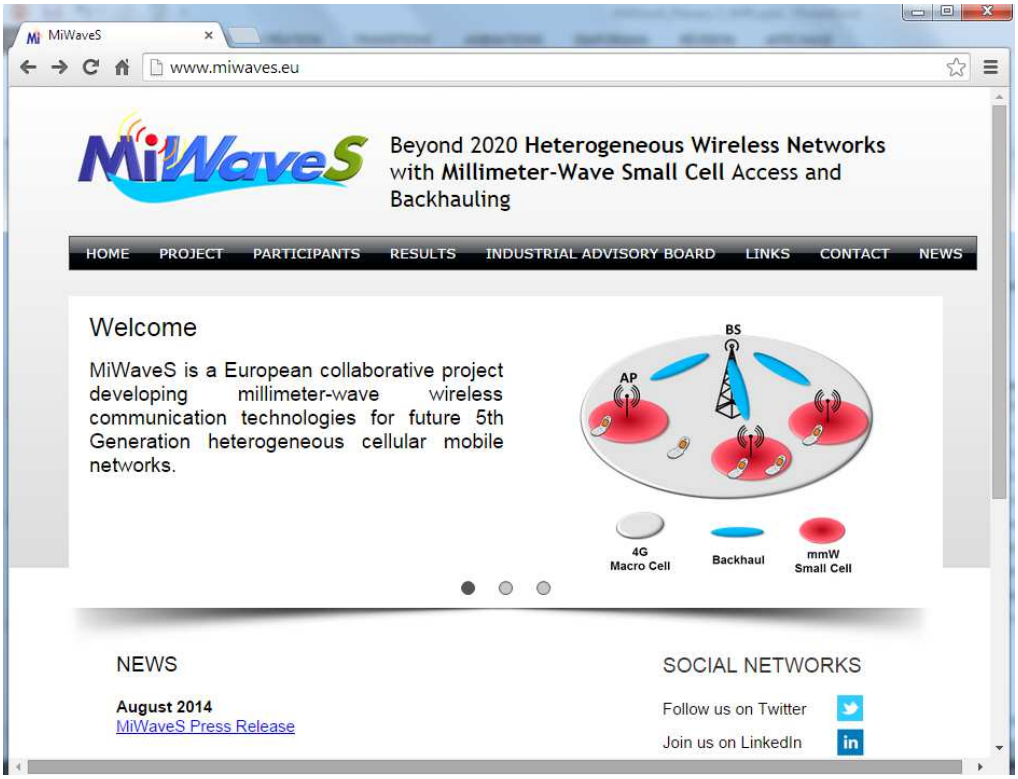

Figure 3-1: Snapshot of the MiWaveS web site.

Figure 3-2: Audience of the MiWaveS web site over the period May 1st, 2014 to January 11th, 2015.

3.2 Social networks

3.2.1 LinkedIn

The LinkedIn group was launched in April 2014 (**Figure 3-3**); to date, it counts 47 members, a majority of them being external to the MiWaveS consortium. The activity on this group is not as high as it could be and more efforts will have to be done in the second year to trigger more discussions on topics relevant to millimeter-wave developments for 5G.

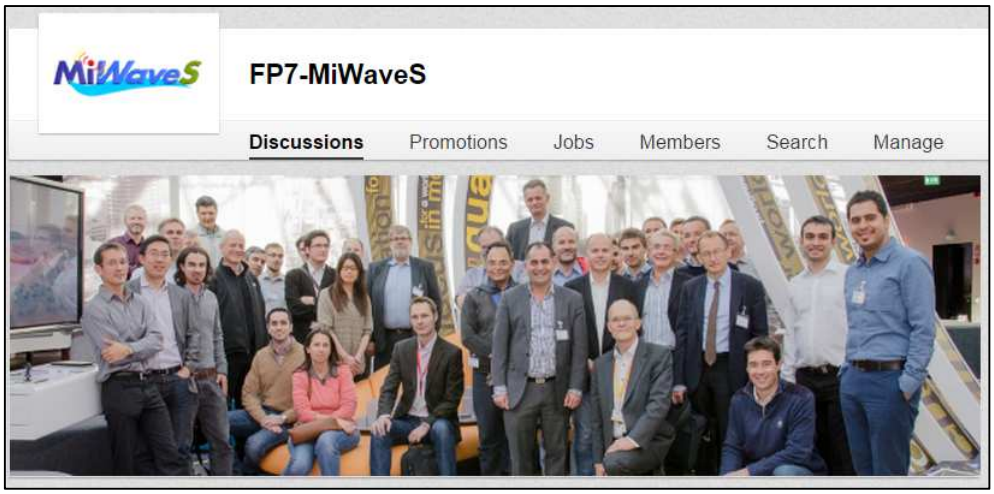

Figure 3-3: Snapshot of the LinkedIn group.

3.2.2 Twitter

The Twitter group (@FP7_MiWaveS) was launched in April 2014 (**Figure 3-4**); to date it counts 25 followers, more than 20 of them being external to the consortium. 14 tweets were posted to date to announce the consortium meetings, publications, panel sessions, press release, etc.

Figure 3-4: Snapshot of the Twitter group.

3.3 Flyer

A one page flyer to present the project and provide basic information (consortium, web site, LinkedIn and Twitter links) was prepared (**Figure 3-5**). It was distributed at the EuCNC and Globecom conferences.

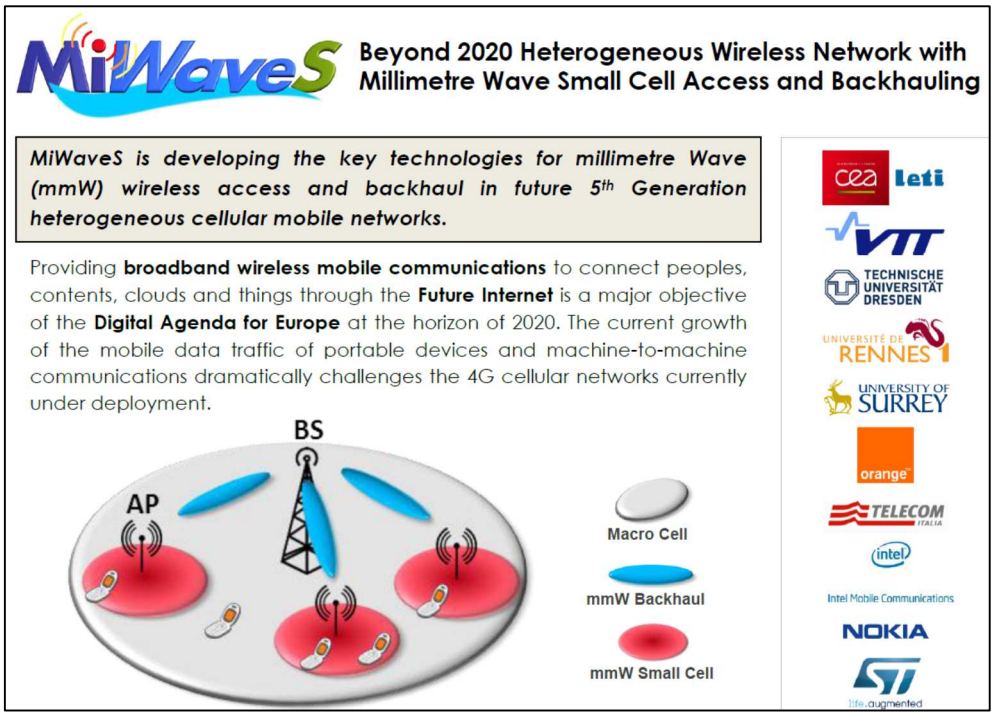

Figure 3-5: Snapshot of the MiWaveS flyer.

3.4 Newsletter

A series of biannual newsletters was started in order to communicate on the project advances and the main events. The first issue was published in July 2014 (**Figure 3-6**) and the second issue is under preparation. These newsletters are posted on the web site, announced on LinkedIn and 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.

Newsletter

July 2014 - Issue Number 1

The EU FP7 funded project MiWaveS is developing key technologies for millimetre-Wave (mmW) wireless access and backhaul, needed in future 5th Generation heterogeneous cellular mobile networks.

We are pleased to start with this issue, the MiWaveS' newsletter that will be released periodically, bringing you updates on the main project activities and progress. This first edition covers the period January to June 2014.
You can find this newsletter on our website (www.miwaves.eu), but you can also pay a visit to our Twitter account (www.twitter.com/FP7_MiWaveS) and join us on LinkedIn (www.linkedin.com/groups/FP7-MiWaveS-6694097) to remain up-to-date with our news.

In this issue:

- Main results
- Dissemination activities
- Project meetings
- Save the date

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TECHNISCHE UNIVERSITÄT DRESDEN
UNIVERSITÉ DE RENNES 1
UNIVERSITY OF SURREY

Figure 3-6: Snapshot of the first issue of the biannual MiWaveS newsletter.

3.5 White papers

A first white paper has been recently published on MiWaveS website to present the project vision and activities. The content of this white paper provides the basis for the project overview presented in Section 2 of this document. It is our plan to enhance further the white paper to include main projects achievements and updates the vision of the partners on what will be the place for mmW technologies in 5G.

3.6 Press releases

The following press release was published to announce the start of MiWaveS project, the announcement was delayed until the web site was fully operational with a significant content:

- "Leading European communications companies and research organisations have launched an EU project developing the future 5th Generation cellular mobile networks", 28 Aug. 2014.

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. It triggered more than 34 online press articles, including an article by EETimes ("EU project takes mm-waves beyond WiGig", EETimes, 11 Sept. 2014).

3.7 Exhibitions

MiWaveS partners Nokia, National Instruments and SiversIMA are currently developing a demonstration to be presented at the next Mobile World Congress in Barcelona (2-5 March 2015).

At least one additional demonstration will be proposed in a future conference, such as EuCNC, IEEE Globecom or IEEE Vehicular Technology Conference.

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 first year as well as the targeted media for the rest of the project.

4.1 Journals

Two journal papers were written up to now (**Table 4-1**). The first one was written before the actual start of the project to present MiWaveS vision in a special issue of IEEE Communications magazine on millimeter-wave communications. The second paper presents the first results obtained in WP4 by the University of Rennes 1 on a novel architecture of high-directivity antenna arrays.

Table 4-1: List of journal papers.

Partners	Authors / Title / Journal	Status
CEA	C. Dehos, J. L. González, A. De Domenico, D. Kténas, and L. Dussopt "Millimeter-wave access and backhauling: the solution to the exponential data traffic increase in 5G mobile communications systems?" *IEEE Communications Magazine*, vol. 52, no. 9, Sept. 2014, pp.88-95.	Published
UR1	F. Foglia Manzillo, M. Ettorre, M. Casaletti, N. Capet, and R. Sauleau "On the Modeling of Wideband Continuous Transverse Stub Arrays" *IEEE Transactions on Antennas and Propagation*, 2014.	Submitted

The objective for the coming two years is to increase significantly the number of journal papers to report the outcome of the project when they will be available. 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.

4.2 Conferences

Few conference papers have been presented so far due to lack of original technical results during the first year of the project (**Table 4-2**). However, this part of the dissemination activities is expected to increase significantly during the second year of the project. 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), Int. Workshop on Antenna Technology (iWAT), IEEE Antennas and Propagation Society Int. Symposium (APSURSI).

Table 4-2: List of conference papers.

Partners	Authors / Title / Conference	Status
CEA, SIG, UR1, IMC	L. Dussopt, C. Dehos, A. De Domenico, V. Kotzsch, E. Ohlmer, M. Ettorre, M. Zhabodov, R. Sauleau, and V. Frascolla "Radio Technologies for Next Generation HetNet with Millimeter-Wave Access and Backhaul" *European Conference on Networks and Communications (EuCNC)*, "Enablers on the road to 5G" workshop, Bologna, Italy, June 23-26, 2014.	Rejected
CEA	L. Dussopt "The path towards Gigabits-per-second access and backhaul using millimeter-wave technologies in future mobile networks: A vision from the collaborative research project MiWaveS" *Mobile World Congress*, 2-5 March 2014, Barcelona, Greece.	Rejected
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.	Accepted
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.	Accepted
UNIS	S. Payami, M. Shariat, M. Ghoraishi, M. Dianati "A practical beamforming approach for Millimeter Wave Systems" 2015 IEEE 81st Vehicular Technology Conference (VTC2015-Spring), 11–14 May 2015, Glasgow, Scotland.	Submitted
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.	Submitted
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.*	Submitted

4.3 Workshops

MiWaveS partners have presented various aspects of the work of the project work in 13 workshop presentations during the first year and two presentations are already planned in the next quarter (**Table 4-3**).

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 first year, MiWaveS contributed to the organization of two workshops:

- "Enablers on the road to 5G" at the European Conf. on Networks and Communications (EuCNC 2014) jointly with METIS, COMBO, 5GNOW, and iJOIN projects.

- 10th IEEE Broadband Wireless Access workshop at the 2014 IEEE Globecom conference jointly with TROPIC, iJOIN, MCN projects.

For the second year, MiWaveS has already issued two workshop proposals:

- "Massive MIMO and Millimeter-waves for 5G Networks" workshop at the 81st IEEE VTC 2015 Spring jointly with MiWEBA project.
- "Millimeter-Wave Technologies for 5G Mobile Networks" workshop at the 2015 European Microwave Week (EuMW 2015).

Table 4-3: List of workshop presentations.

Partners	Authors / Title / Conference	Status
CEA	L. Dussopt "Beyond 2020 Heterogeneous Wireless Network with Millimetre-Wave Small-Cell Access and Backhauling" *Future Networks 12th FP7 Concertation*, RAS Cluster Meeting, 22 Oct. 2013.	Published
CEA	D. Ktenas "Millimeter-wave Small-cell Access and Backhauling Technologies for 5G Heterogeneous Cellular Networks" *INTEL European Research & Innovation Conference (ERIC 2013)*, Nice, France, 22-23 Oct. 2013	Published
CEA	E. Calvanese-Strinati "Millimeter-wave Small-cell Access and Backhauling Technologies for 5G Heterogeneous Cellular Networks" *International Workshop on Cloud Cooperated Heterogeneous Networks (project MIWEBA)*, Osaka, Japan, 23 Oct. 2013.	Published
CEA	E. Calvanese-Strinati "mmW Small Cells: Challenges and Opportunities" *Korea-EU Workshop: Exploring common research interests in the Future Internet*, Seoul, Sept. 30 and Oct. 1, 2013	Published
CEA	L. Dussopt, I. Velez "Millimetre wave small-cell access and backhauling for 5G" *Future Internet Assembly*, "Radio Access and Spectrum Innovations for 5G" workshop, 18-20 March 2014, Athens, Greece.	Published
NSN, CEA, SIG	J. Putkonen, J.Salmelin, J.Kapanen, L. Dussopt, C. Dehos, A. De Domenico, V. Kotzsch, E. Ohlmer "MiWaveS: Beyond 2020 Heterogeneous Wireless Network With Millimeter Wave Small Cell Access and Backhauling" *Brooklyn 5G Summit*, Brooklyn, NY, 23-25 April 2014.	Published
CEA	L. Dussopt "MM-wave radio and antenna technologies for wireless access and backhaul" *European Conference on Networks and Communications (EuCNC)*, "Enablers on the road to 5G" workshop, Bologna, Italy, June 23-26, 2014.	Published
IMC, CEA, UR1, SIG, TI, NSN, TST	V. Frascolla, M. Faerber, L. Dussopt, E. Calvanese-Strinati, R. Sauleau, V. Kotzsch, G. Romano, K. Ranta-aho, J. Putkonen, J. Valiño "Challenges and opportunities for millimeter-wave mobile access standardization" *IEEE Globecom 2014, Workshop on Telecommunications Standards - From Research to Standards*, 8-12 Dec. 2014, Austin, Tx.	Published
CEA	C. Dehos "Toward mmW access-point and relays integration in 5G heterogeneous networks at horizon 2020: stakes, challenges and key technologies" *Scientific Days of the URSI French Chapter*, Paris, France, 25-26 May 2014.	Published
SIG	V. Kotzsch "5G Cellular Wireless: Challenges, Solutions and Early Prototyping" *International ITG Workshop on Smart Antennas*, Nuremberg, Germany, 12 March 2014.	Published
SIG	V. Kotzsch, E. Ohlmer "Prototyping High-Throughput mmWave Small Cells for 5G" *IEEE GLOBECOM 2014, Industry Forum*, Austin, TX, USA, 8-12 Dec. 2014.	Published
CEA	L. Dussopt, E. Calvanese-Strinati "Beyond 2020 Heterogeneous Wireless Network with Millimeter-Wave Small-Cell Access and Backhaul - Innovative Architectures and Systems" *EU-Taiwan Workshop on 5G Research*, Brussels, Belgium, 24 Oct. 2014.	Published

CEA	L. Dussopt, E. Calvanese-Strinati "Beyond 2020 Heterogeneous Wireless Network with Millimeter-Wave Small-Cell Access and Backhaul - Advanced mmW Technologies" *EU-Taiwan Workshop on 5G Research*, Brussels, Belgium, 24 Oct. 2014.	Published
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.	Accepted
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 which technology"*, Phoenix, AZ, 17-19 May 2015.	Submitted

4.4 Panels

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

Table 4-4: List of panel sessions.

Organizers	Contributors / Title / Conference
E. Ohlmer, V.Kotzsch (SIG)	E. Calvanese-Strinati (CEA), T. Draeger (SIG), A. Ghosh (NSN), S. Rangarajan (NEC Lab America), G. Wu (Intel) "5G mmWave Small Cell Networks: Are we ready for multi Gb/s 5G wireless system design and test?" *IEEE GLOBECOM 2014, Industry Forum*, Austin, TX, USA, 8-12 Dec. 2014.
E. Calvanese-Strinati, L. Dussopt (CEA)	V. Frascolla (IMC), M. Nekovee (5G Samsung Electronics R&D, UK), I. Siaud (Orange), R. Sauleau (UR1). "mmW UWB communications: a key enabler for 5G?" *2014 IEEE Int. Conference on Ultra-Wideband (ICUWB 2014)*, Paris, France, 1-3 Sept. 2014.

4.5 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.

The University of Rennes 1 organizes a one-week school on "Millimeter-wave antennas and technologies" every two years in the frame of the European School of Antennas. The last session occurred on May 19-23, 2014, and included two 2-hours presentations on antenna technologies of interest in MiWaveS, where the applications targeted in MiWaveS were presented. The next edition of this school will be organized in 2016 (year 3 of MiWaveS).

Table 4-5: List of short courses.

Partners	Contributors / Title / Conference
UR1	R. Sauleau "SIW antennas, Lenses, and MEMS" *"MM Wave Antennas and Technologies", European School of Antennas course*, Rennes, France, 19-23 May 2014.
CEA	L. Dussopt "Millimeter-wave integrated antennas" *"MM Wave Antennas and Technologies", European School of Antennas course*, Rennes, France, 19-23 May 2014.

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 LinkedIn and 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.

The newsletters will be pursued with a periodicity of six months to provide a regular update about the project progresses. White papers and press releases will be used opportunistically when relevant, as well as publication in generalist medias; for instance, an overview of MiWaveS is under preparation for a special issue of the EU Research journal. Live exhibitions and demonstrations in major conferences will be considered in the remaining of the project (one is already under preparation for the Mobile World Congress 2015).

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 25 contributions have been produced during the first year of the project and are listed in this document. It is expected that this publication activity will be increased in the second and 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 the 2014 Future Internet Assembly.
- The joint organization of workshops was undertaken with METIS and MiWEBA.
- Technical discussions have started with LEXNET partners on electromagnetic field exposure evaluation in the frame of work-packages 1 and 4; this joint activity will certainly lead to joint communications in the second year.

6. References

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

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