



UNIVERSITÀ DI PISA  
**DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE**  
**Dottorato di Ricerca in Ingegneria dell'Informazione**

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Doctoral Course

**“Rapid prototyping of Edge Computing applications using open source frameworks”**

Teacher: Dario Sabella

*INTEL Deutschland GmbH - Germany*

**Short Abstract:**

The course will cover the main aspects of Edge Computing, from a practical perspective and with the aim to provide useful tool for application development. An initial technology overview will provide the description of MEC and related standards and industry associations working in the field, together with various open source frameworks available. A particular emphasis will be given to the ETSI MEC standard (Multi-access Edge Computing), by mentioning as well other SDOs and the relationship with 3GPP for the definition of 5G systems. A classroom exercitation will complete the course, where students will be asked to build their own application example exploiting MEC and based on the open source software introduced during the course.

**Course Contents in brief:**

- Edge Computing, Fog computing, Cloud computing
- ETSI MEC Framework and Reference Architecture
- MEC in 4G, MEC in 5G, MEC in WiFi networks
- MEC Services, MEC Management, MEC Mobility
- MEC APIs (Radio Network Information API, Location API, BW API, ...)
- Open Source frameworks: OpenNESS, OpenAPI MEC APIs representations, ETSI Forge, MEC Sandbox, tools and MEC Ecosystem
- Classroom exercise

**Total # of hours:** 20

**References:**

**References:**

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[MEC002] ETSI GS MEC 002 V1.1.1 (2016-03) Mobile Edge Computing (MEC); Technical Requirements - [http://www.etsi.org/deliver/etsi\\_gs/MEC/001\\_099/002/01.01.01\\_60/gs\\_MEC002v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/MEC/001_099/002/01.01.01_60/gs_MEC002v010101p.pdf)

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- [MEC009] ETSI MEC 009 “General principles for Mobile Edge Service APIs” - [http://www.etsi.org/deliver/etsi\\_gs/MEC/001\\_099/009/01.01.01\\_60/gs\\_MEC009v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/MEC/001_099/009/01.01.01_60/gs_MEC009v010101p.pdf)
- [MEC010-1] ETSI MEC 010-2 “Mobile Edge Management; Part 2: Application lifecycle, rules and requirements management” - [http://www.etsi.org/deliver/etsi\\_gs/MEC/001\\_099/01002/01.01.01\\_60/gs\\_MEC01002v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/MEC/001_099/01002/01.01.01_60/gs_MEC01002v010101p.pdf)
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- [MEC011] ETSI MEC 011 “Mobile Edge Platform Application Enablement” - [http://www.etsi.org/deliver/etsi\\_gs/MEC/001\\_099/011/01.01.01\\_60/gs\\_MEC011v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/MEC/001_099/011/01.01.01_60/gs_MEC011v010101p.pdf)
- [MEC012] ETSI MEC 012 “Radio Network Information API” - [http://www.etsi.org/deliver/etsi\\_gs/MEC/001\\_099/012/01.01.01\\_60/gs\\_MEC012v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/MEC/001_099/012/01.01.01_60/gs_MEC012v010101p.pdf)
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- [MEC016] ETSI MEC 016 “UE application interface” – [http://www.etsi.org/deliver/etsi\\_gs/MEC/001\\_099/016/01.01.01\\_60/gs\\_MEC016v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/MEC/001_099/016/01.01.01_60/gs_MEC016v010101p.pdf)
- [MEC018] ETSI MEC 018 “End to End Mobility Aspects” - [http://www.etsi.org/deliver/etsi\\_gr/MEC/001\\_099/018/01.01.01\\_60/gr\\_MEC018v010101p.pdf](http://www.etsi.org/deliver/etsi_gr/MEC/001_099/018/01.01.01_60/gr_MEC018v010101p.pdf)
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## CV of the Teacher

**DARIO SABELLA** works with INTEL as Senior Manager Standards and Research, driving new technologies and edge cloud innovation for advanced systems, involved in ecosystem engagement and coordinating internal alignment on edge computing across standards and industry groups. In February 2021 has been elected as Chairman of ETSI MEC (Multi-access Edge Computing), while from 2019 he was serving as vice-chairman, previously Lead of Industry Groups, and from 2015 vice-chair of IEG WG. Since 2017 he is also delegate of 5GAA (5G Automotive Association). Before 2017 he worked in TIM (Telecom Italia group), as responsible in various research, experimental and operational activities on OFDMA technologies (WiMAX, LTE, 5G). Author of several publications (40+) and patents (30+) in the field of wireless communications, energy efficiency and edge computing, Dario is IEEE senior member and has also organized several international workshops and conferences.

## Room and Schedule

→ lessons from remote (MS Teams)

## Course Schedule:

### Day1 (half day – Tue 6 April 2021)

Afternoon: 15.00-18.00

Topics:

- Edge Computing, Fog computing, Cloud computing
- MEC Framework and Reference Architecture [MEC003]
- General principles for Mobile Edge Service APIs [MEC 009]
- MEC Platform Application Enablement [MEC011]
- Classroom exercise – part 1

### Day2 (full day – Wed 7 April 2021)

Morning: 9.00-12.00

Afternoon: 14.00-18.00

Topics:

- MEC in 4G, MEC in 5G, MEC in WiFi networks
- MEC in NFV environment (MEC-017)
- MEC support for Network Slicing (MEC-024)
- MEC Management [MEC010-1][MEC010-2]
- MEC Application and E2E Mobility (MEC-018, MEC-021)
- Software Development for MEC
- MEC-027 – MEC support for Containers
- Open Network Edge Services Software (OpenNESS)
- Classroom exercise – part 2

### Day3 (full day – Thu 8 April 2021)

Morning: 9.00-12.00

Afternoon: 14.00-18.00

Topics:

- OpenAPI MEC APIs representations, ETSI Forge
- MEC Sandbox, tools and MEC Ecosystem
- MEC-012 – RNI API, MEC-013 – Location API, MEC-028 – WLAN Information API
- MEC-016 – UE Application Interface, MEC-014 – UE identity API
- MEC Testing Framework (MEC-025), MEC Conformance Test Suite
- Performance Assessment, Metrics Best Practices and Guidelines (IEG006)
- MEC-026 – MEC support for regulatory requirements
- Application Deployment, Application Walkthrough
- Classroom exercise – part 3

### Day4 (half day – Fri 9 April 2021)

Morning: 9.00-12.00

Topics:

- Vertical segments: focus on automotive (MEC-022 “MEC support for V2X use cases”, and MEC-030 “MEC V2X API”)
- MEC-015 – Bandwidth management API
- MEC Federation, inter-MEC system communication
- MEC in action: examples and trials
- OpenNESS and 5G: integration with SimuLTE/5G
- Classroom exercise – presentation of results