Course guide
300041 - SAI - Audiovisual Services on the Internet

Last modified: 19/05/2025

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 744 - ENTEL - Department of Network Engineering.

Degree: BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 4.0 **Languages:** Catalan, Spanish, English

LECTURER

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

Others: Definit a la infoweb de l'assignatura.

PRIOR SKILLS

· Understand basic networking concepts such as protocol, protocol stack, network architecture, services, switching, multiplexing, network information, routing.
· Basic knowledge of IP protocols for streaming, IP telephony and video streaming over IP, which were taught in "Internet Architecture and Protocols".
· Be proficient in the use of protocol analyzers (Wireshark)
· Know and apply the principles of digital signals (sampling, quantization, coding), its parameters and its application to visual signals (sound and image).
· Knowledge of probability and stochastic processes: random variable, most common distributions (uniform, Gaussian, exponential ...)
· Knowledge of the Linux operating system at the user level and administrator: administration, software installation, system calls.

REQUIREMENTS

Pre: Internet Architecture and Protocols (API)
Co: none

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE 21 TEL. Capacidad para construir, explotar y gestionar las redes, servicios, procesos y aplicaciones de telecomunicaciones, entendidas éstas como sistemas de captación, transporte, representación, procesado, almacenamiento, gestión y presentación de información multimedia, desde el punto de vista de los sistemas telemáticos.(CIN/352/2009, BOE 20.2.2009.)

Generical:
3. 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:
2. 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.
06 URI N2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

The lectures consist essentially of magistral lessons (encouraging the active participation of the students), but also ask students to work certain parts of the course on their own (self-learning), from materials provided by the teachers (slides, use case documents / products, book chapters, etc..)

The theory concepts will be strengthened with exercises, which in many cases have the solution, thus providing a self-assessment of learning achieved in each unit and activity.

In laboratory sessions, students will have a guide for each activity in the digital campus Atenea, which must be prepared prior to the activity. The lab sessions will be conducted in the presence of the teacher.

Regarding the use of a third language (English) in the subject, it is expected to provide the material slides, documents, work practices and statements in English. The teacher's explanations in principle be given in Catalan / Spanish, but can be done in English in case of consensus with students. The subject will promote students to respond (in writing) in English, although it may do so in Catalan or Castilian.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student should be able to:
· Identify and describe the operation of the protocols, encoders and network scenarios for delivering audiovisual services over IP networks.
· Choose coders and protocols appropriate to each service (interactive and non-interactive services, in real time and non-real time, etc..) and configure their most important parameters.
· Know and understand the operating principles of lossless data compressors.
· Use software for audiovisual services (clients, servers),set it up, and configure it accordingly.
· Deploy and operate basic IP telephony services (including DNS, NATs, and interconnection with PSTN).
· Deploy and operate audio/video streaming services
· Deploy and operate video distribution services and high quality TV over IP networks.

STUDY LOAD

Type	Hours	Percentage
Hours large group	26,0	26.00
Self study	56,0	56.00
Guided activities	5,0	5.00
Hours small group	13,0	13.00

Total learning time: 100 h

CONTENTS

Introduction to audiovisual services on the Internet

Description:
Summary of the course objectives and relationship with other subjects of the curriculum (0.5 h)
Review of knowledge seen in API - Internet Architecture and Protocols (1.5 hours):
- Taxonomy of Internet audio-visual services, interactive services versus broadcasting services
- Requirements network of audiovisual services: QoS (bandwidth, delay, jitter, loss)
- Protocols related multimedia: RTP, RTSP, SIP basics. NTP
Conclusions

Related activities:
Theory: lecture (2 h) and independent learning (API review) (2 h)
Practice: QoS and audiovisual services (2 hrs + Lab 4h independent learning - preliminary study and report)

Full-or-part-time: 10h
Theory classes: 2h
Laboratory classes: 2h
Self study : 6h

Digitization

Description:
Digitization. Uncompressed codecs (3 h):
· Audio (PCM). Non-uniform quantization (G.711 A / mu law). Analog and digital audio interfaces.
· Image (BMP, GIF, TIFF)
· Video. Concepts of analogand digital TV (ITU-R 601, SD, HD-SDI). Analog and digital video interfaces.

Related activities:
Theory: lecture (3h) and autonomous learning (theory, exercises) (6 h)
Directed activity: questionnaire (0.5 h)

Full-or-part-time: 9h 30m
Theory classes: 3h
Guided activities: 0h 30m
Self study : 6h

Data compression

Description:
Introduction to lossless compression. Information Theory (1 h)
Huffman code and variants (1h)
Based dictionary. LZW (0.5 h)
Run-Length Encoding (0.5h)
Introduction to lossy compression: limitations of the human eye and ear, compression techniques (1h)
Conclusions

Related activities:
Theory: lecture (4 h) and independent learning (theory, exercises) (6 h)
Directed activity questionnaire (0.5 h)

Full-or-part-time: 10h 30m
Theory classes: 4h
Guided activities: 0h 30m
Self study : 6h

Audiovisual codecs

Description:
Introduction to lossy codecs
Audio (3 h):
· Codecs based on waveform prediction (DPCM, ADPCM)
· vocoders (GSM, G.723.1, G.728, G.729)
· perceptual Encoders: MPEG Audio systems HomeCinema
· Transport of audio codecs over IP, streaming audio
Image (2.5 hours):
· Transform DCT, JPEG codec.
· Wavelet transform, JPEG 2000 codec.
· MJPEG video. Digital cinema.
Video (2.5 hours):
· Motion Compensation
· codecs H.261, MPEG-1/2, H.263, MPEG-4 part 2, H.264.
Conclusions

Related activities:
Theory: lecture (8h) and independent learning (theory, case studies, exercises) (8h)
Lab: Audio Coding (2 h + 4 h independent learning lab - preliminary study and report)
Lab: image and video coding (3 h + 6 h independent learning lab - preliminary study and report)
Directed activity: demo of audiovisual equipment (0.5 h)
Directed activity questionnaire (0.5 h)

Full-or-part-time: 32h
Theory classes: 8h
Laboratory classes: 5h
Guided activities: 1h
Self study : 18h

Interactive services - IP Telephony

Description:
Introduction to IP Telephony (1 h)
· Structure, numbering, signaling and transport of the analogue telephone service.
· Introduction to SS # 7
· DTMF
· Why move to IP Telephony?
· Codecs usual IP Telephony
· Challenges in IP Telephony solution: transport, signaling connection with RTC. Mention briefly the solution of the ITU-T H.323.
SIP architecture (2 h)
· Introduction to SIP: features, functions and role of DNS.
· Examples of complete calls
· SIP Extensions (presence, instant messaging, etc).
· Problems in networks with firewalls and NAT.
Interconnection with the Switched Telephone Network (1 h)
· Numbering: E.164, ENUM
· Introduction to H.248.1/MeGaCo/MGCP protocols. Examples of calls to / from PSTN.
Conclusions

Related activities:
Theory: lecture (4h) and independent learning (theory, case studies, Wireshark captures, exercises) (6h)
Lab: IP Telephony (3h) + directed activity (1h) + independent learning (4h)
Directed activity: Visit to UPC IP Telephony system (0.5 h)
Directed activity questionnaire (0.5 h)

Full-or-part-time: 19h
Theory classes: 4h
Laboratory classes: 3h
Guided activities: 2h
Self study : 10h

Diffusion services: Digital TV and IPTV

Description:
Introduction
MPEG Systems Layer (1.5h)
· Elementary Streams, Program Stream, Transport Stream
· MPEG transport over DVB - Digital TV
· MPEG transport over IP / RTP
IPTV services (1.5 h)
· Introduction: services, architecture, protocols
· Architecture of IPTV over managed networks: DVB-IP
· Architecture of IPTV over unmanaged networks: OTT (over-the-top)
· Advanced topics: CDNs, HbbTV, adaptive streaming (DASH)
IP networks in television production (1 h)
· Cases of TV3, BBC, Tele5
Conclusions

Related activities:
Theory: lecture (4h) and independent learning (theory, case studies, Wireshark captures, exercises) (5h)
Lab: IPTV (3h) + directed activity (0.5h) + independent learning (5h)
Directed activity: information search (0.5 h)
Directed activity: questionnaire (0.5 h)

Full-or-part-time: 18h
Theory classes: 4h
Laboratory classes: 3h
Guided activities: 1h
Self study : 10h

Course conclusions and future trends

Description:
Course conclusions and future trends

Related activities:
Lecture (1h)

Full-or-part-time: 1h
Theory classes: 1h

ACTIVITIES

(ENG) PRÀCTICA QOS I SERVEIS AUDIOVISUALS

Full-or-part-time: 2h
Laboratory classes: 2h

(ENG) PRÀCTICA COMPRESSIÓ D'ÀUDIO

Full-or-part-time: 6h
Laboratory classes: 2h
Self study: 4h

(ENG) PRÀCTICA COMPRESSIÓ D'IMATGE I VÍDEO

Full-or-part-time: 9h
Laboratory classes: 3h
Self study: 6h

(ENG) PRÀCTICA TELEFONIA IP

Full-or-part-time: 8h
Laboratory classes: 3h
Guided activities: 1h
Self study: 4h

VISIT/TALK ABOUT UPC'S IP TELEPHONY SYSTEM

Description:
Visit/talk/demo of the UPC IP Telephony system

Specific objectives:
Getting in touch with real equipment

Material:
Guide/Talk

Delivery:
Questions can be asked in the questionnaires

Full-or-part-time: 0h 30m
Guided activities: 0h 30m

(ENG) PRÀCTICA IPTV

Full-or-part-time: 8h
Laboratory classes: 3h
Guided activities: 1h
Self study: 4h

GRADING SYSTEM

Check the evaluation criteria in the infoweb of the course

EXAMINATION RULES.

Exams and exercises will be carried out individually. Lab sessions will be carried out in groups, and the evaluation will include a previous report before the lab session, the work done in the lab, and a final report (after the lab).

BIBLIOGRAPHY

Basic:
- Halsall, Fred. Multimedia communications : applications, networks, protocols, and standards. Harlow [etc.]: Addison-Wesley, 2001. ISBN 0201398184.

Complementary:

- Hersent, Olivier. IP telephony : deploying VoIP protocols and IMS infrastructure. 2nd ed. Chichester: Wiley, 2011. ISBN 9780470665848.
- Hersent, Olivier; Petit, Jean-Pierre; Gurle, David. Beyond VoIP protocols : understanding voice technology and networking techniques for IP telephony. Chichester: John Wiley & Sons, 2005. ISBN 0470023627.