



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 39th cycle

Research Area n. 4 - Telecommunications

**PARTENARIATO PNRR Research Field: ADVANCED SOLUTIONS TO IMPROVE THE
PERFORMANCE OF HIGH FREQUENCY VEHICULAR SYSTEMS**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

This research project is in the framework of
RESTART
PARTENARIATO ESTESO RESEARCH AND
INNOVATION ON FUTURE TELECOMUNICATION
SYSTEMS AND NETWORKS TO MAKE ITALY MORE
SMART
CUP D43C22003080001
Decreto di Concessione D.D. 1549 del 11/10/2022

Vehicular-to-everything (V2X) is an ambitious technology working at mmWave /Sub-THz/THz frequencies. Behind the expectation of sixth generation (6G) KPIs working at such high frequencies, there are several open and unresolved problems to design the way to cope with the severe path loss attenuation, the easy blockage of the small wavelength in mobility conditions, and the line-of-sight dominant propagation. The previous issues prevent the typical multipath diversity that characterizes propagation at lower frequencies, i.e. sub-6GHz. Different scenarios envisioned in 6G need tailored solutions and compliance with strict requirements on latency and reliability, and the main goal of this research is to explore the most challenging over the next decade to create a knowledge basis on how to deal with them. The research activity will push forward in-mobility limits and will



	<p>investigate the stability of collimated connectivity in a highly dynamic context and the use of sidelink as repeaters for range extension. Predictive management will be considered by leveraging on V2X specificities, e.g. predictive user mobility, multi-link connectivity, improved location accuracy for predictive radio resource management, link-blockage prediction and recovery, and predictive Quality of Service (QoS). Moreover, since vehicles exchange each-other or over the edge the raw data properly tailored to maximize the perception of the driving scene. Another goal of the research activity will be that of defining an analytical framework to capture the complex interactions between the medium access control (MAC) and the physical (PHY) layers, such as ultra-massive machine type communication (mMTC) and extreme ultra-reliable low-latency communication (URLLC) services, which must coexist in the same network. The impact of multiple access interference, multi-connectivity, and advanced receivers must be taken into account. The design of new practical schemes for ultra-mMTC and for extreme-URLLC applications will be addressed. The novel designed schemes will include the access strategy and the base station processing and will explore joint PHY and MAC approaches. Energy efficiency will be considered as a design constraint.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research methodology shall include:</p> <ol style="list-style-type: none"> 1) Study of the literature about V2X, outline of the relevant vehicular scenarios, and definition of KPIs and requirements. 2) Theoretical analysis and numerical simulations. 3) Development of novel algorithms. 4) Performance evaluation of designed algorithms and comparison with existing ones available in the literature.
<p>Educational objectives</p>	<ol style="list-style-type: none"> 1) acquire an expertise in technologies for next generation of wireless cellular networks; 2) develop state-of-the-art skills concerning the application of signal processing techniques to improve the performance of wireless communication systems and to reduce power consumption; 3) disseminate research results (oral presentations/written



	publications); 4) ability to identify research problems and to conduct research in a highly focused fashion; 5) develop team working skills through the collaboration with the research groups on both theoretical and practical topics; and 6) develop skills for life-long learning and professional development.
Job opportunities	For the ambitious and disruptive objectives of the research, as well as for the reputation of the involved research groups, it is expected that after completion of the PhD program the candidate will be ready for being part of any research team in public and private institutions and centers, universities, and industry.
Composition of the research group	0 Full Professors 4 Associated Professors 2 Assistant Professors 0 PhD Students
Name of the research directors	Maurizio Magarini

Contacts
E-mail: maurizio.magarini@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>The funding for the scholarship comes from the project RESTART a comprehensive program, that aggregates and integrates the main stakeholders of the Italian Telecommunications sector. RESTART promotes TLC science and technologies advancement for both human and IoT users, applications and services in the most diverse sectors: agriculture, commerce, energy, finance, industry, media, health, safety/security, transportation.</p> <p>LIST OF UNIVERSITIES, COMPANIES, AGENCIES AND/OR NATIONAL OR INTERNATIONAL</p>



INSTITUTIONS THAT ARE COOPERATING IN THE RESEARCH: Politecnico di Milano; Politecnico di Torino; TIESSE.

EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student.

TEACHING ASSISTANTSHIP: (availability of funding in recognition of supporting teaching activities by the PhD student)

There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

COMPUTER AVAILABILITY: individual use

DESK AVAILABILITY: individual use

D.D. 341 del 15/03/2022 Avviso pubblico per la presentazione di Proposte di intervento per la creazione di "Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base" - nell'ambito del Piano Nazionale di Ripresa e Resilienza, Missione 4 "Istruzione e ricerca" - Componente 2 "Dalla ricerca all'impresa" - Investimento 1.3, finanziato dall'Unione europea - NextGenerationEU