

**Session: 2022/23**

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<b>Title of Module: Advanced Wireless Networking Technologies</b>			
<b>Code: COMP11058</b>	<b>SCQF Level: 11</b> (Scottish Credit and Qualifications Framework)	<b>Credit Points: 20</b>	<b>ECTS: 10</b> (European Credit Transfer Scheme)
<b>School:</b>	School of Computing, Engineering and Physical Sciences		
<b>Module Co-ordinator:</b>	Qi Wang		
<b>Summary of Module</b>			
<p>In pursuit of pervasive, cost-effective and high-quality applications and services from anytime, any access network and any smart devices, wireless networking technologies have been experiencing rapid and major changes and gained substantial advances and momentum worldwide in recent years. Evolutionary or revolutionary progress has been achieved at various levels from the perspective of a reference wireless networking protocol stack. For instance, mobile video applications now account for over 50% of total global mobile data traffic. The underlying networking protocols such as mobility management, medium access control and access networks of complementary coverage and capabilities also keep being developed to match the ever-increasing demands in terms of quality of service and experience. Up-to-date, systematic and insightful knowledge and understanding of these latest developments is essential for analysing, planning and deploying smart networks by leveraging and integrating such knowledge and understanding. This module covers the following key aspects of advanced wireless networking technologies, following a top-down approach with a focus on the data link layer and above:</p> <ul style="list-style-type: none"> <li>• Wireless applications chapter addresses video over wireless Internet Protocol (IP) networks, with the latest video codecs highlighted.</li> <li>• 4G chapter focuses on LTE and LTE-Advanced standards.</li> <li>• 5G chapter presents applications, enabling technologies and related standards in 5G mobile networks.</li> <li>• Self-organising networking chapter presents autonomous network management for 5G networks.</li> <li>• Enterprise Mobility Management (EMM) chapter discusses Mobile Device Management and Mobile Application Management technologies in a business context.</li> <li>• Wireless local-area networks chapter introduces the latest WiFi standards and enterprise-class wireless/mobile solutions.</li> <li>• This module will work to develop a number of the key 'I am UWS' Graduate Attributes to make those who complete this module: Universal • Critical Thinker • Ethically-minded • Research-minded Work Ready • Problem-Solver • Effective Communicator • Ambitious Successful • Autonomous • Resilient • Driven</li> </ul>			

<b>Module Delivery Method</b>					
<b>Face-To-Face</b>	<b>Blended</b>	<b>Fully Online</b>	<b>HybridC</b>	<b>HybridO</b>	<b>Work-based Learning</b>
	✓	✓			
<p><b>Face-To-Face</b> Term used to describe the traditional classroom environment where the students and the lecturer meet synchronously in the same room for the whole provision.</p> <p><b>Blended</b> A mode of delivery of a module or a programme that involves online and face-to-face delivery of learning, teaching and</p>					

assessment activities, student support and feedback. A programme may be considered “blended” if it includes a combination of face-to-face, online and blended modules. If an online programme has any compulsory face-to-face and campus elements it must be described as blended with clearly articulated delivery information to manage student expectations

**Fully Online**

Instruction that is solely delivered by web-based or internet-based technologies. This term is used to describe the previously used terms distance learning and e learning.

**HybridC**

Online with mandatory face-to-face learning on Campus

**HybridO**

Online with optional face-to-face learning on Campus

**Work-based Learning**

Learning activities where the main location for the learning experience is in the workplace.

**Campus(es) for Module Delivery**

The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit)

Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
					✓	

**Term(s) for Module Delivery**

(Provided viable student numbers permit).

Term 1	Term 2	Term 3
✓		

**Learning Outcomes: (maximum of 5 statements)**

On successful completion of this module the student will be able to:

- L1. Demonstrate a systematic, comprehensive understanding of the state-of-the-art concepts, principles, technologies, methodologies, processes, architectures, and standards for up-to-date wireless (including mobile) networking technologies/systems.
- L2. Interpret and critically analyse wireless network protocols and other networking information.
- L3. Demonstrate critical evaluation of wireless networks and the performance of wireless applications with well-defined metrics.
- L4. Demonstrate a critical awareness of the capabilities of current and latest wireless networking technologies at, or informed by, the forefront professional practice and research, especially the planning, deployment and management of enterprise-level wireless networks.
- L5. Investigate and analyse the requirements and criteria for an integrated wireless networking system given an application or business scenario, and recommend suitable design, development and deployment strategy considering technology-business alignment and performance-cost trade-off.

**Employability Skills and Personal Development Planning (PDP) Skills**

SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:
Knowledge and Understanding (K and U)	SCQF Level 11. SCQF11 Students will learn systematic, detailed knowledge and acquire critical understanding of various wireless networking concepts, theories, principles and technologies, especially the latest standards in wireless applications and systems of different protocol layers. They will be familiar with the key technical features, capabilities, functions, processes and applicability, advantages and disadvantages in a specific wireless technology, terminology and conventions of a range

	<p>of wireless systems and solutions. They will obtain knowledge and understanding of the commercial and economic context of the technology evolution, and issues related to the operation, management, maintenance of wireless systems. They will also carry out a critical literature and technical review to meet the partial requirements for their written assignment.</p>
Practice: Applied Knowledge and Understanding	<p>SCQF Level 11.  SCQF11 Students will gain in-depth, comprehensive understanding and critical awareness of knowledge of wireless networking technologies, and the ability to apply this in planning, deploying, evaluating and managing wireless/mobile solutions. They will also develop capabilities to apply a range of standard and specialised wireless networking research skills, tools/software, devices and related techniques in response to business requirements for their written assignments and laboratory tasks. In addition, innovation and creativity is encouraged in students' written assignments in designing solutions to address practical business/application requirements.</p>
Generic Cognitive skills	<p>SCQF Level 11.  SCQF11 To complete their written reports and laboratory tasks, students will first build skills to integrate information and apply knowledge from various sources including technology advances informed by research and industry. . Furthermore, they will develop capabilities to apply critical analysis, performance evaluation and system integration to forefront wireless networking issues, and skills to critically review, consolidate and extend knowledge, skills and thinking to solve practical wireless networking problems.</p>
Communication, ICT and Numeracy Skills	<p>SCQF Level 11.  SCQF11 Working in interacting groups for the labs, students will develop technical communication skills with peers and the lecturer. They will also develop the ability to write formal technical reports and documentation. The lectures/tutorials on Medium Access Control (MAC) theories, wireless network site survey etc. will develop their numeracy skills through various calculations. The numerical performance analysis and evaluation will require them to undertake critical evaluations of numerical and graphical data gathered from real-life wireless applications. The labs will develop advanced ICT skills through using standard and specialised wireless networking tools/applications and devices such as Wireshark, VirtualBox/VirtualPC, Wi-Fi routers and WiMAX base stations and client equipment.</p>
Autonomy, Accountability and Working with others	<p>SCQF Level 11.  SCQF11 Each student in each group will be responsible of finding and summarizing information about the assigned task in their laboratory tasks. Students will elect a coordinator and develop a sense of accountability/responsibility to the group members. Each student will conduct an independent, in-depth off-line research to complete his/her individual written assignment, thereby developing autonomy and initiative in such professional activities. The written assignment also requires each student to make informed judgement on technology-business alignment. In addition, he/she will critically reflect on the planning/designing process and his/her own PDP development through this module and how his/her employability has been improved.</p>
<b>Pre-requisites:</b>	<p>Before undertaking this module the student should have undertaken the following:</p>

	<b>Module Code:</b>	<b>Module Title:</b>
	<b>Other:</b>	
<b>Co-requisites</b>	<b>Module Code:</b>	<b>Module Title:</b>

\* Indicates that module descriptor is not published.

<b>Learning and Teaching</b>	
<p>The module will be delivered by means of lectures, tutorials and practical lab work aimed at developing the knowledge and skills required to confidently manage a wireless/mobile network. The lectures will introduce various types of wireless/mobile technologies with a focus on enterprise-class wireless local area networks and develop the essential tasks involved in the design and implementation of wireless networking and mobile computing technologies while the follow-on lab work will enable students to put into practice what they have learned. The tutorial sessions will help consolidate both the lecture material and the skills practiced during the lab work. The delivery plan is as follows.</p> <p>Indicative Lecture Topics:  Module introduction  Wireless applications: Part I  Wireless applications: Part II  Wireless wide-area networks: Part I  Wireless wide-area networks: Part II  Self-organising networking  Enterprise Mobility management  Wireless local-area networks  Module revision session</p> <p>Indicative Lab/Tutorial Topics:  Tutorial on quantifying wireless application performance  Tutorial on mobile networking and application protocol analysis  Lab on wireless application  Lab on mobile networking protocol analysis</p>	
<b>Learning Activities</b>	<b>Student Learning Hours</b>
During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	(Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	24
Tutorial/Synchronous Support Activity	12
Laboratory/Practical Demonstration/Workshop	12
Independent Study	152
	200 Hours Total
<b>**Indicative Resources: (eg. Core text, journals, internet access)</b>	
<p>The following materials form essential underpinning for the module content and ultimately for the learning outcomes:  Castaneda, H. et al. (2006) The Business Case for Enterprise-Class Wireless LANs. Cisco Press.</p>	

IEEE Xplore digital library. (2016) [Online] Available: <http://ieeexplore.ieee.org/Xplore/home.jsp> [Accessed: 12 Feb 2016].

Sanders, C. (2011) Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems. 2nd Edition. No Starch Press.

Varshney, U. (2012) 4G Wireless Networks. IT Professional. Vol. 14(5), pp. 34-39.

VirtualBox. (2016) [Online] Available: <https://www.virtualbox.org/> [Accessed: 12 Feb 2016].

VLC media player. (2016) [Online] Available: <http://www.videolan.org/index.html> [Accessed: 12 Feb 2016].

Wireshark packet analyser. (2016) [Online] Available: <http://www.wireshark.org/> [Accessed: 12 Feb 2016].

Wong, D. (2012) Fundamentals of Wireless Communication Engineering Technologies. Wiley.

EU 5G PPP Architecture Working Group, "5G PPP View on 5G Architecture", June/July 2016, available at <https://5g-ppp.eu/white-papers/>.

GSMA. (2014) Understanding 5G: Perspectives on Future Technological Advancements in Mobile. Dec 2014, <https://gsmaintelligence.com/research/?file=141208-5g.pdf&download> [Accessed: 12 Feb 2016].

Ohm, J. and Sullivan, G.J. (2013). High Efficiency Video Coding: The Next Frontier in Video Compression [Standards in a Nutshell], IEEE Signal Processing Magazine, vol.30, no.1, pp.152-158.

(\*\*N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk\*) to wait until the start of session for confirmation of the most up-to-date material)

### Engagement Requirements

In line with the Academic Engagement Procedure, Students are defined as academically engaged if they are regularly engaged with timetabled teaching sessions, course-related learning resources including those in the Library and on the relevant learning platform, and complete assessments and submit these on time. Please refer to the Academic Engagement Procedure at the following link: [Academic engagement procedure](#)

## Supplemental Information

<b>Programme Board</b>	Computing
<b>Assessment Results (Pass/Fail)</b>	No
<b>Subject Panel</b>	Business & Applied Computing
<b>Moderator</b>	J. Alcaraz Calero
<b>External Examiner</b>	C. Luo
<b>Accreditation Details</b>	

<b>Version Number</b>	1.13
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**Assessment: (also refer to Assessment Outcomes Grids below)**

This written assignment is an individual report, accounting for 60% of the total marks for this module. The purpose of this assessment is to achieve the corresponding learning outcomes set in the module's descriptor with a focus on L02 and LO3:

- L2. Interpret and critically analyse wireless network protocols and other networking information.
- L3. Demonstrate critical evaluation of wireless networks and the performance of wireless applications with well-defined metrics.

Each student will produce a formal, individual academic report in the format of reporting solutions for a series of practical tasks aligned to the labs in this module, together with associated questions. The report will demonstrate the knowledge and skills learnt especially in relation to the above learning outcomes. The report must contain evidence of practical work using the tools from the labs in completing tasks that are similar to those in the labs.

In addition, the report requests a student to perform necessary off-line research to extend knowledge and skills in order to fulfil additional related practical tasks or answer corresponding questions. The report also gives a student the opportunity to define a task based on his/her own interest and explore the solution to it.

This written assignment is an individual report, accounting for 40% of the total marks for this module. The purpose of this assessment is to achieve the corresponding learning outcomes (LOs) set in the module's descriptor with a focus on L01, L04, and LO5:

- L1. Demonstrate a systematic, comprehensive understanding of the state-of-the-art concepts, principles, technologies, methodologies, processes, architectures, and standards for up-to-date wireless (including mobile) networking technologies/systems.
- L4. Demonstrate a critical awareness of the capabilities of current and latest wireless networking technologies at, or informed by, the forefront professional practice and research, especially the planning, deployment and management of enterprise-level wireless networks.
- L5. Investigate and analyse the requirements and criteria for an integrated wireless networking system given an application or business scenario, and recommend suitable design, development and deployment strategy considering technology-business alignment and performance-cost trade-off.

Each student will produce a formal, individual academic report in the theme of business-technology alignment for a smart wireless/mobile networking solution.

The report requests a student to demonstrate a deep understanding and practical application of the theories and technologies learnt and perform off-line research and design for a selected practical and significant business application scenario using advanced wireless networking and mobile computing technologies.

It requires self-critical evaluation of the effectiveness and commercial risks (including security/privacy management) of the proposed technologies, and critical review of current problems, concerns and constraints and future development directions.

Innovation such as innovative/creative application or integration of new technologies will be highly encouraged.

(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed.  
(ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Handbook.)

**Assessment Outcome Grids (Footnote A.)**

<b>Component 1</b>							
<b>Assessment Type (Footnote B.)</b>	<b>Learning Outcome (1)</b>	<b>Learning Outcome (2)</b>	<b>Learning Outcome (3)</b>	<b>Learning Outcome (4)</b>	<b>Learning Outcome (5)</b>	<b>Weighting (%) of Assessment Element</b>	<b>Timetabled Contact Hours</b>
Report of practical/ field/ clinical work		✓	✓			60	0
<b>Component 2</b>							
<b>Assessment Type (Footnote B.)</b>	<b>Learning Outcome (1)</b>	<b>Learning Outcome (2)</b>	<b>Learning Outcome (3)</b>	<b>Learning Outcome (4)</b>	<b>Learning Outcome (5)</b>	<b>Weighting (%) of Assessment Element</b>	<b>Timetabled Contact Hours</b>
Design/ Diagram/ Drawing/ Photograph/ Sketch	✓			✓	✓	40	0
<b>Combined Total For All Components</b>						100%	0 hours

#### Footnotes

- A. Referred to within Assessment Section above
- B. Identified in the Learning Outcome Section above

#### Note(s):

1. More than one assessment method can be used to assess individual learning outcomes.
2. Schools are responsible for determining student contact hours. Please refer to University Policy on contact hours (extract contained within section 10 of the Module Descriptor guidance note). This will normally be variable across Schools, dependent on Programmes &/or Professional requirements.

#### **Equality and Diversity**

The University policies on equality and diversity will apply to this module. In order for the student to complete this module the student will be required to view photographic image materials. Students whose vision and hearing is substantially impaired should be assessed and counselled prior to them selecting courses requiring this module. When a student discloses a disability a special needs advisor will agree the appropriate adjustments to be made, consulting with the module coordinator if necessary. Diversity in cultures, backgrounds, abilities, learning and cognitive styles and individual differences are valued and appreciated. The assessments have taken this into account.

(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School.)

[UWS Equality and Diversity Policy](#)

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