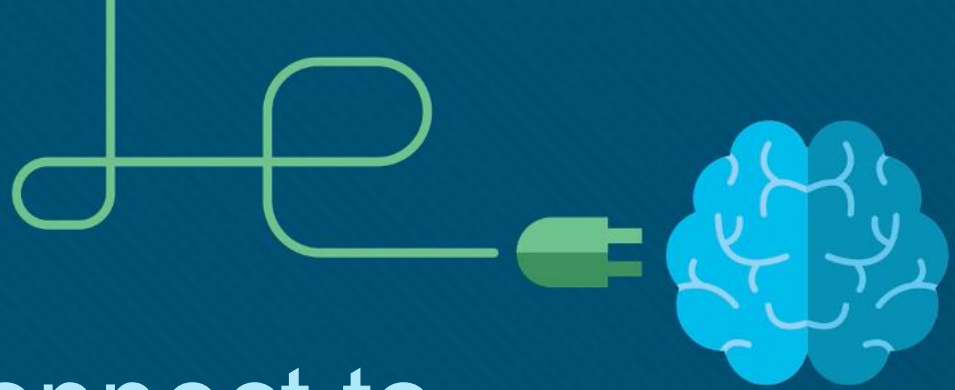# Module 14: Connect to the Internet

Networking Essentials (NETESS)

Module Objective

Module Title: Connect to the Internet
Module Objective: Configure Wi-Fi settings on mobile devices to connect to the internet.

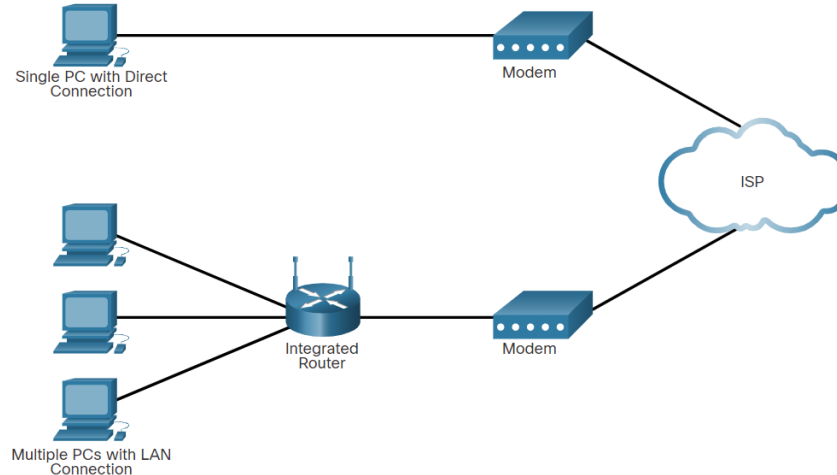| Topic Title	Topic Objective
ISP Connectivity Options	Describe ISP connectivity options.
Network Virtualization	Explain the purpose and characteristics of network virtualization.
Mobile Device Connectivity	Explain how to configure mobile devices for wireless connectivity.

14.1 ISP Connectivity Options

ISP Services

- An Internet Service Provider (ISP) provides the link between the home network and the internet.
- An ISP can be the local cable provider, a landline telephone service provider, the cellular network, or an independent provider who leases bandwidth on the physical network infrastructure of another company.
- An ISP may offer additional services to their customers, such as email accounts, network storage, website hosting, and automated backup or security services.
- ISPs are critical to communications across the global internet. Each ISP connects to other ISPs to form a network of links that interconnect users all over the world.
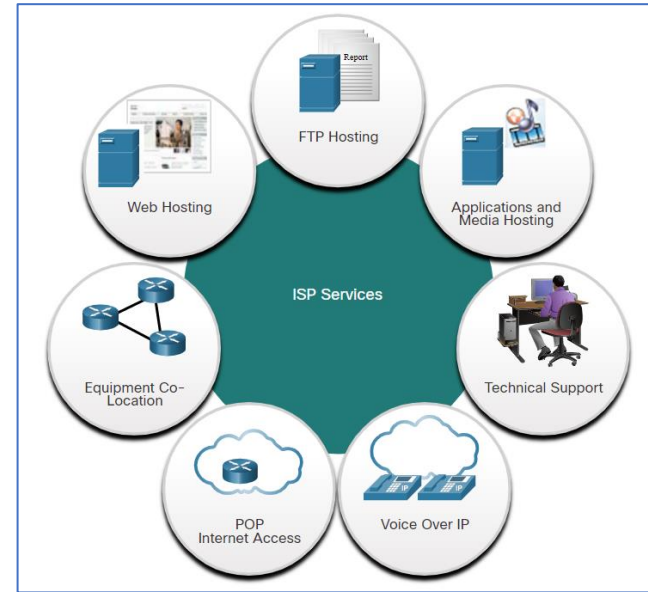
ISP Connections

- The interconnection of ISPs that forms the backbone of the internet is a complex web of fiber-optic cables with expensive networking switches and routers that direct the flow of information between source and destination hosts.

- However, the connection to an ISP from a house or SOHO can be just a connection through a modem or use a router in between to provide additional security configurations.

Cable and DSL Connections

Most home and SOHO customers use cable or DSL to connect to an ISP.

- **Cable** - Typically offered by cable television service providers, the internet data signal is carried on the same coaxial cable that delivers cable television. A special cable modem separates the internet data signal from the other signals carried on the cable

- **DSL** - like cable, Digital Subscriber Line provides a high bandwidth, always on, connection to the internet. DSL runs over a telephone line, with the line split into three channels. One channel is for voice and the other two channels are for data downloading and uploading.
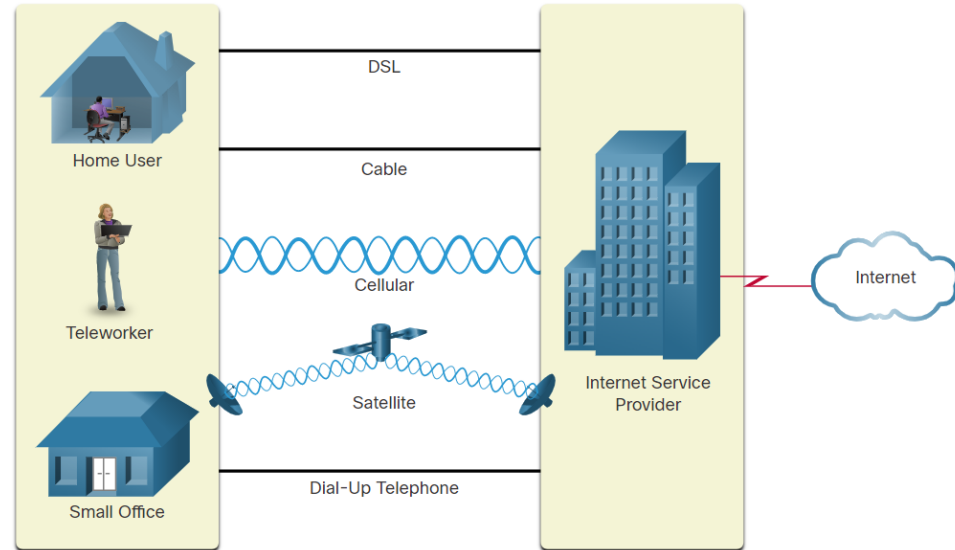
Additional Connectivity Options

Other ISP connection options for home users include:

- **Cellular** - Cellular internet access uses a cell phone network to connect. Performance will be limited by the capabilities of the phone and the cell tower to which it is connected.

- **Satellite** - Satellite service is a good option for homes or offices that do not have access to DSL or cable. Satellite dishes (see figure) require a clear line of sight to the satellite and so might be difficult in heavily wooded areas or places with other overhead obstructions.

- **Dial-up Telephone** - An inexpensive option that uses any phone line and a modem. To connect to the ISP, a user calls the ISP access phone number. The low bandwidth provided by a dial-up modem connection is usually not sufficient for large data transfer.

The choice of connection varies depending on geographical location and service provider availability.

14.2 Network Virtualization

CISCO

Video - Cloud and Virtualization

Cloud Computing

- Cloud computing is one of the ways that we access and store data.

- Cloud computing allows us to store personal files, even backup an entire drive on servers over the internet.

- Applications such as word processing and photo editing can be accessed using the cloud.

- Cloud computing is possible because of data centers.

- Data centers house servers, storage devices, and other network infrastructure equipment.

Types of Clouds

There are four primary cloud models:

- **Public clouds** - Applications and services offered in a public cloud are available to the general population. Services may be free or are offered on a pay-per-use model.
- **Private clouds** - Applications and services offered in a private cloud are intended for a specific organization or entity, such as the government.
- **Hybrid clouds** - A hybrid cloud is made up of two or more clouds (example: part private, part public), where each part remains a separate object, but both are connected using a single architecture.
- **Community clouds** - A community cloud is created for exclusive use by a specific community. The functional needs have been customized for the community. For example, healthcare organizations.
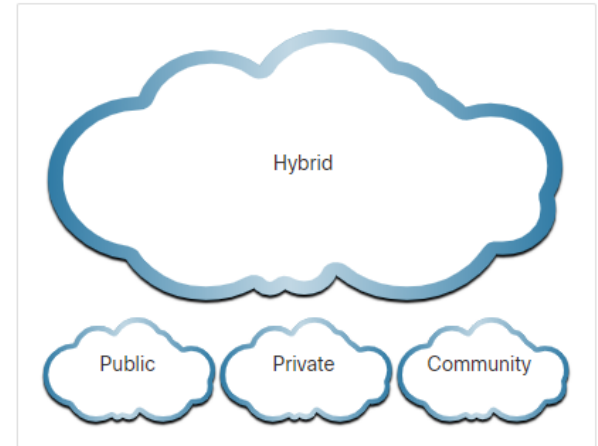
Cloud Services

The three main cloud computing services defined by the National Institute of Standards and Technology (NIST) in their Special Publication 800-145 are:

- **Software as a Service (SaaS)** - The cloud provider is responsible for access to applications and services, such as email, communication, and Microsoft 365, that are delivered over the internet.
- **Platform as a Service (PaaS)** - The cloud provider is responsible for providing users access to the development tools and services used to deliver the applications.
- **Infrastructure as a Service (IaaS)** - The cloud provider is responsible for giving IT managers access to the network equipment, virtualized network services, and supporting network infrastructure.

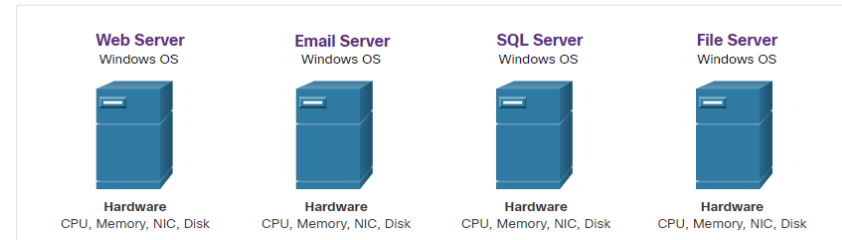| SaaS |
|------|
| **PaaS** |
| **IaaS** |
| **ITaaS** |

Cloud service providers have extended this model to also provide IT support for each of the cloud computing services (ITaaS).

Cloud Computing and Virtualization

- Difference between "cloud computing" and "virtualization":
    - Cloud computing is one of the ways that we access and store data.
    - Virtualization is using technology to create virtualized version of computing resources.

- Virtualizing technology enables a host OS to support one or more client OSs.

- The transformation of dedicated servers to virtualized servers is being rapidly implemented in data center and enterprise networks.

- A major problem of using dedicated servers is that they are underused because they often sit idle for long periods of time.

- Virtualization addresses this issue.

Dedicated Servers

Web Server Windows OS	**Email Server** Windows OS	**SQL Server** Windows OS	**File Server** Windows OS
Hardware CPU, Memory, NIC, Disk	**Hardware** CPU, Memory, NIC, Disk	**Hardware** CPU, Memory, NIC, Disk	**Hardware** CPU, Memory, NIC, Disk

Advantages of Virtualization

One major advantage of virtualization is overall reduced cost:

- **Less equipment is required** - Virtualization enables server consolidation, which requires fewer physical devices and lowers maintenance costs.
- **Less energy is consumed** - Consolidating servers lowers the monthly power and cooling costs.
- **Less space is required** - Server consolidation reduces the amount of required floor space.

A few additional benefits of virtualization include:
- **Easier prototyping** - Self-contained labs, operating on isolated networks, can be rapidly created.
- **Faster server provisioning** - Creating a virtual server is far faster than provisioning a physical server.
- **Increased server uptime** - Most server virtualization platforms offer advanced redundant fault tolerance features.
- **Improved disaster recovery** - Most enterprise server virtualization platforms have software that can help test and automate failover before a disaster happens.
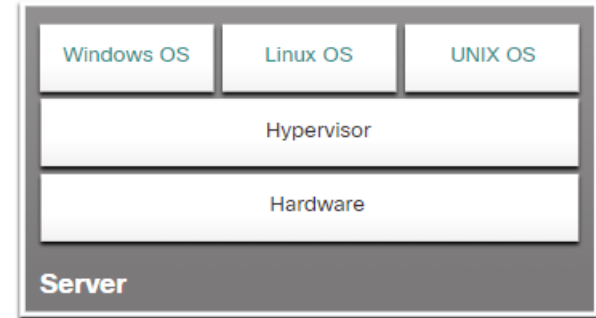
Hypervisors

- The hypervisor is a program, firmware, or hardware that adds an **abstraction layer** on top of the physical hardware.
- The abstraction layer is used to create virtual machines which have access to all the hardware of the physical machine such as CPUs, memory, disk controllers, and NICs.
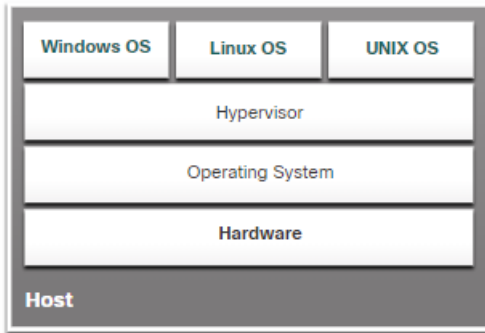
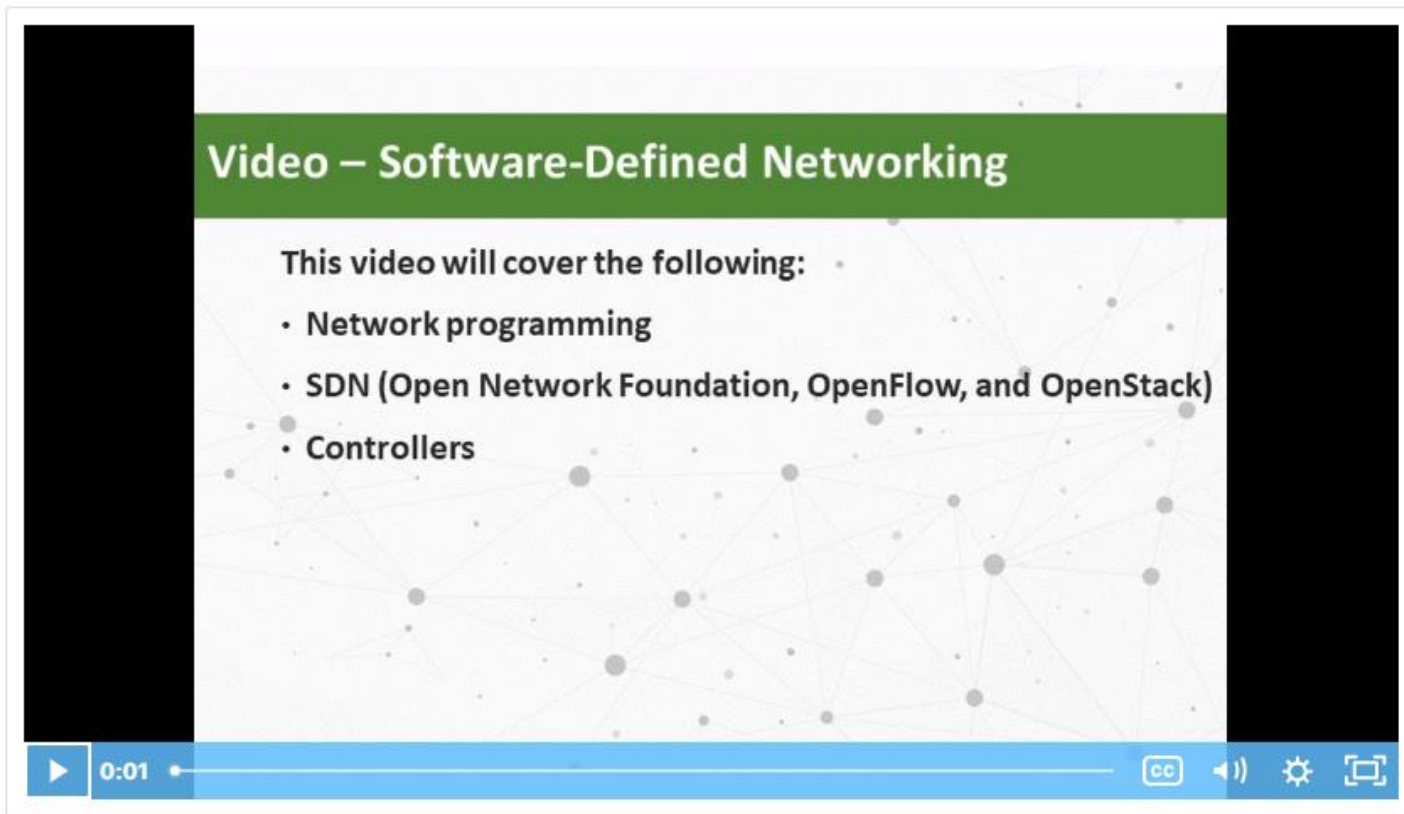**Type 2 Hypervisor - "Hosted" Approach**
- A Type 2 hypervisor is software that creates and runs VM instances on a host computer.
- A Type 2 hypervisor is installed on top of the existing OS on the host.
- One or more additional OS instances are installed on top of the hypervisor.

Type 1 Hypervisor - "Bare Metal" Approach
- Type 1 hypervisors is installed directly on the server or networking hardware.
- Type 1 hypervisors have direct access to the hardware resources. They are more efficient than hosted architectures.
- Instances of an OS are installed on the hypervisor.

Video - Software-Defined Networking

Network Virtualization

- Virtualization separates the operating system (OS) from the hardware.
- Server virtualization takes advantage of idle resources and consolidates the number of required servers. It allows for multiple operating systems to exist on a single hardware platform.
- Network virtualization combines traditional networking hardware and software network resources into a software-based entity, a virtual network.
- Network virtualization combines traditional networking hardware and software network resources into a software-based entity, which is a virtual network.
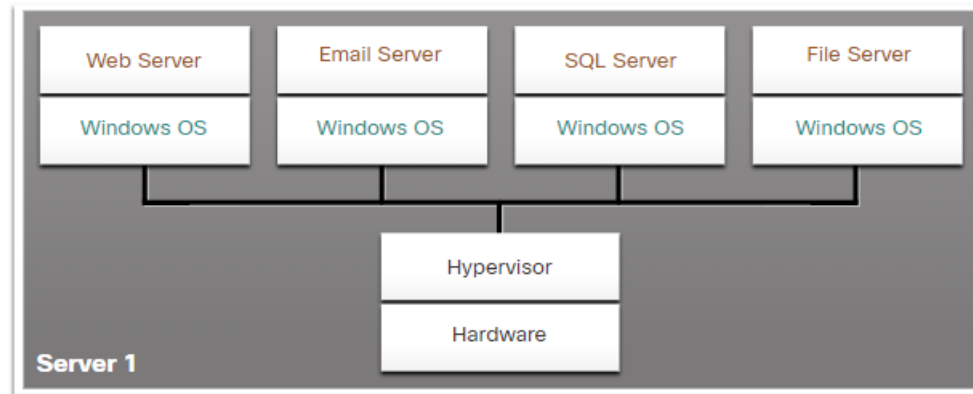
Control Plane and Data Plane

A network device contains two planes:

Control plane - It is used to make data forwarding decisions. The control plane contains Layer 2 and Layer 3 route forwarding mechanisms, such as the IPv4 and IPv6 routing tables, and the ARP table. Information sent to the control plane is processed by the CPU.

Data plane - Also called the forwarding plane, this plane is typically the switch fabric connecting the various network ports on a device. The data plane of each device is used to forward traffic flows. Routers and switches use information from the control plane to forward incoming traffic out the appropriate egress (outgoing) interface. Information in the data plane is typically processed by a special data plane processor without the CPU getting involved.
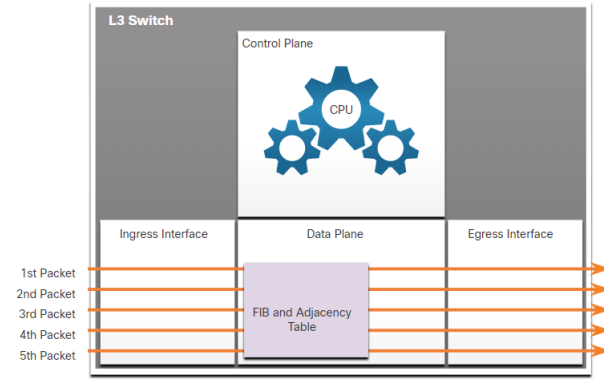
Network Virtualization and SDN

- Network virtualization combines networking hardware and software network resources into a software-based entity which is a virtual network.
- Software-Defined Networking (SDN) is a network architecture that virtualizes the network.
- SDN is the separation of the control plane and data plane. The control plane function is removed from each device and is performed by a centralized controller.
- The centralized controller communicates control plane functions to each device.
- Each device can focus on forwarding data while the centralized controller manages data flow.

Forwarding instructions are sent by the controller to each device.
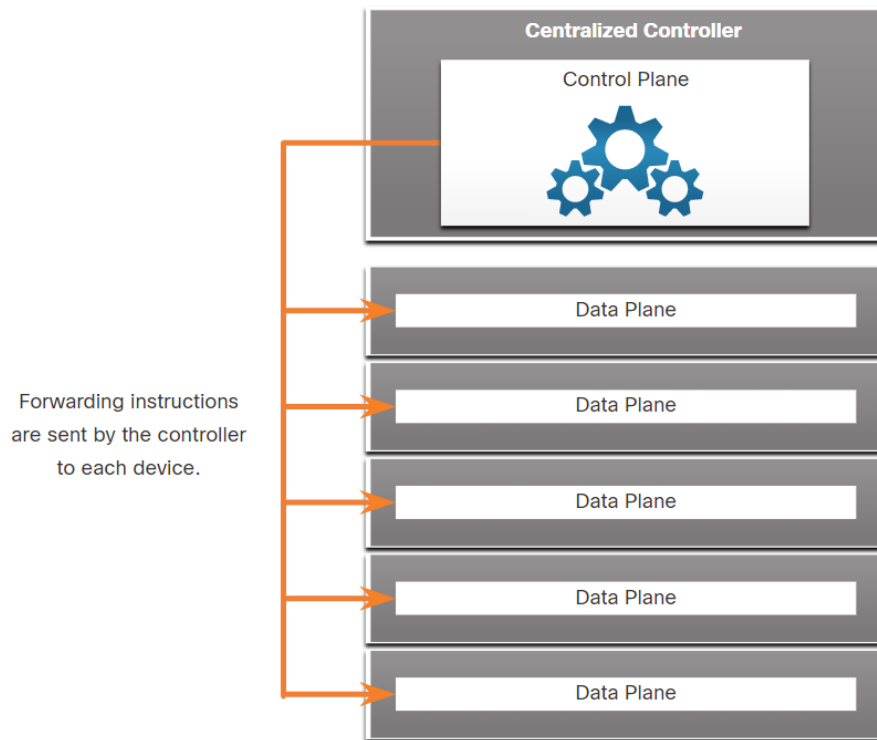
SDN Architecture

- In a traditional router or switch architecture, the control plane and data plane functions occur in the same device.
- In SDN, management of the control plane is moved to a centralized SDN controller.
- The SDN controller is a logical entity that enables network administrators to manage and dictate how the data plane of switches and routers should handle network traffic.
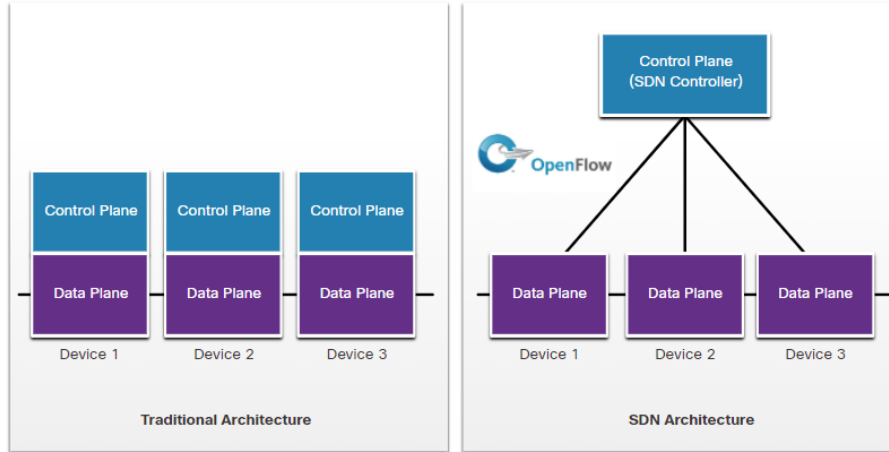
Lab - Install Linux in a Virtual Machine and Explore the GUI

In this lab, you will install a Linux OS in a virtual machine using a desktop virtualization application, such as VirtualBox. After completing the installation, you will explore the GUI interface.

14.3 Mobile Device Connectivity

Mobile Devices and Wi-Fi

- A mobile device may be equipped with multiple wireless connection options, such as Cellular, Wi-Fi, and Bluetooth.
- For data communication, it is advisable to connect to Wi-Fi networks when possible because data used over Wi-Fi does not count against the cellular data plan.
- Wi-Fi radios use less power than cellular radios, connecting to Wi-Fi networks conserves battery power.

Precautions should be taken to protect Wi-Fi communications on mobile devices:
- Never send login or password information using unencrypted text (plaintext).
- Use a VPN connection when possible if you are sending sensitive data.
- Enable security on home networks.
- Use WPA2 or higher encryption for security.

Wi-Fi Settings

To connect an Android or iOS device when it is within the coverage range of a Wi-Fi network, turn on Wi-Fi and the device then searches for all available Wi-Fi networks and displays them in a list. Touch a Wi-Fi network in the list to connect. Enter a password if needed.

Android Wi-Fi Switch
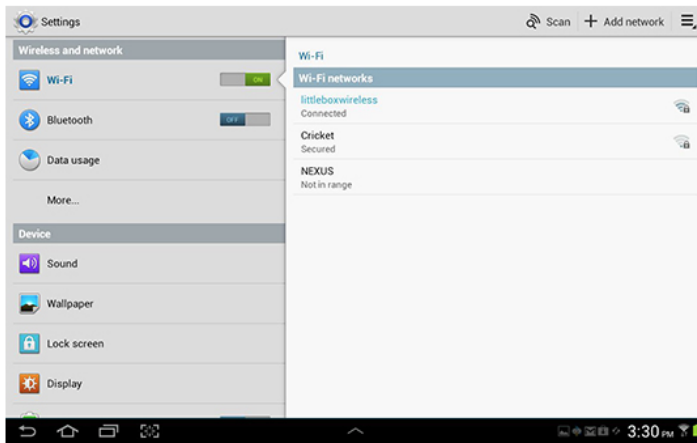
iOS Wi-Fi Switch

Configure Mobile Wi-Fi Connectivity

- If a mobile device does not prompt to connect to a Wi-Fi network, the network SSID broadcast may be turned off, or the device may not be set to connect automatically.

- You can manually configure the Wi-Fi settings on the mobile device.

- Remember that SSIDs and passphrases must be typed exactly as entered on the wireless router setup or the device will not connect properly.

- The detail configuration procedural on an Android device is slightly different from an iOS device.
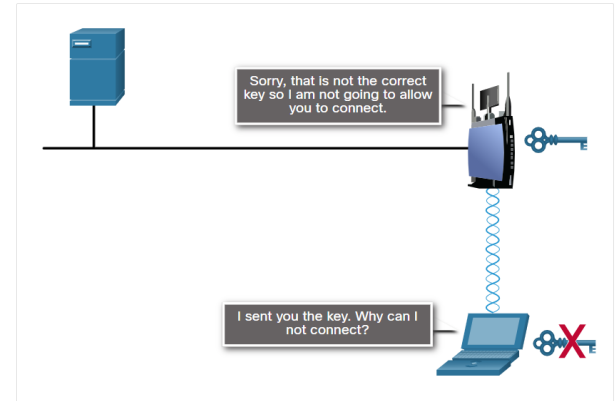
Configure Cellular Data Settings

- Mobile devices are preprogrammed to use a Wi-Fi network for internet if one is available and the device can connect to the access point and receive an IP address.

- If no Wi-Fi network is available, the device uses the cellular data capability if it is configured.

- Cellular data plans are offered by cell phone carriers.

- The bandwidth limitations and charges for usage vary widely by carrier and by plan within carriers.

- Most of the time, transitions from one network to another are performed automatically.

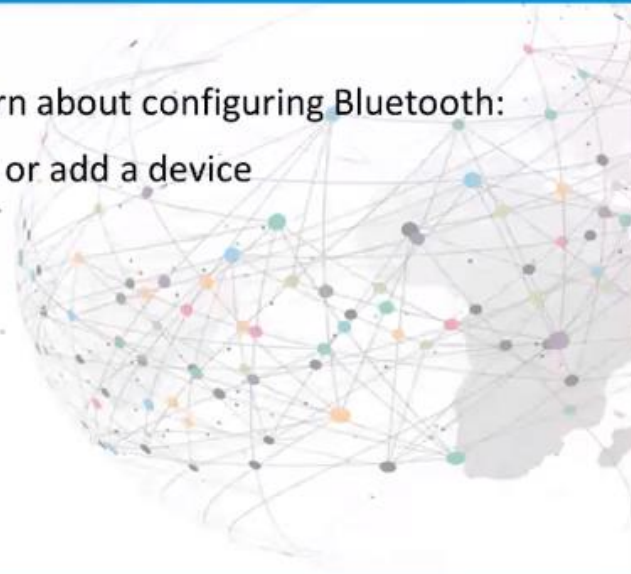Cellular Data Network Connection
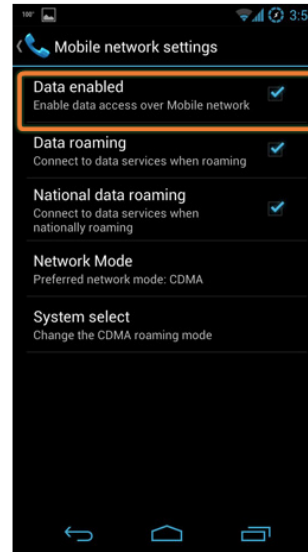
Android Device   **iOS Device**

Video - Bluetooth Configuration

Simple Connectivity with Bluetooth

- Bluetooth technology provides a simple way for mobile devices to connect to each other and to wireless accessories.
- Bluetooth is wireless, automatic, and uses very little power.
- Up to eight Bluetooth devices can be connected to a host at any one time.

A few examples of how devices use Bluetooth:

- **Hands-free headset** - A small earpiece with a microphone can be used for phone calls.
- **Keyboard or mouse** - A keyboard or mouse can be connected to a mobile device to make input easier.
- **Stereo control** - A mobile device can connect to a home or car stereo to play music.
- **Car speakerphone** - A device that contains a speaker and a microphone can be used for making and receiving calls.
- **Tethering** - A mobile device can connect to another mobile device or computer to share a network connection. Tethering can also be performed with a Wi-Fi connection or USB.
- **Mobile speaker** - Portable speakers can connect to mobile devices to provide high-quality audio.

Bluetooth Pairing

- Bluetooth pairing occurs when two Bluetooth devices establish a connection to share resources.
- For the devices to pair, the Bluetooth radios are turned on, and one device begins searching for other devices.
- Other devices must be set to discoverable mode, also called visible, so that they can be detected.
- When a Bluetooth device is in discoverable mode, it transmits the following information when another Bluetooth device requests it:
  - Name
  - Bluetooth class
  - Services that the device can use
  - Technical information, such as the features or the Bluetooth specification that it supports
- During the pairing process, a personal identification number (PIN) may be requested to authenticate the pairing process.
- The PIN is often a number but can also be a numeric code or passkey.

Lab - Configure a Mobile Device for Wi-Fi Connectivity

In this lab, you will complete the following objectives:

- Familiarize yourself with the Wi-Fi settings on mobile devices.
- Turn the Wi-Fi radio on and off.
- Set the device to forget a found Wi-Fi network.
- Connect to a new Wi-Fi network.

14.4 Connect to the Internet Summary

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What Did I Learn in this Module?

- Many services are provided by Internet Service Providers (ISP).
- There are a few methods to connect to ISP.
- The terms cloud computing and virtualization mean different things.
- Virtualization is implemented through hypervisors. There are two types of hypervisors.
- Network virtualization combines traditional networking hardware and software network resources into a software-based entity, a virtual network.
- Software-Defined Networking (SDN) is the separation of the control plane and data plane.
- SDN orchestrates, mediates, and facilitates communication between applications and network elements.
- Mobile devices support multiple technology for network connection, such as Wi-Fi, Cellular, and Bluetooth.
- When using Wi-Fi connection, use security features.
- Bluetooth connection requires the pairing between Bluetooth enabled devices.

Module 14 – Connect to the Internet

New Terms and Commands

- Internet Service Provider (ISP)
- Cable
- Digital Subscriber Line (DSL)
- Cloud Computing
- Cloud Services (SaaS, PaaS, IaaS, and ITaaS)
- Virtualization
- Hypervisors
- Type 1 and Type 2 hypervisors
- Network Virtualization
- Software-Defined Network (SDN)
- Control Plane and Data Plane
- Bluetooth Pairing