ECE 499-02/595-01: Computer Networks

Spring 2017

Project Description
(Feb 16, 2017)

Project Overview

This course project is required for the graduate students in ECE 595-001: Computer Network. All the students, including both undergraduate and graduate, are required to attend all the project presentations. We will give a short quiz at the end of each project presentation. The quizzes will be counted as part of your homework grading.

Project Topic: Routing Protocols in Mobile Ad-hoc Network (MANET)

In this project, you will explore routing protocols in MANET. A MANET is *an infrastructure-less* network with *mobile* nodes. An illustration of MANET is given in Fig. 1. For example, if vehicles are communication nodes and they are free to communicate with any nodes that are within transmission range, it will form a MANET. Note that since nodes are moving, the topology is not fixed. Some links may not be available in the next time slot. Fig. 2 illustrates a different topology in another time slot.

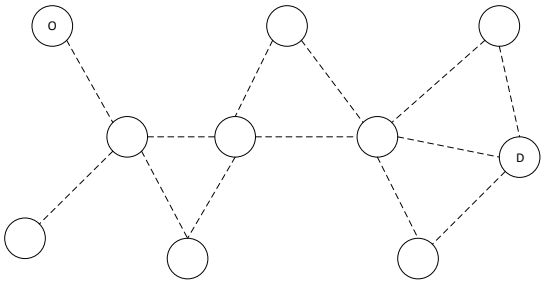

Figure 1. A MANET topology.

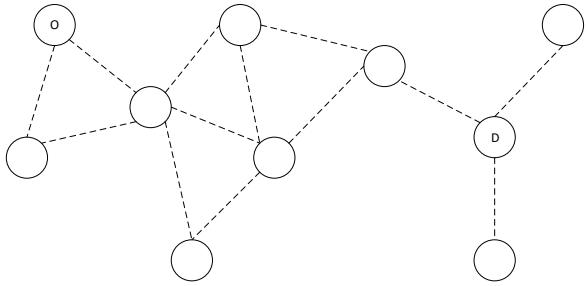

Figure 2. Changing topology due to mobility.

A routing protocol specifies how to select routes between any two nodes in a computer network. For example, if a route is needed between O (origin) and D (destination), the shortest routing protocol will find the route as shown in Fig. 3. (Note: distance in an ad-hoc network is usually measured in the number of hops.) There are many routing protocols, e.g., OSPF, Dijkstra, etc.

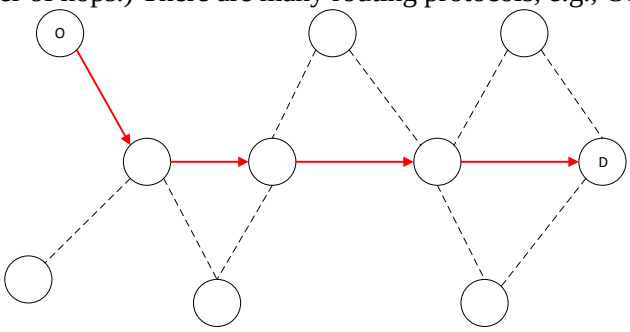

Figure 3. A shortest route from O to D.

You are given two options to finish this project.

1. Implementation of routing protocols in MANET using NS-3. (A bit knowledge of LINUX and Python is required. It's a good time to learn if not.)
   In this option, you are expected to conduct network simulation in NS3 with the following requirements:
   a. Set up a MANET environment with 10-20 nodes. The nodes should be randomly deployed in an area. You may start from a static grid topology. An example is given in Fig. 4. Small circles are nodes, dashed lines are possible communication links, big circles indicate transmission range of a node. A node cannot establish direct communication beyond its transmission range, thus the grid topology. Assume the transmission range does not change for each node.

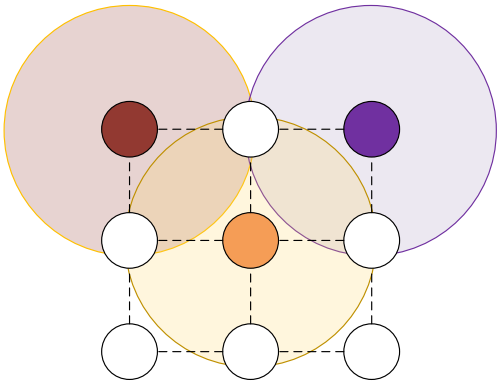

Figure 4. An example of grid topology and transmission range.

   b. Use any existing wireless transmission modules (e.g., Wi-Fi or basic BPSK transmission) provided by NS-3 for direct transmission links.
   c. Randomly choose two nodes as O and D, apply two different routing protocols to establish transmission routes and send packets.
   d. Record routing establishment time (run it for at least 100 times, get the average value)
   e. Record end-to-end delay (run it for at least 100 times, get the average value)
   f. Bonus Credit (up to 5 pts): Propose a NEW routing protocol.
      i. You need to design a routing protocol that is different from existing ones. It doesn't have to be completely novel. For example, you may change just one or two aspects.
      ii. Apply your protocol to the network, record routing establishment time ad end-to-end delay

Note: NS-3 (https://www.nsnam.org/) is a discrete-event network simulator for Internet systems, targeted primarily for research and educational use. You will need a LINUX environment to run NS3.

- The easiest way is to install LINUX (UBUNTU recommended https://www.ubuntu.com/) on your computer.
- Or, you may run a virtual machine. VMware is provided for free. Download it from https://ud.onthehub.com/
- NS-3 does not have a GUI. You can use NetAnim for animation (https://www.nsnam.org/docs/release/3.12/models/html/animation.html).
- Self-motivated learning is required.

- Teamwork is encouraged on setting up the NS-3 environment. But you must finish the network implementation and project report individually.

2. Literature survey and protocol design for MANET

In this option, you will do a more theoretical research oriented project. Please refer to the requirement as follows:

a. A thorough literature of routing protocols for MANET. At least 6 journal articles shall be surveyed. You are required to find all the articles on http://ieeexplore.ieee.org/Xplore/home.jsp**.** You are **only** allowed to survey *IEEE Transactions on xxx* (e.g., Wireless Communications, Mobile Computing, Vehicular Technology, etc.), *IEEE Journal on Selected Areas in Communications* and *IEEE International Conference on Computer Communications*. No other conference proceedings or sources are counted in your literature survey. But you may refer to other sources for knowledge base set up.

b. You will need to summarize the protocols from the literature survey, showing the application area, strength and weakness of each routing protocol.

c. You are expected to propose a NEW routing protocol for MANET. Your design should be superior in at least one or two aspects than existing ones. Possible theoretical analysis and numerical results will be helpful.

d. An 8-page (at least) survey report using IEEE Conference template (double column) is required.

e. No plagiarism! Even with citation, you have to rewrite each sentence in your own words. If using figures from others, you need to give citations correctly.

Project Proposal, Report, Presentation & Quiz Requirements

1. **Project proposal**:

You need to submit a 1-page proposal on Feb. 28, 2017, presenting an abstract of the option you choose, your goal of the project, your possible approaches to achieve the goal, and your schedule.

2. **Project report**:

a. If option 1, your project report should record the network model, simulation set up procedure, parameter settings, and simulation results. Encounter difficulties and your solutions shall be recorded as well.

b. If option 2, your project report is a survey paper that addressed all the pointed listed in the project description.

c. (10% bonus) You are encourage to use LATEX (https://www.latex-project.org/) for your technical report. Download the core files from https://miktex.org/ and an editor from http://www.texstudio.org/ . You may use the template for IEEE conference proceedings. The template and a tutorial can be found at https://www.ieee.org/conferences_events/conferences/publishing/templates.html

d. ***This is an individual project with no teamwork.***

3. **Presentation**: You need to present your work to the class at the end of the semester. Each student should prepare a 15-20 minutes presentation for your project. Presentation shall be made with the media or tool you feel most effective. MS PowerPoint is recommended to make the slides. If you choose to implement routing protocols in MANET, please bring your own system (e.g., laptop) and demo it to the class.

4. **Quiz preparation**: Each presenter will also prepare a one page quiz with up to 5 questions of multiple choices; the questions should be related to your presentation. You should submit your quiz problems with the answers the same time with your final report and your presentation.

Grading Guideline:

Total points: (max 100 + 10 bonus)

- Project Proposal (10)
- Final Report (depending on the creativity, difficulty of the implementations, quality of the demo if applied, etc.) (70)
- Presentation (20)
- Bonus (10)

Due Date and Submission:

- Project Proposal: Feb 28, 2017, in class
- Initial Final Report: Tuesday May 2, 2017, in class
- Presentation Slides: Tuesday May 2, 2017, in class
- Your quiz problems: Tuesday May 2, 2017, email before class

The presentations will be held on May 2 & May 4, 2017, in class

Hardcopy of your report and slides should be handed in on due date.
Softcopy of your report and slides (plus codes and compiled programs if necessary) should be emailed to fye001@udayton.edu on or before due date.

You may keep updating your final report and finalizing your programs until mid-night May 5, 2016. Submit your final report and program through e-mail to fye001@udayton.edu.