APX4 DEVELOPMENT KIT

GETTING STARTED

Thursday, 29 November 2012

Version 1.5

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1 Version history

Version	Comments
0.9	Version history added. Version number changed.
1.0	Improved getting started instructions.
1.1	Added Tips and Tricks section
1.2	Added more examples
1.3	Added Wi-Fi usage examples
1.4	Added OPKG example
1.5	Updated to have "Where to start?" section

2 Introduction

This document is a getting started guide for Bluegiga APx4 development kit. The guide instructs you how to set up the APx4 development kit, power it up and access the Linux operating system on the APx4 wireless System-on-Module.

2.1 What is Bluegiga APx4?

The Bluegiga APx4 is a small form factor, low power system-on-module that includes the latest wireless connectivity standards: 802.11 b/g/n and *Bluetooth* 4.0. APx4 is based on Freescale's i.MX28 processor family and runs an embedded Linux operating system based on the Yocto Project™. In addition to integrating the 454MHz ARM9 processor, the wireless connectivity technologies, Linux operating system the APx4 also includes with several built in applications, such as the 802.11 and *Bluetooth* 4.0 stacks, Continua v.1.5 compliant IEEE manager and many more. This combination provides an ideal platform for designing multi-radio wireless gateways that enables fast time-to-market and minimum R&D risks.

The Bluegiga APx4 software can be easily extended or tailored customizing the Linux operating system with applications. The motherboards for the APx4 can be easily extended to include almost anything from 3G modems to Ethernet and audio interfaces to and touch screen displays.

The Bluegiga APx4 is an ideal product for applications requiring wireless or wired connectivity technologies and the processing power of the ARM9 processor, such as health and fitness gateways, building and home automation gateways, M2M, point-of-sale and industrial connectivity**.**

2.1.1 Key Features

APx4 is a computing platform:

- 450MHz ARM9 core (Freescale i.MX28)
- 64MB RAM and 128MB Flash
- Real Time Clock
- SO-DIMM form factor

A connectivity platform:

- *Bluetooth* 4.0 dual-mode radio
- 2.4GHz 802.11 b/g/n radio with Wi-Fi Access Point mode
- 10/100 Ethernet

With many extension options:

- Up to 800 x 480, 24bit display with resistive touch screen
- MMC/SDIO, USB and USB OTG, multiple SPI, UART and I²C, PWM, GPIO and AIO interfaces
- I²S

Linux operating system:

- Based on the Yocto ProjectTM
- Thousands of open source software packets available

Qualifications:

- *Bluetooth*, CE, FCC and IC*

*Ready before mass production

2.2 APx4 Development Kit

The APx4 development kit is a ready-to-use development platform the the the Bluegiga APx4 wireless System-on-Module. The development kit consists of a single APx4 module, a mother board and the necessary accessories and documentation.

APx4 Development kit consists of the following items:

- 1 x Bluegiga APx4 module
- 1 x Bluegiga APx4 mother board
- 1 x 12V power supply
- 1 x RS232 cable
- 1 x Ethernet cable
- 1 x Micro USB cable
- Getting started documentation

2.3 APx4 Software Development Kit

APx4 Software Development Kit (SDK) is a software development platform that provides tools, methods and documentation allowing you to write applications for the Linux operating system running in the APx4. The APx4 SDK is based on the tools and methods developed and maintained by the Yocto Project.

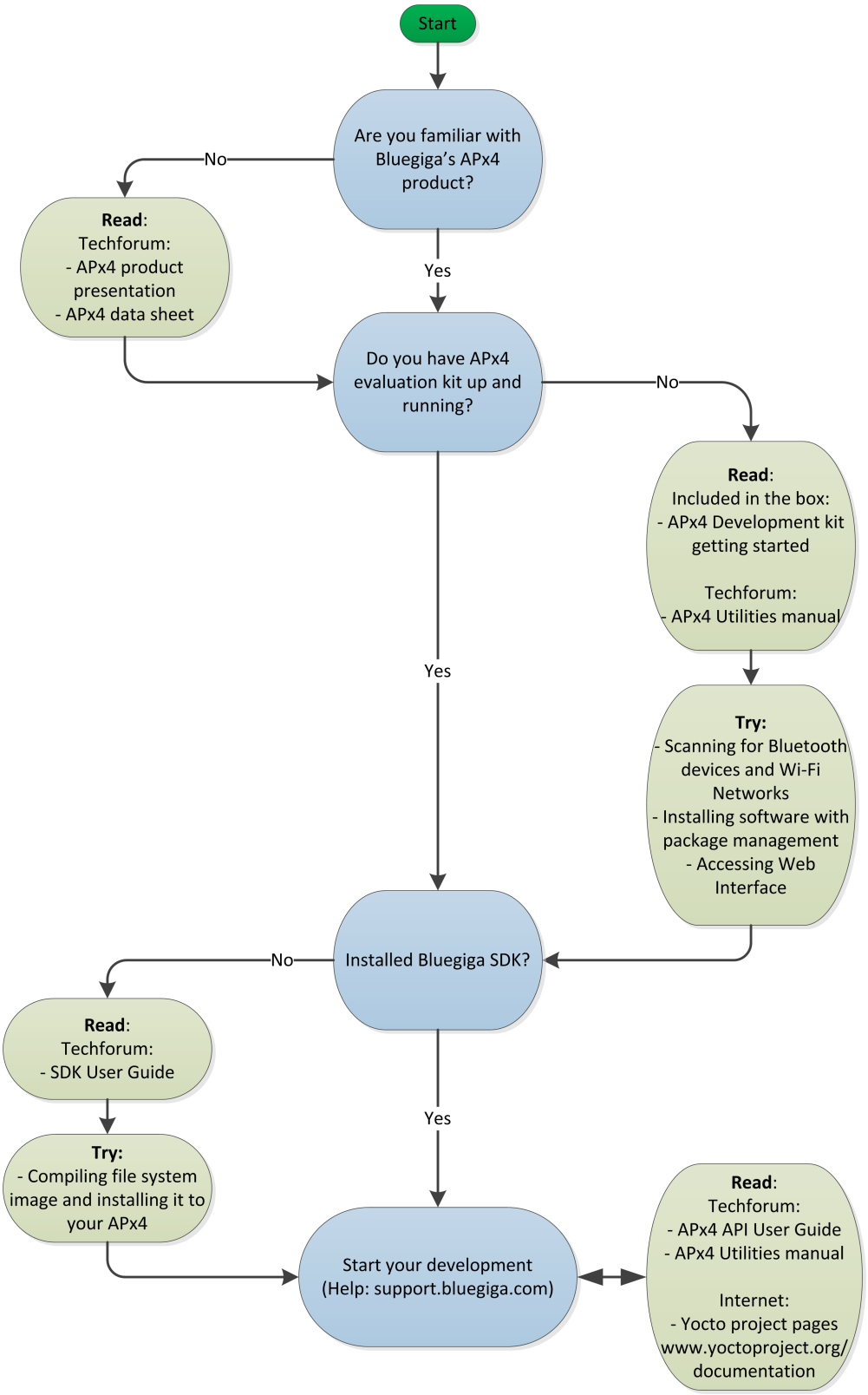
*APx4 Development kit consists of the following items which are downloadable from http://techforum.bluegiga.com

- Development environment for compiling applications
- Example applications
- SDK documentation
- API documentation

The getting started guide for the Bluegiga APx4 SDK is a separate document from this document.

3 Getting started

3.1 How to get started?



3.2 Preparations

1. Make sure the power supply is not connected to the APx4 mother board
2. Connect the APx4 to the motherboard by inserting the APx4 module into the SODIMM socket in 30-45 degrees angle and by pushing the APx4 module into the socket.
    a. Push the module into the socket as far as it goes, otherwise the finger contacts may not connect properly.
    b. Press the module down so that the metal clips on the receptacle engage and make a clear click.
3. Ensure that a jumper is connected to the **CURR. MEAS.** header as shown in the image below. See the yellow rectangle. For ordinary operation this is the only jumper needed.

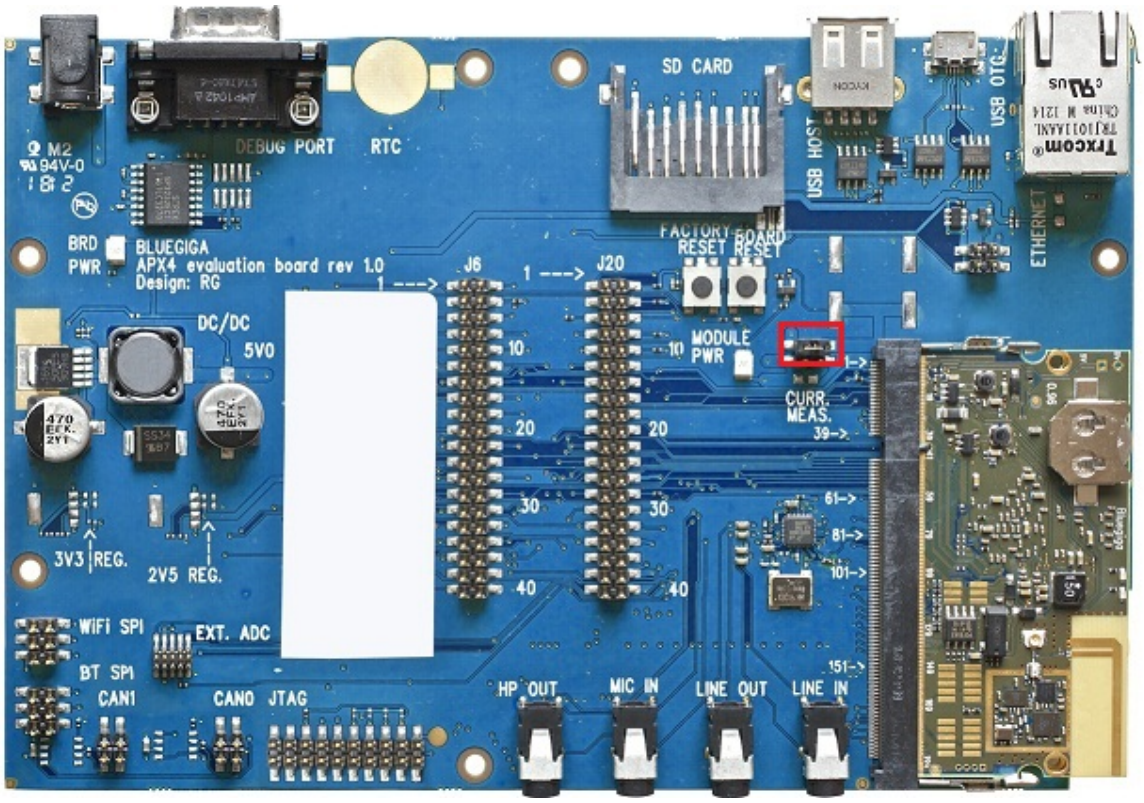


Figure 1: APx4 development kit

There are three ways of accessing the APx4:

- Serial port
- SSH
- Ethernet interface and browser
- Wi-Fi interface and browser

3.2.1 Accessing the APx4 via RS232

1. Connect the RS232 cable to the motherboard's **DEBUG PORT**
2. Open a terminal software and use the following settings:

Property name	Value
Baud rate	115200 bps
Data bits	8
Parity	none
Stop bits	1
Flow control	none

1. Power on the APx4 motherboard
2. From terminal software make sure you see the APx4 boot log

```
U-Boot 2011.12 (Nov 26 2012 - 10:34:49)

DRAM:  64 MiB
WARNING: Caches not enabled
NAND:  128 MiB
MMC:   MXS MMC: 0
In:    serial
Out:   serial
Err:   serial
Net:   FEC
Hit any key to stop autoboot:  0
.
.
.
UBIFS: reserved for root:  0 bytes (0 KiB)
Loading file 'boot/uImage' to addr 0x41000000 with size 1400792
(0x00155fd8)...
Done
## Booting kernel from Legacy Image at 41000000 ...
   Image Name:   Linux-3.2.12
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    1400728 Bytes = 1.3 MiB
   Load Address: 40008000
   Entry Point:  40008000
   Loading Kernel Image ... OK
OK

Starting kernel ...

Uncompressing Linux... done, booting the kernel.
Linux version 3.2.12 (jenkins@green) (gcc version 4.6.4 20120303 (prerelease)
(GCC) ) #1 Mon Nov 26 09:37:59 EET 2012
```

Accessing APx4 Linux console via RS232

1. Once the APx4 has booted a login will be prompted
2. The default user name is : **root**
3. The default password is : **buffy**
4. **bgtinfo** command prints the hardware and software version numbers

```
Enabling fforwarder:
Starting blueconnector:
Starting Lighttpd Web Server: unifi1: SDIO block size 64 requires 8 padding
chunks
unifi1: UniFi f/w protocol version 9.1 (driver 9.1)
unifi1: Firmware build 1089: 2010-10-05 14:50
cindr03_core_softmac_rom_sdio_gcc 1089 bfsw@eagle@630492
lighttpd.
Starting automatic package installer: bgtautoinstalld.
Starting finder:
Stopping Bootlog daemon: bootlogd.


 _____  _                      _
| ___ \| |                    (_)
| |_/ /| | _   _   ___   __ _  _   __ _   __ _
| ___ \| || | | | / _ \ / _` || | / _` | / _` |
| |_/ /| || |_| ||  __/| (_| || || (_| || (_| |
|____/ |_| \__,_| \___| \__, ||_| \__, | \__,_|
                         __/ |     __/ |
                        |___/     |___/
Bluegiga Linux 5.0.0-beta9 apx4devkit ttyAMA0

apx4devkit login:
```

⚠ Avoid removing the APx4 module from the mother board when the power supply is connected in order not to damage the APx4 module.

3.2.2 Accessing the APx4 Linux console via SSH

Prerequisites

- On Windows : PuTTy or similar SSH software
- On Linux: SSH client software

In order to connect the APx4 development kit via SSH:

1. Connect Ethernet cable to the APx4 development kit
2. Connect power supply to the APx4 development kit
3. Wait until APx4 has started
4. Open SSH connection using either PuTTy or SSH client to the IP address of APx4 development kit

Default user name it ***root*** and default password is ***buffy***.

Example how to connect the APx4 development kit from Linux:

```
ssh root@192.168.1.10
```

3.2.3 Accessing the APx4 with a web browser

In order to connect the APx4 development kit with a web browser:

1. Connect Ethernet cable to the APx4 development kit
2. Connect power supply to the APx4 development kit
3. Wait until APx4 has started
4. Open a web browser and type the IP address to the address field (eg. http://192.168.1.10)
    - get the IP address by using instructions in Tips and Tricks section

Default user name it ***root*** and default password is ***buffy***.

3.2.4 Accessing the APx4 through Wi-Fi

1. Make sure Ethernet cable **is not connected** to the APx4 development kit
    a. Having ethernet cable connected will disable the automatic Wi-Fi AP mode
2. Connect power supply to the APx4 development kit
3. Wait until APx4 has started
4. Search for Wi-Fi Access Points with your PC, tablet or smart phone
    a. APx4 Development Kit should be visible with ESSID : ***APx4_sssss***
    b. ***sssss*** are the last five digits of the APx4's serial number
5. Connect to the Wi-Fi Access Point
    a. Default WPA2 password is the APx4 modules serial number
6. Finally connect the APx4 via SSH or web browser as instructed in the previous chapters
    a. The IP address of the APx4 will be by default 192.168.43.3 when it is Access Point mode

4 Supported features of APX4 Development Kit

4.1 Supported features of APX4 Development Kit under Linux

Linux version 3.2.12 from Bluegiga BSP

Driver	Supported	Notes
Bluetooth	✅	Bluetooth 4.0 Smart Ready (dual mode)
Wi-Fi	✅	802.11 b/g/n STA and AP modes supported
Ethernet	✅	10/100
NAND	✅	
USB host	✅	
USB device	⚠	
UART	✅	
I2C	✅	
SPI	⚠	
RTC	✅	PCF8563
Display	✅	Upto 800x480 (WVGA)
Touch screen	✅	Built-in resistive touch
Power management	⚠	
Audio	✅/⚠	codec SGTL5000, recording not supported yet
CAN	❌	Not supported by current model of APX4

Symbol	Meaning
✅	Supported
⚠	Future option
❌	Not supported

5 Tips and Tricks

5.1 Figuring out IP address from Linux command line using *ifconfig* command.

```
root@apx4devkit:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:07:80:01:67:04
          inet addr:10.1.1.125  Bcast:10.1.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1968 errors:0 dropped:7 overruns:0 frame:0
          TX packets:1020 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:218757 (213.6 KiB)  TX bytes:1194666 (1.1 MiB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:22 errors:0 dropped:0 overruns:0 frame:0
          TX packets:22 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:1216 (1.1 KiB)  TX bytes:1216 (1.1 KiB)

root@apx4devkit:~#
```

IP address of eth0 (Ethernet) interface is 10.1.1.125.

5.2 Checking device information with *bgtinfo* command.

```
root@apx4devkit:~# bgtinfo
This board was identified as Bluegiga APx4 (367CC-A).

Software version           : 5.0.0-beta9
Product ID                 : 9
Hardware revision          : 3
Hardware architecture      : apx4
Hardware serial number     : 1205310019
Ethernet MAC address       : 00:07:80:01:66:eb
WLAN MAC address           : 00:07:80:59:ef:74
Bluetooth address          : 00:07:80:01:67:1d (Bluegiga APX4 #1205310019),
bt4.0/1d86
System clock               : Wed Nov 28 09:16:07 2012

Updated software components:
root@apx4devkit:~#
```

5.3 Scanning for *Bluetooth* low energy devices

```
root@apx4devkit:~# searchclient --le-only
| 1353378992 | 00:07:80:ff:f5:88 | "Bluegiga Find Me" | -66 |
| 1353378992 | 00:07:80:4e:71:38 | "Robustness test" | -72 |
| 1353378992 | 00:07:80:4a:aa:ee | "BLED112 dongle" | -79 |
root@apx4devkit:~#
```

Response syntax: | <timestamp> | <BD_ADDR> | <"device name"> | <rssi> |

5.4 Scanning for *Bluetooth* classic devices

```
root@apx4devkit:~# searchclient
| 1353379111 | 00:07:80:42:cd:4f | "enri_ap_ehealth" | -44 |
| 1353379111 | 70:f3:95:ce:54:9a | "SWLTMIKKOS" | -64 |
| 1353379111 | 00:07:80:01:67:12 | "Bluegiga APX4 #1205310008" | -85 |
| 1353379111 | 00:07:80:ff:f8:c4 | "WT32-A" | -87 |
root@apx4devkit:~#
```

Response syntax: | <timestamp> | <BD_ADDR> | <"device name"> | <rssi> |

5.5 Checking Wi-Fi interface status

```
root@apx4devkit:~# iwconfig
lo        no wireless extensions.

wlan0     IEEE 802.11-bgn  Access Point: Not-Associated   Bit Rate=0 kb/s
          RTS thr:off   Fragment thr:off
          Encryption key:off
          Power Management period:500ms  mode:All packets received
          Link Quality:0  Signal level:0  Noise level:0
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:0  Invalid misc:0   Missed beacon:0

eth0      no wireless extensions.

root@apx4devkit:~#
```

5.6 Enabling Wi-Fi interface and performing Access Point scan

```
root@apx4devkit:~# ifup wlan0
wlan0 enabled
Ethernet cable is connected. AP mode disabled.
run-parts: /etc/network/if-pre-up.d/unifi_ap_mode exited with code 1
root@apx4devkit:~# iwlist wlan0 scanning
wlan0     Scan completed :
          Cell 01 - Address: 94:44:52:BC:00:B7
                    ESSID:"bgt"
                    Mode:Managed
                    Frequency:2.437 GHz (Channel 6)
                    Quality=25/40  Signal level=-44 dBm  Noise level=-69 dBm
                    Encryption key:on
                    Bit Rates:1 Mb/s; 2 Mb/s; 5.5 Mb/s; 11 Mb/s; 18 Mb/s
                              24 Mb/s; 36 Mb/s; 54 Mb/s; 6 Mb/s; 9 Mb/s
                              12 Mb/s; 48 Mb/s
                    IE: IEEE 802.11i/WPA2 Version 1
                        Group Cipher : CCMP
                        Pairwise Ciphers (1) : CCMP
                        Authentication Suites (1) : PSK
root@apx4devkit:~#
```

ifup wlan0 enables Wi-Fi interface
***iwlist wlan0* scanning** performs an AP scan

5.7 Installing Python on APx4 using OPKG packet manager

Command **opkg update** needs to be ran once in order to download the list of available packages from the repositories.

```
root@apx4devkit:~# opkg install python
Installing python-core (2.7.2-r2.15) to root...
Downloading
http://update.bluegiga.com/feeds/5.0.0-beta9/ipk/armv5te/python-core_2.7.2-r2.15_
python-re (2.7.2-r2.15) to root...
Downloading
http://update.bluegiga.com/feeds/5.0.0-beta9/ipk/armv5te/python-re_2.7.2-r2.15_a
python-core (2.7.2-r2.15) to root...
.
.
.
Configuring python-lang.
Configuring python-core.
Configuring libncursesw5.
Configuring python-readline.
root@apx4devkit:~#
```

6 Contact information

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