OpenWRT MiniEMBWifi Dev Build

Purpose

Install OpenWrt distribution as a build environment without the Lua web interface and not as a router but as more of a general purpose device

- Build fresh install of firmware
- Capability to develop in other languages
- Supporting libraries for minimal development
- Retain capabilities of on-board peripherals

Hardware

Ralink RT3050 based board
MIPS 24KEc 320 Mhz CPU
1 UART serial port
8MB NOR Flash
32MB DRAM
1 USB2.0 port
1 WAN/LAN Port 10/100M
1 WLAN 802.11a,b,g access point or station modes
Operating Temperature: 0 – 50 Deg Celsius, Storage: -20 – 50 Deg Celsius
Certification: FCC, CE
USB to Serial 4-PIN header for programming/serial console
Antenna 3dBi Dipole detachable antenna
Power Adaptor 5 V 2.5 Amps

Software

- Host System

  Ubuntu 12.04 32-bit Linux 3.2.60-generic kernel

- Target Build System

  ATTITUDE ADJUSTMENT (Attitude Adjustment, r40877) OpenWrt 12.09 Linux 3.3.8

  * OpenWrt is a custom embedded linux distribution integrated with buildroot eliminating need to find correct package combinations when cross-compiling for example

```
kerry@kerry-desktop:/usr/local/src/attitude_adjustment$ ls
bin             Config.in     feeds.conf          package      target
BSDmakefile     conftest.cpp  feeds_conf_default  README       tmp
build_dir       dl            include             rules.mk     toolchain
compile.log     docs          LICENSE             scripts      tools
compilev2.log   feeds         Makefile            staging_dir
```

1. svn co svn://svn.openwrt.org/openwrt/branches/attitude_adjustment

2. Added following lines to feeds.conf in main source directory:

   src-svn packages svn://svn.openwrt.org/openwrt/branches/packages_12.09

   src-svn xwrt http://x-wrt.googlecode.com/svn/trunk/package

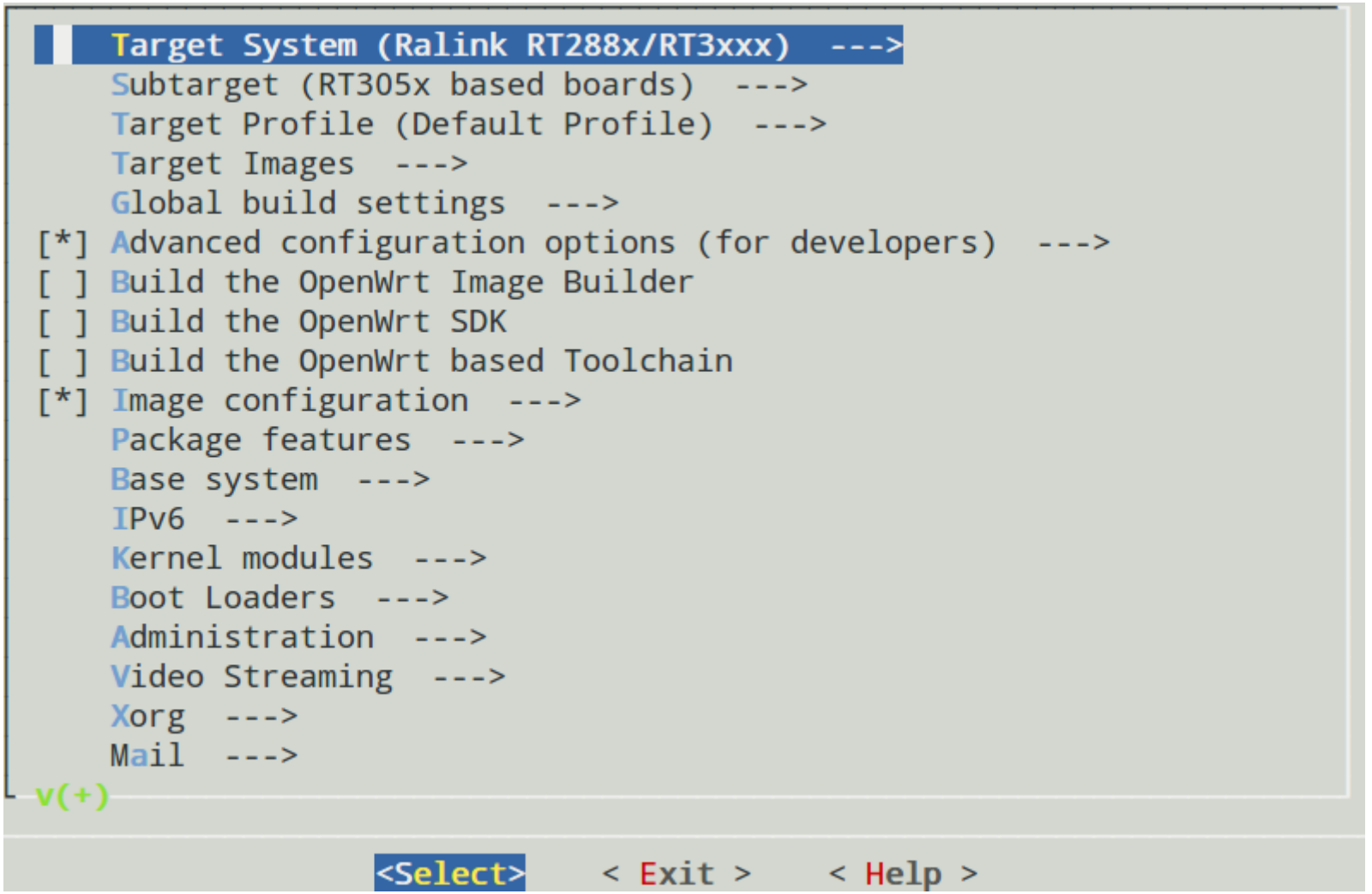
3. According to README file in main source directory:

   ./scripts/feeds update -a

   ./scripts/feeds install -a

   Brings in all packages from sources in feeds.conf

4. make menuconfig



* menu abbreviated for brevity

5. make

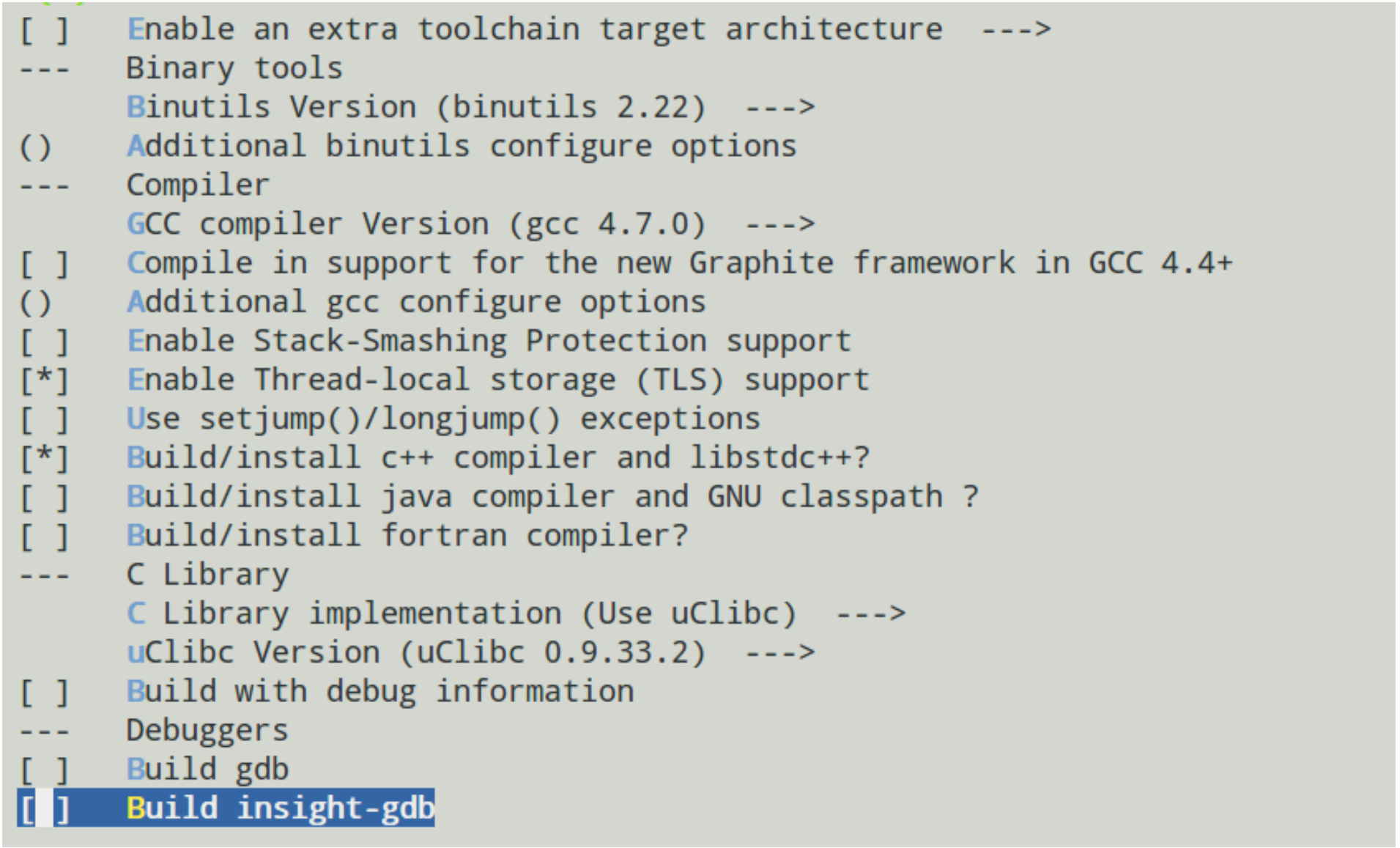
make[1] world
make[2] target/compile
make[3] -C target/linux compile
. . . .

Kernel Build Options

CONFIG_GPIO_SUPPORT=y
CONFIG_USB_SUPPORT=y
CONFIG_mipsel=y
CONFIG_ARCH="mipsel"

CONFIG_KERNEL_DEBUG_FS=y
# CONFIG_KERNEL_PERF_EVENTS is not set
# CONFIG_KERNEL_PROFILING is not set
# CONFIG_KERNEL_KALLSYMS is not set
# CONFIG_KERNEL_FTRACE is not set
# CONFIG_KERNEL_DEBUG_KERNEL is not set
# CONFIG_KERNEL_DEBUG_INFO is not set
# CONFIG_KERNEL_AIO is not set
CONFIG_KERNEL_MAGIC_SYSRQ=y
CONFIG_KERNEL_ELF_CORE=y
# CONFIG_KERNEL_PROVE_LOCKING is not set
CONFIG_KERNEL_PRINTK_TIME=y
CONFIG_USES_SQUASHFS=y
CONFIG_TARGET_ROOTFS_JFFS2=y
CONFIG_TARGET_ROOTFS_SQUASHFS=y
CONFIG_TARGET_OPTIMIZATION=-Os -pipe -mips32r2 -mtune=24kec -fno-caller-saves -mdsp”
CONFIG_SOFT_FLOAT=y
CONFIG_GCC_VERSION=”4.7.0”
CONFIG_ULIBC_VERSION=”0.9.33.2”
CONFIG_USE_UCLIBCXX=y

Toolchain


[ ] Enable an extra toolchain target architecture --->
--- Binary tools
Binutils Version (binutils 2.22) --->
() Additional binutils configure options
--- Compiler
GCC compiler Version (gcc 4.7.0) --->
[ ] Compile in support for the new Graphite framework in GCC 4.4+
() Additional gcc configure options
[ ] Enable Stack-Smashing Protection support
[*] Enable Thread-local storage (TLS) support
[ ] Use setjump()/longjump() exceptions
[*] Build/install c++ compiler and libstdc++?
[ ] Build/install java compiler and GNU classpath ?
[ ] Build/install fortran compiler?
--- C Library
C Library implementation (Use uClibc) --->
uClibc Version (uClibc 0.9.33.2) --->
[ ] Build with debug information
--- Debuggers
[ ] Build gdb
[ ] Build insight-gdb

Installed Packages

binutils - 2.22-5
busybox - 1.19.4-6
dropbear - 2011.54-2
hostapd - 20131120-1
hotplug2 - 1.0-beta-4
iptables - 1.4.10-5
iw - 3.6-1
jshn - 2013-10-19
kmod-button-hotplug - 3.3.8-3
kmod-cfg80211 - 3.3.8+2014-01-23.1-1
kmod-crypto-aes - 3.3.8-1
kmod-crypto-arc4 - 3.3.8-1
kmod-crypto-core - 3.3.8-1
kmod-eeprom-93cx6 - 3.3.8-1
kmod-fs-ext4 - 3.3.8-1
kmod-fs-vfat - 3.3.8-1
kmod-hid - 3.3.8-1
kmod-input-core - 3.3.8-1
kmod-input-evdev - 3.3.8-1
kmod-input-gpio-keys-polled - 3.3.8-1
kmod-input-polldev - 3.3.8-1
kmod-ipt-conntrack - 3.3.8-1
kmod-ipt-core - 3.3.8-1
kmod-ipt-nat - 3.3.8-1
kmod-ipt-nathelper - 3.3.8-1
kmod-leds-gpio - 3.3.8-1
kmod-ledtrig-usbdev - 3.3.8-1
kmod-lib-crc-ccitt - 3.3.8-1
kmod-lib-crc-itu-t - 3.3.8-1
kmod-lib-crc16 - 3.3.8-1
kmod-mac80211 - 3.3.8+2014-01-23.1-1
kmod-nls-base - 3.3.8-1
kmod-nls-cp437 - 3.3.8-1
kmod-nls-iso8859-1 - 3.3.8-1
kmod-ppp - 3.3.8-1
kmod-pppoe - 3.3.8-1
kmod-pppox - 3.3.8-1
kmod-rt2800-lib - 3.3.8+2014-01-23.1-1
kmod-rt2800-mmio - 3.3.8+2014-01-23.1-1
kmod-rt2800-soc - 3.3.8+2014-01-23.1-1
kmod-rt2x00-lib - 3.3.8+2014-01-23.1-1
kmod-rt2x00-mmio - 3.3.8+2014-01-23.1-1
kmod-scsi-core - 3.3.8-1
kmod-usb-core - 3.3.8-1
kmod-usb-hid - 3.3.8-1
kmod-usb-ohci - 3.3.8-1
kmod-usb-rt305x-dwc_otg - 3.3.8-1
kmod-usb-storage - 3.3.8-1
libblkid - 2.21.2-1
libblobmsg-json - 2013-10-19
libc - 0.9.33.2-1
Libgcc – 4.7.0-1
libip4tc - 1.4.10-5
libjson-c - 0.11-2

Installed Packages Cont.

libmount - 2.21.2-1
libnl-tiny - 0.1-3
libopenssl - 1.0.1g-1
librpc - 0.9.32-rc2
librt - 0.9.33.2-1
libubox - 2013-10-19
libubus - 2013-08-08
libuci - 2013-06-11.1-1
libuuid - 2.21.2-1
libxtables - 1.4.10-5
lsof - 4.86-1
netifd - 2013-07-16
objdump - 2.22-5
opkg
ppp - 2.4.5-10
ppp-mod-pppoe - 2.4.5-10
python-mini - 2.7.3-2
sed - 4.2.1-1
ubus - 2013-08-08
ubusd - 2013-08-08
wget - 1.13.4-1
wireless-tools - 29-5
wpad-mini - 20131120-1
zlib - 1.2.7-1

Final Build

```
U-Boot 1.1.3 (Jul  9 2009 - 12:57:03)

Board: Ralink APSoC DRAM:  32 MB
relocate_code Pointer at: 81fac000
flash_protect ON: from 0xBF000000 to 0xBF01FF7F
protect on 0
protect on 1
protect on 2
protect on 3
protect on 4
protect on 5
protect on 6
protect on 7
protect on 8
flash_protect ON: from 0xBF030000 to 0xBF03FFFF
protect on 10
============================================
Ralink UBoot Version: 3.2
--------------------------------------------
ASIC 3052_MP2 (Port5<->None)
DRAM COMPONENT: 256Mbits
DRAM BUS: 16BIT
Total memory: 32 MBytes
Date:Jul  9 2009  Time:12:57:03
============================================
icache: sets:128, ways:4, linesz:32 ,total:16384
dcache: sets:128, ways:4, linesz:32 ,total:16384

 ##### The CPU freq = 320 MHZ ####
```

Final Build Cont.

```
SDRAM bus set to 16 bit
 SDRAM size =32 Mbytes

Please choose the operation:
   1: Load system code to SDRAM via TFTP.
   2: Load system code then write to Flash via TFTP.
   3: Boot system code via Flash (default).
   4: Entr boot command line interface.
   9: Load Boot Loader code then write to Flash via TFTP.
 0

3: System Boot system code via Flash.
## Booting image at bf050000 ...
   Image Name:   MIPS OpenWrt Linux-3.3.8
   Created:      2014-06-15  21:43:55 UTC

 System Control Status = 0x00400000
   Image Type:   MIPS Linux Kernel Image (lzma compressed)
   Data Size:    867144 Bytes = 846.8 kB
   Load Address: 80000000
   Entry Point:  80000000
   Verifying Checksum ... OK
   Uncompressing Kernel Image ... OK
No initrd
## Transferring control to Linux (at address 80000000) ...
## Giving linux memsize in MB, 32

Starting kernel ...

[    0.000000] Linux version 3.3.8 (kerry@kerry-desktop) (gcc version 4.7.0 (GCC)
 ) #11 Sun Jun 15 16:41:50 CDT 2014
[    0.000000] bootconsole [early0] enabled
--More--
```

Final Build Cont.

```
[    0.000000] CPU revision is: 0001964c (MIPS 24KEc)
[    0.000000] Ralink RT3350 id:1 rev:2 running at 320.00 MHz
[    0.000000] Determined physical RAM map:
[    0.000000]  memory: 02000000 @ 00000000 (usable)
[    0.000000] Initrd not found or empty - disabling initrd
[    0.000000] Zone PFN ranges:
[    0.000000]   Normal   0x00000000 -> 0x00002000
[    0.000000] Movable zone start PFN for each node
[    0.000000] Early memory PFN ranges
[    0.000000]     0: 0x00000000 -> 0x00002000
[    0.000000] Built 1 zonelists in Zone order, mobility grouping on.  Total page
s: 8128
[    0.000000] Kernel command line:  board=OMNI-EMB console=ttyS1,57600 mtdparts=
physmap-flash.0:192k(u-boot)ro,64k(u-boot-env)ro,64k(factory)ro,896k(kernel),6976
k(rootfs),7872k@0x50000(firmware) rootfstype=squashfs,jffs2
[    0.000000] PID hash table entries: 128 (order: -3, 512 bytes)
[    0.000000] Dentry cache hash table entries: 4096 (order: 2, 16384 bytes)
[    0.000000] Inode-cache hash table entries: 2048 (order: 1, 8192 bytes)
[    0.000000] Primary instruction cache 16kB, VIPT, 4-way, linesize 32 bytes.
[    0.000000] Primary data cache 16kB, 4-way, VIPT, no aliases, linesize 32 byte
s
[    0.000000] Writing ErrCtl register=000101c0
[    0.000000] Readback ErrCtl register=000101c0
[    0.000000] Memory: 29764k/32768k available (1969k kernel code, 3004k reserved
, 326k data, 176k init, 0k highmem)
[    0.000000] SLUB: Genslabs=9, HWalign=32, Order=0-3, MinObjects=0, CPUs=1, Nod
es=1
[    0.000000] NR_IRQS:48
[    0.000000] console [ttyS1] enabled, bootconsole disabled
[    0.000000] console [ttyS1] enabled, bootconsole disabled
[    0.010000] Calibrating delay loop... 212.58 BogoMIPS (lpj=1062912)
[    0.090000] pid_max: default: 32768 minimum: 301
[    0.090000] Mount-cache hash table entries: 512
```

Final Build Cont.

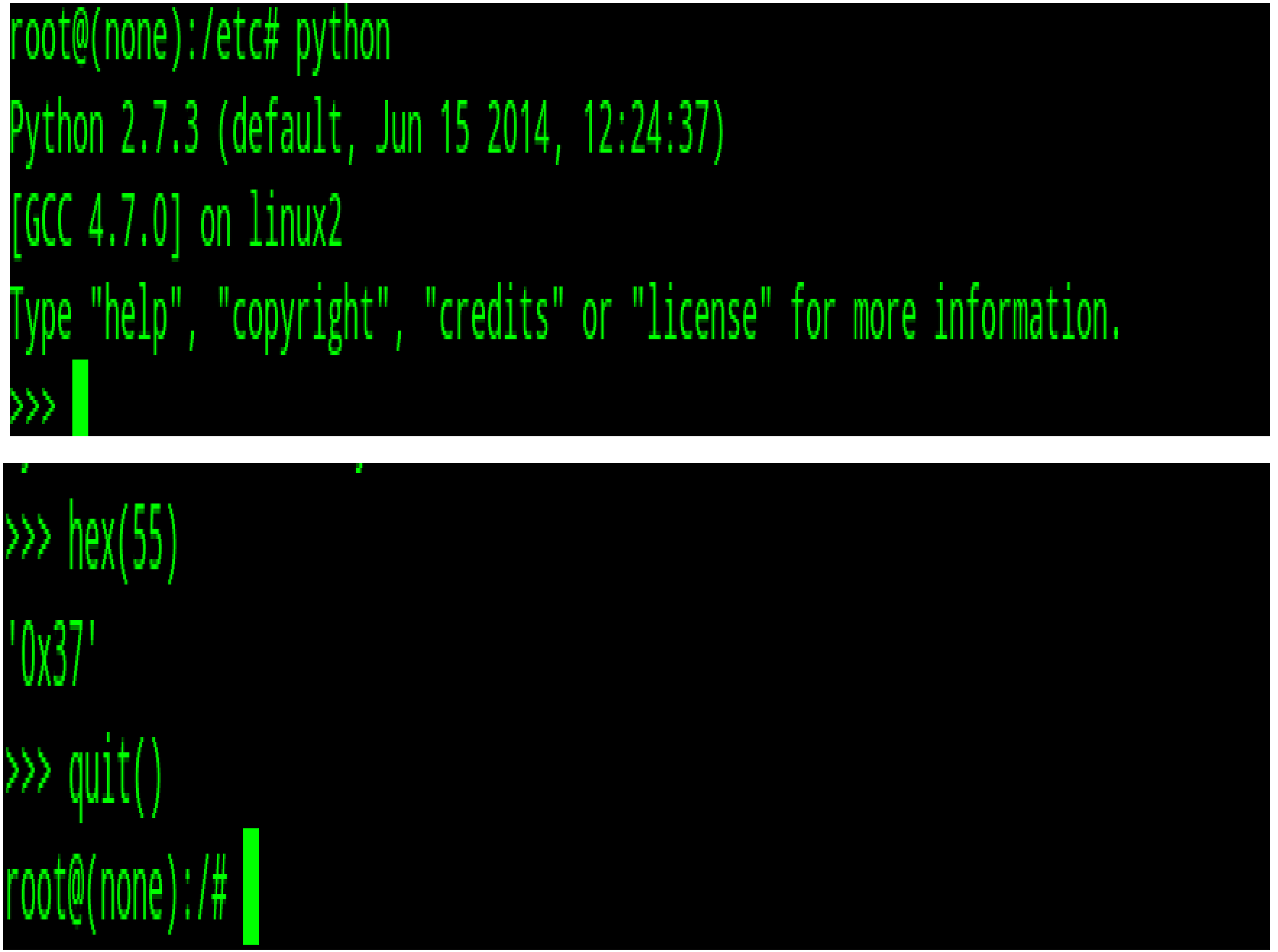
```
[   13.320000] dwc_otg: Init: Port Power? op_state=1
[   13.330000] dwc_otg: Init: Power Port (0)
[   13.340000] hub 1-0:1.0: USB hub found
[   13.350000] hub 1-0:1.0: 1 port detected
[   13.580000] Initializing USB Mass Storage driver...
[   13.590000] usbcore: registered new interface driver usb-storage
[   13.600000] USB Mass Storage support registered.
[   13.970000] usbcore: registered new interface driver usbhid
[   13.980000] usbhid: USB HID core driver
[   20.240000] ramips-wdt: timeout value 60 must be 0 < timeout <= 40, using 40


BusyBox v1.19.4 (2014-06-15 11:50:54 CDT) built-in shell (ash)
Enter 'help' for a list of built-in commands.

  _______                     ________        __
 |       |.-----.-----.-----.|  |  |  |.----.|  |_
 |   -   ||  _  |  -__|     ||  |  |  ||   _||   _|
 |_______||   __|_____|__|__||________||__|  |____|
          |__| W I R E L E S S   F R E E D O M
 -----------------------------------------------------
 ATTITUDE ADJUSTMENT (Attitude Adjustment, r40877)
 -----------------------------------------------------
  * 1/4 oz Vodka      Pour all ingredients into mixing
  * 1/4 oz Gin        tin with ice, strain into glass.
  * 1/4 oz Amaretto
  * 1/4 oz Triple sec
  * 1/4 oz Peach schnapps
  * 1/4 oz Sour mix
  * 1 splash Cranberry juice
 -----------------------------------------------------
root@(none):/#
```

Network Working

```
eth0      Link encap:Ethernet  HWaddr 00:11:22:33:44:55
          inet addr:192.168.1.102  Bcast:192.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:468 errors:0 dropped:1 overruns:0 frame:0
          TX packets:9 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:168719 (164.7 KiB)  TX bytes:780 (780.0 B)
          Interrupt:5
```

```
root@(none):/etc# ping 192.168.1.100
PING 192.168.1.100 (192.168.1.100): 56 data bytes
64 bytes from 192.168.1.100: seq=0 ttl=64 time=1.107 ms
64 bytes from 192.168.1.100: seq=1 ttl=64 time=0.619 ms
^C
--- 192.168.1.100 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0.619/0.863/1.107 ms
```

Python Working



Previous Build

```
Starting kernel ...

[    0.000000] Linux version 3.10.18 (developer@proliant2) (gcc version 4.6.4 (Op
enWrt/Linaro GCC 4.6-2013.05 r38695) ) #47 Wed Jan 29 19:02:42 GMT 2014
[    0.000000] SoC Type: Ralink RT3350 id:1 rev:2
[    0.000000] bootconsole [early0] enabled
[    0.000000] CPU revision is: 0001964c (MIPS 24KEc)
[    0.000000] MIPS: machine is Omnima MiniEMBWiFi
[    0.000000] Determined physical RAM map:
[    0.000000]  memory: 02000000 @ 00000000 (usable)
[    0.000000] Initrd not found or empty - disabling initrd
[    0.000000] Zone ranges:
[    0.000000]   Normal   [mem 0x00000000-0x01ffffff]
[    0.000000] Movable zone start for each node
[    0.000000] Early memory node ranges
[    0.000000]   node   0: [mem 0x00000000-0x01ffffff]
[    0.000000] Primary instruction cache 16kB, VIPT, 4-way, linesize 32 bytes.
[    0.000000] Primary data cache 16kB, 4-way, VIPT, no aliases, linesize 32 byte
s
[    0.000000] Built 1 zonelists in Zone order, mobility grouping on.  Total page
s: 8128
[    0.000000] Kernel command line: console=ttyS0,57600 rootfstype=squashfs,jffs2
[    0.000000] PID hash table entries: 128 (order: -3, 512 bytes)
[    0.000000] Dentry cache hash table entries: 4096 (order: 2, 16384 bytes)
[    0.000000] Inode-cache hash table entries: 2048 (order: 1, 8192 bytes)
```

Previous Build Cont.

```
BusyBox v1.19.4 (2013-11-09 11:49:43 GMT) built-in shell (ash)
Enter 'help' for a list of built-in commands.

ash: can't access tty; job control turned off

 Omnima MiniEMBWiFi - info@omnima.co.uk

 Linux Kernel 3.10.18

 -------------------------------------------------
 OpenWrt BARRIER BREAKER (Bleeding Edge, r38695)
 -------------------------------------------------

root@(none):/# reboot
```

Problems and Resolution

Many problems but the greatest one:

1. Finding an image that worked correctly

First I tried the “Bleeding Edge” distribution like indicated in the guide.

I had problems with the image generating only a squashfs filesystem.

I took it upon myself to download the “Attitude Adjustment” distribution as indicated on openwrt.org.

After sucessfully building and indicating in the menuconfig both a squashfs, jffs2 filesystem be built, I found a testable image.

I tested it by loading it into RAM first as indicated below:

```
RT3052 # printenv
bootcmd=tftp
bootdelay=5
baudrate=57600
ethaddr="00:AA:BB:CC:DD:10"
preboot=echo;echo
ramargs=setenv bootargs root=/dev/ram rw
addip=setenv bootargs $(bootargs) ip=$(ipaddr):$(serverip):$(gatewayip):$(netmask
):$(hostname):$(netdev):off
addmisc=setenv bootargs $(bootargs) console=ttyS0,$(baudrate) ethaddr=$(ethaddr)
panic=1
flash_self=run ramargs addip addmisc;bootm $(kernel_addr) $(ramdisk_addr)
kernel_addr=BFC40000
u-boot=u-boot.bin
load=tftp 8A100000 $(u-boot)
u_b=protect off 1:0-1;era 1:0-1;cp.b 8A100000 BC400000 $(filesize)
loadfs=tftp 8A100000 root.cramfs
u_fs=era bc540000 bc83ffff;cp.b 8A100000 BC540000 $(filesize)
test_tftp=tftp 8A100000 root.cramfs;run test_tftp
ethact=Eth0 (10/100-M)
filesize=2c4e14
fileaddr=80800000
ipaddr=192.168.1.102
serverip=192.168.1.100
autostart=no
stdin=serial
stdout=serial
stderr=serial
bootfile=/tftpboot/openwrt-omni-emb-squashfs.bin

Environment size: 883/65532 bytes
RT3052 # saveenv
```

Results

I found by using the squashfs, jffs2 image with “attitude adjustment” worked and I could actually edit the filesystem and have it stay persistent.

References

- www.openwrt.org
- http://www.omnima.co.uk/store/catalog/MiniEMBWiFi-p-16180.html