Job Description for Position: TUD-1

The *Technische Universität Dresden, Germany*, is seeking to appoint a doctoral candidate to join the Marie Skłodowska-Curie Doctoral Network 'Wireless Networks at Optical Speed with Deterministic Performance' (TeraWireless).

About the TeraWireless project

Future networks will support several applications that require extending fiber-optic quality of experience to wireless links. This means connectivity at extremely high data rates with deterministic performance (guaranteed requirements in terms of reliability and time response). Virtual avatar presence, traffic control, autonomous driving, remote health monitoring, cyber physical systems for intelligent transportation, industrial automation are only a few examples of anticipated use cases. Owing to the large amount of available bandwidth, the European Telecommunications Standards Institute has identified terahertz (THz) as a key technology for future wireless networks. TeraWireless is the first EU training-through-research industrial doctoral network of doctoral candidates and senior supervisors fully committed to lay the theoretical, algorithmic, and architectural foundations for enabling THz systems at optical speed with deterministic performance. TeraWireless will 1) put forth the innovative ultra-MIMO (multiple-input multiple-output) technology for increasing the data rate and link reliability through spatial multiplexing and superdirective beamforming, and will pioneer the development of electromagnetic and communication models for evaluating its performance in low-scattering THz channels, where multipath propagation cannot be exploited, by integrating sensing, localization, communication capabilities; 2) leverage the emerging concept of semantic and goal-oriented communications by folding message semantics and goals of communication within communication layers; 3) develop innovative physics-based ML solutions for energy-efficient, robust, reliable, and explainable-by-design implementations; 4) make available to the research community the EU's and world's first open-access and open-source simulation environment - integrating ray tracing, link-level, and system-level features - for evaluating and optimizing THz large-scale deterministic networks at optical speed.

Position title: Semantic and goal-oriented communication for future communication systems.

Research project: This research project aims to pioneer semantic and goal-oriented communications explicitly tailored for ultra-massive MIMO (U-MIMO) terahertz (THz) networks. Existing 5G networks predominantly focus on reliably transmitting sequences of bits, which suffices for many traditional applications but proves inadequate for emerging THz-enabled critical applications, such as augmented reality/virtual reality (AR/VR) and autonomous driving, requiring massive data throughput (Tbps) and tactile latencies (sub-ms).

To address this challenge, the project will integrate semantic and effectiveness criteria directly into the communication protocol, thereby significantly reducing the number of transmitted bits by filtering task-irrelevant data. The research will frame this as a joint source-channel coding problem, leveraging THz channel characteristics and U-MIMO system models. Semantic extraction will utilize rule-based

machine learning methods, particularly graph neural networks and neural attention mechanisms, to quantify the balance between semantic compression and fidelity.

The resulting semantic communication protocols will be experimentally validated in state-of-the-art facilities, including TUD's 5Glab (5G campus container), Berlin's 5G testbed in collaboration with Deutsche Telekom, and BT's Adastral Park. This approach is expected to substantially enhance the efficiency, scalability, and practicality of THz communications for future critical networked applications.

Objectives: Development, design, and implementation of semantic and goal-oriented communication codes for future communication systems, with emphasize on THz communication.

Location of workplace: Deutsche Telekom Chair of Communication Networks, Technische Universität Dresden, Georg-Schumann-Straße 9, 01069, Dresden, Germany, under the supervision of Prof. Frank Fitzek (https://cn.ifn.et.tu-dresden.de/)

PhD enrollment: The selected applicant will be able to enroll in a Ph.D. program at the Technische Universität Dresden to conduct the planned research activities.

Working Time: Full-time.

Duration: Fixed-term (3 years).

Salary: in agreement with the MSCA-DN financial regulations, including living, mobility, and family allowances (https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-2-msca-actions_horizon-2023-2024_en.pdf)

Secondment: TUD-1 will spend a research stay of 18 months at an industrial partner of the TeraWireless project.

1) An undergraduate degree and a postgraduate Master's degree (or equivalent) in information engineering, electronic or electrical engineering, telecommunications engineering, computer science, mathematics, or a physical sciences subject.
2) Solid background on communication theory, wireless communications, or communication networks.
3) Excellent mathematical skills and background (information theory is a plus).
4) High proficiency in Python, C++, NI LabVIEW, or similar programming software.
5) Excellent written and verbal communication, including presentation skills.
6) Highly proficient English language skills.
7) Excellent organizational skills, attention to details and the ability to meet deadlines.
8) Ability to think logically, create solutions and make informed decisions.
9) Willingness to work collaboratively in a research environment.
10) Willingness to travel and work across Europe.

1) Undertake postgraduate research in support of the agreed doctoral research project.
2) Work closely with the academic supervisors to ensure the compatibility of the individual project with the overall goals of the TeraWireless project.
3) Present and publish research in both academic and non-academic audiences.
4) Attend and participate in academic and non-academic conferences, events, and seminars.
5) Attend and participate in all training events and supervisory meetings.
6) Be seconded to other network partners as necessary to fulfil the grant obligations.
7) Prepare progress reports and similar documents on research for funding bodies, as required.
8) Contribute to the delivery and management of the wider program, including attending and participating in program committee meetings.
9) Actively contribute to the project's public engagement and outreach activities.

As job descriptions cannot be exhaustive, the Researcher may be required to undertake other duties, which are broadly in line with the above duties and responsibilities.

- The applicant must be a doctoral candidate (i.e., not already in possession of a doctoral degree at the date of the recruitment).
- At the time of recruitment, the researcher must not have resided or carried out their main activity (work, studies, etc.) in the country of their recruiting organization for more than 12 months in the three years immediately prior to the recruitment date. Compulsory national service and/or short stays such as holidays are not taken into account.

Selection Process

The selection and recruitment process will be in accordance with the European Charter and Code of Conduct for the Recruitment of Researchers. The recruitment process will be open, transparent, impartial, equitable, and merit based. There will be no overt/covert discrimination based on race, gender, sexual orientation, religion or belief, disability or age. To this end, the following selection criteria will be considered:

2) Academic performance (diplomas, university transcripts, etc.)

8) Other relevant items based on the specific candidate

The application deadline is **31 July 2025**. All applications will be analyzed after the application deadline, and the shortlisted candidates will be invited to a teleconference interview. At the end of the selection process, all the applicants will be informed of the outcome of their application by return email.

Disclaimer

By applying for this position, the applicants:

1) give their consent to circulate their application and personal data within the members of the consortium.
2) declare to fulfil the eligibility requirements defined by above.
3) agree to spend a secondment of 18 months in an industrial partner of the TeraWireless consortium.
4) agree that they will comply with the planned Ph.D. enrollment.

How to Apply

Each application must include the following material:

a) Curriculum vitae setting out the educational qualifications as well as any additional scientific achievements and publications. The CV must clearly indicate the applicant's vitae name, surname, gender, date of birth, nationality, country of residence in the last three years).
b) Evidence of English proficiency.
c) Copy of Bachelor's and Master's certificates.
d) Copy of Bachelor's and Master's transcripts.
e) Any additional material useful for the assessment of the candidate (e.g., recommendation letters, research project/statement in agreement with the requirements specified in previous text).

All materials must be compiled into a single PDF file. The compiled PDF file should be named indicating the surname of the applicant. For example, *Surname_TUD_Position.pdf*. The archive file should be uploaded through the TeraWireless recruitment website terawireless.eu.

Further Information

For more information, please contact Dr.-Ing Juan Cabrera: juan.cabrera(at)tu-dresden.de

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