

# The RESTART project: RESearch and innovation on future Telecommunications systems and networks, to make Italy more “smART”

Cristina E. Costa<sup>1</sup>, Antonella Bogon<sup>1</sup>, Ilenia Tinnirello<sup>2</sup>, Guido Maier<sup>3</sup>, Giacomo Verticale<sup>3</sup>, Raffaele Bolla<sup>4</sup>

<sup>1</sup>CNIT - Consorzio Nazionale Interuniversitario per le Telecomunicazioni,

<sup>2</sup>Università degli Studi di Palermo, <sup>3</sup>Politecnico di Milano, <sup>4</sup> Università di Genova

**Abstract.** RESTART is an extended partnership program kicked-off on January 2023, funded by the European Union – NextGenerationEU. This comprehensive program targets at aggregating, and integrating the efforts of the main stakeholders of the Italian Telecommunications sector, in various specific research projects positioned in an overall framework providing a long-term vision, transversal and supporting actions, and adequate enablers. The cooperation between universities, research centres, companies, and public administrations, shall overcome the current fragmentation of research and development through actions of coordination and synergy between projects. To achieve concrete and measurable results, all phases, from ideas and research (with low TRL) to technological innovation and services (with attention to possible opening with high TRL) are addressed, as well as the birth and growth of companies, transforming research results into practical innovation and value creation for the Italian telecommunications ecosystem. We expect RESTART to produce long-lasting and sustainable results beyond the duration of the program

**Keywords.** Telecommunications, NextGenerationEU, Technological enablers, Innovation, Sustainability

## Introduction

We are entering in the Post-Information Society, fueled by a plethora of various emerging smart technologies enormously enhanced by a never seen before communication capability. Innovative applications and services are flourishing in the most diverse sectors (agriculture, commerce, energy, finance, manufacturing/industry, media, health, safety/security, transportation), changing relationships and distributing intelligence. In this scenario, the telecommunications infrastructure is already playing a fundamental role in interconnecting the human, the digital, and the physical worlds, and setting the premises for becoming in the future, even more than today, a fundamental Critical Infrastructure (CI) of our modern societies, since communication is now the fabric of our societies.

To cope with the increasing demands of the Post-Information Society, future infrastructure shall target not only performance improvement of key indicators, such as service availability, energy efficiency, data rates, etc., but also new societal key values indicators (KVI) such as trustworthiness, inclusiveness, and sustainability addressing human and

societal needs (6G IA). To effectively design this future critical infrastructure, new approaches and paradigms are needed from academia and industry, leveraging on synergy and multidisciplinary.

In this context, RESTART is conceived as a comprehensive program, targeting at aggregating, and integrating the efforts of the main stakeholders of the Italian Telecommunications sector (Fig. 1), in various specific research projects positioned in an overall framework that provides a long-term vision, transversal and supporting actions and adequate tools and enablers (Restart).

<b>Università di Roma, Tor Vergata</b>
<b>Politecnico di Bari</b>
<b>Politecnico di Milano</b>
<b>Politecnico di Torino</b>
<b>Università degli Studi di Catania</b>
Università degli Studi di Firenze
<b>Alma Mater Studiorum – Università di Bologna</b>
<b>Università degli Studi di Napoli "Federico II"</b>
Università degli Studi di Padova
Scuola Superiore Sant'Anna
Università degli Studi Mediterranea di Reggio Calabria
Università degli Studi di Roma "La Sapienza"
Consorzio Nazionale Interuniver. per le TLC
<b>Consiglio Nazionale delle Ricerche</b>
Fondazione Ugo Bordoni
Open Fiber S.p.A.
Prysmian S.p.A.
Athonet S.R.L.
Tiesse S.p.A.
Wind Tre S.p.A.
Vodafone Italia S.p.A.
Tim Italia S.p.A.
Italtel S.p.A.
Ericsson Telecomunicazioni S.p.A.
Leonardo S.p.A.

Fig. 1  
List of current RESTART partners. The color identifies the type, i.e. universities, national research organizations and private organizations. Partners which are also Spoke coordinator are in bold

The strength of this program is the cooperation between universities, research centres, companies and public administrations, that will allow overcoming the current fragmentation of research and development through actions of coordination and synergy between project initiatives. To achieve concrete and measurable results, a specific effort has been put in identifying actions that cover all phases from ideas and research (with low TRL) to technological innovation and services (with attention to possible opening with high TRL), and then to the birth and growth of companies, transforming research results into practical innovation with higher TRL and value creation for the Italian telecommunications ecosystem. The final goal will be being able to produce long-lasting and sustainable results

beyond the duration of the program.

Besides its research and innovation goals, RESTART has as third pillar also social responsibility and education goals, for contributing to society grand challenges related to climate change, circular economy and smart infrastructures, as well as training a new generation of researchers and innovators able to bring the future of telecommunications on their shoulders.

Research projects in RESTART are of two types: (1) structural projects which define the program, they are the backbone of the partnership and give a structure to the overall research work, focusing on the cooperation of a significant number of partners, and integrating the results of a rather large research area. And (2) focused projects which are smaller endeavors, with fewer researchers and partners, aimed at completing the structural projects in specific directions. Focused projects can be of various nature: industrial, targeting specific requirements and needs coming from industrial partners or targeting a definite application scenario; theoretical focusing on long-term research frontiers of special interest; or blue-sky research, not necessarily referred to one or more structural projects.

## 1. Research Infrastructures role in RESTART

The RESTART program, is designed around 7 missions, that complement the Research Mission (Fig. 2).



Fig. 2

General scheme of the RESTART program, displaying all the project missions

One of the objectives of RESTART is to boost up the current Italian Research Infrastructure for the Telecommunications by enlarging the existing laboratories and creating new, shared, ones: the whole Mission 2 is dedicated to “Laboratories, Proofs of Concept and Demonstrators”.

Creating a solid Telecommunications Research Infrastructure (RI) is a key action for long-term impact of the program beyond the projects’ lifespan. The RI in RESTART supports the effectiveness of the research and training missions, and also works towards the consolidation of collaborations. The final ambition is the creation of an Italian ecosystem of telecommunications laboratories and testing facilities where industrial and academic

research can have a shared playground able to stimulate fruitful collaboration and cross-fertilization at different TRLs.

The strategy for achieving this goal includes: i) setting up shared experimental labs and testing platforms tailored to the specific domains; ii) expanding and extending existing laboratories and developing open testbeds at the partners' premises; iii) establishing access rules of both academic and industrial labs that ensure collaboration in the shared facilities; iv) planning for medium-and long-term consolidation and extension of the experimental instruments with other funding sources; v) enhancing in particular the experimental facilities located in the South of Italy.

All resources will be consolidated according to the needs of research institutions and companies to cope with the new technologies, including new higher frequency bands for future wireless network deployments. In addition, new platforms oriented to application scenarios and domain specific networks will be created for research and innovation activities in new emerging research fields such as fully immersive communications, secure communications, convergence of sensors and communications, connectivity in challenging environments, artificial intelligence applications, and others.

All the mentioned infrastructures and laboratories will be exploited for carrying out the proofs of the concept proposed in RESTART.

## **2. The role of RIs in the evolution of Networking technologies for a Future sustainable and inclusive society**

Net4Future is one of the RESTART's Structural projects, and it has the specific ambition of putting in first place society-pull requirements for future digital services (Hexa) by identifying technological enablers and innovation potential. Inclusiveness (to connect the unconnected) and sustainability (to contribute to sustainable utilization of natural resources in different sectors), trustworthiness (to control technology at different user/operator/provider levels), innovative regulation policies (including pricing regulation, competition regulation, privacy and data protection, online dispute resolutions) are the four essential directions to be considered while designing future telecommunications critical infrastructure. Net4Future makes a synthesis of all the relevant outputs of the 18 projects of the RESTART program and offers an experimental toolbox for validating innovative services.

In this context Research infrastructure plays the role of providing tools for validating solutions for future networks, building an end-to-end experimental testbed of future digital services, integrating heterogeneous technology enablers and components, and monitoring performance indicators. Net4Future supports the research in the domain of future Internet networks and beyond-5G (B5G) systems to demonstrate trade-offs across topics investigated in other projects (energy vs AI/ML vs efficiency vs usability). The objective also deals with monitoring solutions and the creation of data repositories.

## **3. From national to international**

In an effort to expand the approach to an International EU level, RESTART RIs closely col-

laborate with the ESFRI Scientific Large-scale Infrastructure for Computing/Communication Experimental Studies (SLICES), a distributed flexible Digital Infrastructure designed to support large-scale, experimental research focused on networking protocols, radio technologies, services, data collection, parallel and distributed computing and in particular cloud and edge-based computing architectures and services (ESFRI). The participation of two RESTART partners, CNIT and CNR, with their distributed facilities to both the projects, assures the capability and potential to have an impact beyond the national stage.

## Acknowledgement

This work was partially supported by the European Union under the Italian National Recovery and Resilience Plan (NRRP) of NextGenerationEU, partnership on “Telecommunications of the Future” (PE00000001 - program “RESTART”).

## References

6G IA, (2022) Vision and Societal Challenges WG, Societal Needs and Value Creation Sub-Group. “What societal values will 6G address? Societal Key Values and Key Value Indicators analysed through 6G use cases,” White Paper

Hexa-X D1.2 “Expanded 6G vision, use cases and societal values”, <https://hexa-x.eu/deliverables/> (accessed 12/04/2022)

ESFRI SLICES Web Sites <https://slices-sc.eu/>

Restart Web Site <https://www.fondazione-restart.it/>

## Authors



Cristina E. Costa [cristina.costa@ieee.org](mailto:cristina.costa@ieee.org)

Cristina E. Costa is a Senior Researcher at the National Laboratory on Smart and Secure Networks at CNIT, the National, Inter-University Consortium for Telecommunications. She gained experience in the fields of wireless and mobile networks, multimedia communications, interfaces and interaction, 5G, and edge computing working in various research centers (CSELT, CREATE-NET, FBK). She was involved in several research projects both at the national and international level and served in the organizing committees of various conferences, as European Wireless, Intetain, UCMedia, and SecureComm. She is a founding member and past secretary of the IEEE Women In Engineering AG Italy Section.

Antonella Bogoni [antonella.bogoni@cnit.it](mailto:antonella.bogoni@cnit.it)

Antonella Bogoni, full Professor at Sant’Anna School, is one of the pioneers of the Integrated Research Center for Photonic Networks and Technologies created in Pisa in 2001 by Sant’Anna School and CNIT where currently she is director of the National Laboratory on Photonic Networks and Technologies-PNTLab and leader of the “digital & microwave photonics” area. Antonella Bogoni dedicated her research activity to photonics technologies for optical communication and sensing.





**Ilenia Tinnirello** [ilenia.tinnirello@unipa.it](mailto:ilenia.tinnirello@unipa.it)

Ilenia Tinnirello is a Full Professor of Telecommunications at the Department of Engineering of the University of Palermo. Her main research interests are focused on emerging technologies for mobile radio networks, and in particular on low-power long-range technologies, programmable cellular networks and wireless testbeds. She is currently a member of the Board of Directors of the National Interuniversity Telecommunications Consortium (CNIT) and the scientific coordinator of the European Digital Innovation Hub called i-NEST. Within the RESTART program, she is the PI of the Net4Future structural project.

**Guido Maier** [guido.maier@polimi.it](mailto:guido.maier@polimi.it)

Guido Maier received his Laurea (1995) and his Ph.D. degree (2000) at Politecnico di Milano (Italy). Until 2006 he has been with CoreCom (research consortium supported by Pirelli in Milan, Italy). On 2006 he joined the Politecnico di Milano as Assistant Professor. In 2015 he became Associate Professor. He is author of more than 200 papers (h-index 28) and 6 patents. He is PI of the RESTART Focused Project WatchEDGE. He is a Senior Member of the IEEE Communications Society.



**Giacomo Verticale** [giacomo.verticale@polimi.it](mailto:giacomo.verticale@polimi.it)

Giacomo Verticale received the Ph.D. degree in telecommunications engineering from the Politecnico di Milano, Italy, in 2003. He is currently an Associate Professor at the Politecnico di Milano. He was involved in several research projects on fixed and wireless broadband access technologies and promoting the smart grid. His current interests focus on the security issues of the smart grid, on network function virtualization, and on edge computing in 5G. He is PI of the RESTART Focused Project LEGGERO.

**Raffaele Bolla** [raffaele.bolla@unige.it](mailto:raffaele.bolla@unige.it)

Raffaele Bolla is a Full Professor of Telecommunications Networks at the Department of Naval, Electrical, Electronic, and Telecommunications Engineering (DITEN) of the University of Genoa. He is currently Vice-President and a member of the Board of Directors of the National Interuniversity Telecommunications Consortium (CNIT), and he is the Director of the Smart and Secure Networks (S2N) CNIT National Laboratory. He has been and is responsible-Principal Investigator for many research projects, primarily in the EU contest. He is also active in standardization, mainly in ETSI and ITU-T. Currently, he is responsible for CNIT's participation in the national project RESTART

