Universidad de Alcalá

TEACHING GUIDE

Network Management and Administration

Degree in
Telematics Engineering (GIT)

Universidad de Alcalá

Academic Year 2025/2026

4th Year - 1st Semester (GIT)

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Network Management and Administration**
Code:	**380010 (GIT)**
Degree in:	**Telematics Engineering (GIT)**
Department and area:	**Automática** **Automatic**
Type:	**Optional (Oriented) (GIT)**
ECTS Credits:	**6.0**
Year and semester:	**4th Year - 1st Semester (GIT)**
Teachers:	To be defined
Tutoring schedule:	To be defined
Language:	Spanish/ English Friendly

1. COURSE SUMMARY

Network and services management is a fundamental activity that must be applied to an enterprise that leverage ICTs, so that information services work following an expected service level and at a reasonable cost. The need for management can be found in lots of scenarios (home networks, organizations and enterprise networks, and big ICTs enterprises, as Internet services providers or cloud services providers, IoT infrastructures,...). It is important to take into account the business model of the enterprise to guarantee a good value for money. Management not only applies to the network infrastructure, but it also covers network services (web server, data base, mail server,...) and any device connected to the network (print server, automation controller,...).

The main objective of this course is to present methodologies, tools and mechanisms to manage the services and elements of a network in order to guarantee a predefined level of service.The main concepts covered are:

- Organization of a NOC (Network Operation Center).
- Knowledge and practice of management technology and tools: SNMP, Syslog, Netconf, NetFlow, RMON, Vagrant, Ansible...).
- Knowledge and exercise of methodologies applied in different managements areas.
- Use cases: data networks, IoT infrastructure, cloud computing infrastructure,...

Prerequisites y Recommendations:

- It is recommended previous knowledge of Computers Networks.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/352/2009:

en_TR3 - Aptitude to solve problems with initiative, decision making, creativity, and to communicate and to transmit knowledge, skills and workmanship, comprising the ethical and professional responsibility of the activity of the Technical Engineer of Telecommunication.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CTE1 - Ability to build, operate and manage telecommunications networks, services, processes and applications, understood as systems for capturing, transporting, representing, processing, storing, managing and presenting multimedia information, from the point of view of telematic services.

en_CTE3 - Ability to build, operate and manage telematic services using analytical planning, sizing and analysis tools.

en_CTE4 - Ability to describe, program, validate and optimize communication protocols and interfaces at different levels of a network architecture.

Learning Outcomes

Students successfully passing this course will be able to:

RA1. Apply the objects of appropriate MIBs for the resolution of a network management and services problem and design particular MIBs in cases where it is necessary.

RA2. Apply network management techniques and services based on monitoring, flow analysis and event notification to solve fault management, performance, accounting and security problems.

RA3. Use tools implement different network management techniques.

RA4. Determine the most appropriate techniques to apply in configuration management.

RA5. Associate different technologies and methodologies of network management and services to apply them to a specific case of infrastructure and telematic services, in different areas.

3. CONTENTS

Contents Blocks	Number of sessions, credits or hours
Introduction to network management Main objectives of network management. Application areas. Integrated management.Management models.Information and communication models in network management. Organization of a network management center. Management tools. Other models (OSI, TMN, Syslog, DMI, WBEM, Netconf, NetFlow, IPFIX, etc.).	8 hours
Internet management Data models and objectives. General architecture. Standards. Information model: SMI. ASN.1 syntax. Examples of MIBs. Communications model. SNMP protocol. Security ofSNMP. BER codification. Codification exercises. Evolution of SNMP: Architecture and applications. Security model. Access control model. Network management based on notifications: trap, syslog. Remote monitoring: RMONv1. Other models: NetFlow, NETCONF, IPFIX, web network management. Traffic analysis: NetFlow. Configuration of an SNMP agent. Network management tools: Network topology discovery, MIB navigation, monitoring, alarms, remote management, scripts, comprehensive management tools (OPManager).	34 hours

Application areas: **1. Configuration and operation management** Motivation. Configuration parameters(relationships, consistency,...).Comprehensive configuration. Configuration processes. Automatic configuration: scripting. **2. Security management** Security management.Risk analysis. Countermeasures:information protection, firewalls, intrusion detection. Other security mechanisms. **3. Failure detection and correction management** Network failures. Problem reporting, symptoms and causes.Diagnosis and solution of problems. Information sources:monitoring, alarms, polling, logs. Examples of failure indicators. Anomaly and event correlation detection. Failure prevention. **4. Accounting and billing management** Business and billing models. Service Level Agreements (SLAs).Service billing. Service accounting based on usage and flat fee subscriptions. Service level classification. Fee sand penalties.Peers agreements.Guarantees and limitations of service levels. **5. Performance managemente and optimization** Performance indicators: delays, usage, congestion, bottlenecks,... Local and end-to-end control. Passivevs. active monitoring.Measure interpretation (peaks, average, etc.).Network capacity planning(router, switch, Internet connection,...). **Network management trends** Management automatization. Application of Artificial Intelligence to data processing for network management(interpretation of alarms, data collection, etc.).Software-defined networking as a generalization of the SNMP architecture. Architecture, OpenFlow protocol and applications. **Network management project** Analysis of the different network management areas applying them to a specific use case (telco networks, company networks, sensors networks, etc.). It might also consist of a detailed analysis of an advance network management technology already studied in the course or stated as a future trend.	14 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

Clases Prácticas (en grupos reducidos)	Concept presentations and/or reviews, mainly practical scenarios. Company visits and/or conferences. Problem solving. Hands-on lab sessions: oriented to consolidate concepts, and for students to get used to different tools and to provide methodologies to enhance their study. Also to be applied in their future careers(data analysis, strategies, decision-making, etc.). Oral presentations and other activities.
Individual, group and online office hours	Solving student questions. Support to autonomous learning.
Autonomous student work	Reading assignments. Activities:exercises, information look up, data analysis.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call

In the ordinary call the student will be assessed by Continuous Assessment (EC) process.

Extraordinary Call

The extraordinary call will consist of a similar quiz to that arising in the evaluation system by FinalExam.

5.2. EVALUATION

Evaluation Criteria

Evaluation Criteria must address the extent of the acquisition of skills by the student. For this purpose, the following ones are defined.

CE1. The student shows that he knows how to select the appropriate objects of the MIBs to solve a management problem, designing a particular MIB in case of not finding the appropriate objects.

CE2. The student shows mastery in the use of the main technologies to make polling and notifications, applied to the resolution of problems of network management and telematic services, and the knowledge of the existence of other alternative technologies.

CE3. The student can use and configure network management tools to collect data and analyze results to meet the management objectives in their different areas.

CE4. The student shows criteria to select the most appropriate techniques to manage the configuration of networks and telematics services, in a specific case.

CE5. The student shows capacity and initiative to justifiably associate different technologies and methodology in the resolution of a concrete problem of network management, distinguishing the main areas in which it is applicable.

Grading Tools

This section specifies the evaluation tools to be applied to each of the evaluation criteria.

1. **Partial Quiz Assessments** (PEI): Consists of a written test of solving practical problems and questions about the topics of the MIB information model and SNMP protocol.
2. **Personal Work with deliverables** (EP): This consists of assessing the student's mastery of different techniques through personal work done at home and/or in class. Some examples of these activities could be analyzing and interpreting MIBs, codifying SNMP messages, exercises to resolve problems using SNMP and MIBS, applying them to the different FCAPS management areas, and remote monitoring using RMON.
3. **Laboratory Tests** (PL): the laboratory teacher will evaluate the knowledge application and skills of the students using network management tools in small group sessions. Some examples of laboratory activities are the configuration of an SNMP agent, the configuration of a Syslog distributed system, the configuration of notifications system based on SNMP and particular MIBs, the configuration of RMON. management tools using a graphics interface.
4. **Final Quiz Assessments** (PEF): It consists of two exercises: 1)the presentation of a project of free theme about network and services management, developing these project the student must integrate different techniques and methodologies seen in the course, and 2) a written exercise resolving a problem like this one in the project, but with a limited time, and a theme was chosen by the teacher. Of the 35% assigned to this test, 20% will correspond to the work and 15% to the written exercise.

GRADING CRITERIA

In the ordinary and extraordinary call of the continuous and final evaluation, the relationship between the criteria, instruments, and qualification is as follows.

Continuous Evaluation

Ordinary Call

Competences	Learning Outcomes	Evaluation criteria	Evaluation Instruments	Score weighting
CTE1, CTE3, CTE	RA1, RA2	CE1, CE2	EP	10%
	RA1, RA3	CE1, CE3	PL	30%
	RA1, RA2	CE1, CE2	PEI	25%
TR3, CTE1, CTE3, CTE4	RA1, RA2, RA4, RA5	CE1, CE2, CE4, CE5	PEF	35%

Extraordinary Call

In the extraordinary call the PEF test will be carried out and the students who have not passed the practical tests (E or PL) will be able to undergo their evaluation again.

Competences	Learning Outcomes	Evaluation criteria	Evaluation Instruments	Score weighting
TR3, CTE1, CTE3, CTE4	RA1, RA2	CE1, CE2	EP	10%
	RA1, RA3	CE1, CE3	PL	30%
	RA1, RA2, RA4,RA5	CE1, CE2,CE4, CE5	PEF	60%

As a general criterion, those students in ordinary call who do not show up for the evaluation of all practices will be considered as Not Submitted.

Final Evaluation

Ordinary and Extraordinary call

Those students who have recognized the right to final evaluation, according to the regulations of theUAH, must take a final exam that includes theoretical questions and the realization of one or more exercises, with a weight of 100% of the final grade. This procedure will be the same both in the ordinary and extraordinary call.

Competences	Learning Outcomes	Evaluation criteria	Evaluation Instruments	Score weighting
TR3, CTE1, CTE3, CTE4	RA1, RA2	CE1, CE2	EP	10%
	RA1, RA3	CE1, CE3	PL	30%
	RA1, RA2, RA4,RA5	CE1, CE2,CE4, CE5	PEF	60%

The grade of "**Not presented**" will be awarded to the student who, having opted for the continuous evaluation procedure, meets any of the following requirements:

When the student has failed to attend at least 60% of the classes in small groups.
When the student has not delivered at least 60% of the requested work.
When the student has not delivered at least 100% of the requested practices. This criterion is equally applicable to the final evaluation of students.

The teaching-learning methodology and the assessment process will be adapted as needed, following the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific

needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

Provided Documentation.

Theoretical concepts, practice books, exercises, RFC references.

6.2. Additional Bibliography

- **Books**
  - Network Management Fundamentals. Ph. D. Alexadre Clemm. Cisco Press. 2007.
  - Automated Network Management Systems. Dougloas E. Comer.Prentice Hall. 2006.
  - Advances in Network Management. Jianguo Ding.CRC Press. 2009.
  - SNMP, SNMPv2M snmpV3 AND rmon 1 AND 2. (3ª edition). William Stallings. Addison Wesley.1999.
  - Network Management Standards. 2ª edition. Uyless Black. McGrawHill.
  - Network Management, a practical perspective. Allan Leinwand, Karen Fang. Addison Wesley.1993.
  - Communication Network Management. Kornel Terplan. Prentice Hall. 1992.

- **Internet References**
  - http://www.simple-times.org
  - http://wwwsnmp.cs.utwente.nl
  - http://www.asn1.com
  - http://net-snmp.sourceforge.net/
  - http://www.mrtg.com/

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.