



Computer Networks

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- What is the name of the network-layer packet?

1. Message
2. Segment
3. Datagram
4. Frame



- Recall that both routers and switches are called *packet switches*. A router and a link-layer switch are the same when it comes to functionality (the way they work).
 - True or false



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- What are the two most important network-layer functions in a datagram network?
 1. Forwarding and call setup
 2. Fragmentation and routing
 3. Routing and multiplexing
 4. Forwarding and routing



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- What is the difference between routing and forwarding?

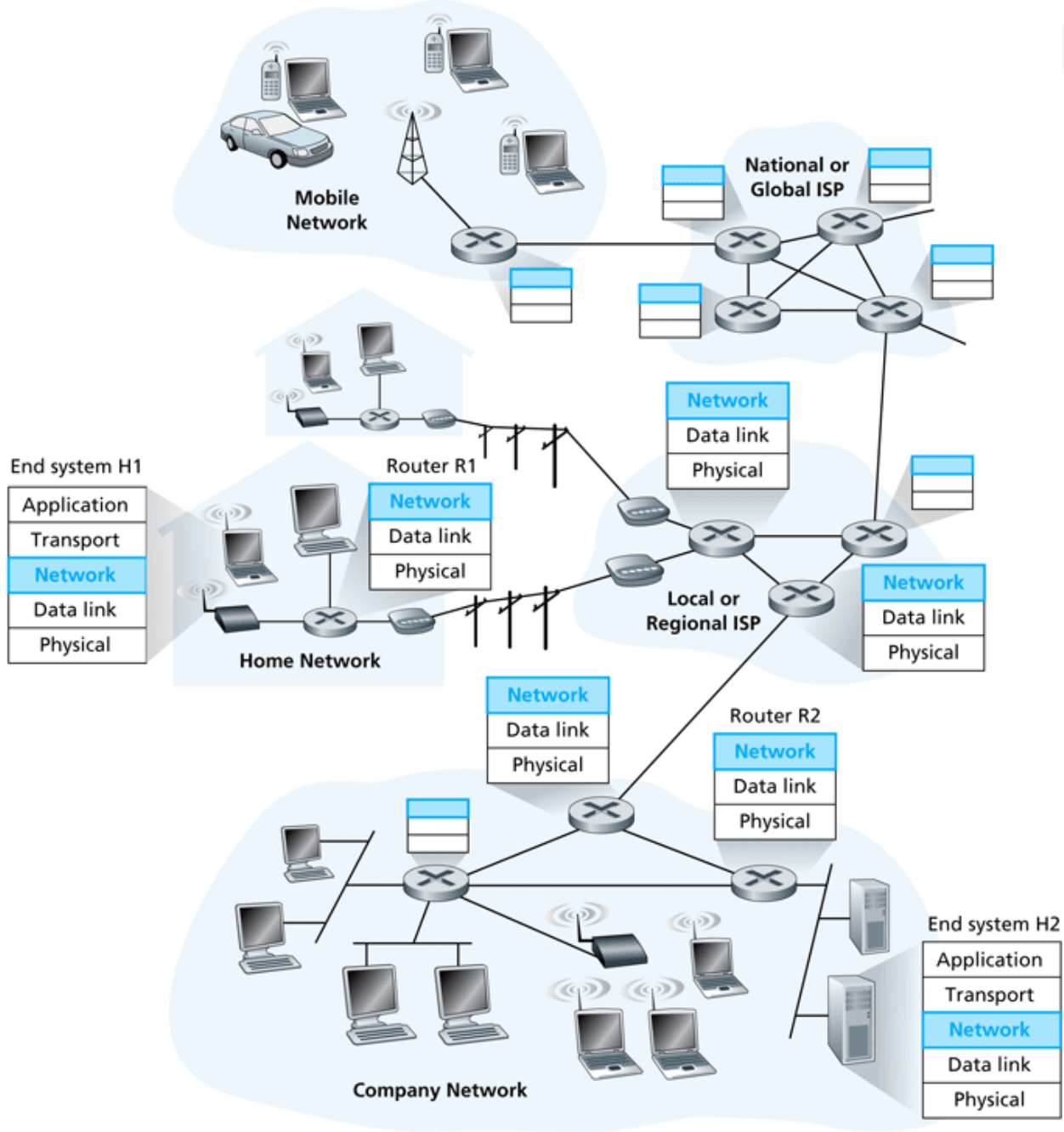


Figure 4.1 ♦ The network layer

Forwarding / Routing

- Forwarding

- Input port to output port

- Routing

- Determine path for packet

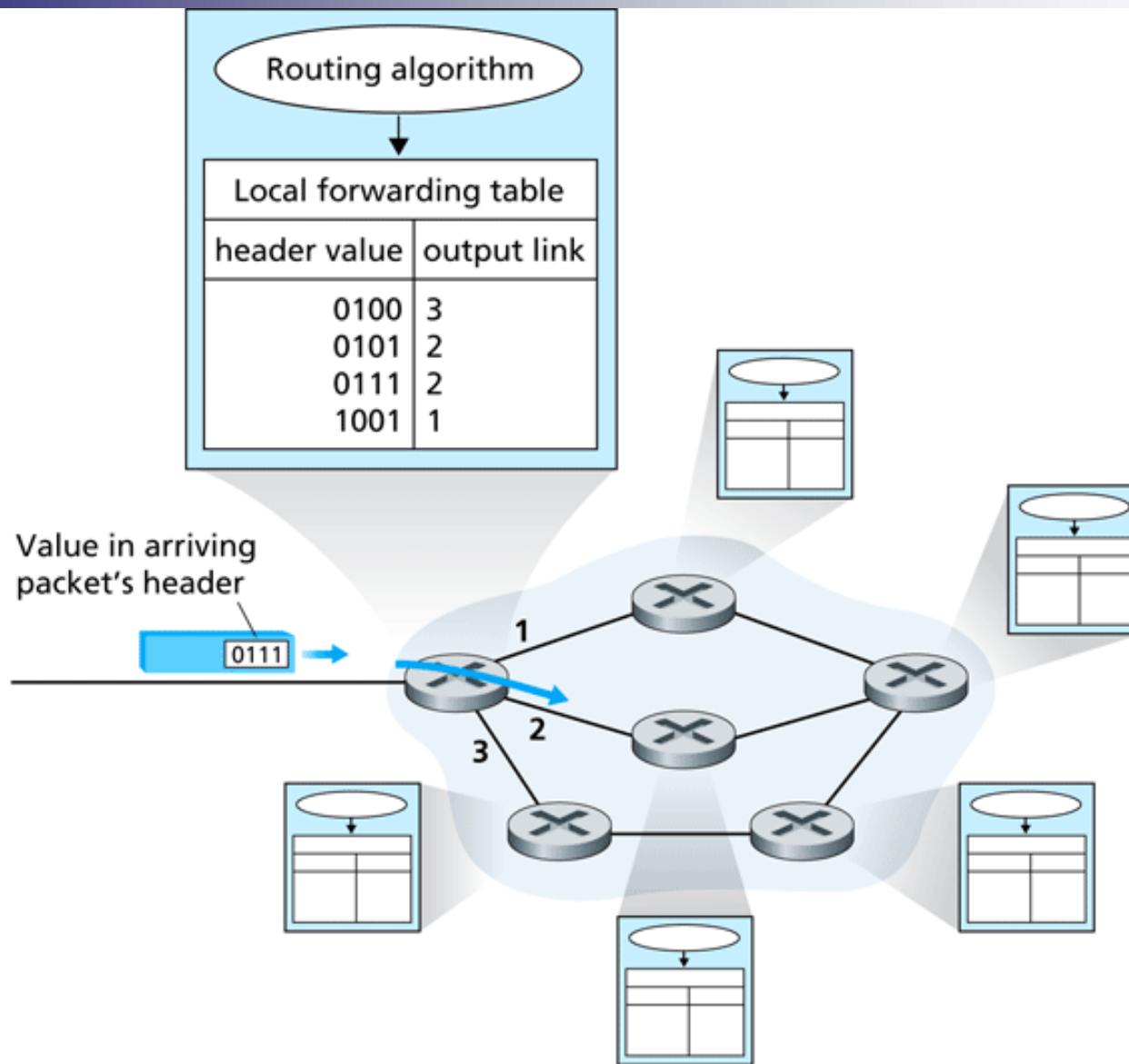


Figure 4.2 ♦ Routing algorithms determine values in forwarding tables.

Network Service Model

- Guaranteed delivery
 - Guaranteed delivery with bounded delay
 - In-order packet delivery
 - Guaranteed minimal bandwidth
 - Guaranteed maximum jitter
 - Security Services
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- Best-Effort Service

Virtual Circuit Networks

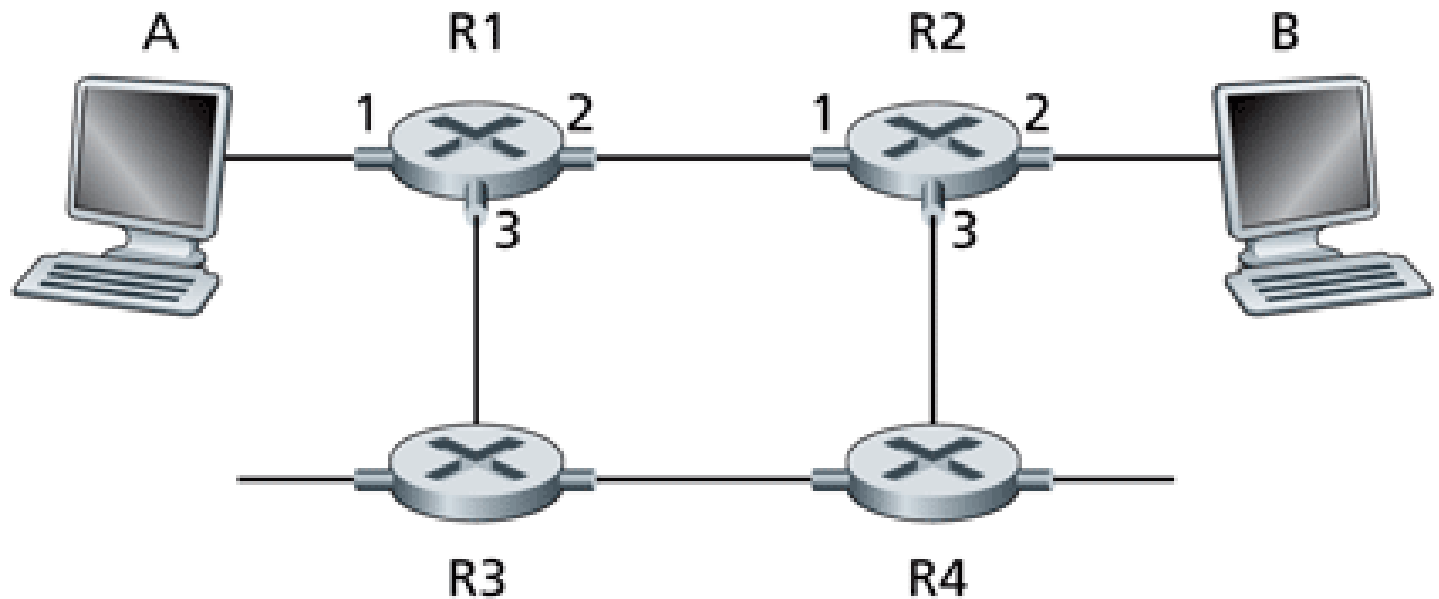


Figure 4.3 ♦ A simple virtual circuit network

VC Table

Incoming Interface	Incoming VC#	Outgoing Interface	Outgoing VC#
1	12	3	22
2	63	1	18
3	7	2	17
1	97	3	87

Network Layer – Virtual Circuits

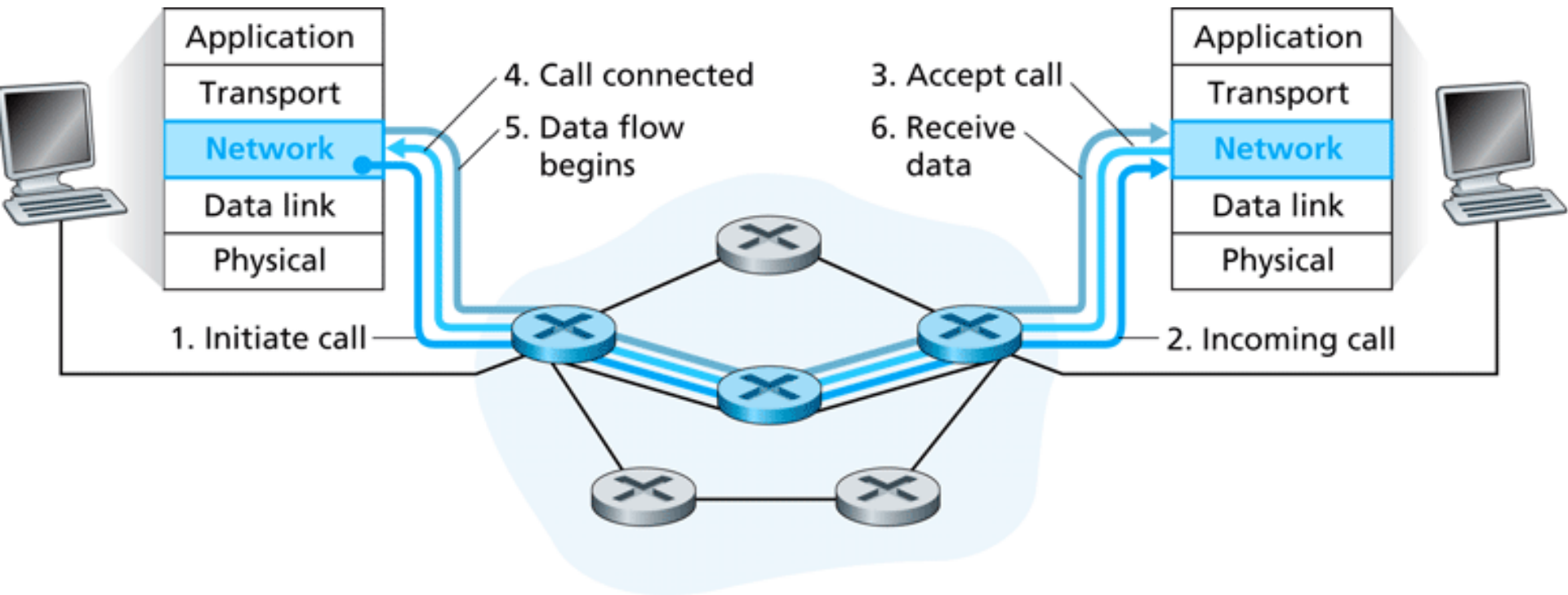


Figure 4.4 ♦ Virtual-circuit setup

Datagram Networks

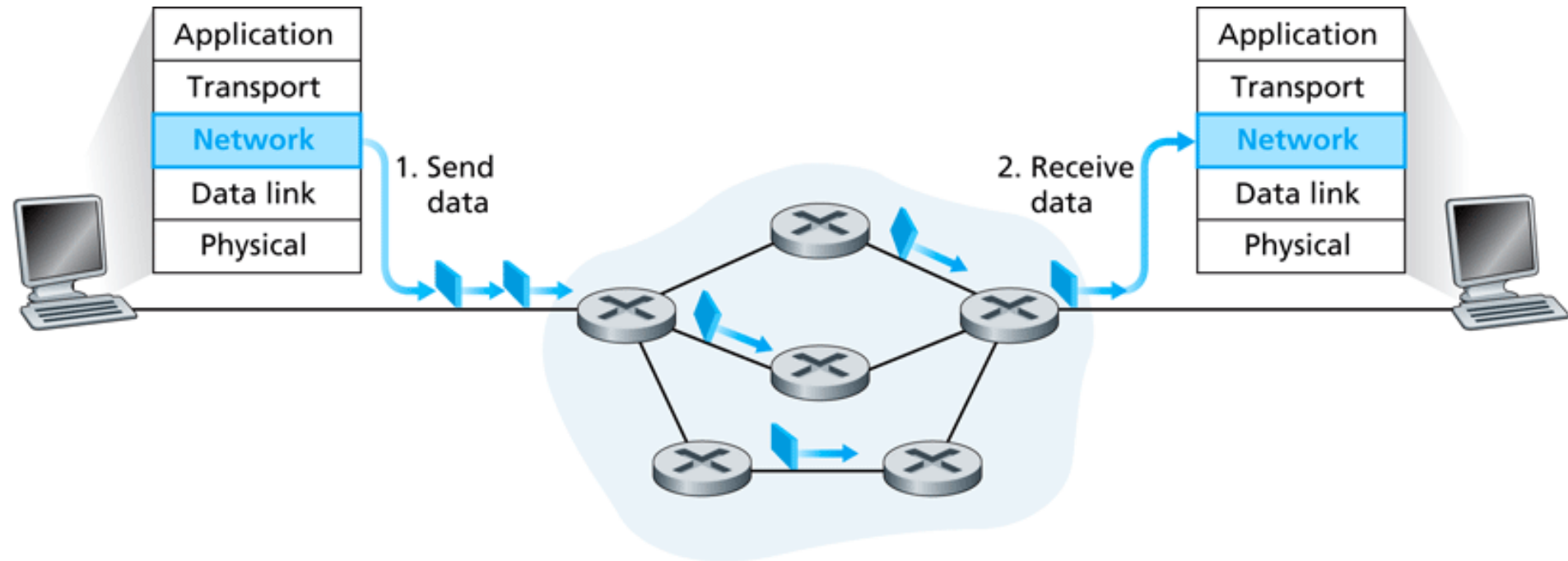


Figure 4.5 ♦ Datagram network

Network Layer Overview

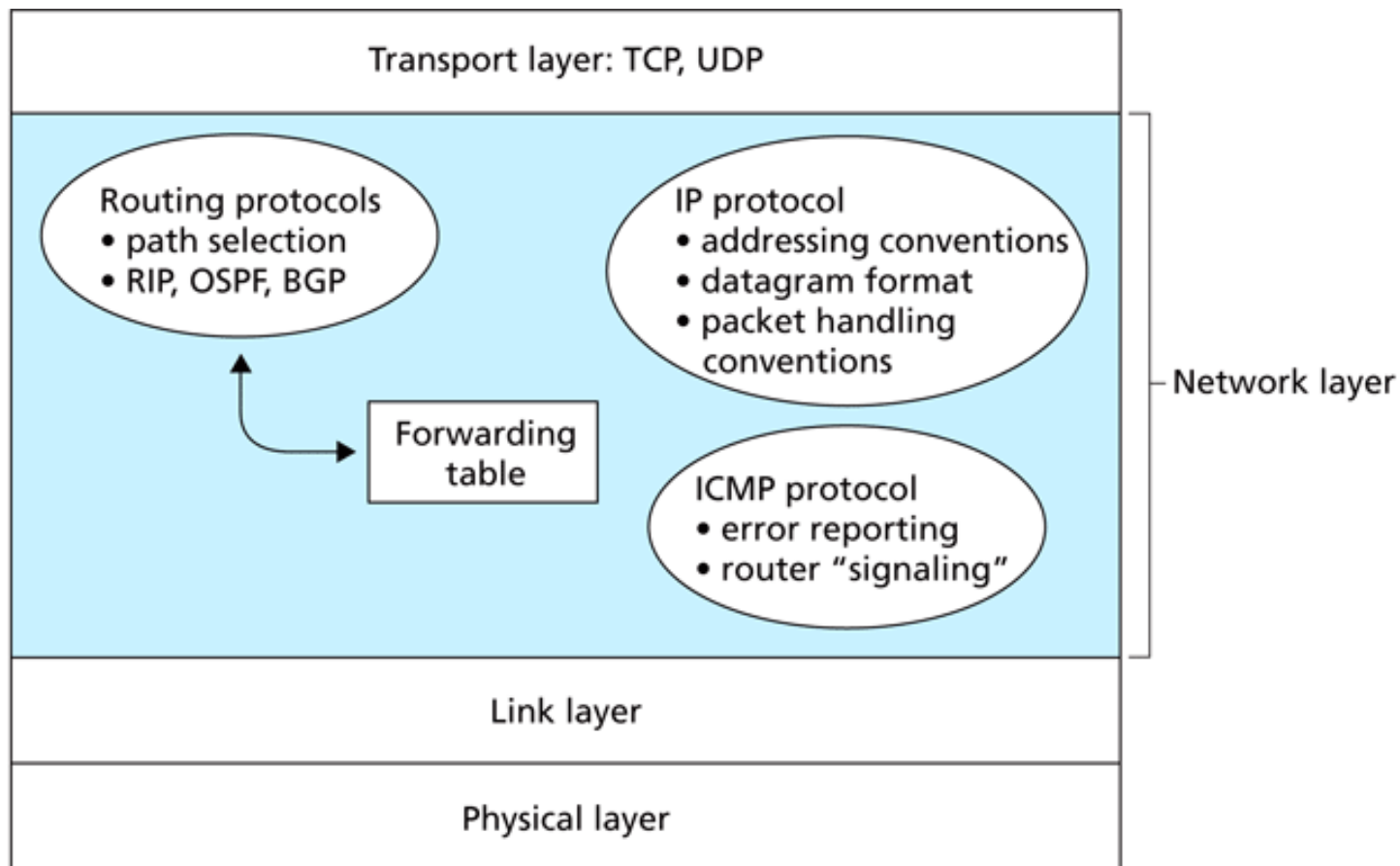
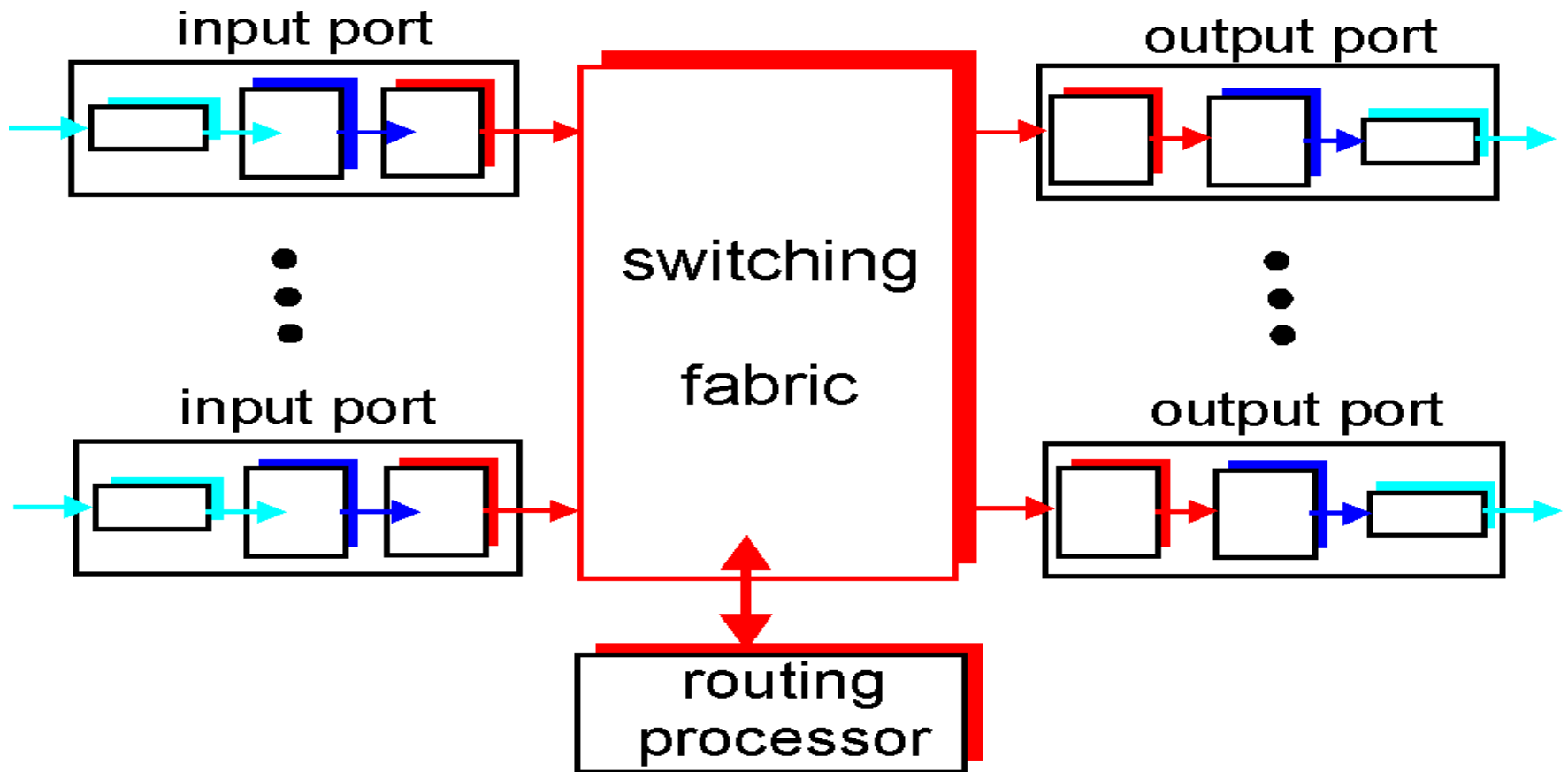
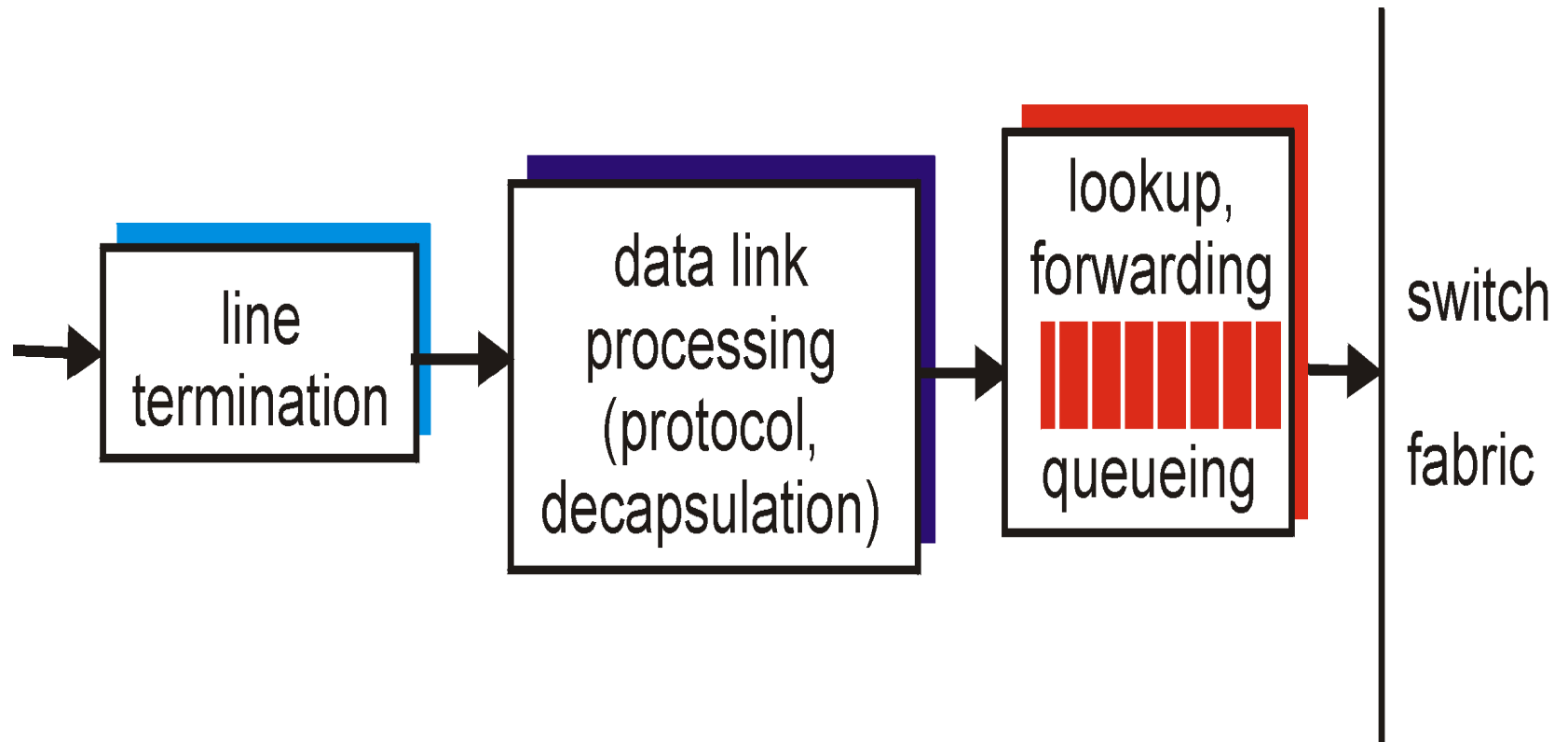


Figure 4.12 ♦ A look inside the Internet's network layer

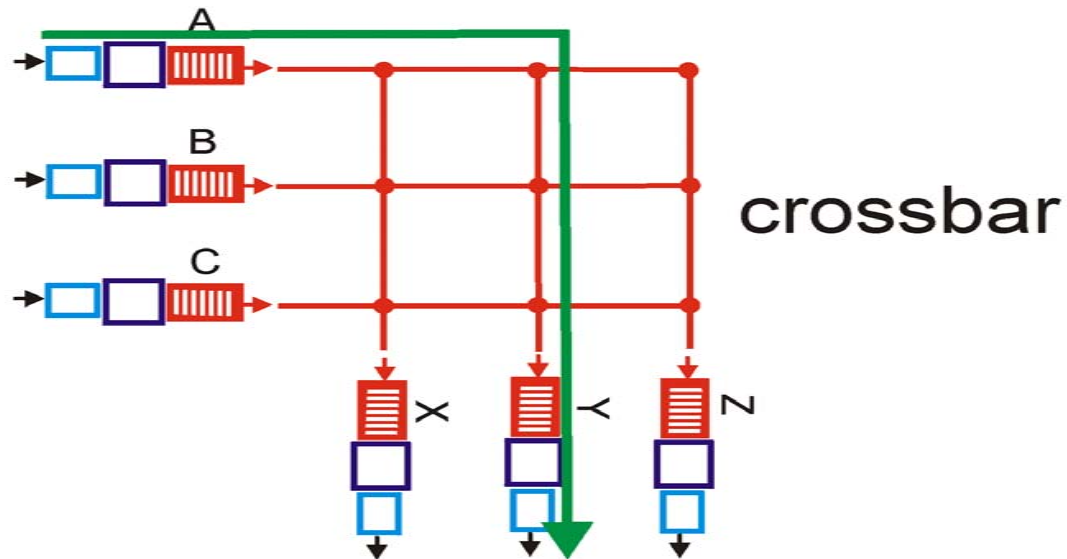
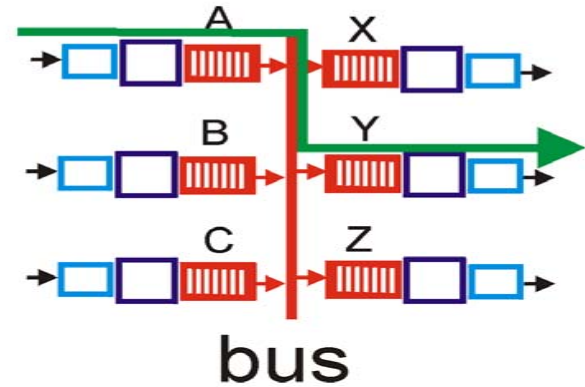
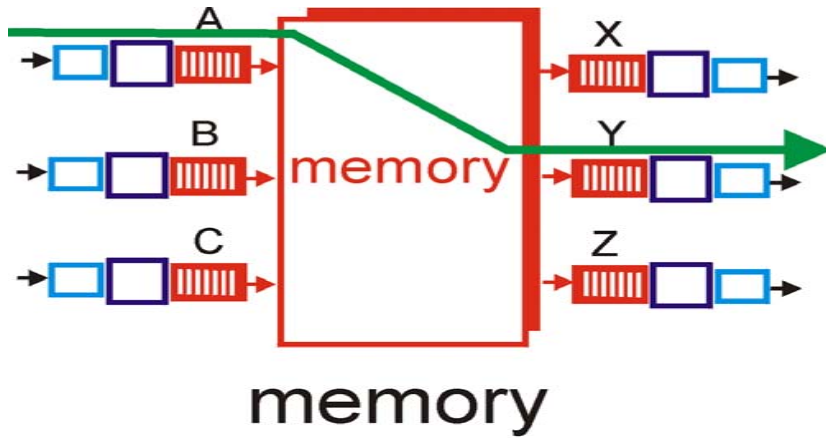
Routers



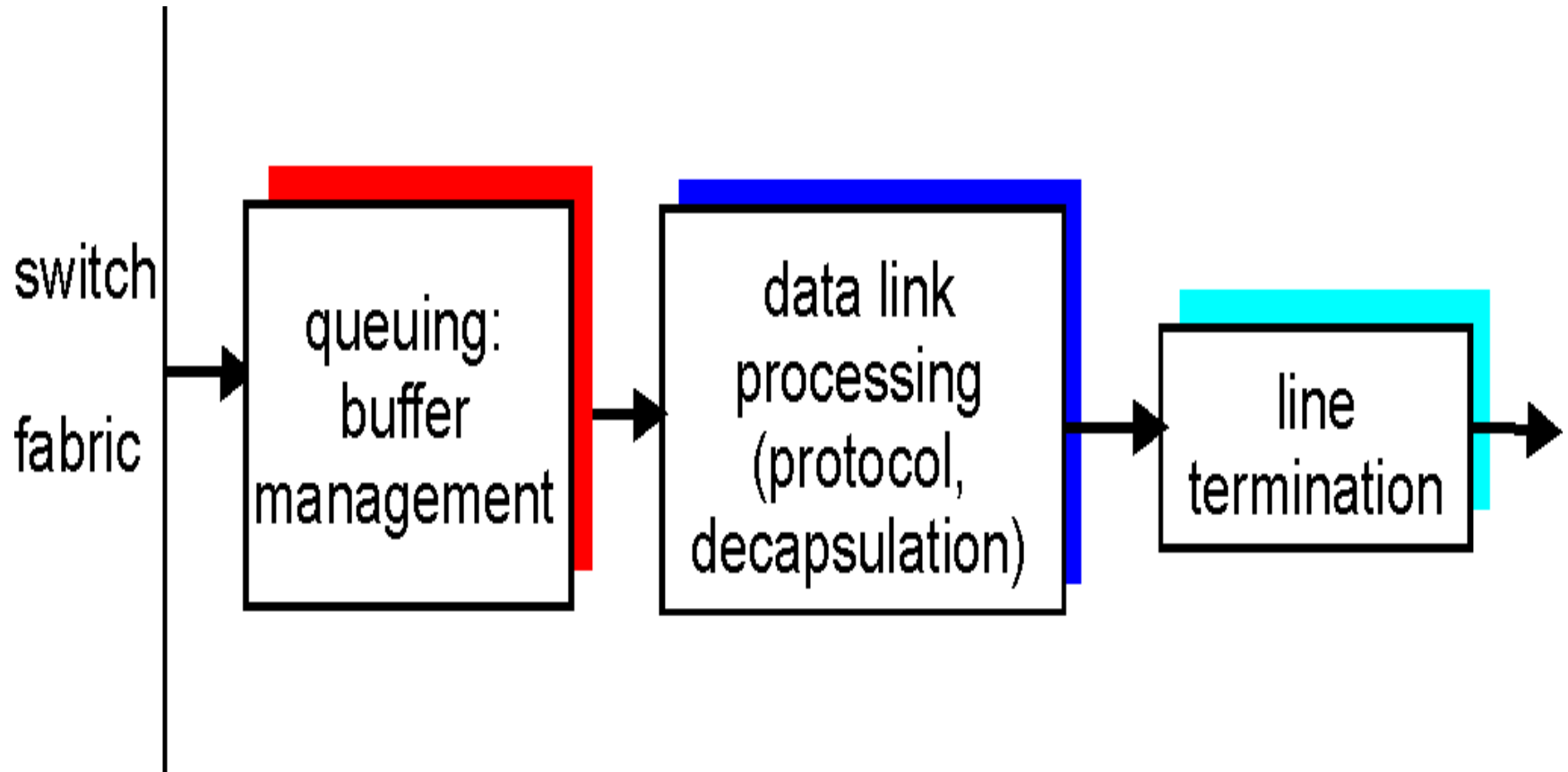
Router Input Ports



Router Switching Fabric



Router Output Ports






- Describe how packet loss can occur at input ports.

1. Another incoming packet
2. No buffer space left
3. Corrupt switching fabric
4. Packet is not fragmented



- Describe how packet loss at input ports can be eliminated (without using infinite buffers).
 1. Add more buffers
 2. Add more input ports
 3. Increase speed of switching fabric
 4. Add more output ports



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- Describe how packet loss can occur at output ports.
 1. Buffer overflow due to slow switching fabric
 2. Buffer overflow due to slow outgoing line speed
 3. Buffer overflow due to too few output ports
 4. Buffer overflow due to packet collisions






Use this for next two questions

- Suppose there are three routers between a source and a destination host.

- Ignoring fragmentation, how many forwarding tables will be indexed to move the datagram from source to the destination?

1. 1
2. 2
3. 3
4. 4
5. 5





■ Ignoring fragmentation, an IP datagram sent from the source host to the destination host will travel over how many interfaces?

- 4
- 5
- 6
- 7
- 8
- 9





Routing Protocols

- Learn routes
- Select routes
- Maintain routes

Routing Algorithms

- Given set of routers, with links connecting the routers, the routing algorithm finds a “good” path from source to destination
- Find Least-cost path
 - The first link in the path is connected to the source
 - The last link in the path is connected to the destination
 - For all i , the i and $i-1$ st link in the path are connected to the same node
 - The sum of the cost of the links on the path is the minimum over all possible paths between source and destination.