**Chapter 04: Introduction to Network Layer**

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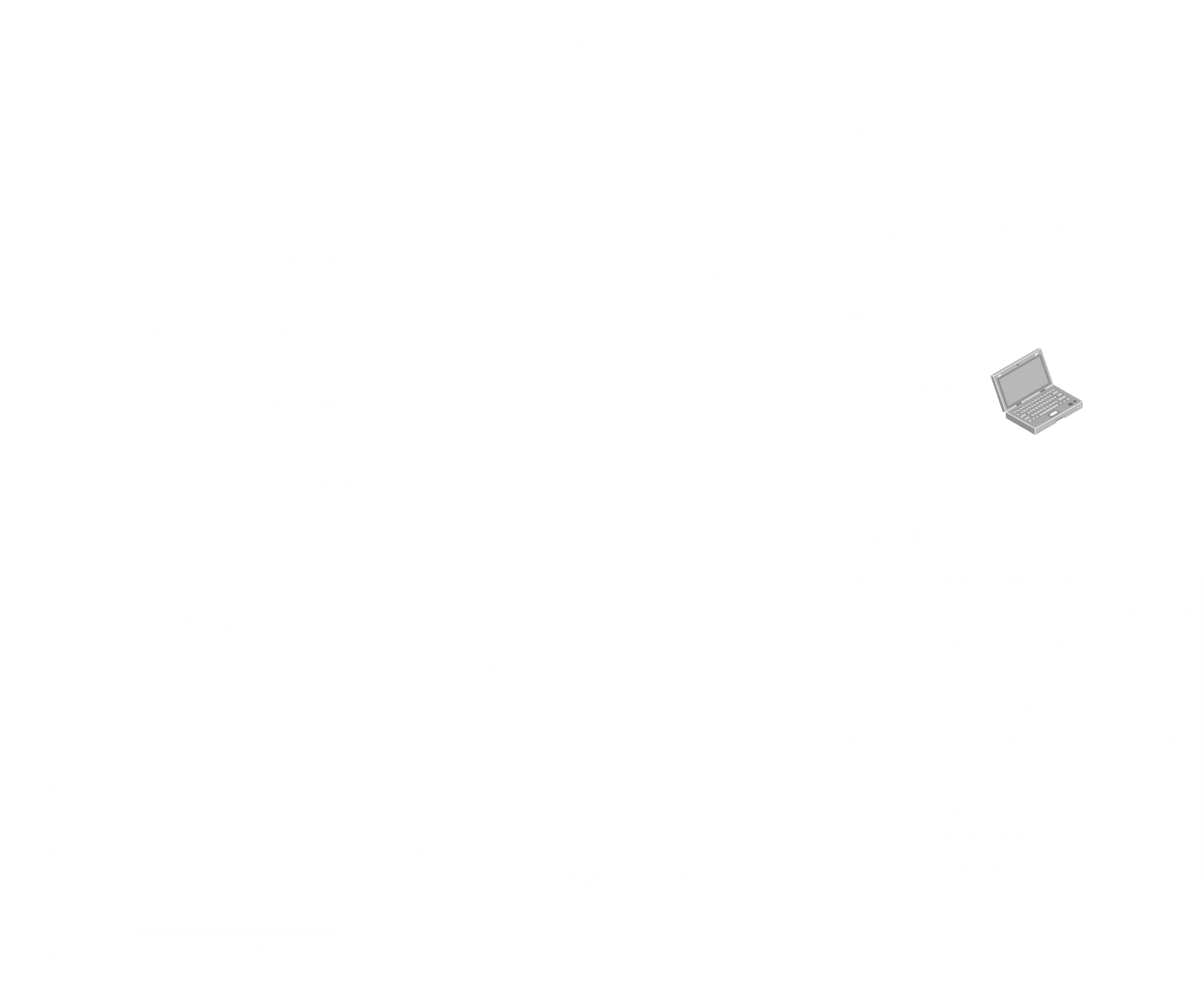
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## 4.4 Network Layer Services

The major service provided by the network layer is just **node-to-node delivery**. If a sender wants to send a packet to a receiver, at the very least, the packet needs to travel from the sender to the regional ISP, from there to the national ISP, then to the regional ISP of the receiver and finally to the receiver itself. This is one possible path, but regardless of what path is taken, the packet needs to travel between multiple nodes. The network layer allows the movement from one node to the next.

### Source Machine

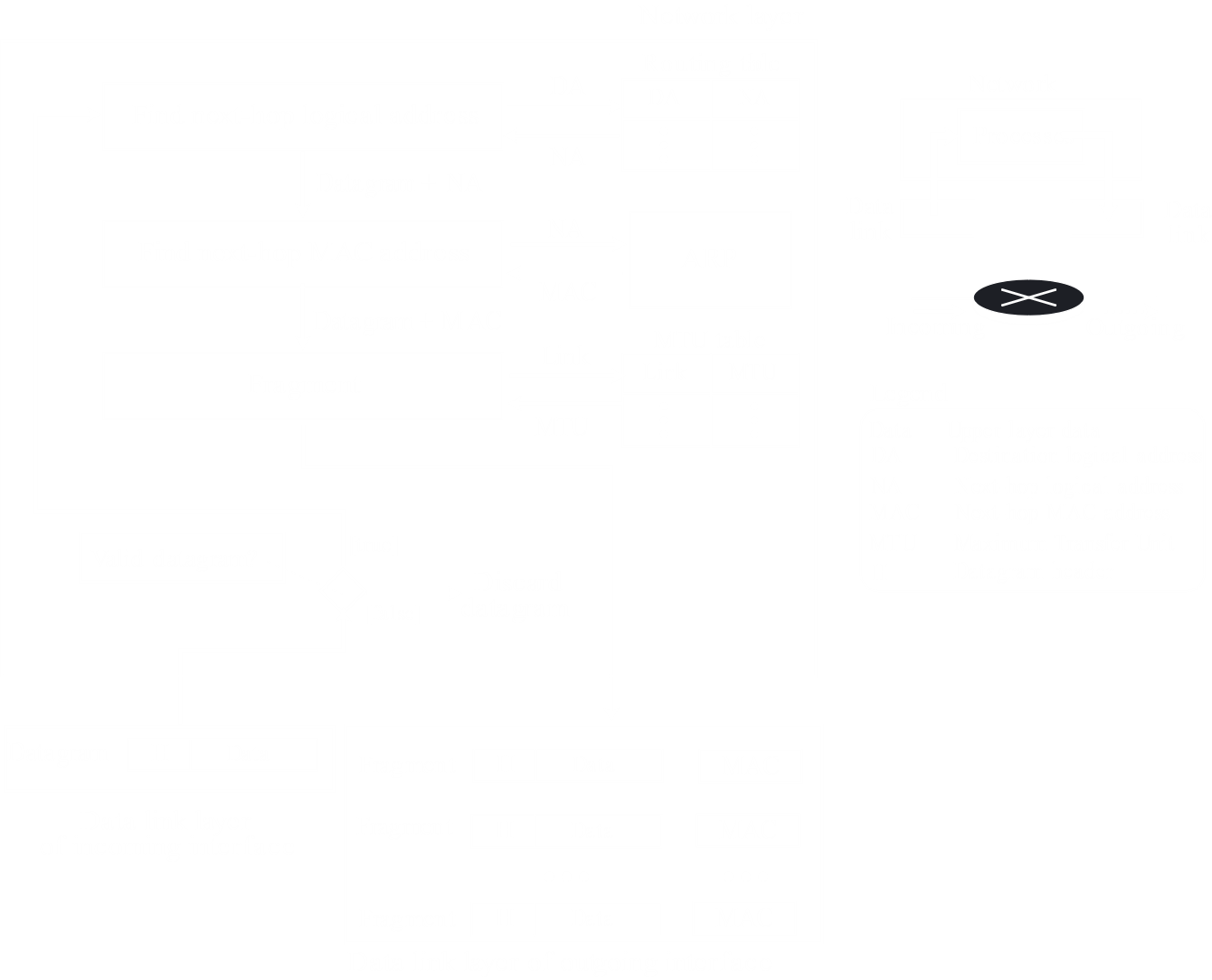


At the source machine, the **transport layer** sends some data down to the network layer. The network layer **packetizes** this data, adding its own headers. We will learn about what exactly the contents of this header are later on.

The packetized data is called the **datagram**. The datagram includes the logical address, or IP address, of the destination, which originally came from the transport layer. This address is used to consult the **routing table** and find the logical address of the **next hop**. Next, we need to find the **physical address**, or the MAC address. This is found using the **ARP Protocol**.

Finally, the network layer may need to break the datagram into **fragments**. It is possible that the datagram is too large for one or more of the links involved in the connection. The network layer consults the **Maximum Transfer Unit** (MTU) table to check for this. If required, it breaks the datagram into fragments. Each of the fragments is then forwarded to the **data link layer**, along with the MAC address.

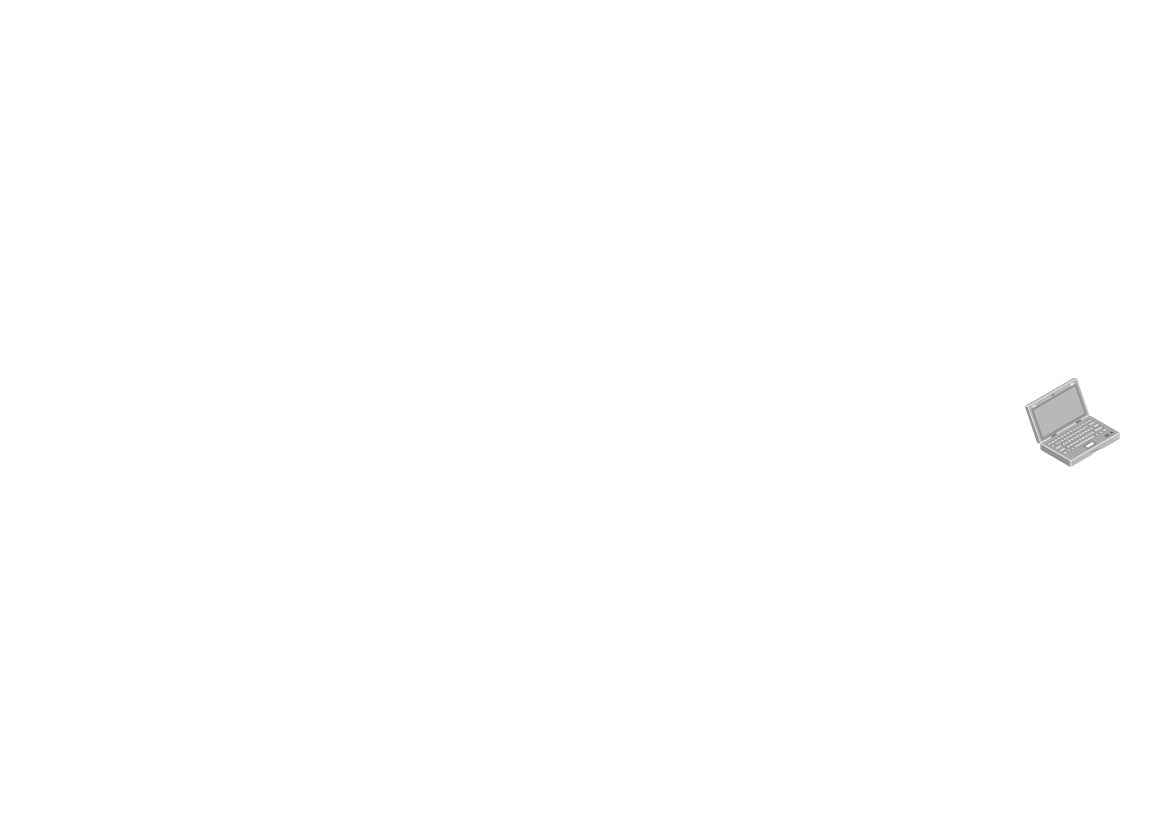
### Routers



At routers, the network layer first receives a packet from the data link layer. It checks whether the packet is **corrupted**, using a checksum, and discards it if it is. For non-corrupted packets, it goes over the **same routine**, finding the logical address of the next hop, finding the physical address of the next hop and possibly fragmenting the packet before giving it back to the data link layer.

Regarding the **fragmentation** step, routers are only allowed to perform this step in IPv4, not in IPv6. In IPv6, fragmentation is only allowed at the host machine.

### Destination Machine



At the destination, **corrupted** datagrams are again discarded initially. Next, **depacketization** is done. It is possible that the packet is arriving in fragments. If so, the fragments are stored and **reassembled**. Once all the fragments are received and the completed packet has been reassembled, the packet is sent to the transport layer.

During the reassembly process, a **time-limit** exists. If all the fragments do not arrive within a specified time period, the received fragments are **discarded**. If this is done, an **error message** is sent to the source machine using the **ICMP** protocol, which we will not be studying in depth here.