Computer Networks

- we see continued evolution in the technology used to support the Internet, with switching at “layer 2”providing rich functionality and powerful tools for network management
  - Layer 2指的是什么比如layer 2 forwarding
  - Layer 2 switching (or Data Link layer switching) is the process of using devices' MAC addresses to decide where to forward frames. Switches and bridges are used for Layer 2 switching.
    - https://study-ccna.com/layer-2-switching/#:~:text=Layer%202%20switching%20(or%20Data,connected%20to%20one%20central%20device.
- 前言中说，按layer来描述网络其实并不是太好
  - 因为有些重点的概念比如安全和性能并不能在一个layer被覆盖完全
  - hese sorts of topics are both critical and cross-cutting
- OSI model is not really successful at organizing the core concepts of networking
  - Such basic requirements as reliability, flow control, or security can be addressed at most, if not all, of the OSI layers.
  - The Open Systems Interconnection model (OSI model) is a conceptual model that characterises and standardises the communication functions of a telecommunication or computing system without regard to its underlying internal structure and technology
- both students and professionals learning about networks for the first time often have the impression that network pro- tocols are some sort of edict handed down from on high, and that their job is to learn as many TLAs (Three-Letter Acronyms) as possible
  - protocols are the building blocks of a complex system developed through the application of engineering design principles
  - they are constantly being refined, extended, and replaced based on real-world experience.
- 人们在网络里的不同角色
  - 使用者
  - 设计者
  - 管理者
  - 应用开发者

1 Foundation
2 Getting Connected
3 Internetworking
4 Advanced Internetworking
5 End-to-End Protocols
6 Congestion Control and Resource Allocation
7 End-to-End Data
8 Network Security
9 Applications

- Foreword
- ***systems approach***–that forms the soul of this book

implications

First Principles

Rather than accept existing artifacts as gospel, we start with first principles and walk you through the thought process that led to today’s networks. This allows us to explain why networks look like they do. It is our experience that once you understand the underlying concepts, any new protocol that you are confronted with will be relatively easy to digest.

Real-world examples

Rather than explain how protocols work in the abstract, we use the most important protocols in use today–most of them from the TCP/IP Internet–to illustrate how networks work in practice. This allows us to include real-world experiences in the discussion.

End-to-end focus

Networks are constructed from many building-block pieces, and while it is necessary to be able to abstract away uninteresting elements when solving a particular problem, it is essential to understand how all the pieces fit together to form a functioning network. We therefore spend considerable time explaining the overall end-to-end behavior of networks, not just the individual components, so that it is possible to understand how a complete network operates, all the way from the application to the hardware.

Design Principles

Networks are like other computer systems–for example, operating systems, processor architectures, distributed and parallel systems, and so on. They are all large and complex. To help manage this complexity, system builders often draw on a collection of design principles. We highlight these design principles as they are introduced throughout the book, illustrated, of course, with examples from computer networks.

Non-layerist

Although the material is loosely organized around the traditional network layers, starting at the bottom and moving up the protocol stack, we do not adopt a rigidly layerist approach. Many topics–congestion control and security are good examples –have implications up and down the hierarchy, and so we discuss them outside the traditional layered model. Similarly, routers and switches have so much in common (and are often combined as single products) that we discuss them in the same chapter. In short, we believe layering makes a good servant but a poor master; it’s more often useful to take an end-to-end perspective.

Software

Although at the lowest levels networks are constructed from commodity hardware that can be bought from computer vendors and communication services that can be leased from the phone company, it is the software that allows networks to provide new services and adapt quickly to changing circumstances. It is for this reason that we emphasize how network software is implemented, rather than stopping with a description of the abstract algorithms involved. We also include code segments taken from a working protocol stack to illustrate how you might implement certain protocols and algorithms.

Performance

The systems approach implies doing experimental performance studies, and then using the data you gather both to quantitatively analyze various design options and to guide you in optimizing the implementation. This emphasis on empirical analysis pervades the book.

Roadmap

Chapter 1

introduces the set of core ideas that are used throughout the rest of the text. Motivated by wide-spread applications, it discusses what goes into a network architecture, provides an introduction to protocol implementation issues, and defines the quantitative performance metrics that often drive network design.

Chapter 2

surveys the many ways that a user can get connected to a larger network such as the Internet, thus introducing the concept of ***links***. It also describes many of the issues that all link-level protocols must address, including encoding, framing, and error detection. The most important link technologies today–Ethernet and Wireless–are described here.

Chapter 3

introduces the basic concepts of switching and routing, starting with the virtual circuit and datagram models. Bridging and LAN switching are covered, followed by an introduction to internetworking, including the Internet Protocol (IP) and routing protocols. The chapter concludes by discussing a range of hardware- and software-based approaches to building routers and switches.

Chapter 4

covers advanced Internetworking topics. These include multi-area routing protocols, interdomain routing and BGP , IP version 6, multiprotocol label switching (MPLS) and multicast.

Chapter 5

moves up to the transport level, describing both the Internet’s Transmission Control Protocol (TCP) and Remote Procedure Call (RPC) used to build client-server applications in detail. The Real-time Transport Protocol (RTP), which supports multimedia applications, is also described.

Chapter 6

discusses congestion control and resource allocation.
The issues in this chapter cut across the link level (Chapter 2), the network level (Chapters 3 and 4) and the transport level (Chapter 5). Of particular note, this chapter describes how congestion control works in TCP , and it introduces the mechanisms used to provide quality of service in IP .

Chapter 7

considers the data sent through a network. This includes both the problems of presentation formatting and data compression. XML is covered here, and the compression section includes explanations of how MPEG video compression and MP3 audio compression work.

Chapter 8

discusses network security, beginning with an overview of cryptographic tools, the problems of key distribution, and a discussion of several authentication techniques using both public and private keys. The main focus of this chapter is the building of secure systems, using examples including Pretty Good Privacy (PGP), Secure Shell (SSH), and the IP Security architecture (IPSEC).
Firewalls are also covered here.

Chapter 9

describes a representative sample of network applications, and the protocols they use, including traditional applications like email and the Web, multimedia applications such as IP telephony and video streaming, and overlay networks like peer-to-peer file sharing and content distribution networks. Infrastructure services–the Domain Name System (DNS) and network management–are described. The Web Services architectures for developing new application protocols are also presented here.