

HELSINGIN YLIOPISTO HELSINGFORS UNIVERSITET UNIVERSITY OF HELSINKI

GEARAVIEW FROM FINLAND

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EdgeAl in Finland: FCAI-6GENESIS Special Interest Group

- "The Flagship Programme is an instrument that promotes excellent research and versatile impact arising therefrom."
- Through this one-time instrument, the Academy of Finland has decided to fund six Flaghips in the 8-year period of 2019-2026
- EdgeAl is a Special Interest Group connecting two flagships: The Finnish Center for AI (FCAI) and the **6GENESIS**
- https://fcai.fi/edge-ai



Challenges with application scenarios

Requirement for local computing power

Object and activity recognition, graphics rendering

Low latency

3D games and AR/VR

Industrial Internet

Autonomous vehicles

Coping with increasing bandwidth requirement

Sensor data feeds from devices and vehicles

User generated content

AR/VR

Requirement for privacy

Localized processing and learning Anonymization



Deploying applications near the users to avoid latency and bandwidth problems

Facilitating elastic and mobile execution of network components and application logic in COTS servers and base stations

The cloudlet architecture from CMU consists of customized ephemeral virtual machines with soft state, and a platform for running them

Cloudlets and containers can even run on clusters of smart devices (Lagerspetz et al. Pervasive Data Science on the Edge, 2020).

Virtualized Multi-access Edge Computing (vMEC). Standards: ETSI MEC, 3GPP 5G architecture

Amazon Wavelength, FaaS (Function as a Service)



Versatile Edge Computing in 5G and Beyond



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MEC considerations

- Impact of mobility (devices, edge servers, base stations)
 - Intra and inter MEC host mobility (the application service is stateful)
- Impact of MEC host placement
- Edge gateway vs core vs closest data center
 - Core deployment may increase latency and data rate variation but reduce need for application mobility
- Dynamic placement based on required and expected service level



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Why we need Al for Edge

- Diverse requirements from different use cases \rightarrow AI is needed for optimizing the network (towards cognitive networking) and for optimizing and supporting verticals
- AI for Edge and 5G and Beyond
 - Radio management
 - Network management and slicing
 - Function placement
 - Vertical support / applications
 - Security
- Edge for Al
 - Distributed and decentralized paradigm
 - Programmability of the network (QoE)
 - Privacy and ethical data management





Programmatically manage and compose IoT devices and services IoT hub running at the edge as an Service Function Chain (SFC) service Intelligent AP, Philips Hue bridge and a light, Chromecast, connected curtain

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Limitations of Al

- ML algorithms are typically not designed to be distributed
 - Data and models are centralized
 - Models are trained on the whole dataset and requite a lot of data
 - Memory optimizations
 - Difficulties in transporting the data across the network
- Many ML algorithms are blackbox algorithms
 - Decision process is difficult to analyze
- Training requires deep technical knowledge about data and the targeted application

Towards Edge Al

- From distributed AI to decentralized AI
- Research roadmap:
 - Application design, development and deployment need to be revisited
 - Seamless edge computing across cloud infrastructures
 - Data/model sharing and aggregation
 - Federated learning and transfer learning as examples
 - Data/models must be anonymized and privacy protected

 Edge AI is key in enabling the next generation of low latency applications and supporting the ubiquitous computing vision of invisible computing

A 5G network slice for air pollution sensing platforms

- sensors



Builds on: Station for Measuring Earth Surface-Atmosphere Relations (SMEAR) https://www.atm.helsinki.fi/SMEAR/

Green path navigation





Directions

- Need seamless edge computing across cloud infrastructures Need distributed and decentralized AI and orchestration
 - Two complementary environments
 - Device edge in-network cloud \rightarrow distribution
 - Fog environment \rightarrow decentralization, opportunistic computing
 - With inherent privacy properties
 - Driving use cases: megacities, traffic and autonomous systems, industry deployments
 - Need to study vertical applications



REAL AI FOR REAL PEOPLE IN THE REAL WORLD



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Finnish Center for Artificial Intelligence



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INFORMATION

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