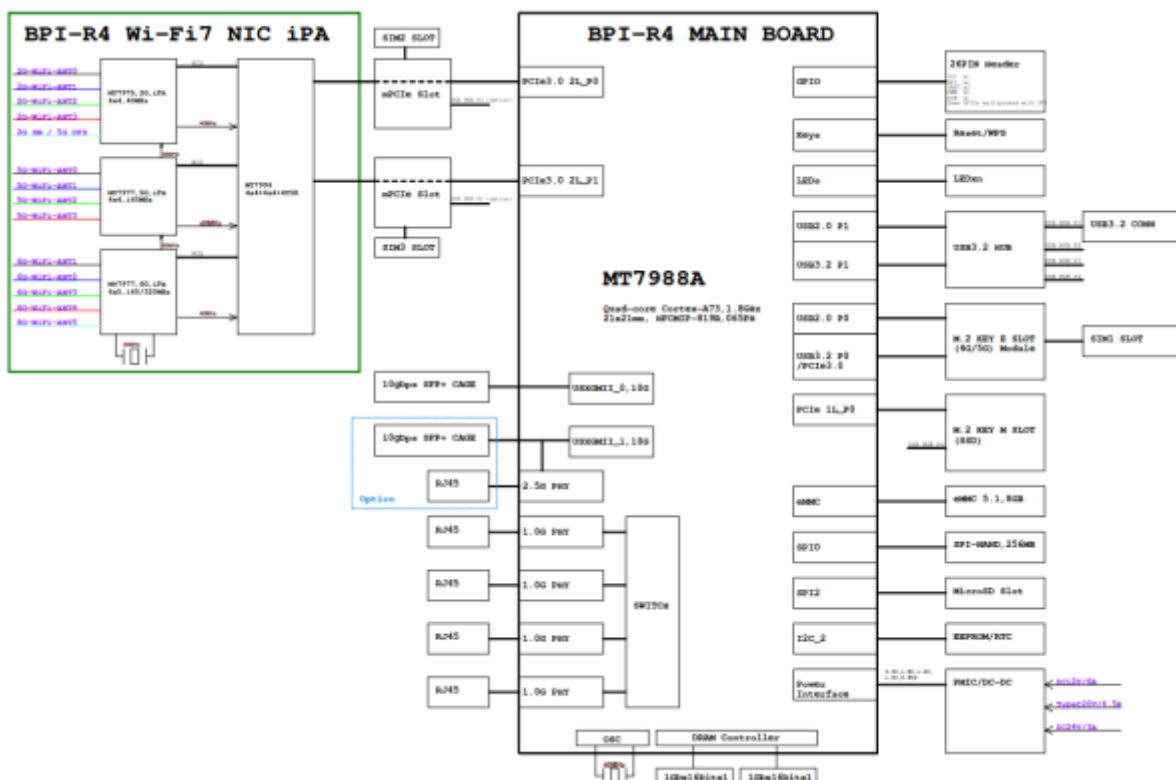


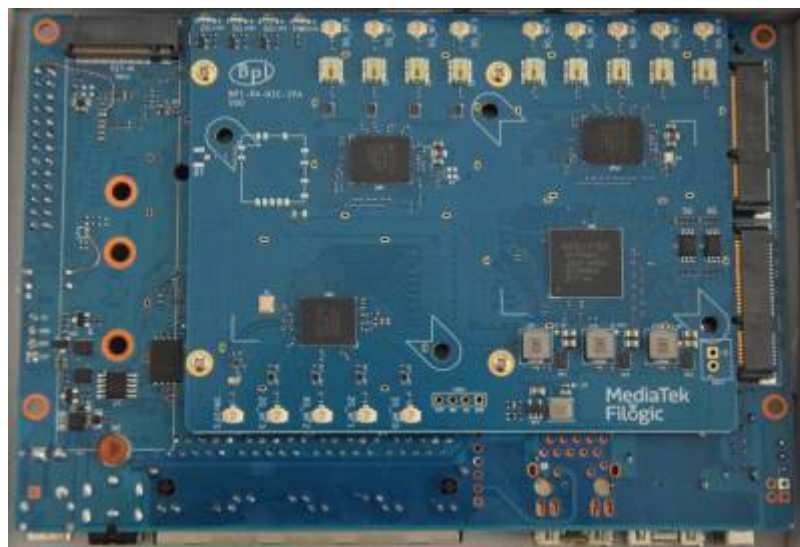
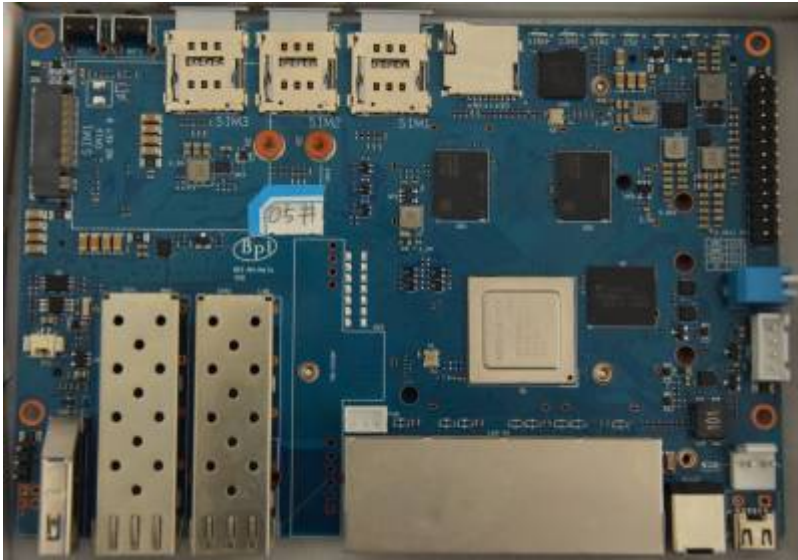
# BananaPi R4

[https://wiki.banana-pi.org/Banana\\_Pi\\_BPI-R4](https://wiki.banana-pi.org/Banana_Pi_BPI-R4)

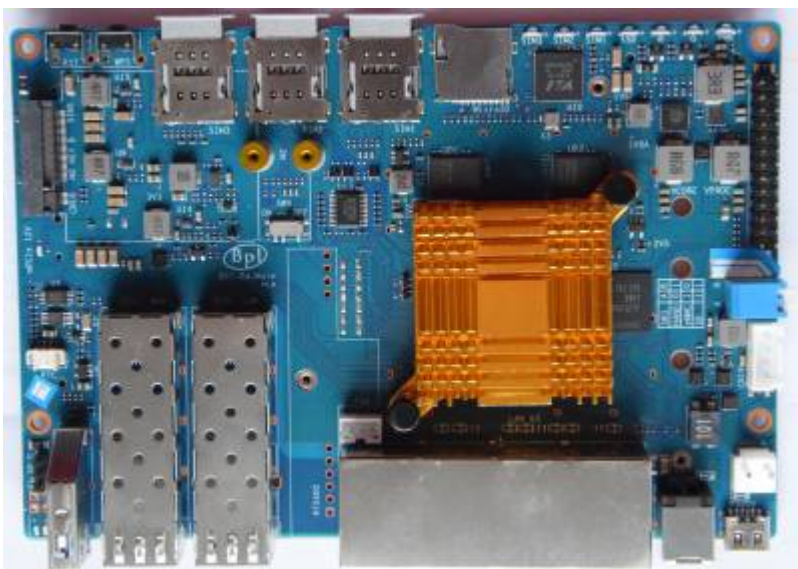
## Hardware

- MediaTek MT7988A (Filogic 880)
  - MT7530 switch builtin (1 cpu-port with 4Gbit/s + 1Gbit/s user-ports)
- 4G RAM
- 8GB eMMC flash
- 128MB SPI-NAND Flash
- either 2x SFP+ (10Gbit/s USXGMII) or 1SFP+ and 2g5 rj45 with PoE ([link](#))
- Wifi7 with additional module connected to the 2 PCIe slots at bottom of board
  - BPI-R4-NIC-BE19 (no public sale): MT7996 + MT7975 (2.4G) + MT7977A (6G) + MT7977B (5G)
  - BPI-R4-NIC-BE14: MT7995AV + MT7976CN + MT7977IAN
- powersupply 12V/5A required when using wifi card, 2A (like on other BPi Routers) is not enough





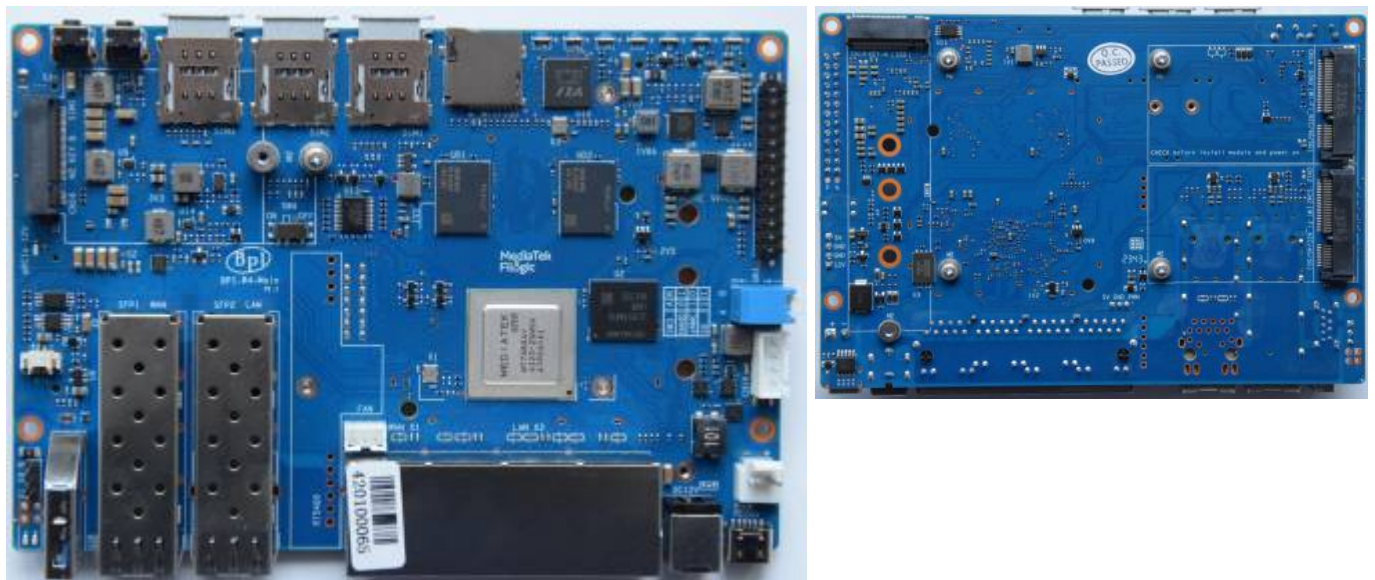
v1.0:





Changes between v0 and v1 (pm): <https://forum.banana-pi.org/t/bpi-r4-linux-bootup/15926/59>

v1.1:



## Network

GMAC0 (4Gbit/s) is connected internally to mt7530 switch variant where the 4 user-Ports are exposed as rj45 on board (1xWan,3xLan).

The SFP(+) cages are connected to SerDes lanes of GMAC1 and GMAC2, and those can be switched between SGMII/1000Base-X/2500Base-X mode for 10M/100M/1000M/2500M (via mtk-pcs-lynxi, just like on MT7622 and MT7986) and USXGMII/10GBase-KR for 5000M and 10000M. Hence it should be possible to support both, SFP modules with 1000M and 2500M, as well as SFP+ modules with 5000M and 10000M.

## Sfp-connections



USB-A	SFP1-WAN	SFP2-LAN	4xRJ-45	12V	USB-C
	USXGMII0	USXGMII1	GSW		
	eth2	eth1	eth0		

pm: <https://forum.banana-pi.org/t/bpi-r4-linux-bootup/15926/101> (changed interface-names because eth2 is wan-sfp)

full 10G will need RSS+LRO implemented in mtk ethernet driver and enabled (not yet working):

```
ethtool -K eth2 lro on # enable hw_lro
ethtool -k eth2 | grep large
large-receive-offload: on
iperf3 -bidir -c 192.168.90.10
```

RSS:  
<https://git01.mediatek.com/plugins/gitiles/openwrt/feeds/mtk-openwrt-feeds/+18f46a84d87308a4f56f9176ca166dc75c38bb20%5E%21/> LRO:  
<https://git01.mediatek.com/plugins/gitiles/openwrt/feeds/mtk-openwrt-feeds/+ddc366751fad05dade79b09932a999c5d5ae890c%5E%21/#F0>

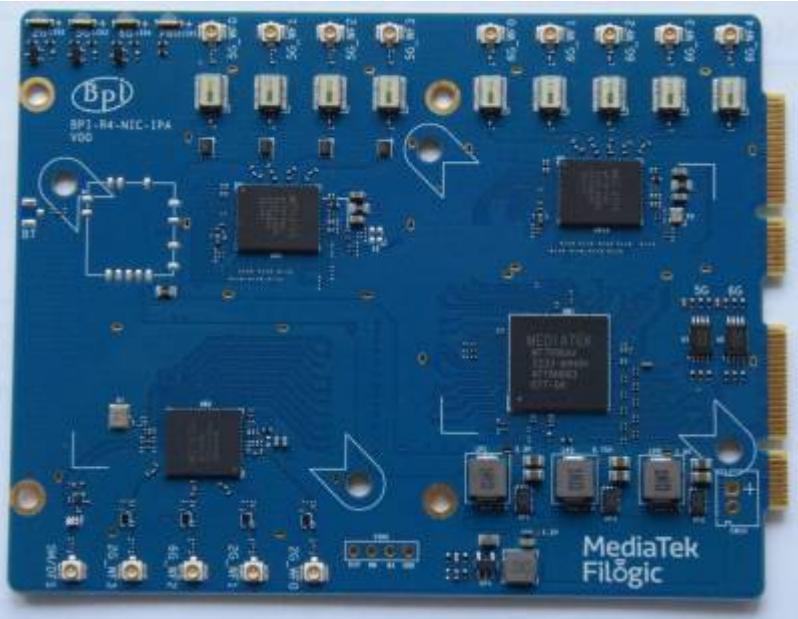
NETSYS: V2 for mt7986 (bpi-r3) V3 for mt7988 (bpi-r4)

Wifi

wifi is realized with daughter board (Network Interface Card) in the 2 mPCIe-Slots at bottom of the board.

Wifi-Module needs 12V...v1 uses sw4 in on-position, v0 used devicetree-overlay which enables the WIFI\_PWR\_EN regulator. Be careful with this setting when using different card in mPCIe slots!

kernel-module: mt7996e.ko





Newer wifi card with reduced antenna-count (6 instead of 14):

<https://forum.banana-pi.org/t/banana-pi-bpi-r4-bpi-be14-wi-fi7-nic-module/17182>

newer card currently has timeout on 3rd wifi interface (6.8-netnext), i guess we need another firmware file for the mt7977ia frontend

PCIE

2x1Lane (M.2 slots) and 2x2lane. the 2x2lane is for wifi (mPCIe slots).

USB

Bootswitch

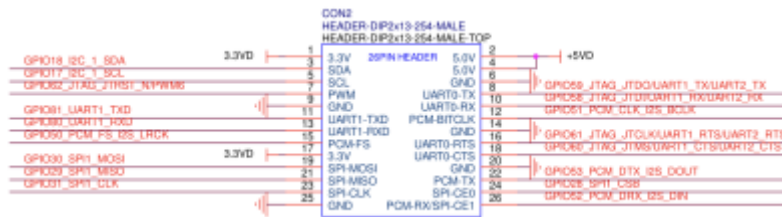
	A	B
nand	0	1
eMMC	1	0
SD	1	1

switch down is „1“, so both down booting from sdcard (v0 had both up to boot from sdcard)

v0:

1. both switches up ⇒ sdcard
  2. down (1),up (0) seems to be nand as this have mtd command
  3. up(0),down(1) also boots into bpis bootmenu, but i have no mtd command, so i guess this is the emmc
  4. both down failed

## GPIO



## uboot/ATF

currently use these:

- uboot: <https://github.com/frank-w/u-boot/tree/2023-10-bpi>
- ATF: <https://github.com/frank-w/u-boot/tree/mtk-atf>

and bootup "my" kernel like this:

```
MT7988> setenv fit 6.5.0-rc1-mt7988.itb
MT7988> setenv kaddr 0x48000000
MT7988> fatload mmc 0:5 ${kaddr} ${fit}
4970220 bytes read in 417 ms (11.4 MiB/s)
MT7988> bootm ${kaddr}
```

kaddr 0x46000000 works too, if uncompressed kernelimage is smaller than 32M (fit size of 14M was too large)

in newer u-boot i have set kaddr to 0x46000000 (fit loadaddr 0x44000000, rdaddr 0x48000000)

swiotlb errors (in ethernet-driver) can be fixed with limiting ram in uboot/cmdline to 3G (32bit border)

## tftp

```
BPI-R4> setenv bootfile 6.5.0-rc1-mt7988-r4.itb
BPI-R4> run bootnetfit
```

## openwrt image

using bin/targets/mediatek/filologic/openwrt-mediatek-filologic-bananapi\_bpi-r4-initramfs-recovery.itb

```
BPI-R4> usb start
BPI-R4> ls usb 0:1 r4
./
../
7929856 openwrt-mediatek-filologic-bananapi_bpi-r4-initramfs-recovery.itb
```

```
1 file(s), 2 dir(s)
```

```
BPI-R4> fatload usb 0:1 0x50000000 r4/openwrt-mediatek-filogic-bananapi_bpi-  
r4-initramfs-recovery.itb  
7929856 bytes read in 672 ms (11.3 MiB/s)  
BPI-R4> bootm 0x50000000#config-mt7988a-bananapi-bpi-r4#mt7988a-bananapi-  
bpi-r4-sd
```

## linux

<https://www.kernel.org/doc/html/v6.1/admin-guide/kernel-parameters.html>

3GB Ram limit not needed anymore as ethernet driver now uses 36bit addressing

Currently we need to limit ram to 3G because of swiotlb buffer full issues in ethernet driver

```
mem=3G
```

in cmdline (bootopts in my uboot uEnv.txt)

## kernel

<https://github.com/frank-w/BPI-Router-Linux/tree/6.6-dango>

## debug

```
# mount -t debugfs none /sys/kernel/debug/  
# cat /sys/kernel/debug/gpio  
# cat /sys/kernel/debug/pinctrl/pinctrl-handles  
# cat /sys/kernel/debug/regulator/regulator_summary  
# cat /sys/kernel/debug/clk/clk_summary  
  
#enable debug for driver probe  
# echo 'file dd.c +p'>/sys/kernel/debug/dynamic_debug/control  
# echo 'file core.c +p'>/sys/kernel/debug/dynamic_debug/control  
  
# echo '11230000.mmc' > /sys/bus/platform/drivers/mtk-msdc/unbind  
# echo '11230000.mmc' > /sys/bus/platform/drivers/mtk-msdc/bind
```

## interface config

```
ip link set lan0 up  
ip a a 192.168.0.19/24 dev lan0  
ip r a default via 192.168.0.10
```

```
date -s "2023-08-23 19:37 CEST"
#stats
ip -s link show dev eth2
ethtool -S eth2
```

DNS needs to be set in /etc/resolv.conf or in systemd like this:

```
mkdir -p /etc/systemd/resolved.conf.d/
cp /etc/systemd/resolved.conf /etc/systemd/resolved.conf.d/TEST.conf
echo "DNS = 192.168.0.10" >> /etc/systemd/resolved.conf.d/TEST.conf
systemctl restart systemd-resolved.service
```

modules in initrd:

```
mount /dev/mmcblk0p6 /mnt
mkdir /lib/modules
mkdir /lib/firmware
mount -o bind /mnt/lib/modules /lib/modules
mount -o bind /mnt/lib/firmware /lib/firmware
modprobe mt7996e
```

## openwrt

- clone openwrt master
- add this to feeds.conf.default: "src-git mtk sdk  
<https://git01.mediatek.com/openwrt/feeds/mtk-openwrt-feeds>"
- scripts/feeds update -f mtk sdk
- make menuconfig:
  - Target System (MediaTek Ralink ARM)
  - Subtarget (Filologic 8x0 (MT798x))
  - Target Profile (MediaTek MT7988a nand rfb) #here i see no sd-variant

adding additional options:

```
CONFIG_PACKAGE_f2fs-tools=y
CONFIG_PACKAGE_e2fsprogs=y
CONFIG_PACKAGE_dosfstools=y
CONFIG_PACKAGE_resize2fs=y
CONFIG_PACKAGE_nano=y
CONFIG_PACKAGE_iperf3=y
#CONFIG_PACKAGE_netcat
CONFIG_PACKAGE_tcpdump=y
CONFIG_BUSYBOX_CUSTOM=y
CONFIG_BUSYBOX_CONFIG_TELNET=y
```

\*-initramfs-kernel.bin is not the production image we're using. We only use it for testing purpose since it contains rootfs and won't read the flash.

\*-sysupgrade.bin is the actual production image. It's a tar ball for nand/emmc/sd boards. It contains separate kernel and rootfs that will be written to ubi volume for nand, or the partitions defined for sd/emmc.



```
tar -xf bin/targets/mediatek/filogic/openwrt-mediatek-filogic-  
mediatek_mt7988a-rfb-nand-squashfs-sysupgrade.bin sysupgrade-  
mediatek_mt7988a-rfb-nand/kernel  
dumpimage -l sysupgrade-mediatek_mt7988a-rfb-nand/kernel
```

## Known Issues

\* Card in M.2 slot causes i2c issues (sfp not detected):

<https://forum.banana-pi.org/t/bpi-r4-nvme-i2c/17152/2>

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