Welcome to the Cloud

Chapter 1

Panko and Panko
Business Data Networks and Security, 10th Edition, Global Edition

Netflix Jumps Into the Amazon

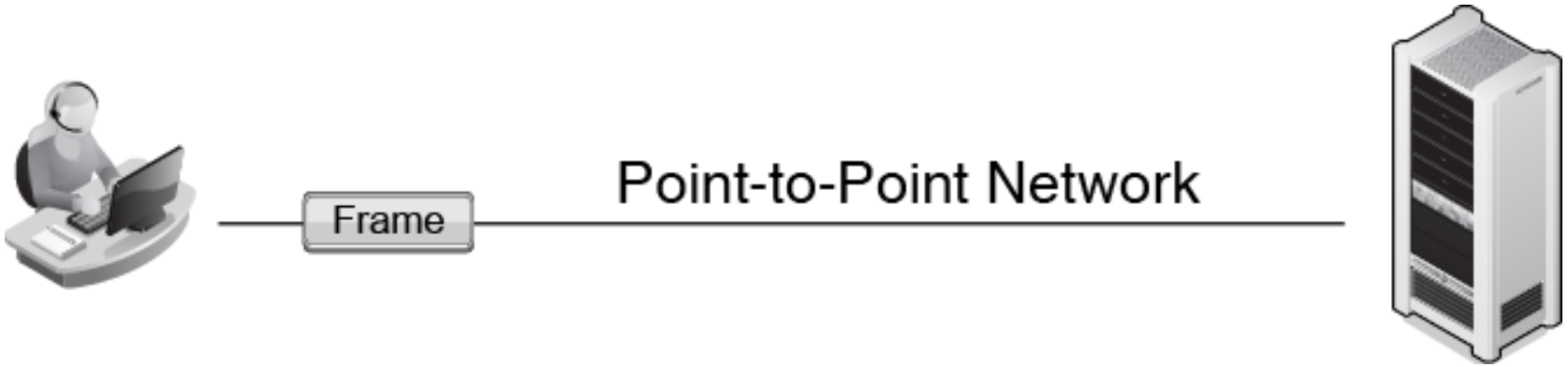
Messages

Single Networks

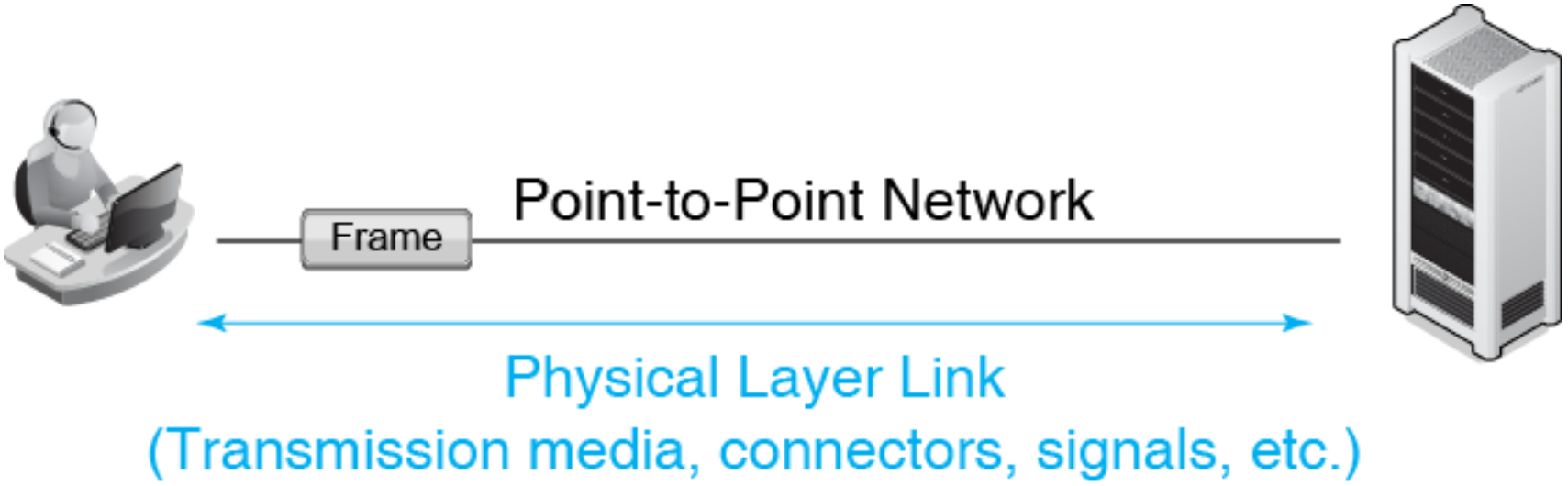
Internets

Standards Layers

1.16 Point-to-Point Single Network



1.16 Point-to-Point Single Network



1.16 Point-to-Point Single Network

Data Link Layer (DLL) Link
(Frame organization)
Point-to-Point Prococol (PPP) is a common standard

1.17 Physical and Data Link Layer Standards

- **Layered Standards**
  - Often, standards are created in layers, with each layer supporting the next higher layer
    - For example, in driving…
    - The soil layer supports the road layer
    - The road layer supports the tyre layer
    - The tyre layer supports the body layer
    - The body layer supports the driver layer

1.17 Physical and Data Link Layer Standards

- Layering allows specialization
  - Road engineers do not have to understand tire standards or body standards in detail

1.17 Physical and Data Link Layer Standards

- **Physical Layer Standards**
  - The physical connection between adjacent devices in a network is a physical link
  - Govern transmission media and connectors
  - Govern signaling to transmit ones and zeroes
  - Layer 1 (L1) standards

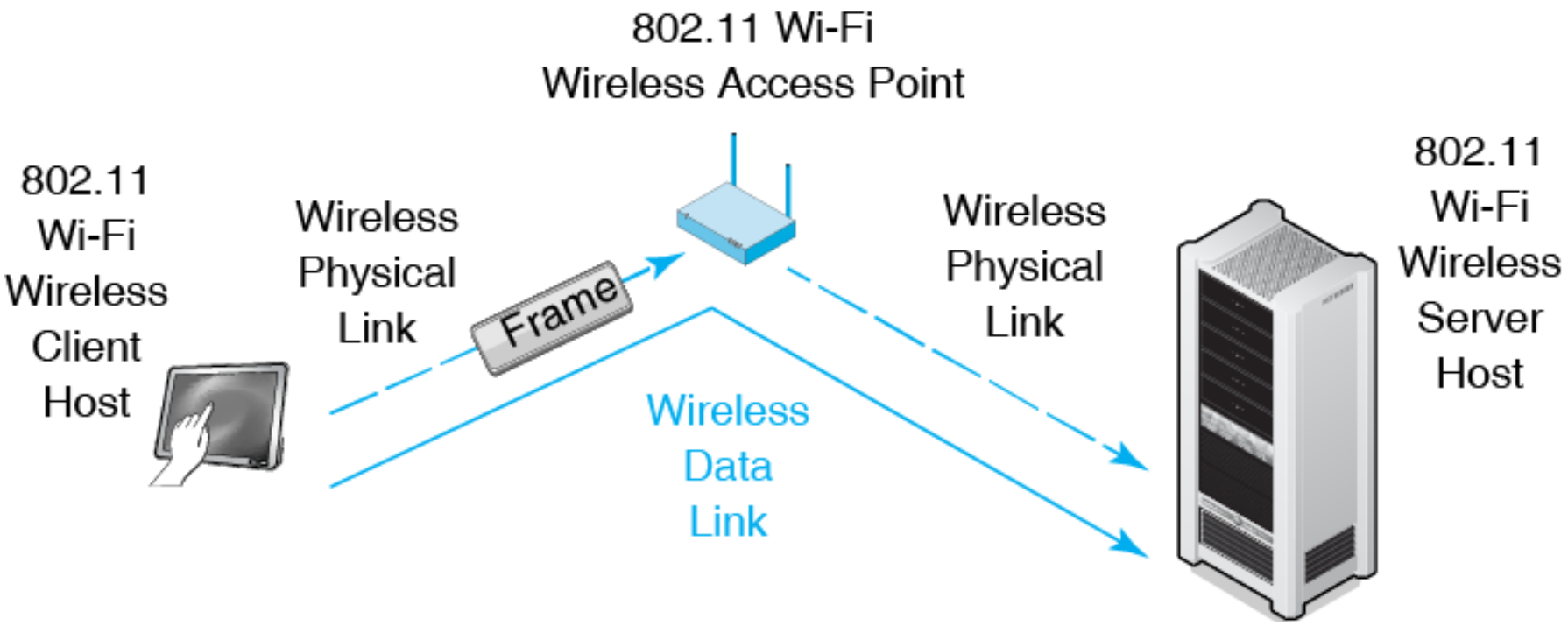
1.17 Physical and Data Link Layer Standards

- **Data Link Layer (DLL) Standards**
  - The end-to-end path of a frame between the source and destination host is a data link
  - Govern frame organization
  - Govern how forwarding devices (access points, switches) forward frames over multiple hops
  - Govern DLL addresses
  - Layer 2 (L2) standards

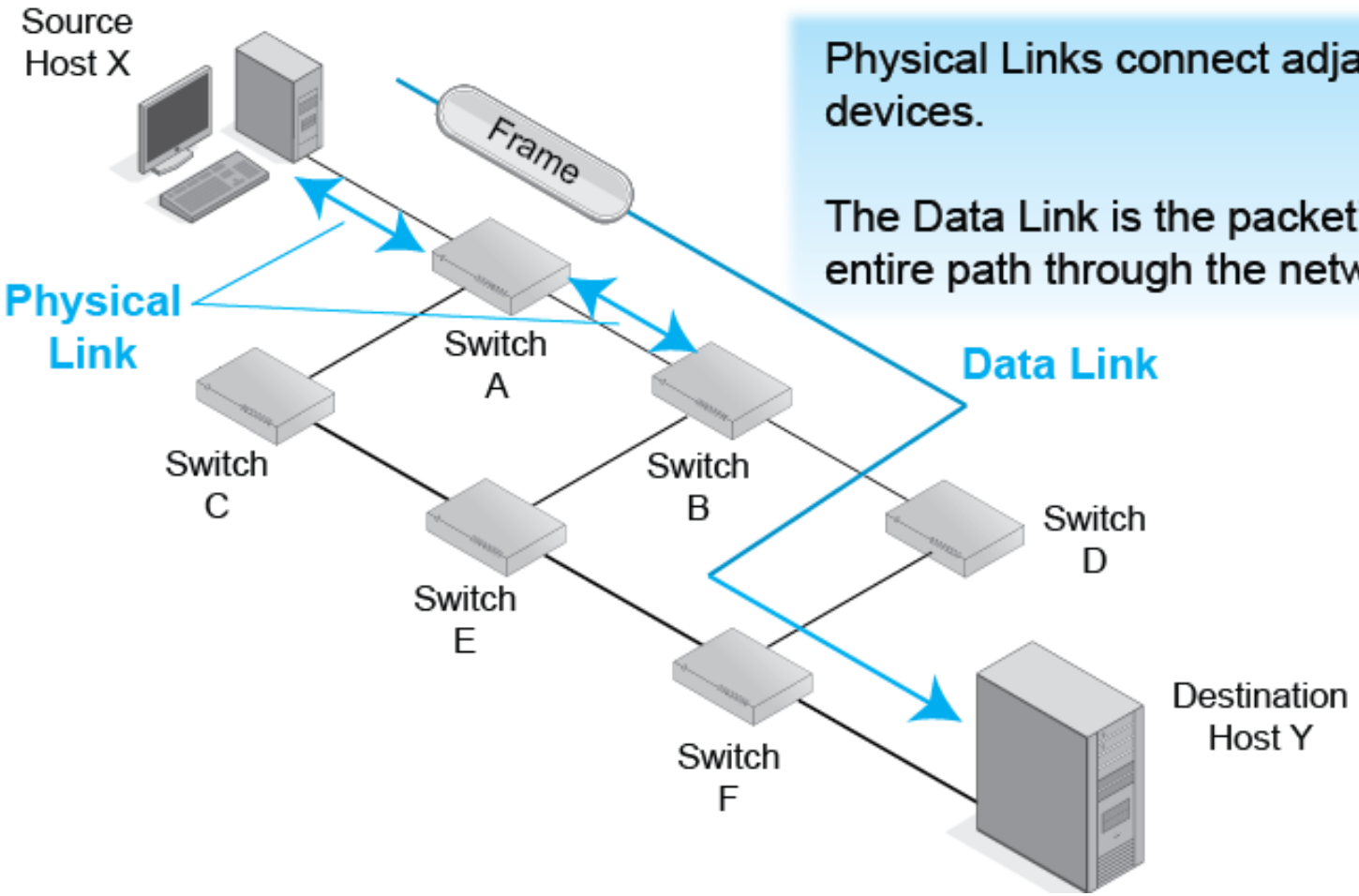
1.17 Physical and Data Link Layer Standards

- **Point-to-Point Protocol (POP)**
  - The dominant data link layer standard for point-to-point networks

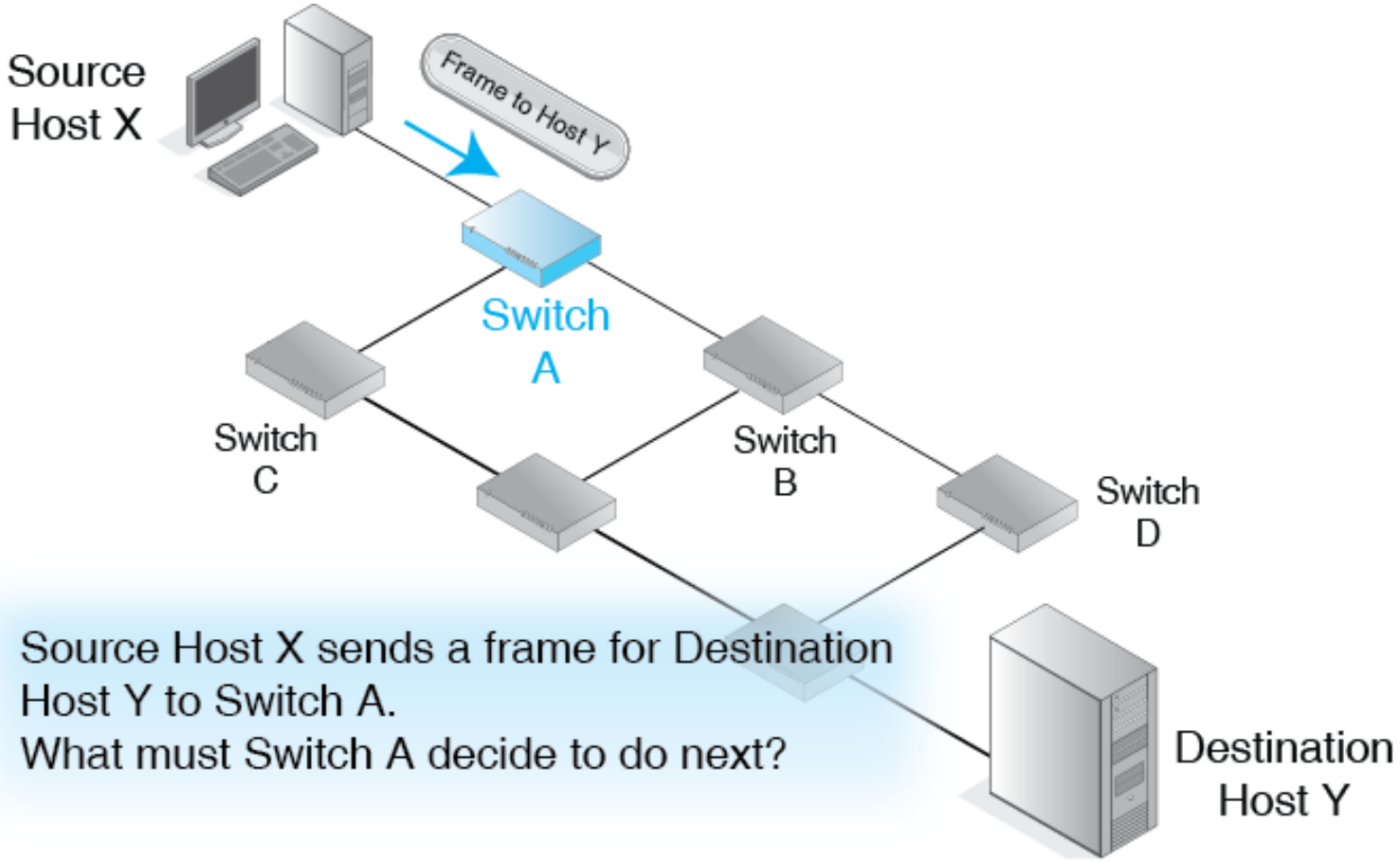
1.18 802.11 Wireless Single Networks



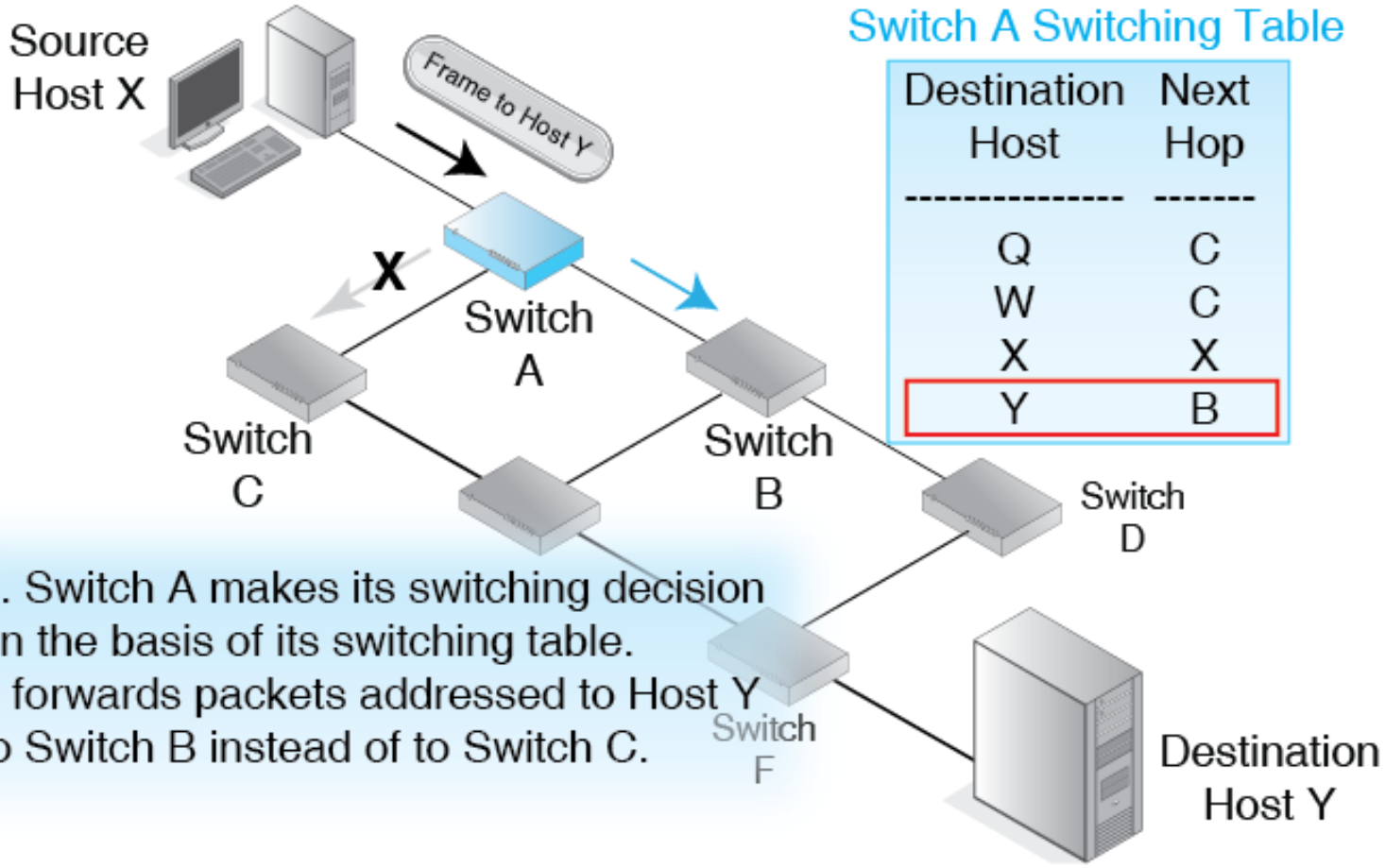
1.19 Physical and Data links



1.20 Switched Network



1.20 Switched Network



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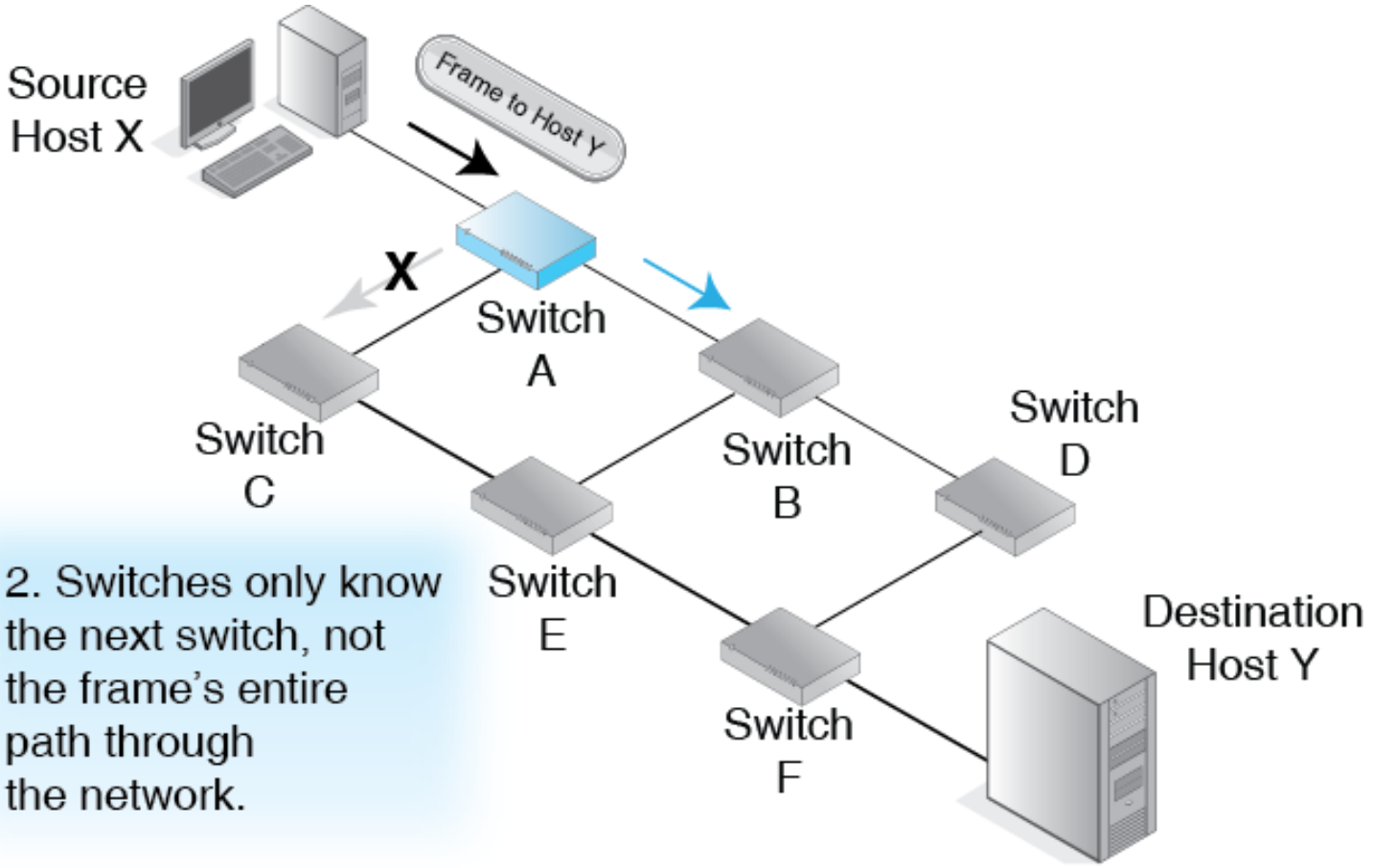
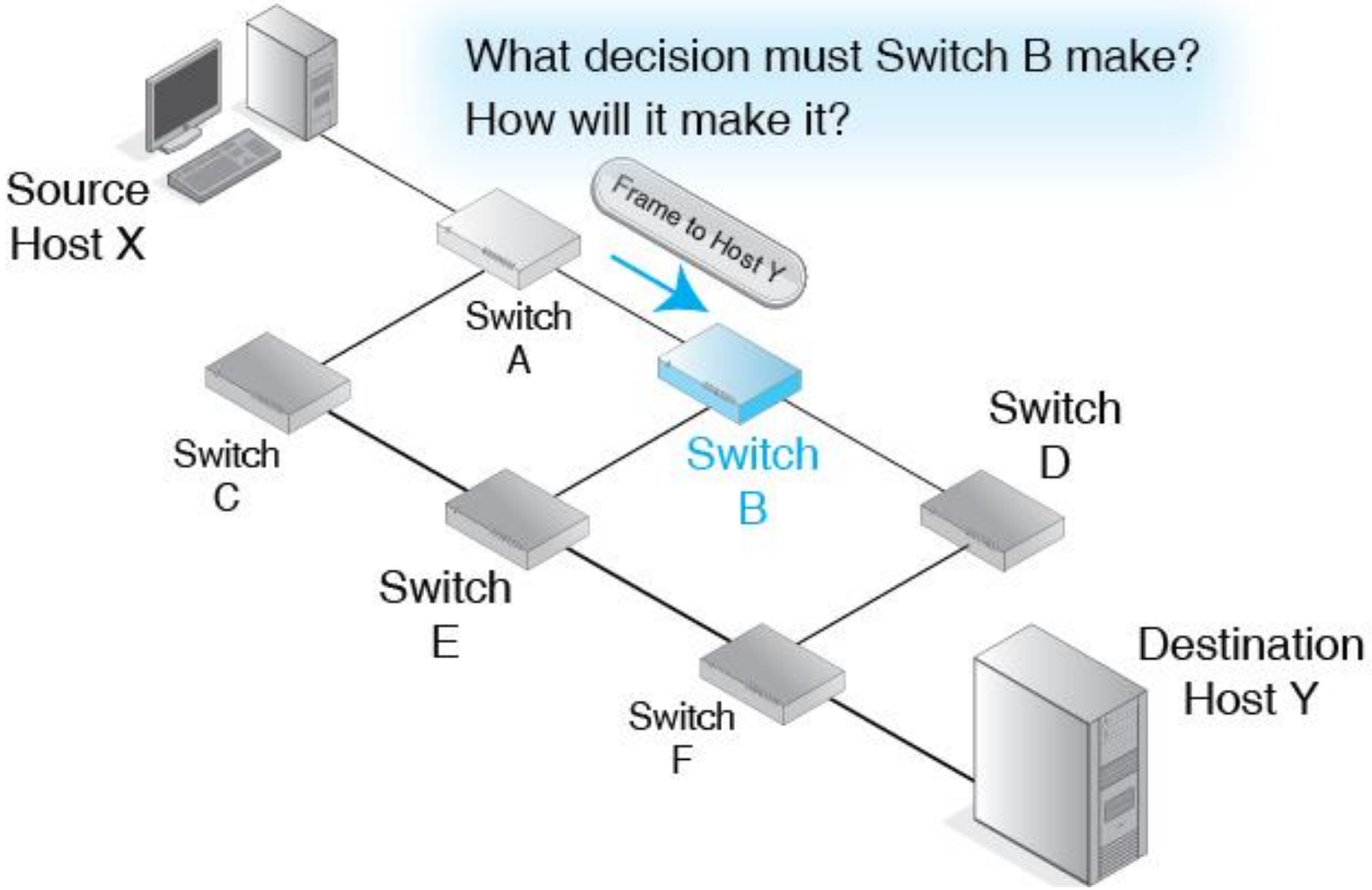
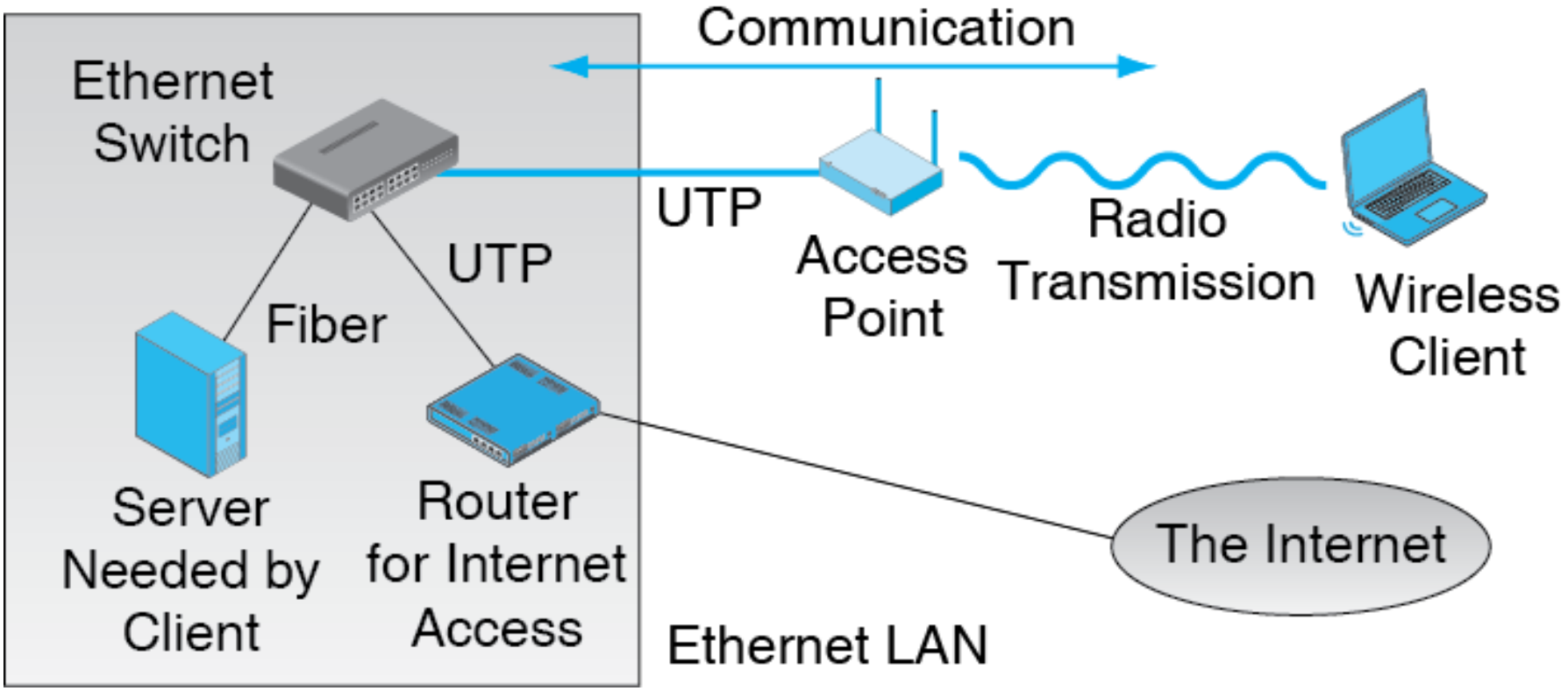


2. Switches only know the next switch, not the frame's entire path through the network.

1.20 Switched Network



1.21 Hybrid Switched/Wireless Network



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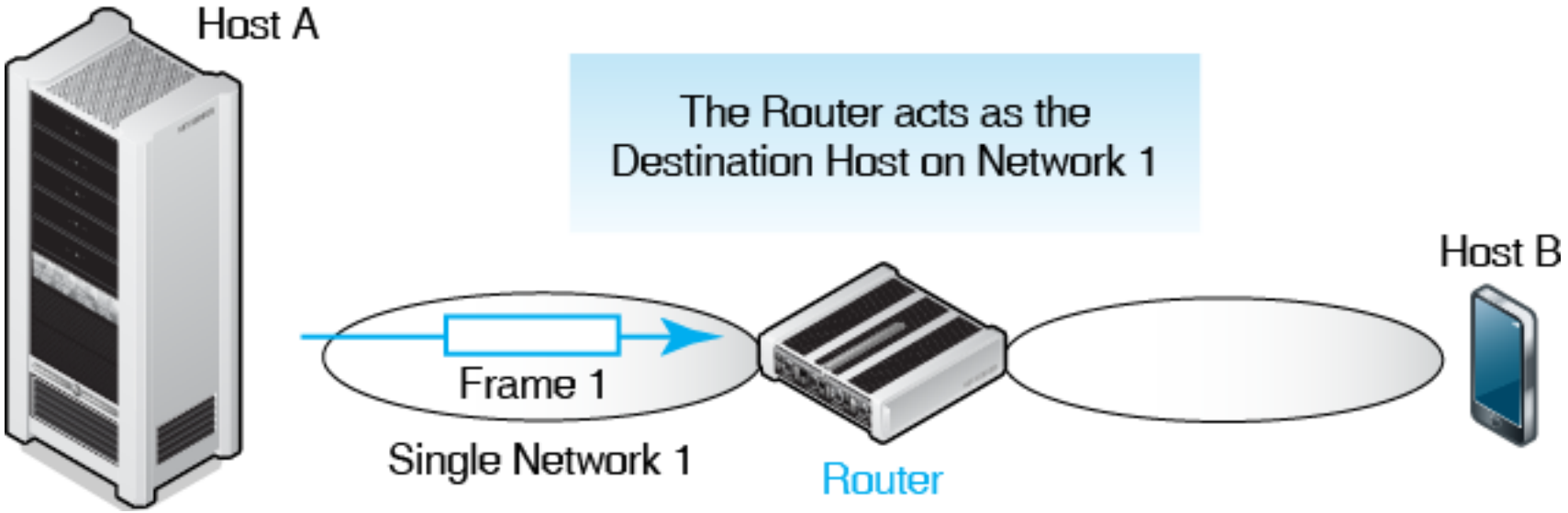
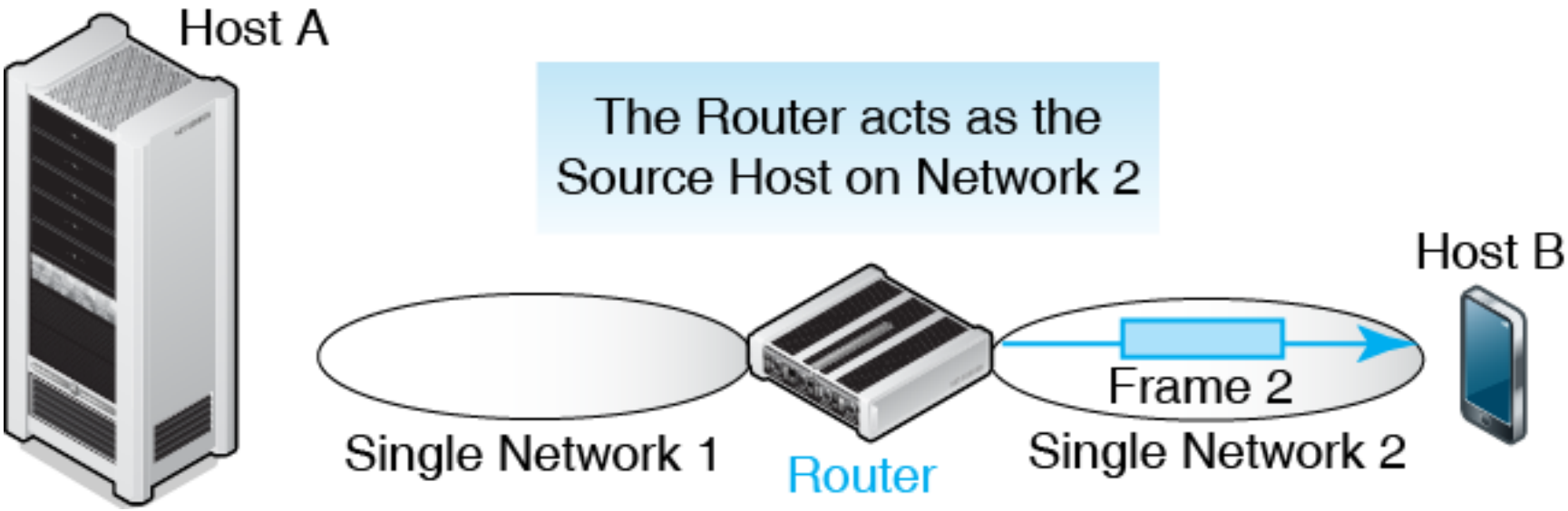
1.22 Problems Connecting Hosts on Different Single Network

- **Different Standards**
- **Overlapping Addresses**
  - Even if the two networks follow the *same* standard, a host on one network may have the same DLL address as a host on the other network.
- **Link to Connect the Single Network**
  - If the link used the standards of one network, it would not connect to the other network for the first two reasons

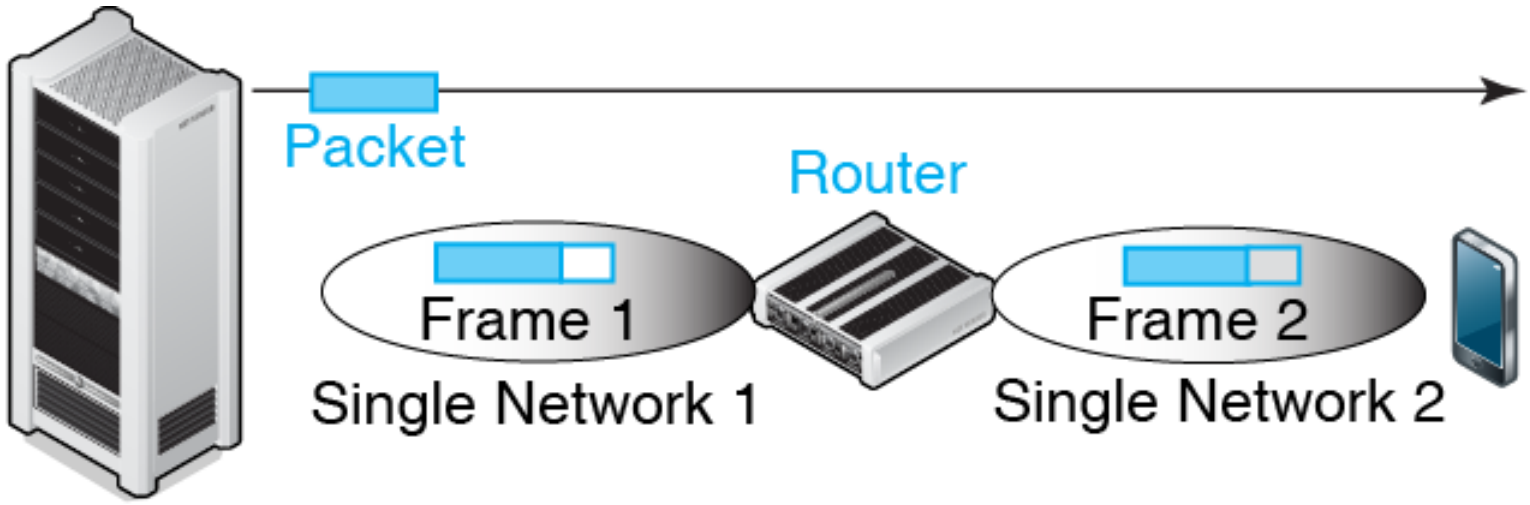
1.23 Internetworking with a Router



1.23 Internetworking with a Router

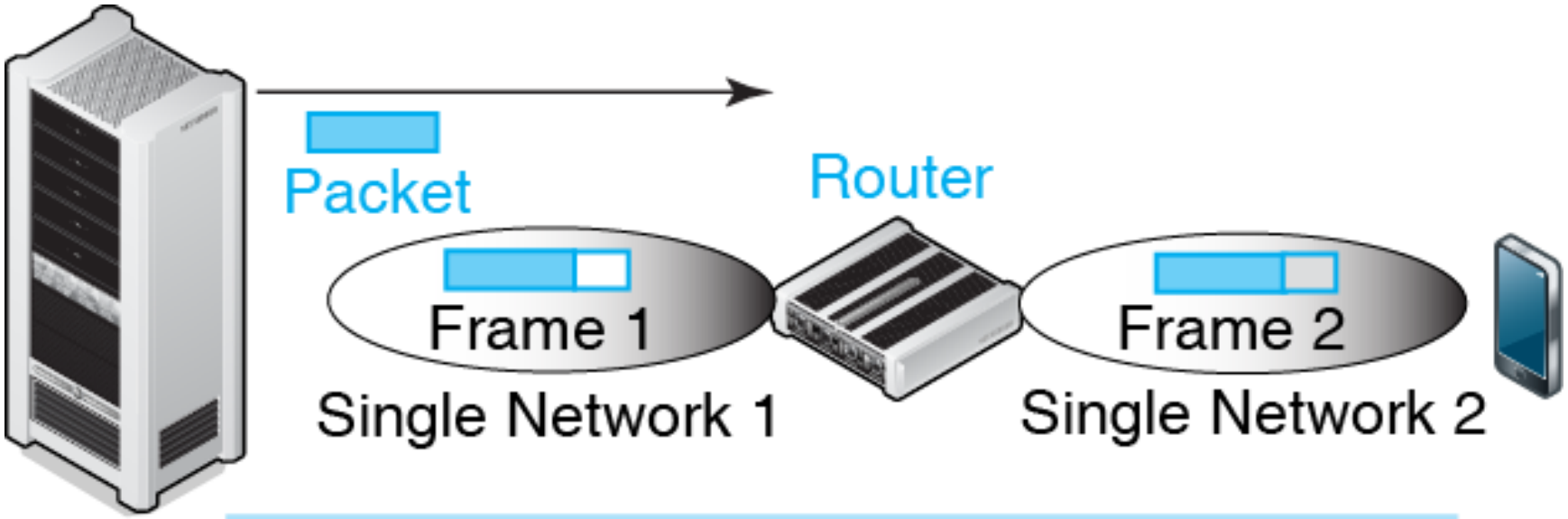


1.24 IP Packet and Data Link Layer Frame



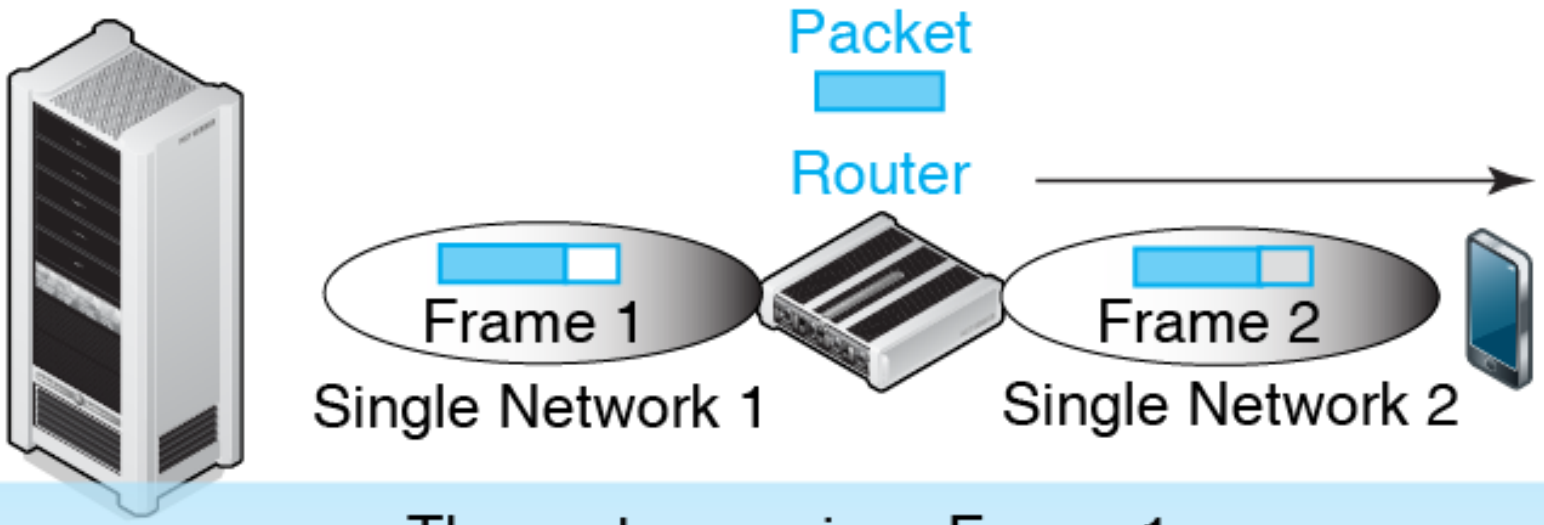
Packet travels all the way to the destination host.
It travels in a different frame in each single network on the way.
Frames travel as far as the next switch or host.

1.24 IP Packet and Data Link Layer Frame



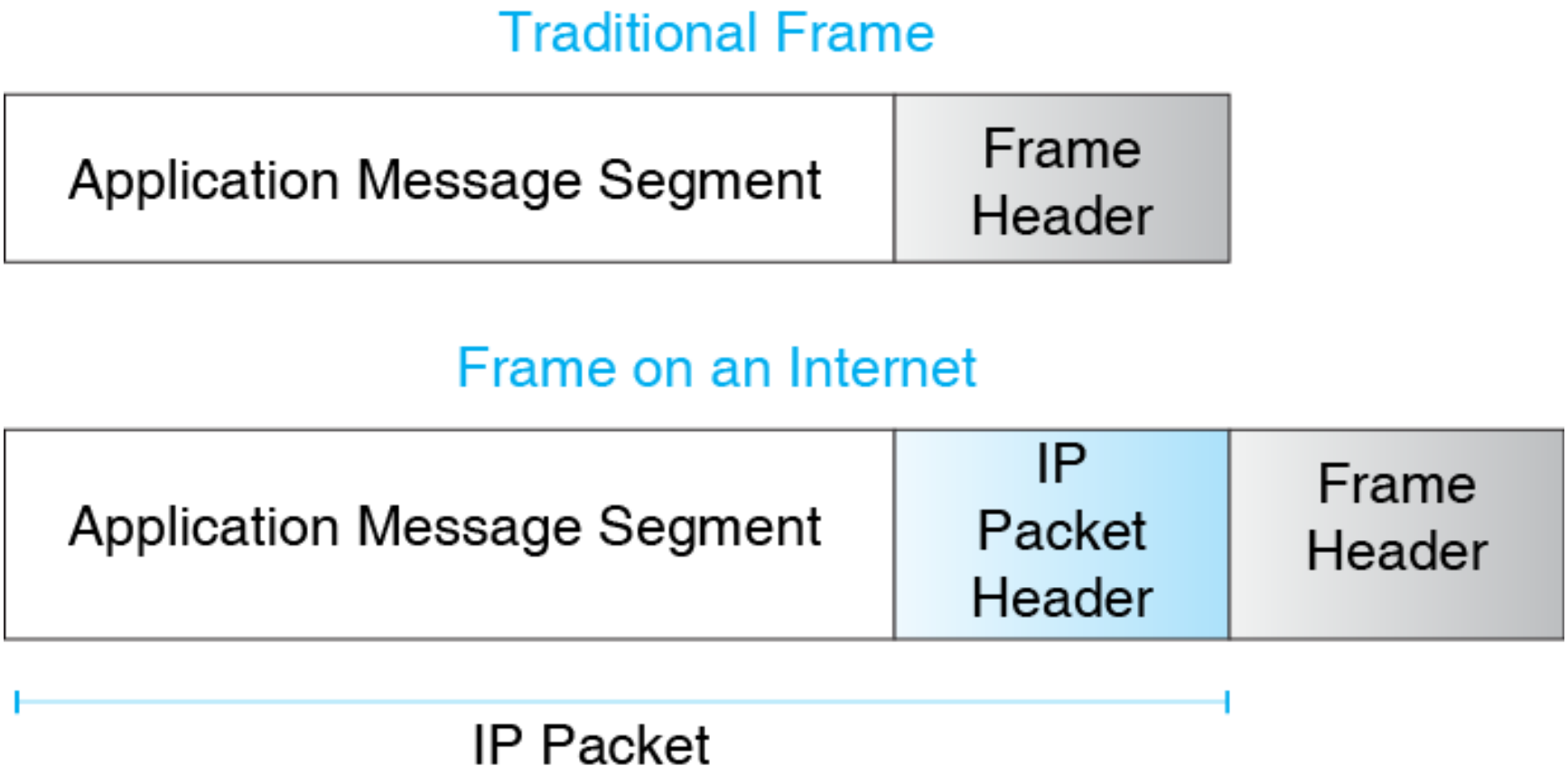
The source host creates the packet.
The host places the packet in Frame 1.
The host transmits Frame 1 to the Router.

1.24 IP Packet and Data Link Layer Frame

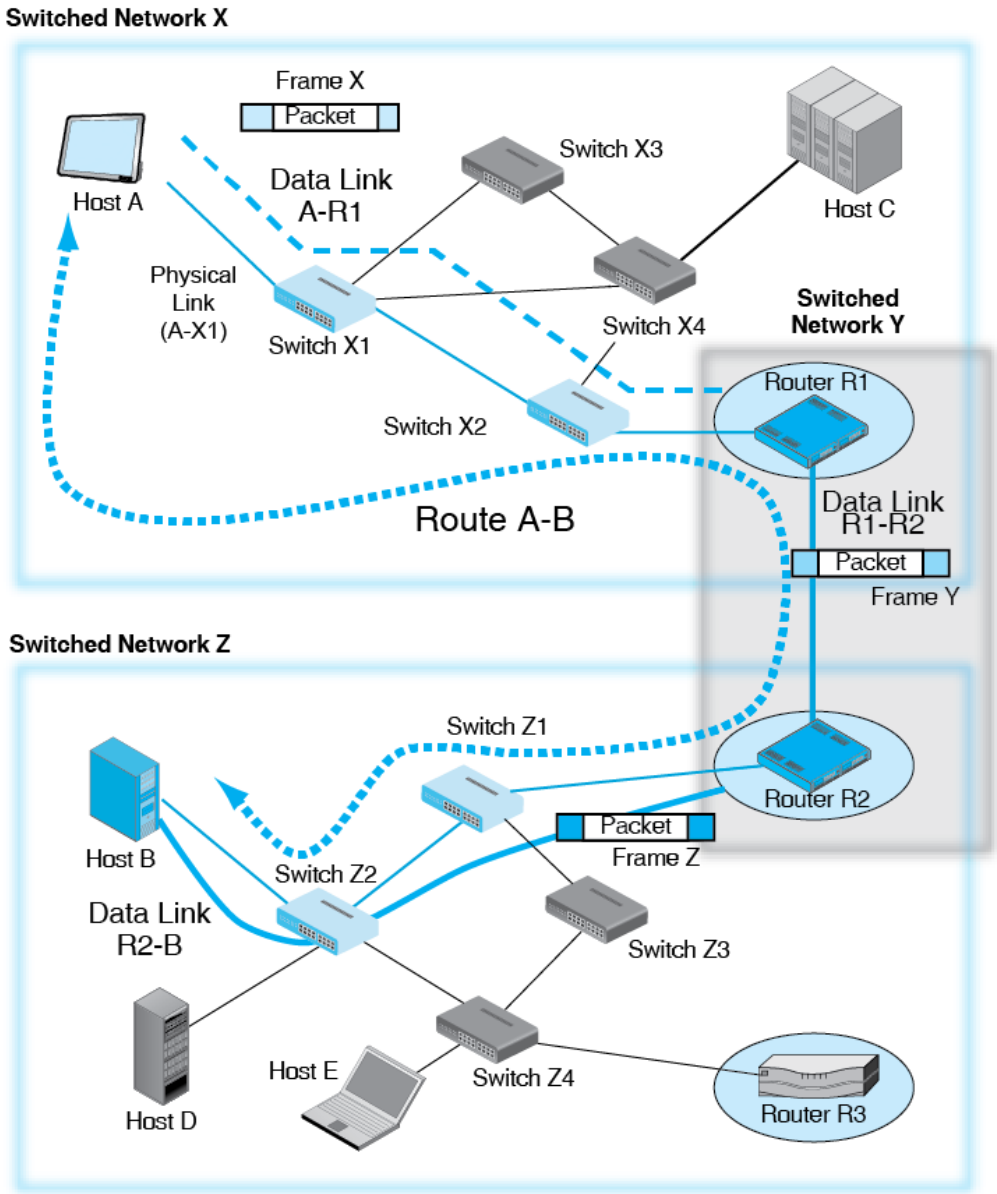


The router receives Frame 1.
The router takes the packet out of Frame 1.
The router places the packet in Frame 2 and
sends the frame over Single Network 2 to the destination host.

1.25 Encapsulation of Network Messages



1.26 More Complex Internet



1.27 Repeated Concepts at the Data Link and Internet Layers

Concept	Data Link Layer	Internet Layer
Layer Number	Layer 2 (L2)	Layer 3 (L3)
Name	Data Link Layer	Internet Layer
Main Standard	Various (Ethernet 802.3, Wi-Fi 802.11, PPP, etc.)	IP
Addresses	Data Link Layer addresses (Often EUI-48 addresses)	IP addresses
Messages	Frames	Packets
Forwarding Devices	Switches, Access Points, etc.	Routers
Paths	Data Links	Routes

1.28 "Packet Switching"

- Fragmentation and placing in an envelope is generically called *packet switching*
  - However, packets are routed
  - And frames are switched
- So technically speaking, packets are never switched

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1.29 General Standards Layers

Panko's Layer Model!

Num	Name	Role
5	Application	Standardize communication between two application programs of a certain type.
4	Transport	Fragmentation and other functions.
3	Internet	Transmit a packet across an internet. Packet organization, router operation, other things needed to transmit a packet across a route in an internet.
2	Data Link	Transmit a frame across a single network. Frame organization, switch and access point operation, and other things needed to transmit a frame across a data link in a single network.
1	Physical	Transmission media, plugs and connectors, signaling.

The OSI Reference Model

- Open Systems Interconnect, Zimmerman 1978
- Standardised by the ISO (International Standards Organisation) and the ITU (International Telecommunications Union, UN) in 1984
- Is a *Reference model*, does not define interfaces or protocols
- ISO standards dominant at physical and datalink and also some application layer standards.

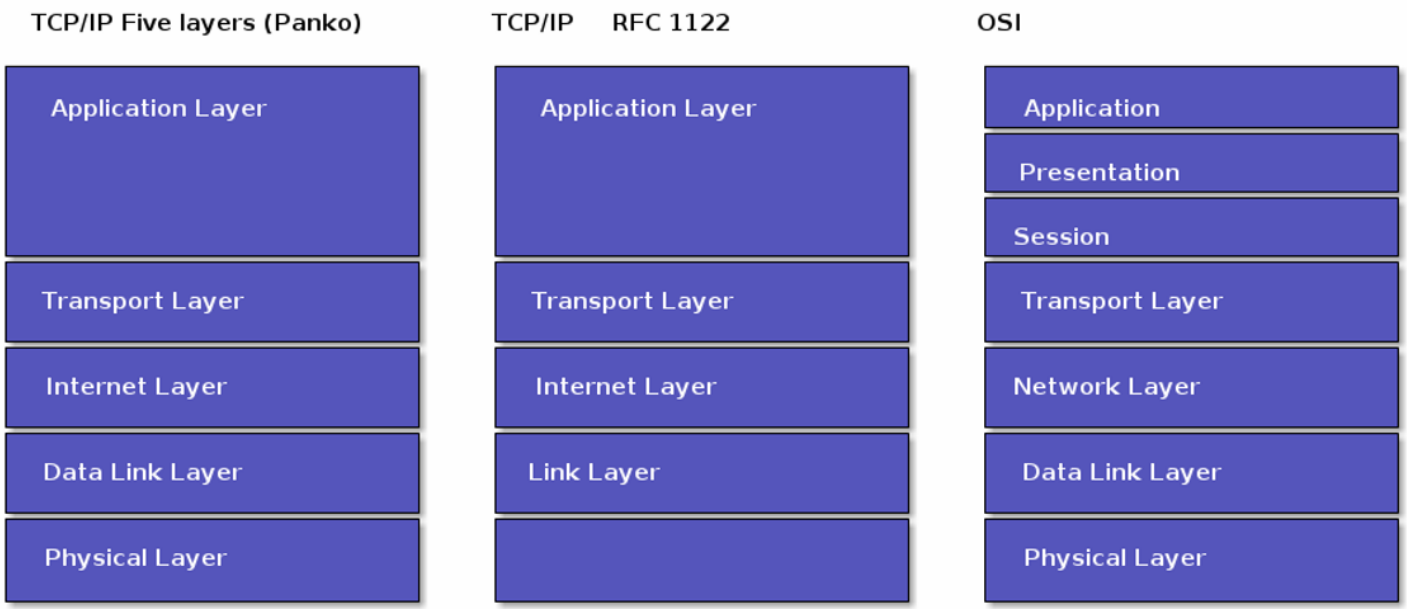
OSI Reference Model

Layer Number	OSI Name	Purpose	Use
7	Application	Governs remaining application-specific matters.	Some OSI applications are used
6	Presentation	Designed to handle data formatting differences and data compression and encryption. In practice, a category for general file format standards used in multiple applications.	Rarely used as a layer. However, many file format standards are assigned to this layer.
5	Session	Initiates and maintains a connection between application programs on different computers.	Rarely used
4	Transport	Generally equivalent to the TCP/IP transport layer. However, OSI transport layer standards are not compatible with TCP/IP transport layer standards.	Rarely used
3	Network	Generally equivalent to the TCP/IP internet layer. However, OSI network layer standards are not compatible with TCP/IP internet layer standards.	Rarely used
2	Data Link	End-to-end transmission in a single switched network. Frame organization. Switch operation.	Nearly 100 percent dominant
1	Physical	Physical connections between adjacent devices.	Nearly 100 percent dominant

1.30 Networking Standards Agencies and Architectures

Architecture	OSI	TCP/IP
Standard agency/agencies	ISO and ITU-T	Internet Engineering Task Force (IETF)
Architecture name	OSI	TCP/IP
Examples of standards	802.3 Ethernet, 802.11 Wi-Fi, optical fiber	TCP, IP, DNS
Layers at which dominant	Physical (1) and Data Link (2)	Internet (3) and Transport (4)

Layers in the Literature



Standards & Governance Bodies

- ISO: International Organization for Standardization
- ITU-T: International Telecommunications Union Telecommunication Standardization Sector (UN)
- ISOC: Internet Society
  - IETF: Internet Engineering Task Force
- W3C: World Wide Web Consortium
- ICANN: Internet Corporation for Assigned Names and Numbers
  - IANA: Internet Assigned Numbers Authority