



ISLANDS

Integrated Sensing and communications for future vehicuLAr systems - a Network of Doctoral Students

Consortium Booklet

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About ISLANDS project

Introduction

While deployment of fifth-generation (5G) wireless networks is progressing in many parts of the world, and 3GPP is working on advanced 5G New Radio (NR) releases, forward-looking research has started to focus on the design of the next generation (6G) of wireless networks, both in industry and in academia. Focusing on radio access technologies, 6G wireless networks will be based on the evolution of some key 5G technologies, – such as, to name a few, massive MIMO, the use of high carrier frequencies (in the millimeter and TeraHertz bands), the use of air interface solutions based on artificial intelligence (AI), – and on brand new technologies, such as reconfigurable intelligent surfaces, holographic communications, and integrated sensing and communications (ISAC). Of these, ISAC, also named "joint communication and sensing" (JC&S) or "dual-function radar-communication" (DFRC), is one of the most striking and promising.

ISAC a new paradigm aiming at integrating the sensing functionality into wireless networks

One of the areas that will be strongly impacted and will benefit the most from the development of ISAC in future 6G networks is by no doubt the **automotive sector**. Indeed, moving people and goods is one of the fundamental needs of our modernized and global society, and we aspire that in the near future mobility will be more sustainable, more automated, more secure and more efficient than ever. These objectives can be reached by fully exploiting information technologies and in particular the potential of wireless networks. 5G wireless networks have been the first to have tried to provide extensive support for connected and automated mobility. As an example, the 5G advanced physical layer solutions, including new numerology and new channel codes to support low latency communications, network slicing and the localization capability, represent a first initial step towards the support of vehicle-to-everything (V2X) communications and Tele-operated Driving (ToD). However, the technological advancement brought by 5G for connected and automated mobility (CAM) services are unanimously considered not enough. Further progress is expected for forthcoming 6G systems. The unique capabilities brought by ISAC such as sensing-assisted communications and communication-assisted sensing, provide an unprecedented tool for the development and deployment of CAM services in terms of reliability, safety, localization accuracy and responsiveness.

How ISAC will revolutionize the wireless and connected/automated mobility landscape

In the following, we list the key ISAC features that hold the potential to revolutionize the wireless communications landscape in general, and CAM services in particular:

- 1. **Increased hardware, spectrum and energy efficiency**. Resource pooling is a well-known way to increase efficiency and achieve a better use of available resources. Performing both the sensing and communication tasks by sharing significant portions of the transceiver hardware (antennas, RF chains, DSPs, chips, etc.), <u>ISAC is such a key resource pooling mechanism</u>. It allows to use a common power budget and spectrum, while saving hardware.
- 2. **Better communication performance by using sensing information, i.e., sensing-assisted communications.** Wireless communication relies on functions such as channel

estimation, beam alignment, beam tracking, handover management, etc. These functionalities are currently implemented through ad-hoc protocols, exploiting suitable reference data signals. An ISAC network will help strengthen the performance of such functions and ultimately improve the performance of the communication system, with better support to CAM services.

- 3. Better sensing performance by using communication data, i.e., communication-assisted sensing. In CAM services, estimating and tracking the position of a vehicle with high accuracy is a crucial task. An ISAC network can improve this task by also exploiting the communication signals transmitted by the vehicles. Moreover, communication signals transmitted by some devices may be helpful to detect and locate nearby passive objects, and to create a map of the surrounding environment.
- 4. **New use-cases and new business opportunities.** A perceptive network can offer a much larger number of services than a traditional "communication only" network. <u>All these new use-cases will naturally generate new business opportunities and the creation of new value-added services with high utility margins.</u>

Why a Doctoral Network?

In order to realize ISAC-empowered wireless networks specifically tailored to the automotive sector, innovative training is to be conceived and realized. **Developing ISAC technologies for the connected vehicle of the future is a highly inter-disciplinary effort.**

Research objectives

The above overall objective is decomposed into the following four research objectives of ISLANDS:

Research Objective 1 – Theoretical framework for ISAC in vehicular environments. Develop new mathematical techniques for theoretical ISAC in high-mobility environments and unveil fundamental trade-offs for dual function radar-communication systems.

Research Objective 2 – Algorithmic framework for ISAC in vehicular environments. Develop new communication schemes, waveforms, beamforming algorithms, Al-based solutions, resource allocation schemes, to come up with effective ISAC schemes for vehicular environments and to cope with the harsh environment caused by doubly selective fading channels.

Research Objective 3 – Developing ISAC hardware. Bring to light novel antenna systems specifically designed for ISAC tasks in vehicles. Develop novel vehicular radar transceivers equipped with the communication functionality. Contribute to the definition and development of ISAC-enabled base station transceivers.

Research Objective 4 – Developing testbeds, demos and an open-access simulator. Develop demos and over-the-air experiments to showcase ISAC functionalities in vehicular environments, from both UE and network sides. Develop a unique and comprehensive open-access system-level software simulator.

Project Partners

The objectives of ISLANDS can only be achieved by capitalizing on the complementary know-how/tools of 9 Beneficiaries and 10 Associated Partners. In the following Table the names, country and the roles are summarized. Further details on the project partners can be found on the website: https://www.islands-mscadoctoralnetwork.eu/project-partners/

Name	Short name	Role	Country
CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELECOMUNICAZIONI	CNIT	Coordinator	Italy

Description

CNIT (National Inter-University Consortium for Telecommunications) is a non-profit Consortium, bringing together 37 Italian Universities and several institutes of the National Research Council (CNR, the largest public research institution in Italy), to foster research activity in the field of telecommunications. CNIT participated in hundreds of research projects, including EU coordinated projects, ERC grants and Italian national-wide initiatives. CNIT is active in the editorial and technical boards of several major journals and conferences, and in standardization bodies (IETF, ITU, OASIS, WWRF). Several CNIT members have been evaluators/reviewers for EU projects. CNIT operates a satellite network, three national laboratories (Photonic Networks, Radar & Surveillance Systems, Multimedia Communications) and 43 Research Units, one for each participating university and participating CNR institute. CNIT will participate to the project with the Research Unit based in the University of Cassino and Southern Lazio (UNICLAM), Cassino, Italy.

Name	Short name	Role	Country
AMERIKANIKO KOLLEGIO ELLADOS, KENTRO EREVNAS	ACG-RC	Beneficiary	Greece

Description

The American College of Greece Research Center (ACG-RC), is a not-for-profit legal entity, established in Greece and operating as a Research and Innovation Center, whose purpose is to perform research and explore innovation opportunities spanning a broad range of scientific areas: natural, social, and computational sciences, technology, education and communications, as well as the liberal and fine arts. ACG-RC fosters a diverse range of research, learning and innovation-oriented activities, hosts researchers and scholars from different countries and backgrounds, participates in collaborative projects — such as research grants funded by various entities — and collaborates with an array of partners from the academic, research, industrial, non-governmental and other domains. ACG-RC hosts funded research activities (such as European Commission-funded projects) involving the faculty members of the educational divisions of The American College of Greece (ACG), as well as the members and fellows of ACG's Institutes, Centers of Excellence and other units. The American College of Greece (ACG) is the oldest and largest US accredited college or university in Europe.

Name	Short name	Role	Country
CHALMERS TEKNISKA HÖGSKOLA AB	CHAL	Beneficiary	Sweden

Description

Chalmers University of Technology was founded in 1829 and named after William Chalmers, a director of the Swedish East India Company, who set aside funds in his will to establish an "industry school for poor children", who were taught to read and write. Chalmers University of Technology now has more than 10,500 students and just under 1,900 teaching and research staff at its two Gothenburg

campuses. Chalmers University of Technology, situated in Gothenburg, Sweden, conducts research and offers education in technology, science, shipping and architecture with a sustainable future as its global vision. Chalmers is well-known for providing an effective environment for innovation and has 13 departments. Graphene Flagship, an FET Flagship initiative by the European Commission, is coordinated by Chalmers.

Name	Short name	Role	Country
TAMPEREEN KORKEAKOULUSÄÄTIÖ SR	TAU	Beneficiary	Finland

Description

Tampere University (TAU) is one of the most multidisciplinary universities in Finland. We bring together research and education in technology, health and society. The University is known for its excellence in teaching and research and it collaborates with hundreds of universities and organizations worldwide. Our community consists of 21,000 students and over 4,000 staff members from more than 80 countries. TAU is organized in seven faculties, the Faculty of Information Technology and Communication Sciences (ITC) being one of them. Within ITC faculty, Tampere Wireless is an internationally recognized research and competence center with 10 professors and some 70-80 researchers, all focusing on fundamental basic science and applied research related to different wireless systems and networks. We develop new technology, e.g., for 5G and 6G mobile cellular networks, Internet-of-Things (IoT) and Industrial Internet applications, including new algorithms, hardware, protocols and networking solutions. Our yearly external project volume is around 4 MEUR, and we actively collaborate with global industry and academia. Our education offers largest curriculum in Finland in the field of communications engineering and radio systems. We have graduated more than 600 M.Sc. (Tech.) and 100 D.Sc. (Tech.) degrees in the field, including various alumni currently in leading positions in the industry.

Name	Short name	Role	Country
ROBERT BOSCH GMBH	BOSCH	Beneficiary	Germany

Description

The Bosch Group is a leading global supplier of technology and services. It employs roughly 421,000 associates worldwide (as of December 31, 2022). The company generated sales of 88.2 billion euros in 2022. Its operations are divided into four business sectors: Mobility, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT provider, Bosch offers innovative solutions for smart homes, Industry 4.0, and connected mobility. Bosch is pursuing a vision of mobility that is sustainable, safe, and exciting. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to facilitate connected living with products and solutions that either contain artificial intelligence (AI) or have been developed or manufactured with its help. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life.

Name	Short name	Role	Country
NOKIA SOLUTIONS AND NETWORKS GMBH & CO KG	NOKIA	Beneficiary	Germany

Description

Nokia is global leader in the technologies that connect people and things, with a position of strength in subscriber data management, in edge and core routers, in mobile and optical communications.

With the state-of-the-art software, hardware, and services for any type of network, Nokia is uniquely positioned to help communication service providers, governments, and large enterprises deliver on the promise of 5G, the Cloud and the Internet of Things. Our company invented the core technologies driving every major life-stage of telecommunications over the past hundred years, including the transistor, the laser, optical fiber, and GSM cellular telephony.

Nokia's research and innovation arm, Nokia Bell Labs, creates the disruptive technologies that are shaping the way the world communicates and connects.

Name	Short name	Role	Country
WAVE UP SRL	WUP	Beneficiary	Italy

Description

Wave Up is a company based in Siena, Italy, born in 2012 as a spin-off of the University of Siena. Since its inception, Wave Up has been developing innovative electromagnetic custom solutions based on the latest Key Enabling Technologies, with major applications in the fields of Telecommunications, Defense and Space. Taking advantage of the strong background of its members, Wave Up can provide highly qualified solutions on a wide range of electromagnetic problems. The close working relationship with both European and national space agencies, as well as industries and large integrators, exposing Wave Up to cutting-edge technologies, has become the vehicle for technological innovation, and has provided a springboard permitting Wave Up to pursue its innovative ideas and to develop ad hoc analyses and design tools allowing for their effective implementation. Wave Up is one of the main actors in the development of planar antennas based on Metasurface technology. These antennas are based on the design of proper impedance boundary conditions, which are normally realized by printing electrically small patches on a grounded dielectric slab. The key features making these antennas very appealing for a large number of applications are the low profile and reduced weight, the great flexibility in polarization and beam shape control, the low power losses, the simple low-cost manufacturing. In recent years, the Company has been heavily focused on developing a new generation of low-profile beam-scanning antennas with reduced power consumption and increased efficiency that can be customized for each scenario.

Name	Short name	Role	Country
UNIVERSITY COLLEGE LONDON	UCL	Beneficiary	UK

Description

Founded in 1826 in the heart of London, UCL is London's leading multidisciplinary university, with more than 16,000 staff and 50,000 students from over 150 different countries. UCL offers world-class research facilities and boasts over 40 Nobel Prize winners amongst its alumni. UCL Engineering ranked 4th in the UK-wide research excellence framework (REF2021), with 97% of the academic staff and 100% of impact cases ranked 4*/3*. The project will be hosted in the Institute of Communications and Connected Systems (ICCS), an interdisciplinary institute aimed at next generation connectivity. UCL is committed to collaborative research in wireless communications by, for instance, leading the €4.3M 2018-2022 project PAINLESS funded by the EU, to foster training and research collaborations among EU institutes, and as a member of the industrially led WWRF forum, dedicated to addressing societal challenges through wireless communications.

Name	Short name	Role	Country
UNIVERSITÀ DEGLI STUDI DI CASSINO E DEL LAZIO MERIDIONALE	UNICLAM	Associated Partner	Italy

Description

UNICLAM is a young and dynamic public university located in Cassino, Italy. UNICLAM is a Research Unit of CNIT. It has about 400 faculty members and 10,000 students, providing B.Sc., M.Sc. and Ph.D. courses in the areas of Economics, Humanities, Laws, and Engineering. The School of Engineering of UNICLAM is a doctoral degree awarding institution and as such provides a pleasant and functional environment for performing academic research. Thanks to the English-taught M.Sc. program in Telecommunications Engineering and to the Erasmus Mundus Joint Master Degree in "Medical Imaging and Applications", the university also attracts several international students at the M.Sc. level. In the field of wireless communications, UNICLAM skills cover 3G/4G/5G cellular technologies, with emphasis on algorithmic design, signal processing for data detection and channel estimation, interference management, game-theoretic resource allocation, optimization theory, energy-efficient communications, energy-harvesting technologies, system design at mmWave frequencies, and massive MIMO systems.

Name	Short name	Role	Country
UNIVERSITÀ DEGLI STUDI DI SIENA	UNISI	Associated Partner	Italy

Description

The University of Siena is one of the oldest Universities in Europe, being funded 760 years ago. The Faculty of Engineering was founded in 1993, and the Department of Information Engineering in 1996. The scientific productivity of the Department was ranked 1st among the medium-sized Schools of Engineering in Italy in the ranking by the Ministry (CIVR – Italian Committee Evaluation of Research). In 2013, the Department has been merged with the Department of Mathematical Science to give rise to a Department of Information Engineering and mathematical Science. The new Department counts 62 professors (16 Full, 26 Associate, 20 Assistant), 21 Post Doc, 46 Ph.D. students, 9 Technicians, 10 administrative staff., for a total of 148 members. The main research areas encompass Automatic Control, Telecommunications, Computer Science, Electrical Engineering, Electromagnetism, Electronics, Mathematical Analysis, Operation Research, Bioinformatics, Mathematical Logic. DII is located in an area of about 3.000 m2, with 80 offices and 20 laboratories, the latter covering an area of about 1000 m 2. The Laboratory of Applied Electromagnetics (LEA), led by Prof. Maci, is composed by 14 researchers and 1 technician, and is one of the most active European research groups in antennas and electromagnetism, with emphasis on 1) Metasurfaces 2) Metamaterials and electromagnetic bandgap materials, 3) Numerical Methods for EM, 4) High Frequency Scattering and Diffraction; 5) Antenna Design, 6) Radio Frequency and ID and microwave sensors. In particular, UNISI has consolidated experience in the modelling and characterization of metasurfaces and metamaterials and in the design of innovative antennas and microwave devices.

Name	Short name	Role	Country
UNIVERSITY OF CYPRUS	UCY	Associated Partner	Greece

Description

The IRIDA Lab is a recently established Strategic Research unit at the Department of Electrical and Computer Engineering of UCY, conducting both basic and applied research in the broad area of wireless communication theory and its applications. The research team represents a unique blend of knowledge in the area of wireless communication theory, signal processing, and optimization theory. The research undertaken at IRIDA, deals with various types of wireless communication networks such as machine-to-machine communications, cellular networks, relaying, cognitive radio, heterogeneous networks, and wireless- powered communications. The IRIDA Lab has close and frequent collaboration with world-leading academic and industrial institutions in the area of

telecommunications in Cyprus, Europe and beyond. It has a vast experience in managing small and large-scale research projects funded by the Cyprus RIF and the EC. Currently, IRIDA is participating in eight research projects, five of which are coordinated by IRIDA, including the highly prestigious ERC Consolidator Grant "APOLLO" and the ERC Proof-of-Concept "WAVE".

Name		Short name	Role	Country	
KARLSRUHER TECHNOLOGIE	INSTITUT	FÜR	KIT	Associated Partner	Germany

Description

Karlsruhe Institute of Technology was established by the merger of the Forschungszentrum Karlsruhe GmbH and the Universität Karlsruhe (TH) on October 01, 2009. Karlsruhe Institute of Technology (KIT) is a public non-profit institution pursuing the tasks of a State University of Baden-Wuerttemberg and of a national research center of the German Helmholtz Association. KIT's mission combines the three strategic lines of activity of research, higher education, and innovation. With about 9.600 employees and 23.500 students, KIT is one of the largest institutions of research and higher education in natural sciences and engineering in Europe. Engineering sciences, natural sciences, the humanities, and social sciences make up the scope of subjects covered by KIT. In high interdisciplinary interaction, scientists of these disciplines study topics extending from the fundamentals to application and from the development of new technologies to the reflection of the relationship between man and technology.

Name	Short name	Role	Country
ORANGE SA	ORAN	Associated Partner	France

Description

Orange is one of the world's leading telecommunications operators with sales of 42.3 billion euros in 2020 and 137,000 employees worldwide in 2021. The Group is present in 26 countries and has a total customer base of 266 million customers worldwide, including 222 million mobile customers and 22 million fixed broadband customers. Orange is also a leading provider of global IT and telecommunication services to multinational companies under the brand Orange Business Services. There are 716 Orange researchers including 132 doctoral/post-doctoral staff with various skills (engineers, technicians, designers, sociologists, developers, etc.). A network of over 150 industrial and academic players with cutting-edge research centres, labotories, academia, industry... and participation in more than 58 cooperative research programs, with French, European or global players.

Name	Short name	Role	Country
ORGANISMOS TILEPIKOINONION TIS ELLADOS OTE AE	ОТЕ	Associated Partner	Greece

Description

Hellenic Telecommunications Organisation S.A. (OTE Group) is the largest technology company in Greece. It is one of the three largest companies listed in the Athens Stock Exchange, according to market capitalization. OTE Group offers fixed-line and mobile telephony, broadband services, pay television and integrated Information and Communications Technology (ICT). At the same time, the Group is involved in a range of activities, notably satellite communications, real estate and professional training. Formerly a state-owned monopoly, OTE's privatisation started in 1996 and is

now listed on the Athens and London Stock Exchanges. Today, OTE Group employs about 13,000 people in Greece and approximately 20,000 in total. Since July 2009 Deutsche Telekom is the largest shareholder of the company.

Name	Short name	Role	Country
SATELLITE APPLICATIONS CATAPULT LIMITED	SAC	Associated Partner	UK

Description

Satellite Applications Catapult is a technology and innovation company based in United Kingdom. It was established to promote the development and commercialisation of the new satellite applications and technologies. We work with businesses, researchers, and government to accelerate the growth of the space sector, by providing access to cutting-edge technologies, expertise, and facilities. We encourage collaboration and partnerships between stakeholders, as well as proving support for the development and commercialisation of new products and services. Some of the key areas that Satellite applications Catapult focuses in include Earth observation, satellite communications, positioning, navigations, in orbit servicing and manufacturing, energy in space and the growth of UK launch. In summary we are a key player in promoting the growth of the space industry in the UK and beyond.

Name	Short name	Role	Country
WEIZMANN INSTITUTE OF SCIENCE	WEIZ	Associated Partner	Israel

Description

The Weizmann Institute of Science is one of the world's leading multidisciplinary basic research institutions in the natural and exact sciences. Ever since our beginnings, we've had an unwavering commitment, passion and focus for the pursuit of our purpose: to provoke transformative breakthroughs for the future of humanity. In parallel, we educate a substantial proportion of Israel's scientific leadership and advance science literacy in schools and among the public. The Weizmann Institute's curiosity-driven research has led to breakthroughs in fighting cancer, multiple sclerosis, and neurodegenerative disorders; to advances in environmental science, computer encryption, and how we study the universe and the physics of matter; and to the creation of novel materials for aerospace, medicine, and protecting the world we live in.

Name	Short name	Role	Country
SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY	SUSTECH	Associated Partner	China

Description

Southern University of Science and Technology (SUSTech) is an innovation-oriented public university founded by Shenzhen government in the background of China's higher education reform. It is widely regarded as a trailblazer and innovator in advancing China's higher education. SUSTech bears the responsibility for exploring and developing a modern university system with Chinese characteristics to serve as a model for cultivating innovative talents. SUSTech aims at a globally renowned university that contributes to the advancement of science and technology. It draws on the experience of world-class science and engineering universities for its disciplinary establishment and governance. It

focuses on science, engineering, and medicine in conjunction with distinctive disciplines, including business, humanities, and social sciences. SUSTech offers undergraduate and postgraduate education while conducting research in a series of innovative disciplines. It aims to produce internationally recognized academic achievements and advance scientific and technological applications.

Individual Research Projects, including secondment plan

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
CNIT-1	CNIT	UNICLAM	M13	Dr. Buzzi	36 months

Project Title: Distributed cell-free vehicle-centric architectures for joint communications and sensing

Objectives: Design and analysis of distributed cell-free vehicle-centric multiantenna deployments for ISAC in vehicular environments.

Expected Results: Novel transceivers and resource allocation schemes for ISAC in cell-free vehicle-centric network deployments.

Secondment(s): CHAL-3 months (M30-M32): acquire knowledge of Al-based implementation of resource allocation schemes; **BOSCH-3 months (M36-M39):** resource scheduling in a network of vehicular radars

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
CNIT-2	CNIT	UNICLAM	M13	Dr. Buzzi	36 months

Project Title: ISAC in vehicular environments using holographic/XL-MIMO antennas

Objectives: Development of ISAC transceiver and resource allocation schemes for CAM services with holographic/XL-MIMO antennas

Expected Results: Novel transceivers and resource allocation schemes for ISAC with beyond-massive MIMO antenna deployments.

Secondment(s): NOKIA-3 months (M30-M32): design holographic MIMO schemes for extremely reliable communications; **WEIZ-3 months (M37-M39):** develop energy efficient ISAC schemes in the near-field for XL-MIMO antenna structures.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
CNIT-3	CNIT	UNICLAM	M13	Dr. Venturino	36 months

Project Title: Automotive radar-centric ISAC system design

Objectives: enable automotive radar sensors to communicate with each other and with backscatter tags while they perform sensing/imaging.

Expected Results: New waveforms/algorithms/hardware for radars and backscatter tags for specific radar-centric ISAC scenarios.

Secondment(s): BOSCH-3 months (M26-M28): develop new automotive radar hardware configurations for ISAC; UCL-3 months (M31-M33): investigate optimal beamforming schemes and waveforms for radar-centric ISAC.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
ACG-RC-1	ACG-RC	UCY	M13	Dr. Krikidis	36 months

Project Title: Shared spectrum access based on ISAC for automotive applications

Objectives: Develop a spectrum sharing framework; design corresponding ISAC schemes for CAM services with (un)licensed spectrum

Expected Results: Spectrum sharing policies with constrained QoS; Development of ISAC schemes in unlicensed bands; OTA experiments.

Secondment(s): ORAN-3 months (M26-M28): investigate on use-cases and KPI related to ISAC in automotive applications; **OTE-3 months (M34-M36):** perform study on regulative support for ISAC in vehicular environment at the European level.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
ACG-RC-2	ACG-RC	UCY	M13	Dr. Krikidis	36 months

Project Title: Resource allocation for ISAC-enabled vehicular networks and system-level performance analysis

Objectives: Development of novel resource allocation schemes for ISAC in vehicular environments and analysis through system level software simulator.

Expected Results: new resource allocation schemes; system-level simulator realization.

Secondment(s): NOKIA-3 months (M26-M28): Development of resource allocation techniques that incorporate industry-imposed system constraints.; **UCY-3 months (M34-M36):** Theoretical analysis of system-level performance of the developed resource allocation techniques.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
CHAL-1	CHAL	CHAL	M13	Dr. Wymeersch	36 months

Project Title: Al-based system design for integrating sensing and communications

Objectives: Design data-driven ISAC transmitters and receivers for CAM services using reinforcement learning and supervised learning.

Expected Results: Novel transceivers schemes based on Al over differentiable channel models in automotive scenarios. OTA experiments.

Secondment(s): CNIT-3 months (M26-M28): design of data-driven approaches to ISAC in cell-free networks; **BOSCH-3 months (M34-M36):** investigate on supervised end-to-end learning solutions for cooperative and sidelink-based vehicular ISAC systems.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
TAU-1	TAU	TAU	M13	Dr. Valkama	36 months

Project Title: Advanced radio-based SLAM algorithms for vehicular systems

Objectives: Develop new algorithms for radio-based SLAM for future vehicular systems in NLOS scenarios.

Expected Results: Novel data association, filtering and tracking algorithms for bistatic and monostatic (self-)SLAM in vehicular systems.

Secondment(s): NOKIA-3 months (M30-M32): evaluate SLAM algorithms performance on industry grade simulators; **CHAL-3 months (M36-M38):** develop new model-based SLAM pre-processing/data assoc./filtering/tracking algorithms in complicated scattering scenarios.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
BOSCH-1	BOSCH	KIT	M13	Dr. Rost	36 months

Project Title: Sensor and data fusion techniques for vehicular communication performance enhancements

Objectives: Study sensor data fusion techniques from 3GPP/non-3GPP sources in automotive applications and develop ISAC mechanisms.

Expected Results: Fusion schemes for sensing data; determine modification to 5G+ protocol stack to enable ISAC in automotive scenarios.

Secondment(s): KIT-3 months (M26-M28): investigate mechanisms and architectures for the sharing of sensor data for distributed fusion and inference; ACG-RC-3 months (M37-M39): develop sensing/data fusion techniques in the presence of spectrum sharing.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
NOKIA-1	NOKIA	KIT	Month 13	Dr. Schmalen	36 months

Project Title: Evolving wireless networks architectures to support ISAC

Objectives: Design of physical (PHY) and medium access control (MAC) layers of radio access networks for ISAC in network devices.

Expected Results: Improvements of PHY and MAC layer procedures to support ISAC; contribute towards the realization of an ISAC-BS

Secondment(s): CNIT-3 months (M26-M28): design of MAC layer functionalities for ISAC-enabled cell-free massive MIMO networks; **TAU-3 months (M34-M36):** investigation on 3GPP-compliant SLAM techniques.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
WUP-1	WUP	UNISI	M13	Dr. Maci	36 months

Project Title: Beam steering metasurface-based vehicular antenna with single reconfigurability parameter

Objectives: Develop a novel reconfigurable metasurface antenna for automotive applications with low-profile and high angular resolution.

Expected Results: EM analytical model for the study of a metasurface; design of a novel vehicular antenna; numerical codes for analysis.

Secondment(s): CHAL-6 months (M34-M39): pursue a system-level optimization approach for the developed antenna frontend.

Fellow	Host institution	PhD enrolment	Start date	PhD University Advisor	Duration
UCL-1	UCL	UCL	M13	Dr. Masouros	36 months

Project Title: Signaling and waveform design for ISAC in vehicular environments

Objectives: Development of new waveforms for ISAC in vehicular environments and theoretical analysis of the achievable performance.

Expected Results: Novel waveforms and performance bounds for MIMO DFRC in vehicular environments; experimental PoC realization.

Secondment(s): SUST-3 months (M26-M28): design and analysis of roadway geometry-aware and 5G NR based sensing assisted V2X communications; **SAT-3 months (M34-M36):** perform experimental implementation of a novel waveform design.

Training

Alongside the research objectives, ISLANDS has the following main training objectives for the DCs:

<u>Training Objective A:</u> Providing a solid understanding of ISAC technologies, 6G, and CAM, from the fundamentals to the algorithmic, and to the practical experimental aspects, encompassing a large number of different disciplines.

<u>Training Objective B:</u> Providing inter-sectoral experience, with training on both theoretical and applied research, as well as in standardization procedures, and the creation of intellectual property rights.

<u>Training Objective C:</u> Providing transferable skills training, (project management, entrepreneurship, gender issues, exploitation and dissemination of results, organization of outreach events, forming collaborations, etc.).

ISLANDS is the first training program focusing on 6G ISAC technologies for the automotive sector, spanning all related facets, from the fundamentals, to the algorithmic, to the practical experimental aspects.

In particular, in addition to specificities one-day workshops, dissemination day and final conference, some School and Complementary courses will be organized. Schools, delivered by experts from industry/academia on specific topics of the project, will be organized to give to the DCs the time to learn and use the material for their individual project, while Complementary courses supplement those offered in academia.

Details of the Schools

School 1: State-of-the-art of ISAC (20h)	Organizers: <u>UCL</u> , CNIT, OTE	Date: M19				
Description: It will provide solid understanding of the fundamentals of ISAC technologies and wireless networks. It will cover fundamentals of radar detection, of wireless networks, and an overview of the key technologies used in 5G and 6G wireless systems. The limitations of current wireless networks for ISAC and the most promising way to overcome them will be discussed.						
School 2: V2X Communications and network-assisted localization	Organizers: BOSCH, TAU, NOKIA, CHAL	Date: M19				
Description: It will provide an overview of cellular and sidelink V2X communications using mmWave frequencies. The challenges posed by the heavy Doppler shifts and by signal blockages will be discussed. Network-assisted localization will also be covered.						
School 3: Theoretical tools for 6G ISAC in Vehicular Environments	Organizers: CHAL, WUP, TAU, KIT	Date: M27				

Description: It will elaborate on the challenges to perform theoretical analysis in ISAC-enabled networks, and will introduce advanced theoretical tools, including multi-objective/sequential optimization, optimal estimation and detection and information theoretic analysis.

School 4: ISAC standardization activities

Organizers: BOSCH, NOKIA, ACG-RC

Date: M31

Description: It will elaborate on the status of standardization activities for ISAC, with focus on the vehicular domain. The activities within 3GPP, ETSI / other standardization bodies will be illustrated, providing a clear view of the path to ISAC standardization for 6G.

School 5: Simulation and hardware platforms for ISAC for CAM

Organizers: NOKIA, BOSCH

Date: M31

Description: It will introduce the simulation and hardware platforms available within the consortium and worldwide for ISAC, with special emphasis on ISAC for the vehicular environment. The challenges to realize large-scale implementations will be presented and the most promising approaches to overcome them will be described.

Details of the Complementary Courses

Course 1: Gender and underrepresented minorities issues (20h)

Organizers: CHAL, CNIT, WUP, UCL

Date: M16

Description: It will train the DCs on gender and minority issues in scientific research, identifying key factors that limit their involvement in science, teaching how to overcome them and how to organize inclusive public engagement events. They will learn how gender- and minority-inclusive approaches maximize the quality of scientific research, improving market penetration of scientific-based products.

Course 2: Scientific misconduct and integrity (20h)

Organizers: UCL, ACG-RC, NOKIA

Date: M16

Description: It will train the DCs on scientific integrity in research, as outlined in <u>European Code of Conduct for Research Integrity</u>. The concepts of plagiarism, self-plagiarism, and data fabrication will be described through examples. The course will describe the procedures used by scientific societies (e.g., IEEE) to identify scientific misconduct and deal with cases of alleged misconduct in case of complaints.

Course 3: Scientific writing and presentation skills (20h)

Organizers: TAU, CNIT, NOKIA

Date: M19

Description: It will present different types of publications, their requirements (e.g., journal vs. conference) and structure, writing and submission practices, addressing reviewers' comments, etc. Training on oral presentations, adaptability to the audience, impact of vocal and body language will be provided. The DCs will attend one training event of the <u>European Union of Science Journalists'</u> Association.

Course 4: Improving communications and teamwork skills (20h)

Organizers: WUP, CNIT, CHAL

Date: M27

Description: It will offer effective communication and personal career development strategies to the DCs, introducing techniques for time management and goal setting. The DCs will be taught how to write their CV and how to perform a job interview. The course will also assist their teamwork and organization skills, task prioritization / delegation / scheduling, and workspace conflict resolution.

Course 5: Writing patents and standardization practices (20h)

Organizers: NOKIA

Date: M27

Description: It will provide an up-to-date view of activities, processes, and policies in standardization bodies and industry consortia (e.g., 3GPP, ITU, IEEE, ETSI). Patent writing, focusing on patent structure and language, inventive steps, standard essential patents, IPR infringement, foreground/background, patent classification, etc. The DCs will learn how to understand if an idea has patenting potential.

Course 6: Competitive proposal writing and management (20h)

Organizers: ACG-RC, WUP, BOSCH

Date: M39

Description: It will provide an overview of major European funding schemes (ERC, MSCA, ICT, etc.) and the latest information on the <u>ALLEA Framework Programme 9</u>. The different project types and requirements will be presented, with guidelines to prepare a successful proposal. Financial and administrative aspects, reporting and reviews, risk analysis, contingency plans, audits, etc. will be discussed.

Course 7: Entrepreneurship, market exploitation and planning

Organizers: BOSCH, ACG-RC, ORAN

Date: M39

Description: It will present strategies for technology commercialization, innovation management, strategic assessment/planning, licensing, and business plan development The setup of innovative startups, concepts of lean startups, agile new product development, access to funding (seed funding, business angels, venture capitals), incubators and other investors will be presented with examples.

Management team

Dr. Stefano Buzzi



CNIT - Consorzio Interuniversitario Italiano per le Telecomunicazioni

He is currently a Full Professor at the University of Cassino and Southern Lazio, Italy, engaged in academic teaching at the graduate and post-graduate level. He received the M.Sc. degree (summa cum laude) in Electronic Engineering in 1994, and the Ph.D. degree in Electrical and Computer Engineering in 1999, both from the University of Naples "Federico II".

He has had short-term research appointments at Princeton University, Princeton (NJ), USA in 1999, 2000, 2001 and 2006. He is a former Associate Editor of the IEEE Signal Processing Letters and of the IEEE Communications Letters, has been the lead guest editor of two IEEE JSAC special issues (June 2014 and April 2016), while is currently serving as an Editor for the IEEE Transactions on Wireless Communications and as guest co-editor of an IEEE JSAC special issue on ultra-reliable low-latency communications. He is also a Member of the IEEE 5G Tech Focus Editorial Board. He has co-authored about 150 technical peer-reviewed journal and conference papers, and among these, the highly-cited survey paper "What will 5G be?" (IEEE JSAC, June 2014) on 5G wireless networks. Dr. Buzzi was an invited speaker at the IEEE 5G Summit held in Montreal in October 2017.

He is ISLANDS General Coordinator, responsible for the overall implementation of the project.

Dr. Constantinos B. Papadias



The American College of Greece Research Center

Dr. Constantinos B. Papadias is the Scientific Director of The American College of Greece Research Center (ACG-RC). At ACG, he is also Professor of Information Technology and Data Science, Head of the Smart Wireless Future Technologies (SWIFT) Lab and Executive Director of the Research, Technology and Innovation Network (RTIN), since 2020.

Prior to these, he was the Dean of Athens Information Technology (AIT), in Athens, Greece, where he was also Head of the Broadband Wireless and Sensor Networks (B-WiSE) Research Group. He currently holds Adjunct Professorships at Aalborg University and at the University of Cyprus. He has been active in ITrelated research, addressing areas such as signal processing and machine learning, wireless telecom systems & networks, biomedical engineering and energy efficient technologies for more than 30 years. He has published over 240 scientific papers, 12 patents and 4 books and has received over 10000 citations and several recognitions for his work, including 4 best paper awards. He has participated in and lead several EU-funded research projects, such as the doctoral network (MSCA) project ISLANDS on integrated communications & sensing, of which he is the Scientific Manager, and the recently completed projects PAINLESS on the topic of energy autonomous infrastructure-less wireless networks (2018-2022) and EU CHIST-ERA project FIREMAN on the topic of predictive maintenance via machine type wireless communication systems (2019-2023). He is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and of the European Alliance of Innovation. From 2020-2022 he was a member of Greece's sectorial scientific council of Engineering Sciences, which supports the country's National Council for Research and Innovation. He currently serves as Director-at-Large of the IEEE Signal Processing Society for Region 8 (Europe, Middle East and Africa).

He is ISLANDS Scientific Manager. He will will coordinate the scientific aspects of the proposal and will lead the preparation of the project technical deliverables.

Dr. Stella Apostolaki



The American College of Greece Research Center

Dr. Stella Apostolaki, is Assistant Professor of Environmental Science, Department of Science and Mathematics, Deree – the American College of Greece and Executive Director of the Centre of Excellence in Sustainability at The American College of Greece (ACG). She is teaching a variety of environmentally focused courses in the respective Program and in the Honours Program at Deree – ACG.

She has prepared and delivered lectures, seminars and environmental awareness raising programs addressed to different audiences, including all educational levels and the wider public. She holds a BSc/(Hons) in Environmental Science, an MSc in Urban Water and Environmental Management and a PhD on sustainable urban drainage systems and river management options, obtained from the University of Abertay Dundee, Scotland – U.K, under funding received by the Environment Agency for England & Wales, in collaboration with the Scottish Environment Protection Agency (SEPA), and by HR Wallingford Consultants.

She has a wide research experience, she is expert evaluator of Call for Proposals for European Commission, has worked as a researcher in collaboration with Universities and Authorities in Greece and in the U.K., and has participated in numerous EU funded projects. She collaborates as external consultant with several entities such as the Green Fund of the Hellenic Ministry of Environment and Energy in the project LIFE-IP AdaptInGR – Boosting the implementation of adaptation policy across Greece. She has been collaborating with the ATHENA Research Centre, the UNSDSN Greece & Climate KIC Greece, P.S.G Environmental Geo-Exploration Ltd. Her main research interests are on integrated water management and innovation, sustainable development, sustainable stormwater management, climate change, conservation of biodiversity, ecosystem restoration, public awareness – stakeholder engagement methods and public education, green urban planning with emphasis on amenity and biodiversity and on the implementation of the United Nations Sustainable Development Goals.

She is ISLANDS Sustainability Coordinator. She will ensure that the project is implemented in a sustainable way, in accordance with the guidelines of the MSCA Green Charter.

Dr. Henk Wymeersch



Chalmers University of Technology

Henk Wymeersch obtained the Ph.D. degree in Electrical Engineering/Applied Sciences in 2005 from Ghent University, Belgium. He is currently a Professor of Communication Systems with the Department of Electrical Engineering at Chalmers University of Technology, Sweden. He is also a Distinguished Research Associate with Eindhoven University of Technology.

Prior to joining Chalmers, he was a postdoctoral researcher from 2005 until 2009 with the Laboratory for Information and Decision Systems at the Massachusetts Institute of Technology. Prof. Wymeersch served as Associate Editor for IEEE Communication Letters (2009-2013), IEEE Transactions on Wireless Communications (since 2013), and IEEE Transactions on Communications (2016-2018) and is currently Senior Member of the IEEE Signal Processing Magazine Editorial Board. During 2019-2021, he was an IEEE

Distinguished Lecturer with the Vehicular Technology Society. His current research interests include the convergence of communication and sensing, in a 5G and Beyond 5G context. He is a Fellow of the IEEE.

He is ISLANDS Recruitment and Gender Balance Manager. He will monitor recruitment regarding gender equality and adequate representation of applicants from new member states, and will ensure that necessary steps are taken to correct shortcomings.

Dr. Mikko Valkama



Tampere University

Mikko Valkama received his M.Sc. (Tech.) and D.Sc. (Tech.) degrees (both with honors) from the former Tampere University of Technology, Finland, in 2000 and 2001, respectively. In 2003, he was with the Communications Systems and Signal Processing Institute at SDSU, San Diego, CA, as a visiting postdoctoral research fellow.

Currently, he is a Full Professor and the Head of the Unit of Electrical Engineering at the newly formed Tampere University, Finland. His general research interests include radio communications, radio localization, and radio-based sensing, with particular emphasis on 5G and 6G mobile radio networks. He has coauthored more than 600 peer-reviewed articles, supervised 28 PhD students, and is an IEEE Fellow.

He is ISLANDS Training Activities Manager. He will lead WP2 (training), liaise with individual supervisors to review the Personal Career Development Plan, and with all project members, including Associated Partners, to adjust and ensure successful delivery of the training strategy, including summer/winter schools, project meetings and workshops. He will also set the agenda for the secondment related parts of the SB meetings, and be in charge of societal, legal and ethical questions that may arise in the Doctoral Network.

Dr. Christos Masouros



University College London (UCL)

Christos Masouros (FIEEE, MIET) received the Diploma degree in Electrical and Computer Engineering from the University of Patras, Greece, in 2004, and MSc by research and PhD in Electrical and Electronic Engineering from the University of Manchester, UK in 2006 and 2009 respectively. In 2008 he was a research intern at Philips Research Labs, UK, working on the LTE standards. Between 2009-2010 he

was a Research Associate in the University of Manchester and between 2010-2012 a Research Fellow in Queen's University Belfast.

In 2012 he joined University College London as a Lecturer. He has held a Royal Academy of Engineering Research Fellowship between 2011-2016. Since 2019 he is a Full Professor of Signal Processing and Wireless Communications in the Information and Communication Engineering research group, Dept. Electrical and Electronic Engineering, and affiliated with the Institute for Communications and Connected Systems, University College London. His research interests lie in the field of wireless communications and signal processing with particular focus on Green Communications, Large Scale Antenna Systems, Integrated Sensing and Communications, interference mitigation techniques for MIMO and multicarrier communications. Between 2018-22 he was the Project Coordinator of the €4.2m EU H2020 ITN project PAINLESS, involving 12 EU partner universities and industries, towards energy-autonomous

networks. Between 2024-28 he will be the Scientific Coordinator of the €2.7m EU H2020 DN project ISLANDS, involving 19 EU partner universities and industries, towards next generation vehicular networks. He is a Fellow of the IEEE, a Fellow of the Asia-Pacific Artificial Intelligence Association (AAIA), and was the recipient of the 2023 IEEE ComSoc Stephen O. Rice Prize, co-recipient of the 2021 IEEE SPS Young Author Best Paper Award and the recipient of the Best Paper Awards in the IEEE GlobeCom 2015 and IEEE WCNC 2019 conferences. He has been recognised as an Exemplary Editor for the IEEE Communications Letters, and as an Exemplary Reviewer for the IEEE Transactions on Communications. He is an Editor for IEEE Transactions on Wireless Communications, the IEEE Open Journal of Signal Processing, and Editor-at-Large for IEEE Open Journal of the Communications Society. He has been an Editor for IEEE Transactions on Communications, IEEE Communications Letters, and a Guest Editor for a number of IEEE Journal on Selected Topics in Signal Processing and IEEE Journal on Selected Areas in Communications issues. He is a founding member and Vice-Chair of the IEEE Emerging Technology Initiative on Integrated Sensing and Communications (SAC), Vice Chair of the IEEE Wireless Communications Technical Committee Special Interest Group on ISAC, and Chair of the IEEE Green Communications & Computing Technical Committee, Special Interest Group on Green ISAC. He is a member of the IEEE Standards Association Working Group on ISAC performance metrics, and a founding member of the ETSI ISG on ISAC. He is the TPC chair for the IEEE ICC 2024 Selected Areas in Communications (SAC) Track on ISAC, and Chair of the "Integrated Imaging and Communications" stream in IEEE CISA 2024.

He is ISLANDS Chief Scientist, he will coordinate the scientific aspects of the proposal and will lead the preparation of the project technical deliverables.

Dr. Carmen D'Andrea



Università degli studi di Cassino e del Lazio Meridionale (UNICLAM)

Dr. D'Andrea is currently non-tenured Assistant Professor at the University of Cassino and Lazio Meridionale, Italy. She received her B.S., M.S., and Ph.D. degrees (summa cum laude) in Telecommunications Engineering from the University of Cassino and Southern Latium, Italy, in 2013, 2015, and 2019 respectively.

In 2017, she was a Visiting Ph.D. student with the Wireless Communications (WiCom) Research Group in the Department of Information and Communication Technologies at Universitat Pompeu Fabra in Barcelona, Spain. In the spring of 2020, she spent three months as a visiting researcher with the Communication System Division of the Department of Electrical Engineering at Linkoping University in Sweden. Since 2020, she has been an Associate Editor for IEEE Communications Letters (Exemplary Editor in 2022) and for IEEE Open Journal of the Communications Society. In 2023, she received the Italian Scientific Habilitation (ASN) as Associate Professor and she is in the World's Top 2% Scientists 2023 in the topic "Information & Communication Technologies – Networking & Telecommunications" listed by Elsevier, Scopus, and Standford University. Her research interests are focused on wireless communication and signal processing, with emphasis on mmWave communications, massive MIMO systems, and the study of waveforms for beyond-5G communication systems.

She is ISLANDS Assistant to the General Coordinator, she will provide support in all matters related to the project.

Dr. Andreas Mueller



Bosch

Dr. Andreas Mueller is the Head of Communication and Network Technology in the Corporate Research Department of Robert Bosch GmbH in Stuttgart, Germany and at the same time the Bosch Chief Expert for Communication Technologies for the IoT. In addition to that, he is coordinating the Industrial 5G activities of Bosch across the different business units. He also serves as General Chair of the "5G

Alliance for Connected Industries and Automation" (5G-ACIA), which is the globally leading organization for driving and shaping Industrial 5G.

Prior to joining Bosch, Andreas was a Research Staff Member at the Institute of Telecommunications of the University of Stuttgart, Germany, where he was contributing to the further development of the 3GPP Long Term Evolution towards LTE-Advanced. Besides, he was working as a Systems Engineer for Rohde & Schwarz, developing a novel software-defined radio based communication system for the German Armed Forces. Andreas holds a German Diploma degree as well as a Ph.D. degree in Electrical Engineering (with distinction) and a M.Sc. degree in Information Technology, all from the University of Stuttgart, Germany.

He is ISLANDS Exploitation Manager. He will lead WP4 and collaborates with SC to identify exploitable IP. Also, works with TC to ensure DCs understand IPR protection and exploitation opportunities.

Dr. Loredana Stendardo



CNIT- Consorzio Interuniversitario Italiano per le Telecomunicazioni

PhD in Modern and Contemporary Theatre History at University "L'Orientale" of Naples. Co-founding partner of the En Kai Pan cooperative in Naples, she handles communication, graphic design and content creation, project organization and management.

She has focused on the theater of historical avant-gardes. Winner of a DAAD scholarship, she conducted a year of research at the Akademie der Künste in Berlin. Fluent in German, she trained at the SETL (European School of Literary Translation) under Magda Olivetti. She has collaborated with the Napoli Teatro Festival Italia in the organization and communication sector and with the International Festival of Contemporary Creation of Terni. She has also worked with independent publishing houses, where she has been involved in translation, editorial work, and layout design.

SHe is ISLANDS Project Manager.

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