Chapter 9

Introduction to Data Link Layer

Objective

- defining the concept of links and nodes
  - the services provided by the data-link layer
  - point-to-point and broadcast links
  - two sub-layers at the data-link layer
- link-layer addressing
  - rationale behind the existence of an addressing mechanism at the data-link layer
  - three types of link-layer addresses
  - Address Resolution Protocol (ARP)

9.1 Introduction

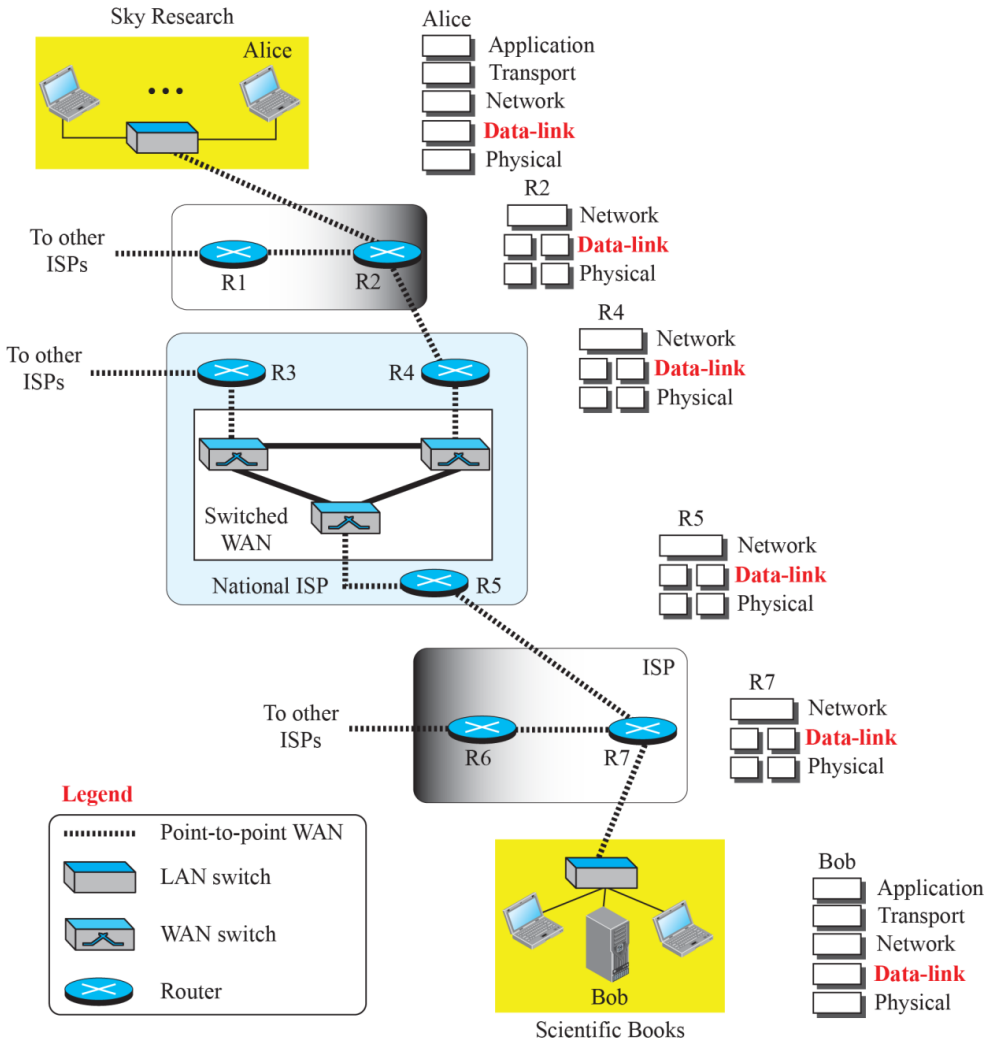
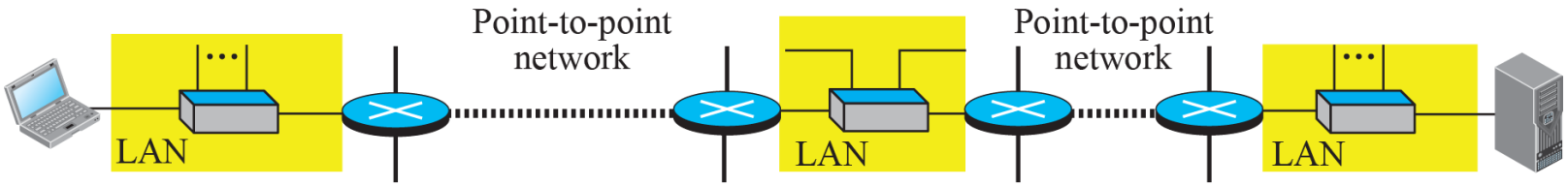


Fig. 9.1 Communication at the data-link layer

9.1.1 Nodes and Link

- Communication at the ***data-link layer*** is ***node-to-node***.
- LANs and WANs are connected by routers.
- It is customary to refer to the two end hosts and the routers as ***nodes*** and the networks in between as ***links***.

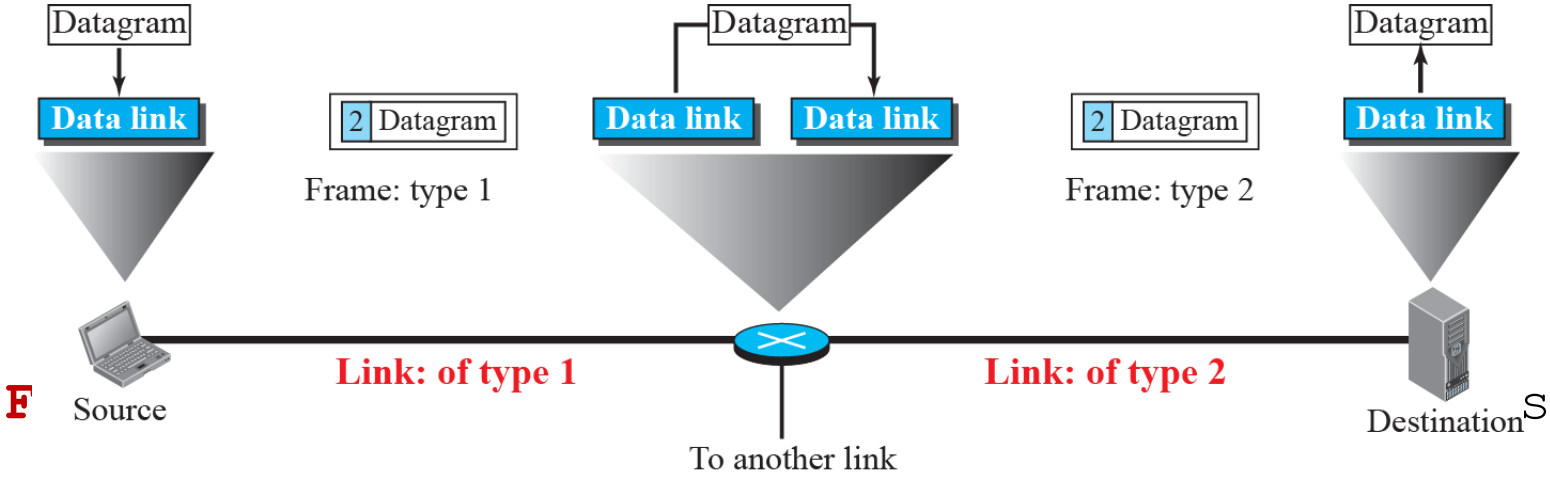


a. A small part of the Internet

b. Nodes and links

9.1.2 Services

- The data-link layer provides services to the network layer; it receives services from the physical layer.
  - Framing
  - Flow Control
  - Error control
  - Congestion Control



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9.1.3 Two Categories of Links

- a point-to-point link.
- a broadcast link.

9.1.4 Two Sublayer

- data link control (DLC)
- media access control (MAC).

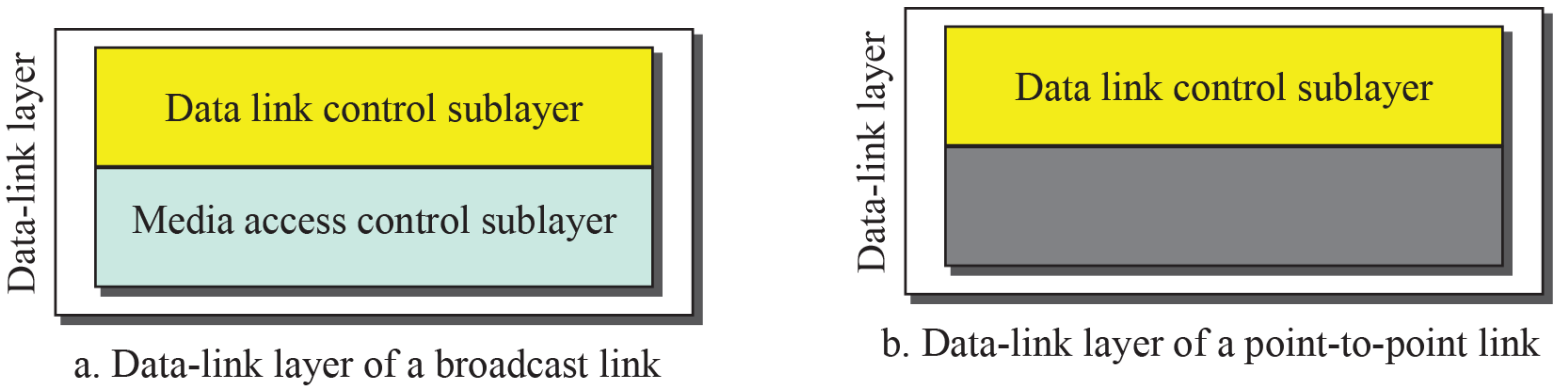


Fig. 9.4 Dividing the data-link layer into two sublayers

9.2 Link-Layer Addressing

- Link layer address
  - Link address
  - Physical address
  - MAC address

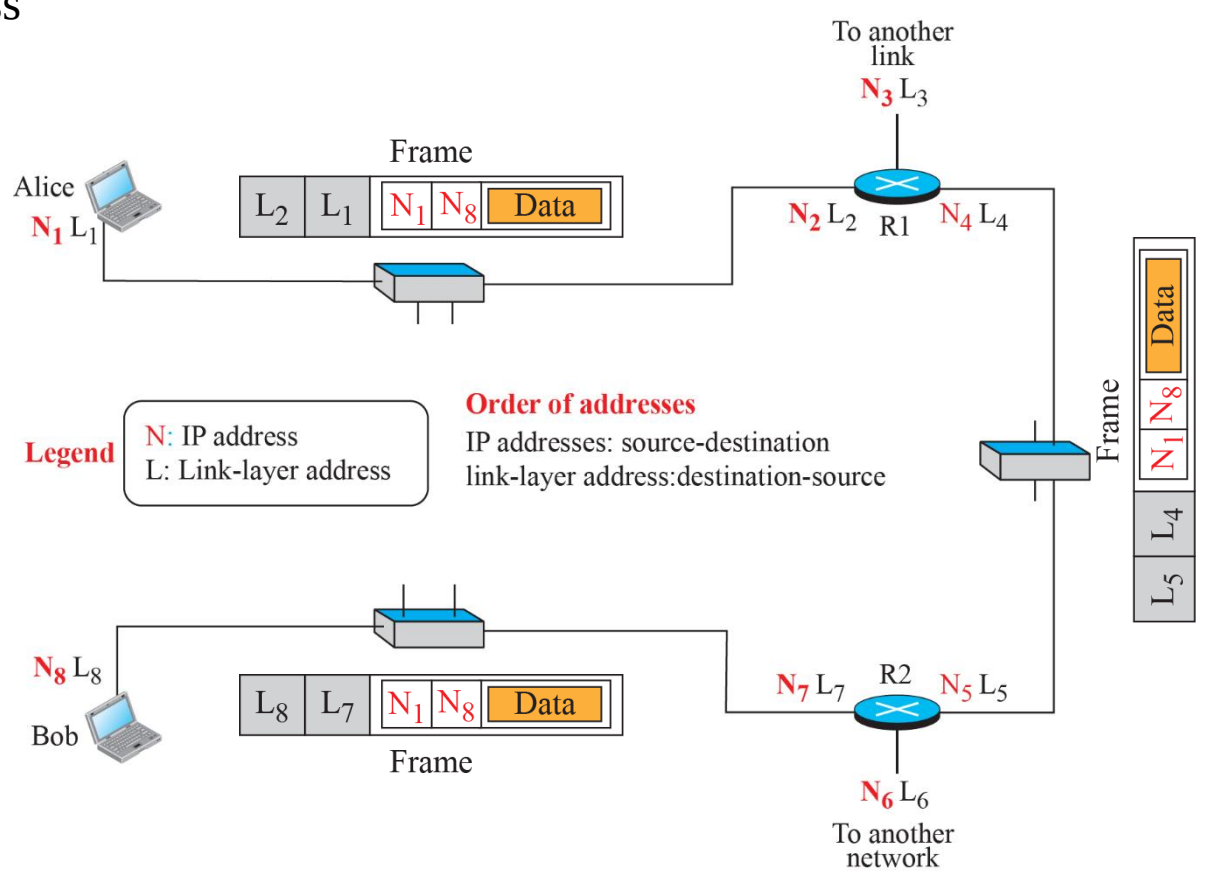


Fig. 9.5 IP addresses and link-layer addresses in a small internet

9.2.1 Three Types of Addresses

- unicast,
- multicast,
- and broadcast

9.2.2 Address Resolution Protocol (ARP)

- is helpful in moving a frame through a link; we need the link-layer address of the next node

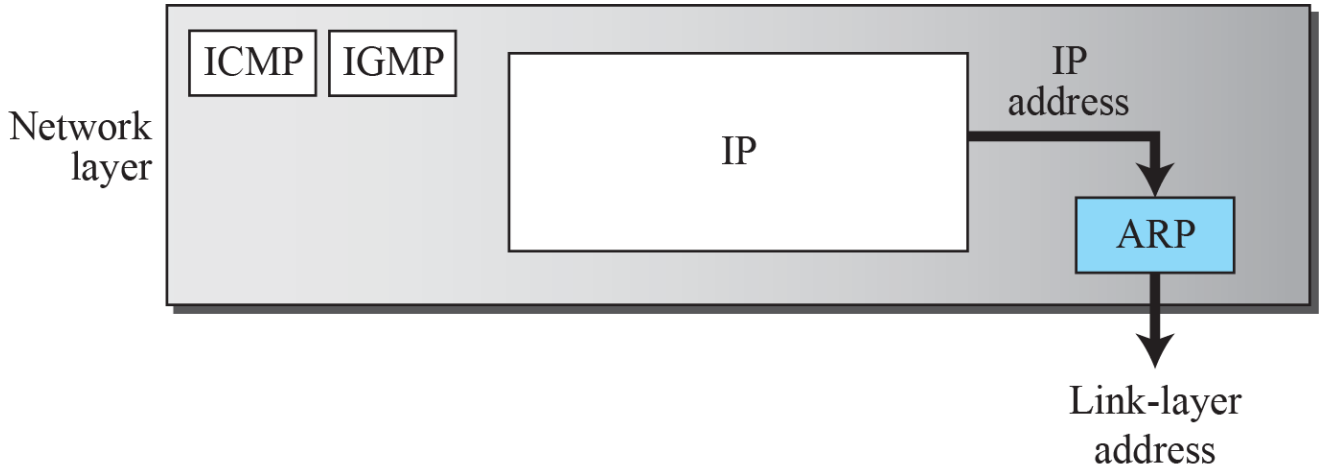
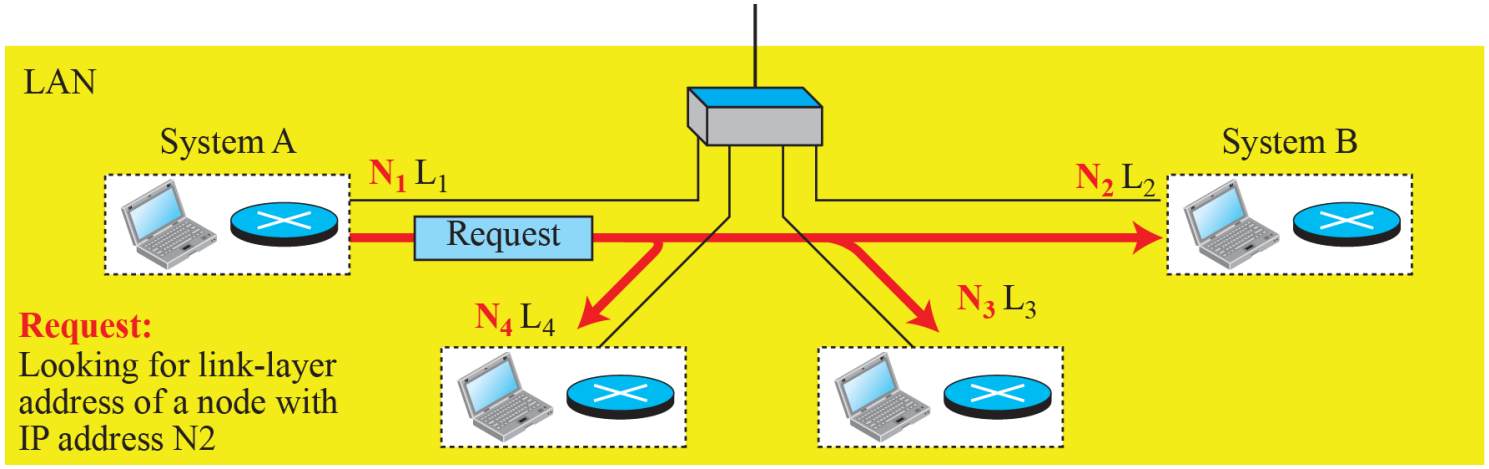
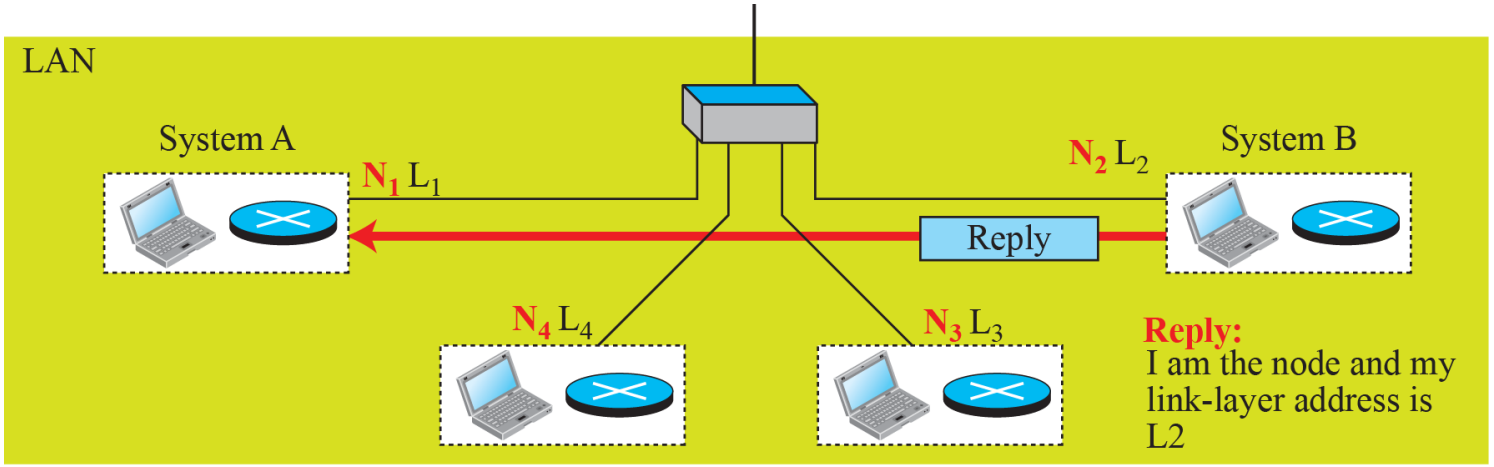


Fig. 9.6 Position of ARP in TCP/IP protocol suite



a. ARP request is broadcast



b. ARP reply is unicast

Fig. 9.7 ARP operation

Caching

- The storing of information in a small, fast memory

Packet Format

Hardware: LAN or WAN protocol
Protocol: Network-layer protocol

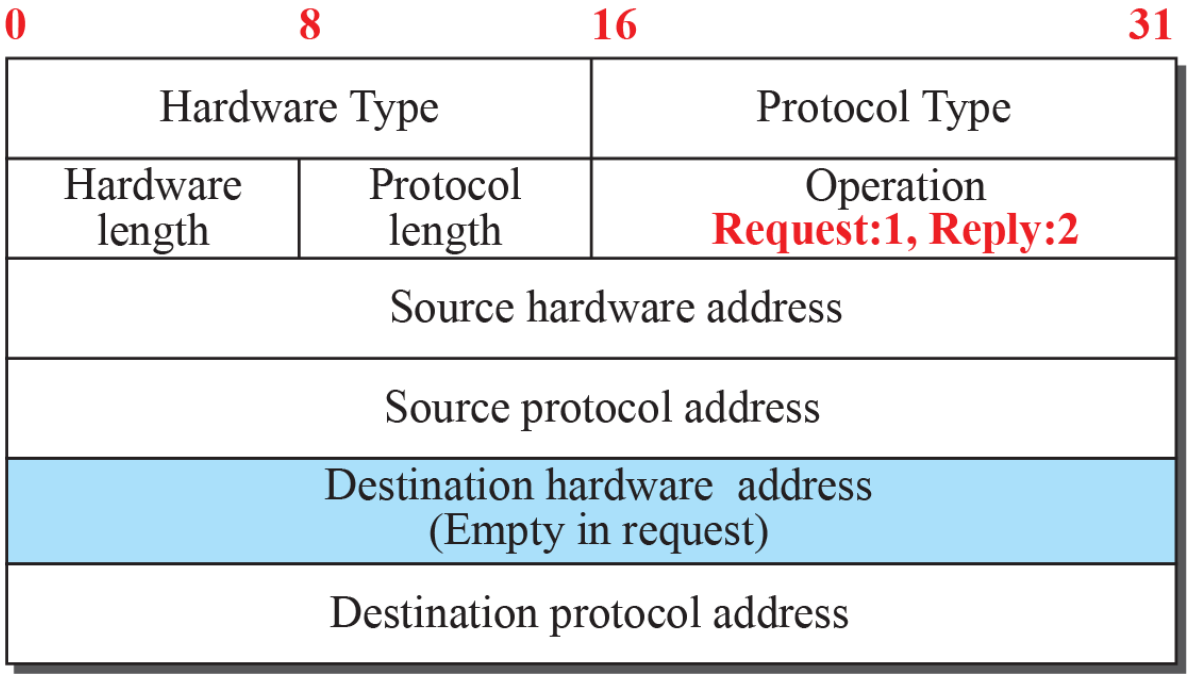


Fig. 9.8 ARP Packet

Ex. 9.4

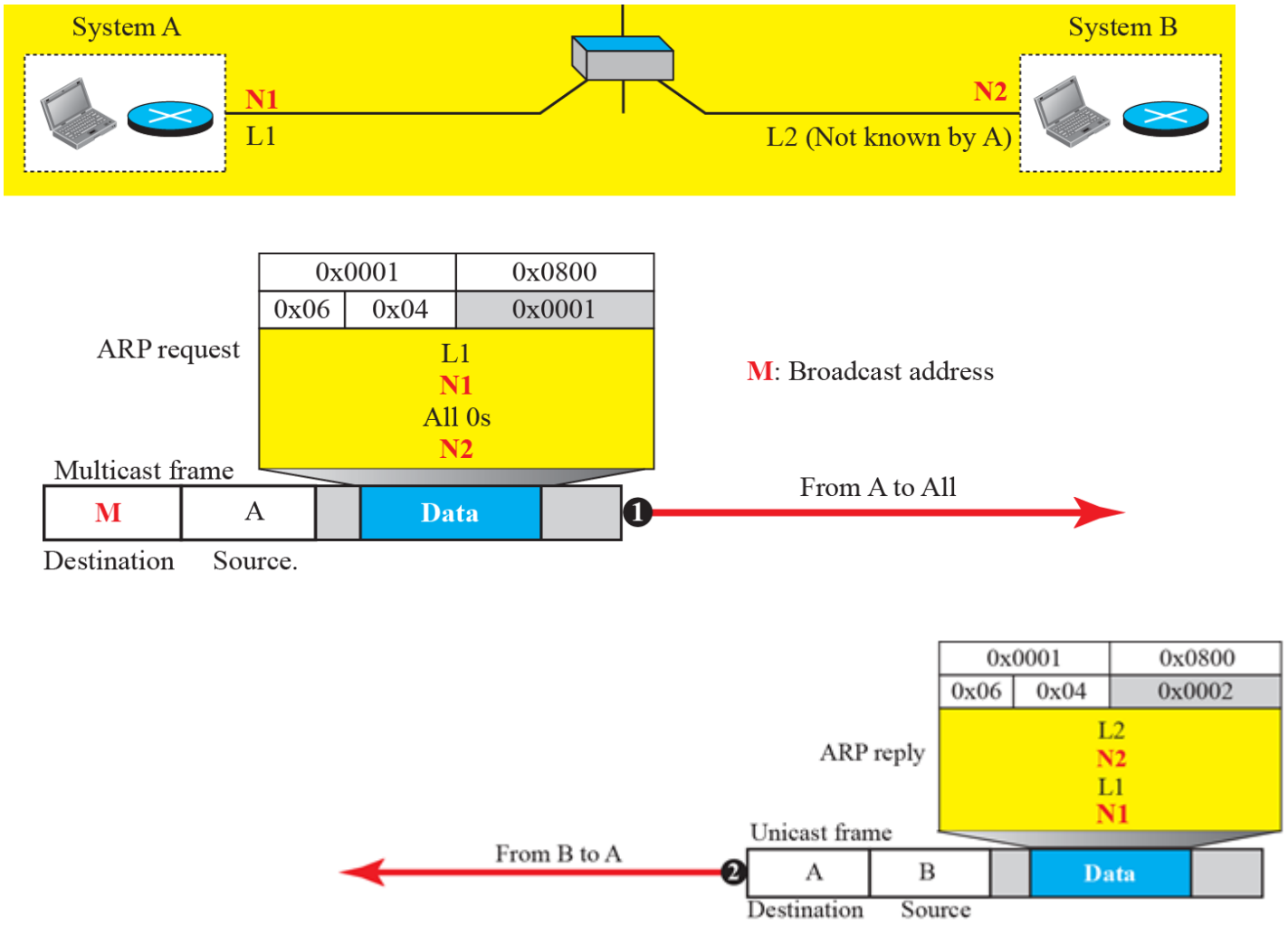
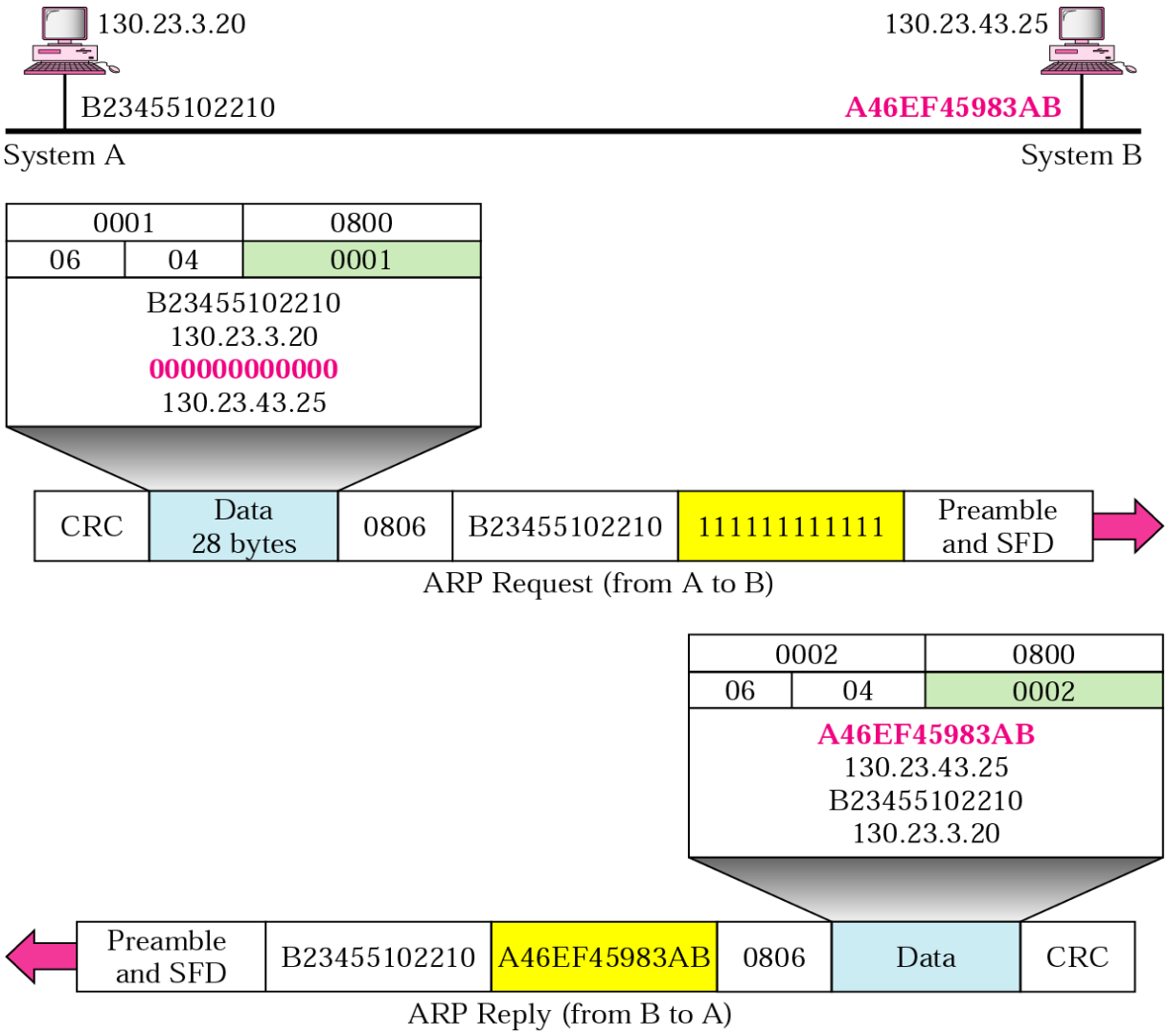


Fig. 9.9 Example 9.4


130.23.3.20
130.23.43.25
B23455102210
A46EF45983AB
System A
System B
0001
0800
06
04
0001
B23455102210
130.23.3.20
000000000000
130.23.43.25
CRC
Data
28 bytes
0806
B23455102210
111111111111
Preamble
and SFD
ARP Request (from A to B)
0002
0800
06
04
0002
A46EF45983AB
130.23.43.25
B23455102210
130.23.3.20
Preamble
and SFD
B23455102210
A46EF45983AB
0806
Data
CRC
ARP Reply (from B to A)

Ex. 9.4

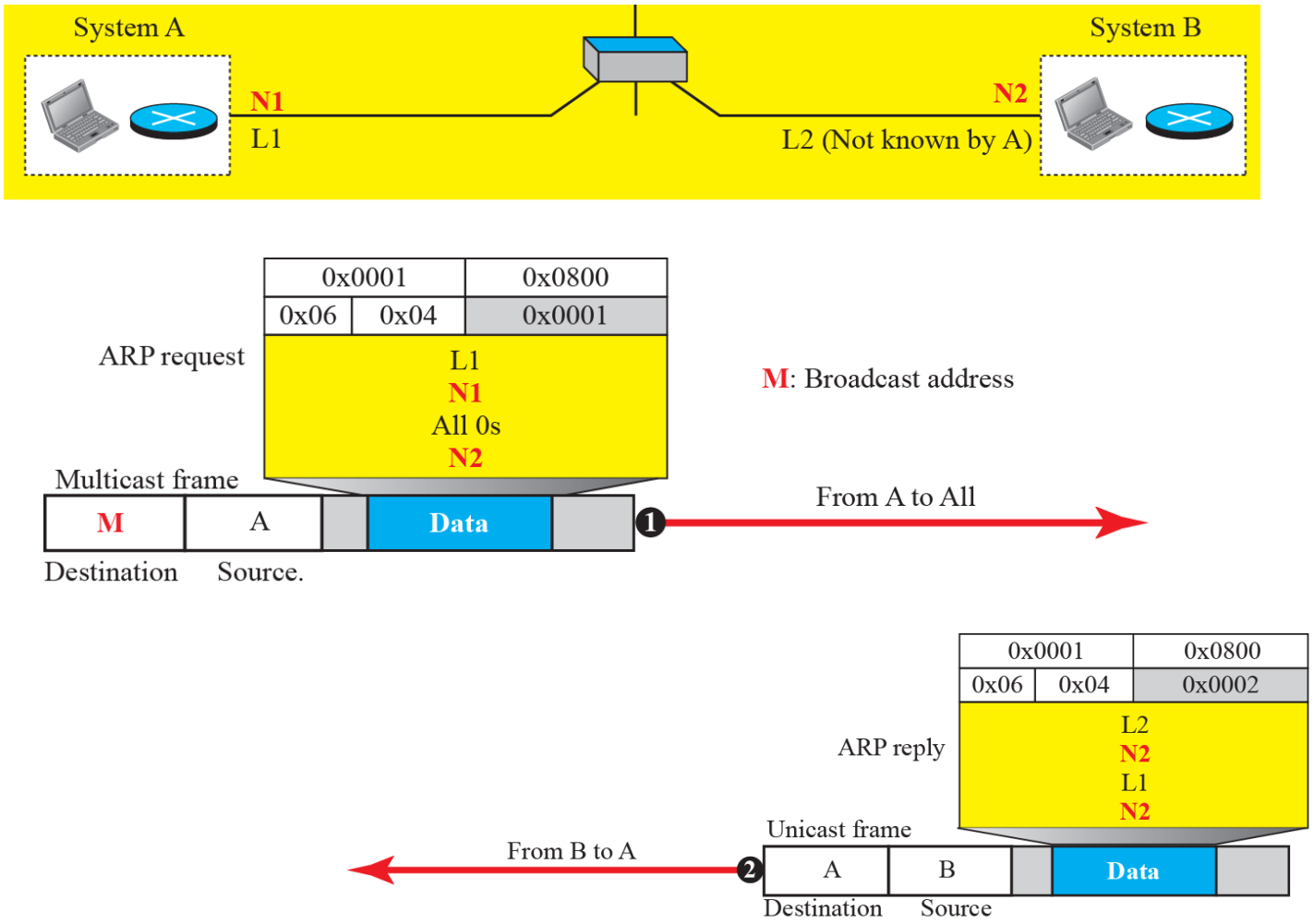


Fig. 9.9 Example 9.4

9.2.3 An Example of Communication

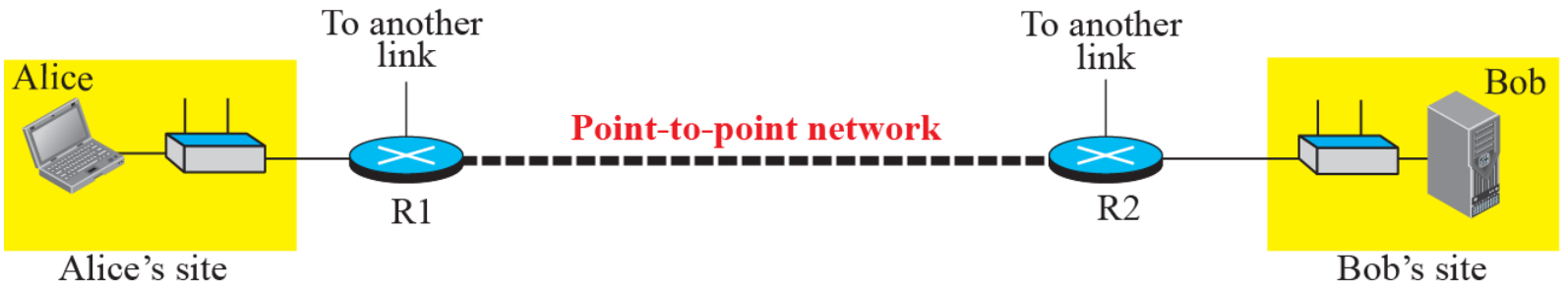


Fig. 9.10 The internet for our example

Activities at Alice's Site

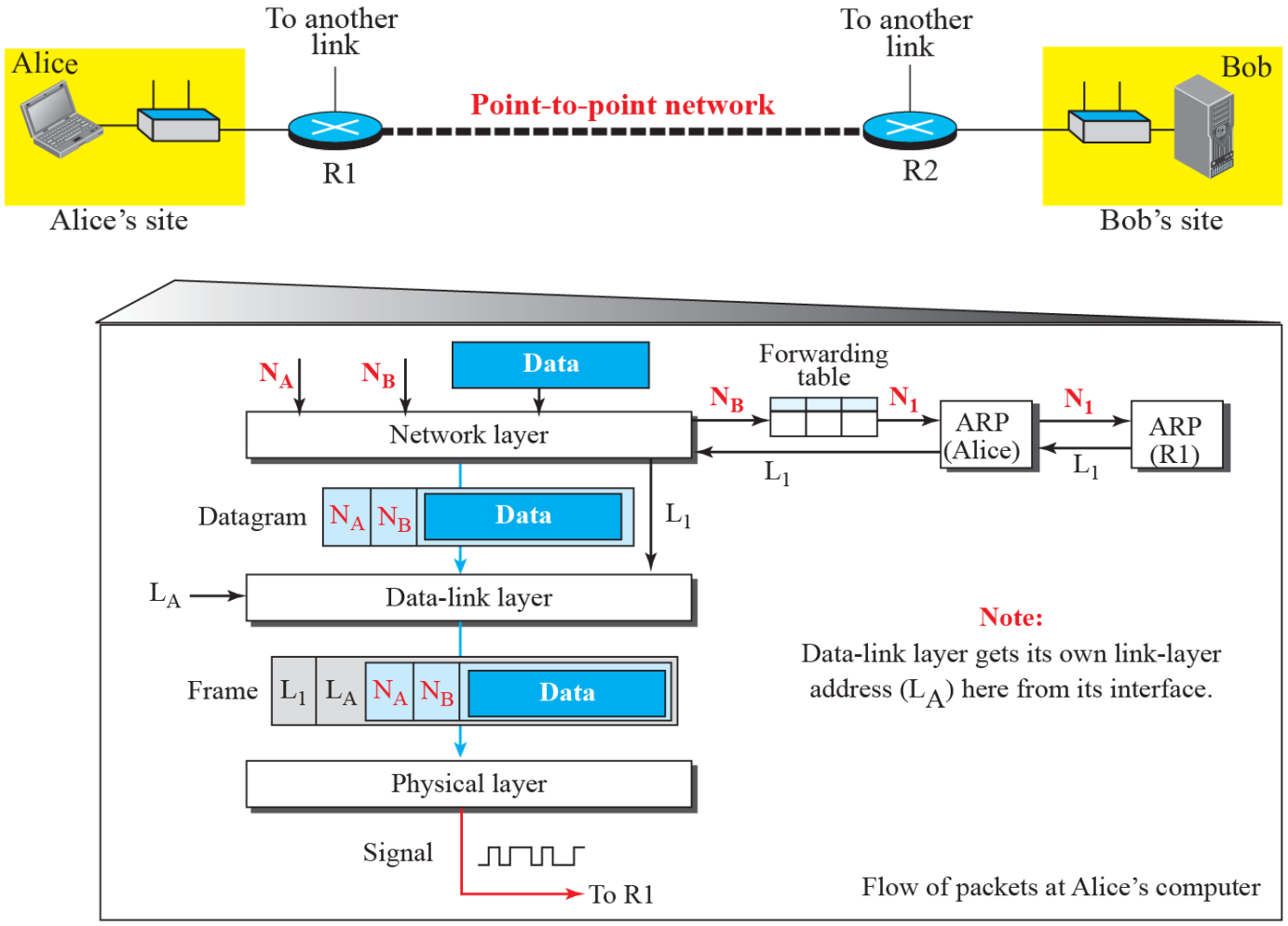


Fig. 9.11 Flow of packets at Alice's computer

Activities at Router R1

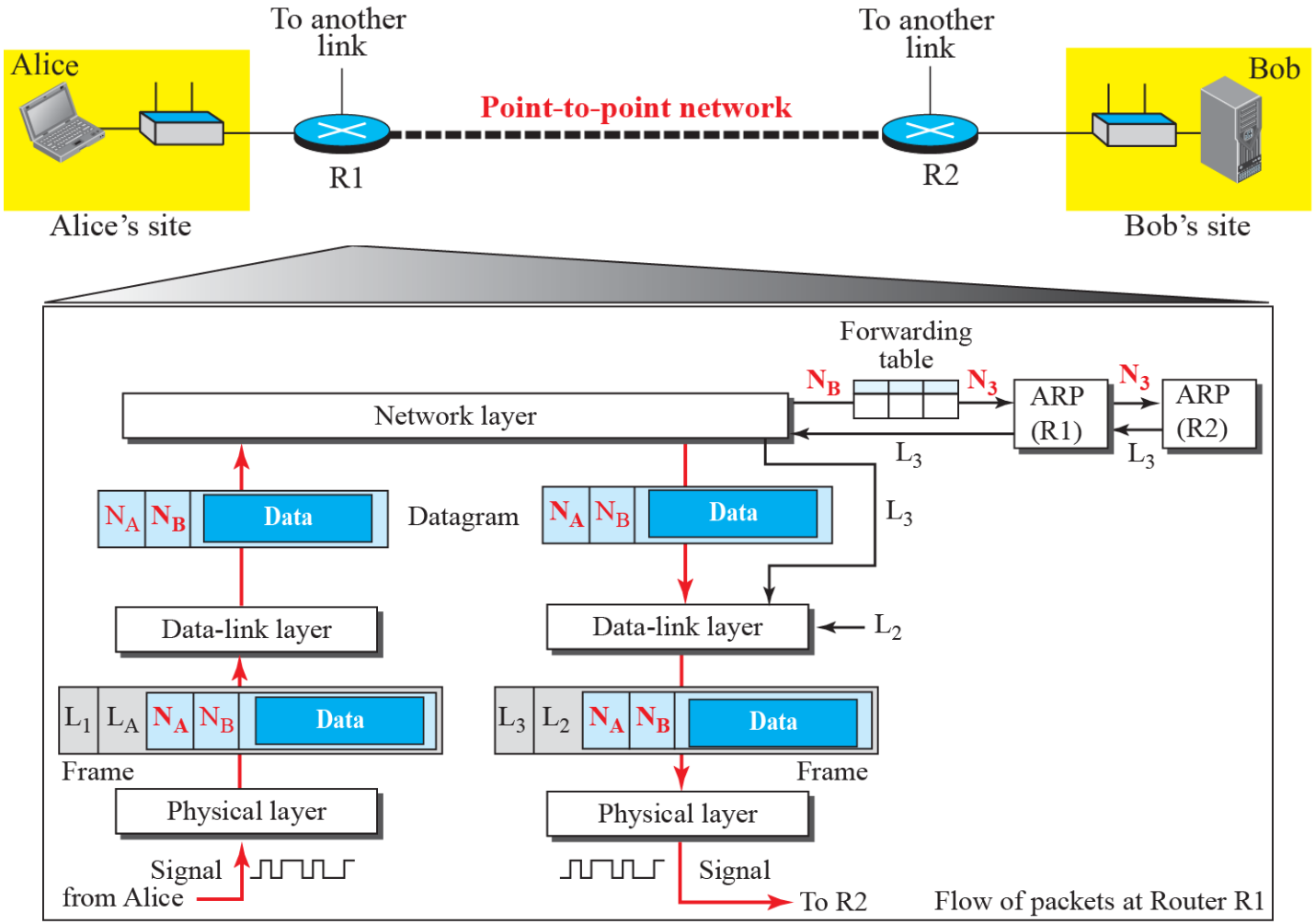


Fig. 9.12 Flow of activities at router R1

Activities at Router R2

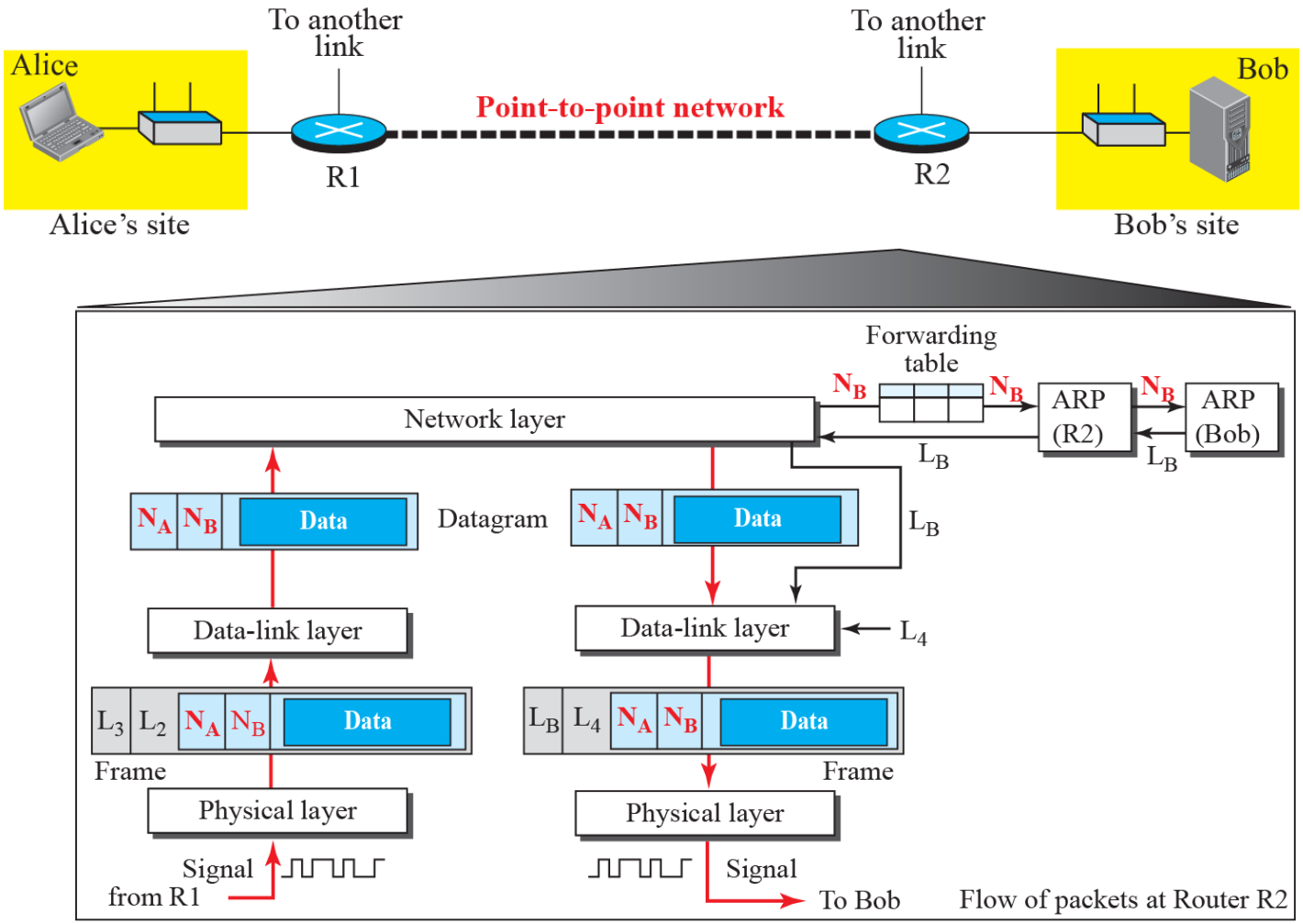


Fig. 9.13 Flow of activities at router R2

Activities at Bob's Site

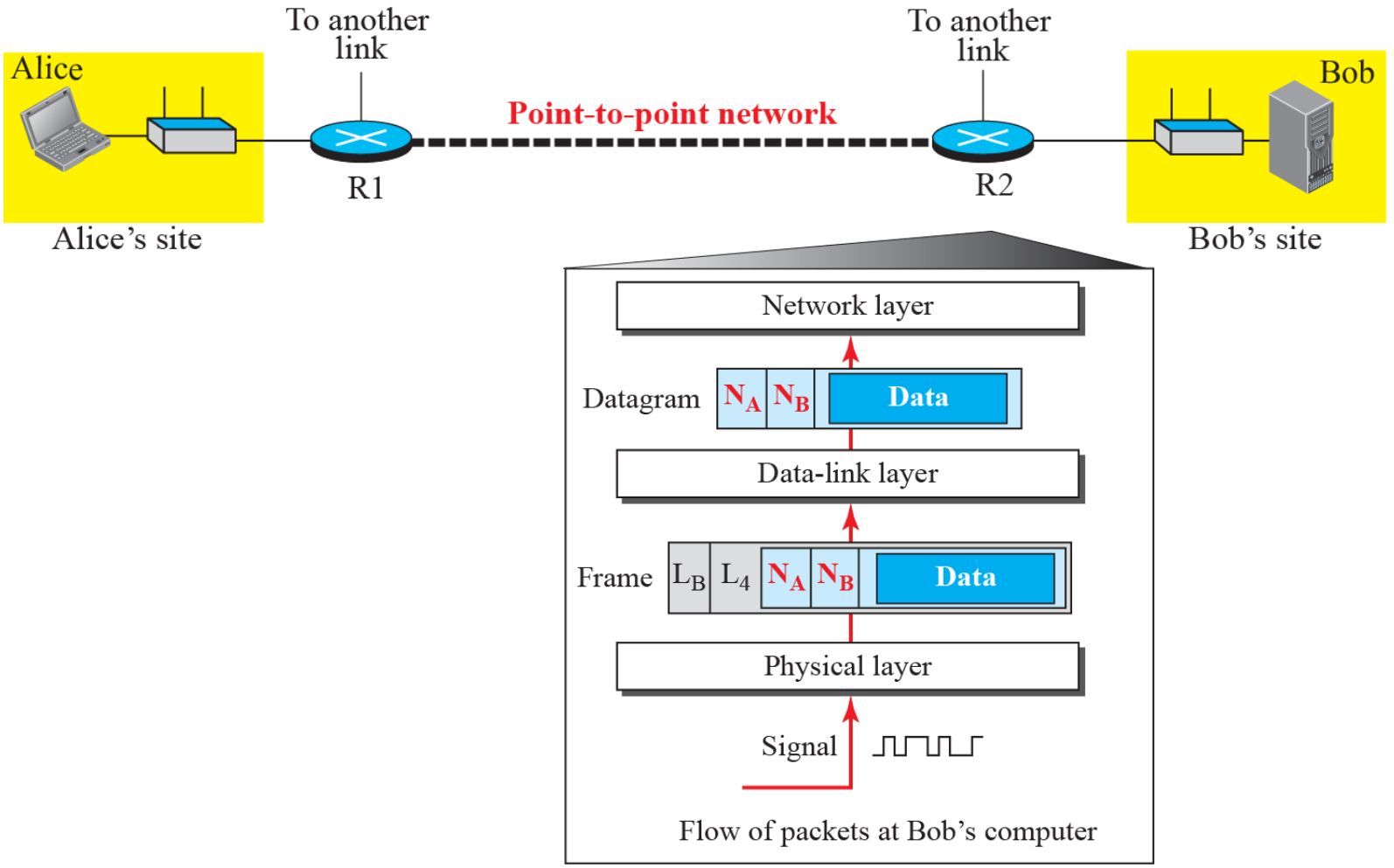


Fig. 9.14 Flow of activities at Bob's site