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.
300046 - PX - Network Planning

· 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 | Hours large group: 26h | 26.00% |
| Total learning time: 100h | Hours medium group: 13h | 13.00% |
| | Hours small group: 0h | 0.00% |
| | Guided activities: 5h | 5.00% |
| | Self study: 56h | 56.00% |
## 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 |
# 300046 - PX - Network Planning

## Dimensioning and planning of packet networks

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 24h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensioning and planning of packet networks</td>
<td></td>
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<tr>
<td>Model of a packet switched network</td>
<td></td>
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<tr>
<td>Traffic matrices</td>
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<td>Analysis of delay</td>
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<td>Optimization problems</td>
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<td>Capacity Assignment</td>
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<td>Flow Assignment</td>
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<td>Internet model</td>
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<td>Topology</td>
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<td>Robustness</td>
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<tr>
<td>Exercises</td>
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<tr>
<td>Applications with Net2Plan</td>
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</tbody>
</table>

**Learning time:** 24h

- Theory classes: 6h
- Practical classes: 3h
- Guided activities: 1h
- Self study: 14h

## Network services

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 16h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network function virtualization (NFV). Architecture. MANO</td>
<td></td>
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<tr>
<td>Service Function Chaining (SFC). Architecture</td>
<td></td>
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<tr>
<td>Network Service Header (NSH). Protocols and functionalities</td>
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<tr>
<td>Use cases: Open MANO, OSM, OpenStack</td>
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</tr>
</tbody>
</table>

**Learning time:** 16h

- Theory classes: 4h
- Practical classes: 3h
- Guided activities: 1h
- Self study: 8h

## 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/