

COMP/ELEC 524: Mobile and Wireless Networking

Course Project

1. Overview

This project will allow you will explore some aspect of mobile and wireless networking in detail. The project will be done in groups of approximately 2–3 people. Each group will be required to:

- choose a topic for their project,
- write a short project proposal and have that proposal approved by us,
- carry out the research described in your proposal, and
- write a final report on the project, presenting the results of your simulation and analysis.

Your project must involve elements of design or analysis, and must use simulation based on *ns-2* in your evaluation. Specifically, your project may be one of two types:

- design of some new protocol, protocol version, or protocol feature or extension, and evaluate the performance and behavior of your design in a range of scenarios using *ns-2*; or
- analyse some specific new behavior or phenomenon of an existing system using *ns-2*, studying its effect on one or more protocols at one or more layers of the protocol stack.

Your project may also include the addition of new features to the *ns-2* simulator, such as improved physical layer models, in order to conduct the evaluation for your project.

The overall project must produce a coherent result that you will describe in your final project report. I expect the project report to be of high quality, approximately equivalent to something that could be submitted for publication (although due to time constraints within the semester, the work described in the report might be less substantial).

2. Project Proposal

Each group will write a proposal describing the area and problems to be explored, a brief survey of related work, possible directions of investigation, and the expected results. Your proposal should contain the following elements (although the structure and order of their presentation are up to you):

1. **Abstract:** A short, concise summary of the essential aspects of your proposal. The abstract should be a “miniature version” of the entire proposal, highlighting the most important parts.
2. **Introduction:** A clear statement of the problem to be solved or the work to be performed, and an overview of the results you expect. You should also provide some background and motivation indicating that this project is worth pursuing.
3. **What you will do:** The solution you propose to the problem, or the experiment you will carry out, etc. This must also include a description of the method by which you plan to evaluate your results, such as the measurements you intend to make. Be as clear as you can on how you plan to carry out your evaluation.

4. **Expected results:** A description of the results you expect to obtain from your work, with some interpretation. Try to be as specific as you can about how you will create your results (the types of simulation experiments you will perform in your evaluation). Also, try to describe type type of results you expect, by making educated guesses where possible. Of course, nobody is going to hold you to your estimates. Nevertheless, differences between what you expect and your actual results are often the source of an interesting discussion.
5. **Related work:** Relate previous work by others to what you plan to do. This should *not* just be a summary of other work, but instead should specifically emphasize the *relation* between your proposed work and that of other researchers. This should, of course, include papers we have covered in class, but you should also find other papers, such as in conference proceedings and journals in the library and on the Web.
6. **Timetable:** A description of how you will divide the work and your time during the project, including particular milestones you expect during the work. This should also give some convincing indication as to why you believe you will be able to carry out the project in the remainder of this semester.

The project proposal should be a *maximum* of 5 typeset pages (and can be shorter if you are able to cover the necessary material in less pages). If you would like feedback on your choice of project or on your proposal before the proposal is due, you can send a brief description of your project to me by e-mail, or you can (of course) come by in person to discuss your project ideas with me.

The project proposal must be sent to me by electronic mail and must be in PDF (Adobe Acrobat) format (specifically, *not* in other strange formats like raw Microsoft Word “.doc” format).

3. Project Report

The final report may follow a format similar to the proposal, except that the sections on what you will do and expected results should be replaced by sections describing what you did and the results you obtained, with some discussion. Also, instead of the timetable in the proposal, your project report should contain a section presenting your conclusions and describing possible avenues for further work. The style in your project report should be similar to that used in the papers we have read (and are reading) in class this semester.

Also, please include in your report a pointer to a location on OwlNet or on the Web, where the source code for what you implemented in your project is available from.

The project report should be a *maximum* of 10 typeset pages. As with your project proposal, please send your completed project report to me by electronic mail. As with your proposal, your project report must be in PDF format.

4. Schedule and Other Details

This project will last until the end of the semester. However, *do not* put off working on it until the last minute. In particular, be aware that writing the final project report will take a reasonable portion of your total time working on the project. The important dates in the schedule of this project are listed below:

Monday, October 8, 2007	Project assignment handed out
Monday, October 29, 2007	Project proposal due, 5:00 pm
Friday, December 7, 2007	Final project report due, 5:00 pm

Note that the proposal date above is the *deadline* for turning in your proposal; you are strongly encouraged to complete and turn in your proposal earlier, if you are ready earlier. You should also talk to me (or to

Yanjun Sun, one of my Ph.D. students) about your ideas for project topics before completing your proposal, if possible.

Each group should turn in a single proposal and a single project report for the entire group, but all group members must participate in all phases of the project, its evaluation, and presentation.

As noted above, *please submit all project proposals and project reports by email in either PDF or PostScript format*. Also, please attach your proposal or report as an email attachment using MIME, to avoid the PDF or PostScript being damaged by the email system. Please also remember to include a pointer to the source code for your project in your report.

5. Project Suggestions

Looking at the subjects we have covered (and are covering) this semester should give you a good starting point for choosing a topic area for your project, although many other topic areas are certainly also possible. Generally, anything involving the network (e.g., data link through presentation levels) could make a good topic if it is wireless and/or mobile. I have listed some *possible* general suggestions for *types* of project topics below. These are offered only as general *examples*, in no particular order, to help you start thinking about your own project topic:

- Simulate a number of different techniques for improving TCP performance in multi-hop wireless ad hoc networks, and compare the effectiveness of the techniques. The techniques you simulate may be some of those proposed in the literature and/or may include new techniques that you may design on your own.
- Add simulation code to model some realistic physical radio phenomenon not already modeled in *ns-2*, and study its effect on some protocol or application.
- Consider the use of directional antennas in wireless ad hoc networks, such that the transmission and reception of the antenna can be aimed (with some beam angle) in the intended direction of transmission or reception of a packet. For example, create some new routing protocol or extension to an existing routing protocol to make effective use of directional antennas (knowing which way to point, when), or assume “perfect” knowledge of where to point your antenna and study how much this might help some existing routing protocol.
- Similar to above, but consider the use of different transmission speeds, such as from different types of modulation and/or different levels of forward error correction (FEC) added to each packet. Lower transmission speeds of course take longer to transmit each packet, consuming more of the total shared bandwidth around the transmitting node, but also should be able to be received correctly a longer distance away from the transmitter. You could, for example, modify the code in the simulator that compares a received packet’s signal strength against the receiver’s receive threshold, to make this check dependent on the way that the packet was transmitted.
- Write simulation code to model the behavior of some existing or new application, and study how well the application performs in an ad hoc network. For example, you may study it in detail for a single ad hoc network routing protocol, or you may compare how its performance and behavior differ between different routing protocols.
- Similar to the suggestion above, but study some protocol, such as a transport protocol, above the routing layer. Possibly suggest and evaluate ideas to improve the protocol’s performance.

- Write simulation code to model some ad hoc network routing protocol not already available in *ns-2*, or add some feature to an existing protocol that you believe will improve its performance. Study its performance in detail, or compare it to some routing protocol already modeled in *ns-2*.
- Model some new MAC protocol, either one of your own design or some existing MAC protocol not already available in *ns-2*, and study its performance.
- Any other project idea you can think of that relates to the material in the class. You should invent something new and evaluate it, or evaluate in detail some phenomenon or some aspect of an existing protocol.

The suggestions above are only general *suggestions of types* of possible project topics, and you are not limited to the topics on this list. For projects that involve the design of some new protocol or extension to an existing protocol, you should model your new design in *ns-2* and evaluate how well your new design works. For projects that involve studying some behavior or phenomenon of an existing system, you should study in detail its causes and effects, and/or its impact on protocols, etc. All projects must be approved through your project proposal, which I will read and grade and return comments to you on.