Future Wireless Communications Empowered by Reconfigurable Intelligent Meta-Materials

Deliverable 4.1: Dissemination, Standardization and Outreach Plan

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***e.g., Accepted, Develop, Modify, Re-edit, Update**

[2] PU = Public; CO = Confidential, only for the members of the Consortium (including the Commission Services)

Contents

Executive Summary

This document is the Dissemination, Standardization and Outreach Plan for the project METAWIRELESS, also registered as deliverable D4.1 of the Work Package 4 (WP4).
On one hand, the purpose of the document is to provide a plan for the dissemination of the activities and results of the project, including also public engagement activities. The aim is to raise the interest on the research outcomes, targeting relevant groups such as scientific community, industry, stakeholders, and the general public on the METAWIRELESS project.
On the other hand, the goal is to outline the communication and public engagement strategies of the project and the range of channels that will be used to promote METAWIRELESS with dedicated messages suited to the wide audiences targeted.
Dissemination opportunities, targeted audiences and key messages will be identified and updated regularly. For the preparation of present version of this deliverable, several reference documentations have been consulted and reviewed with the objective to produce a self-consistent high-quality plan, based on best practices and experiences related to the project. The Dissemination, Standardization and Outreach Plan is an evolving document and will be updated with reflection on the project progress and data generated from the ESRs' activities.

This deliverable is structured in the following seven sections:

1) **Introduction** contains a brief description of the project objectives and how the dissemination aspect was included in the proposal.
2) **Target groups and stakeholders** section lists the main subjects interested in the project results at different professional levels.
3) **Dissemination** section reports the main dissemination tools and channels.
4) **Communication strategy** section describes the internal and external communication strategies exploited in the METAWIRELESS project.
5) **Cost of communication and dissemination strategies** section discusses this aspect in the METAWIRELSS project.
6) **Ethical issues** section explains how the ethical aspects are included in the project.
7) **Conclusions** section reports the main concluding remarks of this document and underlines that the dissemination aspects will be updated in future deliverables during the whole project's lifetime.

List of Project Beneficiaries and Partner Organizations

Name (Short Name)	Role	Country
CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELECOMUNICAZIONI (CNIT)	Beneficiary	Italy
AALTO KORKEAKOULUSAATIO SR (AAL)	Beneficiary	Finland
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)	Beneficiary	France
NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS" (DEM)	Beneficiary	Greece
GREENERWAVE (GRW)	Beneficiary	France
KUNGLIGA TEKNISKA HOEGSKOLAN (KTH)	Beneficiary	Sweden
NEC LABORATORIES EUROPE GMBH (NEC)	Beneficiary	Germany
NOKIA SOLUTIONS AND NETWORKS OY (NOK)	Beneficiary	Finland
TELEFONICA INVESTIGACION Y DESARROLLO SA (TID)	Beneficiary	Spain
TECHNISCHE UNIVERSITAET WIEN (TUW)	Beneficiary	Austria
UNIVERSIDAD POMPEU FABRA (UPF)	Beneficiary	Spain
WAVE UP SRL (WUP)	Beneficiary	Italy
UNIVERSITY OF CASSINO AND SOUTHERN LAZIO (UNICLAM)	Partner Organization	Italy
UNIVERSITÉ PARIS-SACLAY (UPS)	Partner Organization	France
SOUTHEAST UNIVERSITY (SEU)	Partner Organization	China
EM SIMULATION SYSTEMS (EMS)	Partner Organization	Australia
ERICSSON AB (EAB)	Partner Organization	Sweden
UNIVERSITÉ PARIS SCIENCES ET LETTRES (PSL)	Partner Organization	France
UNIVERSITY OF SIENA (UNISI)	Partner Organization	Italy
TSINGHUA UNIVERSITY (TIN)	Partner Organization	China
UNIVERSITY OF PIRAEUS (UNIPI)	Partner Organization	Greece

ACRONYMS

Acronym	Meaning
ESR	Early-Stage researcher
ITN	Innovative Training network
MSCA	Marie Skłodowska-Curie Actions
METAWIRELESS	Future Wireless Communications Empowered by Reconfigurable Intelligent Meta-Materials
WP	Workpackage
RIS	Reconfigurable Intelligent Surfaces
KPI	Key-Performance Indicator

1. Introduction

The need of unprecedented network performance called for a novel technology able to redefine the classical communication paradigm: Reconfigurable Intelligent Surfaces (RISs) are conceived as man-made electronic surfaces able to control the propagation properties of the incoming signal wave. This would result in a revolutionary signal propagation environment where RISs might be optimally placed to achieve outstanding Key-Performance Indicators (KPIs). However, several technical challenges arise when such a novel technology is in place. In this context, major European players must keep the same evolutionary pace of worldwide competitors: RIS may represent the groundbreaking technology to bring Europe at the forefront of current and future telecommunication business segments. Industry and academia are addressing theoretical and practical issues to prove the validness of such paradigm change. However, the technology is at its very-early stage and may require some years before getting first, into main standardization body discussions and, second, turning into real products that will be seamlessly integrated in the commercial and active network infrastructures.

1.1 About METAWIRELESS

While RIS represents the technology turning-point in the upcoming wireless network design, it might be a complex exercise to incorporating such low-cost and low-complex devices without an interdisciplinary effort. This would call for new methodologies that would cope with the major technical issues from all layers of the protocol stack while still providing a synergy among those. Overcoming the classical view of the propagation environment, seen as a black box, would introduce additional degrees of freedom that would make the overall communication more efficient but, at the same time, make the radio resource allocation more complex. The low

complexity property might bring significant benefits, but it comes at no negligible costs. In particular, the overall channel estimation between transmitter and RIS as well as between RIS and receiver might require advanced algorithms where the RIS only acts as a passive device, i.e., without providing any feedback. Therefore, METAWIRELESS will lay the theoretical, algorithmic, and architectural foundation of RIS-enabled future wireless networks and will develop the first open access system-level simulator for network optimization that would put theoretical notions into practice from the communication and localization perspectives.

1.2 METAWIRELESS Dissemination Means and Objective

METAWIRELESS mainly aims at deeply investigating the novel technology of RISs for advanced sensing and communication beyond-5G applications.

The main ***objectives*** of the METAWIRELESS project can be summarized as follows:

- Developing RISs: Bring to light the third generation of meta-materials technology by developing RISs that can be reconfigured in real-time and are able to perform joint communication and sensing tasks.
- Theoretical frameworks: Develop new mathematical techniques to introduce a novel communication theory that overcomes conventional Shannon's theory and unveils the ultimate performance of RIS-based networks.
- Algorithmic frameworks: Develop new communication schemes, optimization protocols, and algorithms for RIS-based networks, coping with the large degrees of freedom and the passive nature of RISs.
- System-level simulator: Develop RIS-tailored ray tracing modules and build the first open access simulation (software) platform to analyze, optimize, and test large-scale RIS-based intelligent radio environments.

The main ***dissemination objectives*** are the following:

- Disseminate the project research results into the main professional institutions and general public.
- Convince publications editors that the RIS technology deserves wide dissemination via featured articles, demos, and ad-hoc interviews.
- Foster the technology implementation by showcasing specific use-cases, proving expected results via simulators and validating algorithms and frameworks via in-lab testbeds.
- Prove that the METAWIRELESS team with all hired ESRs obtained the expertise and knowledge on the novel topic to be the ideal candidates for future research contracts and funded projects.

2. Target Groups and Stakeholders

The communication strategy will be applied to promote the main project results. However, this may include different target groups and stakeholders, such as:

- Industrial community (telecom operators, service providers, etc.)
- Scientific community (research institutes and academia)
- International standardization working groups
- General public
- Students

All the METAWIRELESS partners will be involved in the dissemination activities to raise awareness of the project and its developed technologies and solutions among the various stakeholders. They will take full advantage of open research events and science fairs to showcase the final project results to different target groups and stakeholders and, in particular, to students. This may include initiatives such as those in the context of European Researchers' Night, Youtube channels or broadcasted talks.
We include in the following table the targeted audience, the related activities, the timing, and the metrics of the communication activities, including quantified goals. METAWIRELESS aims to register and publish open-access communication related assets and advertise them in the main social networks.

Target Audience	Main activity	Expected Performance Metric
All	**Project website.** The METAWIRELESS website will mainly disseminate the main concepts, obtained results and main achievements. In addition, this will be synchronized with the project social network accounts being the primary means of communication.	Number of unique visits per page, total number of visits, visitors' country.
All	**Social Networks.** METAWIRELESS will be on the main social networks with official profiles. This will help to advertise all work packages outputs. In addition, such profiles will	Linkedin and Twitter analytics, e.g., number of likes, number of comments, number of tweets.

	inform the main achieved results and upcoming events.	
General public	**Public Communication.** The project will be promoted by means of specific events, EC-related.	Num. of events organized / attended
All	**Press releases and posters.** METAWIRELESS will distribute project poster and press releases to increase the visibility of the project results.	Open-Access metrics (Arxiv). E.g., number of online reads and downloads.
General public, scientific and industrial communities, students	**Youtube video.** METAWIRELESS will work on the creation of public videos to disseminate the new technology potential and achieved results.	Number of all available videos. Number of views.
Scientific and industrial communities, students	**Publication of Journal papers:** Technical papers will be submitted to European and worldwide scientific Journals, magazines and surveys such as IEEE Transactions, Science, Nature, Scientific Reports, IEEE Comm. Surveys & Tutorials etc. These publications will help achieve impact and visibility of the European research at global level.	Journal papers per ESR (hosted both by academic and non-academic partners) in the 3 years of their recruitment
Scientific and industrial communities, international standardization working groups, students	**Participation in conferences and seminars:** This will help to promote the most recent results of the METAWIRELESS project. We foresee paper	Conference contributions/year per ESR (hosted both by academic and non-academic partners) in the 3 years of their recruitment.

	submissions by the ESRs to top-tier European and International conferences European and International conferences such as EUCNC, EUSIPCO, GLOBECOM, ICC, PIMRC, METAMATERIALS, etc.	
Scientific and industrial communities, international standardization working groups, students	**Organization of Conferences and Workshops:** This will help to promote the results of the METAWIRELESS project and promote the innovation achieved in the project to the wide research community.	Number of Workshops, special sessions and conferences organized by the METAWIRELESS partners
Students	**Lecture materials** will be introduced in academic courses and webinars taught by main partner experts.	Number of courses, keynotes, lectures.

3. Dissemination

3.1 Website

The METAWIRELESS project website is reachable at https://h2020-msca-itn-metawireless.cnit.it/.

The URL will be included in all public documents and presentations. Additionally, a file-sharing platform compliant with all partners has been set up. This platform includes all documents with restricted access as well as management tools.

The public section of the website:

- Provides a general overview of the project underlying the project summary and the main objectives;
- Provides a list of the participants and research fellows, a description for each one of them, and the link to the respective website;

- Provides a direct access to the project's recruiting call, including announcement and descriptions of the available positions, requirements, and details of the selection process;
- Will provide a description for each one of the ESRs with bio and abstract of their current activities in order to raise visibility of the involved ESRs;
- Will provide access to the project's public deliverables;
- Will provide a list of publications and presentations given at external conferences;
- Includes a "News" section where relevant news and events are announced;
- Provides contact details to ensure direct communication between the partners and the community.

3.2 Dissemination Activities

METAWIRELESS with its dissemination plan will mainly target academics, industrials, and stakeholders, through the following collaborative activities among the participants.

- **Scientific publications** where each ESR will target to submit 3 conference papers and 3 journal papers to top-tier international conferences, such as IEEE ICC, IEEE GLOBECOM, METAMATERIALS, journals such as IEEE Transactions, Science, Nature, Scientific Reports, and 1 survey to leading review journals, such as IEEE Comm. Surveys & Tutorials on communications and meta-materials.
- **Data management plan.** METAWIRELESS will follow EU guidelines and the H2020 Open Science policy, joining the EU pilot on open research. The data used to validate all project publications will be FAIR: Findable, Accessible, Interoperable, and Reusable. Numerical databases and source codes will be uploaded in open access repositories (e.g., Arxiv, IEEE DataPort, GitHub), monthly updated, and compatible with widespread simulation software (e.g. Matlab, Octave). User guides will be uploaded to the project website, with links to the repositories where the code can be downloaded, and contact information to allow further inquiries by prospective users, thus improving knowledge circulation, innovation creation, scientific research quality, inter-institutional, inter- disciplinary, and international collaborations, ultimately contributing to the EU Responsible Research policy.
- **Simulator.** The obtained METAWIRELESS simulator will be available through an open-source license to everyone and will be free for download from the project website. A user manual and an installation guide will be provided. This is one of the main expected project results, that will increase the overall project visibility and technology spreading.
- **Workshops**. Two one-day workshops will be organized, one at conferences on wireless co-located with EU-sponsored events (e.g. EuCNC) and one at conferences on meta-materials (e.g. METAMATERIALS).
- **Final conference**. One final conference will showcase the project results to the scientific community and to standardization and regulatory bodies. All industry partners will

organize two industrial dissemination days as part of the industry programs of IEEE GLOBECOM and METAMATERIALS. The events will feature presentations from all ESRs as well as invited talks by researchers from other EU projects and standardization/regulatory bodies.

- **Industry and academic panels**. Two half-day panels, one tailored to industry and another to academia will be organized to promote discussions among the largest audience. Target events are the scientific days of Int. Union of Radio Science (URSI) and the 6G Wireless Summit. 500+ attendees are expected.
- **Women workshop**. One workshop at the IEEE ICC flagship conference in collaboration with the Women in Engineering committee will be organized to disseminate the project results towards (and get interactive feedback from) the target audience of women in engineering.
- **Technical committees**. Many project partners are voting members in IEEE Technical Committees relevant to the project. An IEEE Emerging Technical Initiative on RIS-based wireless networks has been already instantiated with NEC as industrial chair.
- **Standardization bodies.** Project partners are in very relevant standardization bodies and technology associations. Specifically, 3GPP already reported planned activities on RIS to be included in Release-18. ETSI has recently accepted a new ISG (Industry Specification group) that will focus only on RIS-related tasks.

The publications will be subjected to the specified procedure for the project quality control and approval prior to submission. All publications will acknowledge the affiliation to the project itself as well as the funding. This will be done including in each publication the following text: “This work has been supported by the EU Horizon 2020 MSCA-ITN-METAWIRELESS, Grant Agreement 956256”.

3.3 Quality of the proposed measures to communicate the activities to different target audiences

Alongside the dissemination activities towards the scientific community, METAWIRELESS will engage the general public and the society at large to make it aware of the obtained research results, of how they impact EU citizens’ everyday life, and of they could be achieved only through European and international collaboration. To this aim, the professional use of the website, Youtube channel and social media accounts (@META WIRELESS – ITN on LinkedIn and Twitter). The social media accounts were set up in M1 and regularly updated (by CNIT) to advertise project results, events, and the MSCA funding program.

Website visits, YouTube videos visualizations, and social media contacts will measure the impact of the project. Social media will provide interactive feedback and the website will feature

gender-inclusive on-line polls to learn end-users' opinions, and a forum section for online debates where visitors can leave comments/requests and receive feedback.

4. Communication Strategy

Due to the diverse nature of the project community, different communication activities and channels will be utilized.

Communication in and around the project will happen at four distinct levels:

a) **between partners**: regular Google Meet calls, emails, face-to-face project meetings and workshops
b) **with stakeholders closely involved with the project**: expert panel, Living Labs participants and partners, workshop participants
c) **general public, scientific community, decision and policymakers**, business and energy service provider community
d) **specific communication activities towards the EU Commission Services**: email and phone calls with project officer, regular reports, deliverables, etc.

4.1 Internal Communication

The central contact for internal communication is the project coordinator, CNIT. An online file repository has been set up for sharing reports and data, using appropriate security and access mechanisms. Internal mailing lists of various hierarchical project levels have been set up and are used for all internal communication within the project. Periodically, the partners participate to online (Google Meet) or face-to-face meetings, to discuss the recent results of the METAWIRELESS project, the ESR Recruitment, the preparation of the deliverables, etc.

METAWIRELESS intranet tool is accessible only to the ESRs and the project participants. This password-protected tool contains all the relevant documents related to the project. Furthermore, it permits the design of tailored apps that facilitates the communication and collaboration of the ESRs among themselves, with their supervisors. Using this tool, many communication & dissemination ideas can be shared and implemented.

4.2 External Communication

The website reachable at the URL https://h2020-msca-itn-metawireless.cnit.it/ offers web-based broadcasts of selected lectures at the network-wide events. METAWIRELESS establishes a presence on popular social media largely used by the non-expert public where regular updates on the action progress are posted. Social media is fully integrated with the project website, and

will be used to advertise the project results, announce events such as conferences and showcases, inform about the most recent results and reports, and provide a platform for discussion. Streaming platforms like YouTube will be leveraged to publish videos showcasing trials and panels to provide a simple and effective way of accessing the project results and main ideas. Finally, the partners will produce white papers aimed at explaining the evolutions of network technologies to the public. Efforts will also be made to reach out to traditional media such as newspapers, TV, or radio, as this is a very effective way to make the general public aware of the benefits to society resulting from research projects. In addition to the website and the blogs, METAWIRELESS project develops and maintains a LinkedIn "Company page". Additional social media pages (like Twitter) are created for the project and used as communication channels.

1 brochure and 1 video will be posted on the project website, media channels, and all project partners channels every year to describe the project advancements and main findings and results, explaining to the general public the resulting socio-economic advantages in a non-scientific language.

Toy demonstrators will show the project positive impact on society, attracting the interest of all attendees, but especially of school students, stimulating them to start a scientific career. Gender-inclusive questionnaires will be distributed and collected to measure the impact, gathering gender-aware feedback. Science festivals. All ESRs will attend every year the science festival organized in different EU countries which bring together school students, companies, and universities, with fruitful discussions about the role of scientific research for societal welfare.

The ESRs will present interactive experiments to catch young attendees' interest. In 4 open days for high school students and families (the ESRs will present interactive experiments designed together with their supervisors to spark the audience interest for science. Gender-inclusive questionnaires will be distributed (also to adult audience) to measure the impact of the event, to gather gender-aware feedback, and to better organize future events. 100+ attendees per event are expected.

To promote the project to stakeholders and policymakers, all ESRs will present their findings through posters, talks or live demonstrations to major events of the Innovation Union:

1) Union EuroScience Open Forum, where researchers, journalists, policymakers, stakeholders debate EU research/global challenges;
2) Innovation Convention & Fringe Sessions organized by stakeholders to network with peers.

5. Cost of Communication and Dissemination Strategies

Generally, it is hard to predict the cost of the activities, as many activities are an integral part of standard research activities. Ideally, it is necessary to estimate the time or cost needed for activities related to data collection, data entry and transcription, data validation and documentation and the cost of preparing data for archiving and re-use. Those resources that include time and effort costs i.e., search costs, maintenance of technical infrastructure, individual preparation effort needed to use the infrastructure etc. are so-called non-monetary costs.
Additionally, there is also to consider that a journal publication usually involves the payment of a publication fee (either for overlength page charges or for papers submitted to open-access journals), which can be in the range from € 700 to € 2000. Similarly, presenting a paper to a conference requires the payment of a conference registration fee (ranging from € 250 up to € 700), plus the cost of travel (flight, hotel, and food), which ranges from € 800, for close, mostly European conference venues, to about € 2500 for overseas conferences (USA, China and Japan).
All these costs are associated with the allocated costs for the project.

6. Ethical Issues

The Project has no violation of the ethical guidelines stipulated by the European Commission and all ethical issues have been addressed properly in the Grant Agreement of the Project.
In particular, regarding these aspects, two issues are to be considered.
First, it is written in the proposal
"*End-users' opinions will be analyzed by gender-inclusive questionnaires distributed at outreach and communication events; 2) the gathered data will be processed in a gender-inclusive way to learn the different needs of male and female end-users and integrated into the research activities. This includes participants in Science Festivals and high school students and families at 4 open days (B1, 26).*"
The described practice could pose a privacy concern. Actually, the questionnaires will be collected in an anonymous form preventing identification. We will be asking for nationality, age range (< 20, 21-30, 31-40, 41-50, > 50 years), gender, instruction level. Name, surname and place and date of birth will not be collected. After that the questionnaires will have been processed and the relevant information will have been extracted, they will be destroyed. Second, our proposal plans to host secondments in non-EU countries. In particular, one secondment is planned at EM Simulation Systems (EMS), Australia. The ESR visiting EMS will have the chance to operate on the ray tracing simulator. This is an activity to be performed in an office using a software tool locally available. Consequently, this is a fully legal activity in any EU country and does not pose any ethical issue. Another secondment is planned at the Department of Electrical Engineering of Tsinghua University (TIN), China. The ESR visiting TIN will have the chance to use the RIS-based wireless communications prototype locally available. This is standard technical research normally performed in universities

and laboratories across the world. The research activities that will be performed at TIN are thus legal in any EU country.

A deliverable on ethics will be produced at M12 on how ethical issues have been and are planned to be handled for recruitment and dissemination.

7. Conclusions

This document presented a comprehensive overview of the dissemination and public engagement activities that will be conducted by the METAWIRELESS project to raise awareness and interest in the project itself. Dissemination strategy includes a common project reference identity, specific tools adapted to the considered target groups, and a well-established communication policy. The dissemination plan includes several activities and tools that will maximize the communication with stakeholders and dissemination of the results.
To further improve the dissemination strategy, the plan will be regularly reviewed and properly updated during the project's lifetime.