Course guide
270639 - CNANM - Computer Network Architectures and Network Management

Last modified: 29/07/2025

Unit in charge: Barcelona School of Informatics
Teaching unit: 701 - DAC - Department of Computer Architecture.

Degree: MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Optional subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: JORDI DOMINGO PASCUAL

Others: Primer quadrimestre:
JORDI DOMINGO PASCUAL - 10
JORDI PAILLISSÉ VILANOVA - 10

PRIOR SKILLS

Bachelor Degree. Admission to MIRI.
For exchange students: a basic course on computer networks is a requisite.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEE2.1. Capability to understand models, problems and algorithms related to distributed systems, and to design and evaluate algorithms and systems that process the distribution problems and provide distributed services.
CEE2.2. Capability to understand models, problems and algorithms related to computer networks and to design and evaluate algorithms, protocols and systems that process the complexity of computer communications networks.
CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

Generical:
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.
CG3. Capacity for mathematical modeling, calculation and experimental designing in technology and companies engineering centers, particularly in research and innovation in all areas of Computer Science.
CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

Transversal:
CTR3. TEAMWORK: Capacity of being able to work as a team member, either as a regular member or performing directive activities, in order to help the development of projects in a pragmatic manner and with sense of responsibility; capability to take into account the available resources.
CTR4. INFORMATION LITERACY: Capability to manage the acquisition, structuring, analysis and visualization of data and information in the area of informatics engineering, and critically assess the results of this effort.
CTR5. APPROPIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.
CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY

Theoretical sessions will be complemented by discussion sessions based on assigned readings.
Studying some selected research papers will provide the flavor of research work.

LEARNING OBJECTIVES OF THE SUBJECT

1.The main goal is to understand the basic concepts of the network architecture, the fundamental principles of network design and of the most relevant algorithms used in protocols and network functions.
2.The main goal will be achieved via discussion sessions based on selected readings. This approach fosters autonomous learning and team work skills.

STUDY LOAD

Type	Hours	Percentage
Hours small group	24,0	16.00
Guided activities	6,0	4.00
Self study	96,0	64.00
Hours large group	24,0	16.00

Total learning time: 150 h

CONTENTS

Evolution of the Network Architecture

Description:
Internet Design Principles.
Key protocols and their evolution.
Internet structure. Exchange Points.
Economic relationships among stakeholders.

Trends in the Evolution of the Network Architecture

Description:
Naming and Addressing.
Addressing and Routing. Mobility.
New Network Architectures.

Routing and Inter-Networking

Description:
Routing Algorithms.
Classless Inter-domain Routing.
Inter-domain Routing. IDR.
BGP. IBGP. BGP attributes. Scalability of BGP.

Transport Network (Backbone)

Description:
Optical Transport Network.
IP over SDH.
IP over WDM/ASON.
IP over WDM/GbEthernet.
MPLS.
From MPLS to GMPLS.
SDN.

New Network and Transport Protocols

Description:
IPv6. IPv4-IPv6 coexistence.
Mobile IP.
IP Multicast.
Other IP protocols (HIP).
Multipath TCP.
Other Transport protocols (QUIC).

Resource Management

Description:
Quality of Service principles.
Quality of Service and Quality of Experience (QoS and QoE).
Integrated Services Architecture.
Differentiated Services Architecture.

5G Network Architecture

Description:
5G Network Characteristics. Key Performance Indicators (KPI).
Framework for 5G networks. Core, edge and access networks.
Virtualization technologies (NFV).
Software Defined Networks (SDN).
Orchestration and management. Slicing.
5G projects and Initiatives.
6G initiatives.

ACTIVITIES

Evolution of the Network Architecture

Description:
Internet Design Principles.
Key protocols and their evolution.
Internet structure, Exchange Points.
Economic relationships among stakeholders.

Specific objectives:
1, 2

Related competencies :
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
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CEE2.2. Capability to understand models, problems and algorithms related to computer networks and to design and evaluate algorithms, protocols and systems that process the complexity of computer communications networks.
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CTR5. APPROPIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.
CTR3. TEAMWORK: Capacity of being able to work as a team member, either as a regular member or performing directive activities, in order to help the development of projects in a pragmatic manner and with sense of responsibility; capability to take into account the available resources.

Full-or-part-time: 36h
Self study: 24h
Theory classes: 12h

Trends in the Evolution of the Network Architecture

Description:
Naming and Addressing. Addressing and Routing. Mobility. New Network Architectures.

Specific objectives:
1, 2

Related competencies :
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
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Full-or-part-time: 18h
Self study: 12h
Theory classes: 6h

Routing and Inter-networking

Description:
Routing Algorithms. Classless Inter-domain Routing. Inter-domain Routing. IDR. BGP. IBGP. BGP attributes. Scalability of BGP.

Specific objectives:
1, 2

Related competencies :
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
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Self study: 12h
Theory classes: 6h

Transport Networks (Backbone)

Description:
Optical Transport Network. IP over SDH. IP over WDM/ASON. IP over WDM/GbEthernet. MPLS. From MPLS to GMPLS. SDN.

Specific objectives:
1, 2

Related competencies :
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Self study: 12h
Theory classes: 6h

New Network and Transport Protocols

Description:
IPv6. IPv4-IPv6 coexistence. Mobile IP. IP Multicast. Other IP protocols (HIP). Multipath TCP. Other Transport protocols (QUIC).

Specific objectives:
1, 2

Related competencies :
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
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Full-or-part-time: 24h
Self study: 16h
Theory classes: 8h

Network Resource Management

Description:
Quality of Service principles. Quality of Service and Quality of Experience (QoS and QoE). Integrated Services Architecture. Differentiated Services Architecture.

Specific objectives:
1, 2

Related competencies :
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
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Full-or-part-time: 24h
Self study: 16h
Theory classes: 8h

5G Network Architecture

Description:
Características de la red 5G. Indicadores clave de rendimiento (KPI). Marco para redes 5G. Redes de núcleo, borde y acceso. Tecnologías de virtualización (NFV). Redes definidas por software (SDN). Orquestación y gestión. Rebanar Proyectos e iniciativas 5G.

Full-or-part-time: 18h
Self study: 12h
Theory classes: 6h

GRADING SYSTEM

Midterm/Assignments: 25%
Discussion sessions: 25%
Active Participation in Class: 10%
Final Exam / Final project: 40%

BIBLIOGRAPHY

Basic:
- Kurose, J.F.; Ross, K.W. Computer networking: a top-down approach. 8th ed., global ed. Harlow, United Kingdom: Pearson Education Limited, 2022. ISBN 9781292405469.
- Jha, S.; Hassan, M. Engineering Internet QoS. Artech House, 2002. ISBN 1580533418.
- Marsch, P. [i 3 més] (eds.). 5G system design: architectural and functional considerations and long term research. Hoboken, New Jersey: John Wiley & Sons, Inc, 2018. ISBN 9781119425120.

Complementary:
- Tanenbaum, A.S.; Feamster, N.; Wetherall, D.J. Computer networks. Sixth edition. Harlow: Pearson, 2021. ISBN 9781292374062.
- Comer, Douglas E. Computer networks and internets. 6th ed, global edition. Pearson Education, 2015. ISBN 9781292061177.
- Keshav, S. Mathematical foundations of computer networking. Addison-Wesley, 2012. ISBN 9780321792105.
- Bertsekas, D.P.; Gallager, R.G. Data networks. 2nd. ed. Prentice-Hall, 1992. ISBN 0132009161.
- Peterson, L.L.; Davie, B.S. Computer networks: a systems approach [on line]. 6th ed. Princeton, New Jersey: Larry Peterson and Bruce Davie, 2019 [Consultation: 25/03/2025]. Available on: https://open.umn.edu/opentextbooks/textbooks/771. ISBN 9781299773592.
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