ADITYA ENGINEERING COLLEGE (A)

COMPUTER NETWORKS

VI SEMESTER

(Professional Elective II)

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ADITYA ENGINEERING COLLEGE (A)

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ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT IV
THE NETWORK LAYER

- The **network layer** is concerned with getting **packets** from the source all the way to the destination.
- Getting to the destination may require making many hops at intermediate routers along the way.
- Thus, the network layer is the **lowest layer** that deals with end-to-end transmission.
- To achieve its goals, the **network layer** must know about the **topology of the network** (i.e., the set of all routers and links) and choose appropriate paths through it, even for large networks.

- It must also take care when choosing routes to avoid **overloading** some of the **communication lines** and **routers** while leaving others idle.
- Finally, when the source and destination are in different networks, new problems occur.
- It is up to the **network layer** to deal with them.
- In this chapter we will study all these issues and illustrate them primarily using the Internet and its **network layer protocol, IP.**

VIRTUAL CIRCUIT AND DATAGRAM SUBNET:

- **Virtual circuit and Datagram Networks** are computer networks that provide **connection oriented** and **connectionless services** respectively.
- **Virtual circuit and datagram networks** are **two fundamental classes** of **computer networks**.
- They use very different information in making their **forwarding decision.**

VIRTUAL CIRCUIT NETWORKS

- **Virtual circuit networks** use **connections** at the **network layer.**
- These network layer connections are called **Virtual Circuits (VCs)**.
- Let us see how a **VC service** can be implemented in a computer network.
- A VC consists of :

1. A **path** (i.e., a series of links and routers) between the source and destination hosts.
2. **VC numbers**, one number for each link along the path.
3. **Entries** in the **forwarding table** in each router along the path.

- A **packet** belonging to a **virtual circuit** will carry a **VC number** in its **header.**
- Because a virtual circuit may have a **different VC number** on each link and each intervening router must replace the **VC number** of each traversing packet with a **new VC number.**
- The **new VC number** is obtained from the **forwarding table.**

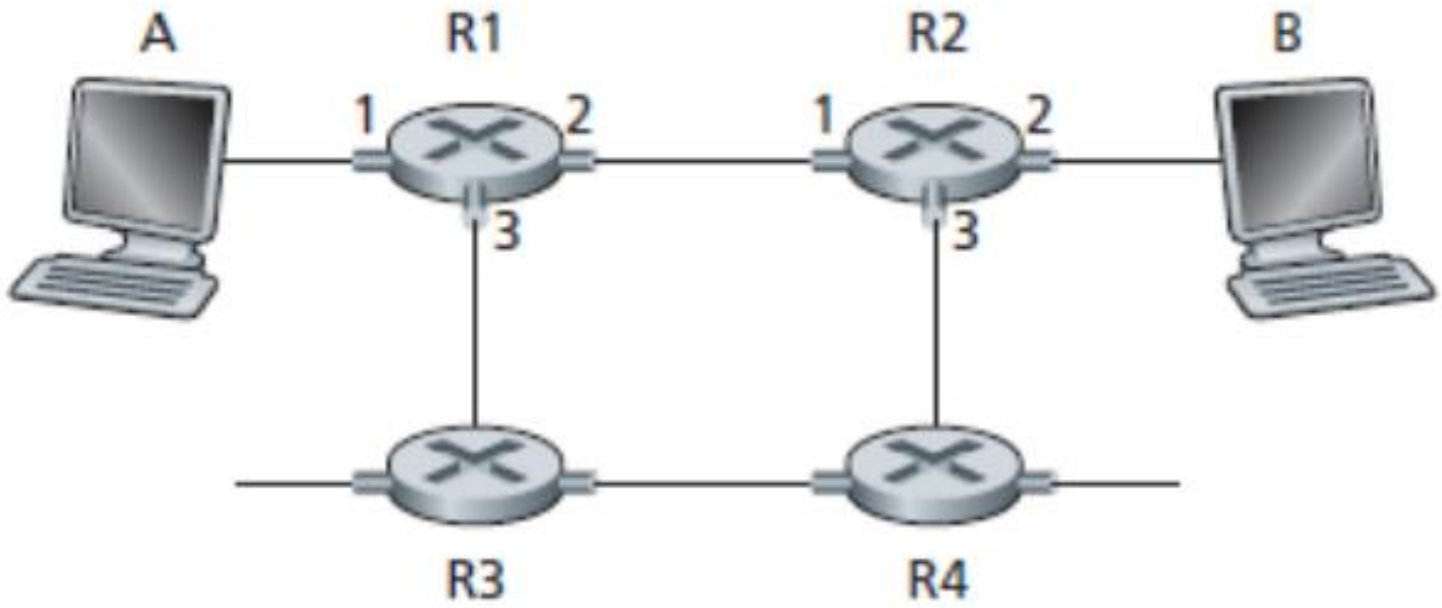

Fig: Virtual circuit network

- The numbers next to links of R1 in the above figure are the **link interface numbers.**
- Suppose now that Host A requests that the network establish a **VC** between itself and Host B.
- Suppose also that the network chooses the path A-R1-R2-B and assigns **VC numbers** 12, 22, and 32 to the three links in this path for this virtual circuit.
- In this case, when a packet in this VC **leaves** Host A, the value in the VC number filed in the packet header is 12; when it leaves R1, the value is 22; and when it leaves R2, the value is 32.
- For a VC network, each router's forwarding table includes VC number translation; for example the forwarding table in R1is shown.

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

Table: Forwarding table

- In a VC network, the network's routers must maintain **connection state information** for the ongoing connections.
- Specifically, each time a **new connection** is established across a router, a **new connection entry** must be added to the router's **forwarding table** and whenever a connection is released, an entry must be **removed** from the table.
- If there is no VC number translation, it is still necessary to maintain **connection state information** that associates VC numbers with output interface numbers.
- There are **three phases** in a virtual circuit:

1. **VC Setup**
2. **Data Transfer**
3. **VC Teardown**

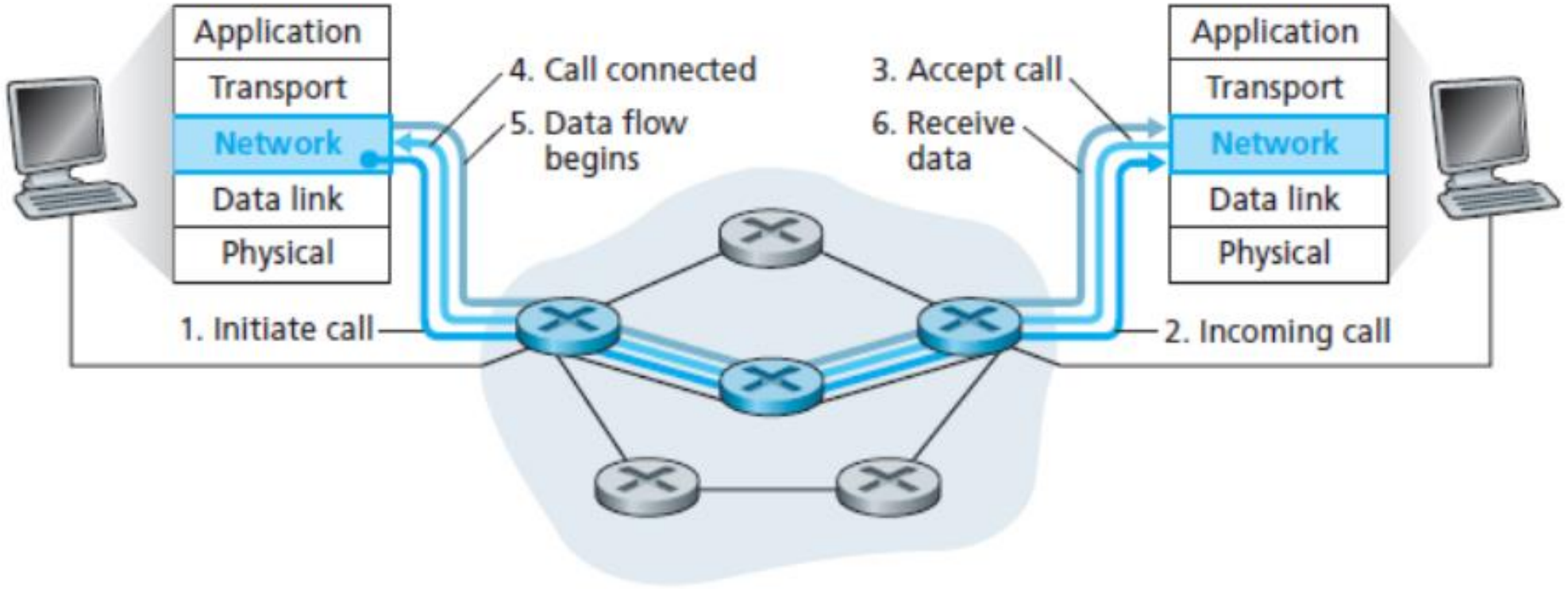

Fig: Virtual Circuit Network

1. **VC Setup** :

- During this setup phase, the sending transport layer contacts the network layer and specifies the receiver's address, and waits for the network to **set up the VC**.
- The network layer determines the **path** between sender and receiver, i.e., the series of links and routers through which all packets of the VC will travel.
- The network layer also determines the **VC number** for each link along the path.
- Finally, the network layer adds an **entry** in the **forwarding table** in each router along the path.
- During VC setup, the network layer may also **reserve resources (such as bandwidth)** along the path of the VC.

2. **Data Transfer** :

- As shown in the figure, once the VC has been established, packets can begin to flow along the VC.

3. **VC Teardown** :

- This is initiated when the sender (or receiver) informs the network layer to **terminate** the VC.
- The network layer will then inform the end system on the other side of the network for **call termination** and **update the forwarding table** in each of the packet routers on the path to indicate that the VC no longer exists.

DATAGRAM NETWORKS

- In a **datagram network**, each time an end system wants to send a packet, it stamps the packet with the **address of the destination end system** and then pops the packet into the network.
- As shown in the figure, there is **no VC setup,** and routers do not maintain any **VC state information**.

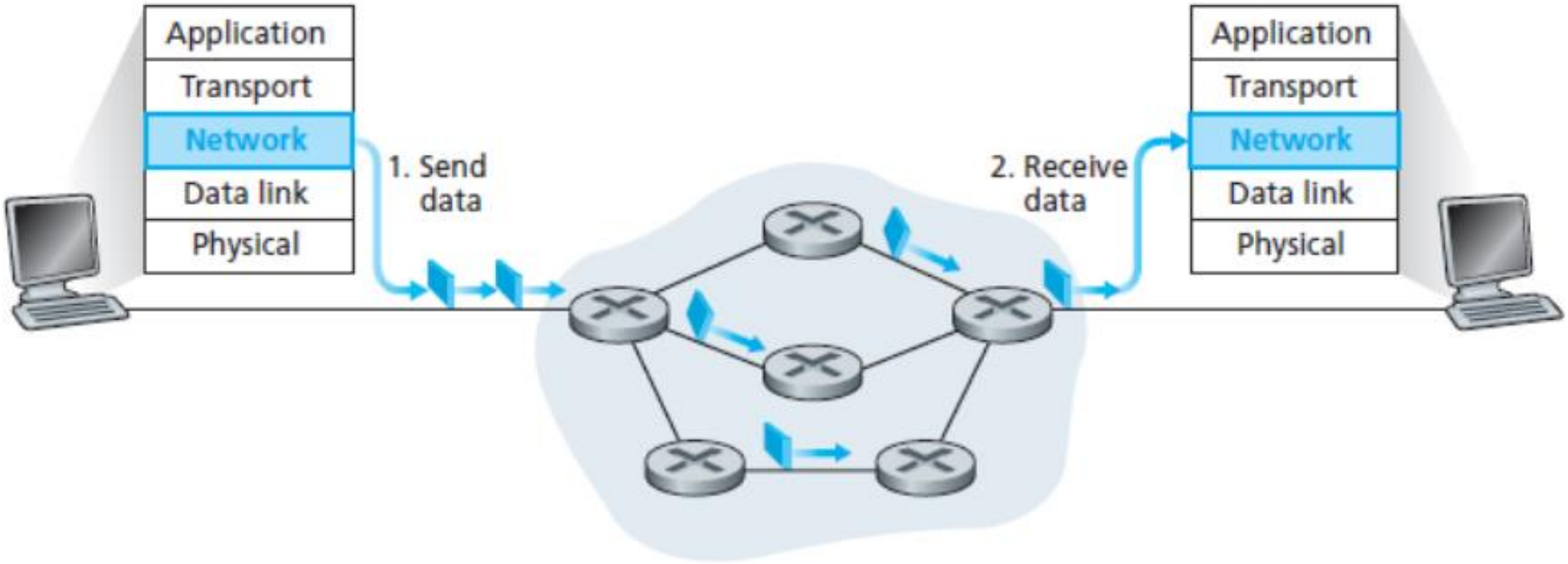

Fig: Datagram Network

- As a packet is transmitted from source to destination, it passes through a **series of routers.**
- Each of these routers uses the **packet's destination address** to forward the packet.
- Each router has a **forwarding table** that maps destination address to link interfaces.
- When a packet **arrives** at the router, the router uses the **packet's destination address** to look up the appropriate output link interface in the forwarding table.
- The router then forwards the packet to that **output link interface.**