

SYLLABUS

1. Data about the program of study

| | |
|--------------------------------------|---|
| 1.1 Institution | Technical University of Cluj-Napoca |
| 1.2 Faculty | Faculty of Electronics, Telecommunications and Information Technology |
| 1.3 Department | Communications |
| 1.4 Field of study | Electronic Engineering, Telecommunications and Information Technologies |
| 1.5 Cycle of study | Master of Science |
| 1.6 Program of study / Qualification | Telecommunications / Master |
| 1.7 Form of education | Full time |
| 1.8 Subject code | TC-E02.00 |

2. Data about the subject

| | | | | | | | |
|---|--|--------------|---|----------------|---|----------------------|-------|
| 2.1 Subject name | Unified Communications in Cloud | | | | | | |
| 2.2 Subject area | Theoretical area Methodological area Analytic area | | | | | | |
| 2.3 Course responsible | Professor Virgil DOBROTA, Ph.D. Virgil.Dobrota@com.utcluj.ro | | | | | | |
| 2.4 Teacher in charge with seminar / laboratory / project | Professor Virgil DOBROTA, Ph.D. Virgil.Dobrota@com.utcluj.ro | | | | | | |
| 2.5 Year of study | 1 | 2.6 Semester | 1 | 2.7 Assessment | E | 2.8 Subject category | DA/DI |

3. Estimated total time

| | | | | | |
|---|-----|----------------------|----|----------------|-------|
| 3.1 Number of hours per week | 4 | of which: 3.2 course | 1 | 3.3 laboratory | 2 |
| 3.4 To Total hours in the curriculum | 42 | of which: 3.5 course | 14 | 3.6 laboratory | 28 |
| Distribution of time | | | | | hours |
| Manual, lecture material and notes, bibliography | | | | | 20 |
| Supplementary study in the library, online specialized platforms and in the field | | | | | 12 |
| Preparation for seminars / laboratories, homework, reports, portfolios and essays | | | | | 20 |
| Tutoring | | | | | 3 |
| Exams and tests | | | | | 3 |
| Other activities: | | | | | |
| 3.7 Total hours of individual study | 58 | | | | |
| 3.8 Total hours per semester | 100 | | | | |
| 3.9 Number of credit points | 4 | | | | |

4. Pre-requisites (where appropriate)

| | |
|----------------|-------|
| 4.1 curriculum | N. A. |
| 4.2 competence | N. A. |

5. Requirements (where appropriate)

| | |
|---|---------------------------|
| 5.1. for the course | Amphitheatre, Cluj-Napoca |
| 5.2. for the seminars / laboratories / projects | Laboratory, Cluj-Napoca |

6. Specific competences

| | |
|--------------------------|--|
| Professional competences | C4. Design, implementation and operation of data, voice, video and multimedia services. This is based on the understanding and the application of fundamental concepts in telecommunications and transmission of information C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks |
| Cross competences | N.A. |

7. Discipline objectives (as results from the key competences gained)

| | |
|-------------------------|---|
| 7.1 General objective | Development of professional skills regarding the design of unified communications (voice, data, images) in the cloud and real implementation of virtualized solutions |
| 7.2 Specific objectives | <ol style="list-style-type: none"> 1. Understanding the basic concepts of IP-based unified communications in public or private cloud 2. Development of skills and abilities necessary for the use of packet-switched WAN technologies (VoIP, Vo802.11, VoMPLS, etc.) 3. Develop the skills and abilities required for unified communications systems: Cisco Unified Communications Manager, Sangoma FreePBX (Asterisk), 3CX, etc., using partial course support from Cisco Collaboration and Cisco CCNA Cloud. |

8. Contents

| 8.1 Lecture (syllabus) | Teaching methods | Notes |
|--|---|---|
| 1. VoIP using the H.323 standard (Part 1): ITU-T recommendations for audio-video and multimedia systems. H.323 standard. RTP and RTCP protocols. | The discipline content and the acquired skills are in agreement with the expectations of the professional | The discipline content and the acquired skills are in agreement with the expectations of the professional |
| 2. VoIP using the H.323 standard (Part 2): H.323 gatekeeper. | | |
| 3. VoIP using the SIP standard: Architecture, signaling, examples of interworking between SIP devices. | | |
| 4. VoIP using the IAX standard: Architecture, signaling, examples of interworking between IAX2 devices. | | |
| 5. STUN (Session Traversal Utilities for NAT), TURN (Traversal Using Relays around NAT) and ICE (Interactive Connectivity Establishment). Example of solution: AnyConnect. | | |

| | | |
|--|---|-------|
| 6. VoIP Using WebRTC Standard. VoIP using the MGCP/ Megaco standard: Architecture, signaling, examples of interworking between MGCP devices. VoIP using Skype. | | |
| 7. VoIP using the SCCP (Skinny Client Control Protocol): Architecture, signaling, examples of interworking between SCCP devices (Cisco Unified Communications Manager Express, Cisco IP Phones). | | |
| 8. Project assignment. | | |
| 9. Comparison between VoIP and other packet switching technologies: VoMPLS / VoATM / VoFR / Vo802.11 / VoLTE/ Vo5G. | | |
| 10. Transfer Rate Calculation per VoIP call | | |
| 11. Design of unified communications models. Single site model. Model with centralized multi-site call processing. Model with distributed multi-site call processing. IP WAN clustering model. The impact of using virtual servers in unified communications | | |
| 12. Software for central PBX-IP management. Cisco Configuration Professional: A Practical Demonstration Alcatel-Lucent Enterprise OmniVista 4760 -> 8770. Micro Focus Network Node Manager i (integration) (NNMi). OpenNMS. Zabbix. Nagios. | | |
| 13. Software-Defined Networking and its interaction with OpenFlow, OpenStack, NFV, OpenDaylight, MPLS, 5G/ B5G/ 6G. | | |
| 14. Recap. Examples of subjects from the previous year's exam. | | |
| Bibliography <ol style="list-style-type: none"> 1. V. Dobrota, "Unified Communications in Cloud", Technical University of Cluj-Napoca, 2024-2025, https://el.el.obs.utcluj.ro/cuc/en_index.htm (in English). 2. C. Jackson, J. Gooley, A. Iliesiu, A. Malegaonkar, "Cisco Certified DevNet Associate DEVASC 200-901 Official Cert Guide", Cisco Press, 2021. 3. L. Peterson, B. Davie, "Computer Networks: A Systems Approach. Sixth Edition", Systems Approach LLC, 2020, Available: https://book.systemsapproach.org/ 4. L. Peterson, C. Cascone, B. O'Connor, T. Vachuska, B. Davie, "Software-Defined Networks: A Systems Approach", Systems Approach LLC, 2021, Available: https://sdn.systemsapproach.org/index.html 5. L. Peterson, O. Sunay, "5G Mobile Networks: A Systems Approach", Systems Approach LLC, 2021, Available: https://5g.systemsapproach.org/ 6. L. Peterson, S. Baker, A. Bavier, Z. Williams, B. Davie, "Edge Cloud Operations: A Systems Approach", Systems Approach LLC, 2022, Available: https://ops.systemsapproach.org/ | | |
| Online references <ol style="list-style-type: none"> 7. "Preferred Architecture for Cisco Collaboration System Release 14 On-Premises Deployments", Cisco Systems, 2021, Available: https://www.cisco.com/c/en/us/td/docs/solutions/PA/overview/14x/clbpa14x.html 8. Cisco Networking Academy, 2024, https://www.netacad.com | | |
| 8.2 Laboratory | Teaching methods | Notes |
| 1. Applications with VoIP equipment using H.323: H.323-PSTN Gateway. Gateway H.323-ISDN | Practical experiments on physical, virtual, cloud and emulator equipment. | N/A |
| 2. Gatekeeper H.323 emulated with GNS3 (I): GNS3 emulator. H.323 software terminal. | | |
| 3. H.323 gatekeeper emulated with GNS3 (II): Call in a network with H.323 gateway and H.323 gatekeeper. | | |

| | | |
|--|--|--|
| 4. Asterisk IP PBX using SIP and IAX. Asterisk architecture. SIP software terminal. IAX2 software terminal. Asterisk configuration (physical machine). | | |
| 5. Asterisk IP PBX using SIP and MGCP. Hardware SIP terminal. Gateway MGCP. Configure Asterisk (virtual machine) | | |
| 6. Cisco IP PBX using SCCP. SCCP terminal. Cisco Unified Communications Manager Express (CUCME). | | |
| 7. OpenStack private cloud orchestrator. OpenStack architecture. Unified communications applications in the cloud. Asterisk demonstration in the cloud | | |
| 8. Project work, stage 1: documentation | | |
| 9. Project work, stage 2: scenario | | |
| 10. Project work, stage 3: configuration | | |
| 11. Project work, stage 4: cloud configuration | | |
| 12. Project work, stage 5: signaling captures and final configuration | | |
| 13. Additional work on projects (optional). Laboratory recoveries | | |
| 14. Project defending | | |
| Bibliography <ol style="list-style-type: none"> 1. V. Dobrota, Unified Communications in Cloud, Technical University of Cluj-Napoca, 2024-2025, https://el.el.obs.utcluj.ro/cuc/en_index.htm (in English). 2. J. Van Meggelen, R. Bryant, L. Madsen, "Asterisk: The Definitive Guide. Fifth Edition", O'Reilly Media Inc, 2019 3. K. Wallace, "Implementing Cisco Unified Communications Voice over IP and QoS (CVOICE). Fourth Edition", Cisco Systems Inc, 2012 4. G.A.A. Santana, "CCNA Cloud CLDFND 210-451 Official Certification Guide. First Edition", Pearson Education Inc, 2016. Online references <ol style="list-style-type: none"> 5. "Cisco Collaboration System 12.x Solution Reference Network Designs (SRND)", Cisco, 2018, https://www.cisco.com/c/en/us/td/docs/voice_ip_comm/cucm/srnd/collab12/collab12.pdf 6. Cisco Networking Academy, 2024, https://www.netacad.com | | |

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The discipline content and the acquired skills are in agreement with the expectations of the professional Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

10. Evaluation

| Activity type | 10.1 Assessment criteria | 10.2 Assessment methods | 10.3 Weight in the final grade |
|-----------------------------|--|--|--------------------------------|
| 10.4 Course | The level of acquired theoretical knowledge and practical skills | Theoretical Test (mark T) : 10 questions with multiple choice answers + 4 problems | T, max 10 pct. 50% |
| 10.5 Seminar/ Laboratory | The level of acquired knowledge and abilities | Project (P): oral and practical exam based on | P, max. 10 pct. 50% |

| | | | |
|--|--|--|--|
| | | laboratory and project (usually 2p is granted for work during the semester). | |
|--|--|--|--|

10.6 Minimum standard of performance

Qualitative point of view

Minimal theoretical and practical knowledge:

- ✓ Understanding the basic concepts regarding unified communications based on IP in public or private cloud
- ✓ Understanding the principles of packet-switched WAN technologies

Minimal acquired competences:

- ✓ Ability to install and configure the main unified communications equipment in the cloud: Cisco UCM and Asterisk
- ✓ Ability to design the transfer rate required for VoIP calls in unified communications

Quantitative point of view

- ✓ $N=(T+P)/2$, $N \geq 5$, $T \geq 5$, $P \geq 5$

| Date of filling in: | Responsible | Title First Name SURNAME | Signature |
|---------------------|--------------|---------------------------------|-----------|
| 20.06.2024 | Course | Professor Virgil DOBROTA, Ph.D. | |
| | Applications | Professor Virgil DOBROTA, Ph.D. | |
| | | | |

| | |
|--|--|
| Date of approval in the Council of the Communications Department 10.07.2024 | Head of Communications Department Prof. Virgil DOBROTA, Ph.D. |
| Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 11.07.2024 | Dean Prof. Ovidiu POP, Ph.D. |