



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Telecommunication Systems and Services

2324-1-F1801Q129

Aims

Provide the notions necessary to understand the main network design and management issues in multimedia communication, enterprise and residential connectivity

Contents

1. Introduction to Communication Theory, Multiplexing and Transmission Media
2. Broadband Access Networks
3. WAN Connectivity
4. Networking Devices and Software-Defined Networking
5. Quality of Service in Networks
6. Voice Coding and Voice-over-IP
7. Mobile Radio Networks
8. Content Delivery Networks

Detailed program

1. Introduction to Communication Theory, Multiplexing and Transmission Media
 - Transmission channel and channel capacity
 - Analog and digital modulation
 - Frequency, time and code multiplexing
 - Multiple access
 - Twisted pair

- Optical fiber
- Radio transmission

2. Broadband Access Networks

- Copper-based networks, fiber-based networks and mixed copper/fiber networks (FTTE, FTTH, FTTC, FTTB)
- xDSL technology and vectoring
- Fixed wireless access (FWA)
- Satellite networks with GEO and LEO (low latency) satellites

3. WAN Connectivity

- Dedicated and generalized connectivity
- MPLS protocol and related signaling protocols (LDP, RSVP-TE)
- Virtual private networks (VPN): VLAN Ethernet, MPLS virtual private LAN service, IP tunneling

4. Networking Devices and Software-Defined Networking

- Router and switch architecture
- Firewall, IDS, load balancer and anti-DDoS architecture
- Basic principles of SDN (with hands-on exercises using a network emulator)
- OpenFlow protocol (with hands-on exercises using a network emulator)
- Basic principles of Network Function Virtualization (NFV)

5. Quality of Service in Networks

- Service Level Agreement e Traffic Conditioning Agreement
- Policing, shaping and marking techniques
- Scheduling techniques
- Call Admission Control (CAC)
- Integrated Services (IntServ)
- Differentiated Services (DiffServ)

6. Voice Coding and Voice-over-IP (VoIP)

- Waveform codec
- Source codec
- Hybrid codec
- Causes of voice degradation in packet switching networks
- VoIP signalling: Session Initiation Protocol (SIP)

7. Mobile Radio Networks

- Basic concepts on cellular networks
- Network planning
- 2G (GSM e GPRS)
- 3G (UMTS e HSPA)
- 4G (LTE)
- 5G

8. Content Delivery Network (CDN)

- Principles and architecture
- DNS redirection and URL rewriting

- Akamai's CDN

Prerequisites

Basic notions of TCP/IP networking; having attended the course "Treatment and coding of multimedia data" (or similar) is a plus

Teaching form

Fourty hours of classroom lectures and ten hours of practical exercises, with the help of a network emulator (Mininet)

Textbook and teaching resource

On-line material on the course website, mainly slides and additional documents

Reference textbooks:

- Jim Kurose, Keith Ross, Computer Networking – A Top-Down Approach, 8th Edition, Pearson, 2021 (o relativa versione italiana intitolata "Reti di Calcolatori e Internet - Un Approccio Top-Down")
- Martin Sauter, From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, 4th Edition, Wiley, 2021

Semester

First Year, Second Semester

Assessment method

The assessment is carried out through a written test and a following optional oral examination, which can be requested by the student or by the teacher.

The written test includes four open question on the topics of the course. If the student gets a grade of at least 18, she/he can ask the teacher to attend the oral examination. This decision cancels the vote taken in the written text, and the oral examination must be taken in the same exam session of the written test. The teacher can ask any student with a positive grade in the written test to take the oral examination, if deemed necessary.

Changes to the assessment method are under evaluation, and they will be communicated to the students (if applied) in the introductory lesson of the course.

Office hours

By appointment

Sustainable Development Goals
