School of Electrical Engineering and Telecommunications
Term 2, 2019
Course Outline

# TELE9782
# Latest Advances in Networking

## COURSE STAFF


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**Consultations:** You are encouraged to ask questions on the course material, after the lecture class times in the first instance, rather than via email. You are welcome to email the lecturer and can also provide you with consultation times. ALL email enquiries should be made from your student email address with TELE9782 in the subject line, otherwise they will not be answered.

**Keeping Informed:** Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

## COURSE SUMMARY

### Contact Hours

The course consists of 3 hours of lectures each week. There are NO lab or tutorial classes.

| | Days | Time | Location |
|---|---|---|---|
| **Lectures** | Tuesday | 6pm - 9pm | Ainsworth 102 |

### Context and Aims

After the second generation (2G) of telecommunications evolution a few decades ago, the term 'telecommunications' started to merge with computer networks to accommodate data requirements. Nowadays, the primary focus of providing telecommunication services is more towards data. Therefore, it is essential for telecommunications students to keep up-to-date with recent advances in computer networks. These network concepts and technologies have been initiated a few years ago, researched for several years, and already adopted by industries. However, the knowledge of these technologies is lacking in fresh university graduates and creates adverse effects when joining the industries. Therefore, this course aims to cover the

recent advances in networking and guide the students to keep up-to-date with the upcoming technologies. These topics include Networking Trends, Data Centre Networking, Server and Storage Virtualization, Cloud Computing, Big Data, OpenFlow, Software Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT).

**Indicative Lecture Schedule**

| **Period** | **Summary of Lecture Program** |
|---|---|
| Week 1 | Course Overview<br>Networking Trends |
| Week 2 | Data Centre Network Topologies<br>Data Centre Ethernet |
| Week 3 | Carrier IP: MPLS<br>Carrier Ethernet |
| Week 4 | **Quiz**<br>Server and Storage Virtualization |
| Week 5 | LAN Extension and Virtualization<br>Virtual Routing Protocols |
| Week 6 | **Mid-term exam**<br>Introduction to IoT and Datalink Protocols for IoT |
| Week 7 | Network Layer Protocols for IoT<br>Messaging Protocols for IoT |
| Week 8 | OpenFlow<br>Software Defined Networking |
| Week 9 | Network Function Virtualization<br>**Assignment due** |
| Week 10 | Big Data and Networking Issues for Big Data<br>Cloud Computing |

**Assessment**

| | |
|---|---|
| Quiz | 15 % |
| Mid-Term Exam | 15 % |
| Individual Assignment | 20 % |
| Final Exam (2 hours) | 50 % |

The students should score overall 50%, and also, 50% for the final exam to pass the course.

## COURSE DETAILS

### Credits

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10 week term.

### Relationship to Other Courses

This is a postgraduate course in the School of Electrical Engineering and Telecommunications.

### Pre-requisites and Assumed Knowledge

- Students are expected to have prior knowledge on:
  - Protocol layers ISO/OSI reference model
  - TCP/IP protocol stack
  - LAN Addressing: Unicast vs Multicast, Local vs Global
  - Extended LANs: Hubs vs. Bridges vs. Routers vs. Switches
  - Virtual LANs (VLANs)
  - IPv4 and IPv6 Addresses: Public vs. Private addresses
  - Subnets
  - Address resolution Protocol (ARP)
  - Internet Control Message Protocol (ICMP)
  - TCP connection setup, Checksum (pseudo-header), Slow start
  - TCP vs. UDP
  - Hypertext Transfer Protocol (HTTP)
- The knowledge gained from TELE3118 (Network Technologies) or equivalent is recommended.
- Suggested reading material for pre requisite knowledge:
  - Books, *e.g. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf*
  - Technical papers, *e.g. Digital Libraries (IEEE Xplore , ACM, ScienceDirect, etc)*
  - Standards documents, *e.g. Request for Comments (RFC) document from the Internet Engineering Task Force (IETF)*

### Learning outcomes

After successful completion of this course, you should be able to:

1. Demonstrate the comprehension of requirements, methods, and standards of recently emerged networking technologies.
2. Analyze the relationships and inter-operability of different technologies.
3. Evaluate the limitations of the latest technologies and implications of possible advances and/or applicability in other domains.
4. Review and identify the emerging areas in networking and comprehensively research in to the details.
5. Review and evaluate recent research papers in networking and improve research techniques.

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in **Appendix A**. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in **Appendix B**). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in **Appendix C**.

## TEACHING STRATEGIES

### Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using formal face-to-face lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding.

### Learning in this Course

You are expected to attend all lectures, quiz, and mid-term exam in order to maximise learning. In addition to the lecture notes/video, you should involve in a significant amount of self-reading of suggested books, technical papers, and standard documents. Reading additional texts will further enhance your learning experience. Group learning is also encouraged. UNSW assumes that a self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

## ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the self-assessing questionnaires, quiz, mid-term exam, and the individual assignment.

### Self-Assessing Questionnaires

These assessments are spontaneous and self-assessing your general understanding of the course material and also the pre-requisites knowledge for a particular lecture session. Marks of these questionnaires are NOT counted for the final mark.

### Quiz

This quiz tests your general understanding of the course material and also pre-requisites knowledge. This is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any material already covered in the course schedule and comprising 15 multiple-choice questions (MCQs). Marks will be assigned according to the correctness of the responses.

### Mid-Term Exam

The mid-term examination tests your general understanding of the course material and is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any material already covered in the course schedule and comprising 15 multiple-choice questions (MCQs). Marks will be assigned according to the correctness of the responses.

### Individual Assignment

The assignment allows self-directed study leading to a survey report. Marks will be assigned according to the originality of the work, adequate addressing of an emerging research area, categorizing/structuring of the research work, comprehensive and clear reporting, and the validity and trustworthiness of the references.

The assignment report will be due by midnight Tuesday in Week 9. Late reports will get a penalty of 10% per day (including weekends). All reports are to be submitted via Moodle. More details on the research topic selection, conduct of the research, report preparation, and the submission, will be explained during the lectures.

### Final Exam

The exam in this course is a standard closed-book 2 hour written examination, comprising five compulsory questions. University approved calculators are allowed. The examination tests analytical and critical thinking

and a general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course. Marks will be assigned according to the correctness of the responses. Please note that you must pass the final exam (score at least 50% of the final exam marks) in order to pass the course.

**Relationship of Assessment Methods to Learning Outcomes**

| | **Learning Outcomes** | | | | |
|---|---|---|---|---|---|
| **Assessment** | **1** | **2** | **3** | **4** | **5** |
| Quiz | ✓ | ✓ | | | |
| Mid-semester exam | ✓ | ✓ | ✓ | | |
| Individual Assignment | | | ✓ | ✓ | ✓ |
| Final exam | ✓ | ✓ | ✓ | | |

## COURSE RESOURCES

### Textbooks

Reference books

- G. Santana, “Data Center Virtualization Fundamentals", Cisco Press, 2013, ISBN:1587143240
- V. Josyula, M. Orr, and G. Page, “Cloud Computing: Automating the Virtualized Data Center”, Cisco Press, 2012, 392 pp., ISBN: 1587204347
- H. Saboowala, M. Abid, S. Modali, “Designing Networks and Services for the Cloud: Delivering business-grade cloud applications and services", Cisco Press 2013, ISBN:1587142945
- K. Hess, A. Newman, “Practical Virtualization Solutions: Virtualization from the Trenches", Prentice Hall, 2009, ISBN:0137142978
- C. Poelker, A. Nikiti, “Storage Area Networks For Dummies", For Dummies, 2009, ISBN:9780470385135
- J. Hurwitz, et al., “Big Data for Dummies”, Wiley, 2013, ISBN:978- 1-118-50422-2
- S. Azodolmolky, “Software Defined Networking with OpenFlow", Packt Publishing, October 2013, 152 pp., ISBN:978-1-84969-872-6
- T. Nadeau and K. Gray, “SDN", O’Reilly, 2013, 384 pp, ISBN:978- 1-449-34230-2B
- O. Hersent, et al., “The Internet of Things: Key Applications and Protocols", Wiley, 2013, 344 pp., ISBN: 9781119994350
- H. Chaouchi, “The Internet of Things: Connecting Objects", Wiley, Jun 2010, 288 pp., ISBN: 9781848211407
- H. Zhou, “The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2013, 365 pp., ISBN: 9781439892992

### On-line resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials, host forums and occasionally quizzes. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Mailing list

Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

## OTHER MATTERS

### Dates to note

Important dates are available at: https://student.unsw.edu.au/dates

### Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see: https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

### Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/guide), and particular attention is drawn to the following:

### Workload

It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and independent, self-directed study. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

### Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

### General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

### Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

### Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the "fit to sit/submit" rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see https://student.unsw.edu.au/special-consideration.

### Continual Course Improvement

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the online student

survey myExperience. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings.

**Administrative Matters**

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies: https://www.engineering.unsw.edu.au/electrical-engineering/resources and https://student.unsw.edu.au/guide.

# APPENDICES

### Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

### Appendix B: UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in self-assessing questionnaires and assessed by assignments and written examinations.
- Developing capable independent and collaborative enquiry, through a series of self-assessing questionnaires and discussion sessions spanning the duration of the course.
- Developing digital and information literacy and lifelong learning skills through assignment work.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and assignment tasks.

**Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard**

| | **Program Intended Learning Outcomes** | |
|---|---|---|
| **PE1: Knowledge and Skill Base** | PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals | ✓ |
| | PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing | ✓ |
| | PE1.3 In-depth understanding of specialist bodies of knowledge | ✓ |
| | PE1.4 Discernment of knowledge development and research directions | ✓ |
| | PE1.5 Knowledge of engineering design practice | |
| | PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice | ✓ |
| **PE2: Engineering Application Ability** | PE2.1 Application of established engineering methods to complex problem solving | ✓ |
| | PE2.2 Fluent application of engineering techniques, tools and resources | ✓ |
| | PE2.3 Application of systematic engineering synthesis and design processes | |
| | PE2.4 Application of systematic approaches to the conduct and management of engineering projects | ✓ |
| **PE3: Professional and Personal Attributes** | PE3.1 Ethical conduct and professional accountability | ✓ |
| | PE3.2 Effective oral and written communication (professional and lay domains) | ✓ |
| | PE3.3 Creative, innovative and pro-active demeanour | ✓ |
| | PE3.4 Professional use and management of information | ✓ |
| | PE3.5 Orderly management of self, and professional conduct | ✓ |
| | PE3.6 Effective team membership and team leadership | |