<table>
<thead>
<tr>
<th>Module Code</th>
<th>CS7NS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Name</td>
<td>Next Generation Networks</td>
</tr>
<tr>
<td>ECTS Weighting¹</td>
<td>5 ECTS</td>
</tr>
<tr>
<td>Semester taught</td>
<td>Semester 1</td>
</tr>
<tr>
<td>Module Coordinator/s</td>
<td>Prof Marco Ruffini and Prof Nicola Marchetti</td>
</tr>
</tbody>
</table>

**Module Learning Outcomes**

On successful completion of this module a student will 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.

**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 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:

¹ TEP Glossary
a. Wireless channel impairments and mitigation techniques, overview of wireless networks
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 will be based on lectures and tutorials.

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Brief Description</th>
<th>Learning Outcomes Addressed</th>
<th>% of total</th>
<th>Week set</th>
<th>Week due</th>
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</thead>
<tbody>
<tr>
<td>Examination</td>
<td>2 hour written examination</td>
<td>LO1, LO2, LO3, LO4, LO5, LO6, LO7</td>
<td>70%</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>In class quiz</td>
<td>Multiple choice quiz</td>
<td>LO1, LO2, LO3, LO4, LO5, LO6, LO7</td>
<td>15%</td>
<td>6</td>
<td>6</td>
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<tr>
<td>In class quiz</td>
<td>Multiple choice quiz</td>
<td>LO1, LO2, LO3, LO4, LO5, LO6, LO7</td>
<td>15%</td>
<td>12</td>
<td>12</td>
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</table>

**Assessment Details**

**Reassessment Details** Examination (2 hours, 100%)

**Contact Hours and Indicative Student Workload**

<table>
<thead>
<tr>
<th>Contact Hours (scheduled hours per student over full module), broken down by:</th>
<th>33 hours</th>
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<tbody>
<tr>
<td>lecture</td>
<td>26 hours</td>
</tr>
<tr>
<td>tutorial or seminar</td>
<td>4 hours</td>
</tr>
<tr>
<td>Invited talks from industry</td>
<td>3 hours</td>
</tr>
<tr>
<td>other</td>
<td>0 hours</td>
</tr>
<tr>
<td>Independent study (outside scheduled contact hours), broken down by:</td>
<td>80 hours</td>
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2 [TEP Guidelines on Workload and Assessment](#)
## Recommended Reading List


## Module Pre-requisites

**Prerequisite modules:** N/A

**Other/alternative non-module prerequisites:** General knowledge of networking protocols and transmission.

## Module Co-requisites

N/A

## Module Website

Material available on black board

## Last Update

08/07/2019 by Marco Ruffini

<table>
<thead>
<tr>
<th>Preparation for classes and review of material (including preparation for examination, if applicable)</th>
<th>76 hours</th>
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<tbody>
<tr>
<td>Completion of assessments (including examination, if applicable)</td>
<td>4 hours</td>
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<tr>
<td><strong>Total Hours</strong></td>
<td><strong>113 hours</strong></td>
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