

# BananaPi R3

[https://wiki.banana-pi.org/Banana\\_Pi\\_BPI-R3](https://wiki.banana-pi.org/Banana_Pi_BPI-R3)

## Hardware

- MT7986(Filogic 830) quad core ARM A53 SoC
- MT7531A Ethernet-switch
- 2G DDR RAM
- 8G eMMC flash, SPI-NAND (128 MiB), SPI-NOR (32 MiB)
- dual-band wifi:
  - 2.4G use MT7975N
  - 5G (wifi 6/5.8GHz,not 6E) use MT7975P frontend
- 2 SFP 2.5GbE and 5 GbE RJ45 ports
- mPCIe slot with only USB 2.0 connected for 4G modem
- M.2 slot key-M with only PCIe x2 interface (no sata/usb) for nvme (key B+M) or wifi-card for 6E (maybe adapter needed)

V1.0:



V1.1:



## debug-uart

3v3 TTL

Usb2serial adapters supported: ch340 (no G),cp2104,FT4232

With Profilic, cp2102, ch340G wifi firmware does not start [issue-report](#)

Gnd-gnd,rx-tx,tx-rx

115200 8n1 (8 databits, 1 startbit), no flow control

## bootmedium

- SD / eMMC sharing 1 mmc-controller in SoC
  - SD 4bit bus, eMMC 8bit
  - switched first 4 data-lanes by sw6/D (bottom on v1.0)
- SPI NAND/NOR sharing SPI0-Bus
  - CS switched by sw5/C

sw2/B on top of board near debug-uart chooses between SPI and MMC

see [bootmedium\\_selection](#) for boot selection table

## Network connections

```
gmac1 (eth0) ---- (p6)mt7531(P0) ---- WAN
                        (P1-4) -- LANx4
                        (p5/lan4) ---- right SFP slot (sfp2)
gmac2 (eth1) ---- left SFP slot (sfp1)
```

<https://forum.banana-pi.org/t/bpi-r3-information/12897/4>

## SFP

We have both sfp slots recognized and working

```
mount -t debugfs none /sys/kernel/debug/
cat /sys/kernel/debug/sfp1/state
```

Some sfp are still not recognized (e.g. gpon).

After some phylink-conversion there are some issues with 2g5 sfp on left sfp/eth1. A workaround is disabling autoneg on the interface

```
ethtool -s eth1 autoneg off
```

Left sfp does not support vlan in linux 6.1 because tag is stripped.

Power: "All SFP power supplies are connected to the system VDD33" which is 3v3/8A [source Dts patch from Daniel](#)

## compatibility

- class: Fibre MM/SM, Copper RJ45, ONT
- bandwidth: 1G/2G5 (only)

| class    | vendor / short    | part no       | supported bandwidth | state   | Link                          | comment                                |
|----------|-------------------|---------------|---------------------|---------|-------------------------------|--|
| Fibre MM | H!Fibre for cisco | ASF85-24-X2-D | 1000baseX only      | working | <a href="#">Amazon vendor</a> | <a href="#">hifibre_glc-sx-mmd.txt</a> |

2g5 sfp currently detected only if autoneg is turned off.

```
ethtool -s eth1 autoneg off
ethtool -s lan4 autoneg off
```

## WIFI

Firmware: <https://git.kernel.org/pub/scm/linux/kernel/git/firmware/linux-firmware.git/tree/mediatek>

## WLAN

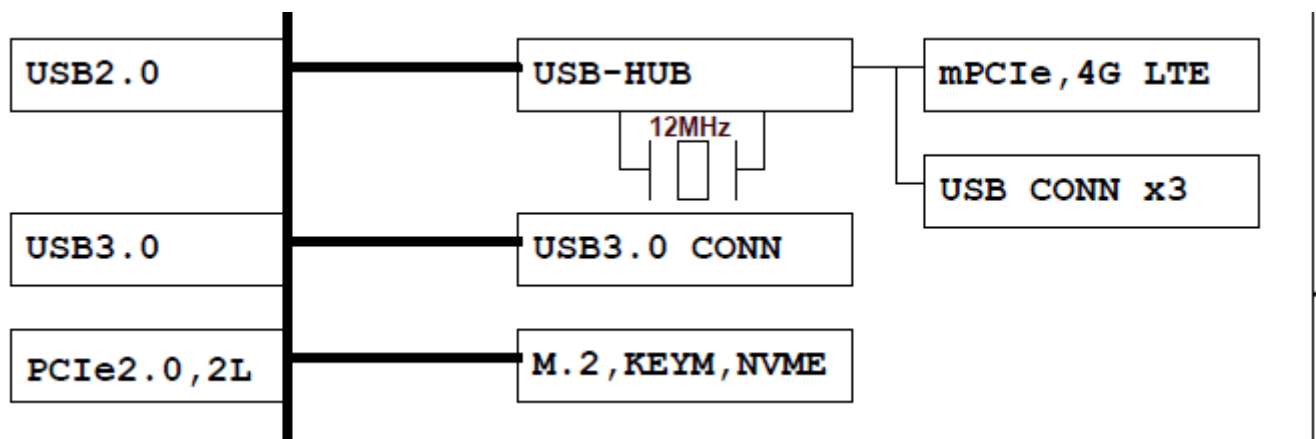
Antenna mounting <https://forum.banana-pi.org/t/how-to-mount-the-antenna-to-the-box/14429/4>

Antenna order by band (5g in corners):

<https://forum.banana-pi.org/t/how-to-mount-the-antenna-to-the-box/14429/15>

## USB / PCIe

The USB3.0 socket of R3 can only provide a maximum current of 1400mA. [source](#)



mPCIe slot is usb-only with SIM connector (bottom of board). PCIe is mapped to m.2 key-m slot for nvme SSD

Sata possible via M.2 KEY-M 2lane interface on bottom side of board (needs PCIe-2-Sata controller!)

I tested mpcie slot with an em7455 [LTE](#) module (+key b adapter)

for m.2-slot there is a patch if nvme is not recognized:

<https://forum.banana-pi.org/t/bpi-r3-nvme-connection-issue/14563/17>

## GPIO

[gpio](#)

## thermal

```
cat /sys/class/thermal/thermal_zone0/temp
```

Thermalpad size: <https://forum.banana-pi.org/t/banana-pi-r3-fan-with-pwm/14406/28>

Change pwm of fan from 5v to 12v (R317/R318): [Schematic location on board](#)

Mt76:

```
cat /sys/class/ieee80211/phy*/hwmon*/temp1_input
```

2g4/5g difference: <https://github.com/openwrt/mt76/issues/729>

FAN-Connector: JST PH 2mm pin-spacing

5V pwm fan: <https://de.aliexpress.com/item/1005003663915828.html>

trigger pwm-fan:

```
echo 1 > /sys/class/thermal/cooling_device0/cur_state
```

## leds

available via sysfs:

- green: power
- blue: status

additional with function

- wf2g
- wf5g
- ssd: blinks on write access on m2-slot (nvme)
- lte: reported to work by daniel

Wifi-leds are fixed in my 6.1 tree and in mt76 master.

## case

<https://forum.banana-pi.org/t/banana-bpi-r3-3d-printed-case/14246/>

Case from finas: <https://www.printables.com/model/335936-banana-pi-bpi-r3-modular-case>

Higher version added here:

<https://www.dropbox.com/s/tng2pi2ud6qd2vo/Banana%20PI%20RPI-3%20case.stl?dl=0>

## Software

### partition layout

blocks á 512 byte

|            | SD        | eMMC     |
|------------|-----------|----------|
| <b>gpt</b> | -         | 0-33     |
| <b>bl2</b> | 34 - 8191 | in boot0 |

|                   | <b>SD</b>                   | <b>eMMC</b> |
|-------------------|-----------------------------|-------------|
| <b>u-boot-env</b> | 8192 - 9215                 |             |
| <b>factory</b>    | 9216 - 13311                |             |
| <b>fip</b>        | 13312 - 17407               |             |
| <b>kernel</b>     | 17408 - 222207 (100MB)      |             |
| <b>rootfs</b>     | 222208 - 12805120 (6144 MB) |             |

bytes (start,size in hex)

|                   | <b>NAND</b>         | <b>NOR</b>          |
|-------------------|---------------------|---------------------|
| <b>bl2</b>        | 0x0, 0x80000        | 0x0, 0x40000        |
| <b>u-boot-env</b> | -                   | 0x40000, 0x40000    |
| <b>reserved</b>   | -                   | 0x80000, 0x80000    |
| <b>factory</b>    | 0x80000, 0x300000   | -                   |
| <b>fip</b>        | 0x380000, 0x200000  | 0x100000, 0x80000   |
| <b>recovery</b>   | -                   | 0x180000, 0xa80000  |
| <b>fit</b>        | -                   | 0xc00000, 0x1400000 |
| <b>ubi</b>        | 0x580000, 0x7a80000 | -                   |

## GPT binaries

32MB kernel/256MB root:

gpt\_sd-20220216.bin

create own partition table: (currently i tried to port to python3,but get crc error, so only python2-support):

[https://github.com/frank-w/BPI-R3-bsp/tree/r3-atf/tools/mediatek/gpt\\_editor](https://github.com/frank-w/BPI-R3-bsp/tree/r3-atf/tools/mediatek/gpt_editor)

```
(cd tools/mediatek/gpt_editor/;python mtk_gpt.py --i example/mt7986-sd.json
--o GPT_SD)
```

Created a gpt with 100mb kernel+6GB root partition with an python2 venv

[https://github.com/frank-w/u-boot/blob/r3-atf/gpt\\_sdmmc\\_100m6g.img](https://github.com/frank-w/u-boot/blob/r3-atf/gpt_sdmmc_100m6g.img)

[https://github.com/frank-w/u-boot/blob/r3-atf/gpt\\_emmc\\_100m6g.img](https://github.com/frank-w/u-boot/blob/r3-atf/gpt_emmc_100m6g.img)

Gpt img file may cause errors when using parted (main and backup gpt corrupt) or gpt errors in uboot on reboot. This can be also caused by backup-gpt not overridden by image (end of disk).

Parted:

```
Error: Both the primary and backup GPT tables are corrupt. Try making a
fresh table, and using Parted's rescue feature to recover partitions.
```

Uboot (sw reboot):

```
*** ERROR: Can't read GPT Entries ***
```

```
find_valid_gpt: *** ERROR: Invalid GPT ***
```

This can be fixed with `sgdisk` by exporting and re-importing the gpt

```
sudo sgdisk --backup=bpi-r3_sgdisk.gpt /dev/sdb
sudo sgdisk --load-backup=bpi-r3_sgdisk.gpt /dev/sdb
```

## manual GPT creation

script for creating gpt with `sgdisk/losetup`  
 bl2-partition needs legacy-boot flag!

## Emmc partition creation

Todo...currently only via linux initrd from nor/usb

It is possible to create gpt in uboot. Example for rk3568:

[https://source.denx.de/u-boot/u-boot/-/blob/master/include/configs/rk3568\\_common.h#L29](https://source.denx.de/u-boot/u-boot/-/blob/master/include/configs/rk3568_common.h#L29)

<https://elixir.bootlin.com/u-boot/latest/source/include/configs/rockchip-common.h#L85>

This creates a env var with the partition definition for rk3568 (not bpi-r3):

```
"uuid_disk=${uuid_gpt_disk};" \
"name=loader1,start=32K,size=4000K,uuid=${uuid_gpt_loader1};" \
"name=loader2,start=8MB,size=4MB,uuid=${uuid_gpt_loader2};" \
"name=trust,size=4M,uuid=${uuid_gpt_atf};" \
"name=boot,size=112M,bootable,uuid=${uuid_gpt_boot};" \
"name=rootfs,size=-,uuid="ROOT_UUID"
```

Which can be used like this:

```
mmc dev 0
gpt write mmc 0 $partitions
```

defined table this way (blocks only):

```
setenv partitions
"uuid_disk=${uuid_gpt_disk};name=gpt,start=0,size=34,uuid=${uuid_gpt_table};
name=u-boot-
env,start=8192,size=1024,uuid=${uuid_gpt_env};name=factory,start=9216,size=4
096,uuid=${uuid_gpt_factory};name=fip,start=13312,size=4096,uuid=${uuid_gpt_
fip};name=kernel,size=100M,uuid=${uuid_gpt_kernel};name=rootfs,size=0,uuid=$
{uuid_gpt_rootfs}"
```

but i got error on write...maybe because a gpt already exists

```
MT7986> printenv partitions
partitions=uuid_disk=;name=gpt,start=0,size=34,uuid=;name=u-boot-
env,start=8192,size=1024,uuid=;name=factory,start=9216,size=4096,uuid=;name=
fip,start=13312,size=4096,uuid=;name=kernel,size=100M,uuid=;name=rootfs,size
=0,uuid=
MT7986> mmc dev 0
switch to partitions #0, OK
mmc0(part 0) is current device
MT7986> gpt write mmc 0 $partitions
Writing GPT: error!
```

## atf / u-boot

### U-Boot

Daniels code: <https://github.com/dangowrt/arm-trusted-firmware/tree/mtksoc-v2.6/>

<https://git.openwrt.org/?p=openwrt/staging/dangole.git;a=shortlog;h=refs/heads/r3-mt7986>

## linux

Own repo: <https://github.com/frank-w/BPI-R2-4.14/commits/6.1-main>

```
./build.sh importconfig
./build.sh #build kernel
```

Then copy bpi-r3.itb to card and start from [u-boot](#)

## openwrt

<https://git.openwrt.org/openwrt/openwrt.git>

Build instructions: <https://forum.banana-pi.org/t/banana-pi-r3-bsp-source-code/14257/2>

Or using firmware selector (currently only snapshot): <https://firmware-selector.openwrt.org/> (adding luci-ssl)

Install: <https://forum.banana-pi.org/t/install-openwrt-snapshot-on-bpi-r3/14231/7?u=frank-w>

```
opkg update
opkg install luci-ssl
```

Change network config without luci:

<https://forum.banana-pi.org/t/banana-pi-r3-cant-save-anything-in-luci/14658/15?u=frank-w>

Add more space on storage:

<https://forum.banana-pi.org/t/bpi-r3-change-or-add-partion-to-overlay/14240/12>



<https://forum.banana-pi.org/t/cannot-resize-my-root-partition-on-bpi-r3/13937/5>

Modifications from user valder:

<https://forum.banana-pi.org/t/bpi-r3-openwrt-whats-the-best-way-to-use-the-rest-of-my-space-on-my-sd-card/15675/10>

## debian

create image with build.sh createimg from my uboot-repo (atf-r3 branch after building uboot+atf) and add rootfs+kernel

generated GPT from mtk-script has some problems with parted (partprobe reports main gpt is damaged), but it can be mounted with losetup -P

```
sudo losetup -P $LDEV $IMGDIR/$IMGNAME.img
```

writing image to sdcard (image not ready yet):

```
gunzip -c bpi-r3_sdmmc_bullseye.img.gz | sudo dd bs=1M status=progress  
conv=notrunc,fsync of=/dev/sdX
```

/etc/apt/sources.list:

```
deb http://ftp.de.debian.org/debian bullseye main contrib non-free  
deb-src http://ftp.de.debian.org/debian bullseye main contrib non-free  
deb http://ftp.de.debian.org/debian bullseye-updates main contrib non-free  
deb-src http://ftp.de.debian.org/debian bullseye-updates main contrib non-free  
deb https://security.debian.org/debian-security bullseye-security main  
contrib non-free  
deb-src http://security.debian.org/debian-security bullseye-security main  
contrib non-free
```

```
root@bpi-r3:~# date -s "2022-09-18 18:02:00+0200"  
root@bpi-r3:~# ip link set lan4 up  
root@bpi-r3:~# ip addr add 192.168.0.19/24 dev lan4  
root@bpi-r3:~# ip route add default via 192.168.0.10  
root@bpi-r3:~# apt update  
root@bpi-r3:~# apt install pciutils usbutils traceroute iperf3 net-tools  
psmisc wget curl
```

dnsmasq vs. systemd-resolved: "Another process is already listening on TCP socket 127.0.0.53:53"

<https://unix.stackexchange.com/a/319501>

## issues

V1.0:

- reset switch low/pressed when card in m2 slot ([link](#))

#### V1.1:

- wifi firmware cannot be started when debug-uart connected ([link](#))
  - bpi reports only affects profilic adapters, ch340,cp2102,FT4232 are ok ([link](#))
  - I tested cp2102 (not working),cp2104 (working),ch340G (not working) and ft232rl (working)
  - Possible fix:<https://github.com/openwrt/mt76/issues/702#issuecomment-1312284560>
- reset-bug still there
  - is reported to be fixed (removed R171 and R173) in newer v1.1
  - tested in uboot with my v1.1 r3 in uboot and plugged m.2 nvme:

```
▪ MT7986> gpio input 9
gpio: pin 9 (gpio 9) value is 1 //initial value
MT7986> gpio input 9
gpio: pin 9 (gpio 9) value is 0 //pressed
```

- dual-nor (no nand) reported by 1 user [link](#)
- wifi temperature issue (2g4 seems wrong): <https://github.com/openwrt/mt76/issues/729>

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Last update: **2023/06/16 07:48**

