CS472 – Computer Networks
Homework 1v3 – Protocol Concepts

Without even realizing it, we use protocols in everyday life to accomplish many different types of tasks. The basic components of any protocol contain a standard set of capabilities, to accomplish a well-defined task.

1. Addressing and Identity: How do you identify yourself, how to you find and identify the other party?
2. Messaging: What messages are valid? How does one party know when the other party is done? Is there an assumed ordering to the messages?
3. State: All communication interactions generally have a setup, some sort of activity, and then a shutdown. How are states transitioned?
4. Error Handling & Recovery: What happens when something unexpected occurs? Do we try to recover? Do we just terminate and start over?
5. Security: Do we need to establish trust between the parties? Is security required for what we are trying to accomplish?

As an example, think about ordering food from a lunch truck. **Addressing/Identity**: You need to go to the location of the truck. If you have been there many times before do you recognize the people working in the truck? **Messaging**: Assuming the truck is open, you need to wait your turn to put in an order, you place your order, the order taker gives your order to the cook, your order is packaged, you are told how much you owe, you pay, you receive your order. **State**: State governs the expected ordering of messages just provided. Would you just walk up and give the lunch truck money first and then they cook something without you placing an order? Likely not. The general state for this protocol is to order, have food prepared, and pay for the food. **Error Handling & Recover:** What happens if the lunch truck realizes it ran out of rolls after your ordered? What happens if they run out of propane? What happens if the truck you wanted to visit is not there today?   What if you don't have enough money to pay for lunch? What happens if you need to get to class, you placed an order, and have already waited 10 min? What happens if they are busy, and when asked for your order, you instead ask questions about the Eagles game the previous weekend? **Security:** How do you validate that the truck you wanted to visit is the truck you intended to visit and not an imposter? If they are offering organic products, do you just trust them, or do you validate?

Question: The above example considers many of the things that are involved to successfully visit a lunch truck and leave with the meal that you expected. Given the description above, lets attempt to design our own custom application protocol for a hypothetical course registration system used by a university. The protocol should include mechanisms for students to register for courses, for instructors to approve or deny course registration requests, and for the registrar's office to manage course enrollment limits and waitlists. Just like I did above for the "food truck" protocol, break down your course registration protocol by considering the key questions that must be addressed from the perspective of (1) Addressing and Identity, (2)

Messaging, (3) State, (4) Error Handling and Recovery, and (5) Security.

For each of the above protocol attributes come up with a short list of important questions (**at least one but no more than three per category**) that must be addressed and then propose a solution to at least one of them from each category. Feel free to be creative in what you come up with as there is no limited fixed list of correct solutions. To get you started consider, the addressing category:

Category: Addressing / Identity
<u>Key Design Considerations:</u>
- How will the specific clients (students, instructors, university employees of the registrars office) of the system be identified to the course registration server, and how will the course registration server be discovered by the client?
- Are there any addressing restrictions on how the various user types can access the system, for example, do all parties have to be on campus or connected using a VPN, or can they interact over the internet using their university ID?
- What happens if somebody has multiple identities relevant to the registration process? For example an individual is a student and needs to register for a course, but the student is also a TA, and needs to be scheduled to cover a lab for another course.

ANSWERS TO QUESTIONS: (I only asked you to provide an answer to one of the questions that you propose, I will answer all 3 here to give you a sense of what I am looking for in this assignment. Feel free to be creative and do some of your own research using the internet. While you are not network or protocol experts (yet) the concepts of using a protocol in real life, your real-world life experiences using the internet, and as a student in a university should enable you to answer these questions.

- How will the specific clients (students, instructors, university employees of the registrars office) of the system be identified to the course registration server, and how will the course registration server be discovered by the client? *A: Users will authenticate to the system using their university provided credentials (ID and Password). Once the credentials are validated, the system can lookup the role of the user to determine if they are a student, instructor, or a member of the registrars office. The system may also determine that the provided university credentials are valid, but the role of the user has no authority to access the registration system. For example a school janitor, an alumni, etc.). The system should have an easily identifiable URL name that is not only used to locate the system, but also convey the intent and purpose of the system. For example "registration.drexel.edu", versus something like 1234-32-18631.drexel.edu.*

- Are there any addressing restrictions on how the various user types can access the system, for example, do all parties have to be on campus or connected using a VPN, or can they interact over the internet using their university ID? *A: Hopefully you know by now that systems can be private (not accessible over the internet – aka you must be on campus to access), virtually private (not accessible over the internet unless you first*

- What happens if somebody has multiple identities relevant to the registration process? For example an individual is a student and needs to register for a course, but the student is also a TA, and needs to be scheduled to cover a lab for another course. *A: This implies that that full identity of a user interacting with this system includes both the users identity as well as the course identity. Why? In most cases students take courses, Instructors teach courses, and Registrar employees manage what courses are taught, when they are offered, and which students are enrolled in individual courses. But like mentioned above, sometimes students are hired to be TAs for other courses, and university employees (instructors, as well as those working in the registrars office) can also be students in other courses. Thus, a robust system must ensure that that the role of the user must be combined with the identity of the course.   Imagine this situation, an employee in the registrars office is taking advantage of a free tuition benefit at a university to obtain an MBA degree. They register as a student for an advanced accounting course next term, but the course is full and they get put on the waiting list by the registration system. Should the system allow them, or anybody else in the registrar's office the ability to move this student off the wait list, which is a capability they would have for a regular student, or an instructor being put on the wait list for a class?*

With the above to get you started, continue to flush out the registration system protocol for the (1) Messaging, (2) State, (3) Error Handling / Recovery, and (4) Security attributes of protocol design.