NXP Semiconductors
Application Note

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Enabling SDIO Wi-Fi on LS1012ARDB

Contents

1 Introduction

One of the important use case of LS1012A is Wi-Fi access point (AP). Wi-Fi radio or Wi-Fi card can either be connected to the PCIe port or one of the two SDIO ports providing wireless connectivity.

This application note is focused on the enablement of Wi-Fi card connected to one of the SDIO port of the LS1012ARDB. The Wi-Fi card used for this activity is Murata Wi-Fi™ card with Broadcom chipset.

This application note explains:

- How to apply Wi-Fi driver patches
- How to build the driver as kernel module
- What all configuration options need to be enabled in kernel config
- How LS1012ARDB can be configured as a Wi-Fi access point
- What all configurations are required in rootfs with respect to bring up of wireless interface
- What are various configuration options in user level utility – hostapd

2 Prepare source code for applying Wi-Fi patches

To obtain LS1012A SDK linux code base:

1. Download the source ISO image of LS1012A SDK 0.5 release from:

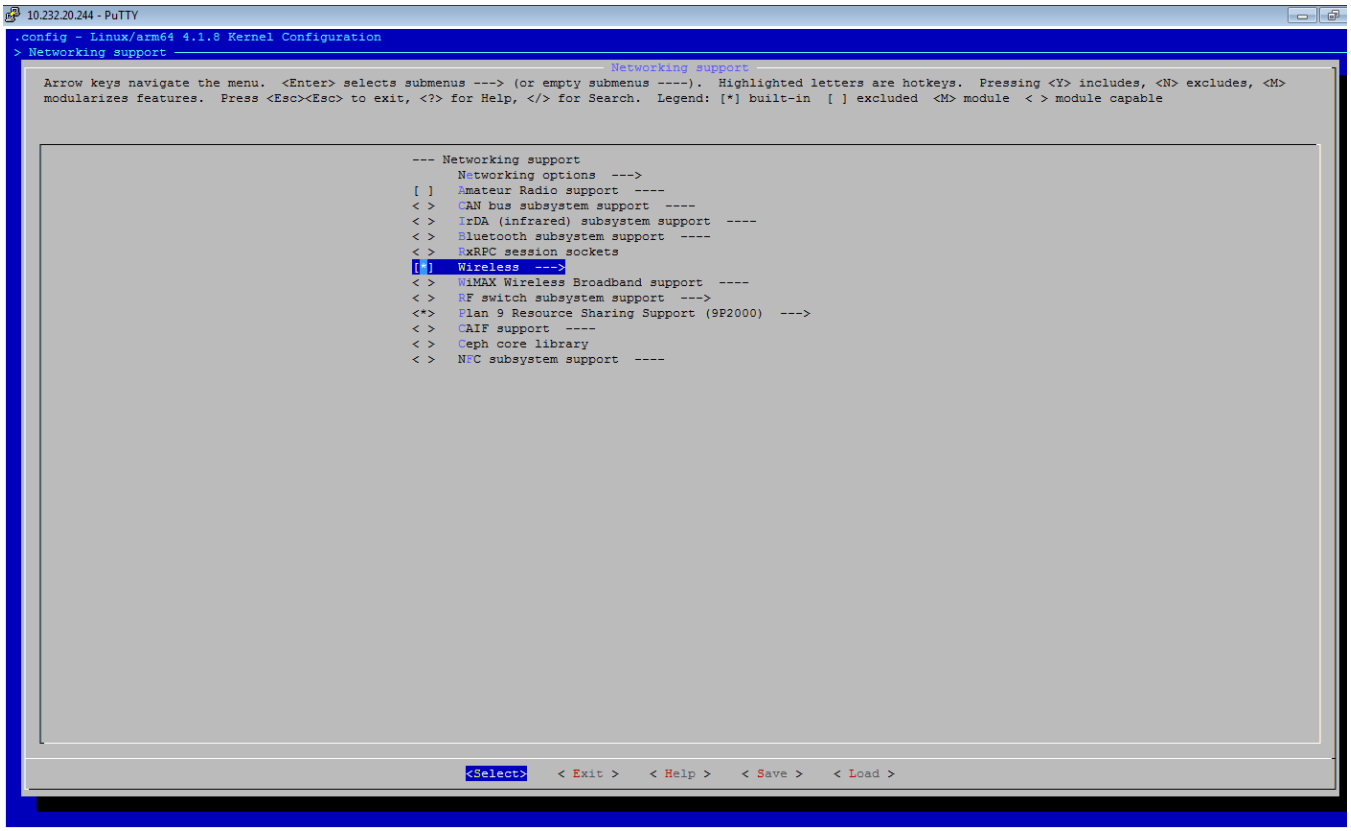
   http://www.nxp.com/products/microcontrollers-and-processors/arm-processors/qoriq-layerscape-arm-processors/qoriq-layerscape-1012a-low-power-communication-processor:LS1012A?&fpsp=1&tab=Design_Tools_Tab

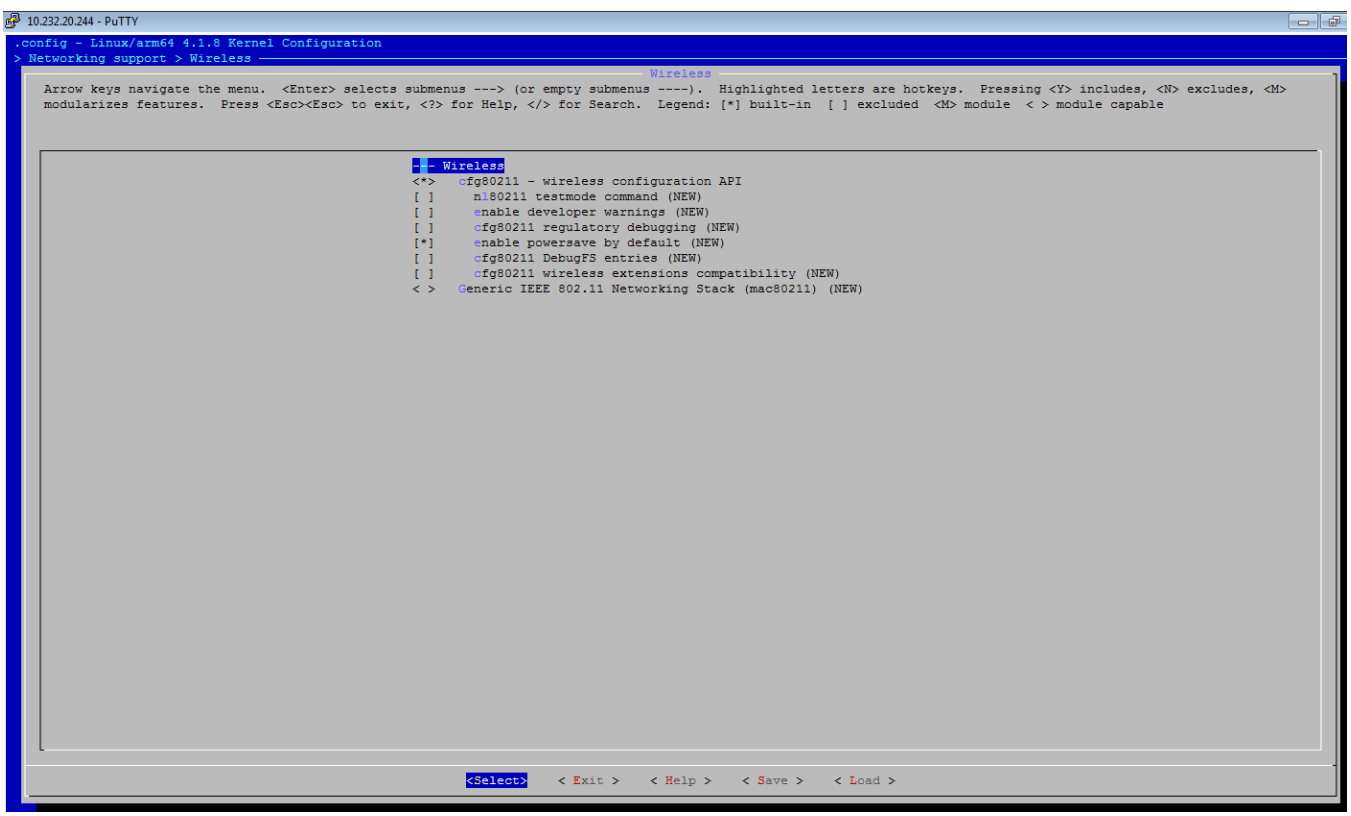
2. Install the ISO on Linux machine.

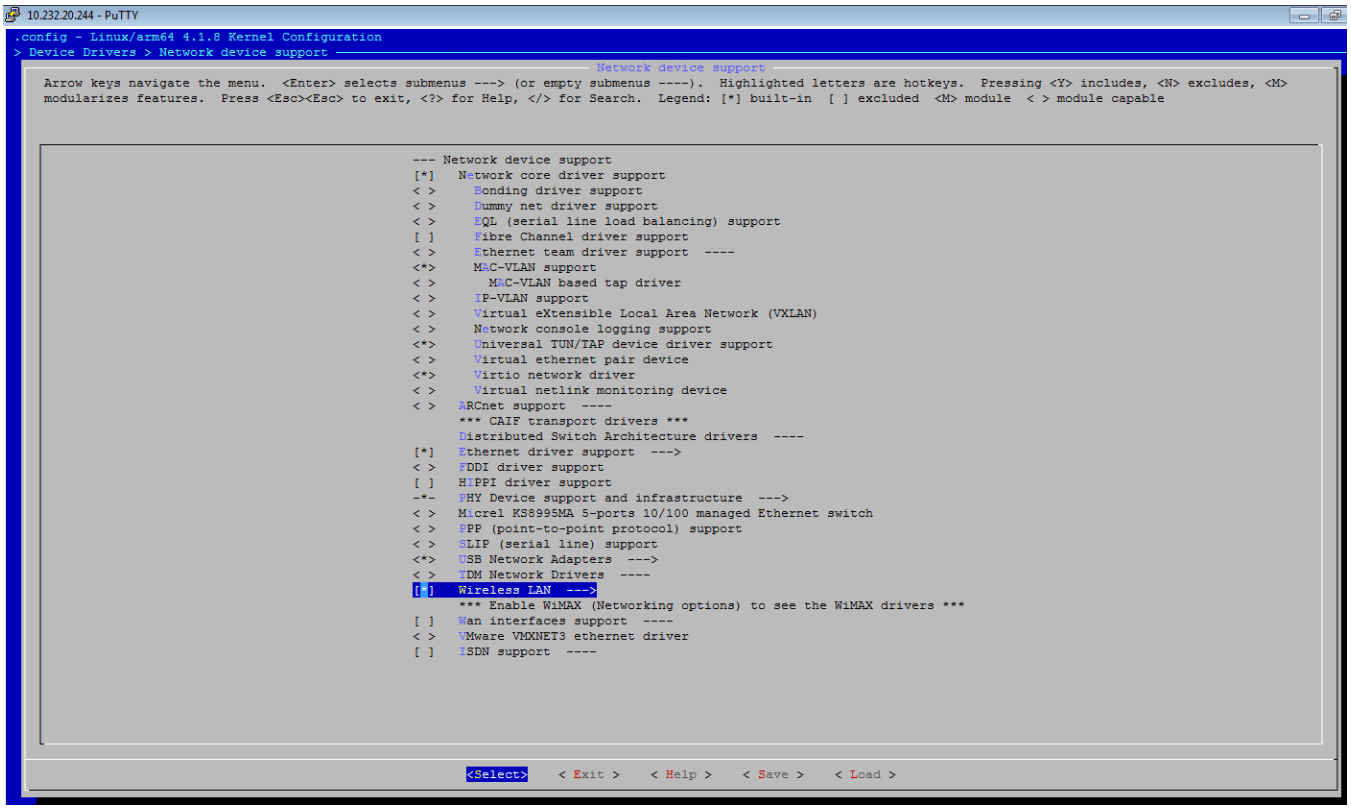
   For steps to obtain the Linux source code, see the Yocto user guide available with NXP SDK release. SDK release can be downloaded from www.nxp.com.

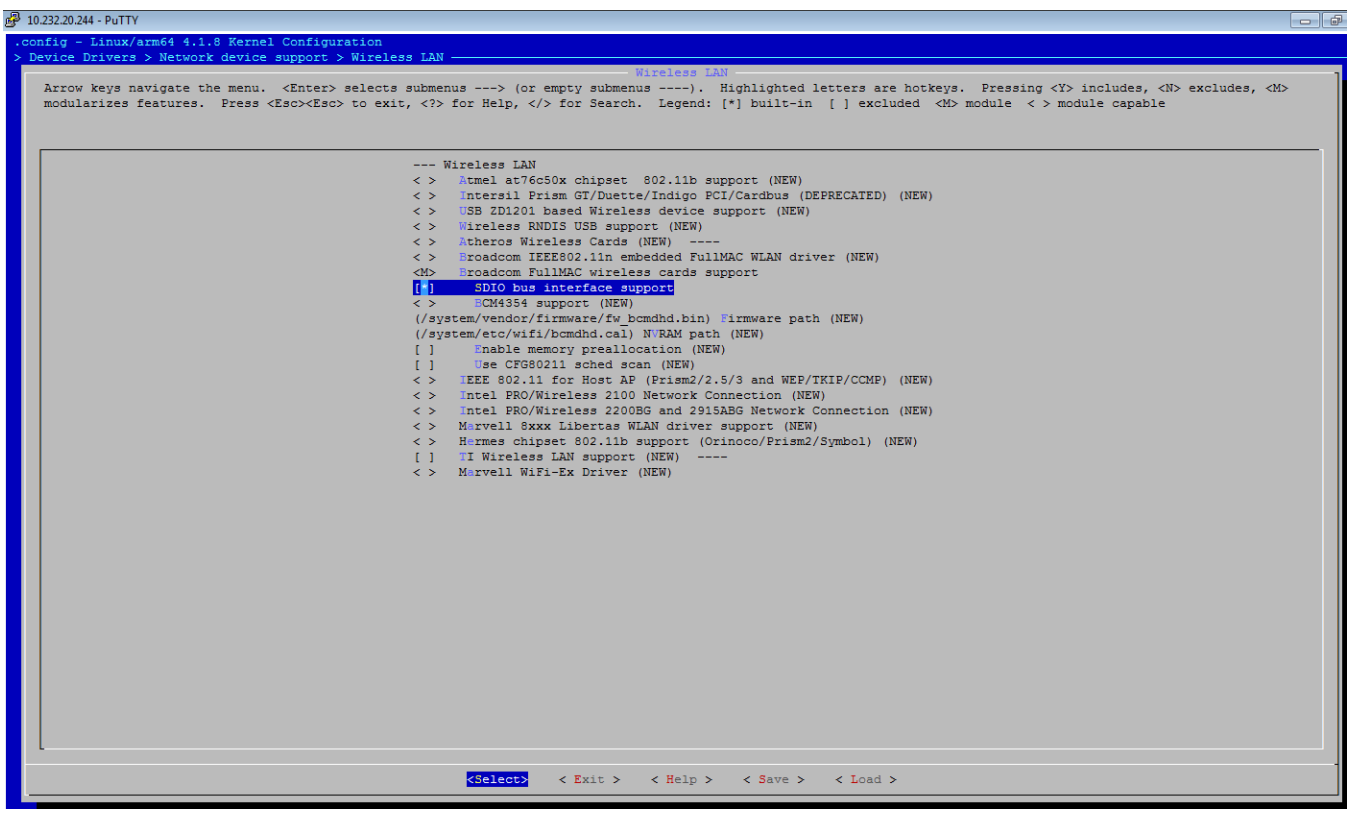
3. Download the SDIO Wi-Fi patch release file from nxp.com. For help, contact nxp.com/support.
4. Apply all the patches to the Linux source code that is obtained at **Step 2**.
   a. `cd <linux source directory>`
   b. `patch -p1 < "patch(s)-path"`
5. Export ARCH and CROSS_COMPILE of the toolchain.
   a. `export ARCH=arm64`
   b. `export CROSS_COMPILE=<toolchain-install-path/sysroots/x86_64-fsl-linux/usr/bin/aarch64-fsl-linux->`
6. Generate `.config` for kernel.

   ```
   ./scripts/kconfig/merge_config.sh arch/arm64/configs/defconfig arch/arm64/configs/freescale.config
   ```
7. Configure the Linux kernel as follows.


10.232.20.244 - PuTTY
.config - Linux/arm64 4.1.8 Kernel Configuration
> Networking support
Networking support
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module < > module capable
--- Networking support
Networking options --->
[ ] Amateur Radio support ----
< > CAN bus subsystem support ----
< > IrDA (infrared) subsystem support ----
< > Bluetooth subsystem support ----
< > RxRPC session sockets
[*] Wireless --->
< > WiMAX Wireless Broadband support ----
< > RF switch subsystem support --->
<*> Plan 9 Resource Sharing Support (9P2000) --->
< > CAIF support ----
< > Ceph core library
< > NFC subsystem support ----
<Select> < Exit > < Help > < Save > < Load >


10.232.20.244 - PuTTY
.config - Linux/arm64 4.1.8 Kernel Configuration
> Networking support > Wireless
Wireless
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module < > module capable
--- Wireless
<*> cfg80211 - wireless configuration API
[ ] nl80211 testmode command (NEW)
[ ] enable developer warnings (NEW)
[ ] cfg80211 regulatory debugging (NEW)
[*] enable powersave by default (NEW)
[ ] cfg80211 DebugFS entries (NEW)
[ ] cfg80211 wireless extensions compatibility (NEW)
< > Generic IEEE 802.11 Networking Stack (mac80211) (NEW)
<Select> < Exit > < Help > < Save > < Load >





8. Compile the kernel.

```
make
```

3 Set up SDIO Wi-Fi card

The latest revisions of LS1012ARDB (revision D and above) contain SDIO Wi-Fi card as a part of the board kit. The SDIO Wi-Fi card is used to enable SDHC based Wi-Fi using Murata SN8000 module.

To use the SDIO Wi-Fi card:

1. Insert the SDIO Wi-Fi card into the SD connector. The opening for SD connector is at the front side of chassis.
2. Insert the SDIO Wi-Fi card as shown in the figure below.

Figure 1. SD Wi-Fi card

NOTE

SD connectors in rev D is different from prior revisions. The card orientation while insertion is also different.

4 Load Wi-Fi driver

After Linux kernel is compiled (see Step 8 in Prepare source code for applying Wi-Fi patches), Wi-Fi kernel module `bcmdhd.ko` is generated as `<linux-source-code>/drivers/net/wireless/bcmdhd/bcmdhd.ko`.

Other than this, there are 2 more files available in SDIO Wi-Fi patch release that are required to set up the Wi-Fi.

- `bcmdhd.SN8000.SDIO.cal`
- `fw_bcmdhd_apsta.bin`

To load Wi-Fi:

1. Flash the RCW file `rcw_800_default_alpha_CD_1_WP_0_swap.bin` provided as part of the patch release.
2. Boot Linux kernel with the kernel generated in Step 8 of Prepare source code for applying Wi-Fi patches
3. tftp the kernel module file `bcmdhd.ko`, configuration file `bcmdhd.SN8000.SDIO.cal`, and the firmware binary `fw_bcmdhd_apsta.bin` on the target board (RDB Rev D).
4. Run `ifconfig -a` and look for the ethernet interfaces. If there are no interfaces, then proceed to step 5. Else, go to step 6.
5. Insmod the Ethernet driver. This driver is copied into `rootfs at /pfe.ko`

   ```
   insmod /pfe.ko
   ```
6. Insmod the Wi-Fi driver.

   ```
   insmod /run/bcmdhd.ko nvram_path=/run/bcmdhd.SN8000.SDIO.cal firmware_path=/run/
   fw_bcmdhd_apsta.bin
   ```
7. The following logs appear at the console after the above command is successful.

   ```
   [   52.899306] dhd_module_init in
   [   52.902654] Power-up adapter 'DHD generic adapter'
   [   52.909130] Wi-Fi_platform_bus_enumerate device present 1
   [   52.933982] F1 signature OK, socitype:0x1 chip:0xa962 rev:0x1 pkg:0x9
   [   52.941265] DHD: dongle ram size is set to 245760(orig 245760) at 0x0
   [   52.948383] Wi-Fi_platform_get_mac_addr
   [   52.952338] CFG80211-ERROR) wl_setup_wiphy : Registering Vendor80211)
   [   52.960681] wl_create_event_handler(): thread:wl_event_handler:62a started
   [   52.967631] CFG80211-ERROR) wl_event_handler : tsk Enter, tsk = 0xffff8000226819c0
   [   52.975691] dhd_attach(): thread:dhd_watchdog_thread:62b started
   [   52.981818] dhd_attach(): thread:dhd_dpc:62c started
   [   52.986796] dhd_deferred_work_init: work queue initialized
   [   53.016705] dhdsdio_write_vars: Download, Upload and compare of NVRAM succeeded.
   [   53.290178] dhd_bus_init: enable 0x06, ready 0x06 (waited 0us)
   [   53.297110] Wi-Fi_platform_get_mac_addr
   [   53.303202] Firmware up: op_mode=0x0002, MAC=00:0b:6c:43:fb:3c
   [   53.312093] dhd_preinit_ioctls buf_key_b4_m4 set failed -23
   [   53.325139] Firmware version = wl0: Apr 30 2015 11:17:10 version 5.90.231 FWID 01-0
   [   53.333298] dhd_preinit_ioctls wl ampdu_hostreorder failed -23
   [   53.339839] dhd_wlfc_init(): successfully enabled bdcv2 tlv signaling, 79
   [   53.347042] dhd_wlfc_init(): wlfc_mode=0x0, ret=-23
   [   53.352511]
   [   53.352511] Dongle Host Driver, version 1.141.72 (r)
   [   53.352511] Compiled from
   [   53.362348] Register interface [wlan0]  MAC: 00:0b:6c:43:fb:3c
   [   53.362348]
   ```

   You can see the Wi-Fi interface (wlan0) in the above log.

NOTE

If you want to use the Root file system, it is shipped as part of this patch release. However, if you want to use customized rootfs, then you need hostapd, dnsmasq, wireless-tools packages for enabling Wi-Fi.

5 Configure LS1012ARDB as Access Point (AP)

To configure LS1012ARDB as AP:

1. Assign IP address to the Wi-Fi interface.

```
root@ls1012ardb:/tmp# ifconfig wlan0 192.168.1.100 netmask 255.255.255.0 up
root@ls1012ardb:/tmp# ifconfig wlan0
wlan0 Link encap:Ethernet HWaddr 00:0b:6c:43:fb:3c
inet addr:192.168.1.100 Bcast:192.168.1.255 Mask:255.255.255.0
inet6 addr: fe80::20b:6cff:fe43:fb3c/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:508 (508.0 B)
```

2. Edit `hostapd.conf` file.

   Look for “passphrase” in the file and give a sufficiently complex password (of at least 8 characters), which is a combination of alphabets and numbers.

3. Edit interfaces file: `/etc/network/interfaces`
   Add the following information in it.

```
auto wlan0
iface wlan0 inet static
hostapd /etc/hostapd.conf
address 192.168.1.1
netmask 255.255.255.0
```

4. Edit/create another file: `/etc/dnsmasq.conf`
   Add the following information in it.

```
interface=lo,wlan0
no-dhcp-interface=lo
dhcp-range=192.168.1.20,192.168.1.254,255.255.255.0,12h
```

5. Enable forwarding by uncommenting the following in `/etc/sysctl.confnet.ipv4.ip_forward=1`
6. Run `hostapd` command with the following arguments:

```
hostapd -B /etc/hostapd.conf
```

   Output:

```
rfkill: Cannot open RFKILL control device
[ 7440.473635] CFG80211-ERROR) wl_cfg80211_del_station : Disconnect STA :
ff:ff:ff:ff:ff:ff scb_val.val 3
Using interface wlan0 with hwaddr 00:0b:6c:43:fb:3c and ssid "test"
[ 7440.538202] CFG80211-ERROR) wl_cfg80211_set_channel : netdev_ifidx(3), chan_type(1)
target channel(1)
[ 7440.548251] CFG80211-ERROR) wl_cfg80211_parse_ies : No WPSIE in beacon
[ 7440.554902] CFG80211-ERROR) wl_cfg80211_parse_ies : No WPSIE in beacon
[ 7440.825741] _dhd_wlfc_mac_entry_update():1649, entry(32)
wlan0: interface state UNINITIALIZED->ENABLED
wlan0: AP-ENABLED
```

7. After doing steps 1-6, a wireless AP would be visible by the name of “test”.
8. Connect to AP from laptop or any other Wi-Fi end point and transfer the data.

6 Revision history

This sections summarizes revisions to this document.

Table 1. Revision history

Revision	Date	Section	Description
0	02/2017		Initial public release.

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