

Module Code	EEU44C04
Module Name	Next Generation Networks
ECTS Weighting¹	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Prof Marco Ruffini and Prof Nicola Marchetti
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	<p>On successful completion of this module, students should be able to:</p> <ul style="list-style-type: none"> • LO1. Describe the basic characteristics, structure and operation of wired and wireless networks. • LO2. Identify appropriate architectural models, systems strategies and use cases for a range of modern network concepts. • LO3. Reason about the challenges and impediments that new, disruptive networking paradigms encounter, as well as their appropriate application. • LO4. Implement solutions to key challenges in modern network architecture, e.g., scalability, cost effectiveness and energy efficiency. • LO5. Implement solutions to key challenges in the wireless space e.g. mobility, interference, energy consumption. • LO6. Evaluate the performance of queues and develop network traffic models. • LO7. Assess the operation of medium access protocols in contemporary wireless standards for local and wide area networks, and Internet of Things, and discuss co-existence between different types of systems. <p>Graduate Attributes: levels of attainment</p> <p>To act responsibly - Enhanced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Enhanced</p>
Module Content	<p>This module aims to provide both a theoretical and practical understanding of modern and next generation networking and systems concepts, principles, practices and technologies. Contemporary and emerging wired and wireless network systems are targeted.</p> <p>Students will be exposed to a variety of system platforms, architectures, protocols, models and algorithms, with a strong focus on key design principles and practices e.g. performance, scalability, mobility, virtualization.</p>

¹ [TEP Glossary](#)

The module also aims to highlight some of the relevant ongoing research and innovation in the space taking place within Ireland and internationally.

Specific topics addressed in this module include:

1. Contemporary and emerging fixed telecommunication network architecture and systems:
 - a. Fixed telecom operator network architectures
 - b. Optical networking and transmission technology
 - c. Next generation fixed access network technologies (latest copper and fibre access technologies)
2. Contemporary and emerging wireless network architecture and systems:
 - a. Wireless channel impairments and mitigation techniques, overview of wireless networks
 - b. Mobile architectures: LTE, LTE-A, LTE-A-PRO
 - c. Wireless local area networks: IEEE 802.11, HetNet and small cell deployments, mmWave
3. Convergence of mobile and fixed architectures: backhaul, fronthaul, midhaul and protocol convergence
4. Multi-service networks and quality of service assurance
5. Centralised network control plane and protocols: Path Computation Element (PCE), Q-in-Q, MAC-in-MAC, MPLS
6. Next generation software-defined network (SDN) controlled systems
7. Traffic modelling
 - a. Introduction to queuing theory: M/M/1 queue, other M/M queues, M/G/1 queue
 - b. Network traffic models: Poisson arrival process, self-similarity
8. Recent trends in wireless networking
 - a. Cognitive radio self-organising networks and spectrum sharing
 - b. 5G and Internet of Things

Teaching and Learning Methods

Teaching and learning will be based on lectures and tutorials.

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
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Assessment Details² Please include the following: <ul style="list-style-type: none"> • Assessment Component • Assessment description • Learning Outcome(s) addressed • % of total • Assessment due date 	Examination	2 hour written examination	LO1, LO2, LO3, LO4, LO5, LO6, LO7	70%	n/a
	In class quiz	Multiple choice quiz	LO1, LO2, LO3, LO4, LO5, LO6, LO7	15%	6
	In class quiz	Multiple choice quiz	LO1, LO2, LO3, LO4, LO5, LO6, LO7	15%	12
Reassessment Requirements	Examination (2 hours, 100%)				
Contact Hours and Indicative Student Workload²	Contact hours: 33				
	Independent Study (preparation for course and review of materials): 76				
	Independent Study (preparation for assessment, incl. completion of assessment): 4				
Recommended Reading List	<ul style="list-style-type: none"> • Wireless Networking, Understanding Internetworking Challenges, J. L. Burbank, J. Andrusenko, J.S. Everett, W.T.M. Kasch, Wiley, 2013. • Computer Networks and Systems: Queuing Theory and Performance Evaluation, 3rd edition, T.G. Robertazzi, Springer, 2000. • QOS-Enabled Networks: Tools and Foundations, 2nd edition, Miguel Barreiros, Peter Lundqvist, Wiley, 2016. • Optical Networks: A Practical Perspective, 3rd Edition, R. Ramaswami, K. N. Sivarajan, G. H. Sasaki, Morgan Kaufmann, 2010 				
Module Pre-requisite	Prerequisite: <i>General knowledge of networking protocols and transmission.</i>				
Module Co-requisite	N/A				

² [TEP Guidelines on Workload and Assessment](#)

Module Website	Material available on black board
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Computer Science and Statistics: module is co- lectured by Prof Marco Ruffini.
Module Approval Date	
Approved by	
Academic Start Year	<i>September 2023</i>
Academic Year of Date	2023-24