CENG797 Ad Hoc Networks

Middle East Technical University
Department of Computer Engineering
2021-2022 Spring

Instructor:	Dr. Ertan Onur	**Location:**	Online for ASELSAN
Email:	eronur@metu.edu.tr	**Class Day**	Wednesdays
Office Hours:	Please email me	**Class Time**	13:40-16:30
Office:	CENG-B211	**Credits:**	3
Phone:	+90 (312) 210 5534	**Term:**	2021-2022 Spring

Catalog Description: Introduction to wireless networks; ad hoc networking architectures; mathematical models of ad hoc networks, medium access control; routing protocols in ad hoc networks; multicast routing; transport layer protocols; cross-layer design, security in ad hoc networks; quality of service; energy management; wireless sensor networks; Internet of things; cooperation for ad hoc networking; distributed algorithms for ad hoc networking; localization, time synchronization, topology control; mobility models; advanced topics in ad hoc networks such as vehicular ad hoc networks or flying ad hoc networks.

Course Objectives: By the end of the course, you will be able to **1)** Describe basic architectures of ad hoc networks, **2)** Compare and contrast ad hoc networks with cellular networks, **3)** Design and implement medium access protocols for ad hoc networks, **4)** Design and implement routing protocols for ad hoc networks, **5)** Identify significant problems that must be solved by distributed algorithms in ad hoc networks.

Communication: ASELSAN's system is the main communication medium. E-mail is the secondary method for official communication with students unless otherwise prohibited by law. The university has the right to send official communication to students by e-mail. If I need to contact you outside of class, I will use your email address registered on Aselsan's system, and expect that you will read and respond to this communication in a timely manner (within 24 hours). Additionally, please recognize standard email etiquette. E-mails should contain a subject, greeting and closing. I will attempt to respond to you within 24 hours. If you have not received a reply from me within 48 hours, please resend the email. Since this is a fully online course, your communications with me and other students are critical to your learning experience. Please be respectful as you communicate.

Textbook (TB): There is not textbook for the course. The following are supplementary to the slides:

1. Kurose, J.F. and Ross, K.W., Computer Networking: A Top Down Approach, 7th Ed., Pearson Education, 2016.
2. Jyoti Prakash Singh, Paramartha Dutta, Amlan Chakrabarti, Ad Hoc Networks: A Statistical Perspective, Springer, 2018
3. Jonathan Loo, Jaime Lloret Mauri, Jesús Hamilton Ortiz, Mobile Ad Hoc Networks: Current Status and Future Trends, CRC, 2012
4. C. Siva Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Pearson Education, 2004
5. Subir Kumar Sarkar, T.G. Basavaraju, C. Puttamadappa, Ad Hoc Mobile Wireless Networks, Principles, Protocols, and Applications, CRC, 2013
6. Papers published in prestigious journals (e.g., Elsevier Ad Hoc Networks)
7. Internet Engineering Task Force (IETF) documents

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Course Conduct: The following topics will be studied.

- **Week 01**: Courseware, syllabus and introduction to computer networks
- **Week 02**: Introduction to networking continued: OSI reference model, TCP/IP reference model.
- **Week 03**: The basics of wireless ad hoc networks and cellular networks will be discussed. Ad hoc networks will be compared to cellular networks. Wireless communication standards for ad hoc networking.
- **Week 04**: Physical layer issues in ad hoc networks: wireless propagation and basic modulation techniques will be discussed. Impact of physical layer issues on ad hoc network modeling will be introduced.
- **Week 05**: Modeling ad hoc networks, mobility models, graph theoretic approaches. Random geometric graphs and basics of network science (degree distribution, link density, clustering coefficient, centrality concepts) will be discussed.
- **Week 06**: Link layer and medium access control (MAC): classification of MAC protocols, evolution of MAC protocols, contention-based protocols, hidden-terminal and exposed terminal problems will be introduced.
- **Week 07**: Advanced MAC protocols: real-time MAC protocols, full-duplex MAC protocols, MAC protocols for directional communication will be discussed.
- **Week 08**: Network layer, topology control and routing: routing protocols will be classified (link-state, distance vector), ad hoc routing protocols will be categorized. Ad-hoc on-demand distance vector (AODV), optimized link state routing (OLSR) and dynamic source routing (DSR) protocols will be introduced.
- **Week 09**: Advanced routing protocols and multicasting: Hierarchical, clustered, zone-based routing protocols, and multicast routing will be introduced.
- **Week 10**: Transport layer protocols: TCP over wireless, TCP/IP based communication in ad hoc networks will be introduced. Cooperation and cross-layer design issues will be discussed.
- **Week 11**: Security in ad hoc networks: basic security issues and solutions will be discussed. Attack vectors specific to ad hoc networks will be introduced.
- **Week 12**: Advanced topics in ad hoc networks, quality of service (QoS), energy management. Sensor networks, Internet of things, and recent advances such as flying or vehicular ad hoc networks.
- **Week 13**: Some selected distributed algorithms in ad hoc networks (**Student Presentations**).
- **Week 14**: Some selected distributed algorithms in ad hoc networks (**Student Presentations**).

This **online synchronous** course requires you to meet virtually via zoom on Wednesdays at 13:40-16:30. This course is designed to be highly interactive and collaborative, thus you are expected to participate on a regular basis and attend all the scheduled online sessions. Participation means being an active contributor and responder in class activities.

Grading:

Term project and presentation 50%
Midterm 20%
Final Exam 30%

Prerequisite: Python programming is a must for carrying out the term project. If you do not master Python, please drop the course.

NA Grade: Regardless of your overall grade at the end of the class, you will get an NA grade if you have not submitted a satisfactory term project or give a presentation.

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Late Submission: Work submitted late and without prior communication with the teaching assistant or lecturer will not be accepted. Please communicate with the teaching assistants or the lecturer as soon as you know you cannot meet a deadline if you would like to request an extension on a specific assignment. Extensions will be permitted on a case-by-case basis considering the pandemic.

Attendance Policy: Attendance to lectures and accomplishing activities are compulsory. An online course unlike a face-to-face course attendance is not taken as roll call or a checklist. Instead, attendance is demonstrated by your participation and engagement in activities and completion of the given assignments. It is essential that you are present and engage in the course and discussion forums.

Accommodation Policy: If you have special needs, please inform the instructor ASAP.

Mutual Expectations: Please remember, if you have any questions, concerns, or comments, to let me know right away. I welcome any feedback you are willing to offer. Mutual expectations are the following: **1)** Please be active and participate in class, ask questions, raise concern and make remarks, **2)** Listen and respect others, **3)** Be comfortable taking risks, **4)** Complete all assignments, **5)** Turn off your cell phones and communication devices during the lectures, **6)** Be punctual for all classes, **7)** Discuss class concerns either after class or during designated office hours, **8)** Be prepared for class by reading chapter prior to lesson.

About Online Videos: It is **strictly** forbidden to distribute the videos and other resources. Our class sessions will be audio-visually recorded for students who are unable to attend at the scheduled time. Students who participate with their camera engaged or who utilize a profile image are agreeing to have their audio/video or image recorded. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. Recordings of the classes will be made online in a couple of hours after the class. The recordings will be available throughout the semester. The recordings will be deleted permanently, after the final grades are announced officially. The exams in this course will be recorded as well. By taking this course, you agree that the class sessions and exams that may contain your avatar, picture, video and/or voice will be recorded and shared for those students and instructors taking part in this specific course.

Academic Honesty: There will be no tolerance to cheating in the exam and to plagiarism (copying someone else's work as if it is yours). The student who cheats will fail the course and be punished according to METU regulations.

METU Code of Honour: As reliable, responsible and honorable individuals, all members of Middle East Technical University embrace only the success and recognition they deserve, and act with integrity in the use, evaluation and presentation of facts, data and documents.

Reminders: 1) Carefully read the documents concerning academic integrity which have been issued to you and the related regulations on the University's website. **2)** Learn in detail which situations fall into the scope of plagiarism in academic studies from relevant resources (e.g. ODTU UEAM website). In cases of plagiarism, excuses such as "I wasn't aware that what I've done is within the scope of plagiarism" are unacceptable. Be informed that the responsibility for such behavior is entirely yours. **3)** Use your own ideas in all of your work such a piece of homework, project etc. Indicate the source of any thought, idea, text, document or finding which does not belong to you. **4)** Prepare all your homework, projects, reports etc. by referring to the accessible original (primary) sources. **5)** During examinations, abide by the rules in the Middle East Technical University Guide for Rules To Be Followed in an Examination Environment as well as the rules determined by the instructor of the course.