NETWORK CONCEPTS

1.2- Classify how applications, devices, and protocols relate to the OSI model layers

Description of apllications, devices and protocols relates to the Osi Model

- MAC address
- IP address
- EUI-64
- Frames
- Packets
- Switch
- Router
- Multilayer switch
- Encryption devices
- Cable
- NIC
- Bridge

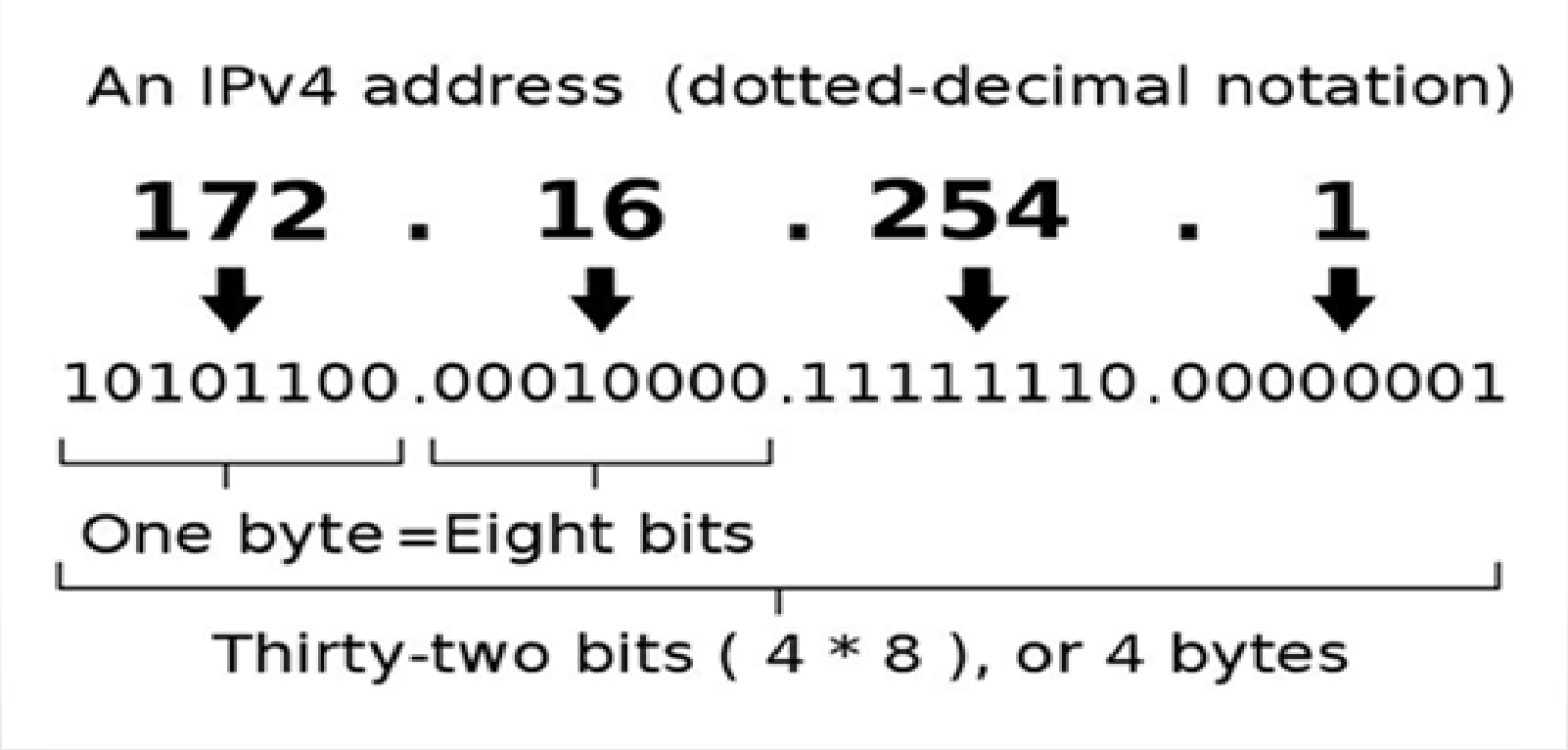
MAC Address

- Also known as hardware address or ethernet address
- A **Media Access Control (MAC) Address** is assigned a unique number by the manufacturer to each device capable of network connectivity.
- MAC Addresses are in a 48-bit hexadecimal format such as 00:2f:21:c1:11:0a.
- They are used to uniquely identify a device on a network, and for other functions such as for being authenticated by a DHCP server.
- MAC addresses are used in the data-link layer of the OSI model

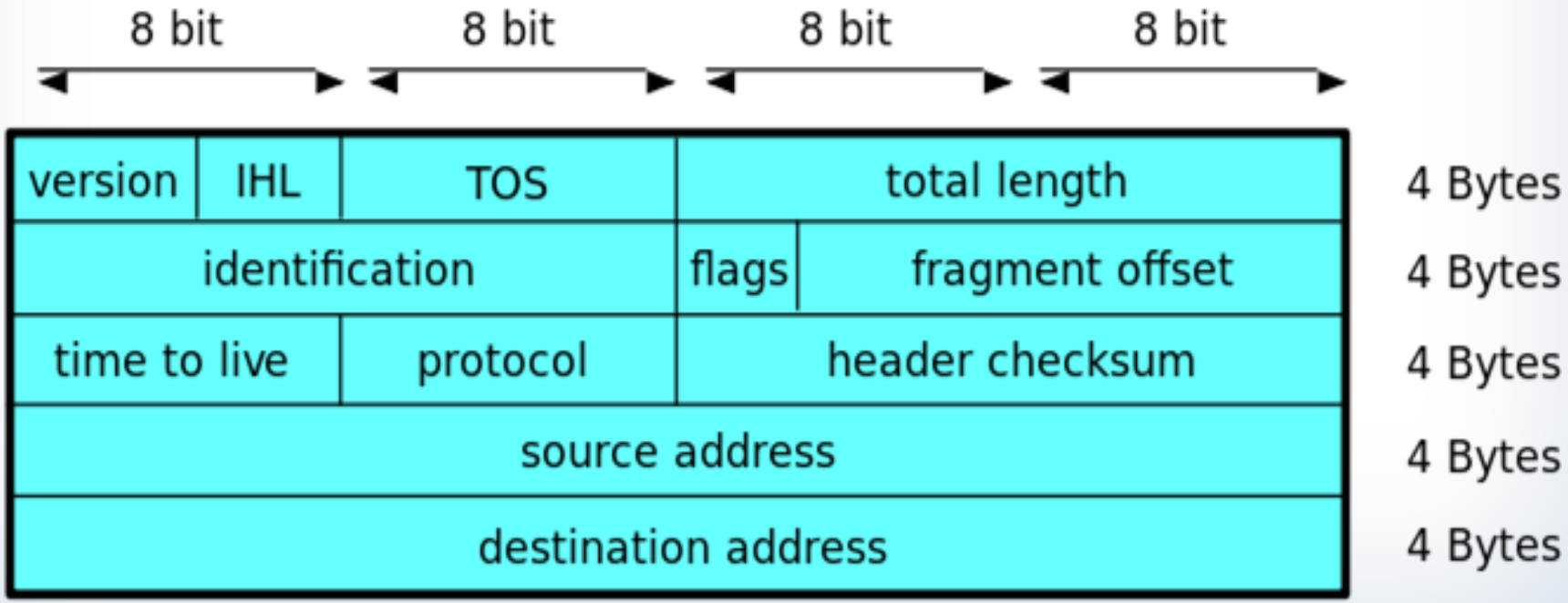
IP Address

- IP address stands for **Internet Protocol Address**
- A unique string of numbers separated by dots that identifies each computer on a network.
- The format of an IPv4 address is a 32-bit numeric address written as four numbers separated by dots.
- Each number can be zero to 255. For example, 1.160.10.240 could be an IP address.
- IP addresses are part of the Network Layer in the OSI model

IP Address (cont)



IP Address (cont)

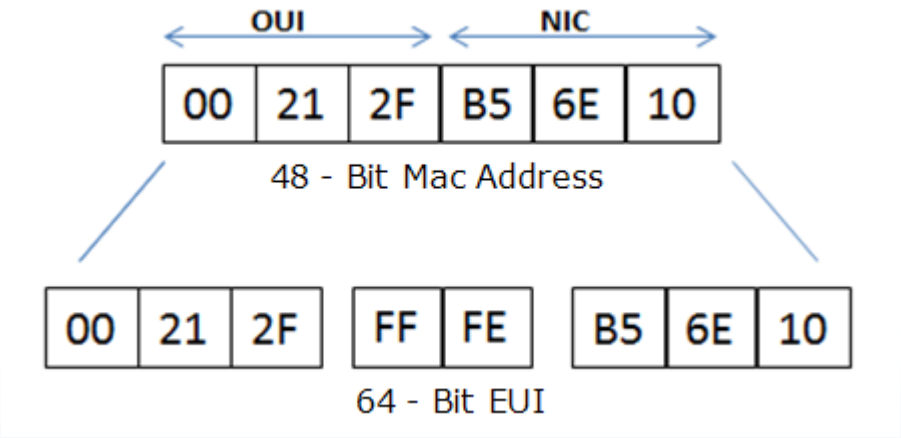


EUI-64

- Extended Unique Identifier (EUI), allows a host to assign iteself a unique 64-Bit IP Version 6 interface identifier (EUI-64).
- The IPv6 EUI-64 format address is obtained through the 48-bit MAC address. The Mac address is first separated into two 24-bits, with one being OUI (Organizationally Unique Identifier) and the other being NIC specific.
- The 16-bit 0xFFFE is then inserted between these two 24-bits to for the 64-bit EUI address.
- IEEE has chosen FFFE as a reserved value which can only appear in EUI-64 generated from the an EUI-48 MAC address.

EUI-64

Here is an example



Frames

- A **frame** is a unit of data transmission
- Frames are part of the Data Link Layer of the OSI model
- A frame is made up of two parts
  - **Header**: Contains data used for addressing and error correction
  - **Packet:** Data being transmitted

Frames

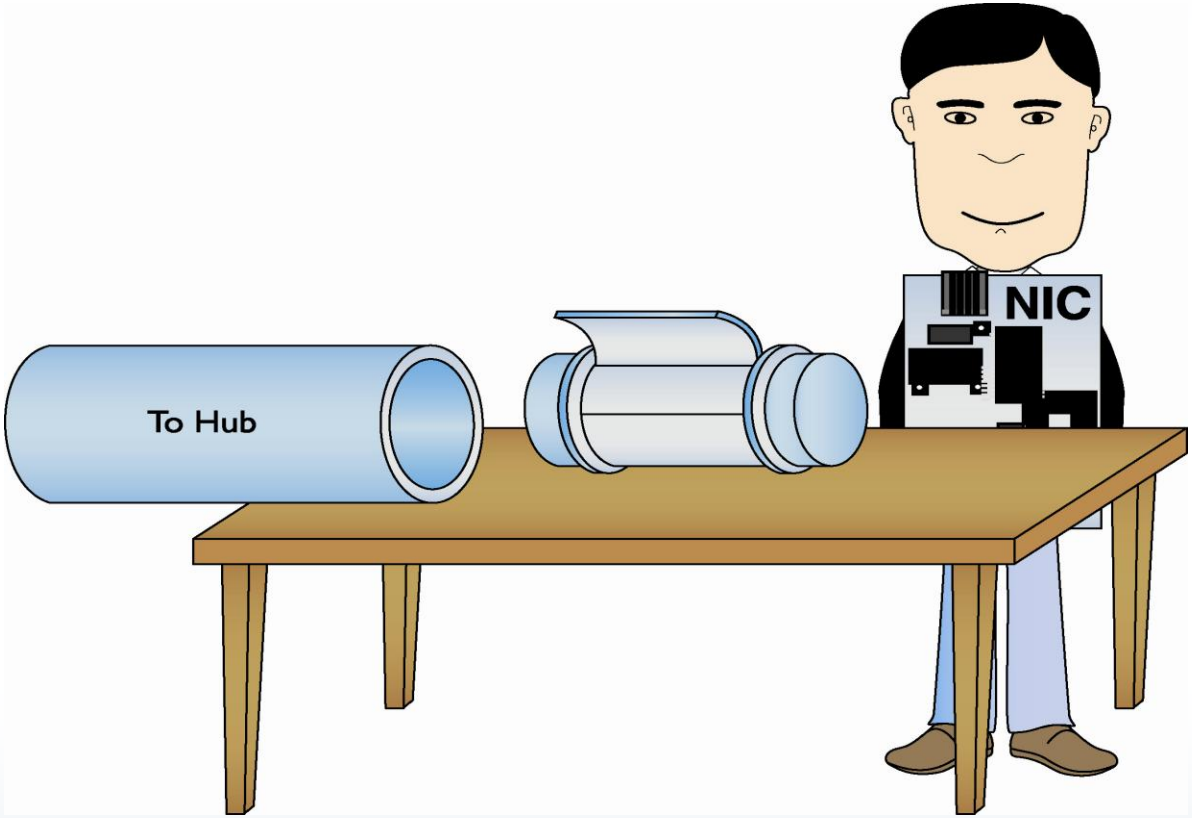


Figure 2-16 **Inside the NIC**

Inside a frame

- Frames are made up of fields that contain information
- Frames contain the recipient's MAC address, the sender's MAC address, the data itself, and a cyclic redundancy check (CRC) for error checking

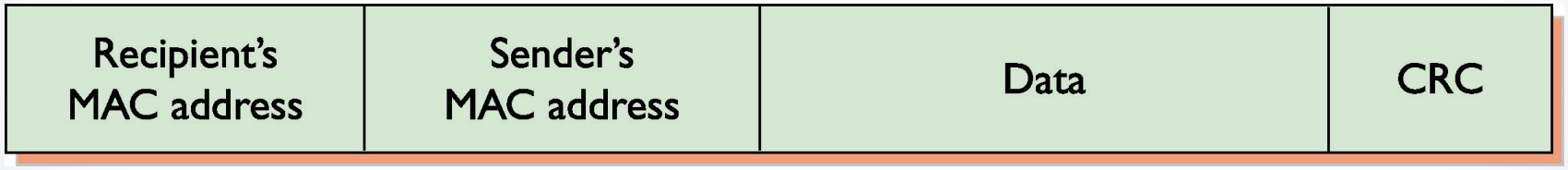


Figure 1.2.1 **Generic frame**

Frame as a canister

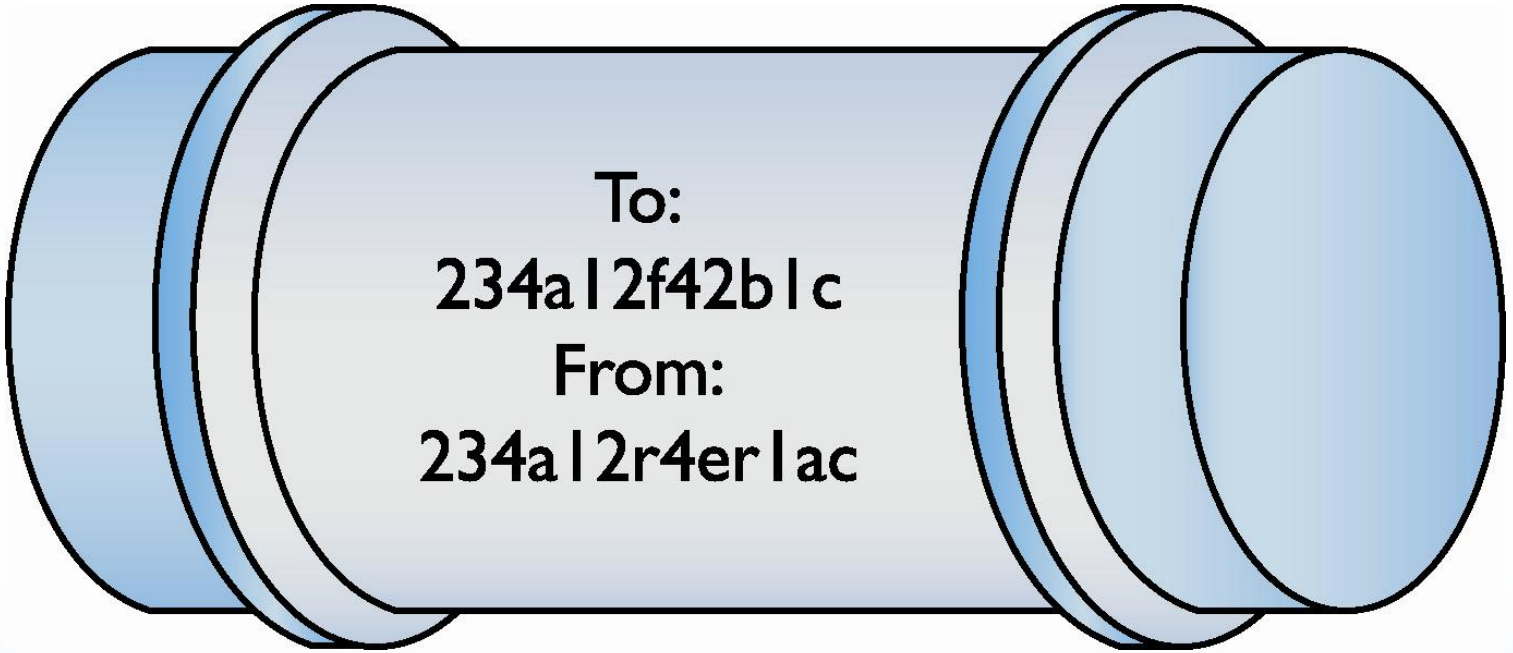


Figure 1.2.2 **Frame as a canister**

Frame Size

- Different networks use different sizes of frames
- Many frames hold about 1500 bytes of data
- The sending software breaks up large amounts of data into smaller chunks
- The receiving station must then put the chunks back together in the proper order

Processing Frames

- All devices on the network see the frame, but only the device that it is addressed to will process it
  - Every frame is received by every NIC
  - The MAC address is used to decide if the frame belongs to a given device

Getting Data on the Line

- Since the cable is shared, only one system may speak at a time
- Processes are used to keep two NICs from talking at the same time

Incoming Frame!

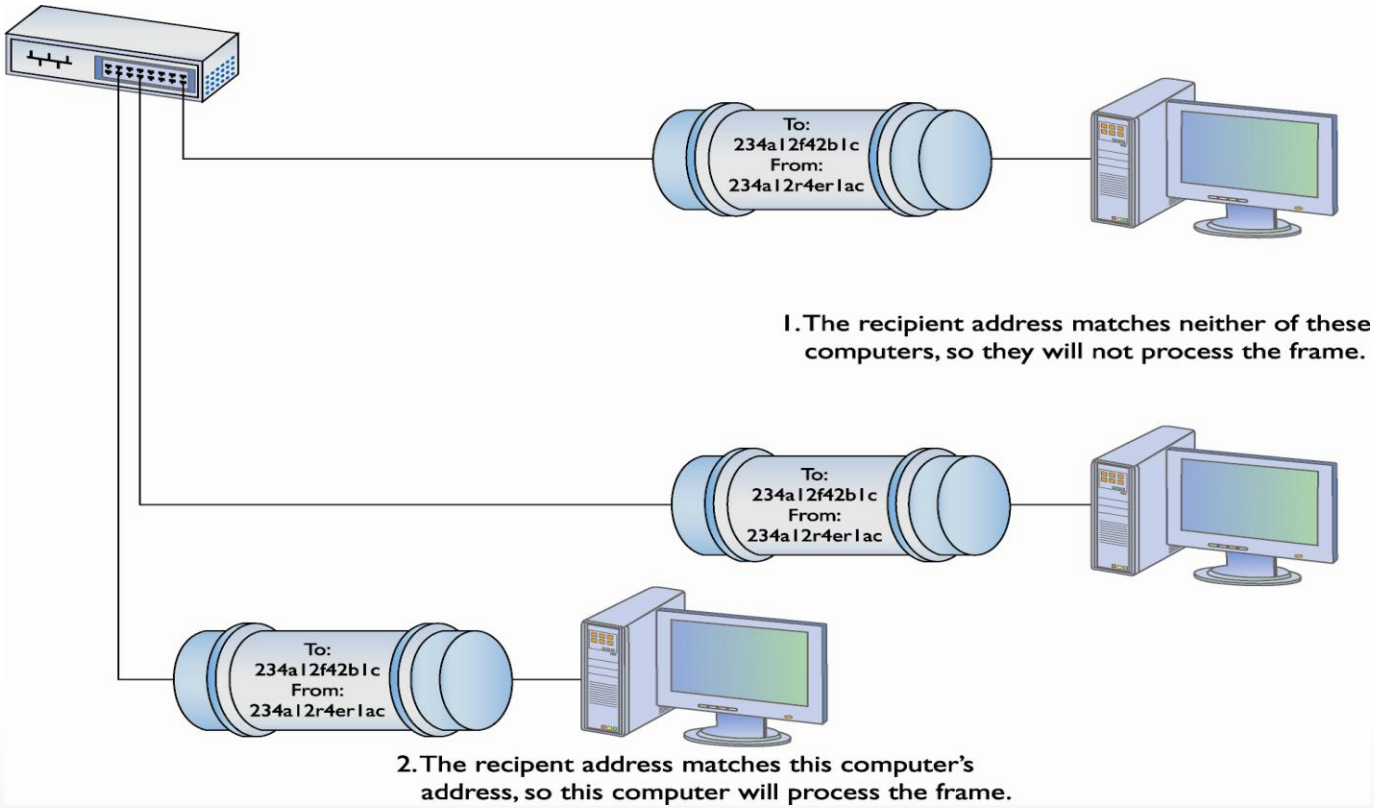


Figure 1.2.3 **Incoming frame!**

Getting To Know You

- Usually two devices have talked before, so the destination MAC address is already known
- If the MAC address is not known, a broadcast message is sent over the network
  - The destination device will respond by sending its MAC address
  - A MAC broadcast address is FF-FF-FF-FF-FF-FF

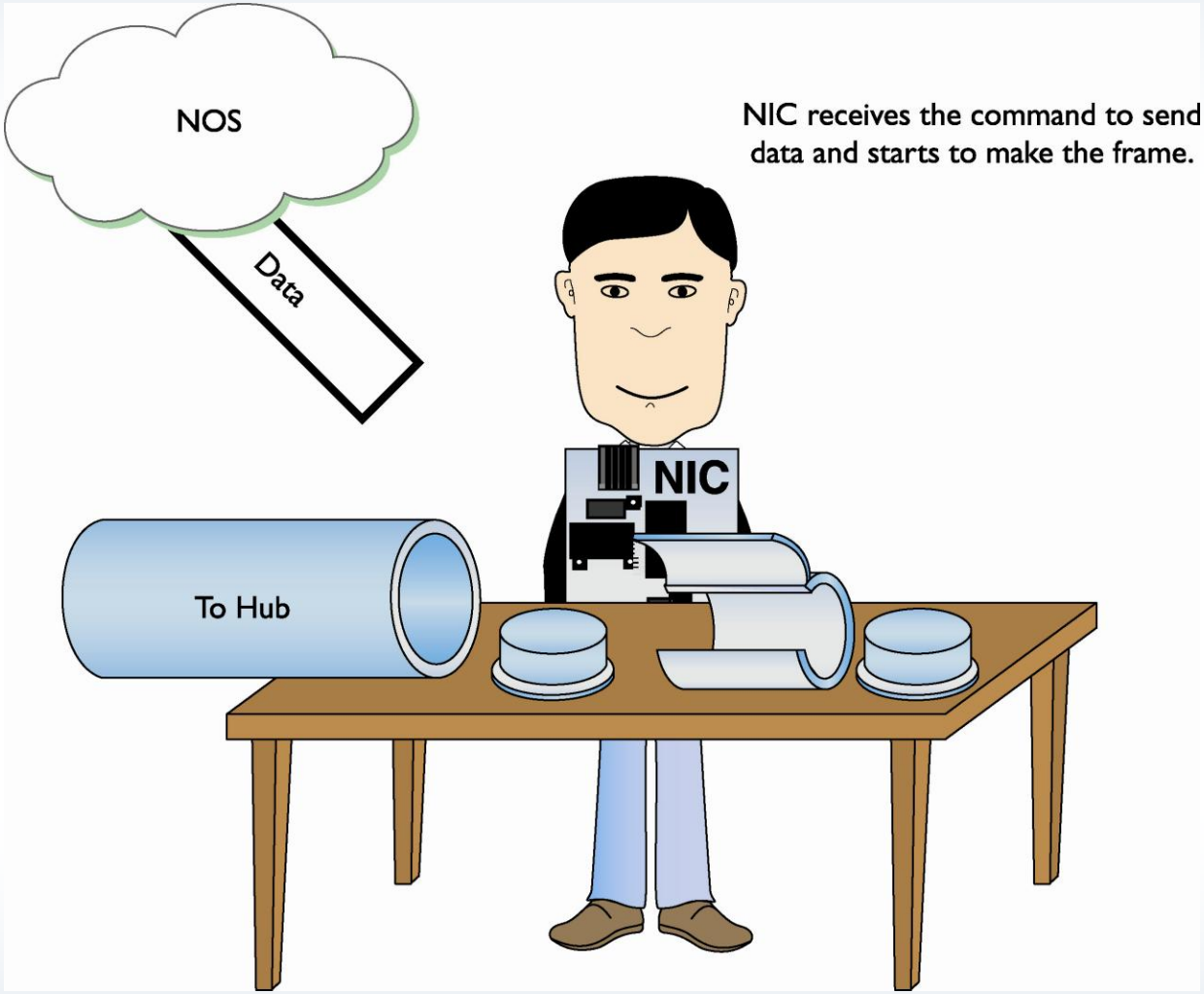


Figure 1.2.4 **Building the frame**

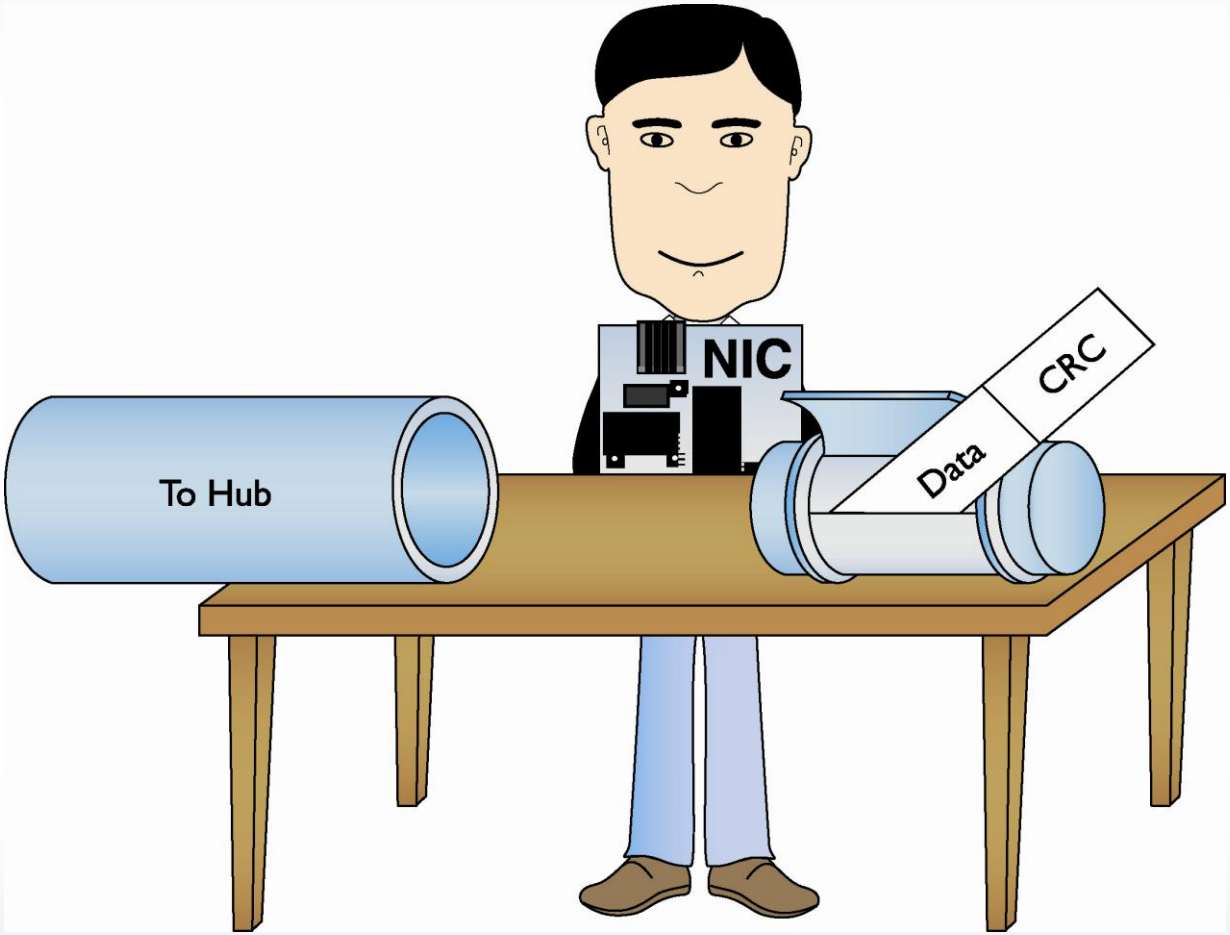


Figure 1.2.4 **Adding the data and CRC to the frame**

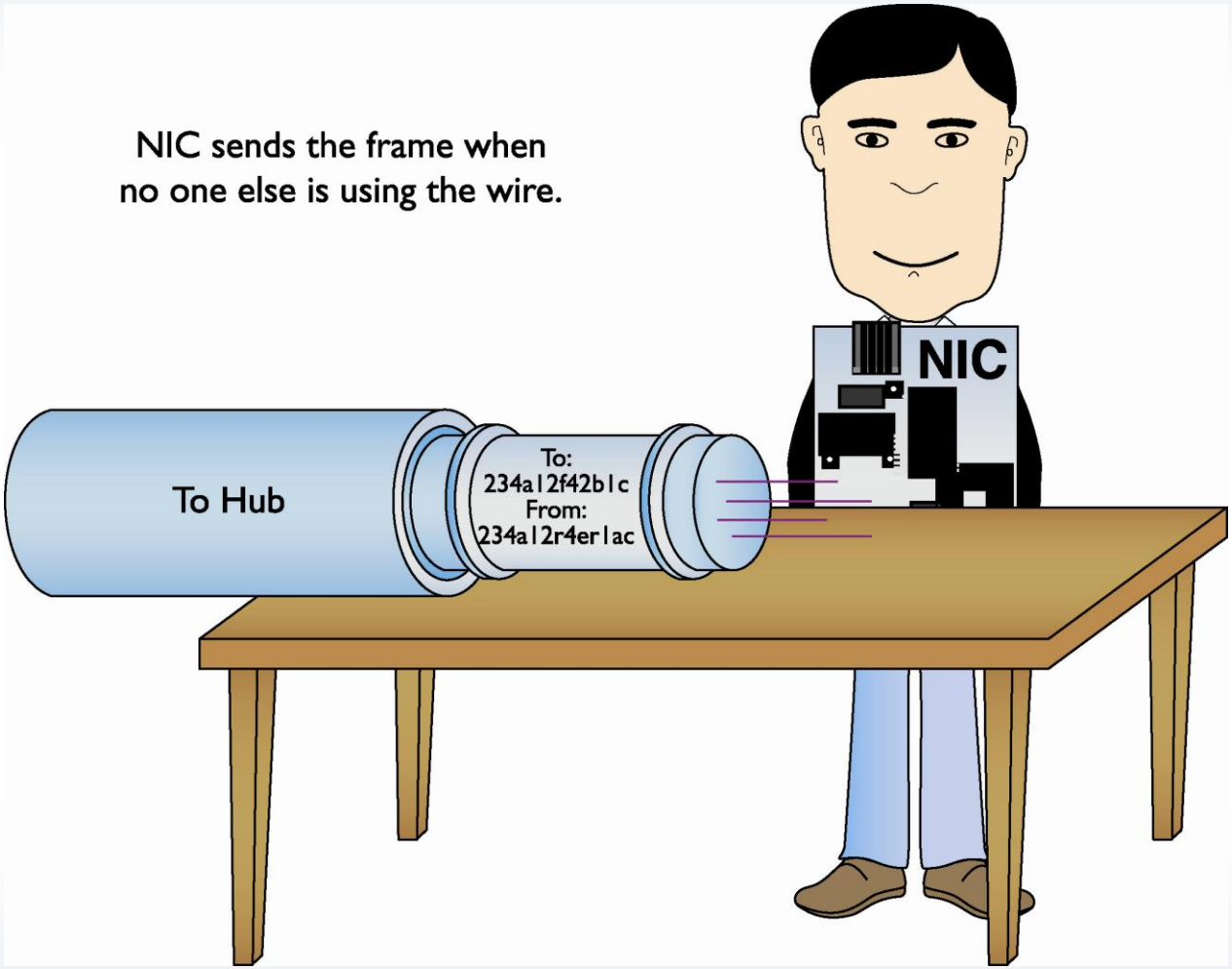


Figure 1.2.5 **Sending the frame**

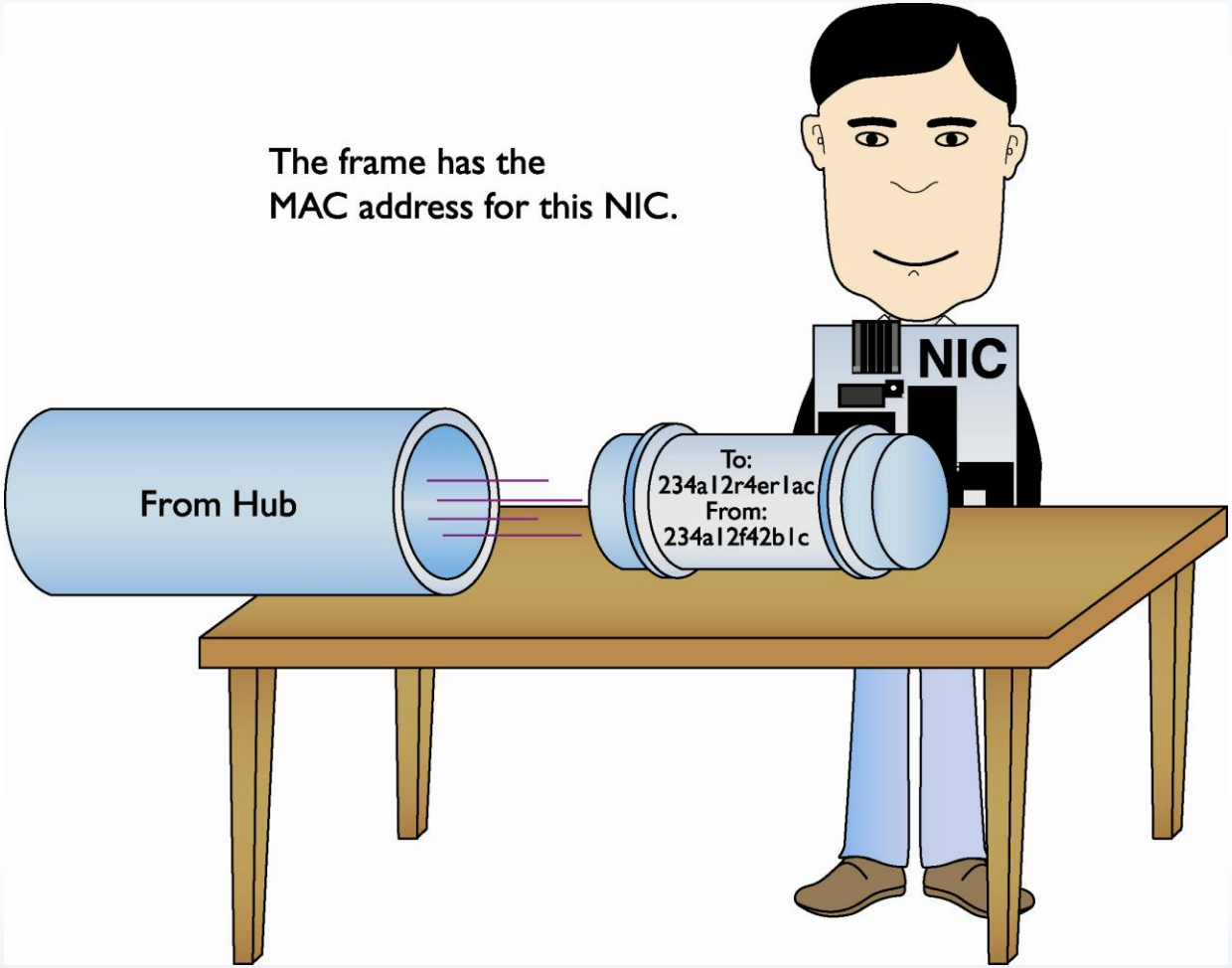


Figure 1.2.6 **Reading an incoming frame**

After the frame is received

- The receiving station checks the CRC value in the frame
  - If the value matches what it should, then the NIC sends the data portion to the network operating system for processing
  - If the value does not match, the frame has errors and must be resent

Packets

- A **packet** is unit of data transmission used in routing data accross a network
- Packets are part of the Network Layer of the OSI model
- A packet is made up of two parts
  - **Header**: Contains data used for validation and routed
  - **Packet:** Data being transmitted

Cabling

- Most networks use a cable, like this one, as a physical channel to move the bits of data

Unshielded Twisted Pair (UTP) cable

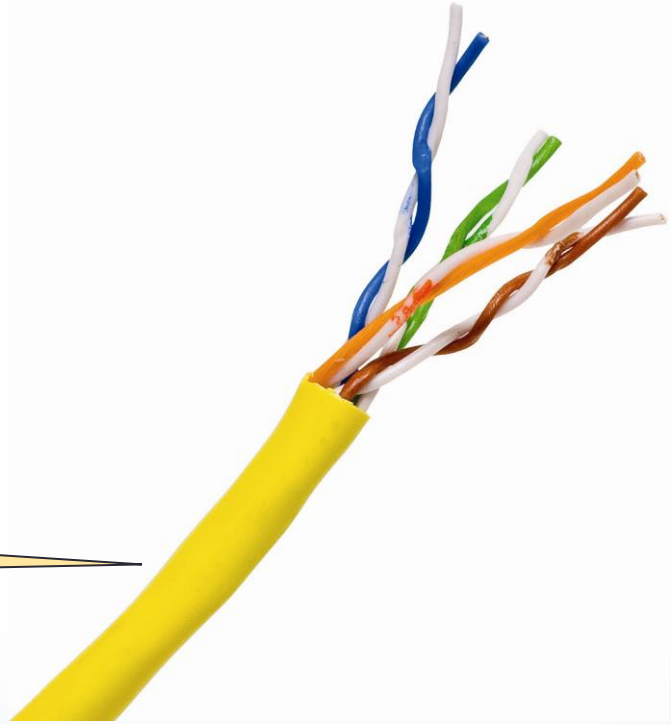


Figure 1.2.7 **UTP cabling**

Network Interface Cards

- Network Interface Cards (NICs) are installed in PCs
- Network cables attach to the NICs

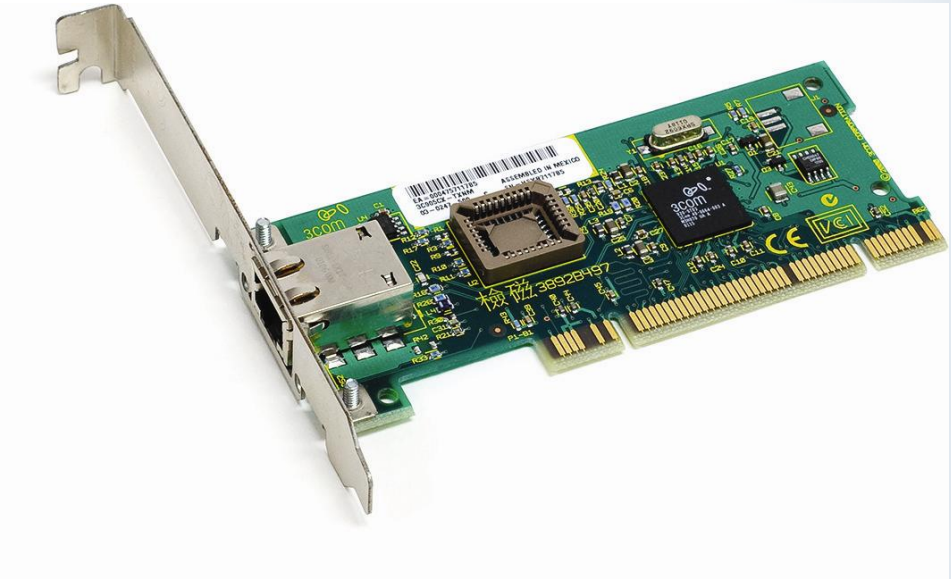


Figure 1.2.8 **Typical NIC**

NIC to Hub Connections

- Cables run from the NIC in the PC to a jack on the wall
- Cables run through the walls to the closet where they connect to a hub

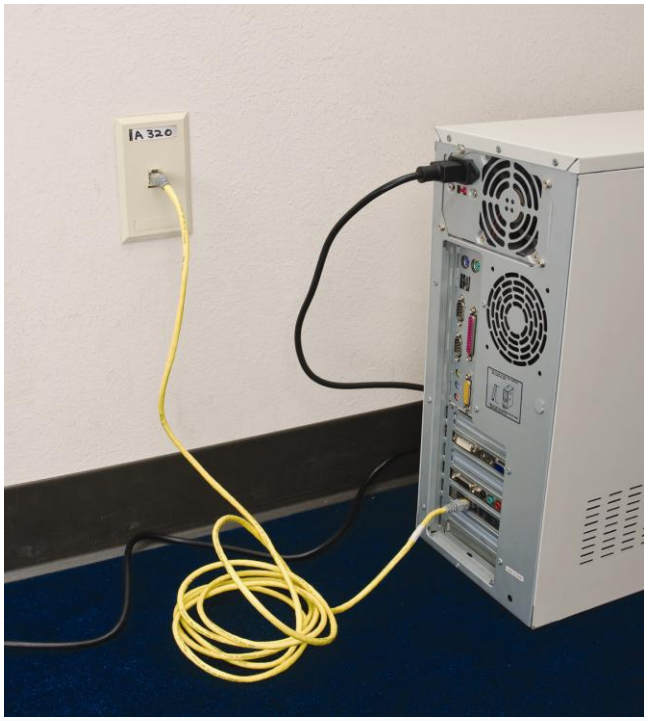


Figure 1.2.9 **NIC with cable connecting the PC to the wall jack**

The NIC

- Each system must have a unique identifier
- Media Access Control (MAC) address
  - A unique address burned into a ROM chip on the network card
  - Each MAC address is 12 hex characters or 48 bits in length

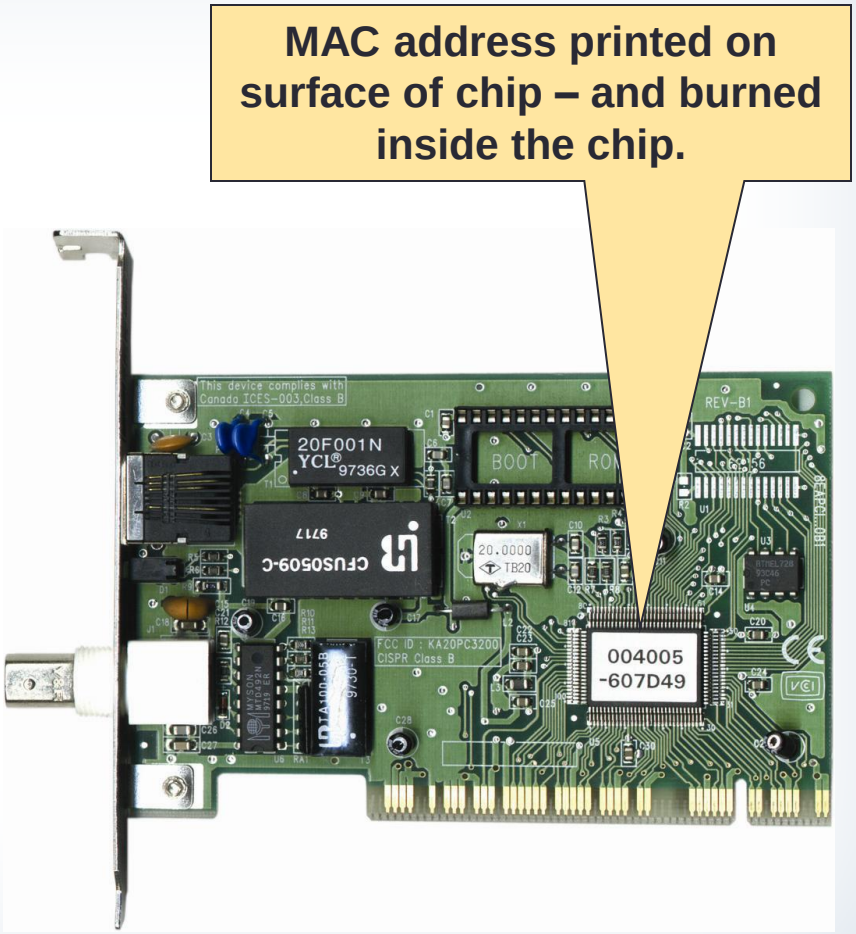


Figure 1.2.10 **MAC address**

Hub

- A **hub** is device used to connected multiple ethernet devices together to act a s a network.
- Any signal or data inputted into one port of the hub is repeated and transmitted to all the other ports.
- The hub operates on in the Physical Layer of the OSI model.
- Hubs are not commonly used and have been largely replaced by Switches and Routers.

Typical hub

Switch

Typical Switch

- A **switch** is device used to connected multiple ethernet devices together to act as a network.
- Unlike hubs, switches only transmit a received message to device intended.
- The hub operates on in the Datalink Layer of the OSI model.
- Switches replaced hubs in most networks because they are more efficient and more secure

Router

- A **router** is used to connect different networks or data lines.
- A router reads the address information from a packet to determine its final destination. It uses stored infromation called a **routing table** to ensure it gets to the right location.
- The hub operates on in the Internet Layer of the OSI model.
- Routers make up the backbone of the internet since they primarily connect two networks together.

Typical Router

Multilayer Switch

Typical Switch

- A **Multilayer switch** is a switch that performs additional functions in higher OSI layers
- Many multilayer switches perform operations in the internet later of the OSI model.
- Even though they operate on the same OSI layer as routers, they are used to connect devices not networks together.

Bridge

Typical Bridge