# **52. LAN ARCHITECTURES**

## **Overview**

* You have studied various network technologies: Routing, Switching, STP, EtherChannel, OSPF, FHRPs, Switch Security Features, etc.
  + Now, let’s look at some basic network design/architecture.
* There are standard "best practices" for network design.
  + However, there are few universal "correct answers."
  + The answer to most general questions about network design is "It depends."
* In the early stages of your networking career, you probably won’t be asked to design networks yourself.
* However, to understand the networks you will be configuring and troubleshooting, it’s important to know some basics of network design.

## **Common Terminologies**

### **Star Topology**

* When several devices all connect to one central device, they form a "Star" shape, known as a **Star Topology**.

### **Full Mesh**

* When each device is connected to every other device, it forms a **Full Mesh Topology**.

### **Partial Mesh**

* When some devices are connected to each other but not all, it forms a **Partial Mesh Topology**.

## **Two-Tier and Three-Tier LAN Architecture**

### **Two-Tier LAN Design**

* Consists of **two hierarchical layers**:
  + **Access Layer**
  + **Distribution Layer**
* Also called a **"Collapsed Core"** design because it omits the **Core Layer** found in three-tier design.

#### **Access Layer**

* The layer that **end hosts** connect to (PCs, printers, cameras, etc.).
* Typically, **Access Layer switches** have lots of ports for end hosts.
* **QoS marking** is typically done here.
* **Security services** like Port Security, DAI, etc., are typically performed here.
* **Switchports** might be **PoE-enabled** for Wireless APs, IP Phones, etc.

#### **Distribution Layer**

* Aggregates connections from **Access Layer switches**.
* Typically serves as the **border between Layer 2 and Layer 3**.
* Connects to services such as **Internet, WAN, etc.**
* Sometimes called the **Aggregation Layer**.

## **Three-Tier Campus LAN Design**

* In large networks with multiple **Distribution Layer switches** (e.g., in separate buildings), the number of connections required between Distribution Layer switches grows rapidly.
* To **scale large LAN networks**, a **Core Layer** is added.
* **Cisco recommends** adding a Core Layer if there are **more than three Distribution Layers** in a single location.

### **Three-Tier LAN Design**

* Consists of **three hierarchical layers**:
  + **Access Layer**
  + **Distribution Layer**
  + **Core Layer**

#### **Core Layer**

* Connects **Distribution Layers** together in large LAN networks.
* The primary focus is **speed (fast transport)**.
* **CPU-intensive operations**, such as security, QoS markings/classifications, etc., should be **avoided at this layer**.
* **Connections are all Layer 3** (No Spanning-Tree!).
* Should maintain connectivity throughout the LAN **even if devices fail**.

## **Spine-Leaf Architecture (Data Center)**

* **Cisco ACI Architecture** (Application Centric Infrastructure) uses this architecture.
* **Data Centers** are dedicated spaces/buildings used to **store computer systems** such as **servers and network devices**.
* Traditional Data Center designs used a **three-tier architecture** (Access-Distribution-Core), which worked well when most traffic was **North-South**.

### **The Shift to Spine-Leaf Architecture**

* With the rise of **virtual servers**, applications are deployed **across multiple physical servers**, increasing **East-West traffic**.
* The **traditional three-tier architecture** led to **bottlenecks in bandwidth** and **variable latency** based on traffic path.
* To solve this, **Spine-Leaf Architecture** (also called **Clos Architecture**) became prominent in data centers.

### **Rules for Spine-Leaf Architecture**

* **Every Leaf switch** is connected to **every Spine switch**.
* **Every Spine switch** is connected to **every Leaf switch**.
* **Leaf switches do not connect** to other Leaf switches.
* **Spine switches do not connect** to other Spine switches.
* **End hosts (servers, etc.) only connect to Leaf switches**.
* Traffic paths are randomly chosen to balance load across Spine switches.
* **Each server** is separated by the same number of **hops**, ensuring **consistent latency** for East-West traffic.

## **SOHO (Small Office / Home Office)**

* **SOHO** refers to the office of a **small company** or a **small home office** with **few devices**.
  + If your home has a network connected to the internet, it is considered a **SOHO network**.

### **SOHO Network Characteristics**

* SOHO networks don’t have complex needs, so all networking functions are typically provided by a **single device**, often called a **"Home Router"** or **"Wireless Router"**.
* This **one device** can serve as a:
  + **Router**
  + **Switch**
  + **Firewall**
  + **Wireless Access Point**
  + **Modem**