

Network Administration/System Administration (NTU CSIE, Spring 2024)

Homework #10

B12902110 呂承諺

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1 課程內容

- (a) 5 GHz Wi-Fi uses frequencies ranging from 5.15 GHz to 5.35 GHz and 5.47 GHz to 5.895 GHz. We choose 5.50 GHz as an average for calculation.

$$\lambda = \frac{c}{f} = \frac{299\,792\,458 \text{ m/s}}{5.50 \times 10^9 \text{ Hz}} = 0.0545 \text{ m} = 54.5 \text{ mm}$$

(b)

$$\frac{P_r}{P_t} = \frac{G_t G_r \lambda^2}{(4\pi d)^2} = \frac{1(1)(0.0545)^2}{(4\pi(1))^2} = 1.88 \times 10^{-5}$$

- (c) For a certain wavelength λ , suppose only the distance changes, while all other factors remain the same.

$$P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi d)^2} \propto \frac{1}{d^2}$$

This shows that both 2.4 GHz and 5 GHz signals attenuate by the same factor.

- (d) Suppose the wavelength is the only changing factor.

$$P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi d)^2} \propto \lambda^2$$

2.4 GHz waves have a longer wavelength than 5 GHz waves, so 2.4 GHz gets a stronger signal.

- (e) Bandwidth refers to the maximum data transfer rate of the connection, while throughput refers to the actual data transfer rate.

References

- [Wi-Fi - Wikipedia](#)
- [List of WLAN channels - Wikipedia](#)
- [Friis transmission equation - Wikipedia](#)
- [Lecture slides "Wireless Communications & Networking" by Professor Michael Tsai, page 12](#)
- [Bandwidth \(signal processing\) - Wikipedia](#)
- [Bandwidth \(computing\) - Wikipedia](#)
- [Bandwidth & Throughput - 魂系架構 Phil's Workspace](#)
- [Network throughput - Wikipedia](#)

2 討論題

- (a)
- (b)
- (c)
- (d)

3 問答題

- (a) SSID

- (1) SSID stands for service set identifier. It is typically the network name that users see.

BSSID stands for basic service set identifier. It is usually the MAC address of the access point.

One extended service set (ESS), identified by an SSID, may consist of one or more access points. Each access point has its own BSSID.

- (2) An AP can provide service of several SSIDs simultaneously. Most home APs today can deploy a main SSID and another guest SSID. Another example is using different SSIDs for 2.4 GHz and 5 GHz signals from the same AP.

Different APs can share the same SSID. Just configure the APs to the same SSID. This is exactly how the `csie` Wi-Fi works in the department.

- (3) An evil twin is a malicious Wi-Fi AP that mimics a legitimate one, often set up to have the same SSID as a public Wi-Fi and a fake login page. When a device automatically connects to the AP, the attacker can start monitoring the victim's traffic and extract sensitive information.

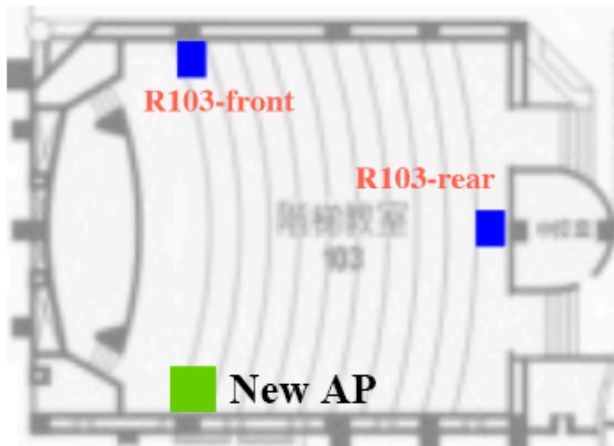
We can prevent the evil twin attack by not connecting to public or insecure Wi-Fi, and by using secure application protocols.

- (4) The device will often choose the AP with the best signal quality or the first one that it connected to. Standards 802.11k, 802.11v, and 802.11r facilitate transition between basic service sets.

References

- [Service set \(802.11 network\) - Wikipedia](#)
- [Evil twin \(wireless networks\) - Wikipedia](#)
- [What is an Evil Twin Attack? Evil Twin Wi-Fi Explained](#)
- [Fast Roaming with 802.11k, 802.11v, and 802.11r - Windows drivers | Microsoft Learn](#)

- (b) I would place the new AP at the front-left of the classroom, as its the farthest to both existing APs.



4 實作題

(a) Steps

- (1) If this is the first time connecting to the Wi-Fi, we need to create a profile in XML format. Here we use a WPA3-Personal profile as an example.

```
<?xml version="1.0"?>
<WLANProfile xmlns="http://www.microsoft.com/networking/WLAN/profile/v1">
  <name>Ultramarine</name>
  <SSIDConfig>
    <SSID>
      <name>Ultramarine</name>
    </SSID>
  </SSIDConfig>
  <connectionType>ESS</connectionType>
  <connectionMode>auto</connectionMode>
  <MSM>
    <security>
      <authEncryption>
        <authentication>WPA3SAE</authentication>
        <encryption>AES</encryption>
        <useOneX>false</useOneX>
      </authEncryption>
      <sharedKey>
        <keyType>passPhrase</keyType>
        <protected>false</protected>
        <keyMaterial>MY_PASSPHRASE</keyMaterial>
      </sharedKey>
    </security>
  </MSM>
</WLANProfile>
```

Then we add it to the system.

```
netsh wlan add profile filename=Ultramarine.xml
```

- (2) Connect to the Wi-Fi with the following command.

```
netsh wlan connect name=Ultramarine
```

Result

```

C:\Users\user>netsh wlan connect name=Ultramarine
Connection request was completed successfully.

C:\Users\user>ping 1.1.1.1

Pinging 1.1.1.1 with 32 bytes of data:
Reply from 1.1.1.1: bytes=32 time=33ms TTL=56
Reply from 1.1.1.1: bytes=32 time=247ms TTL=56
Reply from 1.1.1.1: bytes=32 time=126ms TTL=56
Reply from 1.1.1.1: bytes=32 time=129ms TTL=56

Ping statistics for 1.1.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 33ms, Maximum = 247ms, Average = 133ms

```

References

- [How to connect to a Wi-Fi network on Windows 10 | Windows Central](#)
- [How to connect to a wifi in powershell knowing the SSID and password? - Stack Overflow](#)
- [WPA2-Personal profile sample - Win32 apps | Microsoft Learn](#)

- (b) csie and csie-5g both use WPA2-Enterprise, type PEAP. This can be seen in network properties in Windows' settings.

| 屬性 | |
|----------------|---------------------------------------|
| SSID: | csie-5G |
| 通訊協定: | Wi-Fi 5 (802.11ac) |
| 安全性類型: | WPA2-Enterprise |
| 登入資訊的類型: | Microsoft: Protected EAP (PEAP) |
| 網路頻帶: | 5 GHz |
| 網路通道: | 132 |
| 連結速度 (接收/傳輸): | 650/702 (Mbps) |
| 連結-本機 IPv6 位址: | fe80::a359:d771:3632:24cf%13 |
| IPv6 DNS 伺服器: | 2606:4700:4700::1111 2001:de4::101 |
| IPv4 位址: | 10.5.4.32 |
| IPv4 DNS 伺服器: | 140.112.30.21 8.8.8.8 |
| 主要 DNS 尾碼: | csie.ntu.edu.tw |
| 製造商: | Intel Corporation |
| 描述: | Intel(R) Wireless-AC 9560 160MHz |
| 驅動程式版本: | 22.0.1.1 |
| 實體位址 (MAC): | 84-C5-A6-DF-9B-7F |
| 複製 | |