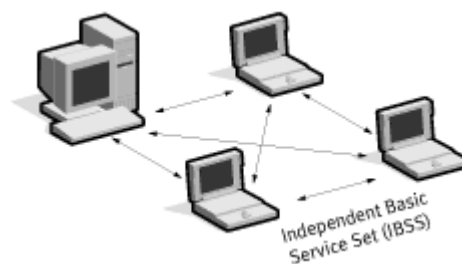


# IA. M4- exam prep.

## Compiled notes

▼ The topology of a WiFi (802.11) network configured as an Independent Basic Service Set (IBSS)

- Damian talks about this in the Week 11 lecture from 2021 at 26 minutes in
- There is no central control point in IBSS (No access point)



- **Physical:** Mesh
- **Logical:** Mesh

▼ The topology of a WiFi (802.11) network configured as an Infrastructure Basic Service Set (BSS)

- Damian talks about this in the Week 11 lecture from 2021 at 29 minutes in
- **Physical:** Star
- **Logical:** Star

▼ WiFi Point Coordination Function (PCF)

- Access Point polls stations to send frames
- Utilises RTS and CTS to provide collision avoidance
- Not implemented in all Access Points
- Access Point controls medium for contention-free access

▼ Antennae

- **Directional:**

- Focused area with stronger signal and farther range
- Is dish shaped
- Good on inside of exterior wall - helps with security
- **Omnidirectional:**
  - Transmits in all directions
  - External dipole antennae or built-in antennae

#### ▼ Service sets

- **Extended Service Set (ESS):**
  - Allows hand-off of stations between access points
  - Has an SSID which is the name of the wireless network
  - Has a BSS id that is the MAC address of the access point
- **Independent Basic Service Set (IBSS):**
  - Has an SSID which is the name of the wireless network
  - The set of all stations that can communicate with each other at the physical layer
- **Infrastructure Basic Service Set (BSS):**
  - Has an SSID which is the name of the wireless network
  - The set of all stations that can communicate with each other at the physical layer
  - Has a BSS id that is the MAC address of the access point
  - Has a BSS id in MAC address format that is randomly generated

#### ▼ Dynamic routing methods

- **Distance vector dynamic routing:**
  - Shares knowledge about its neighbours
  - Only sends advertisements to its neighbours
  - Is normally only used in small networks
  - Is slow to converge
  - Uses the least number of hops to decide how to route a packet

- Suffers from the so-called "count to infinity" problem
- **Link state dynamic routing:**
  - Converges quickly
  - Can be used in large networks
  - Shares knowledge of the entire network
  - Uses a variety of information types to decide how to route a packet
  - Floods the network with route advertisements

#### ▼ Backbone architectures

- **Switched:**
  - Most common type of backbone
  - Moves packets based on data-link address
  - Broadcast traffic limits scalability
  - Simple to manage
- **Routed:**
  - Requires more planning
  - Moves packets based on network layer address
  - Sometimes called subnetted backbone
  - LANs are able to use different data-link layer protocols
  - Increases traffic latency
- **VLAN:**
  - Requires more planning
  - Assigned into LAN segments by software
  - Broadcast domains not tied to physical network topology
  - Moves packets based on data-link layer address

#### ▼ WAN topologies

Ring	Star	Mesh
Messages travel through many nodes	Bottlenecked by a single node	Routing is decentralised
If a link fails, performance is reduced	Balances performance and reliability against cost	Has higher performance than other topologies
Single circuit between nodes	Easiest topology to manage	Is the most expensive to implement
Data can flow in both directions	Network has a single point of failure	

- **Ring:**

- Data can flow in both directions
- Messages travel through many nodes before arriving at the final destination
- Single circuit between nodes
- If a link fails performance is reduced

- **Star:**

- The network is bottlenecked by a single node
- The network has a single point of failure
- Easiest topology to manage
- Is more practical as it balances performance and reliability against cost

- **Mesh:**

- Is the most expensive technology to implement
- Routing is decentralised
- Has higher performance than other topologies

▼ Routers configured for MPLS

- When a router is configured for MPLS, it uses BGP to make forwarding decisions.

▼ Where in a packet is the MPLS label stored?

- Immediately before the IP header
- Immediately after the MAC header

▼ Service providers:

- **Tier 1:**

- Act as national ISPs
- Have no upstream ISPs
- Provide access to local and regional ISPs
- Also known as backbone ISPs
- **Tier 2:**
  - Act as regional ISPs
  - Provide access to local ISPs but not regional ISPs
  - Use national ISPs for upstream connectivity
- **Tier 3:**
  - Act as local ISPs
  - Provides access to end users only
  - Use either national or regional ISPs for upstream connectivity

▼ ISOC organisations:

- Internet Engineering Task Force (IETF) = **RFCs**
- Internet Engineering Steering Group (IESG) = **Standards Track**
- Internet Architecture Board (IAB) = **Strategic Oversight**
- Internet Research Task Force (IRTF) = **Long-term Research**
- Internet Assigned Numbers Authority (IANA) = **DNS TLDs**

▼ Device table

			Media types		
Device	Operates at	Packets	Physical Layer	Data-link Layer	NW Layer
Switch	Data-link	Forwarded by layer-1	Can be different	Must be the same	Can be different
Router	Network	Routed by layer-3	Can be different	Can be different	Must be the same
Application gateway	Application	Filtering not tied to a single layer	Can be different	Can be different	Must be the same
NW gateway	Network	Whatever you want!	Can be different	Must be the same	Can be different
Firewall	Multiple	Filtering not tied to a single layer	Can be different	Can be different	Must be the same
Transport gateway	Transport	Forwarded by layer-4	Can be different	Can be different	Must be the same

- Topics:
  - Routed/Switched/VLAN backbones

---

## Fundamental Backbone Architectures

### ▶ **Switched Backbones**

- most common type of backbone
- used in distribution layer
- used in new buildings
- sometimes used in core layer
- can be rack or chassis based (collapsed).

### ▶ **Routed Backbones**

- move packets along backbone on basis of network layer address
- typically use bus
- Ethernet 100Base-To
  - Sometimes called subnetted backbone

### ▶ **Virtual LANs**

- networks in which computers are assigned into LAN segments by software rather than by hardware
- Can be single switch or multi-switch VLANs
- Very popular technology.

#### ▼ Switched

- Most common type of backbone
- Moves packets based on data-link address
- Broadcast traffic limits scalability
- Simple to manage

#### ▼ Routed

- Requires more planning
- Moves packets based on network layer address
- Sometimes called subnetted backbone
- LANs are able to use different data-link layer protocols
- Increases traffic latency

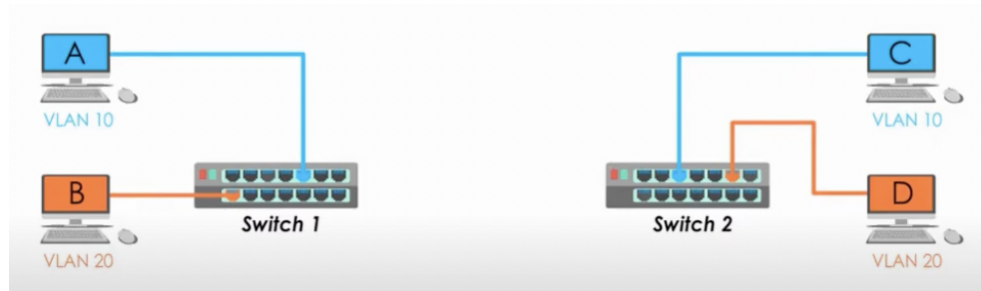
#### ▼ VLAN

- Requires more planning

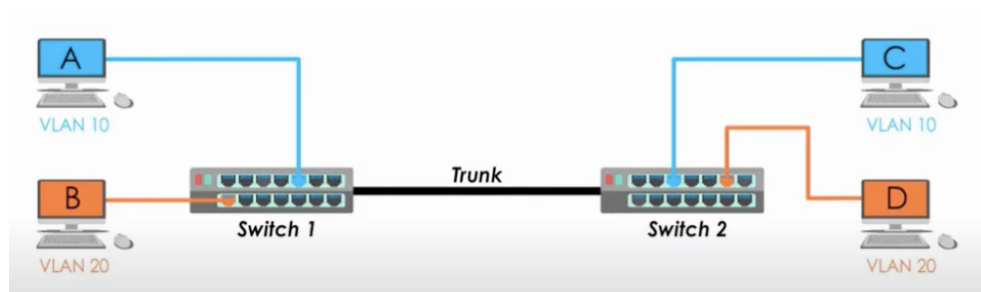
- Assigned into LAN segments by software
- Broadcast domains not tied to physical network topology
- Moves packets based on data-link layer address
- IBSS and BSS
  - IBSS:
    - The set of all stations that can communicate with each other at the physical layer
    - Has a BSS id in MAC address format that is randomly generated
    - Has an SSID which is the name of the wireless network
  - BSS:
    - The set of all stations that can communicate with each other at the physical layer
    - Has a BSS id that is the MAC address of the access point
    - Has an SSID which is the name of the wireless network

<https://www.youtube.com/watch?v=BoLjMiSoesQ>

- BSS - 4:33
- IBSS - 23:23
- 802.1q tagging
  - ▼ <https://www.youtube.com/watch?v=vE5gyvbmR8jg>
    - IEEE 802.1q is also known as Dot1q
    - The network standard that supports VLANs on an Ethernet network
    - Defines a method of tagging traffic between two switches to tell which traffic belongs to which VLAN
    - VLANs are local to each switch and VLAN info is not passed between switches



- Therefore if two computers on the same VLAN are connected to different switches, they will not be able to communicate
- In order for the two computers to communicate we need to link the switches together. This link is called a **trunk**



- It is also called a **802.1q link**, a **Dot1q link**, or a **trunk link**.
- The process of transmitting VLAN traffic over the trunk is called **trunking**
- The trunk provides VLAN IDs for frames that are travelling between switches
- It can be configured between 2 switches or between a switch and a router
- By default, a trunk can carry traffic from all VLANs, but it can be configured to only carry specific VLAN traffic
- A single link becomes a trunk not because of a particular cable, but because of how the switch ports on both ends of the link are configured.
  - These ports are called **trunk ports** using CISCO terminology
  - Otherwise they are called **tagged ports**
  - Regardless of the name, they mean the same thing



- A trunk port will add a VLAN tag to an Ethernet frame to indicate what VLAN the frame belongs to
  - The process of adding a VLAN tag into an Ethernet frame is called **tagging** or **encapsulation**
  - An **access port / untagged port** is a switch port that sends and expects to receive traffic with no VLAN tag
- Wi-fi point coordination function
  - Not implemented in all Access Points
  - Utilises RTS and CTS to provide collision avoidance
  - Access Point controls medium for contention-free access
  - Access Point polls stations to send frames
- MPLS
  - Multi Protocol Label Switching
    - Customer connects to carrier's network using a common layer-2 service (T carrier, SONET, ATM, frame relay, Ethernet)
    - Carrier's switch at network entry point examines the incoming frame and converts the incoming layer-2/3 address into an MPLS address label
    - The carrier can use the same layer-2 protocol inside its network as the customer or something different
    - When delivered, the MPLS switch removes the MPLS header and delivers the packet into the customer's network using whatever layer 2 protocol the customer has used to connect into the carrier's network at this point
- Different tiers of service providers
  - ▼ Tier 1
    - Act as national ISPs
    - Have no upstream ISPs
    - Provide access to local and regional ISPs
    - Also known as backbone ISPs

#### ▼ Tier 2

- Act as regional ISPs
- Provide access to local ISPs but not regional ISPs
- Use national ISPs for upstream connectivity

#### ▼ Tier 3

- Act as local ISPs
- Provides access to end users only
- Use either national or regional ISPs for upstream connectivity

## Internet's Hierarchical Structure

- ▶ **National Internet Service Providers (ISPs)**
  - Provide services to their customers and sell access to regional ISPs and local ISPs
  - Have no upstream ISPs
  - Also called backbone ISPs
  - Tier 1
- ▶ **Regional ISPs**
  - Connect with National ISPs (upstream ISP)
  - Provide services to their customers and sell access to local ISPs
  - Tier 2
- ▶ **Local ISPs**
  - Connected to National or Regional ISPs
  - Sell access to individuals (end users)
  - Tier 3

- ISOC bodies and their corresponding standards
  - Internet Engineering Task Force (IETF) = RFCs
  - Internet Engineering Steering Group (IESG) = Standards Track
  - Internet Architecture Board (IAB) = Strategic Oversight
  - Internet Research Task Force (IRTF) = Long-term Research
  - Internet Assigned Numbers Authority (IANA) = DNS TLDs
- OSPF

- Open Shortest Path First (OSPF) is a routing protocol for Internet Protocol (IP) networks
- It uses Link-State
- BGP
  - It uses Path-Vector (dynamic distance-vector)
- Protocols for each layer of packet transmission
  - Layer 2: Ethernet (Inner), PPP (Outer)
  - Layer 3: IP (Outer)
  - Layer 4: UDP (Outer)
  - Layer 5: ESP (Outer)
  - Layer 3: IP (Outer) IP (Inner)
  - Layer 4: TCP (Outer) TCP (Inner)
  - Layer 5: HTTP (Outer) HTTP (Inner)