Nome Insegnamento	ADVANCED COMMUNICATION
	TECHNIQUES FOR 5G WIRELESS
	NETWORKS
Modulo	
(da compilare solo nel caso di Corso	
integrato)	
Dipartimento:	DIIES
Corso di laurea:	Laurea in Ingegneria Informatica e dei
	Sistemi per le Telecomunicazioni
Tipo Attività formativa:	Caratterizzante
Settore Scientifico-Disciplinare:	ING-INF/03
Numero di Crediti Formativi Universitari:	6
Propedeuticità obbligatoria:	nessuna
Anno di corso:	П
Semestre:	II
Ore di insegnamento:	48
Modalità di esame:	Prova progettuale

# TITOLARE DEL CORSO

## **Objectives:**

The Advanced Communication Techniques for 5G Wireless Networks course is designed to provide students with the theoretical and practical background to understand and assess the main paradigms, network architecture, protocols, interfaces, procedures and radio resource management of the emerging Fifth Generation (5G) networks and to speculate about the best way they could be integrated into existing and future wireless networks.

Novel networking solutions (e.g., information-centric networking, software defined networking), communication paradigms (e.g., Internet of Things, Machine-to-machine), cellular technologies (e.g., device-to-device) will be presented.

The additional goal of this course is to provide the basics for the analysis, design, and evaluation of the introduced technologies and techniques.

To this aim, part of the course will also be complemented by a series of programming exercises and experimental test-beds, referred to as lab work. Lab work offers a nice opportunity to know students better, to help them learn and understand abstract concepts or complex algorithms, and to stimulate their creativeness. Students will work in small groups. The lab work will typically take the form of a study case comprising a theoretical analysis, a validation by computer simulation and/or a deployment with real hardware.

Some lectures addressing the most recent concepts and trends in communications (e.g., advanced networking/communication techniques) may assume the form of a reading group, where the main results of a landmark research paper (or of a set of key papers) centered on a particular topic could be summarized and their implications discussed.

## Program

#### The 5G Wireless Networks

• Overview of the proposed solutions and architectures

## D2D Communications

- The Role of D2D Communications in Emerging 5G Systems
- Standardization Overview
- D2D Network Architecture
- Uses cases and scenarios (Mobility Scenarios, Local Service, Emergency Communications, IoT Enhancement)
- D2D Communications over Cellular Networks
- Challenges and Ongoing Research (Handover, Heterogeneous Networks, mmWave, Massive-MIMO, Full-Duplex, Social Awareness)

#### **M2M Communications**

- The Role of M2M Communications in Emerging 5G Systems
- M2M Network Architecture
  - M2M Access Methods
  - o 3GPP Network Architecture
  - M2M Communications over 3GPP LTE/LTE-A Networks
  - Service Capability Server
  - M2M Communications Applications
- Service Requirements And Features of M2M communications over 3GPP LTE/LTE-A
  - o Standardization Activities for M2M Communications
  - M2M Service Requirements
  - Features of M2M Communications
- Challenges of M2M communications over 3GPP LTE/LTE-A networks
- Open Research Issues
  - Traffic Characteristics
  - o Routing Protocols
  - o Heterogeneity
  - o Security

#### Information-centric Networking

- Future Internet architectures: an overview
- Named data Networking: architecture and core principles
- ICN in wireless networks (VANETs, MANETs, WSNs, IoT)

#### Software Defined Networking/Network Function Virtualization

- Towards Network Softwarization
- Software defined networking (SDN)/Network function virtualization (NFV): main principles, benefits and open issues
- Standardization overview (ETSI, IETF, IRTF, etc.)
- SDN/NFV in wireless networks/IoT

#### Tools for testing and evaluation of future Internet solutions

- Analytical models, simulation and experimental tools for the design and evaluation of advanced communication systems
- Network simulators (ns-3, ndnSim), emulators (mininet)

## **Resources and main references**

[1] K. Zheng, F. Hu, W. Wang, W. Xiang, and M. Dohler, "Radio Resource Allocation in LTE-Advanced Cellular Networks with M2M Communications," IEEE Commun. Mag., vol. 50, no. 7, pp. 184-192, Jul. 2012.

[2] Vodafone, "RACH intensity of time controlled devices," 3GPP, Tech. Rep., R2-102296, Apr. 2010.

[3] 3GPP TS 22.368 V11.5.0, "Service Requirements for Machine-Type Communications," Sep. 2012.

[4] K.-C. Chen and S.-Y. Lien, "Machine-to-machine communications: Technologies and challenges", Ad Hoc Networks, 2013.

[5] D. Kreutz, F.M. Ramos, P. Esteves Verissimo, C. Esteve Rothenberg, S. Azodolmolky, S. Uhlig (2015). Software-defined networking: A comprehensive survey. *proceedings of the IEEE*, *103*(1), 14-76.

[6] R. Mijumbi, J. Serrat, J.L. Gorricho, N. Bouten, F. De Turck, R. Boutaba (2015). Network Function Virtualization: State-of-the-art and Research Challenges.

[7] G. Xylomenos, et al. A survey of information-centric networking research. *Communications Surveys & Tutorials, IEEE*, 2014, 16.2: 1024-1049.

[8] On line documents suggested by the teacher (3GPP, ETSI specifications)

[9] Lecture slides