# EE4900/5900 – Wireless Networking & the Internet of Things

Spring Semester 2015-16. Class number: 13967 (4900), 13969 (5900)
Department of Electrical Engineering and Computer Science
Ohio University, Athens, Ohio.

## Course Description

This course provides a bottom up approach to understanding wireless networks. First, theoretical background for each network layer is taught. Then, specific implementations of network layers are discussed, such as 802.11/802.15.4/LTE. Students will be exposed to network simulators such as ns3, and public IoT testbeds such as FIT where they can implement and evaluate network protocols. As the course material moves upwards in the networking stack, more emphasis will be given to recent advances in Internet of Things and embedded systems research.

## 4900/5900 Differentiation

Graduate students will be expected to come up with publication quality ideas for the final project. Senior graduate students are also expected to mentor undergraduates and junior graduate students, and provide exposure to their area of research.

## Course Topics

Wireless PHY layer, MIMO, antennas, channel capacity, WiFi/Zigbee/Bluetooth, MAC protocols, transmission scheduling, QoS/QoE, rate/power control, routing protocols, MANETs, AODV, OLSR, DSDV, routing optimizations, IP, IPv6, 6lowpan, address assignment protocols, TCP over wireless, selected theoretical results in wireless networks. *IoT related topics:* HTTP2, wireless sensor networks, indoor positioning, RFID, NFC, wireless security

## Lecture sessions

Section 101: MWF in ARC 146 from 10:45-11:40 AM

## Required Materials

1. Nitin H. Vaidya. Wireless Networks. 2010. Available at http://disc.ece.illinois.edu/downloads/vaidya-wireless-classnotes.pdf

## Recommended Textbooks

1. Wireless Communication Networks and Systems. Cory Beard, William Stallings ISBN-10: 0133594173 ISBN-13: 9780133594171. Publisher: Pearson.
   *Note: 2nd edition is fine too.*

## Instructor

Harsha Chenji, Ph.D.
Office: 351 Stocker Center.
Email: chenji@ohio.edu
Website: http://www.ohio.edu/people/chenji/

## Course website

Blackboard: https://blackboard.ohio.edu/
Piazza (for discussions): https://piazza.com/ohio/spring2016/ee49005900

## Office Hours

Instructor: TBD
Appointments required at other times. Please make an appointment via Catmail/Outlook's calendar system at least 1 day in advance. Instructor will be available 24/7 on Piazza ($E[response\ time] < 24\ hours$).

## Prerequisites

Introductory undergraduate or graduate course in computer networks

## Course Policies

1. Assignments are due electronically on Blackboard, unless specified.
2. Late submissions: no consideration will be given to excuses such as (but not limited to) unavailability of resources (e.g. internet was down, my laptop broke), unavailability of time (e.g., travel, Bengals made it to the Superbowl). Do not wait until the last minute to submit a homework or lab report. You will lose 100% of your score if we do not receive your homework or report on time.
   a. Why this policy? Professionally used document submission systems for time sensitive deadlines (e.g. HotCRP/EDAS for technical conferences) are extremely strict when it comes to closing the submission window. One second late? Better luck next *year*!
3. Attendance in lecture sections is strongly recommended but not required.
4. Students are strongly discouraged from having open laptops/smartphones in class during lectures unless instructed.
5. **All work is to be the original work of the individual. Depending on the severity, individuals performing plagiarism, cheating, and/or any other violation of the Student Code of Conduct may result in a zero for the assignment, may receive a grade of F for the class, and may be referred to the Ohio University Judiciaries for disciplinary action. Students may**

**appeal academic sanctions through the grade appeal process. The Office of Community Standards and Student Responsibility may impose additional sanctions**

6. Any student who suspects s/he may need an accommodation based on the impact of a disability should contact the class instructor privately to discuss the student's specific needs and provide written documentation from the Office of Student Accessibility Services. If the student is not yet registered as a student with a disability, s/he should contact the Office of Student Accessibility Services
7. Preferred Name Policy: See https://www.ohio.edu/policy/12-021.html
8. The lectures, classroom activities, and all materials associated with this class and developed by the instructor are copyrighted in the name of Harsha Chenji on this date 1 January 2016.

## Grading

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|---|---|
| Final Project (in class, team) | 40% |
| Homework Assignments (individual/team) | 30% |
| Midterm (in class, individual) | 20% |
| Class Participation | 10% |

## Letter Grade Calculation

All grading is based on the 12-point system. [100-93] A, [92-90] A-, [89-87] B+, [86-83] B, [82-80] B-, [79-77] C+, [76-73] C, [72-70] C-, [69-67] D+, [66-63] D, [62-60] D-, [59-0] F. Instructor reserves the right to lower the limits above, but I promise not to raise them.

## Student Outcomes vs. Course Learning Objectives

### A: An Ability to Apply Knowledge of Math, Science and Engineering

1. Ability to understand wireless networking at the PHY layer.
2. Ability to understand medium access control mechanisms.
3. Ability to understand spectral resource tradeoffs in PHY link design.
4. Ability to understand design decisions behind widely used wireless protocols.
5. Ability to design large scale wireless networks with limited system resources.

### B: Design and Conduct Experiments, Analyze and Interpret Data

1. Ability to evaluate network protocol performance using network simulators.
2. Ability to implement protocols on wireless networking testbeds.
3. Ability to design, build and program individual wireless network nodes.

## Final Exam/Project

Monday, April 25, at 10:10 a.m. in the classroom

## Tentative Course Schedule

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| Week 1 | Introduction, wireless transmission |
| Week 2 | Antennas & MIMO, channel capacity |
| Week 3 | MAC protocols |
| Week 4 | Distributed MAC protocols |
| Week 5 | Case study: WiFi, 4G Cellular/LTE |
| Week 6 | Case study: Bluetooth, Zigbee, ANT |
| Week 7 | Case study wrap up, exam review, Mid term exam |
| Week 8 | Spring Break |
| Week 9 | Routing in wireless networks, routing protocols |
| Week 10 | IP, IPv6, 6lowpan, UDP |
| Week 11 | TCP over wireless networks |
| Week 12 | IoT: HTTP/2, SPDY, QUIC |
| Week 13 | IoT: wireless sensor networks, body area networks, RFID, NFC |
| Week 14 | IoT: indoor positioning systems |
| Week 15 | Wireless security |