Course guide
230684 - FINE - Future (Inter)Net(Works)

Last modified: 06/05/2019

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 701 - DAC - Department of Computer Architecture.

Degree: **Academic year:** 2019 **ECTS Credits:** 5.0
Languages: English

LECTURER

Coordinating lecturer: Josep Solé Pareta

Others: Josep Solé Pareta and others (invited lecturers)

REQUIREMENTS

It is required to have past both courses, "Communication Networks" and "Overlay Networks"

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE8. Ability to understand and to know how to apply the functioning and organization of the Internet, new generation Internet technologies and protocols, component models, middleware and services

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY

The methodology of this course will follow the criteria established for the Superior European Education Space (SEES), which main objective is that the students -learn to learn-. Besides of the attendance and participation in the lectures, the course will rely in two main tasks, namely one consisting of preparing questions and answers based on the specific content taught in class, and the other on the realisation of a Technical Report (done in groups of 2 or 3 students) that will be presented to the class at the end of the course. The students will be also requested to read some selected research papers related with subjects of the course, that later on will be discussed in specific panel sessions.

The main objective of the course is to experimet some specific technics to start to adquare the avilities for doing scientific research, and conduct them to some relevant computer networking topics. In particcular those that are addressing the Broadband Communications and Systems research group of the UPC.

LEARNING OBJECTIVES OF THE SUBJECT

Objective of the lectures: 1) Evaluate the impact of the tremendous explosion of the use of Internet is having in the networking technology evolution. 2) Analyze the contribution of the Internet in the global energy consumption, and study mechanisms to counteract this fact. 3) Review the new networking paradigms and its consistence with the existing ones.

Objective of the discussion sessions based on selected readings: Foster autonomous learning and team work skills.

Objective of preparing a set of question for feeding the midterm exams: Foster comprehensive learning and the ability to summarise and of abstracting concepts.

Objective of the technical report: Enhance the cooperative learning and the capacity of synthesising and transmit concepts.

STUDY LOAD

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

Total learning time: 125 h

CONTENTS

Next Generation Internet

Description:
1) Internet trends

2) IP Traffic Monitoring and Analysis (TMA)
2.1 IP traffic classification
2.2 Anomaly detection and classification
2.3 TMA in Software Defined Networks (SDN) enironments
2.4 Malware and network attack mitigation

3) Evolution of the IP network architecture
3.1 Recursive Internet Architecture (RINA)
3.2 The routing scalability in Internet
3.3 Location/ID split (LISP)

4) The Internet of Things (IoT)

Full-or-part-time: 8h
Theory classes: 8h

IP Transposrt networks, resources optimization and survivability

Description:
1) Multilayer Resilience Networks

2) From MPLS to SDN/OpenFLOW, the new paradigm

3) Deep Reinforcement Learning (DRL) for knowledge based routing and adaptive QoS

4) Optical Packet Switching Networks or the story of what could have been

Full-or-part-time: 8h
Theory classes: 8h

Energy Oriented Internet

Description:
1) Energy consumption in Internet: The problem

2) Optimising the energy consumption in the network

3) The energy consumption in Datacenters and Clouds

Full-or-part-time: 5h
Theory classes: 5h

New Networking Paradigms

Description:
1) Graphene-enabled Wireless Networks
1.1 Large scale Networks-on-Chip
1.2 Reconfigurable metamaterials- Optical Packet Switching Networks

2) Molecular Communcations

Full-or-part-time: 5h
Theory classes: 5h

Miscellaneuos

Description:
- Panel sessions on the selected research papers
- Discussion of the exam-like questions prepared by the students
- Presentation of the Technical Reports done in groups
- Midterm exams (x2)

Full-or-part-time: 13h
Theory classes: 13h

GRADING SYSTEM

The evaluation and marking of the students of this course will be done according with the following percentages:
- Attendance to the lectures: 10%
- Panel Sessions on research papers (chairing the panel and participating in the debate): 10%
- Preparation of exam-like questions*: 10%
- Preparation and presentation of a Technical Report (in groups of 2 or 3 students): 20%
- Midterm exams (x 2): 50%

(*) During the course the students will have to prepare three sets (one per each of the main subjects of the course) of 2 or 3 questions (and their answers) that can be included in the midterm exams of the course (i.e., they have to be not too easy or extremely difficult questions, but fitting with the level taught in the course).

BIBLIOGRAPHY

Basic:

- Casado, M.; Koponen, T.; Shenker, S.; Tootoonchian, A. "Fabric: a retrospective on evolving SDN". Proceedings of the first workshop on Hot topics in software defined networks (HotSDN '12) [on line]. P. 85-90 [Consultation: 26/09/2018]. Available on: yuba.stanford.edu/~casado/fabric.pdf.
- Akyildiz, I.F.; Nie, S.; Lin, S.-C.; Chandrasekaran, M. "5G roadmap: 10 key enabling technologies". Computer Networks [on line]. vol. 106, (sept. 2016), p. 17-48 [Consultation: 26/09/2018]. Available on: https://www.sciencedirect.com/science/article/pii/S1389128616301918?via%3Dihub.- Sanou, B. ICT Facts and Figures 2017 [on line]. Switzerland: International Telecommunications Union (ITU), 2017 [Consultation: 26/09/2018]. Available on: http://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx.
- Mosharaf Kabir Chowdhury, N.M.; Boutaba, R. "Network virtualization: state of the art and research challenges". IEEE Communications Magazine [on line]. Vol. 47, issue 7 (July 2009), p. 20-26 [Consultation: 26/09/2018]. Available on: http://ieeexplore.ieee.org/servlet/opac?punumber=35.- Agrell, E.; Karlsson, M.; Chraplyvy, A.R.; Richardson, D.J.; Krummrich, P.M.; Winzer, P.; Roberts, K.; Fischer, J.K.; Savory, S.J.; Eggleton, B.J.; Secondini, M. "Roadmap of optical communications". Journal of Optics (IOP Science) [on line]. vol. 18, núm. 6 (may 2016), 40 pp.p [Consultation: 26/09/2018]. Available on: http://iopscience.iop.org/article/10.1088/2040-8978/18/6/063002/meta.

Complementary:

- Jajszczyk, A. "Automaticaly switched optical networks: benefits and requirements". IEEE Communications Magazine [on line]. Vol. 43, issue 2 (feb. 2005), p. S10 - S15 [Consultation: 26/09/2018]. Available on: http://ieeexplore.ieee.org/document/1391497/.- Meeker, M. Internet trends 2018 [on line]. Kleiner Perkins Caufield & Byers (KPCB), 2018 [Consultation: 02/05/2020]. Available on: https://www.kleinerperkins.com/perspectives/internet-trends-report-2018/.
- Cholda, P.; Jajszczyk, A. "Recovery and its quality in multilayer networks". Journal of Lightwave Technology [on line]. vol. 28, issue 4 (feb 2010), p. 372-389 [Consultation: 26/09/2018]. Available on: https://ieeexplore.ieee.org/document/5233845.