



Networks and Distributed Systems (ND)

Department of Informatics
University of Oslo

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September 2026

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OF OSLO



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Networks and Distributed Systems (ND) – conducting cross disciplinary research

- **Networking**
- **Distributed Systems**
- **Energy Informatics**



Amir



Carsten



Michael



Omid



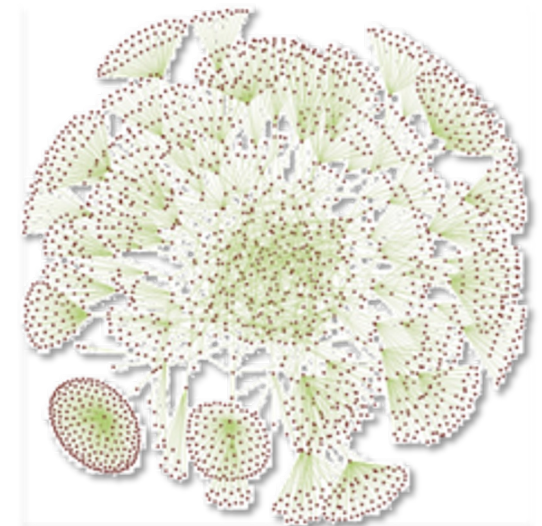
Roman



Sabita



Özgü



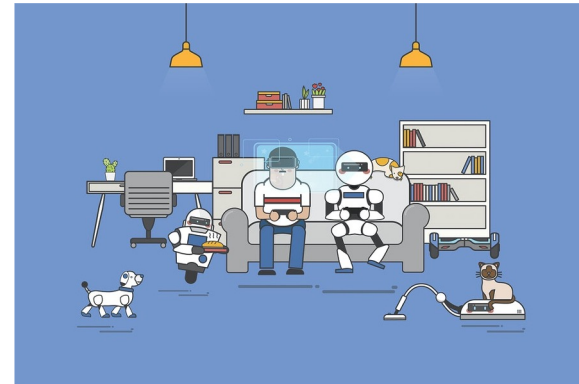
People

- 7 Professors
- 7 Researchers / Postdoc
- 7 PhDs

Networks and Distributed Systems (ND)

Networks

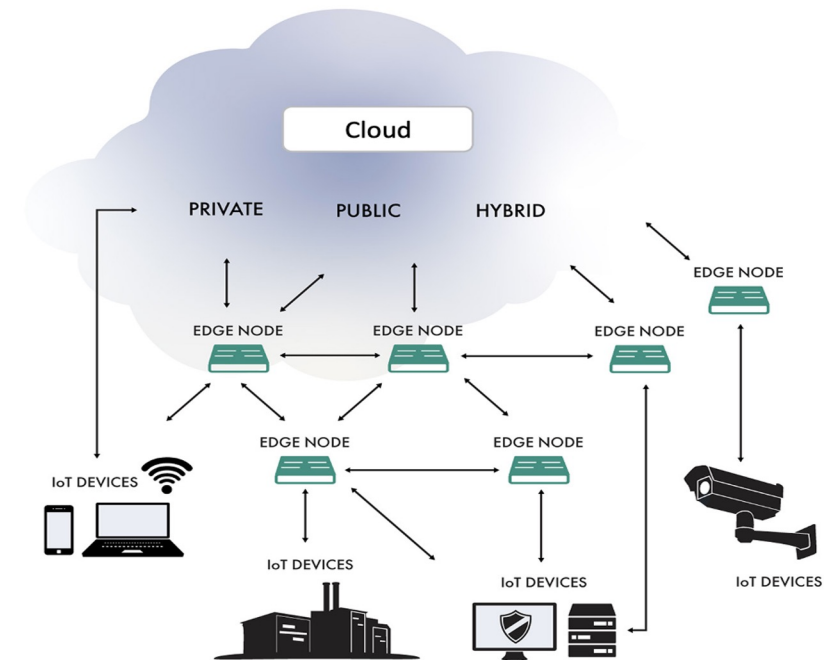
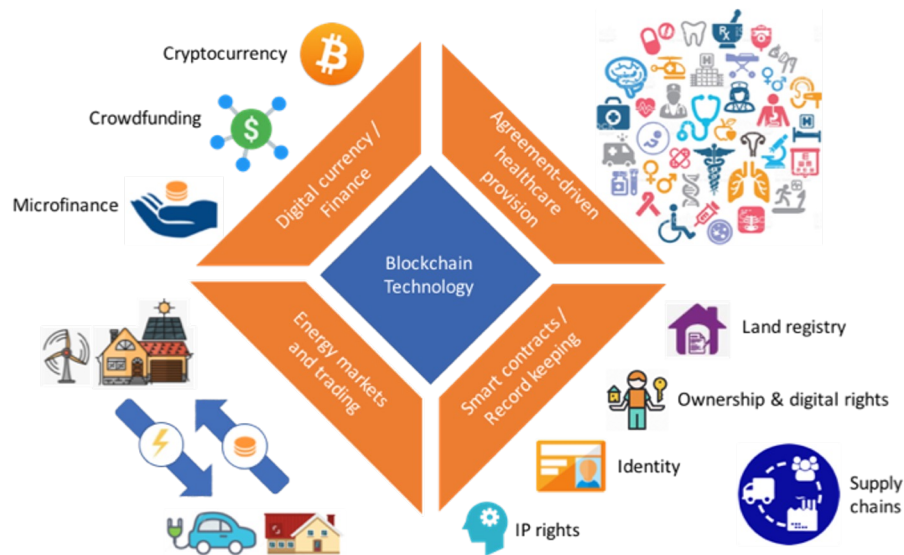
- Enabling technologies (5G/6G, IoT, Tactile)
- Immersive and Interactive Media (Multimedia, AR/VR/XR, EEG)
- Internet protocols (TCP, QUIC, ..)



Networks and Distributed Systems (ND)

Distributed Systems

- Middleware
- Dependability
- Adaptivity
- Data-intensive computing
- Privacy
- Network security



Energy Informatics for sustainable future



Smart Grids, e.g., P2P Energy Trading
/Energy Communities /Demand Flexibility



V2X/EV charging/
E-mobility



Blockchain/
Cyber Security



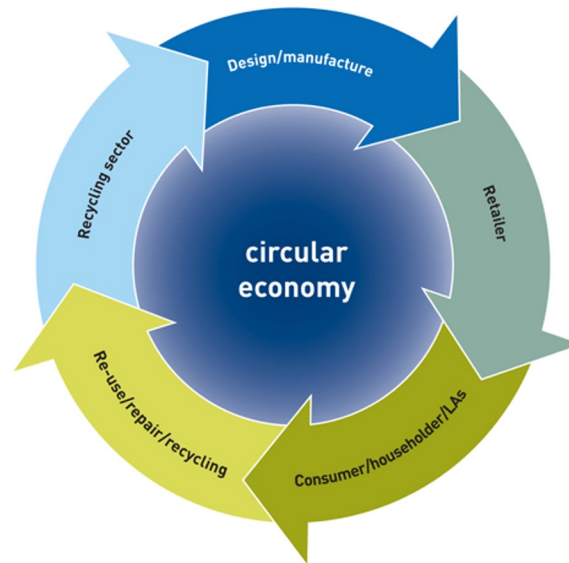
Green Computing with Edge/Cloud, e.g. Internet
of Vehicles, Industrial IoT



Machine learning for , e.g., Edge Intelligence,
Federated and Deep Reinforcement Learning

Other Ongoing Green Initiatives

- The Circular Economy Perspective
 - An integral part of the sustainability agenda
 - to close the loop: essential to reuse, repair and recycle materials from waste

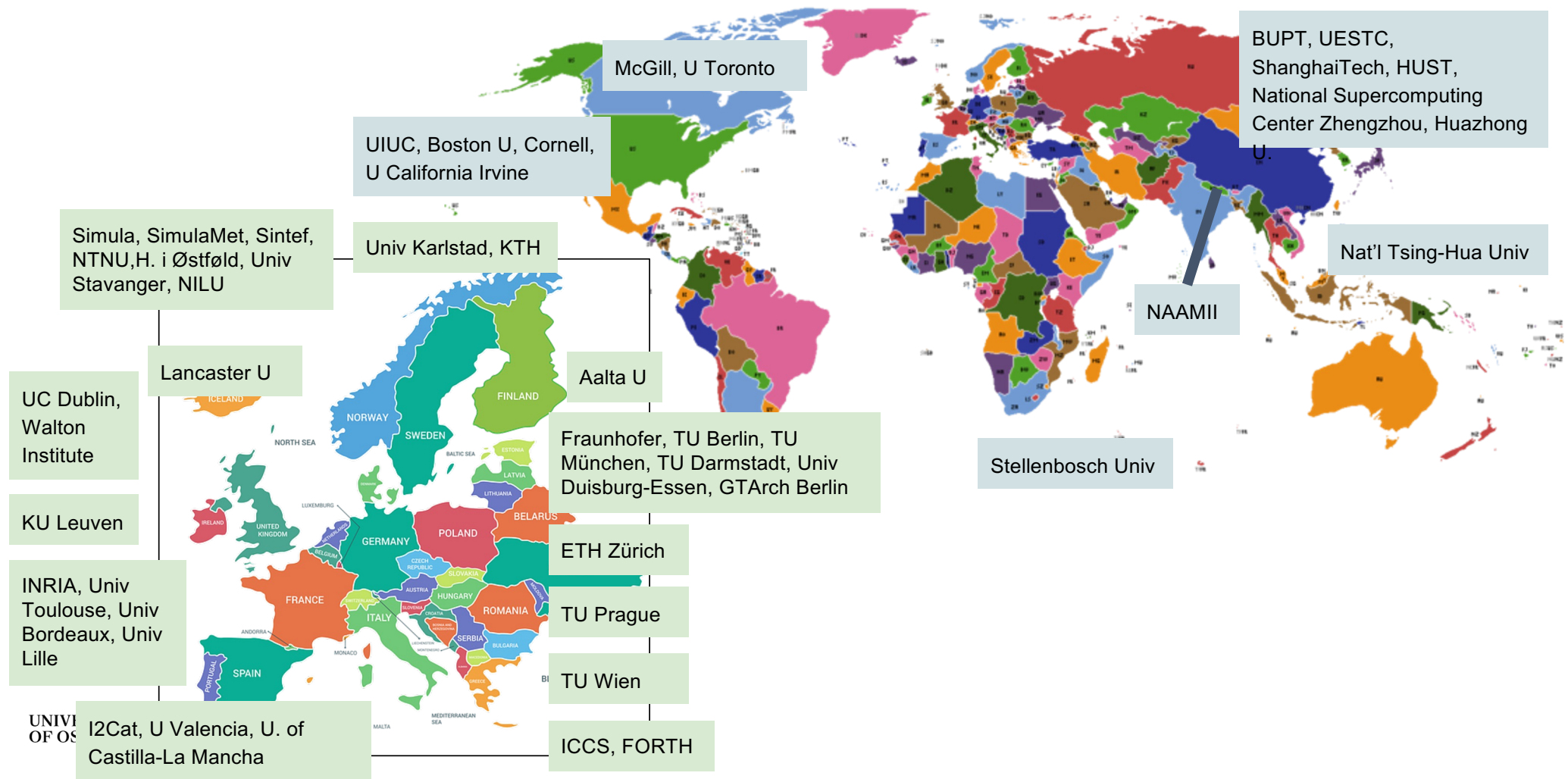


Electronic Waste (e-waste)

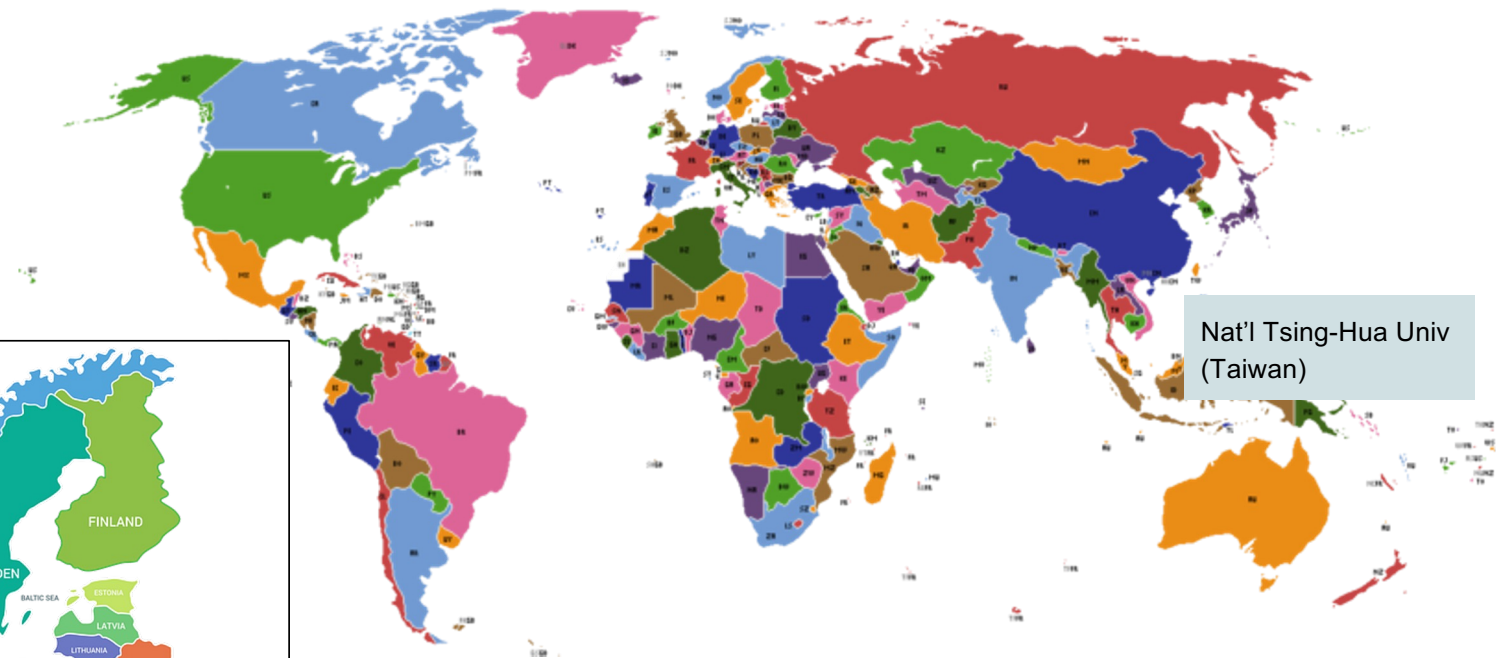
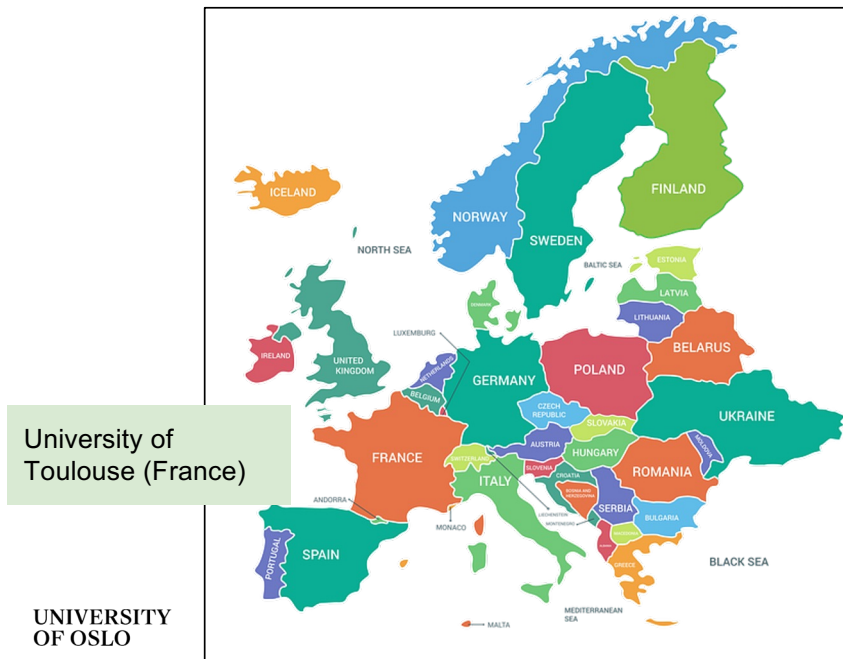
Group's qualities

- Broadness of scope, not a single researcher's brainchild
- Free interaction and frequent collaboration
- Industrial collaboration
 - Blockchain Lab, MoU with IOTA, DNV GL, Dolphin, Numascale, Aker BP, Equinor, Domos, Oracle, Nvidia, Spotify, Statnett, Hafslund, ADLink, 7bulls, Softeam, Activeeon, InAccess, Fraunhofer, Forkbeards AS, Sonitor AS, Lyse Energi, Green Mountain Data Center, Lefdal Mine Datacenter, NCE Smart, OBOS, Altibox, Multinett, Alpha Venturi, Eye Networks, NordPook, NVE, PROSA Security, IOTA, Alpha Venturi, AtomIQ, Bosch, Telenor, Telefonica, Nokia
- Lab collaboration
 - Simula & SimulaMet (eX3, Iler positions), U. Karlstad (Iler position), TU Darmstadt (fellowship), Nokia Labs, OBOS Living Lab

Academic collaboration



Exchange agreement for master students



We have bilateral agreements with both NTHU on Taiwan and the University of Toulouse for student exchanges.

Spend a semester of your master thesis time, either with or without courses, at two prestigious universities

- NTHU: center of chip development
- Toulouse: home of Airbus

Department's qualities cont.

- Open source & open data contributions
- Standards: IETF, ITU-T
 - Think of us every time a packet is lost & retransmitted 😊
- Recognized, industry implemented results
 - in supercomputing (via Nvidia-Mellanox, Oracle)
 - reservoir simulations (via Equinor and Aker BP)
 - in filmmaking (via AliceVision)
- ND has one of the most cited papers of IFI, the following paper has 3165 citations since published in 2018:

[Mobile edge computing: A survey](#)

N Abbas, Y Zhang, A Taherkordi, T Skeie

IEEE Internet of Things Journal 5 (1), 450-465

Collaboration and Innovation

Co-applicant of SFI SIRIUS (the only MatNat-led SFI)

ND has been strongly associated with Simula

- complete group had leave-of-absence from IFI to be at Simula at some time (~2004)
- strong recruitment from Simula
 - 3 people recruited from Simula (today's SimulaMet: including both of our female professors), high citation count, impact
 - of permanent employees: 2 returned from Simula

Innovation

- historical - via Simula
 - Fabriscale (HPC), ForzaSys (video search), Augere (medical imaging), Celerway (wireless communication), LABO Mixed Reality (movie production), Lividi
- currently applying - IFI only
 - WICROW (wireless communication)

Collaboration and Innovation

MishMash Centre for AI and Creativity <https://mishmash.no>

- *create, explore & reflect on AI for, through & in creative practices*
- large Norwegian consortium
- in ND: develop innovative CoCreative AI systems

AI for Decisions Center

- advance AI for decision-making through fundamental research and real-world use cases, ensuring **effective, safe, and trustworthy decisions** in sectors critical to society
- **interdisciplinary research** on technological development, safe and responsible innovation, and **societal and human consequences of human-AI teaming**
- in ND: Multi-agent decisions in **energy systems** for scenarios with **shared resources and interdependent or competing objectives incorporating FATE**

Gemini Center for Sustainable and Trustworth AI

Master courses

IN4230 (Autumn)

- Computer Networks (Michael, Özgü, Tor)

IN5020 (Autumn)

- Distributed Systems (Roman, Amir)

IN5031 (Spring)

- Protocols and AI for Future Internet (Tor)

IN5050 (Spring)

- Programming heterogeneous multi-core architectures (Håkon (2er), Carsten)

IN5060 (Autumn)

- Quantitative Performance Analysis (Özgü, Carsten)

IN5410 (Spring)

- Energy Informatics (Sabita)

IN5420 (Spring)

- Distributed Blockchain Technologies (Roman)

IN4260MCT (Autumn)

- Networked Systems and Creative Computing (Cagri)

Master thesis projects & structure

Master thesis projects –

check ND's home page: <https://www.mn.uio.no/ifi/english/research/groups/nd/master-projects/>



4. semester	Master's thesis	Master's thesis	Master's thesis
3. semester	Master's thesis	Master's thesis	Master's course
2. semester	Master's thesis	Master's course	Master's course
1. semester	Master's course	Master's course	Master's course
	10 ECTS credits	10 ECTS credits	10 ECTS credits

4. semester	Master's thesis	Master's thesis	Master's thesis
3. semester	Master's thesis	Master's thesis	Master's thesis
2. semester	Master's course	Master's course	Master's course
1. semester	Master's course	Master's course	Master's course
	10 ECTS credits	10 ECTS credits	10 ECTS credits

Sustainable Immersive Networking Lab (SINLAB)



Özgü Alay



Carsten Griwodz



Cagri Erdem



Myrthe Tilleman

Sustainable Immersive Networking Lab (SINLAB)



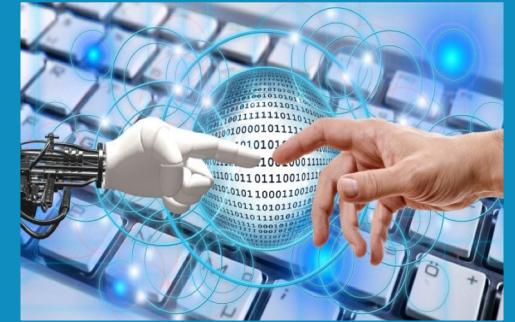
- Tactile Internet
- Immersive remote operations
- Energy Efficiency
- Ethics and trustworthiness

Immersive



- 5G and B5G Networks
- Monitoring and Analytics
- Ultra Low Latency connectivity
- Distributed Edge Intelligence

Sustainability



- Capturing actions and spaces
- Mixing reality and virtuality
- Understanding human senses

Networking



SINLAB Equipment

VR headsets:
Oculus Rift/Quest
HTC Vive



Indoor C-band & mmwave
testbed with Nokia RAN

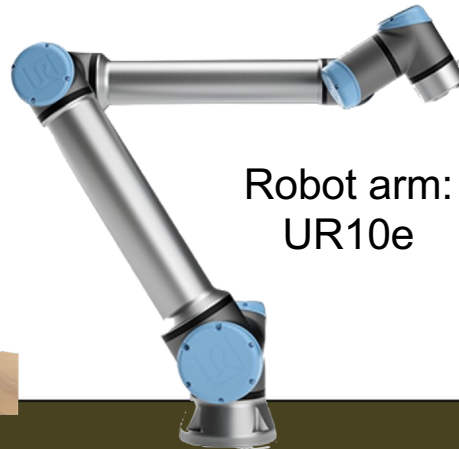
Rokoko
Smart Suit



Bhaptics
Tactsuit



Project Northstar
AR Headset



Robot arm:
UR10e

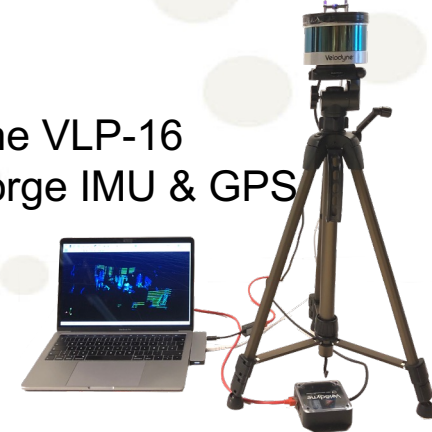


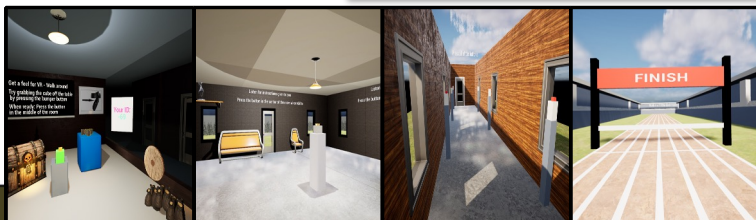
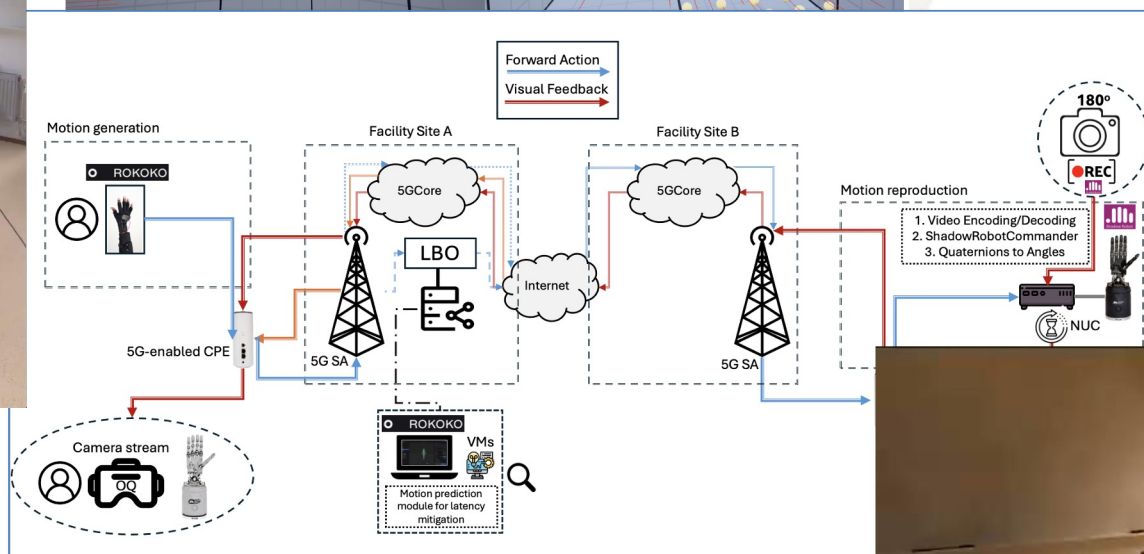
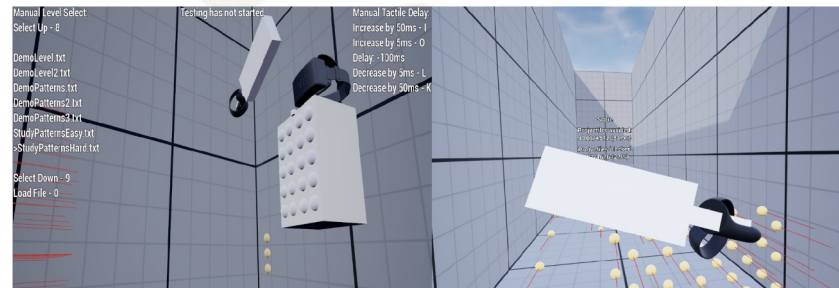
Shadow
Dextrous
Hand

Vive
Tracker



LIDAR:
Velodyne VLP-16
Tinkerforge IMU & GPS





Tutorial Room

Recap House

Fire Drill

Track and Field



OF OSLO

SINLAB Master Theses

SINLAB: Exploring Latency, Prediction, and User Experience in Advanced Teleoperation Systems

SINLAB: Drone LIDAR streaming for Public Safety

SINLAB: XR - human motion from a robot arm?

SINLAB: Immersive Musical Human-AI Interactions

SINLAB: Continuous body emotion recognition during creative tasks

SINLAB: Multimodal and Multi-Agent Frameworks for Interactive Music Generation

SINLAB: Modeling Expressive Guitar Techniques Using Differentiable Digital Signal Processing (DDSP)

SINLAB Master Theses

SINLAB: Empirical analysis of 5G network measurements using Machine Learning

SINLAB: Investigating Deployment Patterns for Mobile Nodes in Edge Computing with Power Usage and Real-Time Support

SINLAB: Mobile Network Secaurity

TCP, when the sender is rate limited

Short description:

- It is extremely common that applications, not the network, limit the rate of traffic (e.g.: video)
- How does TCP (or QUIC) behave, then?

Task:

- Examine TCP implementations (Linux, FreeBSD, Apple, Windows, ..).

Other topics on TCP / QUIC / congestion control could be possible - talk to me (Michael Welzl)

Multimodal Sensing Infrastructure for Human-Centered AI Applications



[1] [IFE Hammlab](#)



Possible Master Theses

Real-Time Multimodal AI Infrastructure:

- Develop a system that integrates RGB and infrared sensing pipelines for real-time human analysis
- Explore how AI models can be efficiently deployed across edge devices and cloud platforms

Privacy-Preserving Human Sensing Systems:

- Investigate approaches for analysing human states while protecting sensitive personal data.
- For example: Extract micro-expression, Motion intensity and abruptness, etc.

Recommend courses: IN5050, IN5060, IN5020, IN4260MCT

Nice to know: Computer Vision, Machine Learning

The Collaboration Teams



PhD Candidate. Chau Thi Thuy Tran

- Researcher at IFE
- Email: chau.tran@ife.no || cttran@uio.no



Prof. Carsten Griwodz (UiO)

- Professor in Digital Infrastructure and Security (DIS).
- Email: griff@ifi.uio.no



Kai Morgan Kjølervbakken – (IFE)

- ADS Department Head.

and more ...

Master's thesis topics

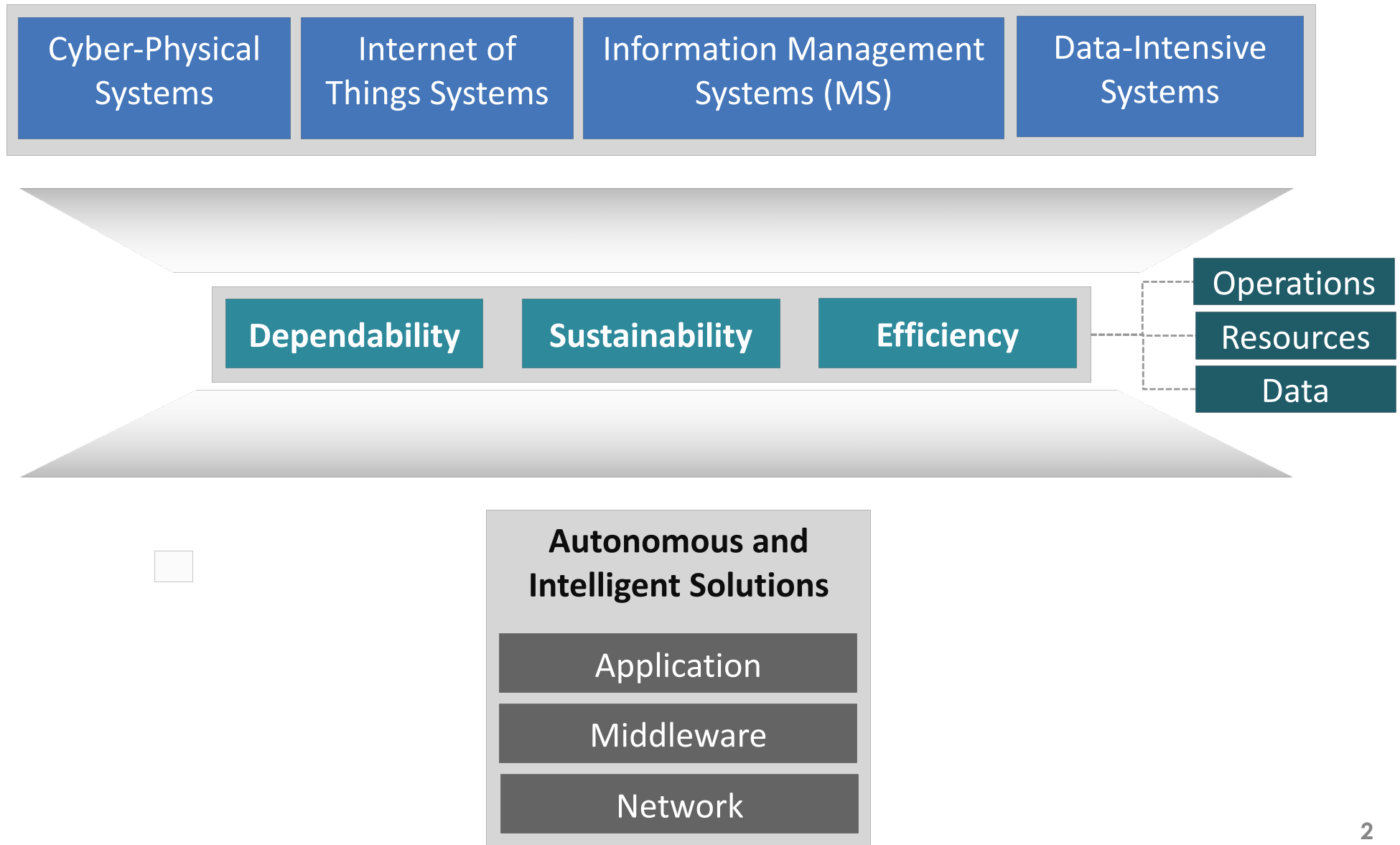
Amir Taherkordi
amirhost@ifi.uio.no

September 8, 2026

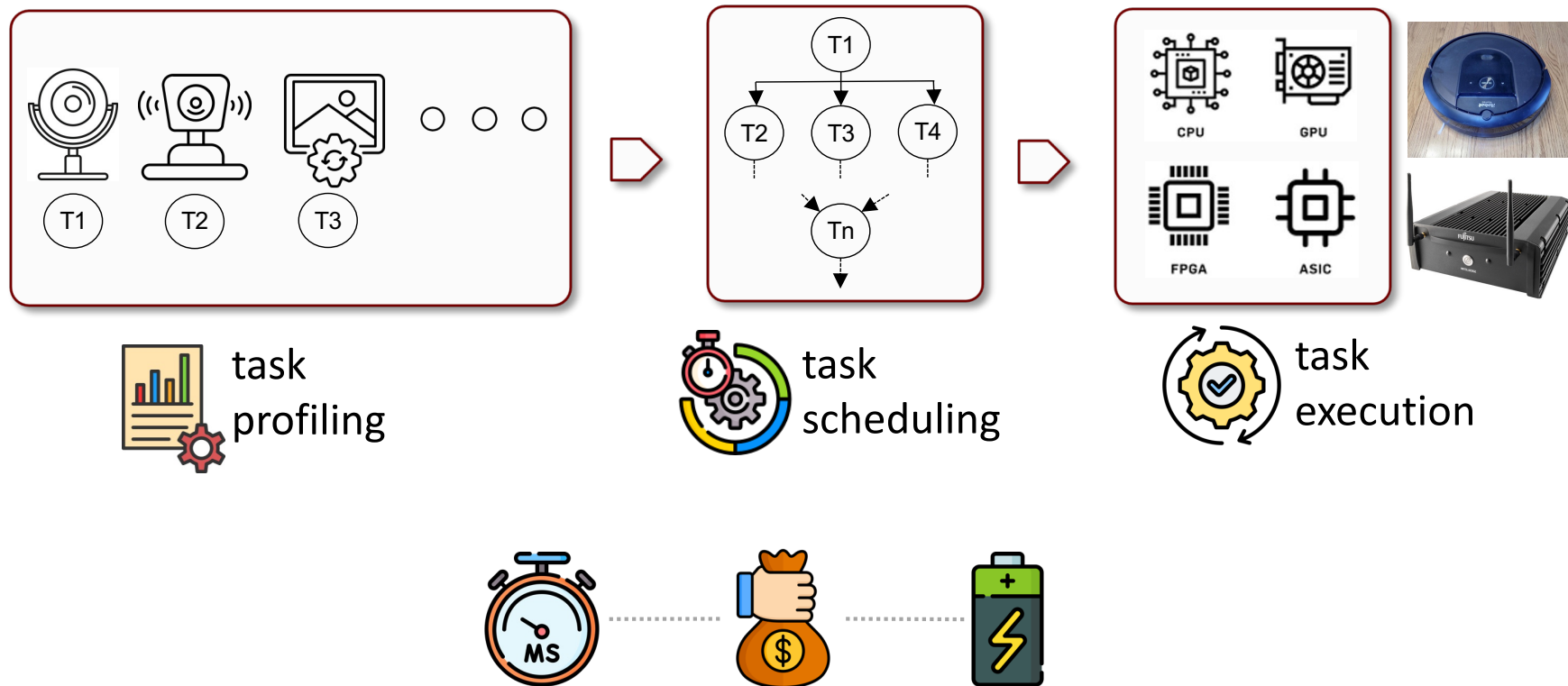


UiO : University of Oslo

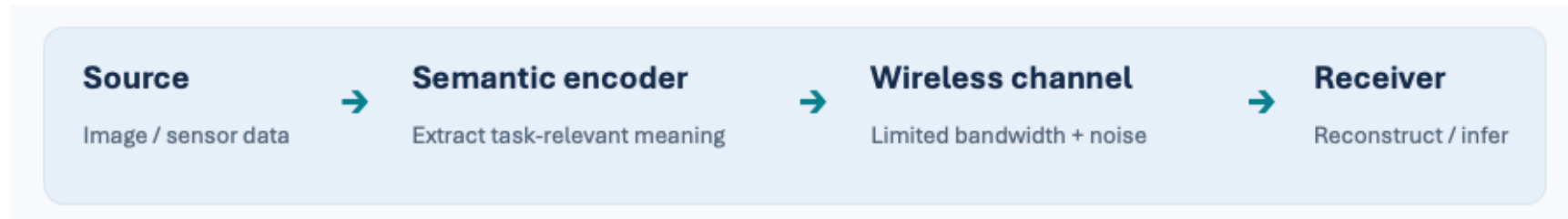
Overview of my research



Topic 1: Distributed MLs and LLM on Edge-Cloud continuum

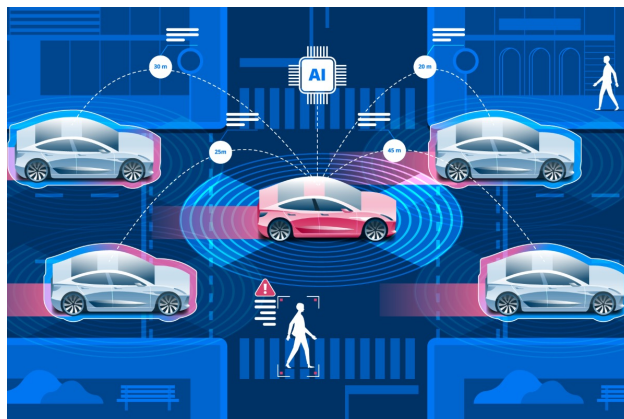


Topic 2: Semantic communication towards 6G



- **Knowledge Graph-Augmented Semantic Communication for Efficient 6G Networks**
 - Investigating using knowledge graphs (KGs) as a structured, shared semantic background, enabling the transmitter to send only semantic "deltas" while the receiver reconstructs meaning by reasoning over the KG.
- **Semantic Communication for Extended Reality (XR) Over 6G**
 - Extended reality (AR/VR/MR) over 6G demands ultra-low latency and high bandwidth
 - Transmitting full scene data is infeasible
 - developing a semantic communication pipeline for XR that transmits only perceptually and contextually significant scene elements

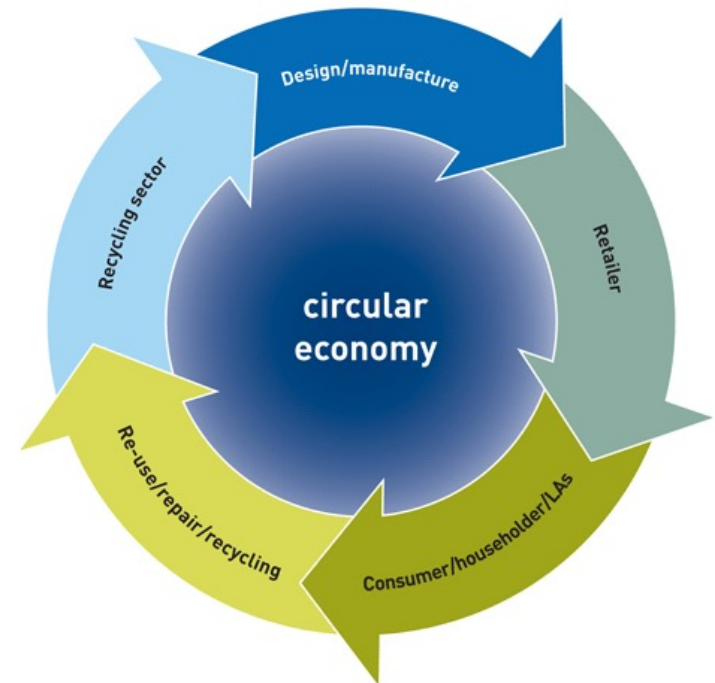
Topic 3: Autonomous Driving Systems (ADS)



- **Trustworthy automated fault diagnosis in ADS**
 - LLM agents can now diagnose faults from logs and metrics
 - but we don't know whether they use the evidence or guess from typical failure patterns
- **Root-cause analysis in ADS**
 - Set up a testbed, inject known faults, and build a pipeline (with an LLM agent on top) that queries logs, metrics, and traces to rank likely causes. Accuracy is measured directly against the injected faults.
- **Moving learned network models between environments**
 - A traffic or anomaly-detection model trained on one network often fails on another.
 - the project diagnoses which parts of the model are affected by the change and adapts only those.

Circular Economy

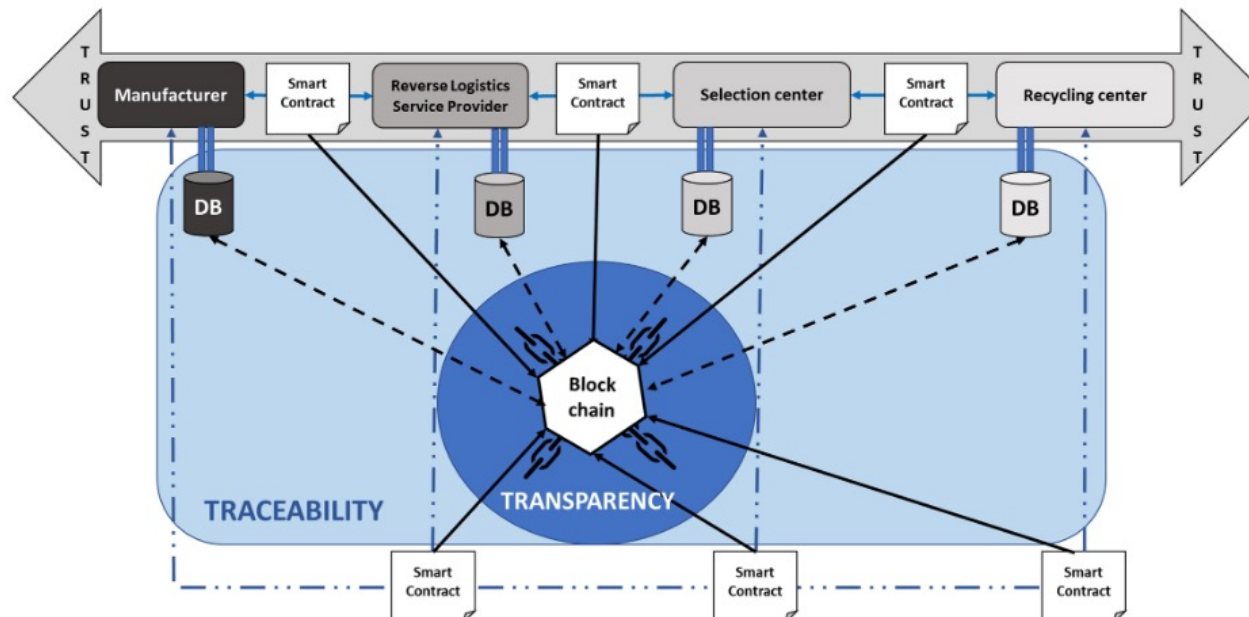
- Circular Economy (CE)
 - an integral part of the sustainability agenda
 - contributes to several different Sustainable Development Goals (SDGs).
 - SDG 12 Responsible consumption and production: heart of CE
- Keeps materials, products, and services in circulation for as long as possible
- A closed-loop economy
 - sharing, reuse, repair, reconditioning, and recycling



Sustainability: Digital Product Passports



■ LLMs for DPPs



Topic 4: Sustainability and Digitalization

■ Event-Driven Digital Twin for Repair & Recycling

- Independent sites publish product and material-flow events. The twin must reconstruct consistent state.

■ LLM-based Semantic Understanding for DPP Question Answering

- understanding DPP questions by learning relationships among questions, ontology concepts, DPP fields, and supporting evidence

■ Carbon- & Reliability-Aware Placement of a LLM Pipeline

- Deploy AI workload across **edge, fog, and cloud**. A transparent scheduling controller selects execution location and model version in real time
- balancing SLOs, energy consumption, live carbon intensity, etc.

Ongoing Relevant Projects

■ Funded by



- EdgeSkills
- CE-RISE
- 3D-Circular
- MSCA DSTrain

■ Funded by



The Research
Council of Norway

- SecondPass
- REWARD
- AirQMan

The master's projects are carried out:

within one of the projects listed above

in collaboration with other professors at the ND&DKM groups

with co-supervision from two senior researchers
and six PhD students working on relevant topics

Blockchain Lab at the University of Oslo

Master thesis projects fall 2026



UiO : University of Oslo

1

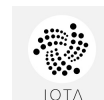
Blockchain Lab at UiO

- A cross-disciplinary center of competence
 - Bridges core research with innovation
 - Cooperation with key technology providers and use case owners
 - Operator of the Norwegian EBSI node, backed by Digdir

- Academic

- Multiple groups and departments at the University of Oslo

- Research institutes, public and private sectors



ALPHA
VENTURI

- Strategic collaboration with



IC3

2

2

Blockchain penetration

Programme

An incubator programme to help imagine, build and launch blockchain pilot projects to improve the life of European citizens.

Spotlight

EBSI is surging ahead!

Blockchain is the future. This technology is transforming our society. This is why the European Commission and the European Blockchain Partnership are building the European Blockchain Services Infrastructure (EBSI), striving for blockchain technology serving European citizens with services based on European values. Meet the Early Adopters programme and multi-university pilot that are showing us how Europe's emerging Blockchain Infrastructure will look in practice.

[LEARN MORE](#)

Who is EBSI for?

Public administrations

It allows public administrations to protect against fraud, increase trust and security and make the verification of data authenticity easy and cost-efficient.

Businesses

It allows businesses to effortlessly interact with government agencies and reduce friction and administrative / compliance costs.

Citizens

It allows citizens to take control of their data, secure them and easily move with their own credentials across Europe.

What is EBSI?

Since 2018, 29 countries (All EU Member States, Norway and Lichtenstein) and the European Commission have joined forces to form the **European Blockchain Partnership (EBP)**. They have committed to working together towards realising the potential of blockchain-based services for the benefit of citizens, society and the economy.

The Partnership is building a European Blockchain Services Infrastructure (EBSI). Their vision is to leverage blockchain to the creation of cross-border services for public administrations and their ecosystems to verify information and make services trustworthy.

Since 2020, EBSI is deploying a network of distributed blockchain nodes across Europe, supporting applications focused on selected use-cases. EBSI is the first EU-wide blockchain infrastructure, driven by the public sector, in full respect of European values and regulations.

Find out who your national EBP representative is [here](#).

3

3

Projects building blockchain-based applications



Self-sovereign digital identities

- Decentralizing digital identities
- Comparison with federated identities
- Realizing the principles of SSI and the role of blockchain in the process



Data sharing in energy trading

- Direct trading between micro-consumers and micro-producers
- Balance between verifiability and compliance with privacy requirements



Verifiability and certification through blockchain



National e-krona (a pilot)



5

5

Projects proposing and improving blockchain technologies



Operating national EBSI node for Norway

Transaction finality in DAG-based blockchain (collaboration with IOTA)

Replacing cryptopuzzles with useful PoW

Experimentation

- Modular blockchain simulator
- Benchmarking blockchain performance
- Synthetic workload generator
- Analyzing the effect of different attacks on blockchain

6

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Modular blockchain simulation network

Simulation Configuration

Repetitions 10

Base Seed 339 Use randomized seed?
☐ Yes ☒ No

NumNodes 100

NumBlocks 50

MaxParallel 4

Honest Node Powers

Add mining power values for each honest node. Total (honest + selfish) must not exceed 1.

+ Add node Clear nodes Delete nodes Total power: 0.20 / 1.00

SelfishNodePower 0.2

Network Models

Network Models fixed

Delays in seconds (h-honest, s-selfish)

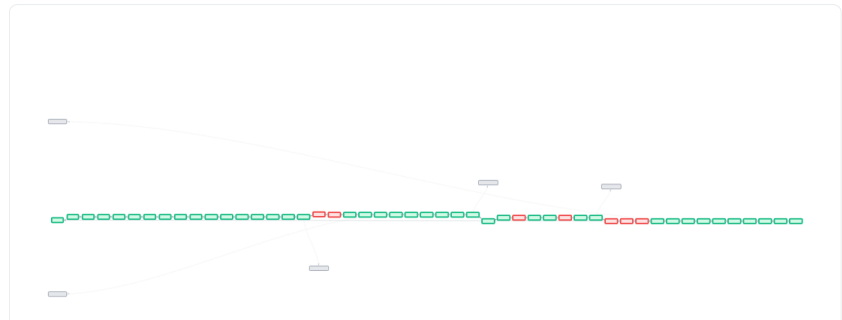
h-h 0,454 h-s 0,454 s-h 0,454 s-s 0,454

If multiple parameters accept arrays, the simulator explores the full combinatorial space across all alternatives.

Save Clear Submit

The simulator is already fully functional; over 15000 lines, mostly in Golang

■ HONEST ■ SELFISH ■ Orphaned



Many interesting extensions are possible:

- Simulation of specific attacks on blockchain
- Communication protocols between the nodes that consider network failures
- Implementation of new popular protocols, such as validators in Ethereum
- Integration with existing benchmarking tools

7

7

Digital credentials and identity wallets

- We are witnessing proliferation of digital wallets
 - Cryptowallets in Bitcoin and other cryptocurrency systems
 - ID wallets storing personal user info and credentials
 - Digital product passports for cars, appliances, and other “things”
- Emerging European standards such as EBSI and EIDAS 2.0
- DigDir is working on integration with digital infrastructure in Norway
- The goal of the project is to bridge over the gap between the requirements and existing technologies

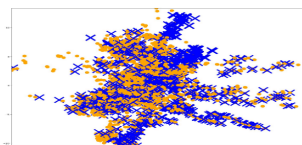


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Visualizing poisoning attacks on federated learning

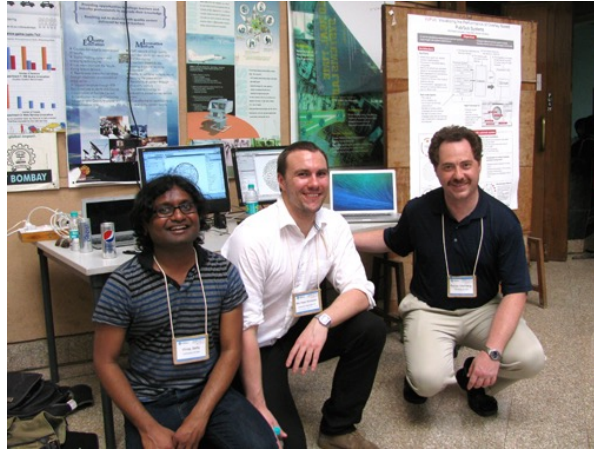
- Federated learning (FL) pools resources of multiple machines that collectively participate in the ML process
 - FL parallelizes model training and allows ML to scale better
- The security problem of poisoning when one of the machines inadvertently or deliberately contributes incorrect data to the process
- Tools for visualizing various aspects of the poisoning attack recently started to emerge
- The goal of the project is to study and improve these tools!



9

9

Past master theses



- Best demo award by Nils Peder Korsveien at ACM DEBS 2014
- Thesis by Endri Hysenaj was nominated for the NR prize

10