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Intermediate dissemination and standardisation activity report

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Abstract

This deliverable presents the intermediate report for standardisation and dissemination activities of the H2020 RISE-6G project within the first 18 months. Hereafter, we provide the list of activities, and we introduce the standardisation roadmap that will include the identification of relevant standardisation development organizations and open-source projects with corresponding accepted contributions. Additionally, we draft the industrial exploitation plan starting from individual exploitation plans provided by industrial partners involved in the project. We finally provide a list of achievements.

Keywords

Beyond-5G, 6G, Standard, 3GPP, ETSI, O-RAN, RIS, Rel-18, publications, dissemination, communication

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1 Introduction

The European Vision of a full digital inclusion with new technological means along with health and safety towards green and sustainable environments well describes the motivation behind the RISE-6G concept. The RISE-6G project vision is defined by the diversity of its project partners; drawn from the wireless industry and importantly from the academic research that in fact provide the focus for value creation activities. The industry is broadly defined by the themes of two different real applications that pose the basis of field trials and demonstrators: the rail station in Rennes (France) and the industrial plant in Turin (Italy). Such use-case applications are paired with the reverberant chamber with a radio EnodeB (eNB) in Ancona (Italy) that encompasses not only technical platforms and solutions that are under development, but a wider experimental and measurement scenario.

In particular, the Work Package 8 (WP8) of the RISE-6G project manages all required processes to fulfil projects objectives of Industrial Communications and Dissemination plan. This report provides a summary of the outcomes up to date towards dissemination, and impact assessment during the project duration. It also provides an opportunity for the project partners to review their exploitation planning and refine their strategic intentions for exploitation of the outcomes of the project. The refreshing of the strategic thinking of the project partners is essential and exactly maps the approach that would be taken in agile developing technology sectors where strategic marketing, technology and business model in-sights will necessitate strategic pivots.

Industrial Communication and Dissemination activities have established all necessary social media channels along with the project website. Content for social media and the website has come from the deliverables as well as blogs from partners and video/social content. International standardisation contributions represent one of the major dissemination activities of the RISE-6G project.

2 Business model context

One of the objectives of the RISE-6G project is to establish a commercial use-case scenario for investment by studying the market appliance in infrastructure sector that is the focus of the project. This contrasts with the traditional commercial drivers for realizing coverage of mobile network services, which was the focus of current network realization approach.

Task 8.3 within Work Package 8 is focused on dissemination, training, and standardisation activities but even more it is interested to understand when benefits of the RIS technology can be truly exploited from the industrial point of view in its commercial networks.

Business validation is the process to assess whether a certain system design is appropriate for the purpose and meets all corresponding business requirements within given constraints. Requirements are the characteristics of the system from the customer's point of view and are expressed according to the customer's "language" whereas constraints are the external factors that impact and limit the final network system design. These can be technical, financial, or regulatory in nature. In RISE-6G, the system design is represented by the use case developed and the experience in reverberant chamber and also in the industrial context for Element development and, furthermore, from the customers experience and security level point of view. Each RISE-6G partner is looking to maximise the economic and commercial impact of the project in their respective market and this will be defined in their respective exploitation plans. WP8 activities will consider these individual exploitation plans and analyse business opportunities for the individual partners. Use cases for technical and commercial analysis across the entire project are defined within WP2 in order to provide the "big picture" of the economic impact of the use cases and have established which uses cases have the most significant commercial impact. WP8 takes specific scenario inputs from WP2 to carry out a more detailed business assessment of the prioritised use cases. The information from WP2 will include service definitions and demand profiles. WP2 will also provide a high-level, qualitative evaluation of the value generated by each use case within each vertical and hence the willingness to pay. WP8 will use the WP2 qualitative evaluation to develop a more detailed quantitative analysis.

2.1 Exploitation plan

The RISE-6G consortium includes top European industrial companies that will lead exploitation activities of the project results. In Table 2-1, we list the industrial players mainly involved in the business and exploitation activities.

Table 2-1: Industrial players

Group	Company
Industry	NEC (NEC)
	Orange (ORA)
	TIM (TIM)
	Greenerwave (GNW)
	French Train Company SNCF (SNCF)
	Stellantis (CRF)

Individual exploitation activities will be used as basis for the overall exploitation task of the RISE-6G project as described hereafter.

2.1.1 NEC

The current data-driven product portfolio will be improved using expected RISE-6G results on the newly emerging technology, namely Reconfigurable Intelligent Surfaces (RIS). This will be used to develop an added-value management and orchestration platform that brings the benefits of Artificial Intelligence to well-established NEC line of products that in turn will impact on the Mobile Radio Access Networks and Mobile Wireless Networking business units. High-quality results are obtained to demonstrate the benefits of the designed platform to potential customers, including major European network operators. NEC expects to derive a converged view about gaps and choke-points in today's technology for mobile carrier networks, the collaborative definition of requirements and findings about new concepts for future network generations (B5G and 6G) that shall support NEC's strategy and approach in directing its standardisation roadmap in global Standards Development Organisations in different areas to build a solid standards and technology base for future communication systems. In particular, NEC plans to build a working nearly passive RIS board that will be fully integrated into the NEC portfolio and showcased to the main network actors.

2.1.2 Orange

The Orange Group has set an ambitious objective to beat the GSMA's objectives by 10 years and achieve carbon neutrality by 2040, despite the explosion of data usage on its networks. In this context, RISE-6G project results will used to enable Orange to identify and develop one of the most promising technical enablers that is expected to improve EE and EMFEU, namely Reconfigurable Intelligent Surface (RIS). RISE-6G will contribute to the company effort to attain its ambitious objective by building their own product that will be firstly tested into one of the operating project field-trials and then integrated into the broad Orange network.

2.1.3 TIM

TIM will foster the key-concept of sustainability that will lead the evolution process of future mobile networks towards applicable green scenarios where the electromagnetic field exposure (EMFE), energy efficiency and security can be identified as key issues to be dealt with. Within this context, the RIS technology will be used to cope with upcoming challenges that operators will have to face, being deeply keen on investigating the matter for paving the way to B5G sustainable networks. TIM will keep on staying on the leading edge of innovation by implementing new technologies and testing those within expected project field-trials, to better serve its customers.

2.1.4 Greenerwave

As the pioneer company developing the novel concept of Reconfigurable Intelligent Surfaces, Greenerwave has made the first experimental works on the topic, published papers, and filed patent applications more than 6 years ago. RISE-6G will allow the company to pursue its developments in the context of RIS thereby enhancing its know-how and skills in the design of innovative RISs, either at sub 6-GHz or at mmWave frequencies. Additionally, RISE-6G will allow the company to work hand-in-hand with top-notch laboratories and companies with a common goal to test RIS in actual wireless communication systems and promote them for future wireless networks.

2.1.5 SNCF

Users transiting the train station aspire increasingly to qualitative electronic communications experiences for professional or leisure needs. Guaranteeing an optimal connectivity experience is perceived as a new lever of attractiveness for travellers and business partners, thus leading to an increase of business activity. For this reason, the connectivity solutions enabled by SNCF must be proven to be sustainable and optimised, not only for pure internal economic reason but also to satisfy the customers. The overall impact for SNCF will be definitely a higher degree of

attractiveness, which could be correlated with a potential revenue increase regarding transportation activity. SNCF is considering the use of passive and / or active intelligent surfaces (RIS) to reach these goals. The advantage of passive surfaces is their optimisation for a given use and their simplicity of integration into the physical environment of the station. It is therefore interesting to compare active and passive solutions to define the best use cases for each.

2.1.6 CRF

Stellantis considers exploitation as the main driver for the participation to research projects, along with the knowledge on current trends on technology. When developing prototypes, CRF ensures that the potential for exploitation is maximised by anchoring the pilots to the Strategic Research Agenda of CRF and applied to the processes of CRF plants, whether existing (brown field) or to be developed (green field). The CRF pilots in RISE-6G will focus on the internal logistics to an Italian CRF plant and developed in collaboration with the Supply Chain Management department in FCA and the staff from the selected plant. CRF will develop a business case for the application of the RISE-6G results in the plant. This will ensure a joint process of requirements elicitation and results sharing and a rapid path for exploitation.

2.1.7 Preliminary exploitation results

A preliminary list of exploitation results is shown in Table 2-2. This list will be updated within the upcoming deliverables.

Table 2-2: Preliminary exploitation results

Description of exploitable result/knowledge	Exploitable product(s) or measure(s) in which the result/ knowledge will be used	Sector(s) of application	Time-plan for use	Deliverable(s) to which RISE6G deliverables/results does the topic relate to	Owner and other beneficiaries involved
Improved knowledge on Use Case definition	NEC RIS (S-Band) ORA RIS (S-Band) GNW RIS (Ka-Band)	Wireless Networks	Now and throughout the lifecycle of the project. For RIS module at the end of the project.	D2.1 D2.2 D2.3 D2.4 D2.5 D7.1	NEC ORA GNW TIM CRF SNCF
Knowledge on Adoption of RIS in 6G architecture	NEC RIS (S-Band) ORA RIS (S-Band) GNW RIS (Ka-Band)	Wireless Networks	2025-2030	D2.5 D7.1	NEC ORA TIM
Knowledge on 6G KPI improvement	NEC RIS (S-Band) ORA RIS (S-Band) GNW RIS (Ka-Band)	Wireless Networks	2025-2030	D3.1 D3.2 D4.1 D4.2	NEC ORA TIM GNW
Standardisation impact	N.A.	Wireless Networks	Now to 2030	D8.2	NEC ORA
IPR	NEC RIS (S-Band)	Wireless Networks	2025-2030	N.A.	NEC ORA GNW

3 Dissemination Activities

The dissemination effort of RISE-6G concerns means and methods for making the outcomes of the project known to the public. For the most part, the dissemination activities include standard academic practices: publications in journals and conferences, organising and chairing special sessions and workshops, editing special issues chairing technical committees, etc. The lists of the various communication and dissemination activities appear in 5.2.2 and Appendix II of the document.

3.1 The Dissemination Package

For the purposes of creating a cohesive dissemination strategy, the “dissemination package” has been created by joint efforts of WP8 and individual partners. This package is consisted of individual material that are purposed to be used by the individual Partners when preparing dissemination and communication material. Concretely, the package includes the following items:

1. The official RISE-6G logo has been prepared. It is presented in **Erreur ! Source du renvoi introuvable.**. By extracting the main colours appearing in the logo, the accompanying colour-palette is also shown. Those colours are utilised when preparing various communication and dissemination items.
2. A unified acknowledgement text to be added to the publications: *“This work has been supported by EU H2020 RISE-6G under grant number 101017011”.*
3. A PowerPoint template has been shared between the partners, which are encouraged to use both during internal as well as external presentations. The front cover of those slides is presented in Figure 3-2.
4. A LaTeX slide has been prepared with the acknowledgement to RISE-6G. This slide fits under the widely used “beamer” package that most academics use when preparing technical slides explaining works. The intention behind this item is to be included when individuals present papers in conferences, so that the acknowledgment to the project is still apparent but without the explicit need to use the PowerPoint template.

Figure 3-1: The RISE-6G official logo and the resulting colour palette.

Figure 3-2: The front slide of the RISE-6G PowerPoint template.

3.2 Publications

The project has submitted so far **115 publications** to conferences and journal. That number includes papers that have been officially published, are pending to appear, or awaiting decision under the peer-review process. High-impact venues are primarily targeted, ass it can be seen from Table 3-1. The full list of the project's publication is given in 5.2.2. In Figure 3-3, the number the publications have been classified according to their relevant WP(s). Inter-WP collaborations are strongly encouraged and **24 of the publications that relate to more than one WP** have emerged. The detailed numbers of inter-WP collaborations are given in Figure 3-4. In a similar manner, collaborative authorship between multiple Partners has been pursued. In fact, **34 of the submitted publications include at least two Partners** in the authors' list, **while 7 publications include at least 3**.

Apart from the large number of output papers, RISE-6G has also achieved high-visibility in its body of published works. At the time of writing, the project's publications count more than **1300 citations**, with **48** citations regarded as **"highly influential"**[1]. As a whole, the project has an **H-index**[2] of **19** and an **i10-index**[3] of **36**.

As exemplary items, the following publications are highlighted:

1. "*Wireless environment as a service enabled by reconfigurable intelligent surfaces: The RISE-6G perspective*", (reference [1]) consists the inaugural paper by the consortium which appeared in EuCNC 2021. It highlights the project's design, objectives, and technical approach.
2. In a similar manner, reference [60], "*Reconfigurable, Intelligent, and Sustainable Wireless Environments for 6G Smart Connectivity*", presents an overview of the novel concept of wireless environments as a service, pioneered by the project. This paper appeared in IEEE Communications Magazine.
3. A prototype metasurface developed by a collaboration between the Partners has been demonstrated in reference [17], "*A prototype of reconfigurable intelligent surface with continuous control of the reflection phase modeling, full-wave electromagnetic characterization, experimental validation, and application to ambient backscatter communications*".

[1] This metric is defined by scemanticscholar.org. See https://www.semanticscholar.org/faq#influential-citations.
[2] H-index of X means that exactly X of the papers have at least X citations.
[3] i10-index of X means that X papers have at least 10 citations.

4. A paper describing one of the two forthcoming field trials of the project, *"RIS-Aware Indoor Network Planning: The Rennes Railway Station Case"* (reference [32]) has appeared in ICC 2022.

Table 3-1: List of conferences and journals RISE-6G has published (or still under review)

Journal / Conference name	Number of submitted publications
Conferences	
European Conference on Networks and Communications (EuCNC) & 6G Summit	5
IEEE International Conference on Communications (ICC)	10
IEEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC)	10
European Conference on Antennas and Propagation (EuCAP)	4
IEEE Wireless Communications and Networking Conference (WCNC)	2
IEEE Global Communications Conference (GLOBECOM)	7
IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)	2
IEEE International Conference on Computer Communications (INFOCOM)	1
IEEE Vehicular Technology Conference (VTC)	1
IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM)	1
International Symposium on Modeling and Optimization in Mobile, Ad hoc, and Wireless Networks (WiOpt)	1
Journals	
IEEE Transactions on Vehicular Technology	6
IEEE Transactions on Communications	5
IEEE Transactions on Wireless Communications	6
IEEE Transactions on Antennas and Propagation	1
IEEE Transactions on Signal Processing	2
IEEE Transactions on Green Communications and Networking	1
IEEE Transactions on Information Forensics and Security	1
IEEE Wireless Communications	3
IEEE Journal of Selected Areas in Communications	5
IEEE Journal of Selected Topics in Signal Processing	2
IEEE Access	1
IEEE Open Journal of the Communications Society	6
Proceedings of the IEEE	1

IEEE Communications Surveys & Tutorials	1
IEEE Network	1
IEEE Wireless Communications Letters	8
IEEE Communications Letters	7
IEEE Communications Magazine	5
IEEE Signal Processing Magazine	1
Frontiers in Communications and Networks	2
Review of Electromagnetics	1
Intelligent and Converged Networks	1
ITU Journal on Future and Evolving Technologies	1
Unclassified (not yet under peer-review, white-papers, e-pubs)	*3*
Total	**115**

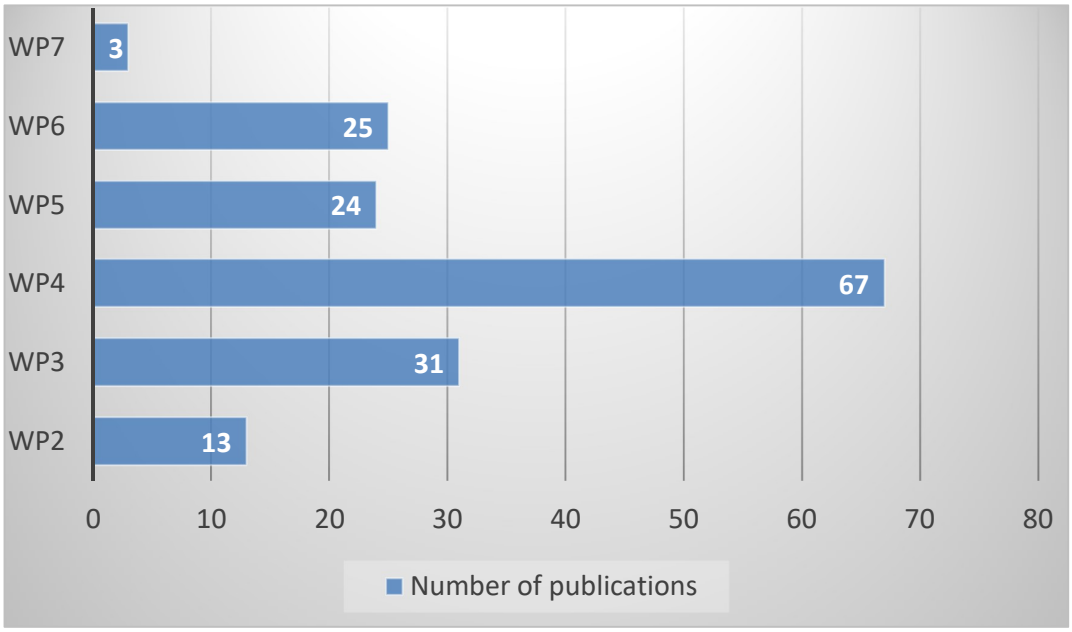

Figure 3-3: RISE-6G publications classified according to the WP(s) of relevance.

3.3 Various Dissemination Activities

There have been various further dissemination actions taken by all the partners to ensure the increased visibility of the project in the academic circles. The full list is given in Appendix II. Toward better communicating the results and ideas of the joint works conducted in the past term, 18 total talks, tutorial, presentations, and lectures were given by individuals in multiple

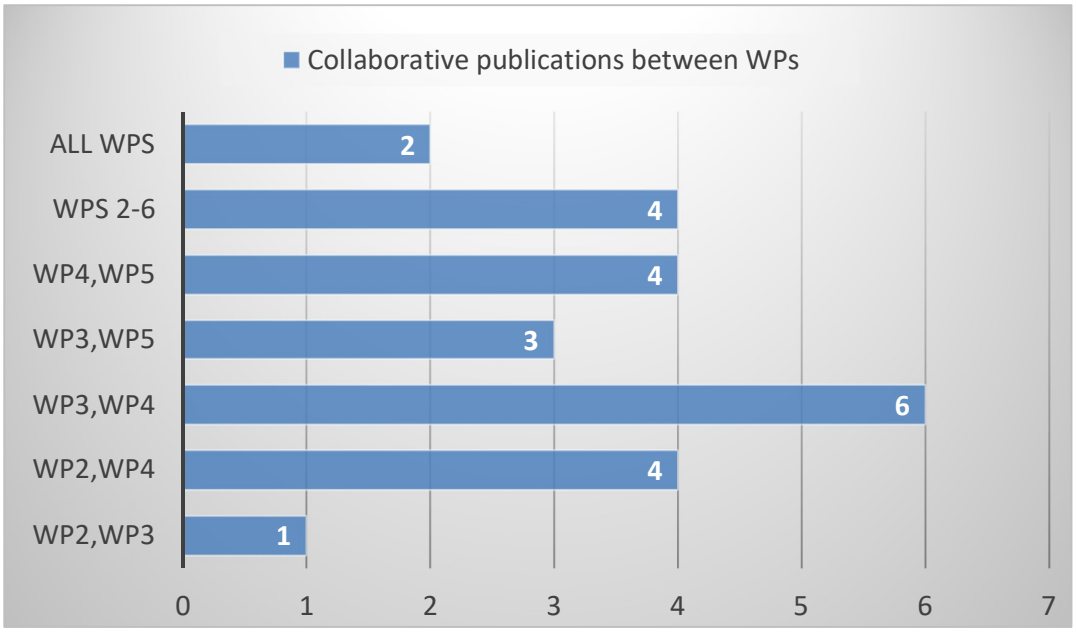

Figure 3-4: RISE-6G inter-WP collaborations in paper authorship

venues and settings. Members of RISE-6G have also featured in three panels during academic conferences. In such events, the opportunity has been taken to co-organise and co-chair 19 relevant special sessions to further enhance the outreach of the project in the community. Finally, three special issues of related topics have been edited by project members.

3.4 5GPPP Interactions

RISE-6G has contributed to 5GPPP activities so far through the following activities:

- Participation in the 5GPPP Architecture Working Group.
- Participation in the 5GPPP Test Measurement and KPI Validation Working Group.
- Co-authorship of white paper "N. Lars at al. Beyond 5G/6G KPIs and Target Values" along with ICT-52 members.

4 Communication Activities

4.1 Project Website

The website of the project has been set up at https://rise-6g.eu/. Its front page is depicted in Figure 4-1. It is designed, hosted and managed by CEA-Leti, while its content is coordinated by the partners, reviewed and updated periodically. The website consists of the primary tool of communication and promotion of the project to distribute all the information to be shared to the public. It has been designed to be the core medium through which RISE-6G while share its concepts, results, and achievements to the widest audience possible. The website contains information and description about the project and specific details about each partner. Important dissemination and communication items (e.g. newsletters, highlighted papers, events) appear there. The complete sitemap which describes the available content is presented in Figure 4-2.

At the same time, the website has been established as the project's open access repository according to the Data Management Plan. Indeed, the perpetually updated list of the publications acknowledging RISE-6G includes links to the open access versions of all the papers, as soon as those versions become available. A similar practice will be established when data and important results (e.g., from the field trials) become available through the second term of the project. The website has been **visited more than 5800 times** at the time of writing.

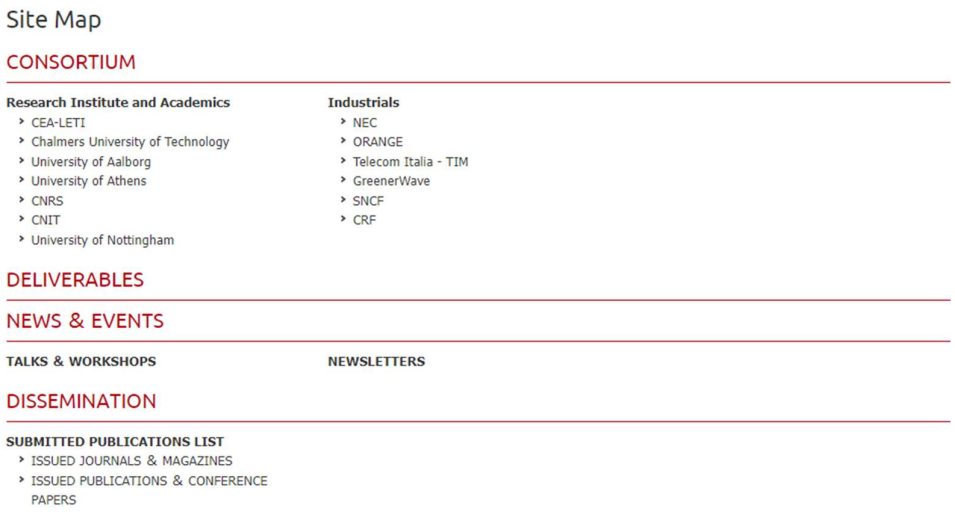

Figure 4-2: The site map of the RISE-6G website.

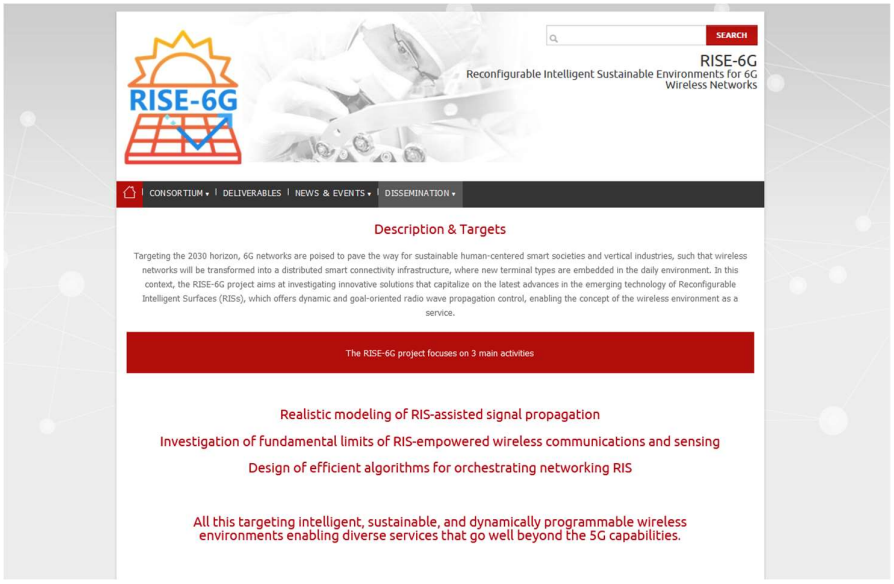

Figure 4-1: The home page of the RISE-6G website: https://rise-6g.eu/

4.2 Poster, Leaflets, and Newsletters

RISE-6G has issued the following items. They have all been shared with interested parties via the project's website, Social media accounts (the official RISE-6G LinkedIn account, as well as

personal accounts from individual Partners), emails to relevant people/institutions, and various institution-level channels (e.g. company/university-wide announcements).

Poster / Leaflet: The two-page document includes the main information about RISE-6G and contains information about its objective, structure, Partners, technical organisation, as well as familiarising the reader with the novel concepts of "Wireless environment as a service" and "Reconfigurable intelligent surfaces", which constitute the core technological focus of the consortium. The first page of the document is to act independently as the first version of the poster. Since in-person events have been limited due to the effects of the pandemic, there has been no need, as of yet, for a single-page poster. Nevertheless, a more compact version of the flyer is planned as the second version of the poster. The two pages of the leaflet are presented in Figure 4-3.

- **Newsletter**: RISE-6G has commenced its newsletter issuing. The first issue came out at the end of the first year and contains the project's overview, the concept of smart radio environments, the technical approach of RISE-6G, a dissemination overview and a listing of the Partners. The second issue (July 2022) focuses on 1st year updates from the technical work-packages and preliminary results. The following issues are planned to include similar updates as well as highlights from important advancements within the project (e.g. RIS prototypes, filed trials).

Figure 4-3: The RISE-6G leaflet.

4.3 Various Communication Actions

The ideas of RISE-6G have been communicated in a variety of ways that are expected to have a greater impact to the community. Orange Labs and TIM hosted two presentations, "The construction of 6G" and "Beyond 5G Expert Days" in 2021 referring to the project. Orange has additionally published the white paper "Orange Vision for 6G" in March 2022 with a clear sub-

section to the benefits RIS technology expected to come from the project. Furthermore, two interviews were given by members of the consortium (CNRS and NEC) in the same year in the magazines “6G World” and “ComSoc Technology News”. An important highlight was also RISE-6G’s contribution, along with other ICT-52 projects to the white paper “Beyond 5G/6G KPIs and Target Values”, published in June 2022. RISE-6G has also had a presence in EuCNC 2022 through the inclusion of a booth, organised and co-hosted by Greenerwave. An in-person presentation of the project was conducted to the Greek Sub-minister of health during her visit in the NKUA premises, regarding the emerging technology, the expected outcomes of the project, and potential benefits to the health & safety sector. The complete list of the communication and dissemination actions in given in Appendix II.

Figure 4-4: Rise-6G communication activities. Left: The Greenrwave/RISE-6G booth at EuCNC 2022. Right: In-person presentation to the Sub-minister of Health at NKUA premises.

The project has kept an active presence in the social media, in order to provide easy access to special highlighted pieces. The RISE-6G LinkedIn group counts 377 members as of the time of writing, with over 50 posts from its inception. This medium is used for sharing important announcements, lightweight content (e.g. group photos), as well as encouraging individuals that are not members of the project to participate into the wider community by allowing various relevant content to be shown. Some multimedia content has also been published, with a special highlight being the video of a demonstration of an RIS prototype from Greenerwave’s LinkedIn account. During the second half of the project RISE-6G is planning to enrich its multimedia output to include dedicated talks, presentations, interviews etc. through dedicated channels. In a similar manner, RISE-6G has initiated a Twitter account and plans for the launch of a YouTube channel with both educational (e.g. tutorials) and promotional (e.g. demos/interviews) content.

5 Standardisation Activities

RISE-6G project will address standardisation activities across relevant standards bodies and fora based on specific standard involvement of key-partners of the project. A specific focus will be on 3GPP and the European standardisation group, namely ETSI, related standards activities, as the most relevant on the definition of upcoming network generation designs. In general, standardisation activities are identified to be key to push for the novel technology, such as RIS, adopted and broadly deployed by the relevant core industrial stakeholders, such as vendors and operators. We list in Table 5-1 the standard groups where RISE-6G is expected to provide contributions while leaving additional standardisation fora for upcoming deliverables. The complete list of RISE-6G's standardisation contributions is given in Appendix III.

Table 5-1: Up-to-date impact on main standardisation bodies

Bodies or fora	Groups	RISE-6G Contribution	Partners
3GPP		3GPP will be the key-standards body for Beyond-5G and 6G system definition. This has been included in some discussion within the Release-18 workshop and will be definitely included as Study Item within the Release-19.	NEC, TIM, ORA, CEA
	SA1 SA2 SA3 SA5	Reference architecture for integrating innovative and novel services that might comprise RIS-enable networks that will impact directly on the Radio Access Networks, including BS (gNB) improvements and novel UE algorithms.	
	RAN1	Advanced localisation techniques that might require timing, synchronisation and novel signals, such as Demodulation Reference Signal (DMRS), Channel Modelling Sounding Reference Signal (SRS) and Orthogonal Time-Frequency Space (OTFS)-related modulation for RIS environments.	
	RAN2	Monitoring of 5G NR guidelines for advanced solutions that might include RIS specifications	
	RAN3	Handover mechanisms in a cell-less deployment where RISs might be in place to provide service continuity.	
ETSI	**RIS**	RIS-related interfaces and protocols. Integration with other existing ETSI ISG. **Two RISE-6G key-partners are rapporteurs of two main GRs of the ETSI RIS standard.**	NEC, NKUA, CEA, CNRS
	THz	RIS-empowered networks working at Terahertz frequencies. Potential liaison between RISE-6G and ETSI THz group.	

	NFV	NFV-MANO administrative domains, Management and connectivity of multi-site network services, Network slicing in NFV), Reconfigurable Radio Systems (RRS) (Cognitive Radio (CR), Software Reconfiguration through Radio Applications)	
	MEC	RIS-aware applications that require pre/post-processing on edge data centres (involving AI-based algorithms).	
	NTECH	Enablers and associated APIs to access network resources, such as network-based authentication, location information, content caching. Service and Network interconnection and interworking with RISs.	
	ENI	AI-based solution supporting RIS activation and operations.	
O-RAN	WG1, WG2, WG3, WG4, WG6	Open fronthaul contribution to have RIS-based deployments. **Interface between RISE-6G architecture and ORAN building blocks.**	NEC, ORA, TIM

Following the main standard bodies, the RISE-6G project has defined a clear standardisation activity roadmap to be in line with ongoing and upcoming activities. This automatically captures updates that might influence industrial choices while keeping RISE-6G output still up-to-date. RISE-6G contributes by means of each involved partner to the main discussions to disseminate project technological innovations giving more visibility to our technical achievements. An updated project timeline matching the major SDOs is depicted in **Table 5-1**.

5.1 3GPP

The 3rd Generation Partnership Project (3GPP) aims at covering cellular telecommunications technologies that will include radio access network (RAN), core network (CN) and service capabilities. This automatically provides the means for creating a complete architecture mobile telecommunication system. In general, specifications from the 3GPP standardisation group are

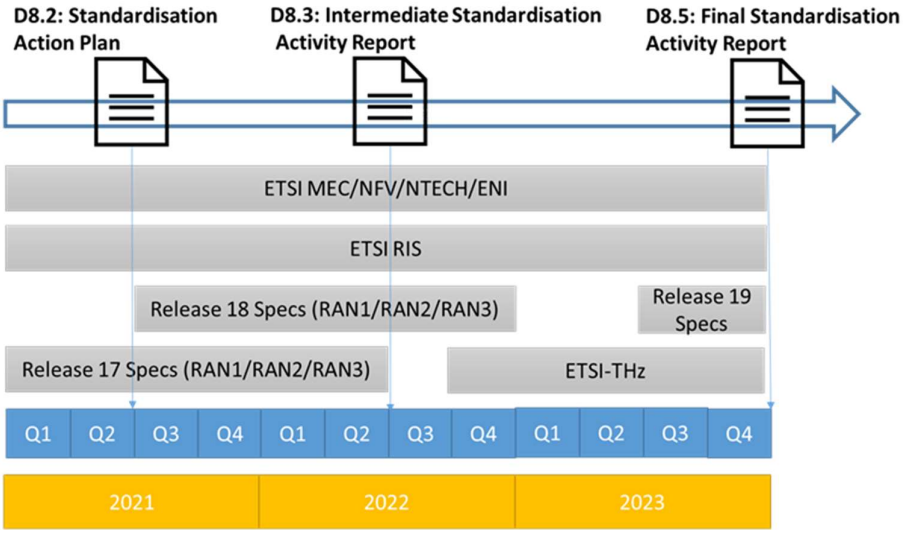

Figure 5-1: RISE-6G timeline over major SDOs.

proposed by each member company within specific Working Groups (WGs) and at the Technical Specification Group (TSG) level. We can identify three different TSGs, such as Radio Access Networks (RAN), Services & Systems Aspects (SA), Core Network & Terminals (CT) with their last release (17) of specifications ready and public within Q2 of 2021. Novel and innovative concepts to be included in 5G-and-beyond (B5G) and 6G network design will be part of the discussion for 3GPP Release 18 and upcoming Release 19.

RISE-6G project will mostly focus on contributions related to radio access network (RAN). However, future standard contributions may also include core networks-related topic to support seamless RIS integration into the existing system. Monitoring activities will be performed to be aligned with the relevant ongoing discussions.

5.1.1 RAN1, RAN2 and RAN3

3GPP has introduced the concept of Smart Repeater with its Release 18, namely Network-Controlled Repeater to evolve the classical RF repeater concept, mostly used for 2G, 3G and 4G networks. Smart Repeaters are a new type of network node able to exploit some side control information to enable a more intelligent amplify-and-forward paradigm and beamforming operations. Smart Repeaters are non-regenerative with two beamforming antennas, e.g., phased antenna arrays, oriented towards the serving gNB and the service area to be covered, respectively. The Smart Repeater can be interpreted as a specific type (more complex) of smart surface. In the RAN Release 18 workshop among the endorsed list of topics for further discussion (RWS-210659), additional RAN1/2/3 candidate topics have been discussed, including RIS (Reconfigurable Intelligent Surfaces) concept. Interestingly, 3GPP will enhance the concept of Smart Repeater within Release 19, making room for a generic concept of Reconfigurable Intelligent Surfaces (RIS).

5.2 ETSI

In Europe, ETSI is the European Telecommunication Institute, a recognized European Standards Organization that deals with telecommunications, broadcasting and other electronic communication networks and services. The standardisation work is carried out by means of different Industry Specification Groups (ISGs), which focus on specific activities and standardisation guidelines. The RISE-6G project will mostly focus on four existing ISGs, such as ETSI MEC, ETSI NFV, ETSI ENI and ETSI NTECH. A new ISG, namely **ETSI RIS**, has been launched in September 2021 with most of the RISE-6G relevant partners directly involved into the standard. Recently, a **new ISG has been approved** to focus on the **novel THz concept,** namely ETSI THz, considering the RIS concept as one of the core technologies.

5.2.1 ETSI RIS ISG

This new ISG is expected to provide an opportunity for all ETSI members to coordinate their pre-standards research efforts on RIS technology across various EU/UK collaborative projects, extended with relevant global initiatives, towards paving the way for future standardisation of the technology. The main mission of this ISG is to finally explore RIS technology and all its applications across the wide spectrum of use cases and deployments, and identify any specification needs that may be required. The scope of the ETSI RIS ISG will cover the following aspects: *i)* defining use cases, KPIs, and deployment and operational scenarios for RIS; *ii)* radio-frequency aspects including surface models, channel characterization, radiation characterization, and radiation exposure limits for RIS; *iii)* RIS-aided air-interface technologies, mechanics, and requirements; *iv)* system and network level control signaling aspects for RIS; *v)* system and network architecture framework considerations for RIS; *vi)* baseline evaluation methodology and performance analysis or RIS (link-level and system-level), *vii)* RIS microelectronics, enabling technologies, and proof-of-concepts (prototyping); *viii)* RIS verification and validation (e.g., hackathons). Many relevant partners are funding the initiative. Most of them are also part of the RISE-6G consortium, as reported in Table 5-2.

Table 5-2: Co-founding members of ETSI RIS

Organization	Country	Type	ETSI Member	ETSI Board Member
British Telecommunications plc	UK	Operator	Yes	Yes
CEA-LETI	France	Research Institute	Yes	No
CNIT	Italy	Research Institute	Yes	No
CNRS	France	Research Institute	Yes	No
IMDEA Networks	Spain	Research Institute	Yes	No
InterDigital Europe Ltd	UK	Vendor	Yes	No
National Physical Laboratory	UK	Research Institute	Yes	No
NEC Europe Ltd	Germany/UK	Vendor	Yes	Yes
UK DCMS	UK	Government	Yes	Yes

University of Oulu	Finland	Academia	Yes	No
University of Surrey	UK	Academia	Yes	No
ZTE	China	Vendor	Yes	Yes

The ETSI RIS follows the roadmap as per Figure 5-2.

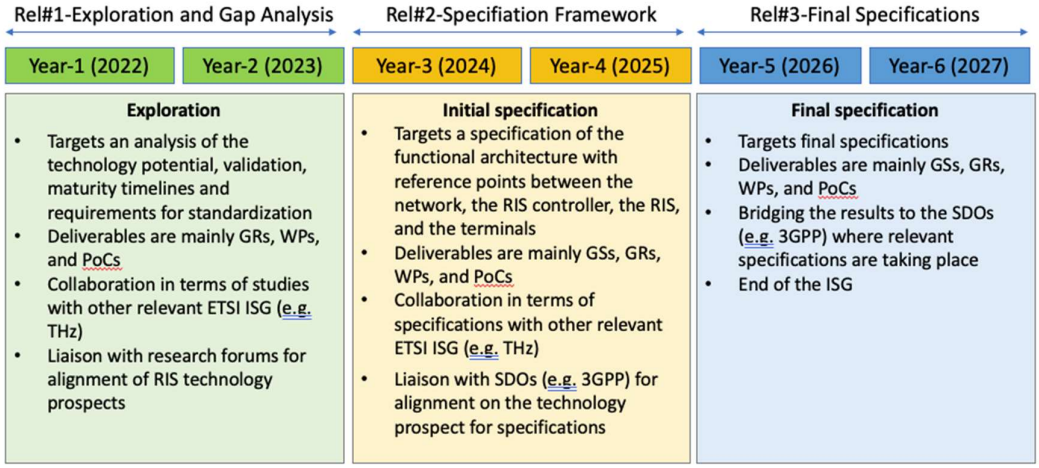

Figure 5-2: Expected ISG Roadmap

Specifically, within the first phase, an exploration and gap analysis will be carried out so as an initial specification will be defined in the next second phase. By the end of 2027 the final specifications will be released trying to make a clear link with other SDOs, such as 3GPP.

Three main ETSI Group Reports (GRs) have been approved:

- GR RIS-001, “Use Cases and Deployment Scenarios”;
- GR RIS-002: “Study on Technological challenges and Impact on networks and standards”;
- GR RIS-003: “Communication Models, Channel Models, and Evaluation Methodology”;

with expected publication early-2023. The rapporteur of ETSI GR RIS-001 and ETSI GR RIS-003 are NEC and CNRS, respectively. Some of the RISE-6G partners are monitoring and actively contributing to the ETSI RIS meetings by reflecting the main findings and intermediate results of the project (please refer to the complete list of standard contribution in the Appendix). GR RIS-001, GR RIS-002 and GR RIS-003 recently turned into the stable draft version (2.0.0).

This gives visibility to the project activities while create a reserved path to disseminate technical solutions and project results directly into the ETSI standard path. Future activities will align expected RISE-6G field-trial demonstrations with current version of ISG specifications.

5.2.2 ETSI ISG THz

Very recently, on the 6th of September 2022, this new ISG was approved, intending, similar to the previous group, to provide an opportunity for all ETSI members to coordinate their pre-standards research efforts on the THz technology and relevant channel modelling across various EU/UK collaborative projects, extended with relevant global initiatives, towards paving the way for the future standardisation of the various technological features.

The group aims at establishing the technical foundation for the development and standardisation of THz communications (0.1-10 THz). The tentative scope of the proposed ISG can be summarised as follows:

- Definition and selection of relevant use cases for THz communications;
- Mapping of selected use cases to relevant channel measurement scenarios;
- Definition of frequency bands of interest;
- Analysis of existing work in the area of THz channel measurements and modelling
- Performing of radio channel measurements and modelling, including:
  - indoor and outdoor environments, with and without mobility,
  - intra/inter device measurements and models,
  - sounding for integrated sensing and communication (ISAC),
  - sounding including reconfigurable intelligent surfaces (RISs),
  - machine learning (ML) methods to generate and analyse radio channels;
- Specification of the evaluation methodology for THz communication systems.

Among the founding members of the newly established group are member of the RISE-6G consortium:

Table 5-3: Co-founding members (not exhaustive list) of ETSI THz

Organisation	Country	Type	ETSI Member	ETSI Board Member
TUBS digital	Germany	Academia	Yes	No
CEA-LETI	France	Research Institute	Yes	No
Huawei Technologies Duesseldorf	Germany	Vendor	Yes	Yes
CNRS	France	Research Institute	Yes	No
NPL (National Physical Laboratory)	UK	Other Gov Body	Yes	No
InterDigital Europe Ltd	UK	Vendor	Yes	No
NKUA	Greece	Academia	Yes	No
NEC Europe Ltd	Germany/UK	Vendor	Yes	Yes
Keysight Tech. UK Ltd.	UK	Vendor	Yes	No
University of Oulu	Finland	Academia	Yes	No
University of Surrey	UK	Academia	Yes	No
Fraunhofer IIS	Germany	Research Institute	Yes	No

A tentative longer-term roadmap for the ISG THz is provided in Figure 5-3, with three phases of two-year duration, namely, Phase 1: Exploration, Phase 2: Initial Specifications, and Phase 3: Final Specifications.

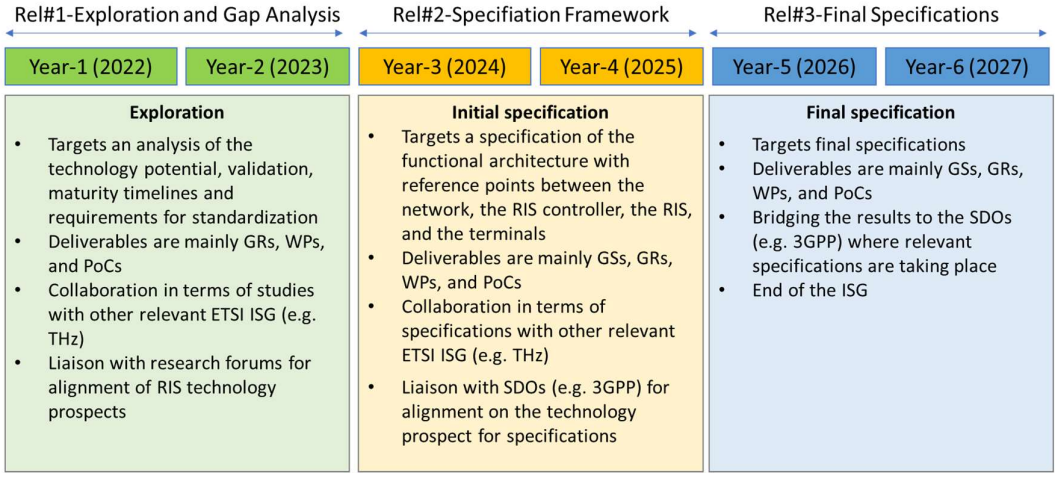

Figure 5-3: Tentative long-term roadmap of the proposed ETSI ISG THz.

6 Conclusions and outlook

In this deliverable, we have presented an initial overall exploitation plan based on the input provided by each individual industrial partner. In addition, we have presented the main achievements of the communication and dissemination activities within the first 18 months of the project. Finally, we have posed the attention on the standardisation track showing how RISE-6G partners have actively contributed to the main standardisation fora bringing the intermediate project findings and results.

Appendix I. List of submitted, accepted, and published publications from RISE-6G

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Appendix II. List of dissemination and communication activities

A. Presentations / Talks / Lectures / Tutorials

1. Emilio Calvanese Strinati; Vincenzo Sciancalepore; George C. Alexandropoulos, "The RISE-6G Project: Wireless Environment as a Service Enabled by Reconfigurable Intelligent Surfaces", Hexa-X - The European 6G Initiative workshop, 2021 Joint EuCNC & 6G Summit (virtual), 9, June 2021.
2. Marco Di Renzo, "Reconfigurable Intelligent Surfaces - Where Wireless, Electromagnetics, and Metamaterials Meet", 42nd EUROMETA School – Future Wireless Systems enabled by advanced and Intelligent Metasurfaces, 8-12 March, 2021 (virtual).
3. Gabriele Gradoni, "Reconfigurable Intelligent Surfaces - a wave chaos approach for modelling smart radio environments", 42nd EUROMETA School – Future Wireless Systems enabled by advanced and Intelligent Metasurfaces, 8-12 March, 2021 (virtual).
4. George C. Alexandropoulos, "Simultaneous Reflecting and Sensing Metasurfaces for 6G Wireless Communications", Recent Progress in Antennas and Metasurfaces for 6G, Special Session, 2021 Joint EuCNC & 6G Summit (virtual), 9, June 2021.
5. B. Denis, "Localization and Sensing Through Reconfigurable Intelligent Surfaces: Benefits and Challenges", Leti Innovation Days 2021 (LIDs'21), Wireless Communications Workshop, Virtual Event, 22-23 June 2021.
6. R. D'Errico, A. Clemente, and J. B. Doré, "Millimiterwave antennas system for 5G/6G: from radio channel modelling to field trials," Scientific Workshop on Integration Challenges for mm-Wave Phased Arrays, 15th European Conference on Antennas and Propagation, EuCAP 2021.
7. OFCOM Report on "Future of Reflective Surfaces in Wireless Communication," in preparation (Gabriele Gradoni, Anas Al Rawi, Simon Burley).
8. Gabriele Gradoni, invited presentation on "RIS design via quantum annealing" at the CNRS ISIS meeting on reconfigurable intelligent surfaces for wireless communications, 2021.
9. Julien Mascolo, Davide Masera (CRF), Internal meetings (physical, remote) with Stellantis staff from technical departments (Supply Chain Management, Manufacturing Engineering) and plants (Mirafiori, Russelsheim).
10. Q. Jian Lim, C. Ross, G. Gradoni, Z. Peng, "Quantum-Assisted Combinatorial Optimization of Reconfigurable Intelligent Surfaces.", 16th European Conference on Antennas and Propagation (EuCAP 2022), Madrid, Spain, 27 March – 1 April 2022. [*Best Electromagnetics Paper Award*]
11. D.-T. Phan Huy "Electro-Magnetic Field Exposure Aware Radio Design Thanks to Backscattering and Reconfigurable Intelligent Surfaces" Meeting of GdR ISIS (gdr-isis.fr) on "Reconfigurable Intelligent Surfaces for Programmable Wireless Environments", 25th May 2021.
12. Tutorial "T1: Reconfigurable Intelligent Surfaces for Future Wireless Communications" (1 day) Organiser: Alessio Zappone, Marco Di Renzo, Dinh-Thuy Phan-Huy, Merouane Debbah. EUSIPCO 2021, 23-27 August 2021.
13. Vincenzo Sciancalepore, "RISE-6G: Reconfigurable, intelligent, and sustainable wireless environments for 6G smart connectivity", ICT-52 Workshop on 6G, 3 February 2022.
14. George C. Alexandropoulos, Invited talk at the 1st Open Annual Workshop on Future ICT in Athens, Greece on 25 May 2022 with title: Programmable radio propagation environments: The RISE-6G perspective. The talk was part of the 5G/6G future ICT area.

15. George C. Alexandropoulos, Henk Wymeersch, “Reconfigurable Intelligent Surfaces: Localization and Communication Convergence”, 2021 Joint EuCNC & 6G Summit (virtual), 9 June 2021.
16. George C. Alexandropoulos; Lingyang Song; Henk Wymeersch; Zhu Han; Boya Di; Hongliang Zhang, “ Reconfigurable Intelligent Surfaces for 6G: Communications, Localization, and Sensing”, 2021 IEEE Globecom.
17. George C. Alexandropoulos, K. Keykhosravi , Tutorial at the IEEE Sensor Array and Multichannel Signal Processing Workshop, Trondheim, Norway on 20 June 2022 with title: Leveraging smart wireless environments for beyond 5G localization and sensing.
18. George C. Alexandropoulos, Research seminar on 9 May 2022 with title: Reconfigurable intelligent surfaces for 6G wireless communications, localization, and sensing. The seminar was organized by PAINLESS, the H2020 Marie Sklodowska-Curie Innovative Training Network with grant number 812991, in the framework of School 4.

B. Panels and Booths

1. Emilio Calvanese Strinati, “Full Duplex: Technologies, Standards, and Roadmap, IEEE Wireless Communications and Networking Conference”, Nanjing, 30 March, 2021.
2. Vincenzo Sciancalepore, “Reconfigurable Intelligent Surfaces (RIS) for B5G Wireless Communications”, Nanjing, 1 April, 2021.
3. RISE-6G Booth (hosted by Greenerwave) at EuCNC & 6G Summit Grenoble, France, 7–10, June 2022.

C. Special Session Organization/Chairing

1. George C. Alexandropoulos and Emilio Calvanese Strinati, “Wireless Communications Empowered by Reconfigurable Intelligent Surfaces”, IEEE SPAWC, 27-20 September 2021.
2. George C. Alexandropoulos (co-chair), “Machine Learning Driven Wireless Networking”, BalkanCom, 15-17 September 2021.
3. Emilio Calvanese Strinati and Benoît Denis (co-chairs), “RIS-empowered Communications and Localization for Smart Radio Environments”, 2021 Joint EuCNC & 6G Summit (virtual), 11 June 2021.
4. George C. Alexandropoulos, Tutorial Co-Chair for 2022 Joint EuCNC & 6G Summit, Grenoble, France, 7–10, June 2022.
5. P. Di Lorenzo and E. Calvanese Strinati (organizers), “Machine learning in Beyond 5G Networks”, IEEE International Conference on Acoustics, Speech, & Signal Processing (ICASSP), Singapore, 2022.
6. A. Clemente and R. Sauleau (organizers), “Space-fed antenna systems for SATCOM and high-performance communication systems”, 15th European Conference on Antennas and Propagation, EuCAP 2022. *(planned)*
7. Gabriele Gradoni co-organizer and Convener of 3 special sessions: “Near field coupling in wireless communications,” “Reconfigurable Intelligent Surfaces for Wireless Communication and Sensing,” “Wave modelling of novel wireless systems,” at the XXXIV General Assembly and Scientific Symposium (GASS) of International Union of Radio Science (URSI), 28 August – 4 September, 2021 – Sapienza Faculty of Engineering, Rome, Italy (online).

8. Gabriele Gradoni convened a session on “Material Intelligence for Next Generation Wireless Systems” at 2021 IEEE AP-S Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, held online on 4-10 December 2021, (originally planned at Marina Bay Sands, Singapore).
9. Gabriele Gradoni, Ari Sihvola, Sana Salous, “Wave modelling of novel wireless systems”, General Assembly and Scientific Symposium of the International Union of Radio Science, 28 August – 4 September 2021.
10. Andrea Michel, Gabriele Gradoni, Paolo Nepa, “Near-field coupling in wireless applications”, General Assembly and Scientific Symposium of the International Union of Radio Science, 28 August – 4 September 2021.
11. Philipp del Hougne, Gabriele Gradoni, “Reconfigurable Intelligent Surfaces for Wireless Communication and Sensing”, General Assembly and Scientific Symposium of the International Union of Radio Science, 28 August – 4 September 2021.
12. Philipp del Hougne, Gabriele Gradoni, “Reconfigurable Intelligent Surfaces”, Atlantic conference of Radio Science (AT-RASC), 29 May – 3 June 2022.
13. Steve Anlage, Gabriele Gradoni, “Wave Chaos of Complex Systems”, Atlantic conference of Radio Science (AT-RASC), 29 May – 3 June 2022.
14. George C. Alexandropoulos and N. Schlezinger, “Machine Learning for Emerging Wireless Communications Technologies”, special session in the framework of the IEEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC), Oulu, Finland, 4–6 July 2022.
15. George C. Alexandropoulos and E. Calvanese Strinati (Co-organizers), “Signal Processing for Wireless Communications Empowered by Reconfigurable Intelligent Surfaces”, special session in the framework of the IEEE SPAWC, Oulu, Finland, 4–6 July 2022.
16. Emilio Calvanese Strinati, Technical Program Chairing, at EuCNC & 6G Summit Grenoble, France, 7–10, June 2022.
17. Gabriele Gradoni (co-organizer), “Near-field coupling in Wireless Communications”, special session at URSI AT-AP RASC 2022, Gran Canaria (Spain) on May 29 - June 3, 2022.
18. Gabriele Gradoni (co-organizer), “Reconfigurable Intelligent Surfaces: Modelling and applications”, special session at URSI AT-AP RASC 2022, Gran Canaria (Spain) on May 29 - June 3, 2022.
19. Gabriele Gradoni (co-organizer), “Wave Chaos of Complex Systems”, special session at URSI AT-AP RASC 2022, Gran Canaria (Spain) on May 29 - June 3, 2022.

D. Special Issues Editing

1. Gabriele Gradoni (Guest Editor), Valter Mariani Primiani (Guest Editor), “EMC Analysis in Wireless Communication”, MDPI Electronics.
2. George C. Alexandropoulos (Guest Editor), "Intelligent Surfaces for 6G Cellular Networks: A Holistic View", MDPI Applied Sciences.
3. Guest Editor (NKUA) to special issue "Antennas and Propagation for 6G Wireless Communications", Int. J. Antennas Prop.
4. Beyond Shannon Communications: a paradigm shift to catalyze 6G JSAC journal (CEA Leti)

5. Special issue at Eurasip Journal on wireless communications and networking (CEA Leti).

E. Public Events / Interviews / News Articles / White Papers

1. "The Construction of 6G", Keynote talk by Eric Hardouin, Orange Labs Research Exhibition 2021, 23-25 March 2021. – Quoted RISE-6G.
2. Marco Di Renzo (interviewed), "RISE-6G Turns to Sustainable Side of Reconfigurable Intelligent Surfaces", 6gworld.com, 9 March 2021.
3. Vincenzo Sciancalepore, "The "O" on Radio Access Networks", ComSoc Technology News, 10 December 2021.
4. Orange, White Paper, "Orange Vision for 6G", March 2022.
5. RISE-6G contributed together with other ICT-52 projects to the White Paper "Beyond 5G/6G KPIs and Target Values", June 2022.
6. In-person presentation of RISE-6G to the Greek Subminister of Health, during her visit to NKUA premises, June 2022.
7. Presentation (TIM) at "Beyond 5G Expert Days 2021 by Rohde & Schwarz".

F. Multimedia

1. Public website at: https://rise-6g.eu/
2. RISE-6G LinkedIn group (/groups/12492572/)
3. Video demonstrating data transfer in non-LOS scenario, by Greenerwave's LinkedIn account.
4. Newsletter (issues #1 and #2 released)
5. Leaflet / flyer

G. Summer Schools

1. "Complex networks and telecommunications - 2nd edition: Towards 6G", Lake Como School of Advanced Studies, 5-9 July 2021, Organised by CEA-Leti.

Appendix III. List of contributions to Standards

1. RIS(22)005014r1 "TP to GR03 on Models of Unit-Cell for various examples of hardware implementations of RIS" Orange, CEA-LETI, ETSI ISG RIS M#05, June 2022
2. RIS(22)004009r4 "Text Proposal to GR#03 Section 8" Orange ; VIVO TECH GmbH ; University of Athens, ETSI ISG RIS M#04, April 2022
3. RIS(22)TM03016r2 "Text Proposal to GR#03 on 1) Unwanted reradiation definition, and 2) Modelling CSI mismatch due to unwanted reradiation" Orange ; University of Athens ; UNIPI; VIVO, ETSI ISG RIS TM#03, March 2022.
4. RIS(22)TM02016 "TP to DGR/RIS-003 Unwanted Re-radiations models" ORANGE SA, ETSI ISG RIS TM#02, Feb 2022
5. RIS(22)TM02007 "TP to DGR/RIS-002 Inter-operator interference measurement and feedback" ORANGE SA, ETSI ISG RIS TM#02, Feb 2022
6. RIS(22)TM02012 "TP to DGR/RIS-001 bandwidth of influence" ORANGE SA, ETSI ISG RIS TM#02, Feb. 2022.
7. RIS(22)TM02011 "TP to DGR/RIS-001 Use Case of Optimisation under EMF exposure constrains" ORANGE SA, ETSI ISG RIS TM#02, Feb. 2022.
8. RIS(21)TM01007 "Use cases and deployment scenarios for RIS" ORANGE SA, ETSI ISG RIS M#01, Nov 2021
9. RIS(21)TM01008 "RIS Communication Models, Channel Models, and Evaluation Methodology" ORANGE SA, ETSI ISG RIS M#01, Nov 2021
10. RIS(21)TM01009 "RIS Technological Challenges, Architecture and Impact on Standardisation" ORANGE SA, ETSI ISG RIS M#01, Nov 2021
11. DGR/RIS-001 v1.0.1, revision by NEC
12. DGR/RIS-001 v1.0.2, revision by NEC
13. DGR/RIS-001 v1.0.3, revision by NEC
14. DGR/RIS-001 v1.0.4, revision by NEC
15. DGR/RIS-001 v1.0.5, revision by NEC
16. DGR/RIS-001 v1.0.6, revision by NEC
17. RIS(22)TM02004 “Preliminaries on DGR/RIS-001 (GR)“, NEC, ETSI RIS TM#02,
18. RIS(22)TM03013 “TP to DGR/RIS-001 on active and passive RISs”, NEC, ETSI RIS TM03,
19. RIS(22)TM03014 “TP to DGR 001 on RIS Modes”, NEC, ETSI RIS TM03,
20. RIS(22)004011, ”hardware_design_RIS_001”, NEC, ETSI RIS#04,
21. RIS(22)006021DGR/RIS-003 v008 working draft
22. RIS(22)006015Reconfigurable Intelligent Surfaces (RIS) – Communication Models, Channel Models, and Evaluation Methodology – Contribution to Section 7.6 and to Section 7.8.2
23. RIS(22)006014 Reconfigurable Intelligent Surfaces (RIS) – Communication Models, Channel Models, and Evaluation Methodology – Contribution to Section 6.1
24. RIS(22)003006WI#3: Proposed Structure and Content
25. 3GPP RAN Rel-18 Workshop, “RWS-210465 Support of Reconfigurable Intelligent Surface for 5G Advanced”, ZTE, Sanechips, China Unicom, NEC, August 2021.

26. DGR/RIS-001 v2.0.0 stable draft, revision by NEC
27. RIS(22)006034 “TP DGR RIS-003 on Scenarios of Interest”, KNUA.
28. RIS(22)006036 “TP DGR RIS-003 on channel estimation”, NKUA.
29. RIS(22)006038 “TP DGR RIS-003 on Methods for unstructured channel models”, NKUA.
30. RIS(22)006038 “TP DGR RIS-003 on Methods for unstructured channel models”.