

PS: „Drahtlose Kommunikation / Wireless Communications“



TECHNISCHE
UNIVERSITÄT
DARMSTADT

Fachgebiet Kommunikationstechnik / Communications Engineering Lab

Information Session:
April 18, 2024



Source: <http://www.edubazarnews.com/2015/11/30/history-of-mobile-communication>

Agenda



- General Information
- Deliverables
- Benefit, what will you learn?
- Practical arrangements
- Presentation of the projects

General Information

- Up-to-date project topics related to mobile communication networks, sensor networks, etc.
- Projects offered by research assistants related to their current research topics
- A team of 2 students works together
- Theoretical work and verification of ideas by implementation in MATLAB or Python

- Before starting to work on the project task:
 - Task structuring sheet
 - Containing project plan, milestones, subtasks, work split, etc.
- Final deliverables:
 - Documentation of the project <10 pages
 - One presentation per team <20 min
 - Every team member gives part of the presentation
 - MATLAB or Python code

Benefits/What will you learn?



- Deep understanding of a particular up-to-date research topic in the field of communication
- Practical experience with journal/conference papers
- Practical experience with MATLAB or Python
- Team work
- Structuring of complex tasks
- Presentation of complex topics
- Documentation of complex topics
- English as “the” language in telecommunications

Practical arrangements



- 8 CP, Total time effort: 240h/student
 - 10 weeks for the seminar → 24h/week/student
- Students of national and international master programs
- Previous knowledge: Digital communications, mobile radio
- The project seminar consist of two parts
 - Lecture part, e.g. talk given by guest scientist visiting TU Darmstadt
 - Project part, team work

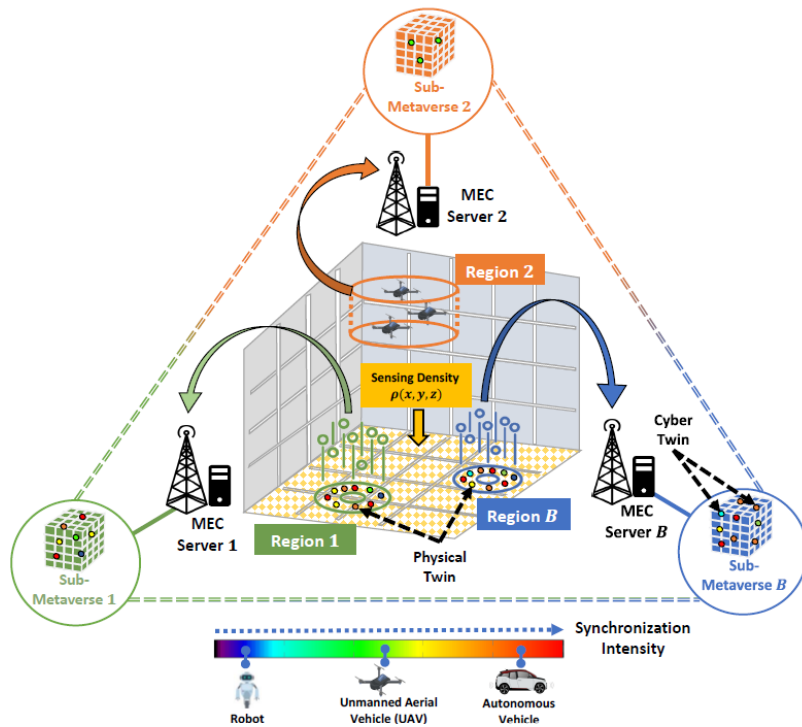
Practical arrangements

- How to select a topic and register?
 - Teams of 2 students
 - Indication of interest for one preferred project and at most one alternative project with only one tutor at latest on April 25, 2024
 - Number of participants is limited
 - Announcement of teams and assigned projects via email
- How to work on the selected topic and successfully complete?
 - Meetings of teams with their tutor to be arranged individually
 - Task structuring sheet due before starting programming task
 - Final presentation and due date for other deliverables on July 6, 2024. All participants of the project seminar should attend the presentations

- K. D. Kammeyer, V. Kühn, *Matlab in der Nachrichtentechnik*; Schlembach Verlag, 2001
- J. G. Proakis, M. Salehi, and G. Bauch, *Contemporary communication systems using MATLAB and Simulink*, Brooks and Cole, 2000
- V. O. K. Li, “Hints on writing technical papers and making presentations,” *IEEE Transactions on Education*, vol. 42, no. 2, May 1999, pp. 134 – 137
- G. M. Blair, “Planning a project,” *Engineering Management Journal*, vol. 3, no. 1, Feb. 1993, pp. 15 – 21

- Additional literature is provided by the group tutor

Project 1: Synchronization of Metaverse and Digital Twins (DTs)



Motivation

- How to ensure the synchronization between the real-world and the metaverse, between the physical systems and their DTs?
- Exploit decentralized, edge-enabled model
 - Region partition and DT accommodation

Tasks

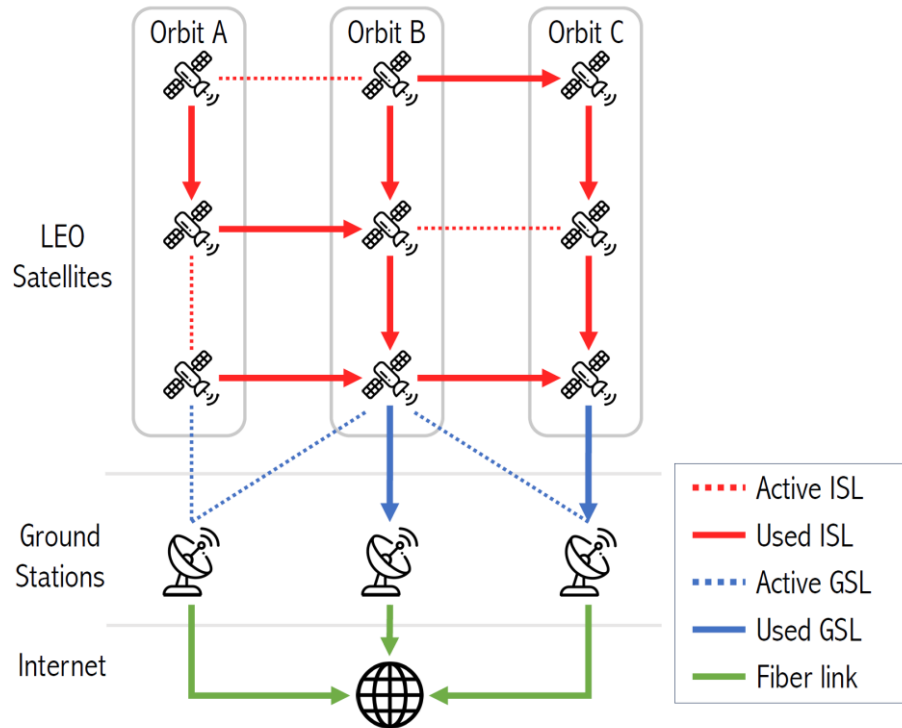
- Implement the iterative algorithm for region partition and DTs association
- Evaluate the performance of the proposed iterative algorithm via simulations
- BONUS: improve the proposed algorithm in the reference paper

Tutor: Yi Wang

Mail: y.wang@nt.tu-darmstadt.de

Room: S310 R316

Project 2: Reinforcement Learning in Satellite Networks



Motivation

- How to route data from users to the internet in LEO satellite networks?

Goal

- Improve a new routing algorithm based on reinforcement learning

Tasks

- Learn how to evaluate routing algorithms using an existing satellite simulator
- Find optimal parameters for a given routing algorithm in different scenarios
- EXTRA: Find better routing algorithms

Tutor: Wanja de Sombre

Mail: w.sombre@nt.tu-darmstadt.de

Room: S310 R319

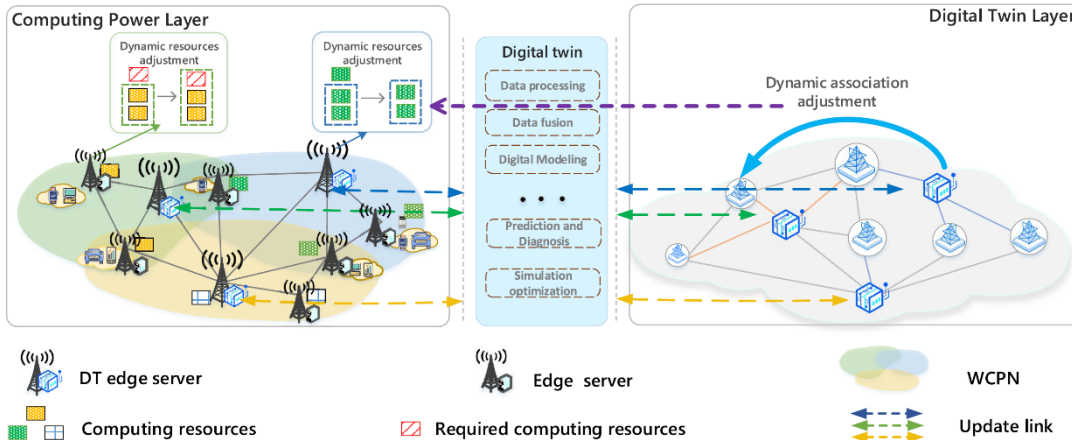
Project 3: Digital Twin Placement in Mobile Edge Computing

Motivation

- Digital twins (DTs) and their physical systems must be synchronized tightly
- DTs are hosted on edge servers
- How to select optimal host edge server in systems with multiple DTs?
 - Game-Theory approach for DT placement

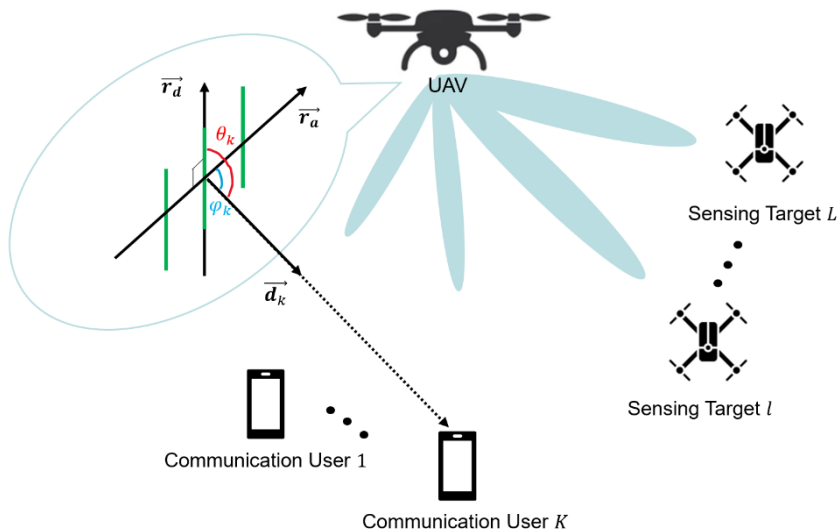
Tasks

- Familiarize yourself with the system model and DT placement problem
- Implement the game-theoretic algorithm and verify the results obtained in reference paper
- BONUS: Implement extended version of the algorithm for migrating DTs between edge servers



Tutor: Maximilian Wirth
Mail: m.wirth@nt.tu-darmstadt.de
Room: S310 R318

Project 4: UAV-aided Integrated Sensing and Communication



Motivation

- How to improve sensing and communication performance when jointly considering the 3D radiation patterns of directive antennas, array's orientation and beamforming?

Tasks

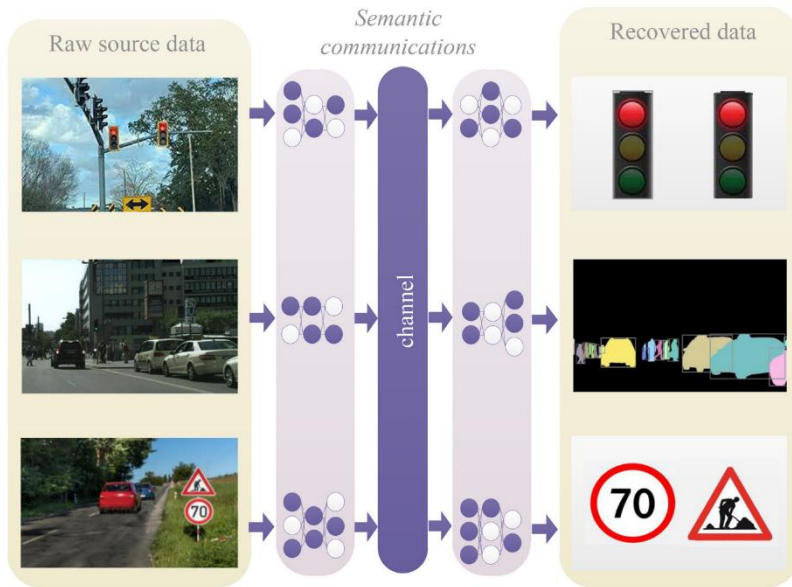
- Implement the iterative algorithm based on convex and manifold optimization to jointly optimize the beamforming and array steering in UAV-aided ISAC.
- Refine the algorithm and determine the patterns of influence caused by different hyperparameters.

Tutor: Fengcheng Pei
Mail: f.pei@nt.tu-darmstadt.de

Room: S310 R318

Available after 29/04/2024

Project 5: Fundamentals of Semantic Communications



Motivation

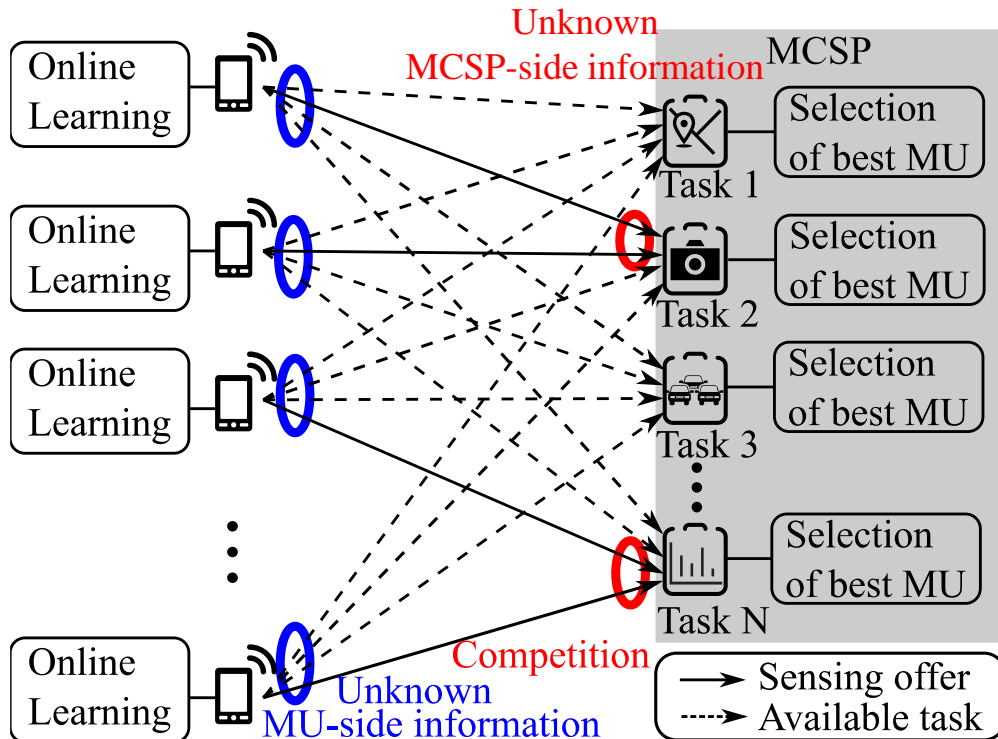
- How to design semantic communication neural networks for different tasks under time-variant channel conditions.
- How to define semantic information, semantic channel and semantic entropy?

Tasks

- Realize some basic task-oriented communications under time-variant channel conditions using deep learning technologies.
- Investigate the semantic information theory.

Tutor: Fengcheng Pei
Mail: f.pei@nt.tu-darmstadt.de
Room: S310 R318
Available after 29/04/2024

Project 6: Learning-guided Matching in Mobile Crowd-sensing



Motivation

- Mobile Crowd-sensing is a viable alternative to traditional wireless sensor networks
- IoT applications, monitoring systems need sensing information from a target area

Goal

- To find task selection and task allocation strategies to maximize task completion
- Consider individual preferences of the MUs

Challenges

- Technical and economic aspects of the problem to consider
- Incomplete information available
- Unknown strategies of other players

Tutor: Sumedh Dongare

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