School of Electrical Engineering and Telecommunications

Term 3, 2019
Course Outline

TELE9752
Network Operations and Control

COURSE STAFF

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Consultations: You are encouraged to ask questions on the course material during, before, or after the lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during lectures. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with TELE9752 in the subject line; otherwise they may 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 the course web-page http://subjects.ee.unsw.edu.au/tele9752/, as well as 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.

Activity	Day	Time	Location
Lecture	Tuesday	6pm - 9pm	CLB1

Context and Aims

This course introduces the principles, techniques, and tools used for the management of modern communication networks such as the Internet. The five major functional areas of network management are discussed: configuration management for configuring the hardware and software on network elements, performance management for measuring and controlling network performance, fault management for detecting and responding to fault conditions in the network, security management for securing and controlling access to resources in the network, and accounting management for tracking and logging network usage. Guest lecturers from industry and group projects with practical hands-on work will enhance student learning.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction to Network Operations and Control
Week 2	Programmability in Network Operations and Control
Week 3	Network Design and Configuration
Week 4	MIB/SNMP and Yang/Netconf
Week 5	Mid-term exam and Project discussion
Week 6	Project Stage 1 Presentation
Week 7	Network Faults and Performance
Week 8	Network Telemetry
Week 9	Network Security and Programmable Data Planes
Week 10	Project Stage 2 Presentation

Assessment

Mid-term Exam	20%
Group Project	40%
Final Exam (2 hours)	40%

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 elective course in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is TELE3118 Network Technologies. It is essential that you are familiar with the functions of the various layers in the TCP/IP protocol stack before this course is attempted. It is highly desirable that you be familiar with the roles of various network devices (switches, routers, firewalls, etc.) and the main protocols used for network communication before this course is attempted. Some prior knowledge of network performance, network security, and network architecture, covered respectively in courses TELE4642 "Network Performance", TELE3119 "Trusted Networks", and GSOE9758 "Network Systems Architecture" respectively, will be useful, though is not essential for this course. It is further assumed that students have good computer literacy.

Following Courses

The course is not a pre-requisite for other courses in the school or faculty.

Learning outcomes

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

1. Describe the five functional areas (FCAPS) of network management in terms of the problems that arise in each functional area and in terms of the technologies that are used to address those problems.

2. Construct Management Information Bases (MIBs) and YANG models that describe the information used to manage network elements and network protocols.

3. Use software APIs to configure network elements and extract telemetry from them.

4. Describe the main features of significant standards for network operations and control.

5. Assess recent developments in automated network operations and control methods.

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*.

Syllabus

This course introduces the principles, techniques, and tools used for the management of modern communication networks such as the Internet. The five major functional areas of network management are discussed: configuration management for configuring the hardware and software on network elements, performance management for measuring and controlling network performance, fault management for detecting and responding to fault conditions in the network, security management for securing and controlling access to resources in the network, and accounting management for tracking and logging network usage. Guest lecturers from industry and group projects with practical hands-on work will enhance student learning.

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;
- Group Project, which supports the formal lecture material and also provides you with practical construction, measurement and debugging skills. The project will provide you with the opportunity to demonstrate your ability to apply the concept of this course to a real-world situation;
- Guest lectures from industry personnel to motivate how the theory learnt in class is applied in the real-world by practitioners.

Learning in this course

You are expected to attend <u>all</u> lectures, project presentations, and mid-term exam in order to maximise learning. In addition to the lecture notes, you should read relevant sections of the recommended texts. Reading additional texts will further enhance your learning experience. Group learning is also encouraged, particularly for the project work. UNSW *assumes* that 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 mid-term exam (week 5) and project stage 1 presentation (week 6).

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. It may contain questions requiring some (not extensive) knowledge of project work, and material presented by guest lecturers. Marks will be assigned according to the correctness of the responses.

Group Project

The group project will require you to design, configure, measure, and control a real-world networking system using the Cisco DevNet platform. You will have to present the first stage of your project on design and configuration in week 6, followed by a final presentation in week 10 on the measurement and control of your network including a demonstration of the working system. Each presentation is worth 10% of the grade, and a final report (worth 20% of the grade) will be due in week 10 that will contain a comprehensive description of the design, configuration, measurement, and control of your network system. This group project will require you to undertake self-directed study and development of independent solutions of partly structured problems. Marks will be assigned according to how completely and correctly the problems have been addressed, the quality of the code written for the assignment (must be attached to the report), and the understanding of the course material demonstrated by the report. Late submissions will either not be accepted or attract a 10% penalty per-day.

Final Exam

The exam in this course is a standard closed-book 2 hour written examination. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course (including project work and guest lectures), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses. *Please note that you must pass the final exam in order to pass the course.*

Relationship of Assessment Methods to Learning Outcomes *(example below)*

Assessment	Learning outcomes				
	1	**2**	**3**	**4**	**5**
Mid-term exam	✓	✓	-	✓	-
Project	-	✓	✓	-	✓
Final exam	✓	✓	-	✓	✓

COURSE RESOURCES

Textbooks

Prescribed textbooks:

- A. Radford et al: Cisco IOS XE Programmability, Cisco, 2018. Available online at: https://www.cisco.com/c/dam/en/us/products/collateral/enterprise-networks/nb-06-ios-xe-prog-ebook-cte-en.pdf

- Google: Site Reliability Engineering: How Google Runs Production Systems, 2016. Available online at: https://landing.google.com/sre/books/

Reference books:

- A. Clemm: Network Management Fundamentals, Cisco Press, 2007.
- D. Comer: Automated Network Management Systems: Current and Future Capabilities, Pearson, 2007.
- M. Subramanian: Network Management: Principles and Practice, Addison Wesley, 2000.

On-line resources

All course material and announcement will be at: https://subjects.ee.unsw.edu.au/tele9752/

Additionally, Moodle will be used to disseminate custom information, 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 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 and laboratory results 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 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. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

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://student.unsw.edu.au/guide
https://www.engineering.unsw.edu.au/electrical-engineering/resources

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 hands-on projects, and assessed by presentations, reports, and written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the group projects and interactive checkpoint presentations.
- Developing digital and information literacy and lifelong learning skills through project work.
- Developing ethical practitioners who are collaborative and effective team workers, through group activities, projects, and presentations.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project 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	✓

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