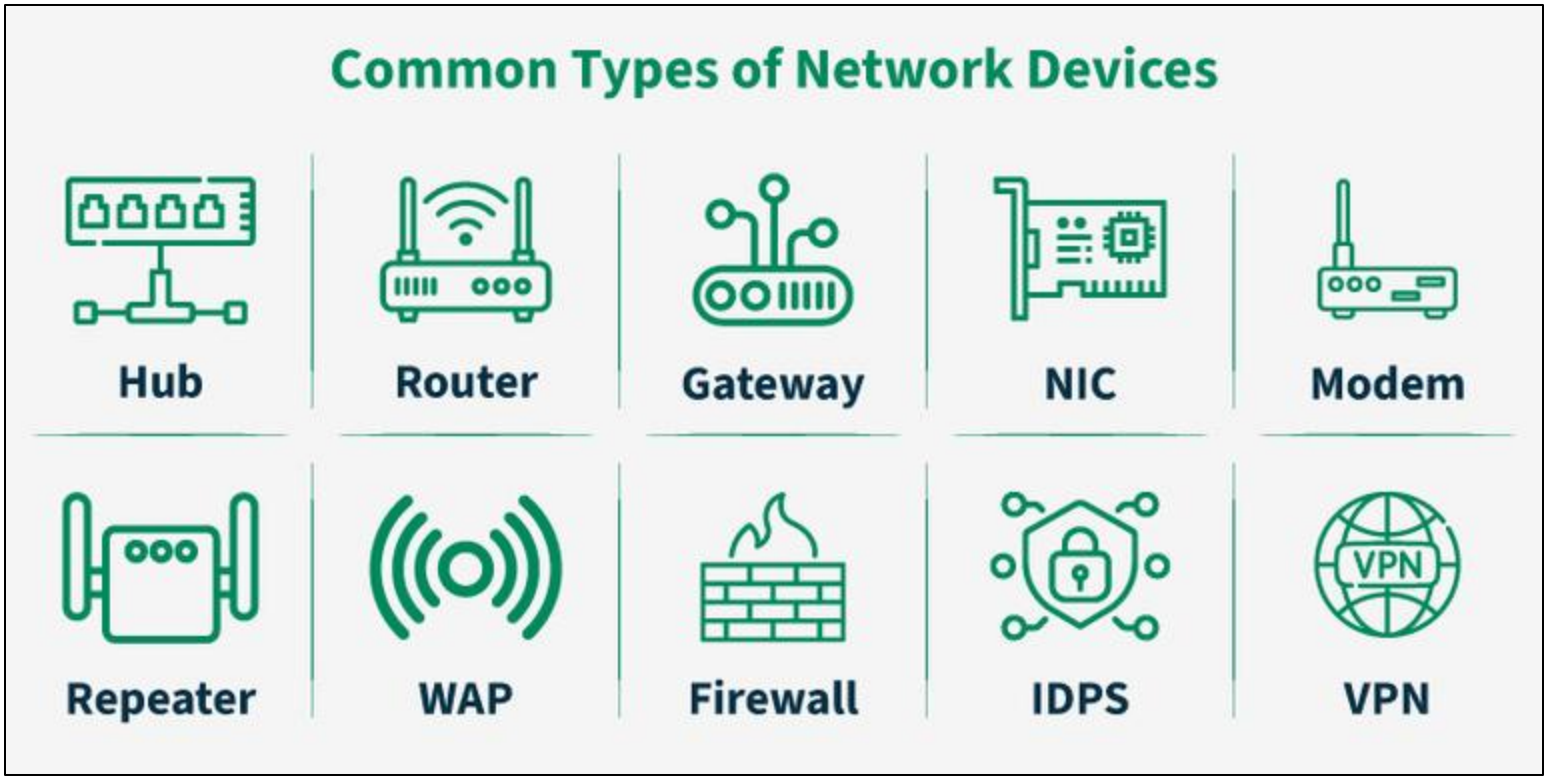
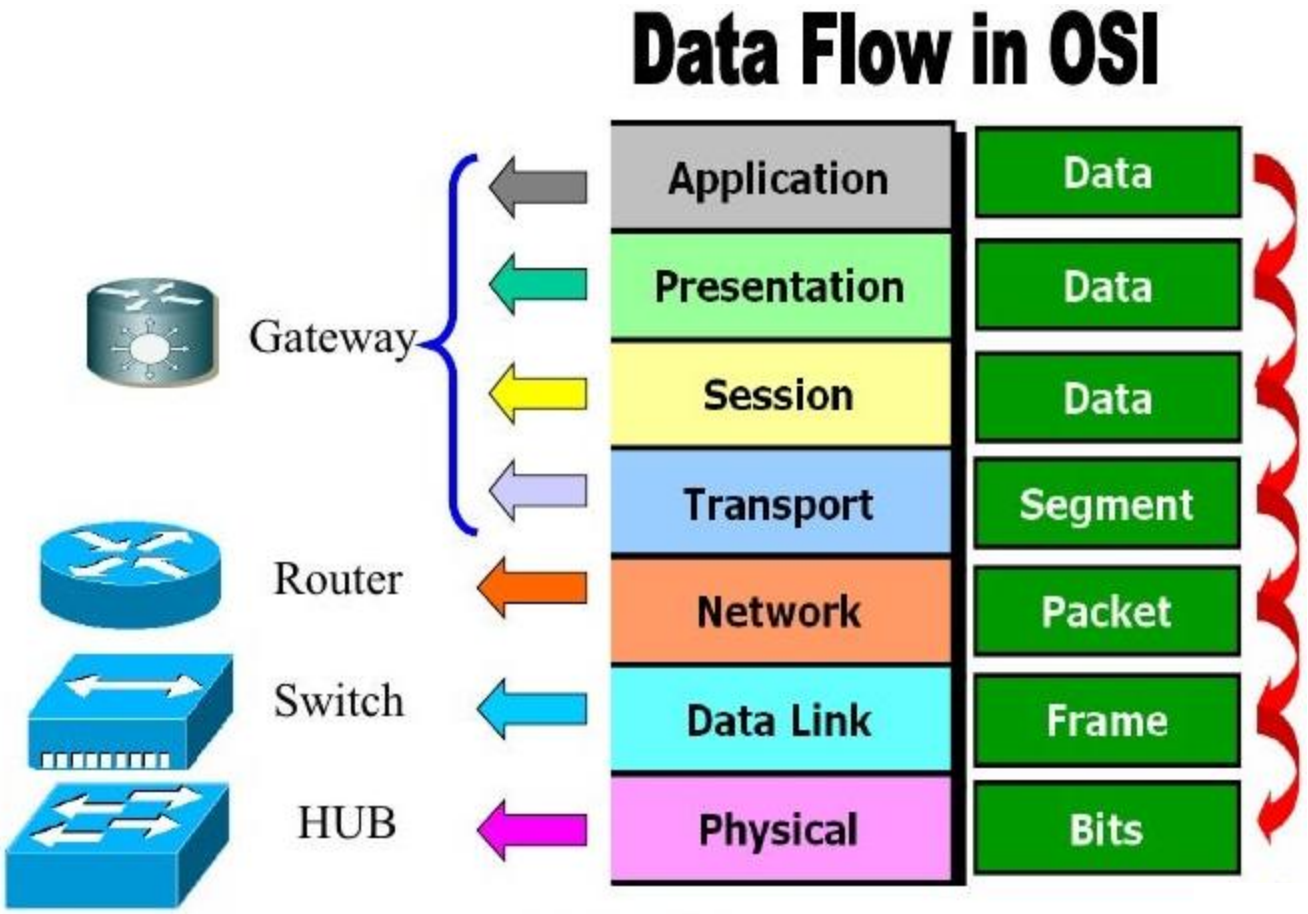
Sanchita Mallick Roy


Common Types of Network Devices
Hub
Router
Gateway
NIC
Modem
Repeater
WAP
Firewall
IDPS
VPN
VPN


Data Flow in OSI
Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Data
Data
Segment
Packet
Frame
Bits
Gateway
Router
Switch
HUB

Repeater

- A repeater connects different segments of a LAN
- A repeater forwards every frame it receives
- A repeater is a regenerator, not an amplifier
- It can be used to create a single extended LAN

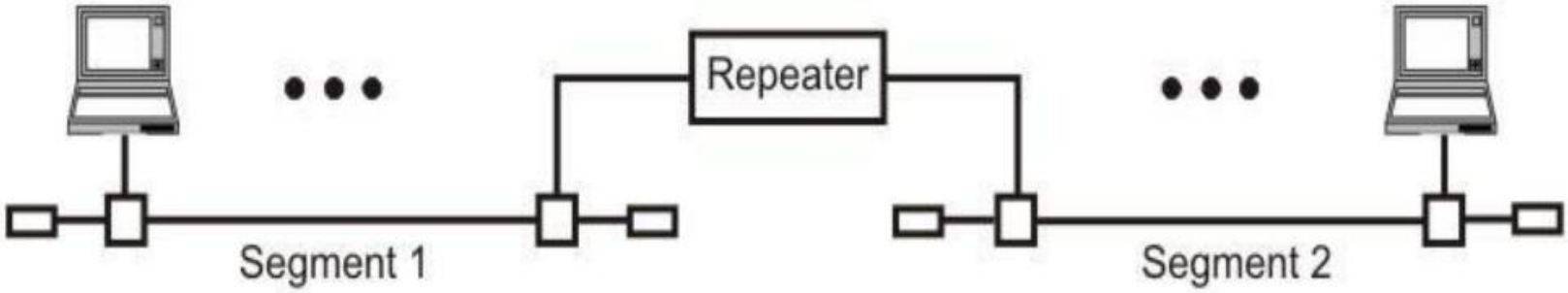


Figure Repeater connecting two LAN segments

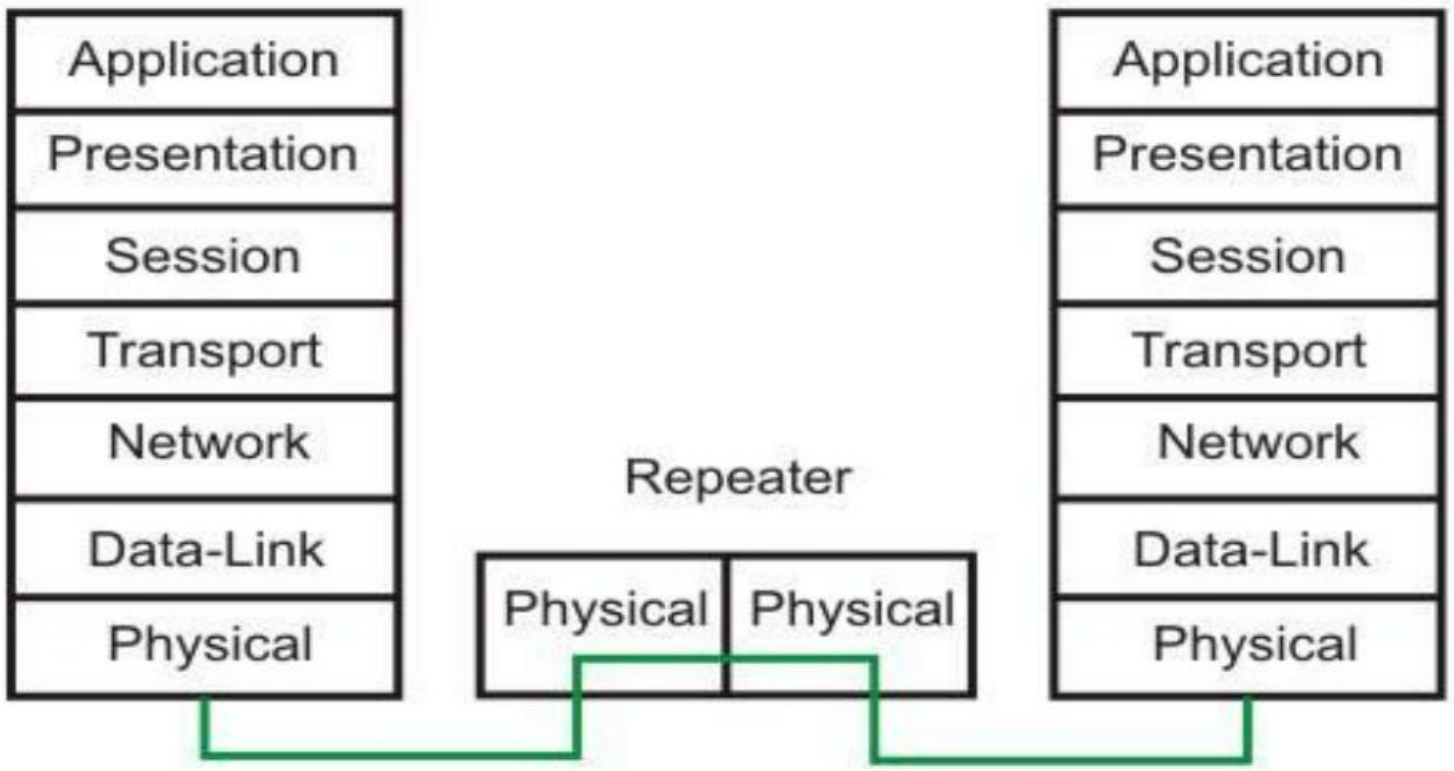


Figure Operation of a repeater as a level-1 relay

Hub

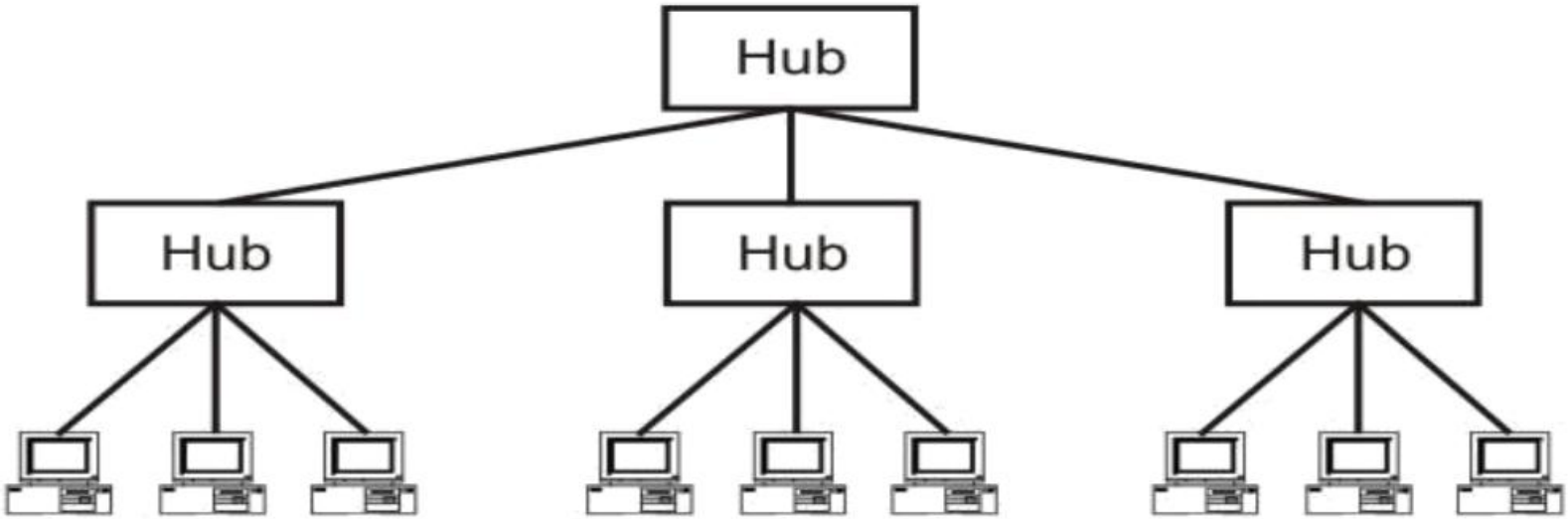


Figure Hub as a multi-port repeater can be connected in a hierarchical manner to form a single LAN with many nodes

A **repeater** strengthens signals to increase network distance, while a **hub** connects multiple devices and broadcasts data to all of them.

Simple Explanation

- **Repeater** → Extends the signal over a longer distance.
- **Hub** → Connects many computers and repeats data to all of them.

Basis	Repeater	Hub
Function	Regenerates or amplifies a weak signal to extend network distance.	Connects multiple devices in a network and broadcasts data to all ports.
Number of Ports	Usually has **2 ports** (connects two segments).	Has **multiple ports** (connects many devices).
Working	Works only to **strengthen signals**.	Works as a **multi-port repeater** and sends data to all connected devices.
Traffic Handling	Does not manage network traffic.	Broadcasts data to all devices, which can increase traffic.

Bridge

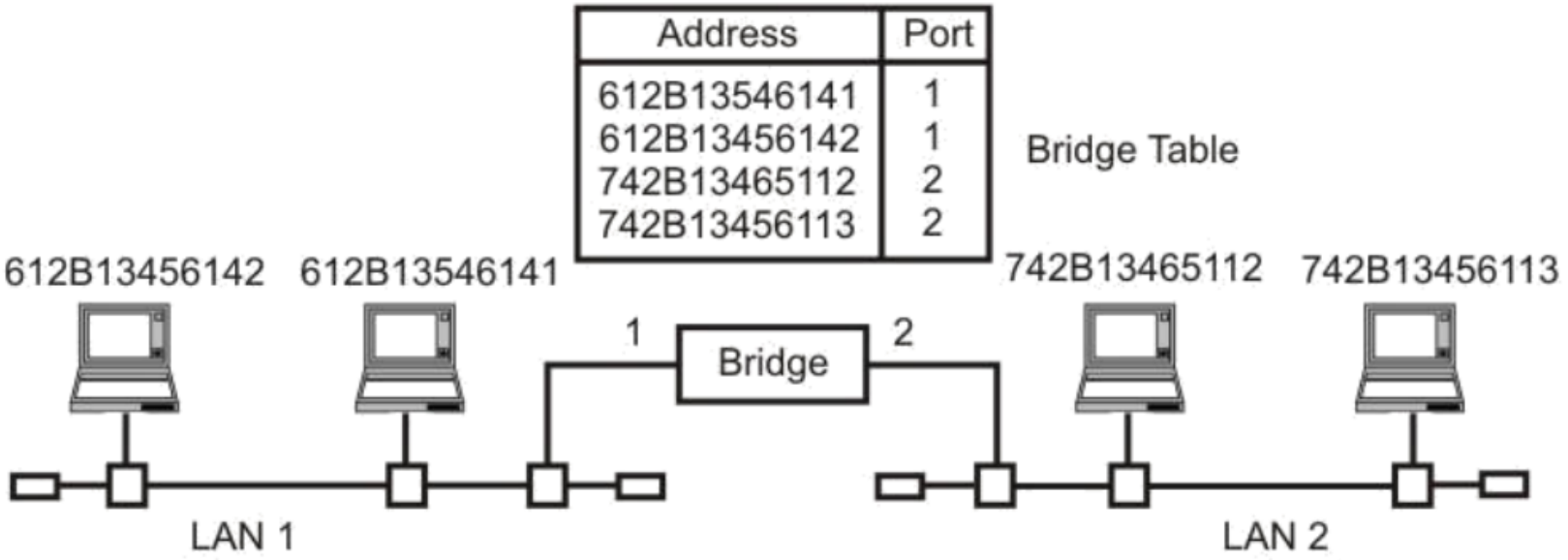


Figure A bridge connecting two separate LANs

- A bridge operates both in physical and data-link layer
- A bridge uses a table for filtering/routing
- A bridge does not change the physical (MAC) addresses in a frame

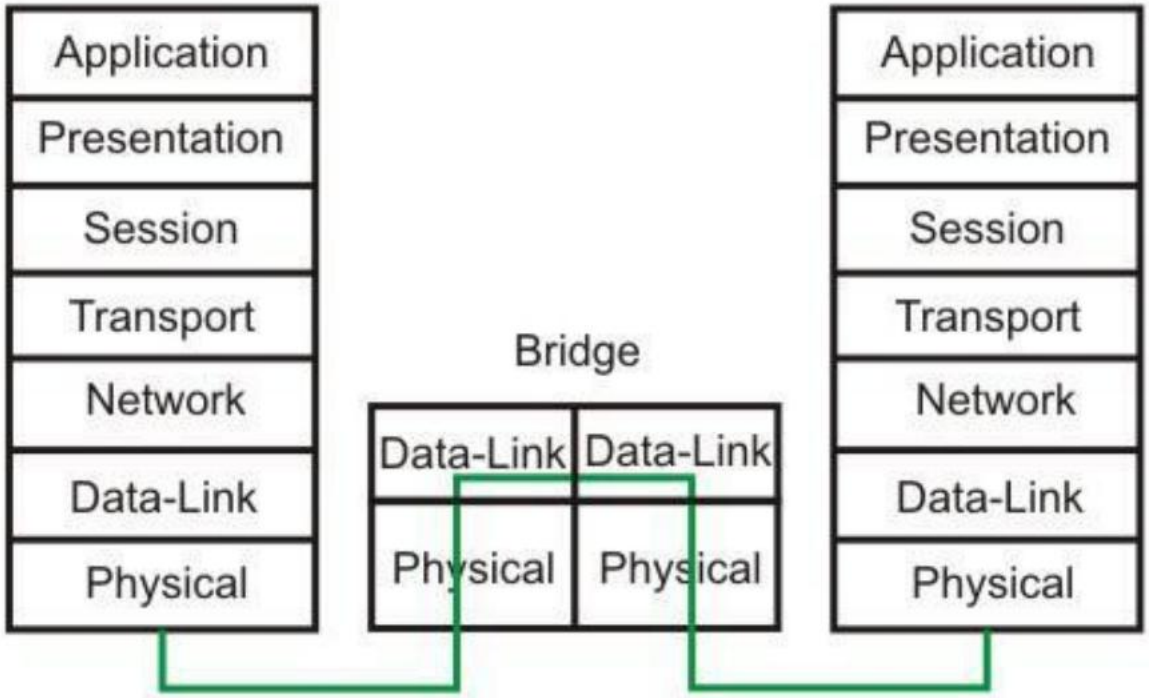


Figure Information flow through a bridge

Switch

- A **switch** is a networking device used to connect multiple devices within a **Local Area Network (LAN)**.
- It operates mainly at the **Data Link Layer (OSI Layer 2)**.
- A switch uses **MAC addresses** to forward data to the correct destination device.
- Unlike a hub, a switch **does not broadcast data** to all devices; it sends data only to the intended receiver.
- Each port of a switch forms a **separate collision domain**, which reduces network collisions.
- Switches improve **network efficiency and performance**.
- Modern switches can support **full-duplex communication**.

Basis	Bridge	Switch
Definition	A bridge connects **two or a few LAN segments** and filters traffic.	A switch connects **many devices** in a LAN and forwards data to the correct port.
Number of Ports	Usually **2–4 ports**.	Usually **8, 16, 24 or more ports**.
Speed	Slower than a switch.	Faster because of hardware-based switching.
Collision Domain	Divides network into a **few collision domains**.	Each port is a **separate collision domain**.
Usage	Used in **small or older networks**.	Used in **modern networks** like offices and labs.

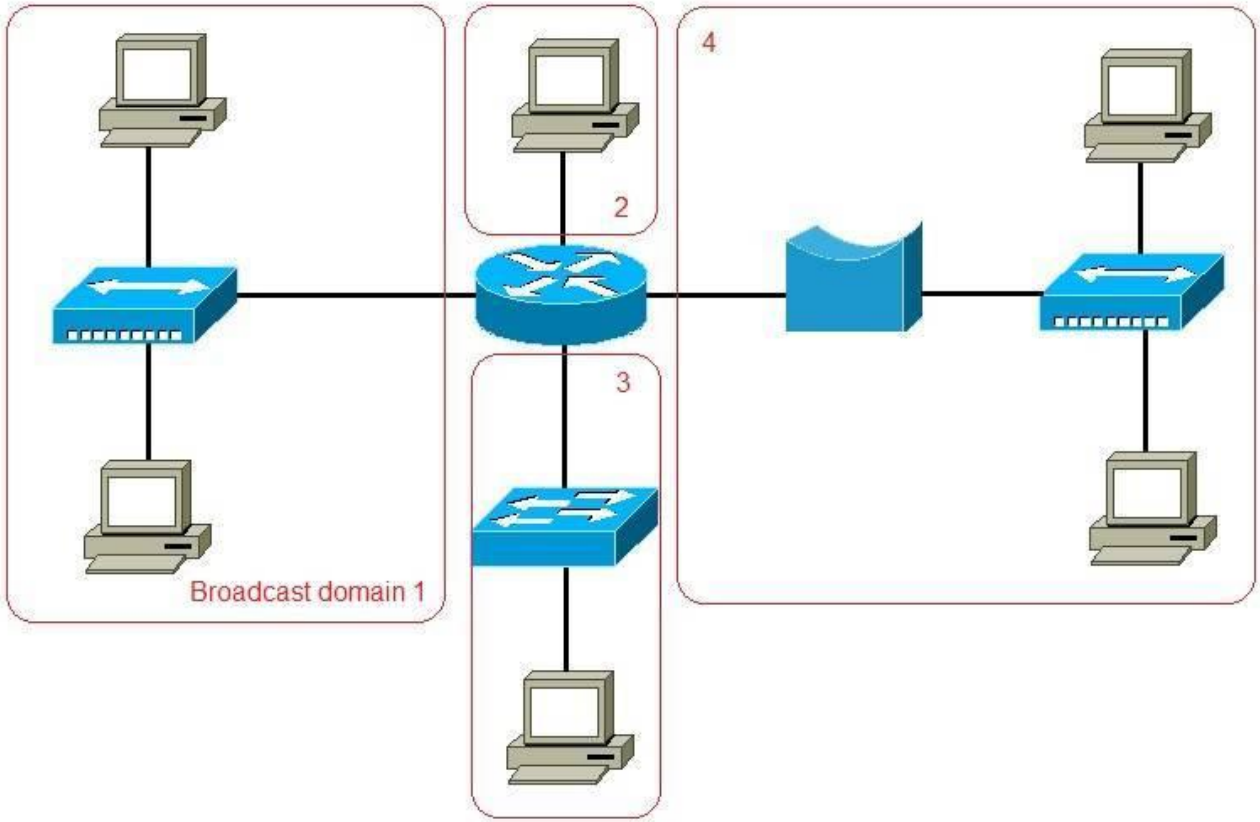
Examples

Bridge Example:

A college has **two computer labs** in different rooms. A bridge connects the two lab networks so they can communicate while reducing unnecessary traffic between them.

Switch Example:

In a **computer lab with 20 computers**, a switch connects all computers so that data is sent only to the intended computer, improving speed and efficiency.



Hub

Bridge

Switch

Router

Router

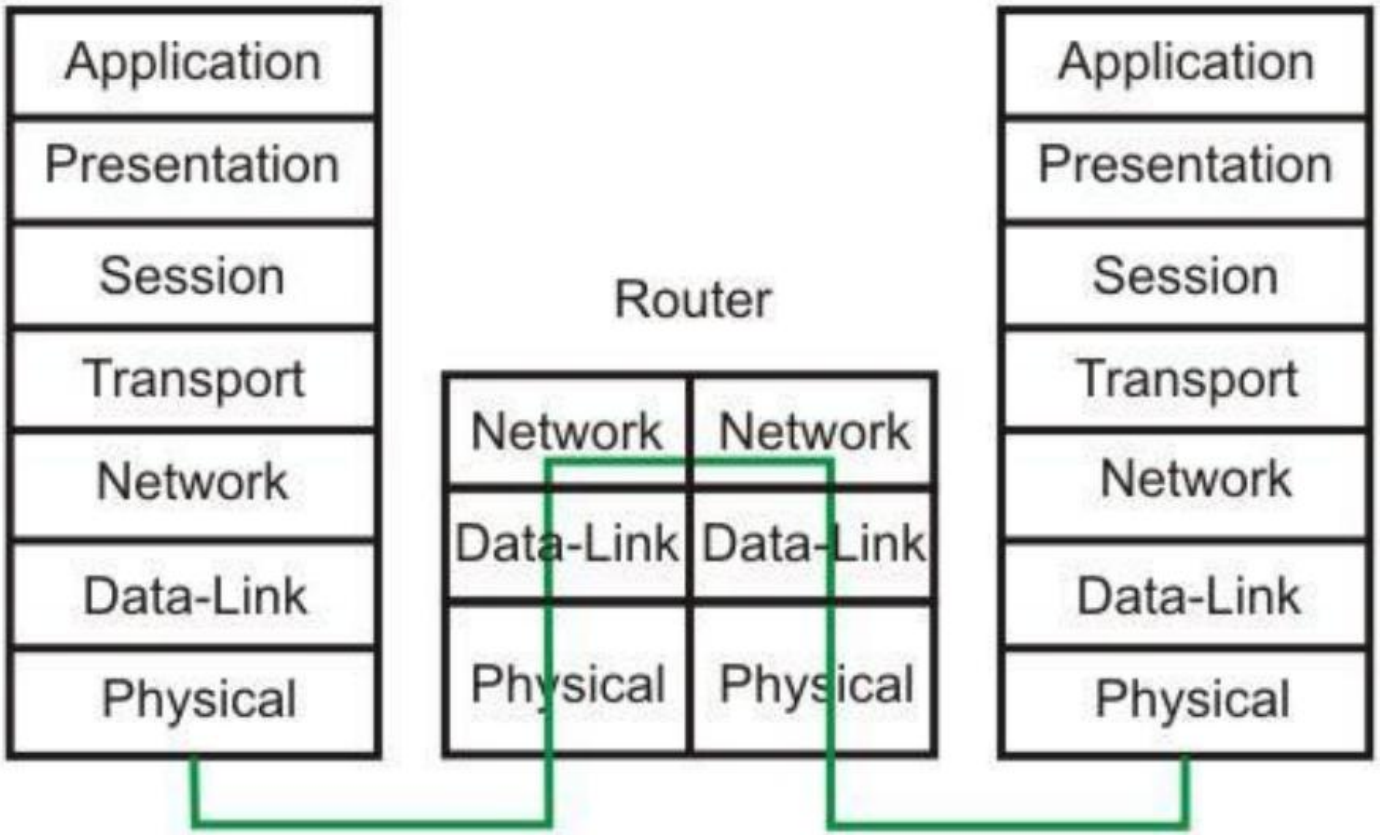


Figure Communication through a router

Router

- A **router** is a networking device used to connect **different networks** together.
- It operates at the **Network Layer (OSI Layer 3)**.
- A router uses **IP addresses** to determine the best path for data transmission.
- It forwards data packets between networks based on **routing tables**.
- Routers help reduce network traffic by **filtering broadcast messages**.
- They provide **security features** such as firewalls and access control.
- Routers support both **wired and wireless communication**.
- They are commonly used to connect **LANs to the Internet**.

Gateway

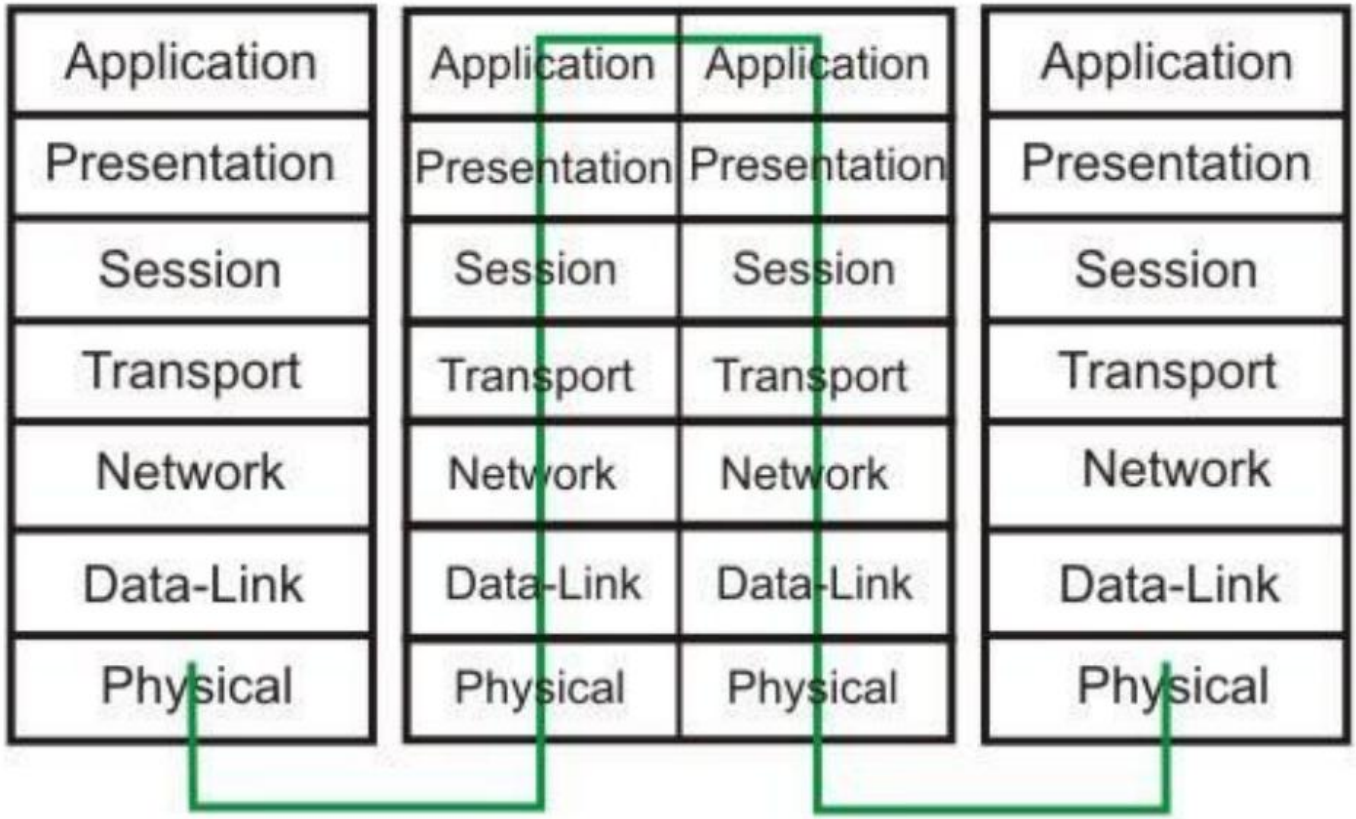


Figure Communication through a gateway

Gateway

- A **gateway** is a networking device that connects **networks using different protocols**.
- It operates at **multiple layers of the OSI model**, unlike routers and switches.
- A gateway performs **protocol conversion** between incompatible networks.
- It enables **communication between different network architectures**.
- Gateways can provide **security functions** such as data filtering and access control.
- They are often used to connect **LANs with WANs or the Internet**.
- A gateway acts as an **entry and exit point** for network traffic.
- It supports **data translation, message formatting, and address mapping**.

Router

Definition:

A router is a networking device that **connects two or more networks** and forwards data packets based on IP addresses.

Examples:

- A **home Wi-Fi router** connecting your **home network to the Internet**.
- In a **college or office**, a router connects the **LAN to the ISP network**.

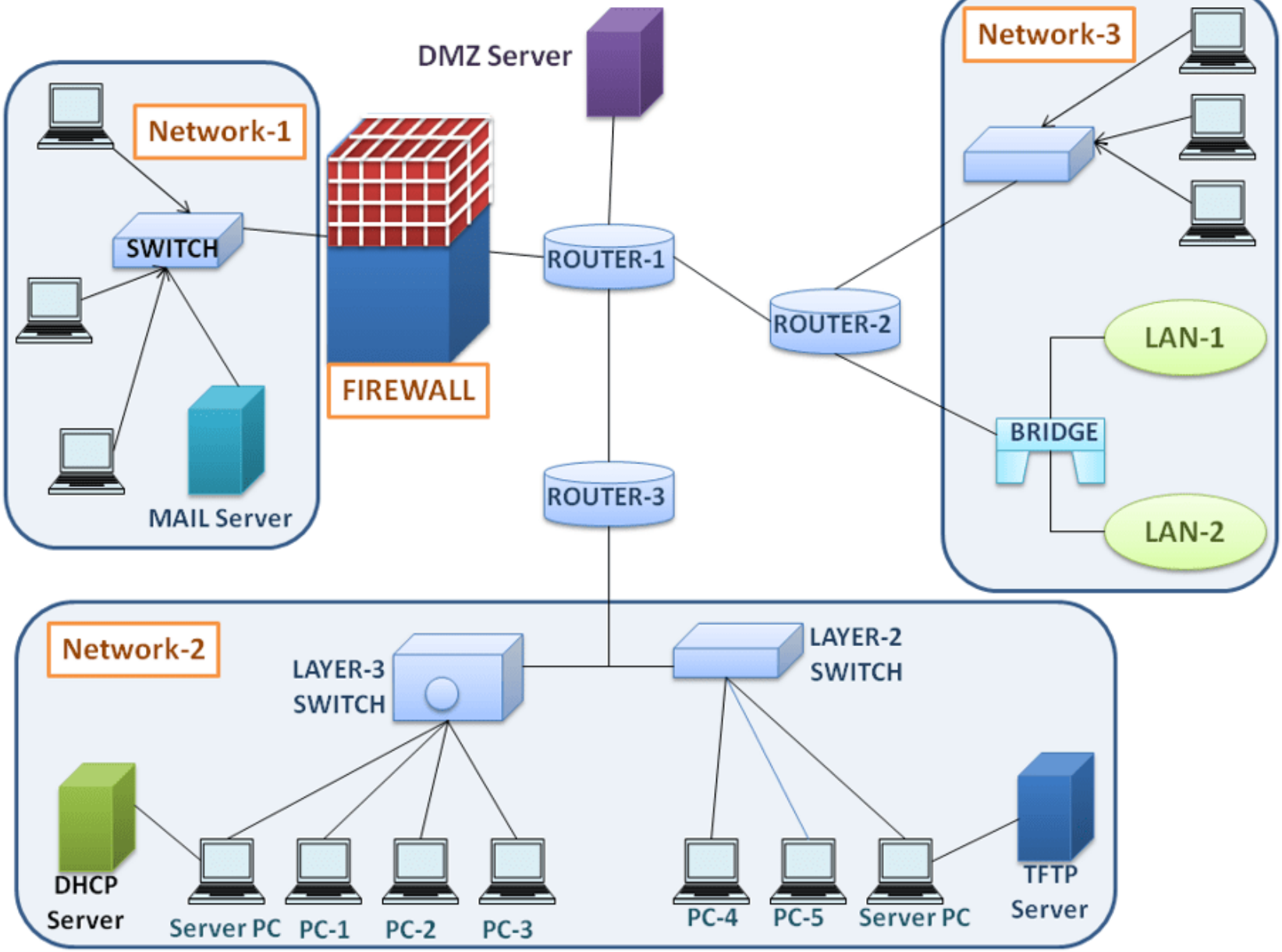
Gateway

Definition:

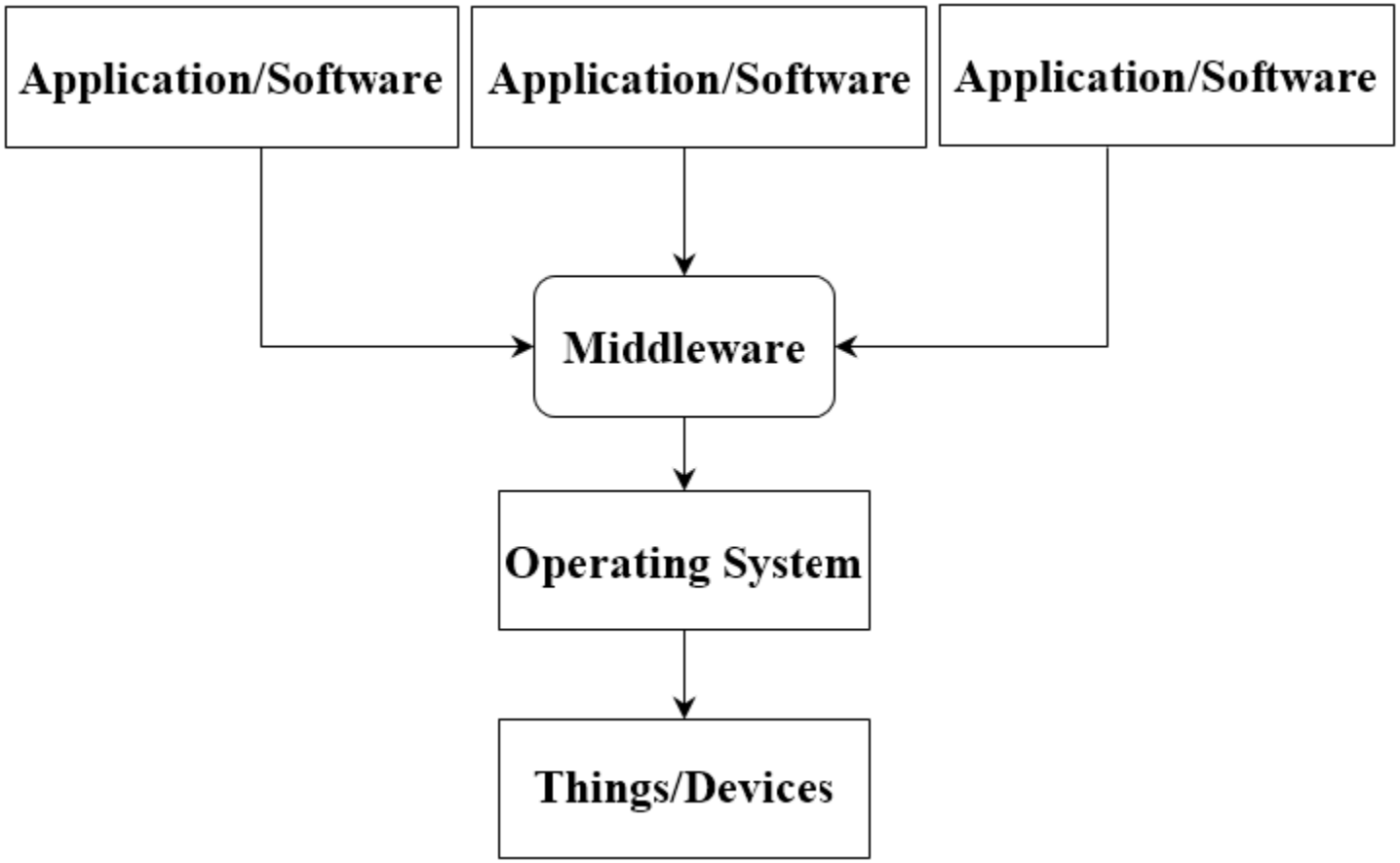
A gateway is a device that **connects different types of networks** and can **translate data formats or protocols** so the networks can communicate.

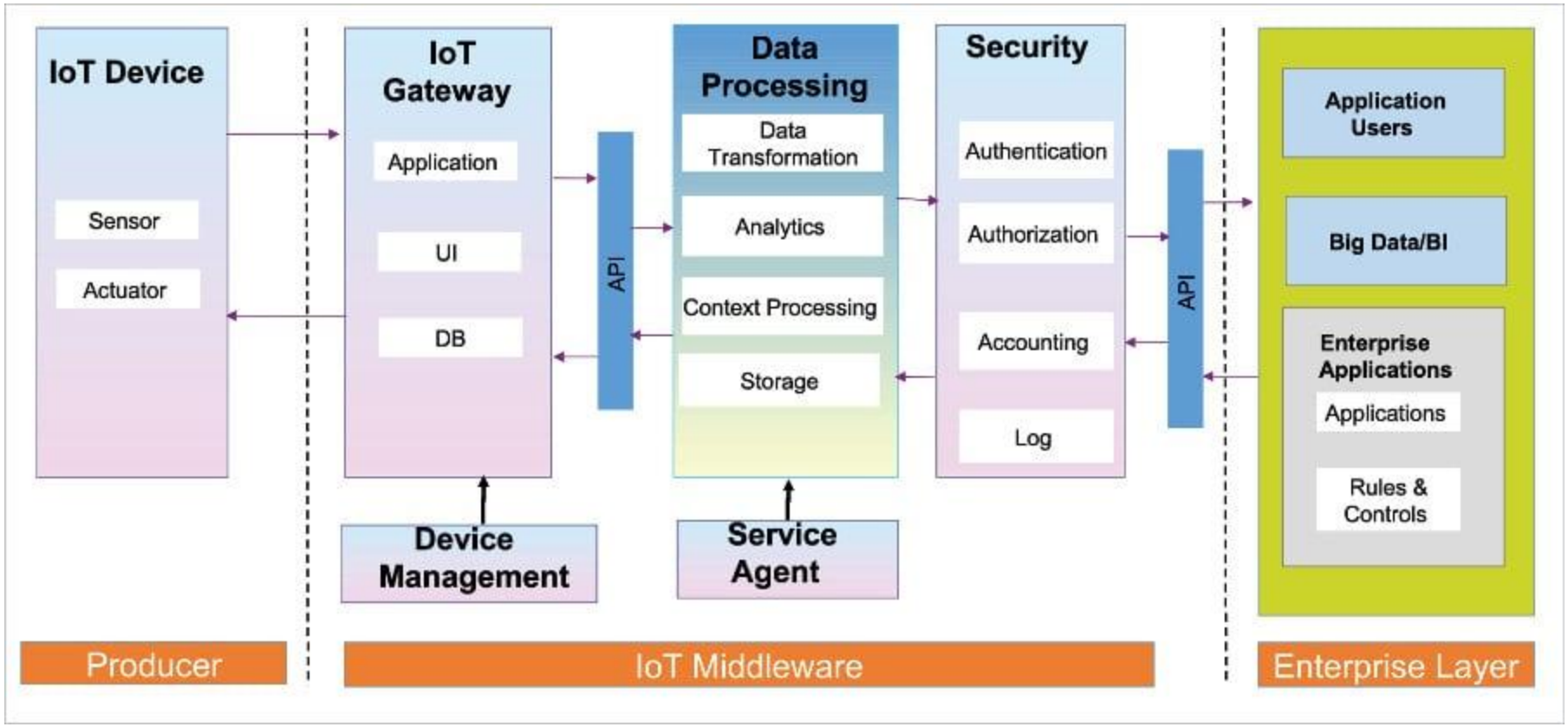
Examples:

- A **network gateway** that connects a **LAN using IPv4** to another network using a different protocol.
- An **email gateway** that converts messages between different mail systems.


DMZ Server
Network-1
SWITCH
FIREWALL
ROUTER-1
ROUTER-2
Network-3
LAN-1
BRIDGE
LAN-2
MAIL Server
ROUTER-3
Network-2
LAYER-3
SWITCH
LAYER-2
SWITCH
DHCP
Server
Server PC
PC-1
PC-2
PC-3
PC-4
PC-5
Server PC
TFTP
Server

IOT middleware




IoT Device
Sensor
Actuator
IoT Gateway
Application
UI
DB
API
Data Processing
Data Transformation
Analytics
Context Processing
Storage
Security
Authentication
Authorization
Accounting
Log
API
Application Users
Big Data/BI
Enterprise Applications
Applications
Rules & Controls
Device Management
Service Agent
Producer
IoT Middleware
Enterprise Layer

Role of Middleware in IoT

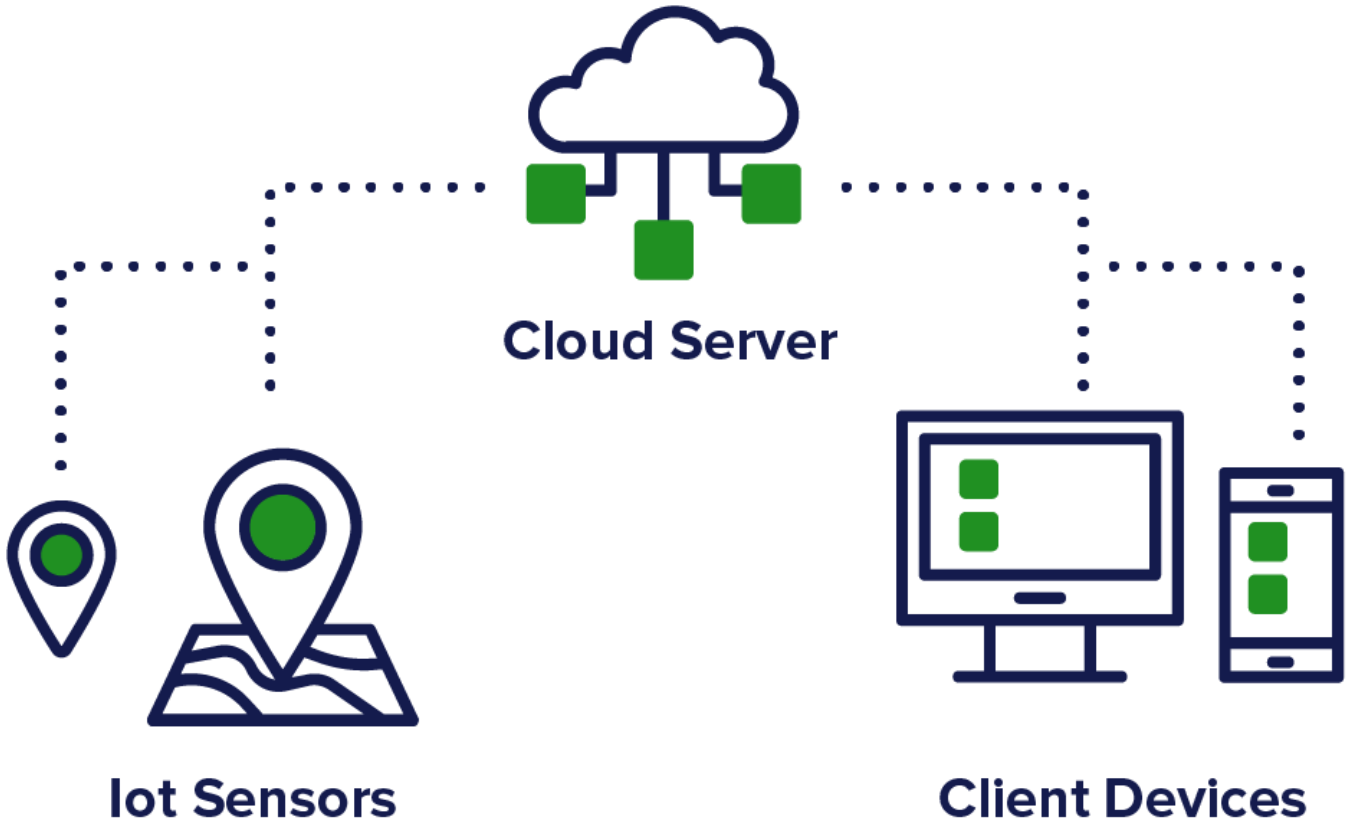
Middleware in the **Internet of Things (IoT)** acts as an **intermediate software layer** between IoT devices (sensors/actuators) and applications. Its main roles are:

- **Device Management:** Handles device registration, configuration, monitoring, and updates.
- **Data Management:** Collects, filters, aggregates, and stores data from heterogeneous IoT devices.
- **Interoperability:** Enables communication between devices and systems using **different protocols and data formats**.
- **Communication Management:** Supports reliable data exchange using protocols such as **MQTT, CoAP, and HTTP**.
- **Scalability:** Manages a large number of devices and data streams efficiently.
- **Security:** Provides authentication, authorization, encryption, and access control.
- **Abstraction:** Hides hardware and network complexity, allowing developers to focus on application logic.
- **Application Integration:** Connects IoT data with cloud services, analytics platforms, and user applications.

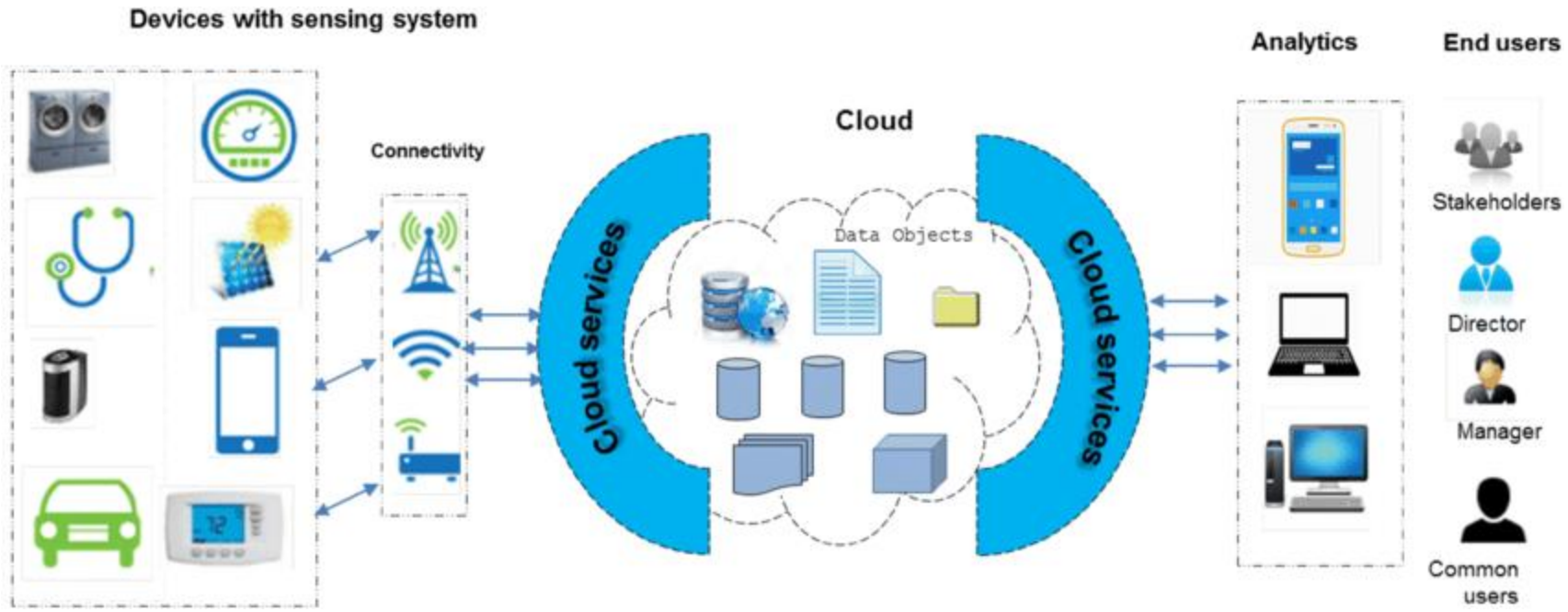
Wired and wireless Technology

Aspect	Wired Network	Wireless Network
Data Speed	High and consistent data rates	Lower and variable compared to wired
Bandwidth	Higher bandwidth availability	Limited bandwidth
Latency	Low latency	Higher latency
Reliability	Very reliable with minimal interference	Affected by interference, obstacles, and distance
Signal Quality	Stable signal quality	Signal degrades with distance and obstacles
Security	More secure (physical access required)	Less secure, more vulnerable to attacks
Mobility	No mobility; fixed connections	High mobility and flexibility
Installation Cost	Higher initial cost due to cabling	Lower installation cost
Maintenance	Easier to troubleshoot and maintain	More complex due to interference issues

Cloud Computing and IoT



Role of Cloud Computing in IoT



1. Data Storage

IoT devices (sensors, smart devices, wearables, etc.) continuously produce large volumes of data.

Cloud platforms provide **secure, unlimited, scalable storage for this data**.

2. Data Processing and Analysis

The cloud offers high computing power to:

•Process real-time data

•Perform big data analytics

•Use AI and machine learning algorithms

This helps in making intelligent decisions.

3. Scalability

Cloud computing allows IoT systems to:

Easily increase or decrease resources

Handle millions of connected devices

Support growing data traffic

4. Remote Access

Users can:

Monitor devices from anywhere

Control IoT systems remotely

Access real-time information through web or mobile apps

5. Security

Cloud service providers offer:

•Data encryption

•Authentication and authorization

•Backup and disaster recovery

6. Cost Efficiency

•No need to buy expensive hardware

•Pay-as-you-use model

•Reduced maintenance cost

7. Integration with Other Services

Cloud platforms easily integrate with:

•Databases

•AI services

•Business applications

Example

In smart homes, IoT sensors collect temperature and security data. The cloud stores and analyzes this data and allows users to control devices through mobile applications.

Thank You