AN1444: SiWT917 RCP Getting Started Guide with Raspberry Pi

This document provides detailed instructions for setting up the SiWT917 Single Band Wi-Fi + Bluetooth Low Energy Development Kit using a Raspberry Pi board to enable Wi-Fi support. It includes steps for flashing the RPI4 OS image and configuring the SiWT917 in Wi-Fi STA mode to connect to a router.

KEY POINTS

- Setup Requirements
- Flashing RPI4 OS
- Wi-Fi STA bring-up

Table of Contents

1. Introduction

This guide provides detailed and comprehensive instructions for setting up the SiWT917 Single Band Wi-Fi + Bluetooth Low Energy Development Kit using a Raspberry Pi board.

The primary goal is to enable Wi-Fi functionality on the development kit. The guide includes step-by-step procedures for flashing the RPI4 OS image onto the Raspberry Pi, ensuring that the operating system is correctly installed and ready for use.

Additionally, it covers the configuration of the SiWT917 in Wi-Fi Station (STA) mode, which allows the device to connect to a Wi-Fi router. This setup enables seamless wireless communication and enhances the overall functionality of the development kit.

2. Prerequisites

Following are the details for the prerequisties required for both hardware and software.

2.1 Hardware Requirements

Following are the details for hardware requirements.

Table 2.1. Hardware Requirements

S.N.	Hardware Components	Quantity	Description
1.	SiWT917 RCP Wi-Fi 6 Single Band + BLE 5.4 Wireless Radio. **Radio board:** BRD4346A. **Adapter board:** BRD8045B.	1	• **SiWx917_RB4346A -** SiWx917 Wi-Fi 6 and Bluetooth LE IC Co-Processor Radio board • **BRD8045B-** Adapter board to mount on Raspberry Pi Expansion Kit (RPI Connector).
2.	PC/Laptop/Embedded Platform with Linux OS	1	Raspberry Pi 4 with SiWT917 RPi image.
3.	Standard WLAN Access Point	1	For Example, TP-Link AX1500 Wi-Fi 6 Router.
4.	Monitor, mouse, and keyboard	1	To access the console or get the UI access of Raspberry Pi 4.
5.	Ethernet/HDMI cables	1	To connect Raspberry Pi 4 with the monitor.

Note: For more information, refer to Getting Started Guide.

2.2 Software Requirements

Following are the details for software requirements.

Table 2.2. Software Requirements

S.N.	Software Components	Description
1.	SiWT917 RCP Driver	si91x-rcp-driver
2.	Kernel Version from 3.18 to 6.1	For example, In this test case, the system's kernel version is 6.1
3.	wpa supplicant	For example, wpa_supplicant 2.10.
4.	hostapd	**Note:** • Hostapd application version used is v.2.10. • If hostapd is not present in system, give the following command to install hostapd application. **Command:** apt install hostapd .

3. Functional Description SiWT917 on Raspberry Pi4

SiWT917 enables Raspberry Pi with Wi-Fi capability. We will enable W-Fi support on the Raspberry Pi 4 board using the SiWT917 Single band Wi-Fi + Bluetooth low energy using the SDIO interface.

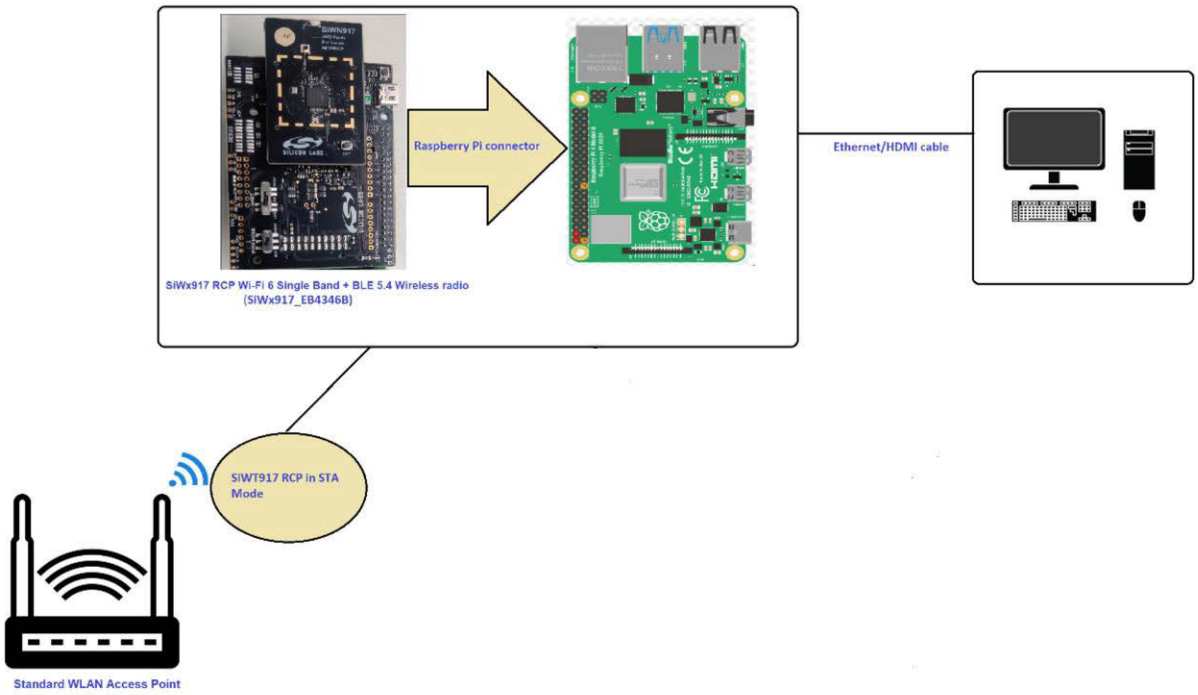

Figure 3.1. Setup Diagram

In the above figure the user needs to connect the SiWT917 RCP module to a Raspberry Pi 4 running Raspberry Pi 4 OS through the Raspberry Pi connector (40 PIN header). The Raspberry Pi should have a kernel version installed between 3.18 to 6.1. To evaluate STA mode, an external standard wlan access point is needed.

3.1 Advantages

Wi-Fi capability on target platform, which can be used to use for network connectivity.

3.2 Use Cases

Enabling Wi-Fi support on the target platform will be used as STA Mode.

4. Usage Guidelines

4.1 Configuration Parameters for Driver Package

1. Download the RPI OS image from the below link : SiWx917_RCP_image_with_RPI4.img.
2. Download the RPI Imager tool: RPI-Imager.
3. Connect the empty SD card (atleast 32 GB size) to the Windows machine via the SD memory card slot/SD card reader/SD card adapter.
4. Launch the RPI imager. It will pop up the window as shown below.

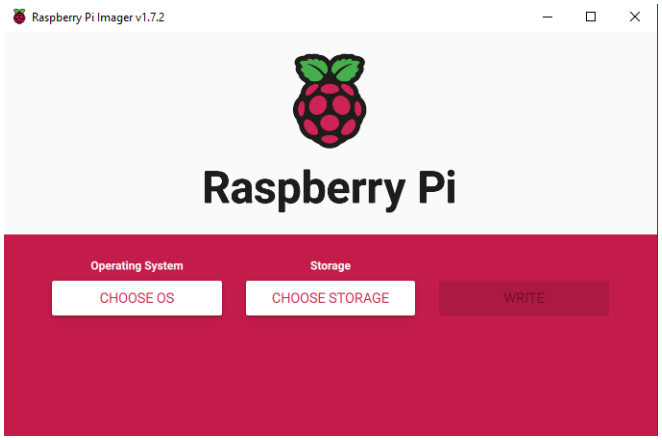

Figure 4.1. RPI image homepage

5. Choose the OS and select **Use custom** icon.

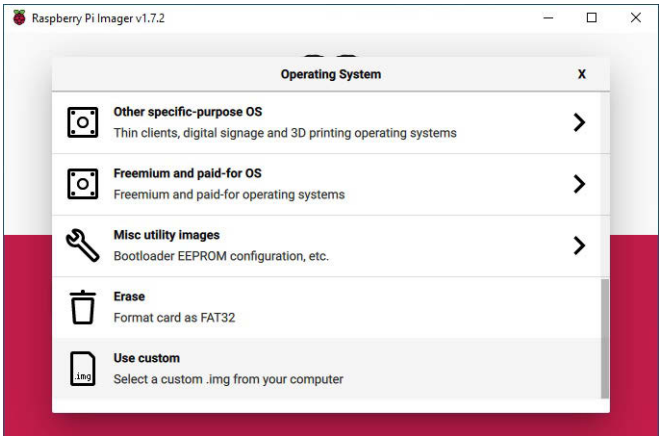

Figure 4.2. Choose OS

6. Select the RPI-4B image from the directory where the image is downloaded. Select the **Choose Storage** button and it will pop up the SD card partition.

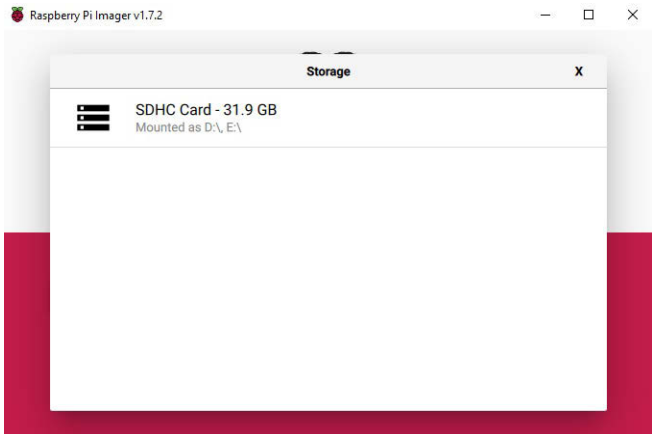

Figure 4.3. Choose Storage

7. Now click on the **Write** button.

Figure 4.4. Write to SD card

8. It will prompt for confirmation. Click, **Yes**.

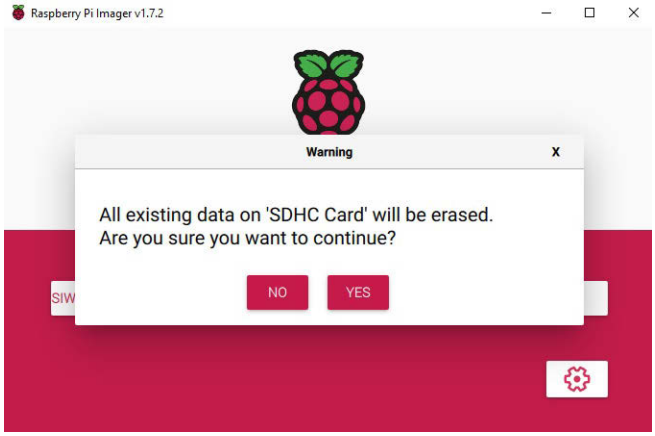

Figure 4.5. Confirm format the existing image

9. The image will start flashing onto the selected SD card partition. Wait until the card flashing is done.

Figure 4.6. Start Flashing

10. Once the flashing is complete. A window will pop up showing that the write was successful.

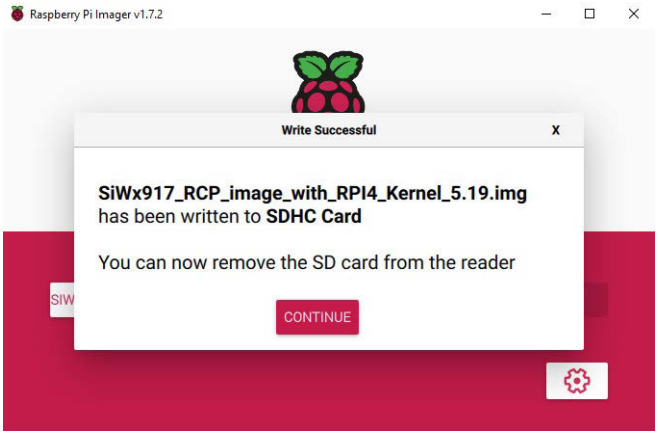

Figure 4.7. Write successful

11. Remove the SD card from the SD card reader and insert it on RPI-4B Pi.

4.2 Connecting SiWT917 to Raspberry Pi 4 and Accessing Console

Connect the SiWT917_BRD8045B and radioboard to the 40 pin header of Raspberry Pi 4, as shown below.

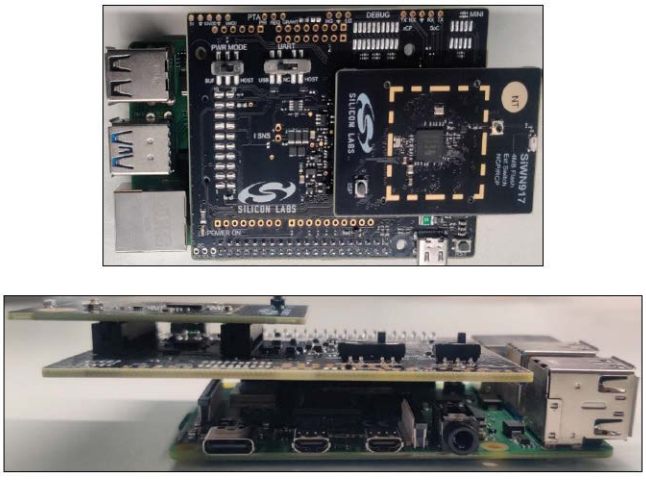

Figure 4.8. Setup diagram

1. Connect the 5V power adapter/power up through USB to the Type C USB port of the RPi4 board.

2. Connect the ethernet cable from the ethernet port on RPi to the Windows/Linux PC.
3. Static IP is assigned to RPI and the IP of the RPi4 is 192.168.30.10
4. Give the IP address for the Linux/Windows PC in the same subnet of 192.168.30.X

   For example:
   - If Linux PC: ifconfig eth0 192.168.30.15
   - If Windows PC: Configure the network settings with 192.168.30.15
5. Check the ping to RPi4 board IP 192.168.30.10(Exp: ping 192.168.30.10).
6. Log in to the RPi4 Console using ssh/putty (By default, the IP address of the RPi4 is 192.168.30.10). or
7. User can access the RPi4 using the HDMI connector cable connected to the HDMI supported monitor.
8. After powering up, it will ask for username and password.
   - **Username:** pi
   - **Password:** test123

4.3 Steps to Bring up in STA Mode

1. Download the si91x-rcp-driver.
2. Place the driver in any local path of the RPi4 home directory.

   Example: <system_path> : cd /home/pi/

   Note: "<system_path>" is the location where the user has downloaded/placed the SiWT917 driver in the system.

3. Unzip the driver using the following command.

```
# unzip SiWT917.x.x.x.x.zip
```

4. Now user needs to enter super user mode by giving the following command and providing the correct username and password.

```
# sudo su
```

The subsection below provides the steps to configure Wi-Fi STA using startup script or manual commands. User can choose any method.

4.3.1 Using Startup Scripts

User can use the script at path “<system_path>/SiWT917.x.x.x.x/release/” to run Wi-Fi concurrent mode.

Example: ./start_SiWT917.sh STA

For more details about the startup script file, refer to the Startup Script section of SiWT917 RCP Developer’s Guide.

4.3.2 Using Manual Steps

1. Compile the driver using the following commands at path `<system_path>/SiWT917.x.x.x.x/`

```
#make clean; make
```

   Note: For compiling from kernel source or for other embedded platforms like iMX6 platform, the user can refer to the section Compilation Steps of the SiWT917 RCP Getting Started Guide.

   Before installing the driver, install the dependencies using the following commands :

```
# modprobe mac80211
# modprobe bluetooth
# modprobe rfcomm
```

2. Before installation, the user needs to stop the existing network manager and unblock WLAN from rfkill. The commands below are used to stop the network-manager on different Linux distributions.
   - For Ubuntu/Raspberry Pi , use the following command:

```
# service network-manager stop
```

   - For Fedora, use the following command:

```
# service NetworkManager stop
```

   - To stop rfkill blocking WLAN, use the following command:

```
#rfkill unblock wlan (or) # rfkill unblock all
```

3. Go to the driver package and copy all the files present in the `<system_path>/SiWT917.x.x.x.x/ Firmware` folder to `/lib/firmware` by following the commands below.

```
# cd <system_path>/SiWT917.x.x.x.x/
# cp Firmware/* /lib/firmware
```

4. After compiling the driver go to the `<system_path>/ SiWT917.x.x.x.x/release` folder and give the following commands:

```
# insmod rsi_91x.ko dev_oper_mode = 1 rsi_zone_enabled = 0x601
# insmod sdio.ko sdio_clock = 50
```

5. Check for the interface created using the command below:

```
# ifconfig -a
```

6. For example, if the driver is loaded successfully and wireless interface is created, then the user will see the following output:

```
wlan0: flags = 4098<BROADCAST,MULTICAST> mtu 1500
ether 94:b2:16:98:ac:dc txqueuelen 1000 (Ethernet) RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Note: In this test case, the wireless interface created after loading of a driver is **wlan0**. The interface name may vary across the systems.

7. Bring up the third-party access point in the desired channel and security. For this test case setup, the **TP-Link AX1500 Wi-Fi 6 Router** is configured with the following credentials, as shown in the figure below.

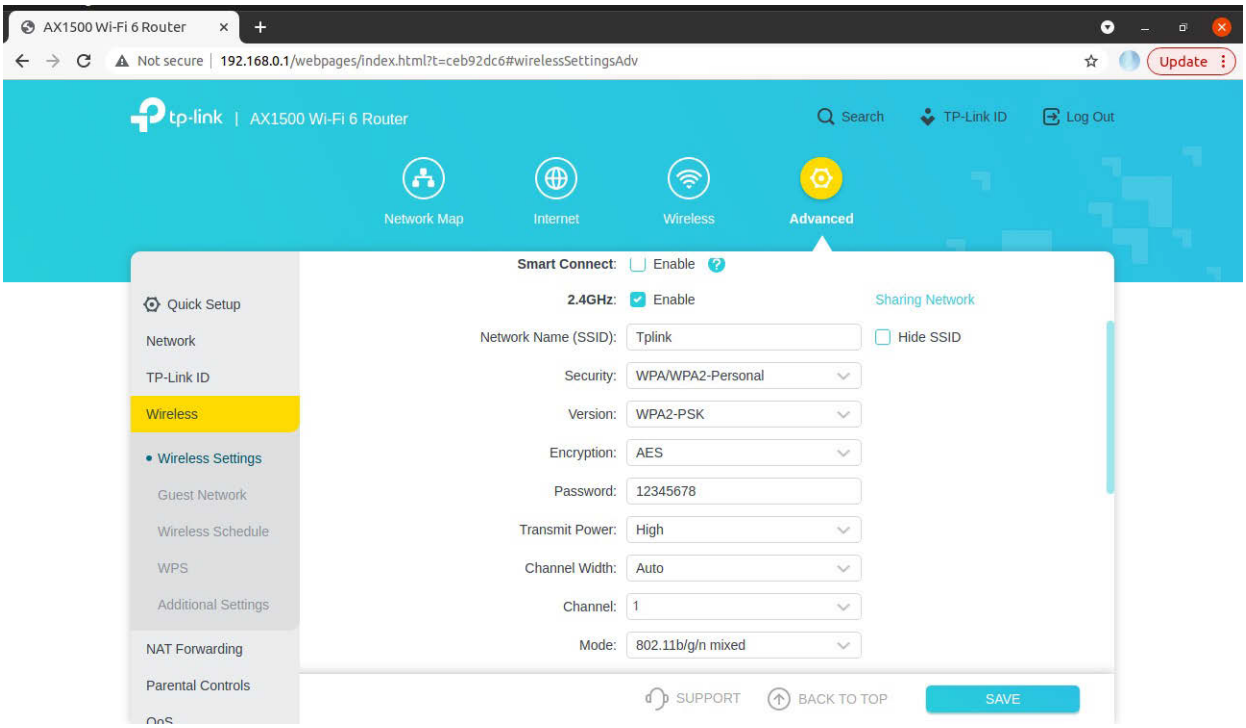

Figure 4.9. AP configuration

8. Edit the network block present in the `<system_path>/SiWT917.x.x.x.x/release/ sta_settings.conf` file which is present in the `<system_path>/ SiWT917.x.x.x.x/release` folder with the credentials of the third-party WLAN access point. For this test case, the network block is updated in the following manner:

```
ctrl_interface=/var/run/wpa_supplicant
update_config=1
#Enable this network block for CCMP/TKIP mode
network={
ssid="Tplink"
pairwise=CCMP TKIP
group=CCMP TKIP
key_mgmt=WPA-PSK
psk="12345678"
# bgscan="simple:15:-45:20"
proto=WPA2 WPA
}
```

9. For more details regarding how to update the network block for other security modes in `system_path>/ SiWT917.x.x.x.x/release/sta_settings.conf` file, the user needs to follow the section Configure station mode using wpa_supplicant.
10. Run wpa_supplicant to connect SiWT917-STA to the TAP.

```
#wpa_supplicant -i <interface name> -D nl80211 -c
<system_path>/SiWT917.x.x.x.x/release/sta_settings.conf -dddt > log &
Example : wpa_supplicant -i wlan0 -D nl80211 -c /home/
SiWT917.x.x.x.x/release/sta_settings.conf -dddt > supp.log &
```

11. To check whether the connection is successful or not use the following command:

```
# iwconfig
```

12. If the connection is successful, then the connected Access point SSID along with the MAC address is displayed as shown below.

```
wlan0 IEEE 802.11 ESSID:"Tplink"
Mode:Managed Frequency:2.412 GHz Access Point: B0:A7:B9:C4:52:CA
Bit Rate=39 Mb/s Tx-Power=16 dBm
Retry short limit:7 RTS thr=2353 B Fragment thr=2352 B
Encryption key:off
Power Management:off
Link Quality=80/80 Signal level=-28 dBm
Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0
Tx excessive retries:0 Invalid misc:18 Missed beacon:0
```

13. If it is not connected to an Access point, a message "Not Associated" is displayed as shown below.

```
wlan0 IEEE 802.11 ESSID:off/any
Mode: Managed Access Point: Not-Associated
Tx-Power=0 dBm Retry short limit:7 RTS thr:off Fragment thr:off
Encryption key:off
Power Management:off
```

14. After successful connection check the IP address using the below commands

```
# dhclient wlan0 -r
# dhclient wlan0 -v
```

15. To check if the SiWT917-STA has been assigned with an IP address from the third-party WLAN access point , the user can give the following command:

```
#ping <IP_adrress of TAP>
Example: ping 192.168.0.1
```

16. For example, if SiWT917-STA has successfully got IP, we will see the following output.

```
PING 192.168.0.1 (192.168.0.1) from 192.168.0.228 wlan0: 56(84) bytes of data.
64 bytes from 192.168.0.1: icmp_seq=1 ttl=64 time=26.8 ms
64 bytes from 192.168.0.1: icmp_seq=2 ttl=64 time=10.8 ms
64 bytes from 192.168.0.1: icmp_seq=3 ttl=64 time=4.00 ms
64 bytes from 192.168.0.1: icmp_seq=4 ttl=64 time=6.25 ms
64 bytes from 192.168.0.1: icmp_seq=5 ttl=64 time=1.77 ms
64 bytes from 192.168.0.1: icmp_seq=6 ttl=64 time=5.05 ms
64 bytes from 192.168.0.1: icmp_seq=7 ttl=64 time=2.18 ms
64 bytes from 192.168.0.1: icmp_seq=8 ttl=64 time=5.63 ms
64 bytes from 192.168.0.1: icmp_seq=9 ttl=64 time=2.72 ms
64 bytes from 192.168.0.1: icmp_seq=10 ttl=64 time=3.01 ms
64 bytes from 192.168.0.1: icmp_seq=11 ttl=64 time=2.32 ms
64 bytes from 192.168.0.1: icmp_seq=12 ttl=64 time=3.14 ms
--- 192.168.0.1 ping statistics ---
12 packets transmitted, 12 received, 0 % packet loss, time 11019 ms
rtt min/avg/max/mdev = 1.766/6.133/26.773/6.665 ms
```

17. For example, if SiWT917-STA has not assigned with an IP address, we will see below output for the ping command.

```
# ping: connect: Network is unreachable
```

5. Summary/Conclusion

This document provided detailed instructions for the compilation, installation, and bring up of SiWT917 RCP module in STA mode using a Raspberry Pi 4 board.

6. Appendix A: Terminology

Common acronyms and abbreviations used in this document:

- **AP -** Access Point.
- **STA -** Station.
- **TAP -** Third party WLAN Access Point.
- **SiWT917-STA -** Station interface that is created for SiWT917 RCP after loading the driver.
- **SiWT917-AP -** Access Point interface that is created for SiWT917 RCP after loading the driver.

7. Appendix B: Refrences and Related Documentation

- Refer to SiWT917 RCP Developers Guide and Getting Started Guide.
- Refer to the following link for the purchase of Raspberry Pi board: https://www.raspberrypi.com/products/.

8. Appendix C: Troubleshooting

- Ensure that dev_oper_mode is configured as per the mode selected. (for STA mode: dev_oper_mode = 1).
- If unknown symbols are observed in the dmesg logs, run the commands below and reload the driver.
  - modprobe mac80211
  - modprobe bluetooth
  - modprobe rfcomm

9. Revision History

Revision 1.1

January 2025

- Removed BRD4357A radio board reference from Table 2.1 Hardware Requirements on page 4 .

Revision 1.0

January 2025

- Initial release.

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