COMP2250 Assignment 2 Research

# Question 1

## 802.11 Standards

### General Information

* “802.11 or 802.11x refers to a family of specifications developed by the IEEE for Wireless LAN (WLAN)” ([src](https://www.webopedia.com/definitions/802-11/))
* Specifies an over-the-air interface between 2 wireless networked devices (client or base station) ([src](https://www.webopedia.com/definitions/802-11/))
* IEEE accepted specifications in 1997
* 802.11 uses the CSMA/CA (Carrier-sense multiple access / Collision avoidance) protocol for standard WLAN ([src](https://brainly.in/question/13790601))
* “Always remember that radio frequency (RF) is a half-duplex medium and that the 802.11 medium contention protocol of **CSMA/CA consumes much of the available bandwidth**” ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* As 802.11x protocols utilise radio frequencies to transmit data, and as this technology is half-duplex, there is an inefficiency of transmission
* As more hosts try to transmit data through a single access point, collisions can occur, pausing communication to handle the collisions ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* Within laboratory conditions, TCP throughput of 60% - 70% can be achieved with 1 access point and 1 client ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* Within real world situations and in a complicated 802.11 wireless network with competing clients, it can be observed that a transmission rate of 50% of the theoretical maximum can be achieved in a best case ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))

### 802.11n “WiFi 4”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 2009
* Theoretical maximum speed: 600 Mbps
* Frequency Bands: 2.4/5 (GHz)
* Implemented MIMO
* Implemented Beam Forming
* Implemented Transit Beamforming (TxBF)
* ***Nearly legacy, only supported for older devices like old phones and IOT devices (802.11AC routers will often have 802.11n fallback features to support 2.4Ghz)***

### 802.11ac “WiFi 5”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 2013
* Theoretical maximum speed: 1,300 Mbps
* Frequency Bands: 5 (GHz)
* “While technically 802.11ac does NOT support 2.4 GHz bands, in practice most 802.11ac routers are dual-band and can fallback to 802.11n if needed”
* ***Current standard***

### 802.11ax “WiFi 6 & WiFi 6E”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 2019
* Theoretical maximum speed: 9,600 Mbps
* Frequency Bands: 2.4/5 (GHz) (*also 6 GHz – see below*)
* With the implementation of WiFi 6E (a future development of 802.11ax), a Frequency Band of 6 GHz will be used ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* “802.11ax is backward compatible with older 802.11x standards”
* Most devices do not support WiFi 6 standards, performance difference between 802.11ac and 802.11ax will be small because of this
* Best for future-proofing
* “802.11ax isn't as widespread or affordable as 802.11ac in general” – More expensive

## WiFi Frequency Bands and Channel Widths

<https://www.minim.com/blog/wifi-channels-explained-what-is-wifi-channel-width>

### 2.4GHz

* Less expensive
* More devices 2.4GHz capabilities
* Other devices such as microwaves, garage door openers, baby monitors, etc use this frequency band
* Can cause more radio frequency interference with these devices
* Travels further than 5GHz
* Penetrates solid objects better than 5GHz
* Lower data rate
* Spans over 100MHz of range
* Usually used with 20MHz channel width and can fit a total of 14 20MHz channels within this range
* 14 x 20MHz = 180MHz (THIS IS HIGHER THAN THE ALLOWED 100MHz OF 2.4GHZ, THEREFORE THERE IS OVERLAP) ([src](https://www.cbtnuggets.com/blog/certifications/cisco/when-to-use-20mhz-vs-40mhz-vs-80mhz))
* In a 2.4GHz 20MHz environment, only channels 1, 6, 11, and 14 do not overlap
* Some countries have regulations around usable channels (E.G. USA ONLY ALLOWS USE OF 11 OF THE 14 CHANNELS) ([src](https://www.cbtnuggets.com/blog/certifications/cisco/when-to-use-20mhz-vs-40mhz-vs-80mhz))

### 5GHz

* More expensive
* Less existing devices have 5GHz capabilities
* Cannot penetrate solid objects as well
* Has a shorter range

### 20 MHz

* Channels of 22MHz width
* Legal channel use in Australia 1-13
* Other countries ban some channels (consideration when expanding internationally)
* Theoretical max speed of 1 22MHz channel is

Diagram

Description automatically generated

MIMO (Multiple In Multiple Out \_\_\_ 802.11n)

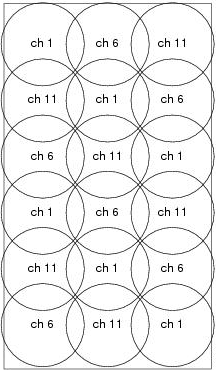
* [src](https://www.netxl.com/blog/networking/what-is-mimo/)
* Increasing number of antennas
* Collect same data from multiple antennas
* Use them to clean the data stream of the Electromagnetic waves
* Using multiple antenna receivers to aggregate the data is has a lower computation expense than trying to de-noise a single input

MU-MIMO (Multiple Users - Multiple In Multiple Out \_\_\_ 802.11ac)

* [src](https://www.netxl.com/blog/networking/what-is-mimo/)
* Also has more antennas and does all the same things as MIMO
* 802.11n also implemented a technology called Transit Beamforming (TxBF) which is used to identify the rough position of a user / device based on the direction and strength of the RF waves
* MU-MIMO uses multiple antennas to identify more accurately the location of a user and thus can more accurately filter out noise / interference with the pattern of the signal of the user

Chart, funnel chart

Description automatically generated

Can select multiple channels across all WAPs to minimise collisions

* 1, 5, 9, 13 (Minor collision)
* 1, 6, 11 (No collision)
* ([src](https://documentation.meraki.com/MR/WiFi_Basics_and_Best_Practices/Channel_Planning_Best_Practices))

[good src](https://www.duckware.com/tech/wifi-in-the-us.html)

# Question 2

## Modern WAN Connections (the actual sending of data)

* MPLS (Multiprotocol Label Switching)
* Broadband
* 4G/LTE Network
* Cable
* Metro Ethernet
* VSAT?
* DSL
* Telco Lines (SOMETHING ELSE?)
  + Leased Line
  + Circuit-Switched
  + Packet-Switched

## WAN setups

* Router Centric Mode (Always Route to On-Prem - **EXPENSIVE**)
* SD WAN (Connect On-Prem + Cloud – **EXPENSIVE**)
* Enterprise / Business Grade Cloud Based VPN (**CHEAP**)
* Virtual / Remote Desktop Infrastructure (Cloud Based OS Application – **VERY SECURE**)

WHY SD WAN (Ayden)

* Redundancy – able to use multiple different WAN connection technologies
  + MPLS
  + Broadband
  + 4G / LTE
* Easier to manage - simpler – lowers IT talent requirements (TCO)
* Allows management of multiple providers
* Security Policy Management

# Question 3

## Firewalls

* Filters traffic (inbound + outbound)
* Policies can be used to stop users on networks from accessing specific sites
* Policies can be used to reject traffic from specific sites
* Sits in front of the LAN network and is the first line of defence

## End-point security (Anti-virus)

## Micro-Segmentation

## Zero-Trust policies

## SSID / guest networks

## Cyber Forensics tools

## Cyber insurance

## Employee Phishing and general cyber security training

## Email security

## Vulnerability Management

## Disaster Recovery

## VPN services / end-to-end encryption

## Network Authentication

## Load-Balancing