IoT and Edge Computing
HW/SW Co-design for IoT at the Intelligent Edge

Ovidiu Vermesan, SINTEF

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SW in ECS based digitisation
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Outline

• IoT Edge Granularity
• Distributed Architectures
• IoT Edge Ecosystem-HW/SW Device to Platform
• Priorities in the area of IoT and Edge Computing
• Challenges in the area of IoT and Edge Computing
IoT Edge Granularity

Internet of Intelligent Things

Cloud

Fog MEC

Meta Edge

Deep Edge

Micro Edge

Smart Sensors/Actuators Integration

IoT devices including sensing/actuating, connectivity, intelligent processing (CPUs, GPUs, TPUs). Resource and energy-constrained IoT and edge processing.

Embedded HW/SW Co-design

Deep Edge

Fog MEC

Cloud

Multi-access edge computing (MEC)

IoT and processing, network computing units and intelligent controllers (PLCs, RTUs, DCS).

Micro and clustered servers to (e.g., high-end CPUs, GPUs, FGPAs, etc.), on premises edge computing, local edge, high performance embedded edge computing.

Organic Computing

Continuum-X

Fusion

Sensors

Actuators

Smart Sensors/Actuators Integration
Distributed Architectures

Internet of Intelligent Things

Distributed Architectures
Mesh Topologies

Green HW/SW

Green IoT and Computing

IoT Edge Applications

Physical, Digital, Virtual, Cyber

IoT sensing and autonomic computing

Systems of Heterogenous Systems


Dependability
Trustworthiness

Holistic view of sensors/actuators HW/SW/algorithms integration
IoT Edge Ecosystem-HW/SW Device to Platform

- SW/HW tools
- Frameworks
- OSs
- Building blocks in the form of containers, microservices, virtualization
- Orchestration methods
- Programming languages (beyond Go, Swift, Rust, TypeScript)
- Platform and IDE-based codesign for intelligent embedded IoT systems
- Virtual simulation tools
- Autonomic IoT and edge computing tools
Priorities in the area of IoT and Edge Computing

- Evolutionary Internet of Intelligent Things and Edge Computing

- SW/HW hybrid modelling, IoT digital twins simulation SW and virtual environments for IoT and edge
- Software and algorithms for multiple upgrades and updates on the devices
- Intelligent embedded software combining (data acquisition, AI, expert systems, neural networks models).
- Swarm computing and neuromorphic SW/HW technologies

- IoT and edge embedded HW/SW co-design
- Evolutionary algorithms and software tools to optimise task scheduling problem for the IoT
- Resource-constrained software including embedded AI techniques
- IoT systems mission-specific and power-constrained
- SW/HW neuromorphic IoT and bioinspired heuristics and hybrid models for evolutionary and organic computing for IoT
Challenges in the area of IoT and Edge Computing

- SW for mesh and IoT swarm base systems
- SW correct by constratction
- Phyton extension to IoT and edge for integrating complex mathematical operations, data analysis, machine learning, and neural network building.
- Over the air software tools – ennergy and connectivity efficient.
- HW/SW co-design of reconfigurable IoT edge HW
- Automatic code-generation (visual, natural ways etc.). Low Code/No Code.
- Autonomous SW tools for IoT and edge computing verification validation and testing
- Toolchain to develop, test, and validate SW/HW-IoT based functionalities
Challenges in the area of IoT and Edge Computing

- SW Mobile edge system level management
- Mobile IoT edge platforms management
  - IoT edge orchestrators
  - Service authorizations, traffic rules, DNS configuration
- Simulation platforms to experiment for various IoT edge application scenarios
- Mobility management allowing users to seamlessly access edge applications including service continuity
- Heterogeneous access management: wireless, cellular
- Edge granularity and IoT edge continuum
- Virtualized location-based applications at the edge IoT devices
- Contextual location awareness, low latency, geographical distribution wireless access, large-scale IoT mesh networks, IoT intelligent mobile devices, real-time interactions, interoperability, federation, support for real-time analytics, cognitive and AI functions and features.
Alliance for Internet of Things Innovation

@aioti_eu
www.aioti.eu