Internet Tendencies

Academic Year: (2023 / 2024) **Review date: 30-03-2023**

Department assigned to the subject: Telematic Engineering Department

Coordinating teacher: GARCIA MARTINEZ, ALBERTO

Type: Electives ECTS Credits : 3.0

Year : Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Communications Networks and Services

OBJECTIVES

In the period from may 2013 to may 2018, the IPv6 traffic as reported by Google has raised from 1.3% to 22% (https://www.google.com/intl/en/ipv6/statistics.html, being the remaining of the traffic IPv4, the IP flavor with 32-bit addresses). This growth is determined by the exhaustion of the IPv4 address space in the main regions of the world The aim of this course is to allow the student to obtain deep knowledge on IPv6. It is also an objective to increase the knowledge on IPv4.

To complete these objectives, the student must acquire the following knowledge:

- Understand the limitations of the Internet network layer, in particular IPv4 address scarcity. Know the alternatives to solve these problems: IPv6 and its basic operation principles.
- Understand the technical and economic context, and the difficulties in deploying a new technology like IPv6. Identify the actors involved in this process and their motivations.
- Be able to perform IPv6 configurations of medium complexity in both hosts and routers.

Besides, as the advanced functionalities provided by IPv6 are presented, such as address configuration mechanisms, or support for multiple addresses in the same interface, we will analyze its equivalence for the IPv4 protocol, when appropriate. In this way, the course also deals with advanced topics in IPv4 not addressed in other courses.

Regarding to the general abilities, in this course we will work on:
- Realizing the importance of business models in the deployment of new technologies
- A critic attitude about current and developing technologies
- The ability to work in teams to design and configure systems, balancing work load in order to face complex problems
- The ability to configure real equipment, both individually and as a team.

In relation with the Program Outcomes specified for the degree, this course aims to cover:
"a) an ability to apply knowledge of mathematics, statistics, science, telecommunication technologies and engineering
e) an ability to identify, formulate, and solve engineering problems
h) the broad education necessary to understand the impact of tele-communication solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice"

DESCRIPTION OF CONTENTS: PROGRAMME

1. Addressing and address assignment policies in the Internet
   1.1 IPv4 address scarcity
   1.2 The NAT solution to the IPv4 address scarcity problem, and impact of those solutions
   1.3 IPv6 as a solution to the address scarcity problem

2. Addressing model for IPv6. Managing multiple addresses in IPv4 and IPv6
   2.1 Global IPv6 addresses
   2.2 Link-Local addresses

2.3 Unique Local IPv6 Unicast addresses
2.4 IPv6 Multicast addresses
2.5 IPv6 Anycast addresses

3. Packet format for IPv6.
3.1 IPv6 header
3.2 Fragmentation and Path MTU

4 ICMPv6 and auto-configuration mechanisms for addresses and other parameters.
4.1 ICMPv6 header and message types
4.2 Multicast group management in IPv6: Multicast Listener Discovery
4.3 Neighbor Discovery
4.3.1 IP-to-MAC resolution
4.3.2 Neighbor Unreachability Detection
4.3.3 Duplicate Address Detection
4.4 Configuration of network parameters in hosts
4.4.1 Introduction to DHCPv6
4.4.2 Router discovery and address configuration through Router Advertisements
4.5 ICMPv6 Redirect

5. Other layers and its relation with IPv6: DNS and application programming in IPv6.
5.1 DNS in IPv6

6 IPv6 deployment and IPv4/IPv6 coexistence
6.1 The dual-stack strategy
6.2 Tunnel-based mechanisms
6.2.1 Manual tunnels
6.2.2 6RD tunnels
6.3 Translation-based mechanisms

LEARNING ACTIVITIES AND METHODOLOGY

Learning activities are organized as follows:
Learning activities are organized as follows:
(1) Students receive teaching materials and manage basic reference texts to allow them to complete their knowledge in the topics in which they are most interested.
(2) In classes the knowledge the students must acquire is debated, and some exercises are solved to consolidate it
(3) In practical sessions students configure simple IPv6 networks.
(4) Students solve exercises, being some of them evaluated, so that they can obtain feedback about the knowledge acquired.
(5) Students may optionally make a presentation about an article/document in which they gain deeper knowledge about IPv6.
(6) Students can ask the teacher individually to solve the questions raised during their learning process.

ASSESSMENT SYSTEM

Ordinary period:
- 2 partial exams, performed during the lecturing hours of the course.
  The value of the first exam is 2.25 points (out of 10). It consists of theory and problems
  The value of the second is 2.25. It consist of a problem.
- Evaluation of the practical work, with a total value of 2 of the final grade. Practices done out of the class scheduling will be performed individually, and have a total value of 0.1. Practices performed in class hours will be done in pairs and have a value of 1.9.
- Theory exam, done in the date reserved for the ordinary exam, with a value of 4.5 points (of the global qualifications, which are evaluated over 10 points). The student must obtain a minimum qualification of 40% of the value of the exam to pass.

Note that the sum of these parts can reach 11 points. The final qualification is obtained as max {10, sum(student¿s qualifications)}

Extraordinary period:
Exam = Part A (4.5) + Part B (5.5)
Part A: Theory
Part B: problems.

Students with more than 3.5 points in 'partial exams + laboratory' may choose to be evaluated with Part A, if they had obtained more than 4 out of 10 in Part A (>= 1.8)
In this case, the final qualification is obtained as min {10, Part A + partial exams + laboratory}

% end-of-term-examination:	45
% of continuous assessment (assigments, laboratory, practicals…):	55

BASIC BIBLIOGRAPHY

- E. Nordmark, R. Gilligan RFC 4213. Basic Transition Mechanisms for IPv6 Hosts and Routers, IETF, 2005
- Iljitsch van Beijnum Running IPv6. , Apress, 2006
- R. Hinden, S. Deering RFC 4291. IP Version 6 Addressing Architecture, IETF, 2006
- S. Deering, R. Hinden RFC 2460. Internet Protocol, Version 6 (IPv6) Specification, IETF, 1998
- S. Thomson, T. Narten, T. Jinmei RFC 4862. IPv6 Stateless Address Autoconfiguration, IETF, 2007
- T. Narten, E. Nordmark, W. Simpson, H. Soliman RFC 4861. Neighbor Discovery for IP version 6 (IPv6), IETF, 2007