

Course guide 300026 - API - Internet Architecture and Protocols

Last modified: 01/06/2023

Academic year: 2023	ECTS Credits: 6.0 Languages: Catalan, Spanish, English
Degree:	BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject). BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Optional subject).
Unit in charge: Teaching unit:	Castelldefels School of Telecommunications and Aerospace Engineering 744 - ENTEL - Department of Network Engineering.

LECTURER	
Coordinating lecturer:	Definit a la infoweb de l'assignatura.
Others:	Definit a la infoweb de l'assignatura.

PRIOR SKILLS

• Be familiar with concepts such as: protocol, stack of protocols, network architecture, services, switching, multiplexing, framework of information, addressing.

 \cdot Be familiar with packet switching technologies and LAN standards, the services they offer, characteristics of the interconnection devices and common problems of this technologies such as access to the environment or resources sharing.

 \cdot Knowledge of the Address Resolution Protocol (ARP).

· Knowledge of metrics related to the network performance such as throughput, employment, delay.

· Programming fundamentals, use of Linux/Unix operating systems and familiarity with protocol analysers.

REQUIREMENTS

Prerequisite:

- Network Interconnection Techniques.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. CE 20 TELECOM. Conocimiento de la normativa y la regulación de las telecomunicaciones en los ámbitos nacional, europeo e internacional.(CIN/352/2009, BOE 20.2.2009.)

2. CE 7 TELECOM. Capacidad de utilizar aplicaciones de comunicación e informáticas (ofimáticas, bases de datos, cálculo avanzado, gestión de proyectos, visualización, etc.) para apoyar el desarrollo y explotación de redes, servicios y aplicaciones de telecomunicación y electrónica.(CIN/352/2009, BOE 20.2.2009.)

Generical:

6. EFFICIENT USE OF EQUIPMENT AND INSTRUMENTS - Level 2: Use the correct instruments, equipment and laboratory software for specific or specialized knowledge of their benefits. A critical analysis of the experiments and results. Correctly interpret manuals and catalogs. Working independently, individually or in groups, in the laboratory.

Transversal:

3. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.

4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

5. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.



TEACHING METHODOLOGY

The teaching methodology is based on the work in the laboratory.

The laboratory sessions will usually start with an explanation of the teacher followed by a round of questions to clarify doubts and to answer the questions of the students. Then, the students will have to follow the lab book to build some scenarios and to complete several exercises to study the protocol, service, or application from a practical perspective. Before each lab session, the students will receive a document containing a theoretical explanation of the protocol, service or application that will be discussed and studied in the next session as well as the enouncement of the laboratory activities. The goal of each session is therefore threefold: 1) consolidation through the experimentation of theoretical concepts previously studied autonomously 2) learning to use and configure real tools and 3) data acquisition for its later study.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the subject, the student must be capable of:

· Explaining the principles of the IP protocol, the operation of a router, the routing problem and the CIDR paradigm.

· Performing a network address planning

• Distinguishing between intra and inter domain routing protocols and among different routing algorithms: distance vector, link state, and path distance.

- · Configuring different dynamic routing protocols, explaining how they work and the interaction between them.
- \cdot Applying the idea of grouping prefixes and redistribution
- \cdot Distinguishing between unicast, multicast and any cast routing.
- \cdot Explaining the operation and structure of the Internet from the perspective of routing.
- \cdot Explaining the DNS system, configuring DNS servers and managing the domain namespace.
- \cdot Distinguishing the levels or layers of the TCP / IP protocol stack; in the Internet model.
- \cdot Distinguishing the most used transport protocols on the Internet.
- \cdot Understanding the client-server model.

 \cdot Understanding the operation of services such as email, web and VoIP and configure servers and clients to offer and receive these services.

· Explaining the functionality of a firewall and a NAT. Configure both types of functionality in Linux.

STUDY LOAD

Туре	Hours	Percentage
Self study	84,0	56.00
Guided activities	14,0	9.33
Hours small group	52,0	34.67

Total learning time: 150 h

CONTENTS

Introduction

Description: Subject and lab introduction. Summary of the objectives of the subject and interaction with other subjects of the curriculum.

Related activities: Activities A1, A13.

Full-or-part-time: 0h 30m Laboratory classes: 0h 30m



Fundamentals of IPv4 addressing and routing

Description:

Review of IPv4 addressing. Subnetting i supernetting. CIDR routing. Routing tables and Longest-Prefix Matching. Functional description of a router. Static IP unicast routing.

Related activities: Activities A1, A13.

Full-or-part-time: 8h Laboratory classes: 5h Self study : 3h

Unicast IP Routing Protocols - Interior Gateway Protocols

Description:

Dynamic routing, routing algorithms and protocols. RIPv2 Protocol. OSPF Protocol: · LSAs and OSPF database.

 \cdot Area division.

Related activities: Activities A2, A3, A13.

Full-or-part-time: 22h 30m Laboratory classes: 9h Self study : 13h 30m

Multicast IP routing protocols

Description:

Multicast concept and addressing space. IGMP protocol to manage the multicast group membership. PIM-SM protocol as an example of a dynamic IP multicast Routing protocol.

Related activities: Activities A4, A13.

Full-or-part-time: 14h 30m Laboratory classes: 5h 30m Self study : 9h



Unicast IP Routing Protocols - Exterior Gateway Protocols

Description:

Structure of Internet, Autonomous Systems and ASNs. BGP4 Protocol:

· Path distance paradigm.

· BGP4 protocol functionalities.

· Attributes and Routing policies.

Related activities: Activities A5, A13.

Full-or-part-time: 24h 30m Laboratory classes: 9h 30m Self study : 15h

Introduction to IPv6

Description:

Current problems with IPv4. IPv6 Protocol:

- \cdot Differences with IPv4 and packet format.
- · IPv6 Addressing.
- · IPv6 Routing.

 \cdot New functionalities: Multicast Listener Discovery, autoconfiguration, etc.

- Transition IPv4 to IPv6:
- Dual-Stacks.
- \cdot Tunnels.

Related activities:

Activities A6, A13.

Full-or-part-time: 7h 30m Laboratory classes: 3h Self study : 4h 30m

Transport protocols in the Internet

Description:

Necessity and Functions of the transport layer. UDP Protocol.

TCP Protocol:

- \cdot Concepts of connection, sequence number, acknowledgement number and retransmission.
- \cdot Transmission window, reception window, congestion window and zero window.

Related activities: Activities A7, A13.

Full-or-part-time: 7h 30m Laboratory classes: 3h Self study : 4h 30m



The Domain Name System (DNS)

Description:

DNS system architecture FQDNs, TLDs, RRs. Concepts of domain, zone, and delegation. Resolvers and master and slave servers. DNS Protocol. Recursive and iterative resolution. DNS for IPv6.

Related activities: Activities A8, A13.

Full-or-part-time: 14h 30m Laboratory classes: 5h 30m Self study : 9h

Electronic mail (e-mail)

Description: e-mail service. SMTP, POP3 and IMAP4 protocols. e-mail routing.

Related activities: Activities A9, A13.

Full-or-part-time: 7h 30m Laboratory classes: 3h Self study : 4h 30m

World Wide Web and HTTP protocol

Description:

Introduction to the World Wide Web (www). Web architectures. Web server's configuration. HTTP Protocol. Static Web. Web services (REST).

Related activities: Activities A10, A13

Full-or-part-time: 14h 30m Laboratory classes: 5h 30m Self study : 9h



Firewall and Network Address Translation (NAT)

Description:

Basic network security. Firewalls stateful and stateless. Policies and topologies. DMZs. Proxies. NATs: DNAT, SNAT and their utility.

Related activities: Activities A11, A13.

Full-or-part-time: 14h 30m Laboratory classes: 5h 30m Self study : 9h

Introduction to the VoIP service

Description:

SIP protocol and its application to the VoIP service. Introduction to SDP protocol. Introduction to RTP protocol.

Related activities: Activities A12, A13.

Full-or-part-time: 14h Laboratory classes: 5h Self study : 9h

ACTIVITIES

IPv4 addressing and static routing

Description:

In this activity, the concepts of IPv4 addressing, and IP Routing are reviewed, and static routes are configured.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 8h

Laboratory classes: 5h Self study: 3h

Unicast IP Routing Protocols - Interior Gateway Protocols - RIP Protocol

Description:

In this activity, the RIP unicast Routing protocol is studied.

Material: Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 7h Laboratory classes: 2h 30m Self study: 4h 30m



Unicast IP Routing Protocols - Interior Gateway Protocols - OSPF Protocol

Description:

In this activity, the OSPF unicast Routing protocol is studied.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 14h Laboratory classes: 5h Self study: 9h

Multicast IP Routing Protocols. PIM-SM Protocol

Description:

In this activity, the IGMP protocol and the PIM-SM multicast Routing protocol are studied.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 14h Laboratory classes: 5h

Self study: 9h

Unicast IP Routing Protocols - Exterior Gateway Protocols - BGP Protocol

Description:

In this activity, the BGP unicast exterior Routing protocol is studied.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 22h 30m Laboratory classes: 7h 30m Self study: 15h

An Introduction to the IPv6 Protocol

Description: In this activity, the IPv6 protocol is studied.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 7h Laboratory classes: 2h 30m Self study: 4h 30m



Transport protocols in the Internet

Description:

In this activity, the need and functionalities of the transport layer, and the most used standard transport protocols, UDP and TCP, are studied in a theoretical and practical way.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 7h Laboratory classes: 2h 30m Self study: 4h 30m

The Domain Name System (DNS)

Description:

In this activity, the DNS System is studied.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 14h Laboratory classes: 5h Self study: 9h

The Electronic Mail (e-mail)

Description:

In this activity, it is studied, from a practical perspective, how the electronic mail (e-mail) service works.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 7h

Laboratory classes: 2h 30m Self study: 4h 30m

World Wide Web and HTTP protocol

Description:

In this activity, the WWW is studied, as well as the protocol HTTP and a brief introduction to web services (REST).

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 14h Laboratory classes: 5h Self study: 9h



Firewall and Network Address Translation (NAT)

Description:

In this activity, a Firewall and NAT device is configured and tested.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 14h Laboratory classes: 5h Self study: 9h

Introduction to the VoIP service

Description:

In this activity, the VoIP service as well as the related protocols that make it possible (SIP, SDP, RTP) are studied and tested.

Material:

Lab workbook, recommended bibliography, and software guide.

Full-or-part-time: 14h Laboratory classes: 5h Self study: 9h

Evaluable activities (scoring exercises)

Description:

These activities include exercises to assess the knowledge acquired by the students.

Full-or-part-time: 7h 30m Laboratory classes: 7h 30m

GRADING SYSTEM

Definit a la infoweb de l'assignatura

EXAMINATION RULES.

Laboratory sessions are mandatory. The non-attendance (without a justified motive) at 3 or more session may imply to fail the subject.



BIBLIOGRAPHY

Basic:

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- Hall, Eric A. Internet core protocols : the definitive guide [on line]. Cambridge, Mass.: O'Reilly, 2000 [Consultation: 26/07/2022]. A vailable on:

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- Stallings, William. Data and computer communications [on line]. 8th ed. Upper Saddle River, NJ: Pearson Education International, 2009 [Consultation: 22/12/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5173 650. ISBN 9780135071397.

- Keshav, Srinivasan. An engineering approach to computer networking : ATM networks, the internet, and the telephone network. Reading, Mass.: Addison-Wesley, 1997. ISBN 0201634422.

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Complementary:

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- Zwicky, Elizabeth D.; Chapman, D. Brent; Cooper, Simon. Building Internet Firewalls. 2nd ed. Sebastopol: O'Reilly & Associates, 2000. ISBN 1565928717.

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- Kosiur, David R. IP multicasting : the complete guide to interactive corporate networks. New York [etc.]: John Wiley & Sons, 1998. ISBN 0471243590.