Module Code	EEP55C27
Module Name	Next Generation Networks
ECTS Weighting[1]	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	On successful completion of this module, students should be able to: • 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. **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Enhanced
Module Content	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. Students will be exposed to a variety of system platforms, architectures, protocols, models and algorithms, with a strong focus on key design

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[1] TEP Glossary

principles and practices e.g. performance, scalability, mobility, virtualization.

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
Assessment Details[2] **Please include the following:** • **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 Workload[2]	**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	• 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.

[2] TEP Guidelines on Workload and Assessment

	• Optical Networks: A Practical Perspective, 3rd Edition, R. Ramaswami, K. N. Sivarajan, G. H. Sasaki, Morgan Kaufmann, 2010
Module Pre-requisite	**Prerequisite module:** General knowledge of networking protocols and transmission.
Module Co-requisite	N/A
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	
Academic Year of Date	12th September 2022