# ELEC887

## Heterogeneous Networks: Theory and Practice

S1 Day 2016

*Dept of Engineering*

# Contents

# General Information

Unit convenor and teaching staff
Convenor
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Friday 2pm

Credit points
4

Prerequisites
Admission to MEng

Corequisites

Co-badged status

Unit description
This unit explores the trend in modern wireless communications toward massive densification of network infrastructure, with multi-tiered networks, ranging from tiny picos and femtos up to large macrocells. Topics covered include propagation, spectrum planning, cell association, interference management, scheduling, and stochastic models.

## 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:

> Be able to solve path-loss and link budget calculations for cellular systems

> Be able to solve frequency planning problems for cellular systems

> Be able to solve mobility and handover problems for cellular systems

Demonstrated understanding of cell association in HetNets

Demonstrated ability to integrate advanced concepts to design a HetNet system to meet system-level constraints

Demonstrated ability fo critique the literature and write a research-level review article

Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

# Assessment Tasks

| Name | Weighting | Due |
|------|-----------|-----|
| Assignment 1 | 10% | Week 3 |
| Assignment 2 | 10% | week 5 |
| Assignment 3 | 10% | week 7 |
| Assignment 4 | 10% | Week 9 |
| Project | 40% | Week 12/13 |
| Class Test | 20% | Week 12 |

## Assignment 1

Due: **Week 3**
Weighting: **10%**

Problems about pathloss and link budgets due end of week 3

On successful completion you will be able to:
- Be able to solve path-loss and link budget calculations for cellular systems
- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

## Assignment 2

Due: **week 5**
Weighting: **10%**

Problems about multiple access and cellular networks

On successful completion you will be able to:
- Be able to solve frequency planning problems for cellular systems

- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

# Assignment 3

Due: **week 7**
Weighting: **10%**

Problems about mobility and handover

On successful completion you will be able to:
- Be able to solve mobility and handover problems for cellular systems
- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

# Assignment 4

Due: **Week 9**
Weighting: **10%**

Problems about HetNets

On successful completion you will be able to:
- Demonstrated understanding of cell association in HetNets
- Demonstrated ability to integrate advanced concepts to design a HetNet system to meet system-level constraints
- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

# Project

Due: **Week 12/13**
Weighting: **40%**

Research paper and presentation on an area of 5G Wireless Networks. The task is to read a set of selected papers, and provide a critical review of the research area covered by those papers, as well as integrating the relevant material from the lectures. The review must be written as a review article in the format that would be submitted for publication in an IEEE Journal publication, with abstract, introduction, conclusions and references, as well as the main body of the paper. The report is due in week 12 and will be worth 30% of assessment for the unit. Each student will give a 15 minute presentation in week 13, worth 10% of assessment for the unit. The total of report and presentation is 40% of assessment for the unit.

On successful completion you will be able to:

- Demonstrated ability fo critique the literature and write a research-level review article
- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

## Class Test

Due: **Week 12**
Weighting: **20%**

Class test worth 20%

On successful completion you will be able to:

- Be able to solve path-loss and link budget calculations for cellular systems
- Be able to solve frequency planning problems for cellular systems
- Be able to solve mobility and handover problems for cellular systems
- Demonstrated understanding of cell association in HetNets
- Demonstrated ability to integrate advanced concepts to design a HetNet system to meet system-level constraints

# Delivery and Resources

There will be a sequence of lectures and tutorials each week. These lectures will include new material as well as problem solving practice. Lecture notes, problem sheets, including problems for assessment, will be posted to ilearn.

Reference material will be made available on closed reserve in the library. References are:

"Wireless Communications: Principles and Practice", by Theodore Rappaport (Prentice Hall)

"Wireless Communications" by Andrea Goldsmith (Cambridge University Press)

"LTE-The UMTS Long Term Evolution: From Theory to Practice" (2nd Edition) by Stefania Sesia, Issam Toufik and Matthew Baker

"Millimeter Wave Wireless Communications" by Theodore Rappaport, Robert Heath, Robert Daniels and James Murdock (Prentice Hall)

"Computer Networks: A Top-Down Approach" by James Kurose and Keith Ross (Addison Wesley)

# Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

**New Assessment Policy in effect from Session 2 2016** http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/ne

w_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

## Results

Results shown in *iLearn*, 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.

# Student Support

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

## Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

# Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

# Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

# 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.

# Graduate Capabilities

## PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

### Learning outcome

- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

### Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4
- Project

## PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

### Learning outcomes

- Be able to solve path-loss and link budget calculations for cellular systems
- Be able to solve frequency planning problems for cellular systems
- Be able to solve mobility and handover problems for cellular systems
- Demonstrated understanding of cell association in HetNets

## Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4
- Project
- Class Test

# PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

## Learning outcomes

- Demonstrated ability to integrate advanced concepts to design a HetNet system to meet system-level constraints
- Demonstrated ability fo critique the literature and write a research-level review article

## Assessment tasks

- Assignment 4
- Project
- Class Test

# PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

## Learning outcomes

- Be able to solve path-loss and link budget calculations for cellular systems
- Be able to solve frequency planning problems for cellular systems
- Be able to solve mobility and handover problems for cellular systems
- Demonstrated understanding of cell association in HetNets

## Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4
- Project
- Class Test

# PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

## Learning outcomes

- Demonstrated ability fo critique the literature and write a research-level review article
- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

## Assessment task

- Project

# PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

## Learning outcome

- Demonstrated ability in the following areas of professional engineering practice: - self motivation and self learning - production of quality work to meet a given deadline

## Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3

- Assignment 4
- Project