Teacher’s Notes

Chapter 2: Network Standards

# Role in the Course

Chapter 1 gave students a view of networking concepts and issues from 10,000 feet. Chapter 2 dives into standards. Without standards, you would have to buy all of your equipment and software from individual vendors with all of the problems that would create. Chapter 2 covers general standards concepts we will see throughout the book. Sneakily, it illustrates these concepts with five of the most important protocols in networking—Ethernet 802.3, IP, TCP, UDP, and HTTP.

# Material Covered

After a short discussion of why standards are important, the chapter introduces the key concepts of network standards: including messages, syntax, semantics, ordering, and reliability.

The chapter then covers message order (turn-taking) using HTTP and TCP to show opposite extremes in message order complexity.

There is a big section on message syntax, which is the structure of messages. Message syntax is the key to network standards. Messages are just streams of bits. Syntax divides these bits into meaningful units. We look at syntax of Ethernet frames, IP packets, TCP segments, UDP datagrams, and HTTP request and response messages. These standards show three different ways to express syntax.

A big job if the application layer is to encode its applications from meaningful units into groups of bits. At lower layers, everything is expressed in bits. Text, numbers, voice, and other types of application data are encoded in different ways. This part of the chapter shows how different types of information is encoded.

When a frame is transmitted over a network, it is like a nesting Russian doll. Inside the frame is the packet, inside the packet is the TCP or UDP message, and inside that message is an application layer message or at least a fragment of the application layer message. We will see how nesting, which is formally called encapsulation is done.

# Hard Parts

The section on the three parts of messages requires care because you must know which parts of messages are uncommon, common, and universal. Tell students to study holistically, absorbing the framework and then the individual facts.

Syntax is a challenge because there is a lot of it. Amid this abundance, students must understand quite a few of the fields. Different messages have different fields. Be sure as you study that you know which fields are parts of what messages. Be sure to have them get the concept of TCP and UDP port numbers and sockets very clearly in their heads. There is interrelated stuff here that must be gone over multiple times to really understand.

Students will probably find parts of encoding to be challenging. Most of this material is straight forward, but converting whole numbers to binary notation and encoding alternatives require considerable attention. Many students gloss over encoding alternatives instead of mastering it. This is a mistake that haunts them throughout the course, because encoding alternatives keeps reappearing.

Encapsulation confuses most students at first. After looking at it a few times, a light bulb goes off and you will see the essential simplicity of the process.

# CEPTs

A key central concept is the importance of standards. The three general parts of any message is also a CEPT for the course. Message syntax, semantics, ordering, reliability, and connections are also continuing parts of networking’s background music. Encoding is a crucial application layer concept. Students should not just study application layer encoding examples. Clearly understand the overall concept of encoding and why it is done.

# Teaching Suggestions

This is a lecture chapter. It is important to emphasize that different standards organizations display syntax differently. I bring this up with each new syntax figure and compare differences.

I also try to emphasize whether there is a trailer. (Only in Ethernet.) Sometimes, there is only a header (TCP SYN, ACK, FIN, etc. often only have a header.)

It is also good to compare the syntax for the standard you are currently presenting with one or more previous standards you already presented.

I am sometimes tempted to cover all of the fields in the sample messages, but these will come up in later chapters. Ethernet in Chapter 5. IP, TCP, and UDP in Chapters 8 and 9.