Business Data Networks and Security, 11th Edition

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INSTRUCTORS' MANUAL

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PART I: BROAD MATTERS

This instructor's manual has three parts.

- ✓ **Broad Matters** has key information about the book and using it in your course.
- ✓ **Chapter Information** gives information for teaching individual chapters.
- ✓ **Answer Keys and Multiple-Choice Questions** are tied to individual Test-Your-Understanding (TYU) questions in each chapter.

Why Networking and Security?

The preface for adopters has more detail on why the book is right for courses. Here's the short version:

- ✓ It's right for a pure business data networking course because security is a huge part of todays' networking profession. General security courses do not cover many relevant network security concepts. Cover the 11 chapters plus some hands-on "a" chapters.
- ✓ Its also right for the growing number of schools that combine introductory networking and security courses. The Appendix adds additional information on planning and response that balance the protection information in other chapters. It is good to cover the Appendix after Chapter 4, which is the security overview. It is also a fun way to end the term.

Concepts and Principles; Then Applications to Technologies

As noted in the Preface for Instructors, businesses want graduates who can approach technologies like Wi-Fi, Ethernet, and applications holistically—how standards, management, and technology apply to each because that is how networking and security are done in organizations. This learn-and-apply approach to networking and security concepts and principles also helps burn them into students' mental ROM by applying them to different situations.

- ✓ **First Concepts and Principles**. The first four chapters discuss general concepts, standards, network management, and security. (Security, as you might expect, also weaves through the first three.) In a combined introductory networking and security course, I teach the Appendix right after Chapter 4.
- ✓ **Then Applying Concepts and Principles Holistically**. The rest of the book applies these concepts and principles to a series of technologies: Ethernet (Chapter 5), Wi-Fi (Chapters 6 and 7), the Internet of Things devices (Chapter 7), the Internet (Chapters 8 and 9), WANs (Chapter 10), and applications, including cloud computing (Chapter 11). Figure P-1 shows how this works for 802.11 Wi-Fi.

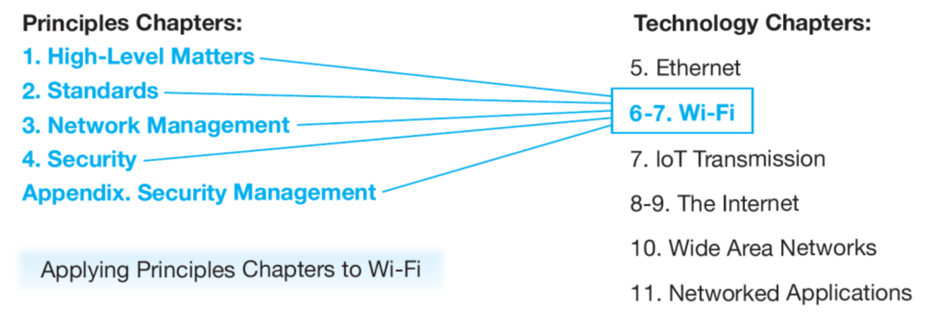


FIGURE P-1 Principles and Applications

Teaching Individual Chapters

Coverage

Each chapter takes about 2.5 hours of class time. In semester courses, that is a week. If Chapter 4 (security) is taught interactively, it will take a little longer. I also like to schedule extra time for Chapter 1 to cover the hands-on experiences in Chapter 1a in class. The Appendix and Chapter 5 may also merit an extra class day.

I suggest *not* covering More Information sections with deeper background information the first time through the book. I usually don't cover them even later.

Pedagogy

In class, I normally use the PowerPoint presentations. More on them later.

- ✓ **Class Discussions**. Some chapters, especially Chapter 4 on security, lend themselves to discussions in class. For that chapter, I go to the board and have them come up with lists of attackers and attacks. They know a lot, and they feel good showing it. In most chapters, however, there are too many new and complex concepts for this. Even then, however, you can go over something and ask a few questions about it to reinforce learning.
- ✓ **Chapter-Opening Caselets**. Several chapters begin with opening caselets. I usually assign these for study before the class. To warm up the class, I begin with a few minutes going over Test-Your-Understanding questions from the caselet, then launch into the PowerPoint presentation.
- ✓ **Test Your Understanding Questions**. The book is built around Test-Your-Understanding questions. Individual multiple-choice questions are keyed to individual TYU questions. If you tell students to skip a section in the book, it is easy to avoid including multiple choice questions that on that section.
- ✓ **Homework**. Each subsection (Level 2 heading) ends with Test-Your-Understanding questions. The best students read a subsection and then immediately go over the TYU questions to see if they understand it well enough. There are too many TYU questions to assign for homework, so I

assign selected ones that are important or tend to cause problems. I then spend about 20 minutes of the next class going over the ones students want to go over.

PowerPoint Presentations

- ✓ **Full Lectures**. The PowerPoint presentations are full lectures, not just “a few chosen examples.”
- ✓ **Larger Figures**. Some figures are too large to show on a PowerPoint slide, and just breaking them down into pieces can cause confusion. Most chapters have “Larger Figure” files that students can download. These show the larger figures for the chapter. It helps them follow the PowerPoint presentations for these figures.
- ✓ **Calculations and Examples**. When there are calculations to be done, take time to work through the example in the presentation, and have them do another couple of examples in the presentation. Also, ask questions a lot to see if they have gotten various points. Yes, this is just Teaching 101.
- ✓ **Multistep Processes**. Many students have a hard time with multistep processes. They must simultaneously learn both individual steps and the overall flow. It’s like learning to play a violin while giving a performance. Go through each step closely, recapping where they are in the process frequently. Give them confidence that they can learn these things. It is a critical academic skill that is too often not achieved in school or in life. It is, of course, crucial in business.
- ✓ **Choosing Alternatives**. Another common problem is that networking is usually about choosing among alternatives. Some students myopically understanding individual alternatives, but this is not enough. Students must learn to compare them, contrast them, and choose between them. The PPT presentations emphasize this.
- ✓ **Notes**. Versions of the PowerPoint presentations for authors will have slide notes about how to teach a particular slide.
- ✓ **Notes 2**. Sometimes slide notes have additional information you can use to inject background into your presentation.
- ✓ **Skipping Stuff**. If you trust your students to read the book, cut out some straightforward sections and tell them to read it. This lets you move more slowly through the hard stuff.
- ✓ **Illustrations**. Slides with illustrations are best covered in a particular way.
    - First, discuss the problem that must be solved. In Figure 1-1, this is how distributed denial-of-service attacks are conducted.
    - Then, “set the scene.” Note the individual parts and discuss each’s role briefly. In Figure 1-1, these are the botmaster, the KrebsOnSecurity website, the IoT devices and bots.
    - Then go through the process that is depicted. What the botmaster does, what the individual IoT bots do, and what happens on the website.

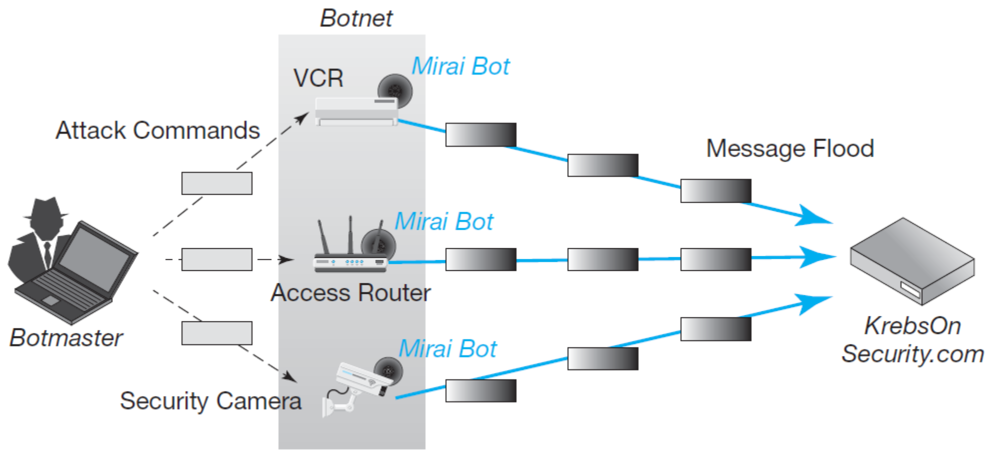
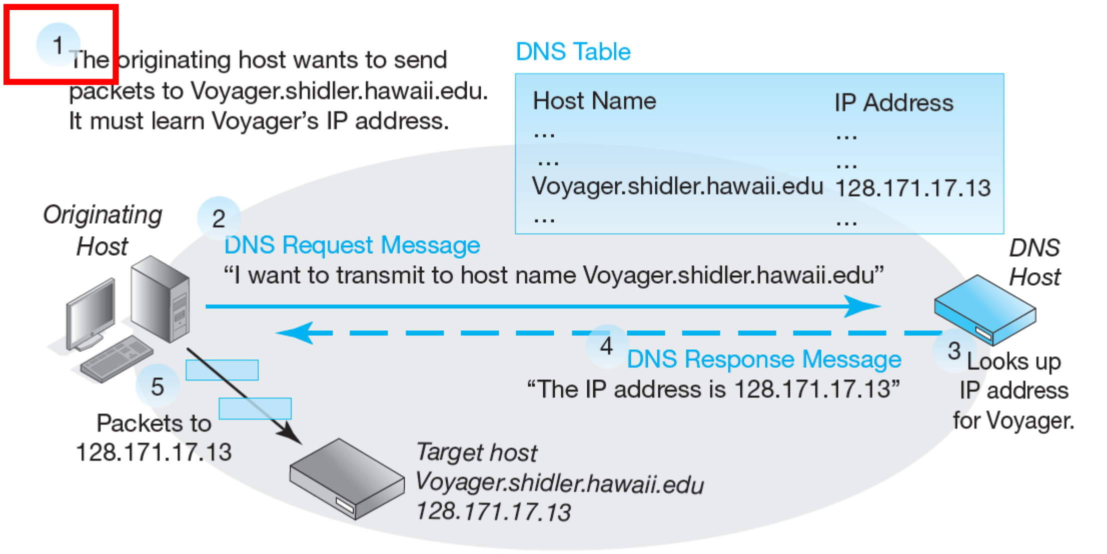


FIGURE 1-1 Simplified Depiction of Mirai Distributed Denial-of-Service Attack

- ✓ For more complex illustrations, there are sequence numbers to guide your explanation after you give the problem and set the scene. In the PowerPoint deck, slide builds help you walk through them systematically (and make each part more understandable). This also reduces student panic when they see a complex slide (and sometimes teacher panic).



1 The originating host wants to send packets to Voyager.shidler.hawaii.edu. It must learn Voyager's IP address.

Host Name	IP Address
…	…
…	…
Voyager.shidler.hawaii.edu	128.171.17.13
…	…

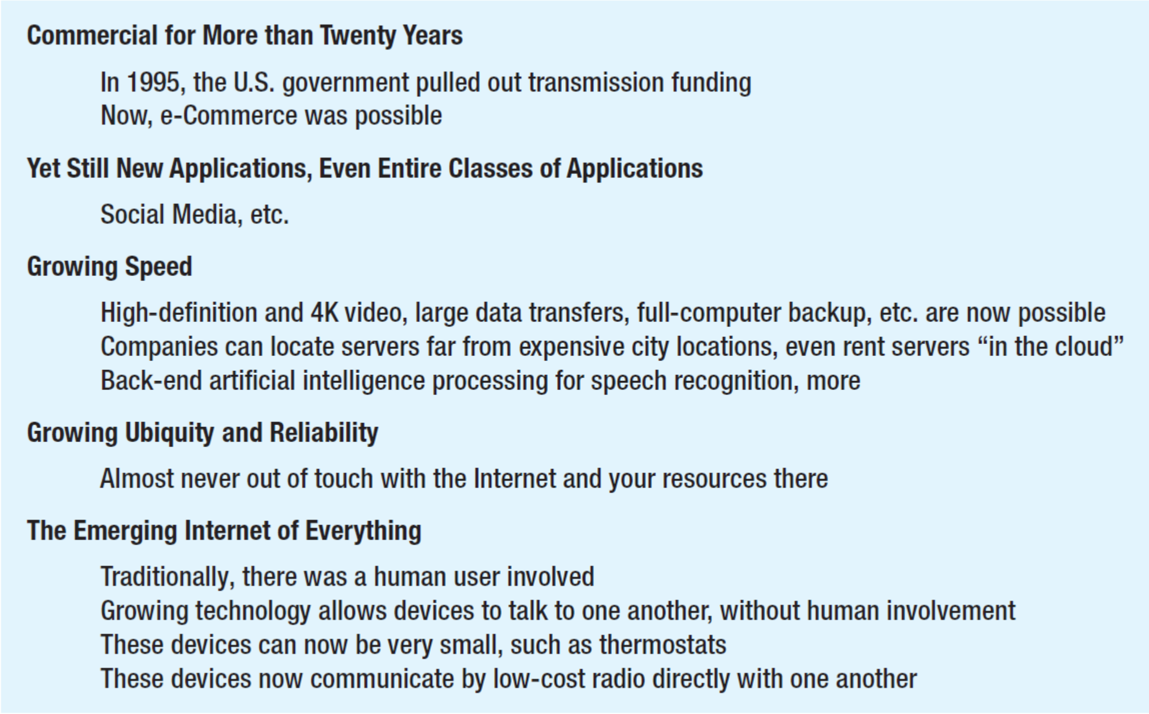
2 DNS Request Message "I want to transmit to host name Voyager.shidler.hawaii.edu"

3 Looks up IP address for Voyager.

4 DNS Response Message "The IP address is 128.171.17.13"

FIGURE 1-20 Domain Name System (DNS)

- ✓ **Study Figures**. Some figures are text figures that simply recap basic information in the text. Essentially, we take notes for the students. Thanks to text figures, nearly every important point is covered in the figures. This makes them great for exam study.



Commercial for More than Twenty Years

In 1995, the U.S. government pulled out transmission funding
Now, e-Commerce was possible

Yet Still New Applications, Even Entire Classes of Applications

Social Media, etc.

Growing Speed

High-definition and 4K video, large data transfers, full-computer backup, etc. are now possible
Companies can locate servers far from expensive city locations, even rent servers "in the cloud"
Back-end artificial intelligence processing for speech recognition, more

Growing Ubiquity and Reliability

Almost never out of touch with the Internet and your resources there

The Emerging Internet of Everything

Traditionally, there was a human user involved
Growing technology allows devices to talk to one another, without human involvement
These devices can now be very small, such as thermostats
These devices now communicate by low-cost radio directly with one another

FIGURE 1-3 The Ever-Changing Internet (Study Figure)

Hands-On Chapters

Several chapters are followed by brief hands-on chapters to give students some concrete experience to help them understand what they have just learned. I usually assign them as homework, but I do a "warm up" demo in class to see what they will experience. I go over what they actually learned briefly in the next class. In my class forum, I have students post questions to help them get around any glitches.

For Chapter 1a, I (the older author) actually go through some of it when I teach Chapter 1. Traceroute is a great way to show them how many routers their packets travel through to reach the destination host, and it burns the idea of routers, data links, and destination hosts into their mental ROM.

Networking and security are brain games, so working examples on network capacity calculations is more fundamental than cutting and connectorizing 4-pair solid-wire UTP. However, students really crave more hands-on work. I wish classes could cover all of the hands-on ability needed for Cisco certifications, but there is not enough time without tacking on additional credits.

Online Resources for Teachers

Beyond this Instructor's manual, there are online resources for courses.

For Teachers

This instructor's manual is only available to teachers.

So are annotated PowerPoint presentations for teachers.

For Students

Students can download the student versions of the PowerPoint presentations to follow along in class.

Students can also download homework file so that you can see their answers in the context of the specific questions asked. These are in Word for Windows file format.

In addition to PowerPoint presentations, you and students can download "Larger Figures." This is a word file that contains one or more large figures. PowerPoint slide builds are great for presentation, so we use them a lot. However, students also need to see whole figures.

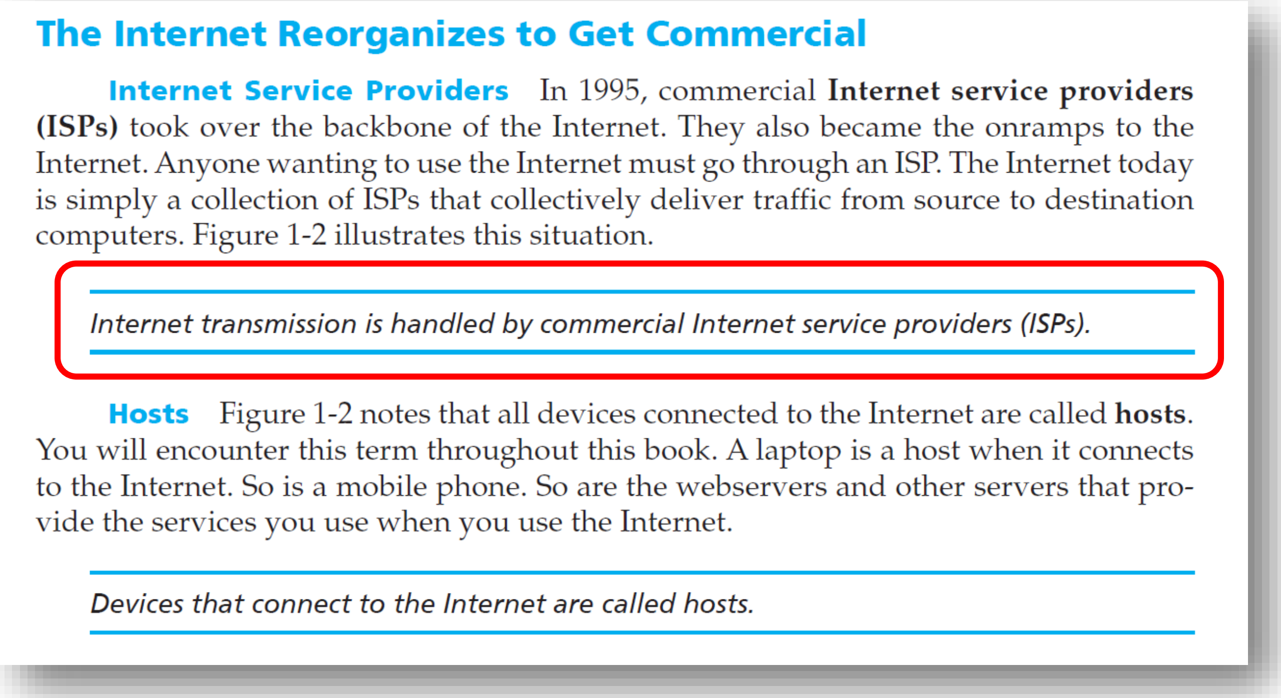
Student Pedagogy in the Book

Sections. Each chapter's flow is broken into a lot of sections, subsections, and sub-subsections. Each has a header giving the gist of what is covered. Students have a difficult time reading through multipage blocks of text without their eyes glazing over and losing the flow. Some teachers hate all the subsections, but they make the book look less intimidating to students and help them focus on what each block of text is about.

Test-Your-Understanding Questions. Again, PowerPoint presentations help, but students need to work by themselves to learn the material. Networking is both complex and unfamiliar. Security is more familiar but similarly nuanced. Test-Your-Understanding questions are central to learning the material. It is best to study a section, then do the TYU questions, and then go back over the section to learn what they aren't sure about. Honestly, only the best students do it, but it's a powerful tool.

TYU questions are also important because multiple-choice questions are taken directly from them. Of course, they can't just memorize questions and answers because the wording on multiple-choice questions will be different, but the content will be the same.

Process for Exam Study. To study for exams, I recommend that students first read through material that is broken out with solid lines above it and below it. These are key concepts. I then ask them to go over each figure and give a lecture snippet to explain it. Finally, there is going over the TYU questions and going back to restudy if they do not have high confidence in their answers.



The Internet Reorganizes to Get Commercial

Internet Service Providers In 1995, commercial **Internet service providers (ISPs)** took over the backbone of the Internet. They also became the onramps to the Internet. Anyone wanting to use the Internet must go through an ISP. The Internet today is simply a collection of ISPs that collectively deliver traffic from source to destination computers. Figure 1-2 illustrates this situation.

Internet transmission is handled by commercial Internet service providers (ISPs).

Hosts Figure 1-2 notes that all devices connected to the Internet are called **hosts**. You will encounter this term throughout this book. A laptop is a host when it connects to the Internet. So is a mobile phone. So are the webservers and other servers that provide the services you use when you use the Internet.

Devices that connect to the Internet are called hosts.

Fun Footnotes. No, that is not an oxymoron. We limit chapter content to what all students should be able to master in an introduction to networking course. Sometimes, it is useful for some students if a bit more information is available to satisfy their curiosity. We put them in footnotes. They are not required reading, so they are not deadly detailed. Sometimes, footnotes are used for illustrative (and occasionally a bit snarky) comments.

Changes Since the Last Edition

Based on experience teaching the last edition and listening to others who have taught it, this new edition contains a lot of new writing. Much of this involves presenting sections of material in improved ways. Changes are listed in the sections for individual chapters. However, we should note several general changes here.

- ✓ As much as possible, We have streamlined the chapters by removing material that is not absolutely essential. Gone are several technologies and concepts that now sleep with the fishes. Other information, which is nice to know, has been moved to footnotes for students who are interested. In general, chapters are about 10% to 20% lighter.
- ✓ Some of this streamlining has been used to add more examples of things that students have a difficult time with. These sections need a little more class time and student exercises. In addition, when a figure has multiple steps, callouts are sometimes added to show the order in which things should be understood. These become builds in PowerPoint presentations.
- ✓ In the last edition, Chapter 3 dealt with network security while Chapter 4 covered network and security management.

- In this edition, the third chapter is now on network management. All SDN material has been placed in this chapter.
- Security is now introduced in depth in Chapter 4 because it is important to cover all possible network principles to be able to talk about network security as opposed to security in general.
- The Appendix has security information that is important but that the teacher may not wish to cover in a networking course. It covers security planning from Chapter 3 in the last edition and expands on this topic. It also covers response to incidents in considerably more detail.