300046 - PX - Network Planning

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 744 - ENTEL - Department of Network Engineering
Academic year: 2018
Degree: BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 4
Teaching staff
Coordinator: Definit a la infoweb de l'assignatura.
Definido en la infoweb de la asignatura.
Defined at the School web info of the course.
Others: Definit a la infoweb de l'assignatura.
Definido en la infoweb de la asignatura.
Defined at the School web info of the course.

Prior skills
Understanding the basic concepts of access and transport networks, teletraffic, and telematics applications and services.

Degree competences to which the subject contributes

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.

Teaching methodology
The classes consist essentially of lecture classes by the teacher (encouraging the active participation of the students), although students will also be asked to work certain parts of the subject on their own (autonomous learning), based on the materials provided by the professors (slides, documents about cases of use / products, chapters of books, etc.).

The concepts of theory will be reinforced by solving problems, which will in many cases be the solution, thus providing a self-evaluation of the learning achieved in each unit and activity.

The laboratory sessions (hands on) will be done in pairs and software simulation and planning tools and SDN / NFV network environments will be used.

Learning objectives of the subject
At the end of the course, the student must be able to:

· Modeling the rules governing the packed switching networks from the point of view of the user and the operator.

· Know the basic elements of Theory of Graphs and apply them to the analysis of networks and services.
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- Use a specific simulation environment used in the modeling of networks with graphs.
- Know some models to evaluate social networks.
- Identify the bases and requirements for planning a packet switching network.
- Identify and apply the main algorithms for allocation of capacities, flows and topology used in the design of a packet switching network.
- Use a specific simulation environment used in network planning.
- Understand and configure the architecture of networks defined by software (SDN) and virtualized network functions.

### Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 100h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group:</td>
<td>26h 26.00%</td>
</tr>
<tr>
<td>Hours medium group:</td>
<td>13h 13.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>0h 0.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>5h 5.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>56h 56.00%</td>
</tr>
</tbody>
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## Content

### Introduction to the planning and dimensioning of networks and services

**Learning time:** 6h  
- Theory classes: 2h  
- Self study: 4h

**Description:**  
Evolution of networks and services. Internet  
Virtualization & Federation  
Software Defining Networks. Network function virtualization

### Mathematical tools for characterizing and modelling networks and services

**Learning time:** 24h  
- Theory classes: 6h  
- Practical classes: 3h  
- Guided activities: 1h  
- Self study: 14h

**Description:**  
Introduction to Graph Theory. Definitions  
Degree distribution  
Minimum cut set. Maximum flow  
Feature extraction. Neighbourhood, centrality, hubs  
Models of the WWW. Page Rank.  
Models of Internet. Small world. Scale-free networks  
Simulation and analysis tools: Pajek  
Analysis of GEANT and/or a social network  
Exercises. Examples: www, Netflix

### Software-defined networking (SDN) & NFV

**Learning time:** 30h  
- Theory classes: 8h  
- Practical classes: 4h  
- Guided activities: 2h  
- Self study: 16h

**Description:**  
Concept, architecture, applications  
Virtualization. Definition. Features  
Openflow protocol & interfaces. Description. Controllers. OpenDaylight  
Analytical model of SDN  
Design and evaluation of a SDN-LAN  
Emulation tools and deployment: mininet & Open vSwitch
### Dimensioning and planning of packet networks

**Learning time:** 24h  
- Theory classes: 6h  
- Practical classes: 3h  
- Guided activities: 1h  
- Self study: 14h

**Description:**  
Dimensioning and planning of packet networks  
Model of a packet switched network  
Traffic matrices  
Analysis of delay  
Optimization problems  
Capacity Assignment  
Flow Assignment  
Internet model  
Topology  
Robustness  
Exercises  
Applications with Net2Plan

### Network services

**Learning time:** 16h  
- Theory classes: 4h  
- Practical classes: 3h  
- Guided activities: 1h  
- Self study: 8h

**Description:**  
Network function virtualization (NFV). Architecture. MANO  
Service Function Chaining (SFC). Architecture  
Network Service Header (NSH). Protocols and functionalities  
Use cases: Open MANO, OSM, OpenStack

### Qualification system

Definit a la infoweb de l'assignatura.  
Definido en la infoweb de la asignatura.  
Defined at the School web info of the course.
Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

OpenFlow Switch Consortium
https://www.opennetworking.org/

Pajek
http://vlado.fmf.uni-lj.si/pub/networks/pajek/

mininet
http://mininet.org/