The Edge Networking Evolution and the Softwarization of Internet of Things

Lefteris Mamatas, Assistant Professor
emamatas@uom.edu.gr
University of Macedonia, Greece
Motivating use-case: IoTs and the maritime industry

Challenges:
- IoT node heterogeneity
- Challenging connectivity with the shore
- Large amounts of data
- Resource constraints
- Scalability
- Security
Internet of Things: An IPv6 address is not enough

Currently:
- IoTs with wide-range of network conditions and requirements
- Separated context-sensitive solutions

Four enablers:
1) IoT network softwarization
2) Cloud orchestration for IoTs
3) E2E network slicing up-to the IoT device
4) Softwarized IoT testbeds
Enabler I: IoT network softwarization

Softwarized IoT Protocols

Evolutionary
WSN -> SDNs

Revolutionary
SDNs -> WSNs

Issues:
• Control channel overhead
• Intermittent connectivity with the controller
• Scalability of control messages
• Mobility
• No single protocol that works everywhere

Supported by the open call schemes of the WiSHFUL (grant agr. no 645274) and MONROE (grant agr. no 644399) projects.
Enabler II: Cloud orchestration for IoTs

- **Cloud-to-edge compute continuum:**
  - micro-services
- **Utilize alternative edge cloud resources:**
  - resource abstractions

- **Programmable orchestration features**
  - efficient resource allocation
- **Network flow control**
  - dynamic load balancing

Supported by the open call schemes of the WiSHFUL (grant agr. no 645274) and MONROE (grant agr. no 644399) projects.

http://swn.uom.gr
Enabler III: E2E network slicing up-to the IoT device

Supported by the EU-BRA Horizon 2020 NECOS Project (grant agr. no 777067) funded by the European Commission and the Brazilian Ministry of Science, Technology, Innovation, and Communication (MCTIC) through RNP and CTIC.

http://swn.uom.gr
Enabler IV: Softwarized IoT test-bed facilities

- **Test-bed federations** (e.g., FED4FIRE+) allocating both cloud and IoT resources:
  - *edge clouds*: test-beds with low-end physical machines (e.g., wireless test-beds)
  - *IoT test-beds*: programmability of IoT devices, realistic radio communication conditions and data collection, e.g., IMEC w-iLab.t
  - *Smart-city IoT deployments*: replicating real application requirements, e.g., IMEC Citylab

- **New test-bed control abstractions** implementing E2E network slicing up-to the IoT protocol level

- **Radio and network control abstractions** over heterogeneous IoT nodes, e.g., WiSHFUL platform ([http://github.com/wishful-project](http://github.com/wishful-project))

- **Softwarized IoT platforms**, e.g., MINOS or CORAL-SDN.

- **Realtime programmability** of IoT protocols:
  - Over the air programming
  - Dynamic ELF loading

- Relevant source code can be found at: [http://github.com/swnrg](http://github.com/swnrg)
Conclusions

• There is **no single IoT protocol** solution:
  • protocol softwarization is the answer

• We need the **right abstractions**, interfaces and open standards:
  • spanning over both IoT and cloud resources

• **E2E network slicing** covering the IoT network protocol stack:
  • high-level IoT service descriptions triggering the slicing

• **Softwarized IoT test-bed experimentation** is important:
  • open-access test-bed federations can have a catalytic impact