WB Logging and Troubleshooting
WB45NBT and WB50NBT

Application Note

INTRODUCTION

Laird’s WB products (WB40NBT, WB45NBT, and WB50NBT) are full Linux systems and come pre-equipped with a wide array of logging and troubleshooting tools. This application note explains how to work with these tools to help integrate a WB product into your environment.

REQUIREMENTS

The document assumes you’re working with a WB45NBT or WB50NBT mounted on a BB45/BB40 development board and running GA5 release software. Due to varying hardware revisions and software revisions, different tools or access methods may be required. This application note attempts to cover the most general procedures.

INTERFACES

Troubleshooting resources vary across the WB’s interfaces. The widest set of tools is available from the command console. Depending on your device’s configuration, you may access the command console one of two ways:

- Connect over the DEBUG UART serial port interface
- Log in via SSH over any network interface (Wi-Fi, Ethernet, or USB Ethernet Gadget)

Laird’s WebLCM browser application provides many useful logging and troubleshooting tools. WebLCM is available on the following interfaces:

- Over HTTPS when connected to the WB over Wi-Fi in AP mode
- Over HTTPS when both the WB and your host computer are connected over Wi-Fi to the same network
- Over HTTPS on the Ethernet interface
- Over HTTPS on the USB Ethernet interface

**Note:** WebLCM is not available in all versions of WB software.

LOGGING

The WB provides several logging functions for diagnostic purposes. The following logs are active by default:
- **syslog** – syslog is the primary combined log of Linux. Many different daemons and programs report to the main system log. Much of the kernel log output also goes into this log. The supplicant (sdcsupp), event monitor (event_mon), and SDK applications all log to the syslog.
- **Kernel log** – The kernel log is used by the kernel, drivers, and various system components. The kernel log is accessed by the program dmesg. By default, WARNING (level 4) and higher messages are printed to the log.

These two logs are easily accessible by either the WebLCM (if available) or the console. The steps to access these logs are detailed in the following sections.

**WebLCM**

To access the log output through WebLCM, follow these steps:

1. Enter the IP address of your WB in a web browser.
2. Enter your login information. By default, the user name is *root* and the password is *summit*.
3. Click the **About** tab (Figure 1).

![Figure 1: WebLCM About tab](image)

On this page, you can find both logs. The syslog is available in the *Logread Output* rollout and the kernel log is available in the *Dmesg Output* rollout.

4. Click on one of these headers to open the respective log.

**Console**

Both logs are also available at the command console. From any console (DEBUG UART, SSH login, or similar), enter commands; the log directly outputs to the console.

**Syslog**

To read the syslog, enter `logread` and press *Return*. The output should resemble the following:

```
Jan 01 00:41:23 summit user.info usbmout[749]: executing command: run-parts
Jan 03 01:22:29 summit user.info nis: wl down stop
Jan 03 01:22:30 summit user.info nis: wl up start
Jan 03 01:22:31 summit user.warn kernel: ath6kl: INIT GENERIC NETLINK ATHEROS COM
Jan 03 01:22:31 summit user.info kernel: ath6kl: ar6003 hw 2.1.1 sdio fw 3.4.0.0.0084* api 4
Jan 03 01:22:33 summit user.info laird[1464]: Laird Event Monitor Version 1.1.2
Jan 03 01:22:33 summit user.info laird[1464]: Current Registered Bitmask 0x00000003FA008000
```
Kernel Log

To read the kernel log, enter `dmesg` and hit return. The output should resemble the following:

```
usb0: MAC 7e:07:10:8c:e5:e5
usb0: HOST MAC 4a:24:fc:b7:0d:41
gadget: Ethernet Gadget, version: Memorial Day 2008
gadget: g ether ready
ath6kl: INIT GENERIC NETLINK Atheros COM
ath6kl: ar6003 hw 2.1.1 sdio fw 3.4.0.0084\x01 api 4
nf_conntrack version 0.5.0 (947 buckets, 3788 max)
macb f802c000.ethernet eth0: link up (100/Full)
ip_tables: (C) 2000-2006 Netfilter Core Team
cfg80211: Calling CRDA for country: US
cfg80211: Regulatory domain changed to country: US
cfg80211: (start freq - end freq @ bandwidth), (max antenna gain, max eirp)
cfg80211: (2402000 KHz - 2472000 KHz @ 4000 KHz), (300 mBi, 2700 mBm)
cfg80211: (5170000 KHz - 5250000 KHz @ 4000 KHz), (300 mBi, 1700 mBm)
cfg80211: (5250000 KHz - 5330000 KHz @ 4000 KHz), (300 mBi, 2000 mBm)
cfg80211: (5490000 KHz - 5600000 KHz @ 4000 KHz), (300 mBi, 2000 mBm)
cfg80211: (5650000 KHz - 5710000 KHz @ 4000 KHz), (300 mBi, 2000 mBm)
cfg80211: (5735000 KHz - 5835000 KHz @ 4000 KHz), (300 mBi, 3000 mBm)
cfg80211: (57240000 KHz - 63720000 KHz @ 2160000 KHz), (N/A, 4000 mBm)
```

log_dump

A utility to collect both logs and other important information about the system is provided in the form of `/usr/bin/log_dump`.

When run, a `log_dump.txt` file is created along with a message about its location and instructions to contact support with the file:

```
# log_dump
creating /tmp/log_dump.txt
The file /tmp/log_dump.txt was created. Please provide this file to your support contact at ews-support@lairdtech.com
```

See Appendix X for an example of the `log_dump.txt` file

Setting the Kernel Log level

The log level is used by the kernel to determine the importance of a message and to decide whether it should be presented to the user immediately, by printing it console. The console will output kernel messages as they are put into the log if the loglevel is smaller (greater importance) then the console log level value. By default, the console kernel log contains messages of less then WARNING level (4). At run time, you can change the minimum level of the output.

To determine your current `console_loglevel`, enter the following into the command console:

```
# cat /proc/sys/kernel/printk
4 7 1 7
```

The first integer of the output shows your current `console_loglevel`; the second shows the default log level.

To change your current `console_loglevel`, write to this file and change the settings. In order to get all messages printed to the console, enter the following into the command prompt:
Once this is set, all kernel messages appear on the console.

Additional information on the kernel module loglevel can be found here:
https://github.com/torvalds/linux/blob/master/Documentation/kernel-parameters.txt#L2033

**Setting the Driver and Supplicant Log Levels**

The sdc-cli utility can set the logging level for both the driver and supplicant.

To see the current logging levels, issue:

```
# sdc-cli logging show
```

```
supplicant level: none
driver level: none
```

To set a log level for the driver:

```
# sdc-cli logging set driver <0-3>
```

To set a level for the supplicant:

```
# sdc-cli logging set supplicant
```

**UNDERSTANDING THE LOGS**

**syslog**

For much of Linux, syslog is the common combined log. Most background programs (daemons) and other system scripts and programs write to the log. Any script can write to the log by using the program logger.

A typical line looks like the following:

```
Jan 2 16:53:58 summit user.notice client_wd(wlan0): scanning for udhcpc
```

It starts with a date and time stamp, followed by the hostname (the WB’s default is `summit`). This is followed by the type of message it is, in our example this is a user notice. Then is the application sending the message, followed by the message itself.

The formatting of the application and the message is up to the sender.

Common sources include:

- `kernel` – These are kernel printk messages (the same information as you’d get from dmesg)
- `nis` – Network interface status information
- `laird[###]` – Event messages from event_mon
- `client_wd(interface)` – dhcp watchdog monitor
Laird Events

The networking stack components all output event messages when certain things happen. This event system was designed so a network management application could be written to manage the state of the radio. A program, event_mon, runs on the WB and routes the event messages to the syslog or the console. When the WB boots, event_mon starts in the background and logs events to the syslog.

The following is an example of event_mon messages for a successful connection using LEAP authentication via a logread dump of syslog:

Below is an example of a failed connection attempt with LEAP using the wrong password:
A typical event_mon logging message contains and Event, Status, Reason information. Once the client associates to an AP, the AP MAC address is then printed. For SDC_E_DHCP events that indicate a status of BOUND, RENEWED, DECONFIG, or RELEASED, an output of the DHCP leases file also displays.

Currently the event_mon running at start-up outputs SDC_E_CONNECTION_STATE, SDC_E_DHCP, SDC_E_READY, SDC_E_ROAM, SDC_E_SCAN_REQ, SDC_E_DISCONNECT_REQ, SDC_E_SCAN, SDC_E_REGDOMAIN, SDC_E_CMDERROR, SDC_E_INTERNAL, and SDC_E_FW_ERROR events to the syslog.

**Note:** For more about Laird Events, see the Events section of the SDK Programmer’s Guide.

**Kernel Log**

The kernel log is read by the program dmesg. Use the parameter –c to clear the log after reading it.

All subsystems in the kernel use the log, printing messages to it. The messages are labelled with a priority and usually with the subsystem from which it came.

Typical log entries look like the following:

```
atmel_usba_udc 500000.gadget: FIFO at 0x00500000 mapped at c4c00000
gadget: using random host ethernet address
usb0: MAC 7e:07:10:8c:e5:e5
usb0: HOST MAC 02:bb:09:17:5b:66
  gadget: Ethernet Gadget, version: Memorial Day 2008
gadget: g_ether ready
ath6kl: INIT GENERIC NETLINK Atheros COM
ath6kl: ar6003 hw 2.1.1 sdio fw 3.4.0.0084\x01 api 4
```

Messages are pre-pended with the subsystem from which they arrive.

Important subsystems:

- **ath6kl** – This is the Wi-Fi chip driver for the WB45. If you’re having trouble with the Wi-Fi chip specifically, these messages are key.
- **cfg80211** – This is the subsystem that is responsible for Wi-Fi configuration parameters in the kernel.
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- **MMC0** – This is the MMC card and SDIO driver subsystem. Look here if you’re having low-level SDIO problems.
- **UBIFS** – Our devices use the UBI filesystem. This is the tag for these drivers.

If a message doesn’t make sense or is confusing, it’s advisable to search for the message text online or search the Linux kernel source code for answers.

TROUBLESHOOTING AND DEBUGGING

Version Information

It’s important to know how to find the version information from your device. This is one of the first pieces of information Laird Support and Engineering will request.

A single place for most important version information is sdc_cli. Enter sdc\_cli version at the terminal and hit return:

```
# sdc_cli version
CLI: 3.5.0.5
SDK: 3.5.0.5
Hardware Chipset: 45
Driver: 3.5.0.1
Firmware: ar6003 hw 2.1.1 fw 3.4.0.0084 api 4
Supplicant: sdcsupp v3.5.20.6
Build: Laird Linux wb45n-laird\_fips-3.5.0.17
```

This same information is available in the WebLCM interface on the About tab.

Another useful piece of information is the kernel version. Enter `uname -a` at the terminal and hit return:

```
# uname -a
Linux summit 3.8.0-laird21.01 #1 PREEMPT Thu Aug 7 15:57:13 EDT 2014 armv5tejl
GNU/Linux
```

Network Information

A large amount of information is presented by our various network programs and scripts. Following is a list of commands that provide useful information:

- **ifrc\_v wlan0** – This gives you information about a specific interface (wlan0 one in this example).
- **ifrc\_v** – Gives detailed information about all the interfaces.
- **ifrc br0** – Gives information about the bridge mode if enabled.
- **ip route show** – shows routing table information.
- **ip addr show** – shows the IP address information on configured interfaces.
- **cat /var/log/ifrc/wlan0** – shows the debug log for ifrc’s management of the Wi-Fi interface.

The following is an example session for finding this information (commands in bold):
# ifrc -v wlan0
Configuration for interface: ...managed, active, associated

wlan0:  <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 state UP
        link/ether 40:2c:f4:d3:9e:b5 brd ff:ff:ff:ff:ff:ff
        inet 192.168.10.102/24 brd 192.168.10.255 scope global wlan0

WiFi:  active
Associated to 64:e9:50:d1:0c:40 (on wlan0)
        SSID:  ccopen1
        freq: 2427
        signal: -43 dBm
        tx bitrate: 72.2 MBit/s MCS 7 short GI

Routing:
        192.168.10.0/24 proto kernel scope link src 192.168.10.102

ARP:

Connections:

Processes:
    345 S    /usr/bin/sdcsupp -iwlan0 -Dnl80211 -s
    500 S    ifplugd -iwlan0 -miff -s -fa -qMp -u0 -d0 -Ir/etc/network/ifrc.sh
    587 S    udhcpc -iwlan0 -R -t4 -T2 -A5 -b -o -Dlease -Odomain -Odns -Ohostname -Osubnet
             -Orouter -Oserverid -Obroadcast -p/var/run/dhcclient.wlan0.pid -s/etc/dhcp/udhcpc.script
    589 S    ash /etc/dhcp/client_wd -iwlan0

# ifrc -v
Configuration for all interfaces                           (try -h to see usage)

Available, but not configured:  usb0

lo:  <LOOPBACK,UP,LOWER_UP> mtu 65536 noqueue state UNKNOWN
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo

eth0:  <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 state UP
       link/ether 00:17:23:d0:12:e0 brd ff:ff:ff:ff:ff:ff
       inet 192.168.0.111/24 brd 192.168.0.255 scope global eth0

usb0:  <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 state DOWN
       link/ether 7e:07:10:8c:e5:e5 brd ff:ff:ff:ff:ff:ff
       inet 192.168.3.1/24 brd 192.168.3.255 scope global usb0

wlan0:  <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 state UP
        link/ether 40:2c:f4:d3:9e:b5 brd ff:ff:ff:ff:ff:ff
        inet 192.168.10.102/24 brd 192.168.10.255 scope global wlan0

WiFi:  active
Associated to 64:e9:50:d1:0c:40 (on wlan0)
        SSID:  ccopen1
        freq: 2427
        signal: -44 dBm
        tx bitrate: 72.2 MBit/s MCS 7 short GI

Routing:
        default nexthop via 192.168.10.2 dev wlan0 weight 4
        next hop via 192.168.0.1 dev eth0 weight 1
        192.168.0.0/24 dev eth0 proto kernel scope link src 192.168.0.111
        192.168.3.0/24 dev usb0 proto kernel scope link src 192.168.3.1
        192.168.10.0/24 dev wlan0 proto kernel scope link src 192.168.10.102

DNS:  resolv.conf	nameserver 68.87.76.182
      nameserver 8.8.8.8
      nameserver 8.8.8.8
      options timeout:3
# ifrc br0
...not available, not a kernel-resident interface

# ip route show
default	nexthop via 192.168.10.2 dev wlan0 weight 4
tenexthop via 192.168.0.1 dev eth0 weight 1
192.168.0.0/24 dev eth0 proto kernel scope link src 192.168.0.111
192.168.3.0/24 dev usb0 proto kernel scope link src 192.168.3.1
192.168.10.0/24 dev wlan0 proto kernel scope link src 192.168.10.102
# ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN
link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
inet 127.0.0.1/8 scope host lo
inet6 ::1/128 scope host
valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
link/ether 00:17:23:d0:12:e0 brd ff:ff:ff:ff:ff:ff
inet 192.168.0.111/24 brd 192.168.0.255 scope global eth0
inet6 fe80::217:23ff:fed0:12e0/64 scope link
valid_lft forever preferred_lft forever
3: usb0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast state DOWN qlen 1000
link/ether 7e:07:10:8c:e5:e5 brd ff:ff:ff:ff:ff:ff
inet 192.168.3.1/24 brd 192.168.3.255 scope global usb0
4: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
link/ether 40:2c:f4:d3:9e:b5 brd ff:ff:ff:ff:ff:ff
inet 192.168.10.102/24 brd 192.168.10.255 scope global wlan0
inet6 fe80::422c:f4ff:fed3:9eb5/64 scope link
valid_lft forever preferred_lft forever

# cat /var/log/ifrc/wlan0
mp_cdt:dhcp
eni sk:2124956927 349
ifrc_i:w=wl=wlan0 fsl="" mm="" vm="" qm=>/dev/null
   -- v20140612 - md5:ffhbae3fc65c1514a59cda208796287f
      11.15 /etc/network/ifrc.sh wl up -- 110 rcS
      12.57 __/etc/dhcpcd/udhcp.scrip deconfig
      12.80 __/etc/dhcpcd/udhpc.script requesting
      13.00 __/etc/dhcpcd/udhpc.scrip bound
   1620.89 __/sbin/ifrc --v wlan0
   2401.74 __/sbin/ifrc --v wlan0

Wi-Fi Protocol Information

The above examples provide a great amount of information about the Wi-Fi interface. The following tools illustrate how to troubleshoot the Wi-Fi interface.

Profile Information

Wi-Fi connections are managed by profiles. To troubleshoot a profile, first look in the WB’s profile settings. The WebLCM presents this information and allows you to configure it on the Wi-Fi tab (Figure 2):
The window above shows the information after selecting the Default profile and clicking **Show**.

You can accomplish the same task with the `sdc_cli` program on the console:

```
# sdc_cli profile list
Default ACTIVE

# sdc_cli profile Default show
Name: Default
SSID: ccopen1
Client Name:
Tx Power: auto
Auth Type: open
EAP Type: none
WEP Type: wep-off
Bitrate: auto
Mode: ABGN
Powersave: fast
```

When the WB is having trouble connecting to an AP, the most likely problem is some overlooked configuration problem. See the `sdc_cli` User Guide for more information.

**Atheros Wi-Fi Drive Debugging Logs**

The driver logging level can be set through the `sdc_cli` as indicated in the Setting the Driver and Supplicant Log Levels section of this document.

This level can also be set manually and for specific flags. The ath6kl driver for the AR6003 and AR6004 chips used on the WBs can output much more specific information.

The debugging flags are values set as a bitmask in `drivers/net/wireless/ath/ath6kl/debug.h`:
enum ATH6K_DEBUG_MASK {
    ATH6KL_DBG_CREDIT = BIT(0), /* hole */
    ATH6KL_DBG_WLAN_TX = BIT(2), /* wlan tx */
    ATH6KL_DBG_WLAN_RX = BIT(3), /* wlan rx */
    ATH6KL_DBG_BMI = BIT(4), /* bmi tracing */
    ATH6KL_DBG_HTC = BIT(5),
    ATH6KL_DBG_HIF = BIT(6),
    ATH6KL_DBG_IRQ = BIT(7), /* interrupt processing */
    /* hole */
    ATH6KL_DBG_WMI = BIT(10), /* wmi tracing */
    ATH6KL_DBG_TRC = BIT(11), /* generic func tracing */
    ATH6KL_DBG_SCATTER = BIT(12), /* hif scatter tracing */
    ATH6KL_DBG_RAWBYTES = BIT(13), /* dump tx/rx frames */
    ATH6KL_DBG_AGGR = BIT(15), /* aggregation */
    ATH6KL_DBG_SDIO = BIT(16),
    ATH6KL_DBG_SDIO_DUMP = BIT(17),
    ATH6KL_DBG_BOOT = BIT(18), /* driver init and fw boot */
    ATH6KL_DBG_WMI_DUMP = BIT(19),
    ATH6KL_DBG_SUSPEND = BIT(20),
    ATH6KL_DBG_USB = BIT(21),
    ATH6KL_DBG_USB_BULK = BIT(22),
    ATH6KL_DBG_RECOVERY = BIT(23),
    ATH6KL_DBG_ANY = 0xffffffff /* enable all logs */
};

Combining the different bits enables varying debug output from the driver.

The debug_mask module parameter may be set either at the time you load the driver or during run time. Certain bits, like the BMI tracing and BOOT flags, are only useful when set at the time that the driver is loaded.

The most useful flag to set when debugging is the WMI flag. Laird support engineers might ask you to enable this bit when helping to track down a problem.

To set the debug mask on load:

```
# modprobe ath6kl_core debug_mask=0x00050000
# modprobe ath6kl_sdio
```

To set the debug mask at runtime:

```
# echo 0x00002400 > /sys/module/ath6kl_core/parameters/debug_mask
```

## Supplicant Logs

As with the driver, the supplicant logging level can be set via the sdc_cli utility. See the Setting the Driver and Supplicant Log Levels section of this document.

## Roaming Information

The AR6003/AR6004 of the WB45NBT/WB50NBT allows you to dump the roam table in order to facilitate debugging of roam situations. To look at the table, you must mount the debugfs, which is not mounted by default:

```
# mount -t debugfs nodev /sys/kernel/debug
```
Then the roam table becomes available:

```
# cat /sys/kernel/debug/ieee80211/phy0/ath6kl/roam_table
roam_mode=0
# roam_util bssid rssi rssidt last_rssi util bias
510 64:e9:50:d1:0c:40 34 0 34 0 15 0
```

The roam table lists, with one candidate per line, the different candidate APs the AR6003/AR6004 might consider roaming to. The different parameters are, from left to right:

- **roam_util** – This is the computed likelihood the chip chooses this AP if it roams. The entry with the highest roam_util is chosen. The majority of the roam_util is calculated as follows:
  \[ \text{roam\_util} = \text{rssi} \times \text{util} + \text{bias} \]
  In other words, it is calculated by taking [RSSI field] times [util field] and, if enabled, the bias is added.
- **BSSID** – The BSSID of the AP
- **RSSI** – An average of the last several RSSI measurements.
- **RSSIDT** – The rate of change of the last several RSSI averages calculated for this table.
- **last_rssi** – The last RSSI reading taken.
- **util** – A specific utility multiplier which is either 15 for the currently connected AP or 10 for non-connected APs.
- **bias** – If set, and the bias roam mode is turned on, this value is added into the roam_util equation.

**Wi-Fi Firmware Restart**

Laird’s AR6003 and AR6004 firmware and driver on the WB is capable of reloading and restarting in the event of an unrecoverable error. By default, this feature is enabled the scripts that load and start Laird’s drivers.

If you need to enable the feature when manually loading the drivers, you simply enable the correct parameters:

```
recovery_enable =1 heart_beat_poll=200
```

```
# modprobe ath6kl_core recovery_enable=1 heart_beat_poll=200
# modprobe ath6kl_sdio
```

**Note:** The recovery enable feature is already enabled by default in GA3 and higher releases. It is unavailable in earlier releases.

**Wi-Fi Protocol Capture**

Using a Wi-Fi protocol sniffer like Wireshark is helpful in debugging protocol problems. Laird support may ask you for a capture in PCAP format. For more information, visit [https://www.wireshark.org/](https://www.wireshark.org/).

**Flash Image**

Information about the current running environment and what images are flashed on which partition can sometimes be useful in troubleshooting problems. The `fw_select` and `fw_printenv` utilities can be used to gather this information.
WB45

```
# fw select --show
wb45n - flash memory
  mtd   address     size      description
    0:  0x00000000  0x00020000  at91bs       3.4.4-laird2
    1:  0x00020000  0x00080000  u-boot 2013.01-laird2-00096-ge5cf952-dirty
    2:  0x000a0000  0x00020000  u-boot-env
    3:  0x000c0000  0x00020000  redund-env
    4:  0x000e0000  0x00280000  kernel-a Linux-3.8.0-laird21.01
    5:  0x00360000  0x00280000  kernel-b Linux-3.8.0-laird21.01
    6:  0x02be0000  0x02600000  rootfs-b wb45n-laird_fips-3.5.0.17
    7:  0x051e0000  0x02d20000  user
    8:  0x07f00000  0x00080000  logs
  Laird Linux wb45n-laird_fips-3.5.0.17
  --> summit 3.8.0-laird21.01 on rootfs-a
  bootup:
    kernel-a
    rootfs-a
```

WB50

```
# fw select --show
wb50n - flash memory
  mtd   address     size      description
    0:  0x00000000  0x00020000  at91bs       3.7.1-laird05
    1:  0x00020000  0x00080000  u-boot 2014.07-laird03
    2:  0x000a0000  0x00020000  u-boot-env
    3:  0x000c0000  0x00020000  u-boot-env
    4:  0x000e0000  0x00500000  kernel-a 4.1.13-laird12
    5:  0x005e0000  0x00500000  kernel-b 4.1.13-laird12
    6:  0x0ae0000  0x03000000  rootfs-a wb50n-laird-3.5.2.16
    7:  0x03ae0000  0x03000000  rootfs-b wb50n-laird-3.5.2.16
    8:  0x06ae0000  0x014e0000  user
  Laird Linux wb50n-laird-3.5.2.16
  --> summit 4.1.13-laird12 on rootfs-b
  bootup:
    kernel-b
    rootfs-b
    # fw_printenv
    RegDomain=3
    _mtd=mtdparts default; set bootargs ${bootargs} ${wbti} ${mtdparts}
    autoload=no
    baudrate=115200
    bootdelay=1
    ethact=macb0
    ethaddr=00:17:23:d0:12:e0
    fileaddr=22000000
    filesize=1680000
    gatewayip=192.168.0.1
    ipaddr=192.168.0.60
    serverip=192.168.0.18
    stderr=serial
    stdin=serial
    stdout=serial
    bootargs=console=ttyS0,115200 loglevel=4 rw noinitrd mem=64M rootfstype=ubifs
    root=ubi0:rootfs ubi.mtd=6
    rootsubi0:rootfs ubi.mtd=6
    bootcmd=cmd read 0x22000000 0x000e0000 0x00280000; run _mtd; bootm
```
APPENDIX A: ATH6KL DEBUG FLAGS TABLE

Print the following table and use it as a handy tool to calculate the debug log mask values for the ath6kl driver. Either set the debug value on the command line when starting the driver or set the value in /sys/module/ath6kl_core/parameters/debug_mask at run time.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

APPENDIX X: EXAMPLE LOG_DUMP.TXT FILE

```
log_dump file created with version 20151125
Thu Jan  1 07:12:19 UTC 1970
-----uptime-----
07:12:19 up  7:12,  load average: 1.20, 1.24, 1.23
-----system-----
Laird Linux wb50n-laird-3.5.2.16
-----kernel info-----
Linux summit 4.1.13-laird12 #1 PREEMPT Thu Mar 24 23:37:58 EDT 2016 armv7l GNU/Linux
-----kernel cmd line-----
console=ttyS0,115200 earlyprintk loglevel=4 mem=64M rw rootfs type=ubifs ubi.mtd=6 root=ubi0:rootfs
-----uboot env-----
autoload=no
autostart=no
baudrate=115200
bootdelay=3
dnsip=168.95.192.1
```
ethact=macb0
fileaddr=20000000
filesize=1940000
gatewayip=192.168.100.1
ipaddr=192.168.100.219
loadaddr=0x22000000
lrd_name=sama5d31-wb50n
netmask=255.255.255.0
serverip=192.168.100.121
stderr=serial
stdin=serial
stdout=serial
RegDomain=3
md5_at91bs=0ad0e8e6960eee6e62695fe91bfb94bb
md5_u-boot=4672abc7a4c9e288bcf4bf0d9832d834
ethaddr=c0:ee:40:00:50:00
md5_kernel-b=87c37a75288af259506834b8727357d3
md5_rootfs-b=71df71a81216b1a0088c3e332b277c91
md5_kernel-a=b89ed7fbd22f65095a22bb09b330281d
md5_rootfs-a=ef9ff54a6f23b5e4293dfad4477af
bootargs=rw rootfstype=ubifs ubi.mtd=6 root=ubi0:rootfs
boottcmd=nand read 0x22000000 0x000e0000 0x00500000; bootm
-----sdc_cli version-----
CLI: 3.5.2.10
SDK: 3.5.3.11
Hardware Chipset: 50 Workgroup Bridge
Driver: 3.5.0.1
Firmware: ar6004 hw 3.0 fw 3.5.0.10008 api 5
Supplicant: sdc supp v40.3.3.0
Build: Laird Linux wb50n-laird-3.5.2.16
-----sdc_cli status-----
  Status: Authenticated
  Profile name: bill
  SSID: Bill Wi The Science Fi
  Channel: 11
  RSSI: -29
  Device Name:
  MAC: c0:ee:40:0a:b6:99
  IP: 192.168.1.1 (Static)
IPv6: fe80::c2ee:40ff:fe0a:b699
AP MAC: 54:a0:50:d4:60:92
Bit Rate: 144.4 Mbps
Tx Power: 25 mW
Beacon Period: 100 ms
DTIM: 1

-----sdc_cli profile list-----
Default
bill ACTIVE
foo
-ap1
ap4
- denotes auto-profile (auto-profile is Inactive)

2 profiles
----------
Profile 1:
  Name: Default
  SSID:
  Client Name:
  Tx Power: Auto
  Auth Type: Open
  EAP Type: None
  WEP Type: None
  Mode: ABGN
  Powersave: Fast
  PSP Delay: 200 msec

Profile 2:
  Name: bill ACTIVE
  SSID: Bill Wi The Science Fi
  Client Name:
  Tx Power: Auto
  Auth Type: Open
  EAP Type: None
  WEP Type: WPA-PSK-TKIP
  Mode: ABGN
  Powersave: Fast
  PSP Delay: 200 msec
PSK: ********

-------------------
-----ifrc -v wlan0-----
Configuration for interface: wlan0 - static/managed, active, associated

wlan0:  <BROADCAST,MULTICAST,UP,LOWER_UP>
        mtu 1500 group default state UP
        link/ether c0:ee:40:0a:b6:99 brd ff:ff:ff:ff:ff:ff
        inet 192.168.1.1/30 brd 192.168.1.255 scope global
        inet6 fe80::c2ee:40ff:fe0a:b699/64 scope link

WiFi:   active
Associated to 54:a0:50:d4:60:92 (on wlan0)
        SSID: Bill Wi The Science Fi
        freq: 2462
        signal: -29 dBm
        tx bitrate: 144.4 MBit/s MCS 15 short GI

Routing:

ARP:
    ...192.168.2.39 at 10:40:f3:95:9f:fa STALE

Processes:
    1287 S /usr/bin/sdcsupp -iwlan0 -Dnl80211 -s
    1345 S ifplugd -iwlan0 -miff -s -fa -qMp -u0 -d0 -Ir/usr/sbin/ifrc -x&
-----ifrc -v-----
Configuration for all interfaces:                          (try -h to see usage)

lo:     <LOOPBACK,UP,LOWER_UP>
        mtu 65536 noqueue group default state UNKNOWN
        link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
        inet 127.0.0.1/8 scope host
inet6 ::1/128 scope host

eth0:  <BROADCAST,MULTICAST,UP,LOWER_UP>
  mtu 1500 group default state UP
  link/ether c0:ee:40:00:50:00 brd ff:ff:ff:ff:ff
  inet 192.168.2.124/24 brd 192.168.2.255 scope global
  inet6 fe80::c2ee:40ff:fe00:5000/64 scope link

usb0:  <NO-CARRIER,BROADCAST,MULTICAST,UP>
  mtu 1500 group default state DOWN
  link/ether b2:6f:1e:49:cc:9c brd ff:ff:ff:ff:ff
  inet 192.168.3.1/24 brd 192.168.3.255 scope global

wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP>
  mtu 1500 group default state UP
  link/ether c0:ee:40:0a:b6:99 brd ff:ff:ff:ff:ff
  inet 192.168.1.1/30 brd 192.168.1.255 scope global
  inet6 fe80::c2ee:40ff:fe0a:b699/64 scope link

WiFi:  active
Associated to 54:a0:50:d4:60:92 (on wlan0)
  SSID: Bill Wi The Science Fi
  freq: 2462
  signal: -29 dBm
  tx bitrate: 144.4 MBit/s MCS 15 short GI

Routing:
default via 192.168.2.1 dev eth0
  192.168.1.0/30 dev wlan0 proto kernel scope link src 192.168.1.1
  192.168.2.0/24 dev eth0 proto kernel scope link src 192.168.2.124
  192.168.3.0/24 dev usb0 proto kernel scope link src 192.168.3.1

Rules..
  0:   from all lookup local
  32764: from all to 192.168.2.124 lookup t.eth0
  32765: from 192.168.2.124 lookup t.eth0
  32766: from all lookup main
  32767: from all lookup default
DNS:

```
resolv.conf
nameserver 192.168.2.1
nameserver 8.8.8.8
options timeout:3
```

-----bridge status------
...not available, not a kernel-resident interface

-----image info-----

```
wbn5n - flash memory

<table>
<thead>
<tr>
<th>mtd</th>
<th>address</th>
<th>size</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0x000000000 0x00020000</td>
<td>at91bs</td>
<td>3.7.1-laird05</td>
</tr>
<tr>
<td>1</td>
<td>0x00020000 0x00080000</td>
<td>u-boot</td>
<td>2014.07-laird03</td>
</tr>
<tr>
<td>2</td>
<td>0x000a0000 0x00020000</td>
<td>u-boot-env</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0x000c0000 0x00020000</td>
<td>u-boot-env</td>
<td></td>
</tr>
<tr>
<td>-&gt; 4</td>
<td>0x000e0000 0x00500000</td>
<td>kernel-a</td>
<td>4.1.13-laird12</td>
</tr>
<tr>
<td>5</td>
<td>0x005e0000 0x00500000</td>
<td>kernel-b</td>
<td>4.1.13-laird09</td>
</tr>
<tr>
<td>-&gt; 6</td>
<td>0x03ae0000 0x03000000</td>
<td>rootfs-a</td>
<td>wb50n-laird-3.5.2.16</td>
</tr>
<tr>
<td>7</td>
<td>0x03ae0000 0x03000000</td>
<td>rootfs-b</td>
<td>20160314</td>
</tr>
<tr>
<td>8</td>
<td>0x06ae0000 0x014e0000</td>
<td>user</td>
<td></td>
</tr>
</tbody>
</table>
```

```
wbn5n - Laird Linux wb50n-laird-3.5.2.16
-> summit 4.1.13-laird12 on rootfs-a

bootup:
  kernel-a
  rootfs-a

-----route info-----

default via 192.168.2.1 dev eth0
192.168.1.0/30 dev wlan0 proto kernel scope link src 192.168.1.1
192.168.2.0/24 dev eth0 proto kernel scope link src 192.168.2.124
192.168.3.0/24 dev usb0 proto kernel scope link src 192.168.3.1

-----ifrc log-----

mp_cdt:f4=static ip=192.168.1.1 bc=192.168.1.255 nm=255.255.255.252 cdt{ post_cfg_do="/etc/network/dsrc-rules.conf' pre_dcfg_do="/etc/network/dsrc-rules.conf' ; }
eni_sk:1466017293 324
ifrc_i:wlan0=wlan0 f1s="" mm= vm= qm=; mpr=yes
-- v2.03

14.18 -- 492_ifrc wlan0 up <- rcS
post-cfg-do: dsrc-rules.conf 127

25110.02 -- 1168_ifrc wlan0 restart

25110.40 -- 1189_ifrc -x wlan0 down
pre-dcfg-do: dsrc-rules.conf 127

25114.72 -- 1303_ifrc wlan0 up
post-cfg-do: dsrc-rules.conf 127

25116.45 -- 1368_ifrc wlan0 up <- ifplugd
dt->up wlan0 up f4=static
probable roam, was dormant

25940.36 -- 1712_ifrc -v wlan0

-----top-----
Mem: 26940K used, 33020K free, 704K shrd, 0K buff, 12576K cached
CPU:  23% usr   0% sys   0% nic  76% idle   0% io   0% irq   0% sirq
Load average: 1.61 1.33 1.26 1/59 1876

   PID  PPID USER     STAT   VSZ %VSZ %CPU COMMAND
     679   677 root     S     8080  13%   8% /usr/bin/php-cgi
     1301     1 root     S    48872  81%   0% /usr/bin/event_mon -ologging -b0x0000
    003FA3008000 -m
     545     1 root     S    14172  24%   0% smartSS -E 7 -d -a -c /usr/share/smar
tBASIC/apps/$autorun$.SPPBridge.Socket.wb.sb
     1287     1 root     S    14000  23%   0% /usr/bin/sdcsupp -iwlan0 -Dnl80211 -s

     677     1 root     S    5112   9%   0% /usr/sbin/lighttpd -f /etc/lighttpd/lighttpd.conf

     88     1 root     S    2968   5%   0% /sbin/syslogd -D -C512 -m0
     95     1 root     S    2728   5%   0% /sbin/udevd -d
     555     1 root     S    2536   4%   0% -sh
     915     1 root     S    2532   4%   0% /usr/sbin/inetd -e /tmp/inetd.conf
    16900   555 root     S    2460   4%   0% {log_dump} /bin/sh /usr/bin/log_dump
<table>
<thead>
<tr>
<th>PID</th>
<th>Username</th>
<th>State</th>
<th>%CPU</th>
<th>%MEM</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% init</td>
</tr>
<tr>
<td>267</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% /lighty_wd /bin/ash /usr/sbin/lighty_wd</td>
</tr>
<tr>
<td>627</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% ash /etc/dhcp/client_wd -ieth0</td>
</tr>
<tr>
<td>1876</td>
<td>root</td>
<td>R</td>
<td>2456</td>
<td>4%</td>
<td>0% top -b -n 1</td>
</tr>
<tr>
<td>90</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% /sbin/klogd</td>
</tr>
<tr>
<td>339</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% ifplugd -ieth0 -s -fa -qMp -u0 -d0 -I r/usr/sbin/ifrc -x&amp;</td>
</tr>
<tr>
<td>344</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% ifplugd -iusb0 -s -fa -qMp -u0 -d0 -I r/usr/sbin/ifrc -x&amp;</td>
</tr>
<tr>
<td>625</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% udhcpc -ieth0 -R -t4 -T2 -A5 -b -o -o lease -Odomain -Odns -Ohostname -Osubnet -Orouter -Oserverid -Obroadcast -p/var/run/dhclient.eth0.pid -s /etc/dhcp/udhcpc.script</td>
</tr>
<tr>
<td>1345</td>
<td>root</td>
<td>S</td>
<td>2456</td>
<td>4%</td>
<td>0% ifplugd -iwlan0 -miff -s -fa -qMp -u0 -d0 -Ir/usr/sbin/ifrc -x&amp;</td>
</tr>
<tr>
<td>553</td>
<td>root</td>
<td>S</td>
<td>1688</td>
<td>3%</td>
<td>0% input-event-daemon</td>
</tr>
<tr>
<td>697</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [kworker/0:2]</td>
</tr>
<tr>
<td>1281</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [ksdioirqd/mmc1]</td>
</tr>
<tr>
<td>3</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [ksoftirqd/0]</td>
</tr>
<tr>
<td>1156</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [kworker/u2:1]</td>
</tr>
<tr>
<td>2</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [kthreadd]</td>
</tr>
<tr>
<td>7</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [rcu_preempt]</td>
</tr>
<tr>
<td>12</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [kdevtmpfs]</td>
</tr>
<tr>
<td>1450</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [kworker/u2:2]</td>
</tr>
<tr>
<td>5</td>
<td>root</td>
<td>SW&lt;</td>
<td>0</td>
<td>0%</td>
<td>0% [kworker/0:0H]</td>
</tr>
<tr>
<td>8</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [rcu_sched]</td>
</tr>
<tr>
<td>9</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [rcu_sh]</td>
</tr>
<tr>
<td>10</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [watchdog/0]</td>
</tr>
<tr>
<td>11</td>
<td>root</td>
<td>SW&lt;</td>
<td>0</td>
<td>0%</td>
<td>0% [khelper]</td>
</tr>
<tr>
<td>13</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [khungtaskd]</td>
</tr>
<tr>
<td>14</td>
<td>root</td>
<td>SW&lt;</td>
<td>0</td>
<td>0%</td>
<td>0% [writeback]</td>
</tr>
<tr>
<td>15</td>
<td>root</td>
<td>SW&lt;</td>
<td>0</td>
<td>0%</td>
<td>0% [crypto]</td>
</tr>
<tr>
<td>16</td>
<td>root</td>
<td>SW&lt;</td>
<td>0</td>
<td>0%</td>
<td>0% [bioset]</td>
</tr>
<tr>
<td>17</td>
<td>root</td>
<td>SW&lt;</td>
<td>0</td>
<td>0%</td>
<td>0% [kbloqdk]</td>
</tr>
<tr>
<td>19</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [kswapd0]</td>
</tr>
<tr>
<td>20</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [fsnotify_mark]</td>
</tr>
<tr>
<td>62</td>
<td>root</td>
<td>SW&lt;</td>
<td>0</td>
<td>0%</td>
<td>0% [deferwq]</td>
</tr>
<tr>
<td>64</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [ubi_bgt0d]</td>
</tr>
<tr>
<td>65</td>
<td>root</td>
<td>SW</td>
<td>0</td>
<td>0%</td>
<td>0% [ubifs_bgt0_0]</td>
</tr>
</tbody>
</table>
166 2 root SW 0 0% 0% [irq/94-atmel_us]
351 2 root SW< 0 0% 0% [cfg80211]
663 2 root SW< 0 0% 0% [ipv6_addrconf]
706 2 root SW 0 0% 0% [kworker/0:0]
1271 2 root SW< 0 0% 0% [ath6kl]
1417 2 root SW 0 0% 0% [kworker/u2:0]

-----df------

Filesystem 1K-blocks Used Available Use% Mounted on
ubi0:rootfs 39336 22252 17084 57% /
devtmpfs 21712 0 21712 0% /dev
tmpfs 29980 0 29980 0% /dev/shm
tmpfs 29980 196 29784 1% /tmp
tmpfs 29980 196 29784 1% /tmp

-----logread-----
(logread contents)

---processes---

<table>
<thead>
<tr>
<th>PID</th>
<th>USER</th>
<th>COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>root</td>
<td>init</td>
</tr>
<tr>
<td>2</td>
<td>root</td>
<td>[kthreadd]</td>
</tr>
<tr>
<td>3</td>
<td>root</td>
<td>[ksoftirqd/0]</td>
</tr>
<tr>
<td>5</td>
<td>root</td>
<td>[kworker/0:0H]</td>
</tr>
<tr>
<td>7</td>
<td>root</td>
<td>[rcu_preempt]</td>
</tr>
<tr>
<td>8</td>
<td>root</td>
<td>[rcu_sched]</td>
</tr>
<tr>
<td>9</td>
<td>root</td>
<td>[rcu_bh]</td>
</tr>
<tr>
<td>10</td>
<td>root</td>
<td>[watchdog/0]</td>
</tr>
<tr>
<td>11</td>
<td>root</td>
<td>[khelper]</td>
</tr>
<tr>
<td>12</td>
<td>root</td>
<td>[kdevtmpfs]</td>
</tr>
<tr>
<td>13</td>
<td>root</td>
<td>[khungtaskd]</td>
</tr>
<tr>
<td>14</td>
<td>root</td>
<td>[writeback]</td>
</tr>
<tr>
<td>15</td>
<td>root</td>
<td>[crypto]</td>
</tr>
<tr>
<td>16</td>
<td>root</td>
<td>[bioset]</td>
</tr>
<tr>
<td>17</td>
<td>root</td>
<td>[kblockd]</td>
</tr>
<tr>
<td>19</td>
<td>root</td>
<td>[kswapd0]</td>
</tr>
<tr>
<td>20</td>
<td>root</td>
<td>[fsnotify_mark]</td>
</tr>
<tr>
<td>62</td>
<td>root</td>
<td>[deferwq]</td>
</tr>
<tr>
<td>64</td>
<td>root</td>
<td>[ubi_bgt0d]</td>
</tr>
<tr>
<td>65</td>
<td>root</td>
<td>[ubifs_bgt0_0]</td>
</tr>
<tr>
<td>88</td>
<td>root</td>
<td>/sbin/syslogd -D -C512 -m0</td>
</tr>
<tr>
<td>90</td>
<td>root</td>
<td>/sbin/klogd</td>
</tr>
</tbody>
</table>
95 root /sbin/udevd -d
166 root [irq/94-atmel_us]
267 root [lighty_wd] /bin/ash /usr/sbin/lighty_wd
339 root ifplugd -ieth0 -s -fa -qMp -u0 -d0 -Ir/usr/sbin/ifrc -x&
344 root ifplugd -iusb0 -s -fa -qMp -u0 -d0 -Ir/usr/sbin/ifrc -x&
351 root [cfg80211]
545 root smartSS -E 7 -d -a -c /usr/share/smartBASIC/apps/$autorun$.SPPBr
idge.Socket.wb.sb
553 root input-event-daemon
555 root -sh
625 root udhcpc -ieth0 -R -t4 -T2 -A5 -b -o -Olease -Odomain -Odns -Ohost
name -Osubnet -Orouter -Oserverid -Obroadcast -p/var/run/dhclient.eth0.pid -s/e
tc/dhcpc/udhcpc.script
627 root ash /etc/dhcp/client_wd -ieth0
663 root [ipv6_addrcnf]
677 root /usr/sbin/lighttpd -f /etc/lighttpd/lighttpd.conf
679 root /usr/bin/php-cgi
697 root [kworker/0:2]
706 root [kworker/0:0]
915 root /usr/sbin/inetd -e /tmp/inetd.conf
1156 root [kworker/u2:1]
1271 root [ath6kl]
1281 root [ksdioirqd/mmcl]
1287 root /usr/bin/sdcsupp -iwlan0 -Dnl80211 -s
1301 root /usr/bin/event_mon -ologging -b0x0000003FA3008000 -m
1345 root ifplugd -iwlan0 -miff -s -fa -qMp -u0 -d0 -Ir/usr/sbin/ifrc -x&
1417 root [kworker/u2:0]
1450 root [kworker/u2:2]
1690 root {log_dump} /bin/sh /usr/bin/log_dump
1879 root ps
- - - - - - - - - - DMESG - - - - - - - - -
[ 0.000000] Booting Linux on physical CPU 0x0
...
## Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Notes</th>
<th>Approver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>06 April 2016</td>
<td>Initial Release</td>
<td>Jay White</td>
</tr>
</tbody>
</table>

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