



Session 1: Introduction to WiFi Network Security

eduroam deployment Workshop

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Summary

1. Overview
2. Introduction to wireless network
3. Wireless bands and channels
4. Wireless equipments
5. Wireless operation
6. Wireless network security



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Overview

Ethernet is a family of wired computer networking technologies commonly used in :

- ++ Local Area Network (LAN);
- ++ Metropolitan Area Network (MAN);
- ++ Wide Area Network (WAN).

It is based on the IEEE 802.3 standard (1983).

Due to its design and the support media. It didn't comply with user Mobility.

WiFi network -IEEE 802.11standard (1999) provides a solution for the 802.3 lack of mobility. But, also introduces serious security challenges.



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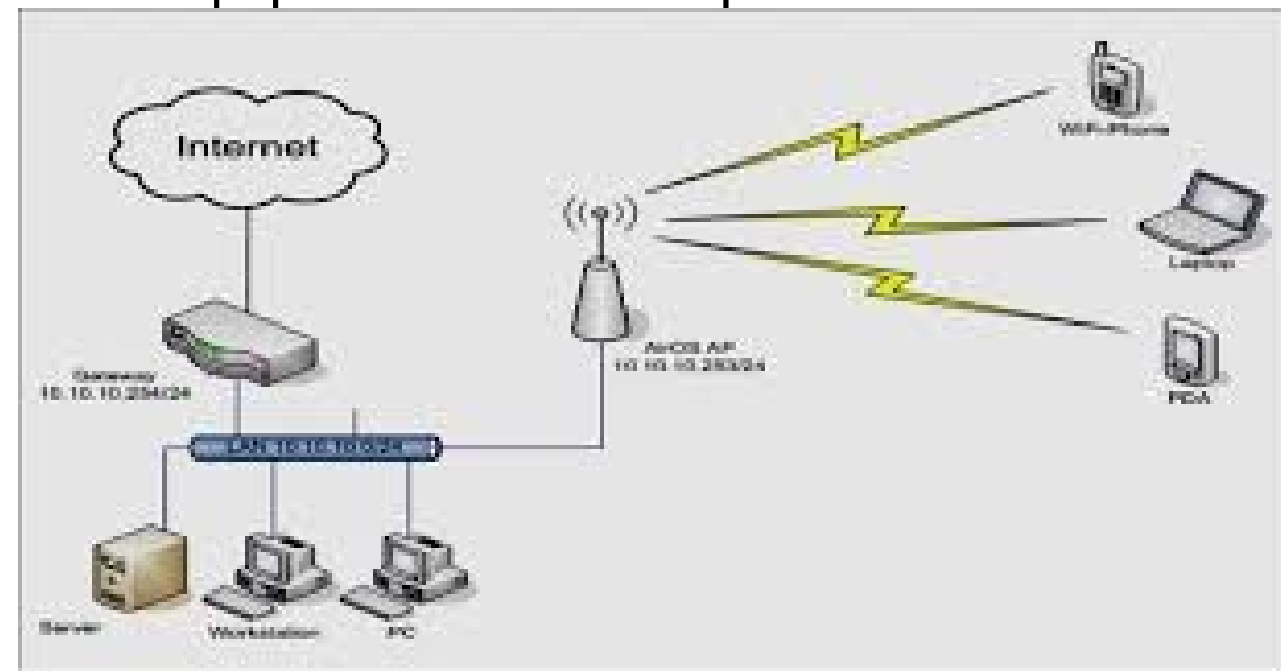


Introduction to Wireless Network

A Wireless Network(**WiFi**) is a **networking technology** that uses **radio waves** to transmit data. It's used to link many varieties of equipments used to process and transfer data for day-to-day operations. It was originally **designed to extend the Ethernet** infrastructure to provide additional connectivity options, mainly **mobility**.

The resources interconnected range from :

- ++ personnel devices
- ++ to business equipments



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Introduction to Wireless Network

WiFi defines many standards

- 802.11 : the original standard ; offers 1-2Mb/s in the 2.4 GHz band
- 802.11b :improve the original standard and supports up to 11Mb/s with DSSS modulation
- 802.11a :supports up to 54Mb/s, uses OFDM modulation in 5.5GHz band
- 802.11g :supports up to 54Mb/s, but uses DSSS or OFDM
- 802.11n :....
- 802.11mc :..

	PAN	LAN	MAN	WAN
IEEE Standard	Bluetooth 802.15.3	802.11	802.11, 802.16,802.20	GSM, CDMA,Satellite
Speed	< 1 Mbits/s	From 11 to 54Mbits/s	10-100x54Mbits/s	10Kbits/s-2Mbits/s
Scope	short	medium	middle-long	long
Application	Peer to Peer	Enterprise or Home	City/State	Mobile devices



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Introduction to Wireless Network

WiFi characteristics

Radio Frequency(**RF**) has **no visible boundaries** ;

RF is **unprotected** from outside signals ;

RF transmission is subjected to **noise** from outside signals ;

RF is subjected to **Country regulation**

RF is **attenuated**

RF bands 900MHz, 2.4GHz and 5GHz are unlicensed by ITU for ISM communities



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Introduction to Wireless Network

WLAN vs Ethernet

IEEE Standard	802.11 Wireless LAN	802.3 Ethernet LAN
Physical Layer	Radio Frequency(RF)	Copper Cable
Media Access	Collision Avoidance	Collision Detection
Signal Interference	Yes	No consequences
Regulation	Additional regulation by local authorities	IEEE standard dictates



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Introduction to Wireless Network

Key concepts

WiFi : Wireless Fidelity refers to Wireless Local Area Network(WLAN), the originally defined wireless network. It's based on IEEE 802.11 standard.

Association : Process of connecting a wireless device to an access point

Authentication : Process that helps an access point to determine who a client device is

SSID : the Service Set Identifier

BSSID : The MAC address of the an Access Point that has setup a Basic Service Set

Bandwidth : The maximum amount of data that may be broadcasted over a connection



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Introduction to Wireless Network

Advantages

Installation is fast and easy and eliminates wiring through

walls and ceilings ;

It's easier to provide connectivity even in area where it is difficult to lay cable ;

Access to the network can be from anywhere within the range of the access point ;

Public places like airports, libraries, schools or even coffee shops offer you constant internet connections using Wireless LAN.

Disadvantages

Security is a big issue and may not meet expectations ;

As the number of computers on the network increases, the bandwidth suffers ;

WiFi enhancements can require new wireless cards and/or access point ;

Some electronic equipments can interfere with the WiFi networks ;



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Wireless Bands & Channels

wireless networks delivers signal under a certain frequency groups called Band.

The most known bands are the ISM

bands :

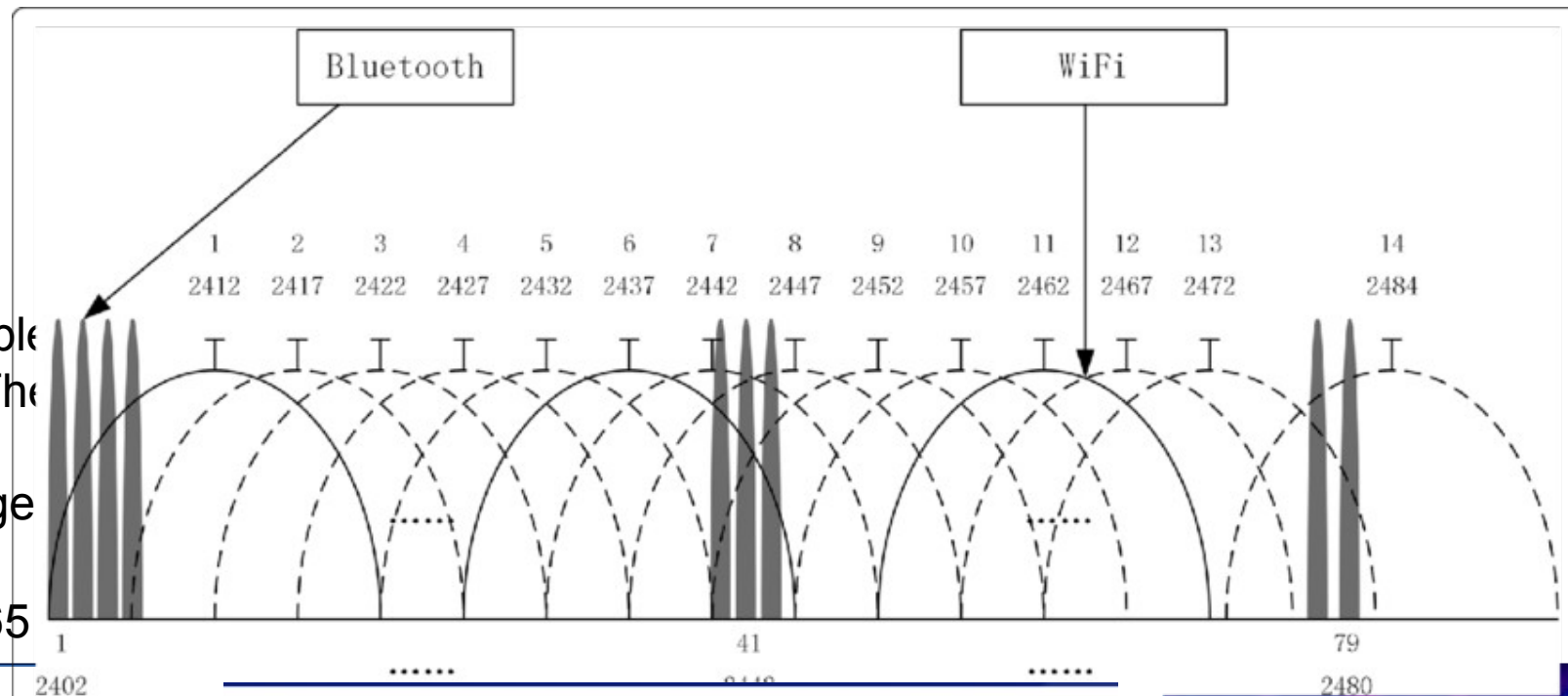
2.4GHz ;

5GHz from outside signals.

Under each bands, signal may be accessible with a limited set of allowed frequencies. The sets are referred to as channels :

2.4GHz, 802.11b/g/n band's channels range from 1 to 13 ;

5GHz band's channels range from 7 to 165



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Wireless equipments

modem



Access Point



WiFi controller



Switch



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Wireless equipment : Access Point positioning

When deploying a wireless network a key point is the AP positioning to optimize network accessibility and user experience. there are several smart WiFi access positioning techniques and tools used to estimate a device's location based on WiFi signals

Technique	Advantages	Challenges
RSSI(Received Signal Strength Indicator): Measures the strength of the signal from WiFi access points (APs) to estimate distance. By comparing RSSI values from multiple APs, the device's location is triangulated	Simple to implement with existing WiFi infrastructure.	Accuracy is affected by obstacles (walls, furniture), interference, and changes in the environment.



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Wireless equipment : Access Point positioning

Technique	Advantages	Challenges
Time of Flight (ToF): Measures the time taken for a WiFi signal to travel between the AP and the device. The longer the travel time, the farther the device is from the AP.	Provides better accuracy than RSSI, less affected by interference.	Requires more advanced hardware and synchronization between APs and devices. environment



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Wireless equipment : AP positioning tools & Platforms

Tool/platform	Description
Ekahau	A widely used WiFi design and planning tool that also supports positioning. It allows for site surveys and builds heatmaps for WiFi signals. Ekahau can be used for indoor positioning by utilizing signal strength from various APs
CISCO DNA Spaces	Provides location analytics and positioning services using existing Cisco WiFi infrastructure. It leverages RSSI, fingerprinting, and advanced algorithms to track devices
Google Wi-Fi RTT	Supported on Android devices (version 9 and above), Wi-Fi RTT enables highly accurate indoor positioning using round-trip time measurements from multiple APs.



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Wireless equipment : AP positioning tools & Platforms

Tool/platform	Description
Aruba Meridian	A platform by Aruba Networks, designed for indoor location services using WiFi, BLE, and other data sources. It supports location-based services like wayfinding and asset tracking
Navisens	A positioning solution that combines WiFi signals with inertial sensors (accelerometers, gyroscopes) on smartphones to improve indoor positioning accuracy
Mist(by Juniper Networks)	Mist AI uses machine learning and big data analytics to provide precise indoor positioning with WiFi and BLE (Bluetooth Low Energy). It offers services such as wayfinding, location-based messaging, and asset tracking



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Wireless security

Due to its characteristics Wi-Fi network is subjected to many threats and attacks:

- ++ eavesdropping
- ++ traffic analysis
- ++ cracking wep or wpa key evil twin AP
- ++ honeypot access point

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WEP and **WPA-PSK** are easily hackable by **aircrak-ng** tool suite. WPA2-Enterprise should be the de facto security Wi-Fi security implementation



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Thank you!

THANKS!