The overall theme of your term project is to address practical challenges that can arise when you want to implement intelligent policies on WiFi (IEEE 802.11). Many research studies make the assumption that we can act like God in a wireless network – We have the complete knowledge of the whole network, and we can control the precise timing and content of every transmission. In practice, however, we are not that powerful. We cannot know the status of a different device unless we probe it, which causes some overhead. A lot of WiFi mechanisms are built in the hardware, and we cannot modify them. Therefore, we only have indirect control over the transmissions of WiFi devices.

In this term project, you need to identify some practical challenges in WiFi networks, and propose a solution that improves the performance under these practical constraints. You need to implement your policies and demonstrate their performance in ns-2. In your second midterm report, you need to describe a scenario and a reasonable baseline policy. You need to explain why using the baseline policy in the scenario will lead to poor performance, and use ns-2 simulations to support your claim. In your final report, you should build upon your second midterm report and propose your own solution. You need to demonstrate that your solution indeed outperforms the baseline policy.

You can find many good tutorials about WiFi on Internet. Below is a tutorial that I find very useful

http://www.sss-mag.com/pdf/802_11tut.pdf

You can also find many good resources on ns-2. A very popular tutorial is:

http://www.isi.edu/nsnam/ns/tutorial/

Below are some potential topics for your term project. Upon the instructor's approval, you can also work on other topics.

1. Downlink transmission

   In downlink transmission, packets arrive at the access point (AP), which then transmits these packets to wireless clients, such as laptops, smartphones, etc. When packets arrive at the AP, your policy needs to forward them to the hardware. (In ns-2, that means you need to forward them to the Mac/802_11 module) You can delay a packet, forward packets to the hardware in any arbitrary order, or even delete a packet without forwarding it. However, once you forward a packet to the hardware, you no longer have any control over it. The hardware will transmit packets according to the order that you forward them. The hardware will keep transmitting packets until they are all delivered, and it will not delete a packet even when the packet expires. Upon the delivery of a packet, the hardware may send you a signal so that you know it is done. Design a policy in this scenario.

   Baseline policy: At the beginning of an interval, the policy forwards all packets to the hardware according to their debts. (This statement will become clear to you as the course progresses.)

2. Uplink transmission with Point Coordination Function (PCF)

   In uplink transmissions, packets arrive at wireless clients, and they need to send the packets to the AP. A big challenge is to decide which client can transmit at any given point of time. In PCF mode, the AP decides which client can transmit: The AP will first send a POLL packet to the selected client.

A client can only transmit its packet after it receives the POLL packet from the AP. This allows the AP to have full control over which client transmits. However, there is one problem: Packets arrive at the clients, and the AP cannot know which client has packets for transmission.

In this topic, you will assume that each client generates a random number of packets at the beginning of the interval. You then need to design a policy for the AP to poll clients.

Baseline policy: At the beginning of each interval, the AP asks each client, one by one, the number of packets that it generates. After this process, the AP also knows the number of packets at each client, and it can make the best decision. However, this process itself can waste a lot of time.

3. Uplink transmission with Distributed Coordination Function (DCF)

In DCF mode, the AP does not control who to transmit. Rather, each client uses the DCF function to randomly access the channel. When multiple clients transmit at the same time, a collision happens and all transmissions fail. In this topic, your policy can delay a packet or delete it. However, like the first topic, you lose any control over the packet once you forward it the hardware.

Baseline policy: When packets arrive, forward them to the hardware directly.