ECE 595-008 Mobile Edge Comp & Network

Instructor: Dr. Xiang Sun

❖ **Course Description**

The main goal of this course is to provide the students with the knowledge on cellular networks from the 4th generation. Meanwhile, the course will cover the key technologies (such as device-to-device communications, successive interference cancellation, and beamforming) applied in the 5th generation cellular networks. In addition, the course will explore the concept of mobile cloud computing and mobile edge computing (MEC), the recent MEC architecture, related MEC applications, and some key technologies involved in MEC.

❖ **Prerequisites**

Computer Networks, Wireless Communication Systems

❖ **Instructor information**

Lecture Time & Place	Mon & Wed 10:00-11:15 am	ECE 118
Course Instructor	Dr. Xiang Sun	sunxiang@unm.edu
Office Hour and Location	Monday 2:00-4:00 pm	Room 224C, ECE

❖ **Textbook(s)/Materials**

1. Stefania Sesia, Issam Toufik, and Matthew Baker, "LTE-The UMTS Long Term Evolution: From Theory to Practice", 3rd Edition, 2016. (optional)

2. The following publications will be used as class materials.

   - J. Liu, N. Kato, J. Ma and N. Kadowaki, "Device-to-Device Communication in LTE-Advanced Networks: A Survey," in IEEE Communications Surveys & Tutorials, vol. 17, no. 4, pp. 1923-1940, Fourthquarter 2015.
   - W. Roh et al., "Millimeter-wave beamforming as an enabling technology for 5G cellular communications: theoretical feasibility and prototype results," in IEEE Communications Magazine, vol. 52, no. 2, pp. 106-113, February 2014.
   - A. Checko et al., "Cloud RAN for Mobile Networks—A Technology Overview," in IEEE Communications Surveys & Tutorials, vol. 17, no. 1, pp. 405-426, Firstquarter 2015.
   - E. G. Larsson, O. Edfors, F. Tufvesson and T. L. Marzetta, "Massive MIMO for next generation wireless systems," in IEEE Communications Magazine, vol. 52, no. 2, pp. 186-195, February 2014.
   - X. Sun and N. Ansari, "Green Cloudlet Network: A Distributed Green Mobile Cloud Network," IEEE Network, vol. 31, no. 1, pp. 64-70, January/February 2017.
   - X. Sun and N. Ansari, "Adaptive Avatar Handoff in the Cloudlet Network," IEEE Transactions on Cloud Computing, vol. 7, no. 3, pp. 664-676, 1 July-Sept. 2019.
   - X. Sun and N. Ansari, "Green Cloudlet Network: A Sustainable Platform for Mobile Cloud Computing," IEEE Transactions on Cloud Computing, doi: 10.1109/TCC.2017.2764463, early access.
   - Al-Hourani, S. Kandeepan and S. Lardner, "Optimal LAP Altitude for Maximum Coverage," in IEEE Wireless Communications Letters, vol. 3, no. 6, pp. 569-572, Dec. 2014.

- X. Sun and N. Ansari, "Jointly Optimizing Drone-Mounted Base Station Placement and User Association in Heterogeneous Networks," 2018 IEEE International Conference on Communications (ICC), Kansas City, MO, 2018, pp. 1-6.
- Michael R. Hines, Umesh Deshpande, and Kartik Gopalan. 2009. Post-copy live migration of virtual machines. SIGOPS Oper. Syst. Rev. 43, 3 (July 2009), 14-26.
- S. M. R. Islam, N. Avazov, O. A. Dobre and K. Kwak, "Power-Domain Non-Orthogonal Multiple Access (NOMA) in 5G Systems: Potentials and Challenges," in IEEE Communications Surveys & Tutorials, vol. 19, no. 2, pp. 721-742, Secondquarter 2017.
- S. Sen, N. Santhapuri, R. R. Choudhury and S. Nelakuditi, "Successive Interference Cancellation: Carving Out MAC Layer Opportunities," in IEEE Transactions on Mobile Computing, vol. 12, no. 2, pp. 346-357, Feb. 2013.
- T. Han and N. Ansari, "On Optimizing Green Energy Utilization for Cellular Networks with Hybrid Energy Supplies," in IEEE Transactions on Wireless Communications, vol. 12, no. 8, pp. 3872-3882, August 2013.

❖ Topics

1. Introduction
   - Introduction to Mobile Edge Computing and Networking
   - Mobile Network Evolution (From 1G to 4G)

2. Long Term Evolution (LTE) and LTE-Advanced Pro
   - Physical channel design in LTE
   - LTE network architecture
   - Handover in LTE
   - Resource management in LTE
   - Heterogeneous networks in LTE
   - Drone-assisted mobile access networks
   - Green energy powered mobile access networks

3. Key Technologies in 5G Mobile Networks
   - mmWave communications and beamforming
   - Massive MIMO
   - Device-to-device communications
   - Successive interference cancellation
   - Cloud radio access network (C-RAN) architecture

4. Mobile Edge Computing (MEC)
   - Computational workload offloading in mobile cloud computing
   - MEC architecture and applications
   - Workload balancing in MEC
   - Green MEC

❖ Grading

Homework: 20 %; Midterm exam: 20 %; Final exam: 20 %; Project 40%.

Project:

- Each group (maximum 2 students) may pick one research topic by yourselves. The research topic should be related to mobile networks and mobile edge computing. Each group will have two presentations during the semester.
- 1st presentation (Mar. 22): 1) Introduction of your research topics (backgrounds and concepts). 2) Related works; 3) Motivations (i.e., what are the problems or issues in the existing literature).
- 2nd presentation (May 6): 1) System models and problem formulation. 2) Methods/Algorithms of solving the problem. 3) Evaluation/Simulation. 4) Conclusion.
- You need to submit one report (including the mentioned seven parts of your two presentations) at the end of the semester.
- The grading of the project is based on the following aspects: 1) clearness and rightness of your report and your presentation; 2) novelty of your research topic and proposed methods/algorithms; 3) performance validation for your proposed methods/algorithms.

❖ Accommodation Statement

Accessibility Services (Mesa Vista Hall 2021, 277-3506) provides academic support to students who have disabilities. If you think you need alternative accessible formats for undertaking and completing coursework, you should contact this service right away to assure your needs are met in a timely manner. If you need local assistance in contacting Accessibility Services, see the Bachelor and Graduate Programs office.

❖ Cell Phones

As a matter of courtesy, please switch your cell phones to vibrate or turn off your cell phones prior to the beginning of class.

❖ Library and Tutorial Services

UNM-Main campus provides many library services and some tutorial services for students. For library services, go to http://www.unm.edu/libraries/ to link to a specific library or to contact a librarian. For tutorial services, go to http://caps.unm.edu/services/online-tutoring/ to explore UNM's online services.