

# Switching

- When a message reaches a connecting device, **a decision needs to be made to select one of the output ports through which the packet needs to be send out. In other words**, the connecting device acts as a switch that connects one port to another port.
- data communications switching techniques are divided **into two** broad categories, **circuit switching and packet switching**.

## 1. Circuit Switching

- **A physical circuit (or channel)** is established between the source and destination of the message before the delivery of the message. After the circuit is established, **the entire message**, is transformed from the source to the destination.
- In circuit switching, the whole message is sent from the source to the destination without being divided into packets.
- The circuit switching was never implemented at the network layer; it is mostly used **at the physical layer**

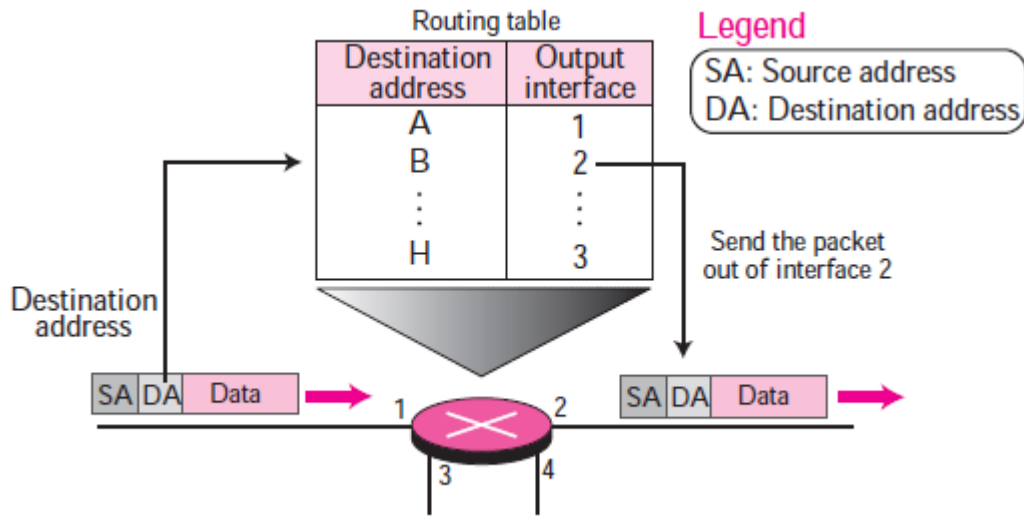
## 2. Packet Switching

- In packet switching, the message is first **divided into manageable packets** (normally called datagrams) at the source before being transmitted. The packets are assembled at the destination.
- **The network layer** is designed as a packet-switched network.
- **A router**, in fact, is a switch that creates a connection between an input port and an output port or a set of output ports.
- packet-switched network can use **two different approaches** to route the packets: **the datagram approach** and **the virtual circuit approach**.

### A. Datagram Approach: Connectionless Service

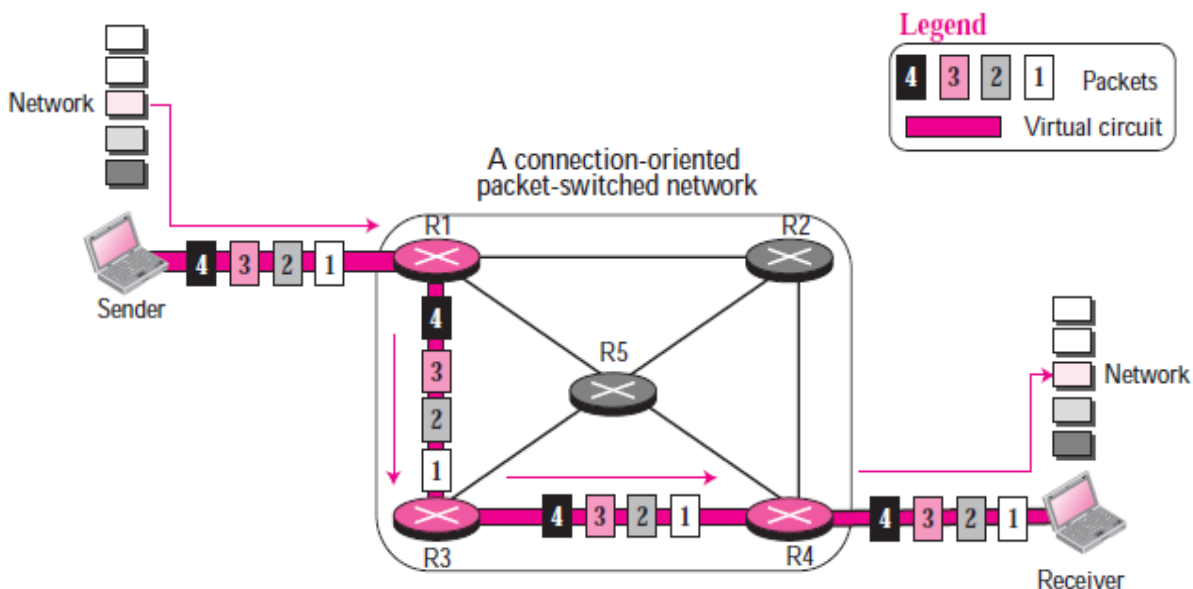
- When the Internet started, **to make it simple**, the network layer was designed **to provide a connectionless service** in which the network-layer protocol **treats each packet independently**, with each packet having no relationship to any other packet. In this approach, **the packets in a message may or may not travel the same path to their destination**.

- Each packet is routed based on the information contained in its header: **source and destination address.**

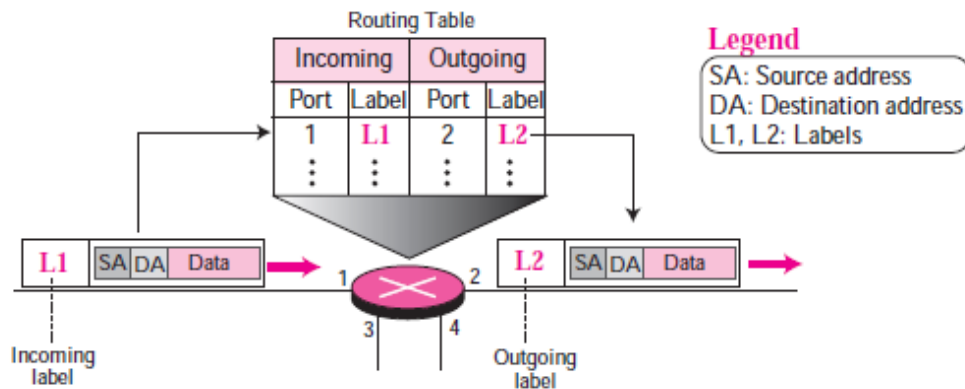


### B. Virtual-Circuit Approach: Connection-Oriented Service

- In a connection-oriented service (also called a virtual-circuit approach), **there is a relationship between all packets belonging to a message.** Before all datagrams in a message can be sent, **a virtual connection should be set up** to define the path for the datagrams. After connection setup, the datagrams can all follow the same path. In this type of service, not only must the packet contain the source and destination addresses, **it must also contain a flow label**, a virtual-circuit identifier that defines the virtual path the packet should follow.
- In a connection-oriented packet switched network, **the forwarding decision is based on the label of the packet.**



The following figure shows the forwarding process in a router when used in a connection-oriented network.

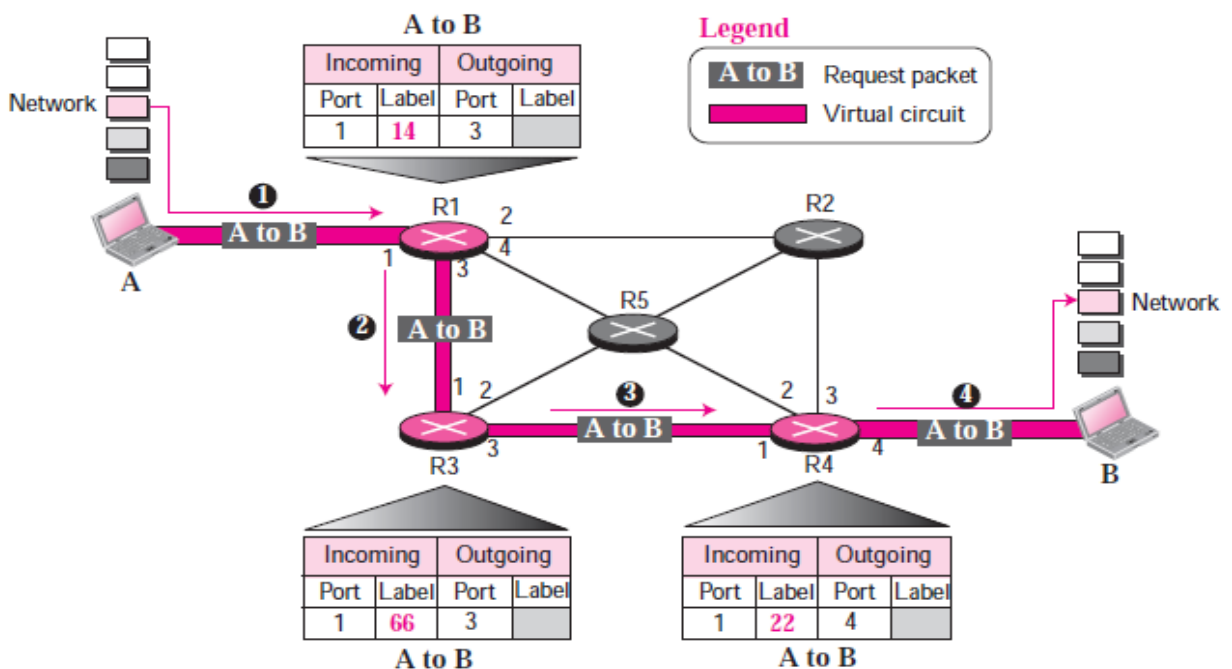


To create a connection-oriented service, a **three-phase process** is used: **setup, data transfer, and teardown**. In the **setup phase**, the **source and destination addresses** of the sender and receiver is used to make table entries for the connection-oriented service. In the **teardown phase**, the **source and destination inform** the router to delete the corresponding entries. **Data transfer** occurs between these two phases.

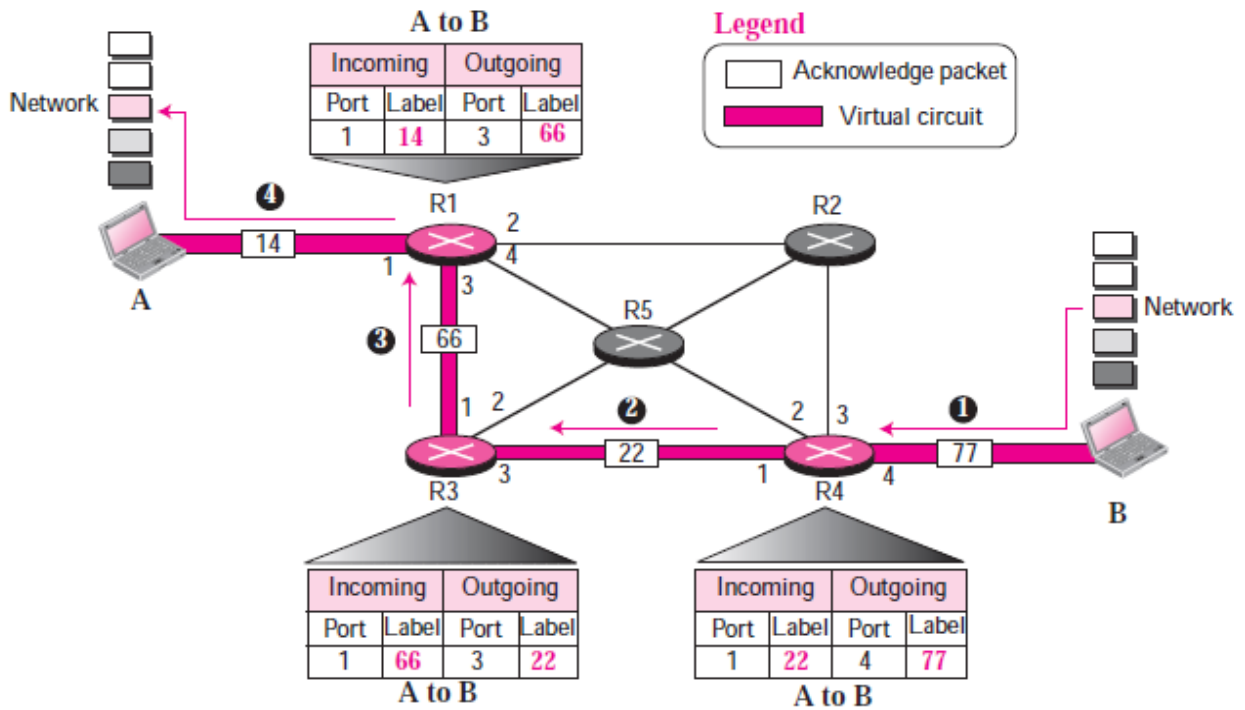
### 1. Setup Phase

In the setup phase, a router creates **an entry for a virtual circuit**. **Two auxiliary packets** need to be exchanged between the sender and the receiver: **the request packet and the acknowledgment packet**.

- ✓ **Request packet:** A request packet is sent from the source to the destination. This auxiliary packet carries **the source and destination addresses**.

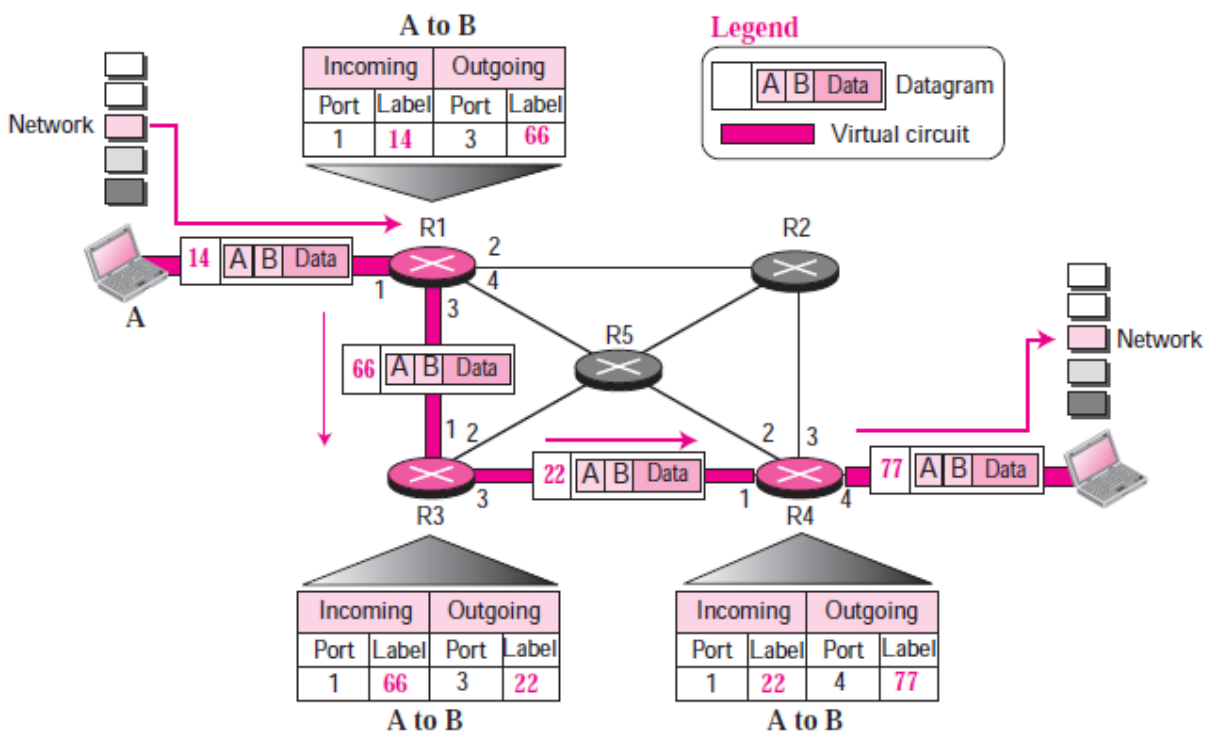


- ✓ **Acknowledgment Packet:** A special packet, called the acknowledgment packet, **completes the entries in the switching tables.**



## 2. Data Transfer Phase

The second phase is called the data transfer phase. After all routers have created their routing table for a specific virtual circuit, then the network-layer packets belonging to one message can be sent one after another.



### 3. Teardown Phase

In the teardown phase, **source A**, after sending all packets to B, **sends a special packet called a teardown packet**. **Destination B** responds with a confirmation packet. All routers delete the corresponding entry from their tables.