# Internet network architecture

**Academic Year: ( 2021 / 2022 )** **Review date: 25-06-2021**

**Department assigned to the subject: Telematic Engineering Department**

**Coordinating teacher: GARCIA MARTINEZ, ALBERTO**

**Type: Electives ECTS Credits : 3.0**

**Year : Semester :**

## OBJECTIVES

The 'Internet Architecture' course is devoted to understand how Internet works at a global scope in the current moment. We will understand how networks are connected one to each other, which are the economic incentives and their implications in the way networks connect along with the roles played by the different agents involved.
One of the most relevant problems Internet faces is IP address scarcity (in the Internet Protocol version most widely used, IPv4). We will understand the magnitude of the problem. We will also understand the current deployed solutions: different ways of using private addressing (NAT, VPNs, etc.), IPv4 address market, and the development of a new protocol with a larger address space, IPv6. We will discuss the
implications of each of these solutions to network functionality.
Regarding to the methodology for the course, the approach followed is practical, focused on the analysis of real data and the deployment (in a virtual environment) of the proposed solutions. We intend knowledge to emerge from the access, processing and analysis of real data, and from the experience in the configuration of network scenarios. The objective is to empower the student to access by himself to the data/experience and build from this input its own knowledge.

## DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Python.
1.1 Data processing with Python: 'pandas' library

2. Internet Architecture.
2.1 Interdomain routing. BGP routing. Pricing and relationships between networks. Internet business model
2.1.1 Quantitative analysis of the current Internet.
2.2 Content Data Networks (CDN), cloud, datacenters
2.2.1 Quantitative análisis of connectivity to CDNs

3. Addressing in the Internet
3.1 Public address assignment governance and policies. Address scarcity. Address market.
3.1.1 Quantitative analysis of assigned addresses.
3.1.2 IP address market
3.2 Use of private addresing
3.2.1 Tunnels
3.2.2 NATs
3.2.1.1 Configuring NATs
3.3. IPv6 addressing

## LEARNING ACTIVITIES AND METHODOLOGY

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Data analysis is a skill growingly required in the job market, that is just assumed to be known by any engineer. In this course we provide basic knowledge to data processing through a programming interface. For real data analysis, we use Python, and in particular the pandas library, a tool providing

flexible data processing with a low entry barrier (we devote some course time to present these tools). We apply the tool to real data to analyse in the laboratory how many different networks are in the Internet, which is the distance between them, how many addresses have been assigned to date, who is the owner, which are the top buyers and sellers, how many routers are traversed when accessing to most popular destinations, etc.

On the other hand, we use virtual network topologies (using the CORE virtual network framework) to understand how NATs are configured.

The syllabus is completed with short videos that address more descriptive (less technical) topics.

Finally, we post (current) news regarding to topics related to the course to promote the connection of the student with the professional world.

## ASSESSMENT SYSTEM

35% laboratory
45% partial exams
20% final examn

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| **% end-of-term-examination:** | 20 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 80 |

## BASIC BIBLIOGRAPHY

- Iljitsch van Beijnum BGP, O'Reilly.

- Sam Lau, Joey Gonzalez, and Deb Nolan. Principles and Techniques of Data Science., https://www.textbook.ds100.org/, 2019

## ADDITIONAL BIBLIOGRAPHY

- Ivan Vidal, I. Soto Multimedia Networking Technologies, Protocols, & Architectures, Artech House Communications and Network Engineering, 2019
- Wes McKinney Python for data analysis. , O'Reilly Media, Inc., 2017