COMP8293

IoT Communication Networks and Security

Session 1, In person-scheduled-weekday, North Ryde 2024

School of Computing

Contents

General Information

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Credit points
10

Prerequisites
COMP6250

Corequisites

Co-badged status

Unit description
The networking and communication platforms supporting IoT infrastructure must handle the huge amount of data generated by millions of devices. These networks can be very complicated, merging several different standards to achieve a common communication objective. Furthermore, connecting IoT-enabled devices to IoT networks opens up security vulnerabilities and increases the potential risk of hackers discovering and attacking such networks.

The unit will involve a detailed study of network and security protocols, standards, and algorithms to enable and secure the real-world deployments of IoT communication and networking infrastructure. Communication and security standards and technologies for industrial IoT systems and networks and cyber-physical systems will also be discussed.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Analyze, build, troubleshoot, and compare IoT networks such as low-power and wide-area (LPWA) communication networks and technologies.

ULO2: Describe at a conceptual level, the principles underlying scalable front end IoT networking infrastructure, communication and routing protocols for IoT and configure and troubleshoot them.

ULO3: Determine the right mix of components, technologies, and protocols to build IoT communications networks that best meet the application requirements.

ULO4: Identify different security and privacy issues in IoT networks and understand, configure, implement, and troubleshoot solutions to secure such networks and communication systems.

ULO5: Validate and test the performance of IoT networks using various simulation tools.

ULO6: Collaborate in a group project and communicate effectively through oral presentation and report.

General Assessment Information

In this unit, students are encouraged to engage actively in their learning through a multifaceted approach. Attending lectures consistently, taking comprehensive notes, and actively participating in discussions are vital components of this active participation. Regular attendance at workshops and practical sessions is emphasized, and students are advised to seek instructor feedback to enhance their understanding of assignments. Pursuing excellence in assignments is a fundamental expectation, requiring thorough preparation to showcase a firm grasp of the content and meet prescribed standards. Additionally, students are urged to engage actively with assigned readings, supplementing their notes and formulating thoughtful questions for further clarification during discussions with lecturers or tutors. Thoughtful responses to tutorial questions, demonstrating a deep understanding of the material, and contributing meaningfully to discussions are also highlighted. Furthermore, timely completion of assigned tasks or simulation projects within given timeframes is essential for successfully and punctually fulfilling unit requirements. Overall, this holistic approach aims to ensure students actively contribute to and excel in various aspects of their learning experience in the unit.

Attendance and Participation Guidelines:

- Class Attendance and Active Engagement: Attending most classes is strongly recommended, actively participating in discussions by asking and answering questions and contributing perspectives from personal backgrounds and workplaces.

- Utilization of Supplementary Resources: Supplementary resources, including lecture materials and digital recordings available through Echo360 via iLearn login, are

accessible for review purposes and in case of missed lectures. However, it is essential to note that these recordings should not be solely relied upon, and copyrighted material may be excluded.

- Effective Out-of-Class Communication: iLearn is the primary platform for effective out-of-class communication and engaging in discussions on various topics. Accessible at http://learn.mq.edu.au, iLearn provides forums for active participation and is a valuable resource for information dissemination. Regularly reviewing iLearn and conducting background reading before each class is highly encouraged to enhance your overall learning experience. Assignment Submission

Assignment Submission

Your assignment is to be submitted online using iLearn.

Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or presentation assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. The submission time for all uploaded assessments is **11:55 pm**. A 1-hour grace period will be provided to students who experience a technical concern. For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration.

Assessments where Late Submissions will be accepted

- Assignment 1 - YES, Standard Late Penalty applies
- Assignment 2 - YES, Standard Late Penalty applies
- Workshop-based tasks - NO, Standard Late Penalty applies
- Exam - NO, unless Special Consideration is Granted

Supplementary Exam

If you receive Special Consideration for the final exam, a supplementary exam will be scheduled after the normal exam period, following the release of marks. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Requirements to Pass this Unit

To pass this unit, you must achieve a total mark equal or greater than 50%. This unit does not

have hurdle assessments.

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	40%	No	Week 7
Assignment 2	40%	No	Week 11
Workshop-based tasks	20%	No	Weekly

Assignment 1

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 40 hours
Due: **Week 7**
Weighting: **40%**

Development and Testing:given an IOT application scenario, design an IOT networking solution that meets the resource constraints of this scenario.

On successful completion you will be able to:

- Analyze, build, troubleshoot, and compare IoT networks such as low-power and wide-area (LPWA) communication networks and technologies.
- Describe at a conceptual level, the principles underlying scalable front end IoT networking infrastructure, communication and routing protocols for IoT and configure and troubleshoot them.
- Determine the right mix of components, technologies, and protocols to build IoT communications networks that best meet the application requirements.
- Identify different security and privacy issues in IoT networks and understand, configure, implement, and troubleshoot solutions to secure such networks and communication systems.

- Collaborate in a group project and communicate effectively through oral presentation and report.

Assignment 2

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 38 hours
Due: **Week 11**
Weighting: **40%**

Analysis and Problem Solving: The purpose of the problem solving assignment is to help the students to get accustomed to dealing with real world problem situations/issues. It is designed to help students analyse a particular problem and find its best solution.

On successful completion you will be able to:

- Analyze, build, troubleshoot, and compare IoT networks such as low-power and wide-area (LPWA) communication networks and technologies.
- Describe at a conceptual level, the principles underlying scalable front end IoT networking infrastructure, communication and routing protocols for IoT and configure and troubleshoot them.
- Identify different security and privacy issues in IoT networks and understand, configure, implement, and troubleshoot solutions to secure such networks and communication systems.
- Validate and test the performance of IoT networks using various simulation tools.

Workshop-based tasks

Assessment Type [1]: Participatory task
Indicative Time on Task [2]: 20 hours
Due: **Weekly**
Weighting: **20%**

Weekly tasks to be completed during the workshop sessions.

On successful completion you will be able to:

- Analyze, build, troubleshoot, and compare IoT networks such as low-power and wide-area (LPWA) communication networks and technologies.

- Determine the right mix of components, technologies, and protocols to build IoT communications networks that best meet the application requirements.
- Identify different security and privacy issues in IoT networks and understand, configure, implement, and troubleshoot solutions to secure such networks and communication systems.
- Validate and test the performance of IoT networks using various simulation tools.
- Collaborate in a group project and communicate effectively through oral presentation and report.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

COMP8293 is structured to include both lectures and tutorial/workshop sessions. Lecture classes are conducted onsite every Thursday from 2 to 4 PM. Also, workshop classes occur onsite on Tuesdays from 6 to 8 PM. This attendance policy underscores the interactive and real-time nature of the learning experience, encouraging students to actively participate in lectures and workshops for an optimal educational outcome.

Lectures

COMP8293 lecture sessions are dedicated to the in-depth exploration of IoT communication networks, blending theoretical concepts, network design, and hands-on applications. The focus extends to practical implementation, particularly networking simulator software, to provide students with a comprehensive understanding of conceptual and design principles. The unit emphasizes applying this knowledge in designing communication networks across various real-world scenarios. IoT communication network simulation software tools, including Netualizer, Wireshark, and CISCO Packet Tracer, will support the learning process. Lecture sessions are the foundation for grasping conceptual knowledge, with practical application during workshops, which involve tasks such as IoT networking and protocol implementation.

While weekly lecture notes will be provided, students are urged to view them as a guide rather than a substitute for personal notes or the recommended reading list. Active engagement with the material is encouraged, supplementing understanding through provided lecture notes, personal notes, and suggested readings. This proactive approach is crucial for a robust comprehension of the syllabus topics and contributes to an enriched learning experience in real-time operating systems.

Assignments

The predominant weightage in this class is allocated to Assignment 1 and Assignment 2, collectively amounting to 40% of each assignment. These assignments are strategically designed to gauge students' proficiency in conceptualizing and implementing network and Internet of Things (IoT) solutions across diverse applications. Students are granted a substantial four-week period to complete each assignment, with Assignment 1 due by week 7 and Assignment 2 by week 11.

The breakdown of the assessment percentage for these assignments is as follows: of the total 40%, 20% is attributed to the design and implementation of a programming application, evaluating students' practical skills. An additional 10% is allocated for answering assignment-specific questions, emphasizing theoretical comprehension. The project report holds a weightage of 5%, assessing students' ability to articulate their project details effectively. The remaining 5% is dedicated to presentations and discussions, reinforcing the importance of communication skills and ensuring students comprehend the intricacies of the program they have developed. This comprehensive assessment structure aims to foster a holistic understanding of network and IoT design applications among students.

Workshop

The workshop sessions will be onsite across 12 meetings from Week 2 to Week 13. During weeks 2 to 11, students will concentrate on practical modules, while Week 12 and Week 13 are designated for make-up sessions. Make-up classes are exclusively for students unable to attend previous workshops, and each student is limited to taking only two make-up classes. This workshop component contributes 20% to the overall score, with each meeting assigned a value of 2 marks, making a maximum of 20 marks for the entire workshop. Students are strongly encouraged to attend all sessions to gain a comprehensive understanding of implementing IoT Networking infrastructure and communication in experiments with networking simulation tools. Full participation ensures a thorough grasp of the practical aspects of IoT and Networking applications in real-world scenarios.

TEXT

Course Reading Material Information - COMP8293

Please be aware that there isn't a single textbook covering all the content for this unit. However, your lecturer will provide comprehensive reading materials and detailed notes corresponding to each week's lecture topics. These resources will be provided every week for your convenience. It's essential to note that purchasing these books is not obligatory; their inclusion is based on individual preferences and needs. Students are encouraged to evaluate their requirements and determine whether acquiring these supplementary resources aligns with their learning preferences and objectives.

1. Daniel Chew, "The Wireless Internet of Things, A Guide to The Lower Layers," Wiley, 2019, ISBN: 9781119260578.

2. Rolando Herrero, "Practical Internet of Things Networking, Understanding ioT Layered Architecture," Springer, ISBN: 9783031284427

Methods of Communication: Our primary means of communication will be through your university email and announcements on iLearn. It is crucial to consistently check your university email for important updates and information related to the course. Additionally, significant announcements will be posted on iLearn, a centralized platform for accessing vital details about the course. Should you have any queries or require assistance from the teaching staff, including the unit convenor, you have two communication channels. Firstly, you can post your queries on the iLearn discussion board, providing an interactive space for instructors and peers to engage in discussions. Alternatively, you may send emails to the corresponding addresses of the teaching staff using your university email address for official communication. Through these communication methods, we aim to ensure effective and timely dissemination of information and provide the necessary support throughout the course.

Unit Schedule

Week	Topic	Learning Outcome
1	Introduction to the Unit and IoT Networking	UL03
2	Exploring Traditional Networks	UL02, UL03, UL04
3	IoT Communication Protocols (Short Range Wireless IoT: WPAN I: 802.15.4/802.15.4E, Zigbee)	UL03, UL05
4	Short Range Wireless IoT: WPAN II: 6LoWPAN, IEEE802.15.1 Bluetooth, 6loBLE (Bluetooth Extension)	UL03, UL05
5	WiFi for IoT: WIFI HaLow: 802.11AH	UL02, UL03, UL05
6	Long Range Wireless IoT I: LP WAN Technologies and LoRAWAN	UL01-UL06
7	Long Range Wireless IoT II: LP WAN technologies and NB-IoT, LTE-M (Pre-5G technologies), 5G-IoT integration	UL03, UL04
8	IoT Data Protocols: MQTT, COAP, AMQP, HTTP	UL03, UL04
	Break	
9	Industrial Internet of Things	UL03, UL04
10	Smart Home and Smart Cities	UL01, UL02, UL03
11	IoT Security I (Threats, Services, mechanisms: An Overview; Types of attacks: A taxonomy; IoT Security Architecture (Protocol Stack Perspective): perception layer security, network layer security, processing layer security, and application security)	UL05, UL06
12	IoT Security II (IoT Security Architecture) - Trust and Key Management, Privacy Protection in IoT Applications, IoT Security: Use Cases	UL05, UL06
13	Unit Review and IoT network applications	UL01-UL06

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Standards and Grading

Grades

At the end of the semester, you will receive a grade that reflects your achievement in the unit

• **Fail (F)**: does not provide evidence of attainment of all learning outcomes. There is missing or partial or superficial or faulty understanding and application of the fundamental concepts in the field of study; and incomplete, confusing or lacking communication of ideas in ways that give little attention to the conventions of the discipline.

• **Fail (FH)**: has obtained a raw mark over 50, yet failed all available attempt of at least one hurdle assessment.

• **Pass (P)**: provides sufficient evidence of the achievement of learning outcomes. There is demonstration of understanding and application of fundamental concepts of the field of study; and communication of information and ideas adequately in terms of the conventions of the discipline. The learning attainment is considered satisfactory or adequate or competent or capable in relation to the specified outcomes.

• **Credit (Cr)**: provides evidence of learning that goes beyond replication of content knowledge or skills relevant to the learning outcomes. There is demonstration of substantial understanding of fundamental concepts in the field of study and the ability to apply these concepts in a variety of contexts; plus communication of ideas fluently and clearly in terms of the conventions of the discipline.

• **Distinction (D)**: provides evidence of integration and evaluation of critical ideas, principles and theories, distinctive insight and ability in applying relevant skills and concepts in relation to learning outcomes. There is demonstration of frequent originality in defining and analysing issues or problems and providing solutions; and the use of means of communication appropriate to the discipline and the audience.

• **High Distinction (HD)**: provides consistent evidence of deep and critical understanding in relation to the learning outcomes. There is substantial originality and insight in identifying, generating and communicating competing arguments, perspectives or problem solving approaches; critical evaluation of problems, their solutions and their implications; creativity in application.

In this unit, the final mark will be calculated by combining the marks for all assessment tasks according to the percentage weightings shown in the assessment summary. There are no hurdles in this unit.

Concretely, in order to pass the unit, you must obtain an overall total mark of **50%** or higher. Students obtaining a higher grade than a pass in this unit will (in addition to the above)

• have a total mark of 85% or higher to obtain High Distinction;

◦ have a total mark of 75% or higher to obtain Distinction;

◦ have a total mark of 65% or higher to obtain Credit.

You are encouraged to:

• set your personal deadline earlier than the actual one;

• keep backups of all important assessed tasks;.

• make sure no one else picks up your printouts. All work submitted should be readable and well

presented.

You should never commit plagiarism in any of your submitted work, including tutorial and practical answers

Changes since First Published

Date	Description
05/02/2024	There's a duplicated sentence in the policies and procedures.

Unit information based on version 2024.02 of the Handbook