OpenWrt - Re-visited

Waikato Linux Users Group
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OpenWrt – “Open Wireless Router”

The OpenWrt Project is a Linux operating system targeting embedded devices.

Instead of trying to create a single, static firmware, OpenWrt provides a fully writable filesystem with package management.

This frees you from the application selection and configuration provided by the vendor and allows you to customize the device through the use of packages to suit any application.

For developers, OpenWrt is the framework to build an application without having to build a complete firmware around it; for users this means the ability for full customization, to use the device in ways never envisioned.

OpenWrt - Re-visited

WLUG presentation on 25 February 2019.

https://github.com/WLUG/meetings/tree/master/2019/2019-02-25

3 x Slides shows. 140 slides

OpenWrt 18.06.1 (19 Aug 2018)
Kernel 4.9.120
BusyBox 1.28.3
Python 3.6.5 (default, 31 Jan 2019, 14:35:22)

```
root@OpenWrt:/# cat /etc/openwrt_release
DISTRIB_ID='OpenWrt'
DISTRIB_RELEASE='18.06.2'
DISTRIB_REVISION='r7676-cddd7b4c77'
DISTRIB_TARGET='brcm63xx/smp'
DISTRIB_ARCH='mips_mips32'
DISTRIB_DESCRIPTION='OpenWrt 18.06.2 r7676-cddd7b4c77'
DISTRIB_TAINTS=''
```

OpenWrt - Re-visited

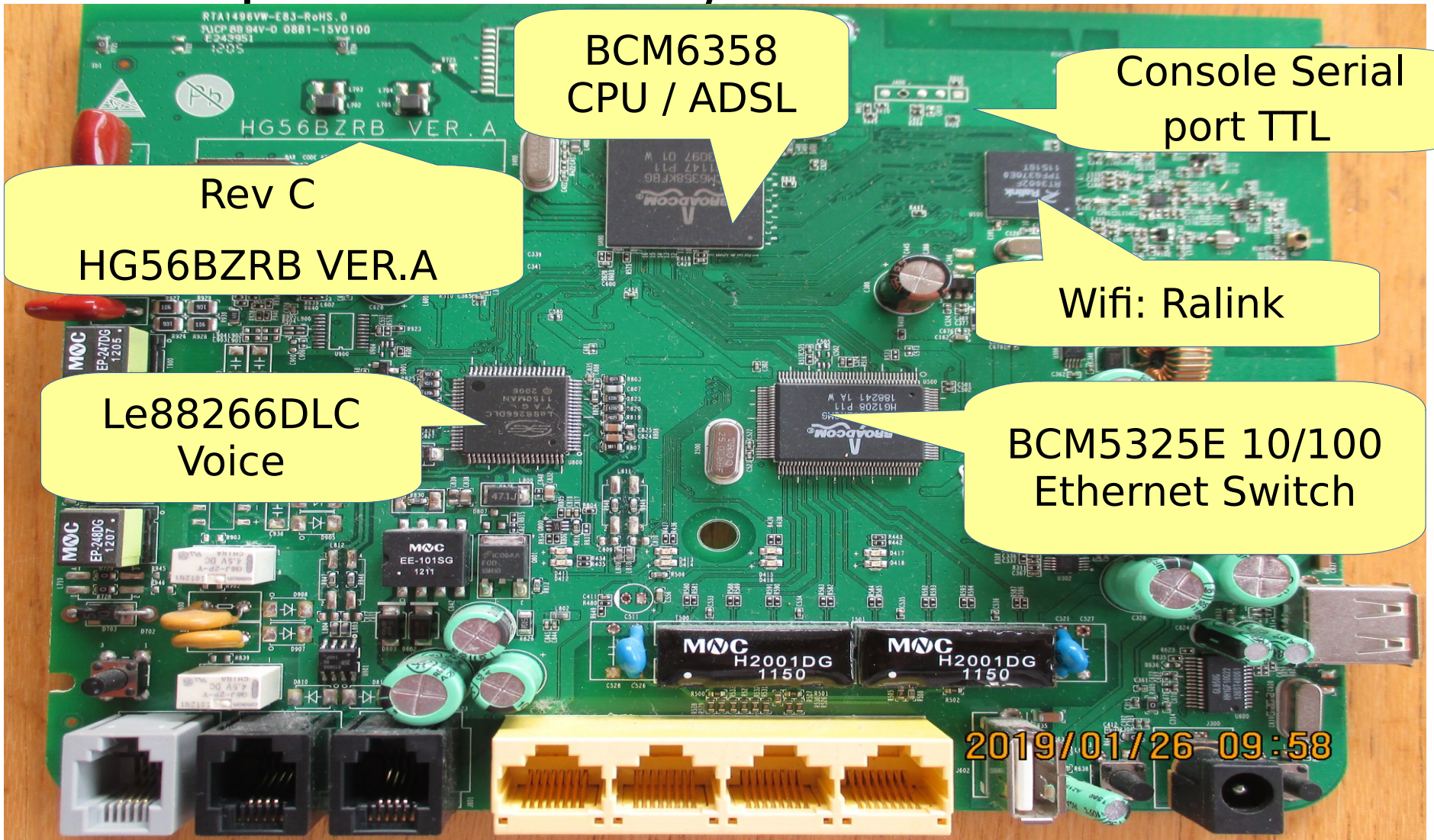
Current stable series: OpenWrt 21.02 released on 25. October 2021.

OpenWrt 21.02.1
Kernel 5.4.154
BusyBox 1.33.1
Python 3.9.10-1

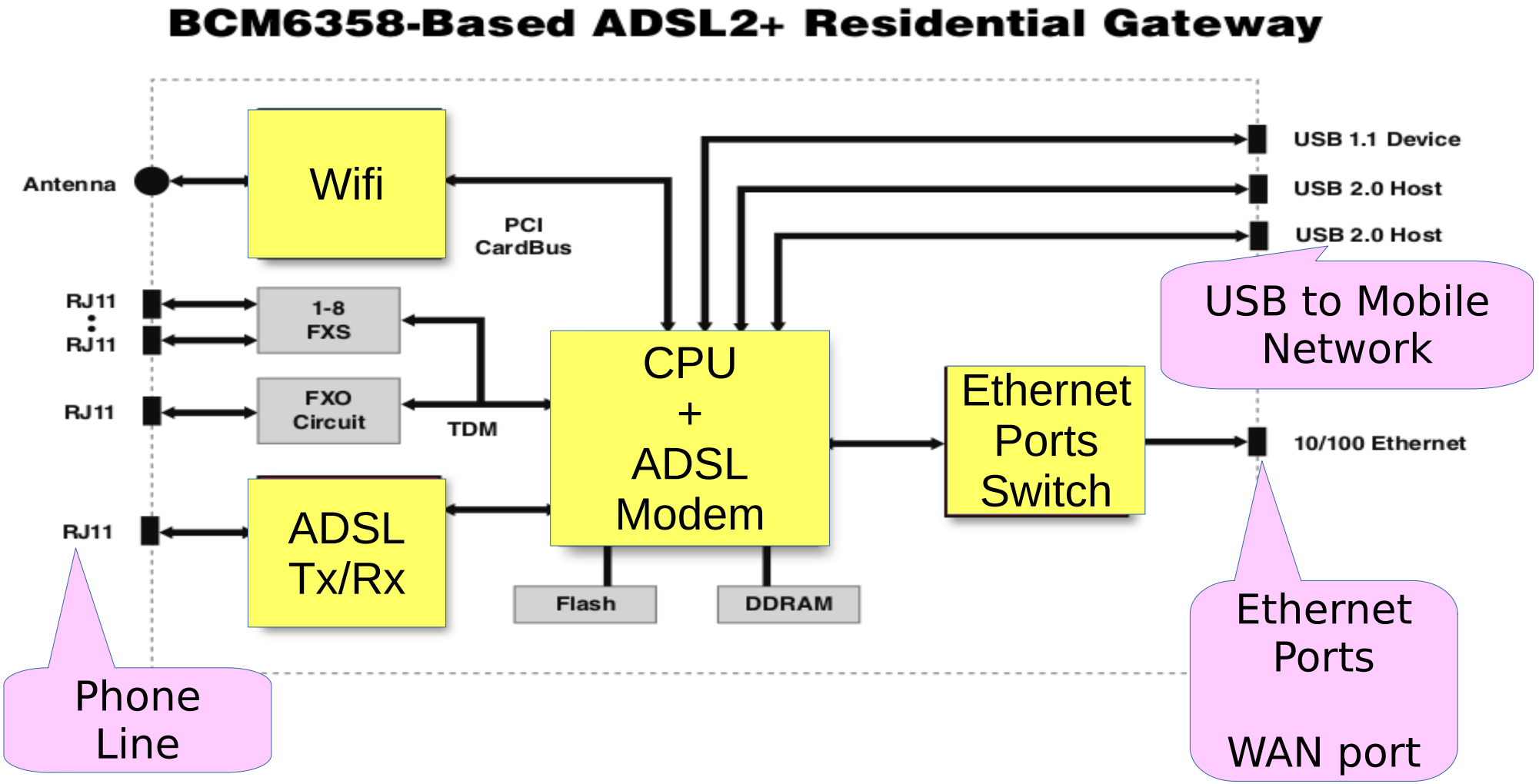
```
root@OpenWrt:/etc# cat openwrt_release
DISTRIB_ID='OpenWrt'
DISTRIB_RELEASE='21.02.1'
DISTRIB_REVISION='r16325-88151b8303'
DISTRIB_TARGET='bcm63xx/generic'
DISTRIB_ARCH='mips_mips32'
DISTRIB_DESCRIPTION='OpenWrt 21.02.1 r16325-88151b8303'
DISTRIB_TAINTS=''
```

Example: Vodafone / Huawei HG556a

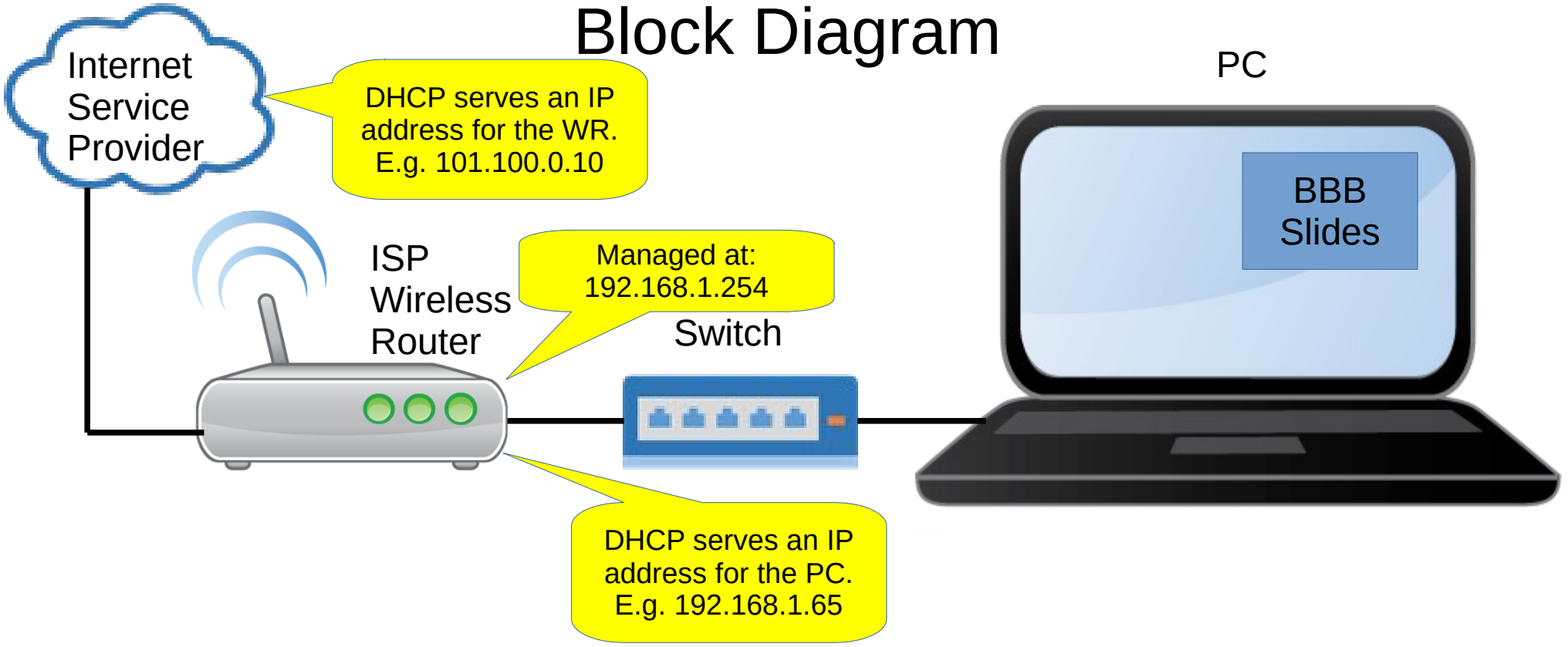
Example: Vodafone / Huawei HG556a C



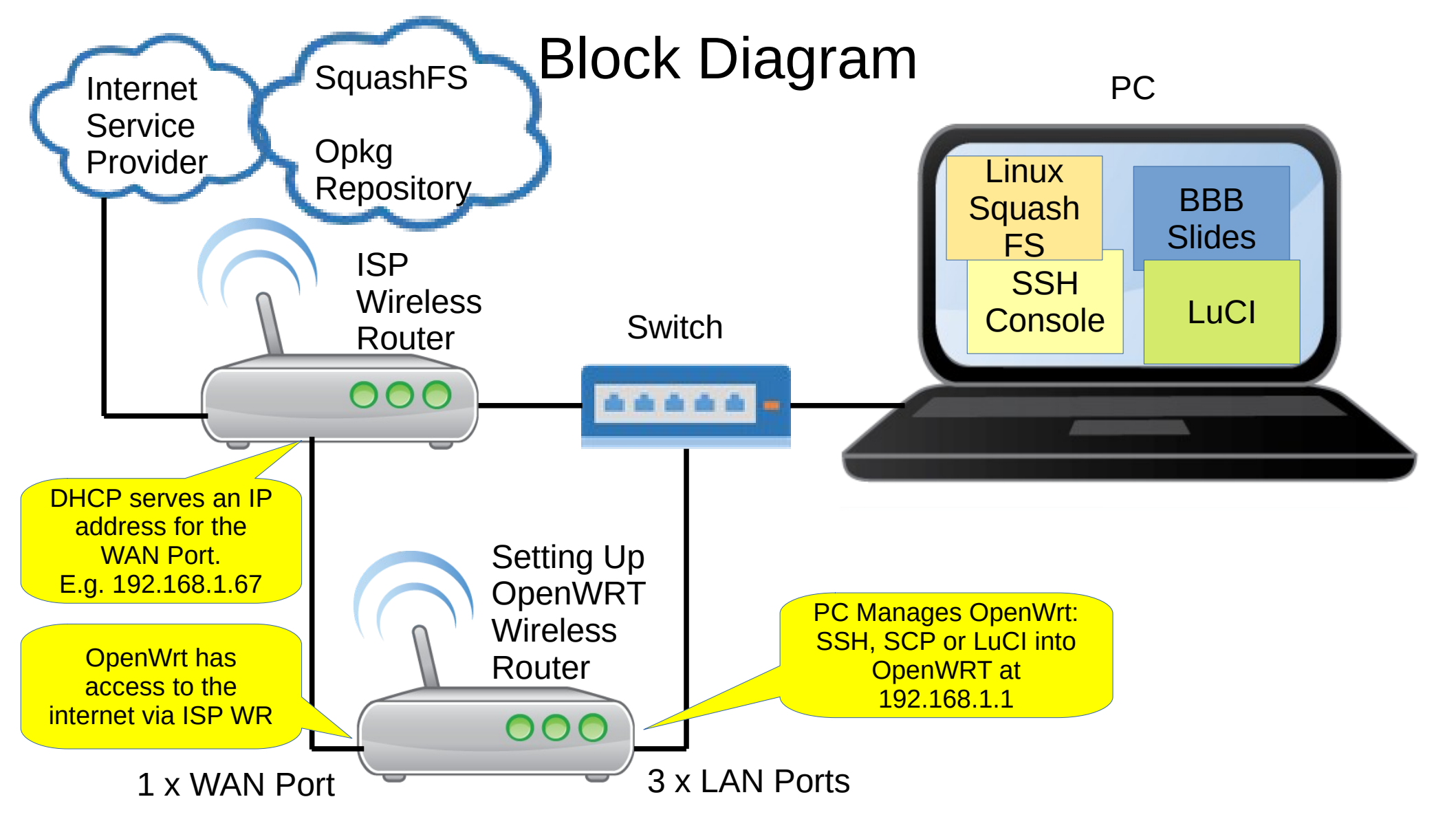
Home Gateway – Broadcom Block Diagram



Block Diagram



Block Diagram



OpenWrt - Installation

See the slide shows from 3 years ago at...

https://github.com/WLUG/meetings/tree/master/2019/2019-02-25

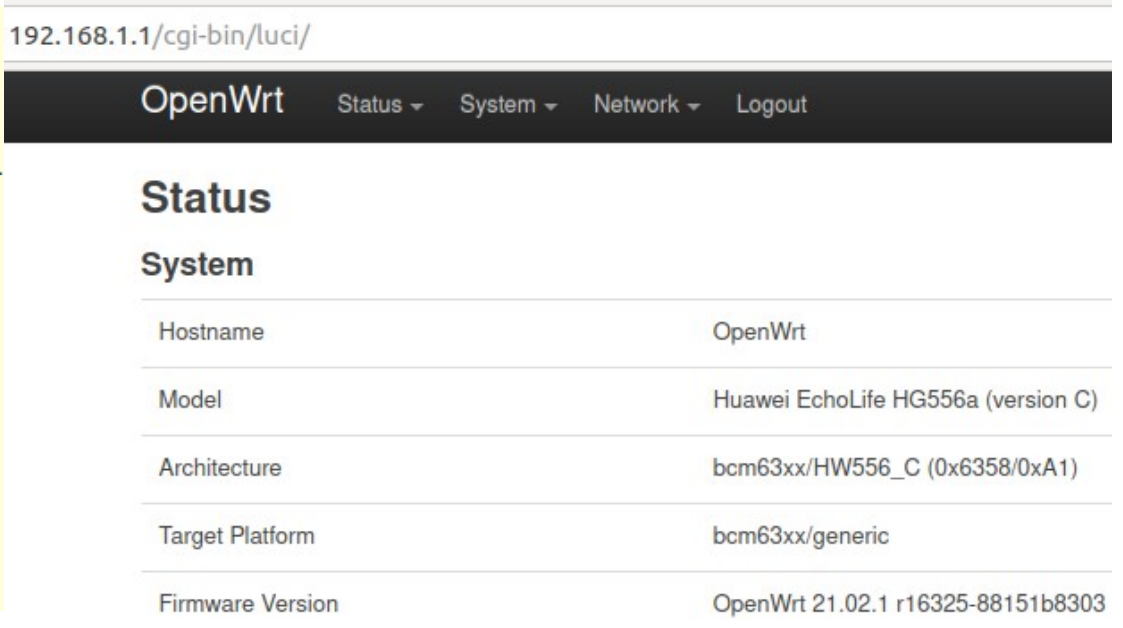
...for details on:

- Verifying if your modem is supported by OpenWrt.
- Downloading the OpenWrt Squashed file system image to your PC.
- Powering on the modem so it goes into Software Update mode.
- Booting OpenWrt
- SSHing from the PC into the OpenWrt modem
- Using a web browser to access OpenWrt’s LuCI web server on the modem.

OpenWrt - Management

- OpenWrt can be managed completely using SSH and the terminal.
- SCP to transfer files from PC to OpenWrt modem.
- LuCI WebUI makes many administration tasks easier.
- A TTL console port may be connected up to the motherboard.
- Recent OpenWrt full releases ship with the LuCI WebUI installed.

```
ian@hp:~$ ssh root@192.168.1.1
root@192.168.1.1's password:


BusyBox v1.33.2 (2022-02-19 09:01:03 UTC) built-in shell


 _______                     ________        __
|       |.-----.-----.-----.|  |  |  |.----.|  |_
|   -   ||  _  |  -__|     ||  |  |  ||   _||   _|
|_______||   __|_____|__|__||________||__|  |____|
         |__| W I R E L E S S   F R E E D O M
 -----------------------------------------------------
 OpenWrt 21.02.1, r16325-88151b8303
 -----------------------------------------------------
root@OpenWrt:~# date
Sat Feb 26 04:13:28 UTC 2022
root@OpenWrt:~#
```



Busybox Ash 1/2

alias
ash
askfirst
awk
basename
bg
board_detect
brctl
break
bunzip2
busybox
bzcat
cat
cd
chdir
chgrp
chmod
chown
chroot
clear
cmp
command
config_generate
continue
cp
crond
crontab
cut
date
dbclient
dd
devstatus
df
dirname
dmesg
dnsmasq
dropbear
dropbearkey
du
echo
egrep
env
eval
exec
exit
export
expr
FALSE
fg
fgrep
find
firstboot
flock
free
fsync
fw3
fwtool
getopts
getrandom
grep
gunzip
gzip
halt
hash
head
hexdump
history
hostapd
hotplug-call
hwclock
id
ifconfig
ifdown
ifstatus
ifup
init
insmod
ip
ip6tables
ip6tables-restore
ip6tables-save
ipcalc.sh
iptables
iptables-restore
iptables-save
iw
iwinfo
jffs2mark
jffs2reset
jobs
jshn
jsonfilter
kill
killall
kmodloader
ldd
led.sh
less
let
ln
local
lock
logd
logger
login
logread
ls
lsmod
lua
lua5.1
luci-bwc
luci-reload
md5sum
mkdir
mkfifo
mknod
mkswap
mktemp
modinfo
modprobe

Busybox Ash 2/2

mount
mount_root
mtd
mv
nc
netifd
netmsg
netstat
nice
nslookup
ntpd
ntpd-hotplug
odhcp6c
odhcpd
odhcpd-update
opkg
opkg-key
passwd
pgrep
pidof
ping
ping6
pivot_root
poweroff
pppd
printf
procd
ps
pwd
px5g
read
readlink
readonly
reboot
reload_config
reset
return
rm
rmdir
rmmod
route
rpcd
scp
sed
seq
set
sh
sha256sum
shift
signify
sleep
sort
source
ssh
start-stop-daemon
strings
swapoff
swapon
swconfig
switch_root
sync
sysctl
sysupgrade
tail
tar
tee
test
time
times
top
touch
tr
traceroute
traceroute6
trap
TRUE
type
ubus
ubusd
uci
uclient-fetch
udevtrigger
udhcpc
uhttpd
ulimit
umask
umount
unalias
uname
uniq
unset
upgraded
uptime
urandom_seed
urngd
usign
validate_data
vi
wait
wc
wget
which
wifi
wpa_supplicant
wpad
xargs
xtables-legacy-multi
yes
zcat

Files in: /etc/config/

```
root@OpenWrt:/etc/config# ls -l
-rw-------    1 root     root           959 Oct 24 09:01 dhcp
-rw-------    1 root     root           134 Oct 24 09:01 dropbear
-rw-------    1 root     root          4632 Oct 24 09:01 firewall
-rw-r--r--    1 root     root           862 Oct 24 09:01 luci
-rw-------    1 root     root           599 Oct 24 14:31 network
-rw-------    1 root     root           167 Oct 24 09:01 rpcd
-rw-------    1 root     root           623 Oct 24 09:01 system
-rw-r--r--    1 root     root           788 Oct 24 09:01 ucitrack
-rw-------    1 root     root           783 Oct 24 09:01 uhttpd
-rw-r--r--    1 root     root           306 Oct 24 11:43 wireless
```

$ cat /etc/config/network ~ Original

```
config interface 'loopback'
    option device 'lo'
    option proto 'static'
    option ipaddr '127.0.0.1'
    option netmask '255.0.0.0'

config globals 'globals'
    option ula_prefix 'fd15:95fb:7907::/48'

config device
    option name 'br-lan'
    option type 'bridge'
    list ports 'eth0.1'

config interface 'lan'
    option device 'br-lan'
    option proto 'static'
    option ipaddr '192.168.1.1'
    option netmask '255.255.255.0'
    option ip6assign '60'
```

```
config switch
    option name 'switch0'
    option reset '1'
    option enable_vlan '1'

config switch_vlan
    option device 'switch0'
    option vlan '1'
    option ports '0 1 2 3 5t'
```

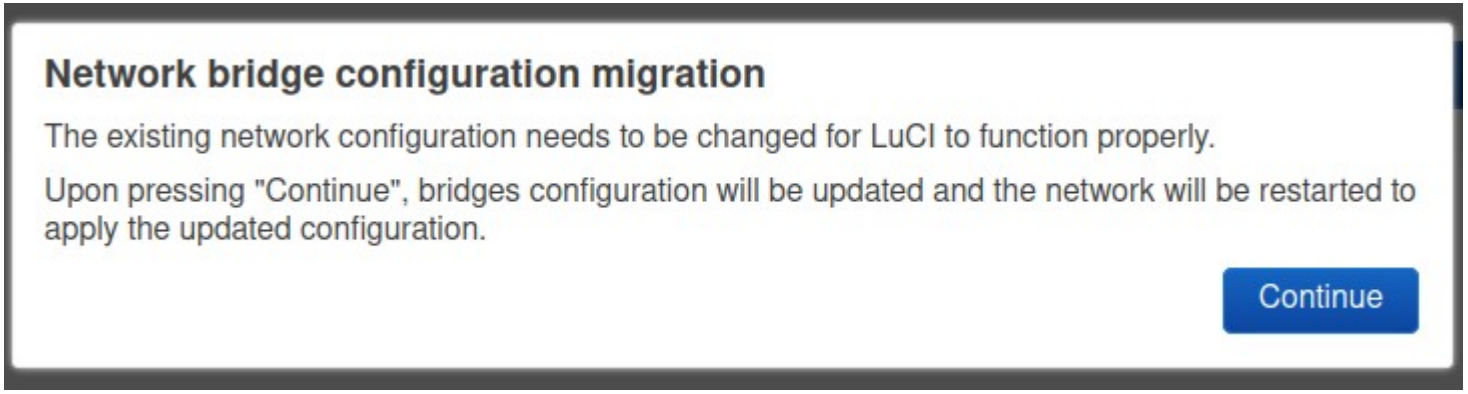
$ cat /etc/config/network ~ Suggested

```
config interface loopback
        option ifname   lo
        option proto    static
        option ipaddr   127.0.0.1
        option netmask  255.0.0.0

config interface lan
        option type     bridge
        option ifname   eth0.1
        option proto    static
        option ipaddr   192.168.1.1
        option netmask  255.255.255.0

config interface wan
        option ifname   eth0.2
        option proto    dhcp

config switch eth0
    option enable   1
    option reset    1
    option enable_vlan 1
```

```
config switch_vlan
    option device   eth0
    option vlan     1
    option ports    "0 1 2 5t"

config switch_vlan
    option device   eth0
    option vlan     2
    option ports    "3 5t"
```

Suggested config/network
https://openwrt.org/toh/huawei/hg556a#switch_ports_for_vlans

LuCI Network --> Interfaces

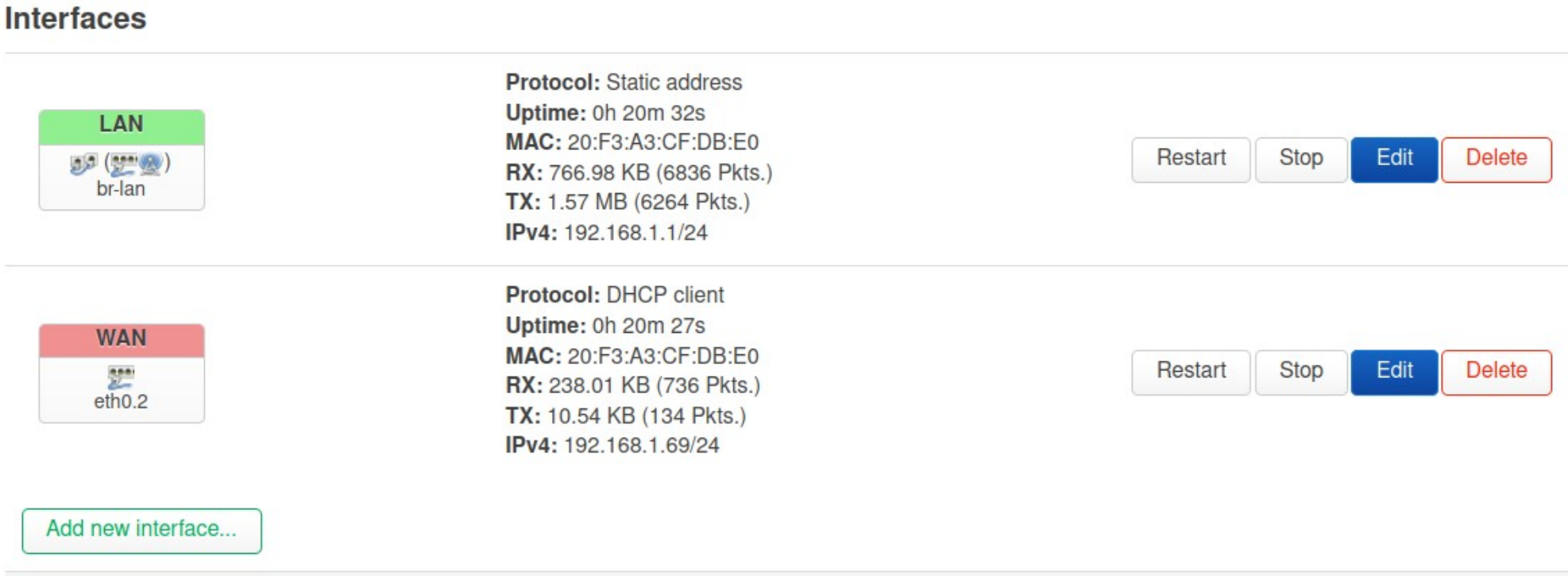


$ cat /etc/config/network ~ After LuCI mod

```
config interface 'loopback'
    option proto 'static'
    option ipaddr '127.0.0.1'
    option netmask '255.0.0.0'
    option device 'lo'

config interface 'lan'
    option proto 'static'
    option ipaddr '192.168.1.1'
    option netmask '255.255.255.0'
    option device 'br-lan'

config interface 'wan'
    option proto 'dhcp'
    option device 'eth0.2'

config switch 'eth0'
    option enable '1'
    option reset '1'
    option enable_vlan '1'
```

```
config switch_vlan
    option device 'eth0'
    option vlan '1'
    option ports '0 1 2 5t'

config switch_vlan
    option device 'eth0'
    option vlan '2'
    option ports '3 5t'

config device
    option name 'br-lan'
    option type 'bridge'
    list ports 'eth0.1'
```

LuCI Network --> Interfaces



LuCI Network --> Switch

Switch eth0 has an unknown topology - the VLAN settings might not be accurate. Dismiss

Switch

The network ports on this device can be combined to several VLANs in which computers can communicate directly with each other. VLANs are often used to separate different network segments. Often there is by default one Uplink port for a connection to the next greater network like the internet and other ports for a local network.

Switch "eth0"

VLANs on "eth0"

VLAN ID	Description	Port 1	Port 2	Port 3	Port 4	Port 5	CPU (eth0)	
Port status:		 100baseT full-duplex	 no link	 no link	 100baseT full-duplex	 no link	 100baseT full-duplex	
1		untagge	untag	untag	off	off	tagged	Delete
2		off	off	off	untagge	off	tagged	Delete

$ cat /etc/config/wireless

```
config wifi-device 'radio0'
    option type 'mac80211'
    option channel '11'
    option hwmode '11g'
    option path
'pci0000:00/0000:00:01.0'
    option htmode 'HT20'

config wifi-iface 'default_radio0'
    option device 'radio0'
    option network 'lan'
    option mode 'ap'
    option ssid 'OpenWrt'
    option encryption 'none'
```

LuCI Network --> Wireless

Wireless Overview

radio0 — **Generic MAC80211 802.11bgn**
Channel: 11 (2.462 GHz) | **Bitrate:** 104 Mbit/s
[Restart] [Scan] [Add]

-71 dBm — **SSID:** OpenWrt | **Mode:** Master
BSSID: 20:F3:A3:CF:DB:E1 | **Encryption:** None
[Disable] [Edit] [Remove]

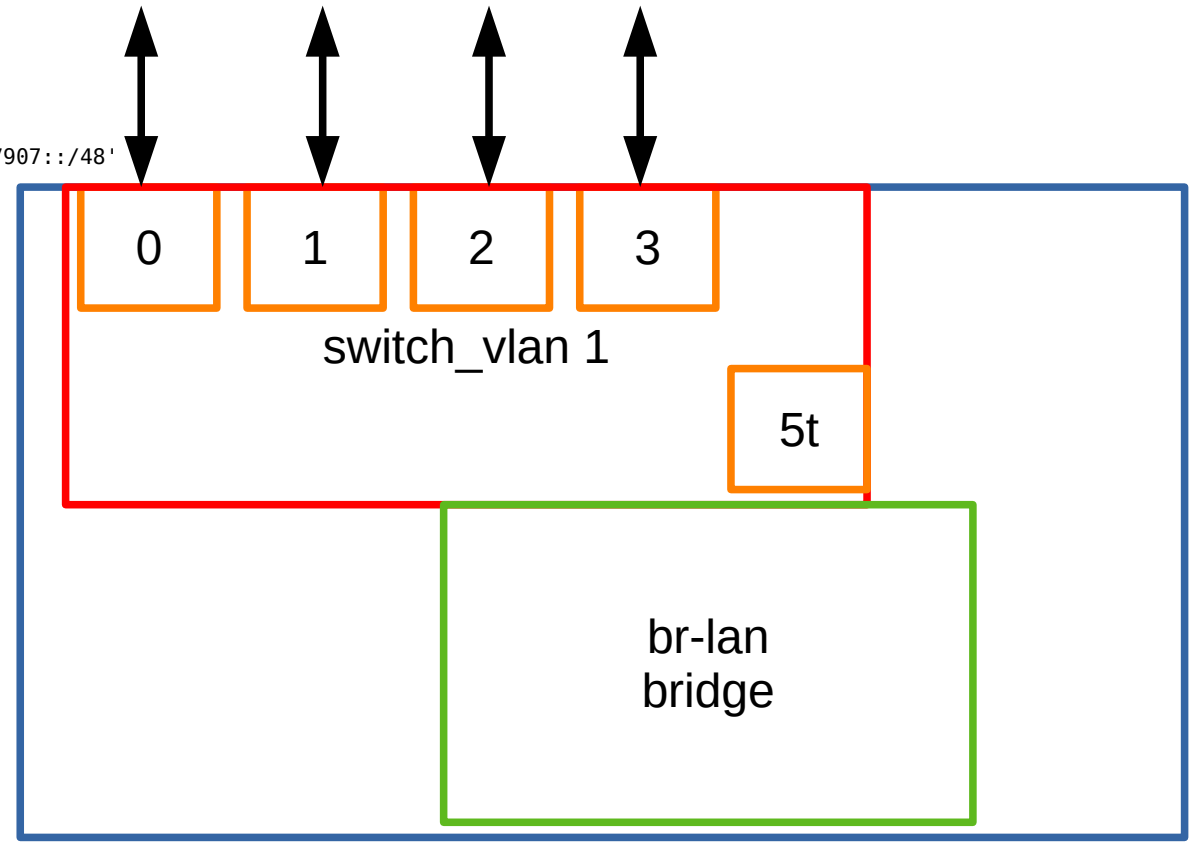
Associated Stations

Network	MAC address	Host	Signal / Noise	RX Rate / TX Rate	
Master "OpenWrt" (wlan0)	D0:37:45:AB:F4:94	fe80::9795:d44:f834:9beb	-71 dBm	65.0 Mbit/s, 20 MHz, MCS 7 78.0 Mbit/s, 20 MHz, MCS 12	Disconnect

[Save & Apply ▾] [Save] [Reset]

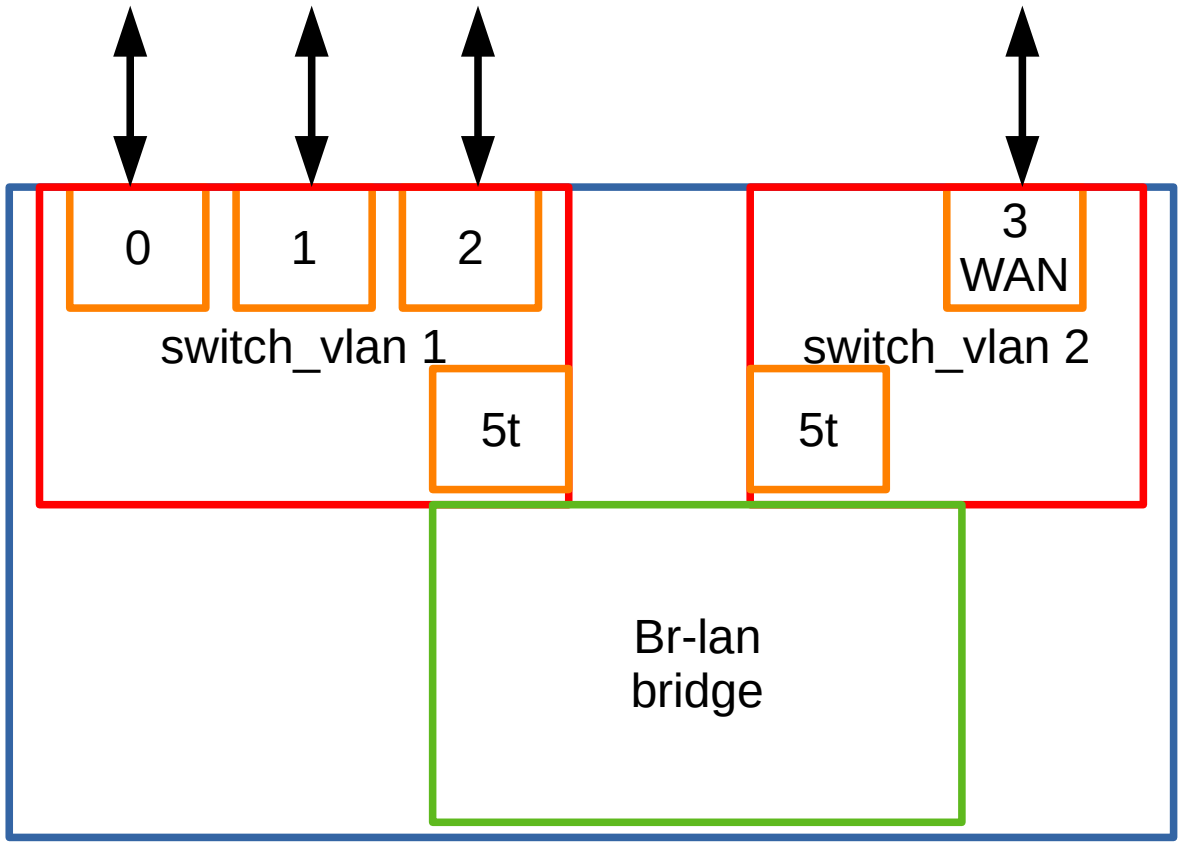
OpenWrt – Original Network block diagram?

```
cconfig interface 'loopback'
        option device 'lo'
        option proto 'static'
        option ipaddr '127.0.0.1'
        option netmask '255.0.0.0'

config globals 'globals'
        option ula_prefix 'fd15:95fb:7907::/48'

config device
        option name 'br-lan'
        option type 'bridge'
        list ports 'eth0.1'

config interface 'lan'
        option device 'br-lan'
        option proto 'static'
        option ipaddr '192.168.1.1'
        option netmask '255.255.255.0'
        option ip6assign '60

config switch
        option name 'switch0'
        option reset '1'
        option enable_vlan '1'

config switch_vlan
        option device 'switch0'
        option vlan '1'
        option ports '0 1 2 3 5t'
```



OpenWrt – Network block diagram - WAN?

```
config interface 'loopback'
        option proto 'static'
        option ipaddr '127.0.0.1'
        option netmask '255.0.0.0'
        option device 'lo'

config interface 'lan'
        option proto 'static'
        option ipaddr '192.168.1.1'
        option netmask '255.255.255.0'
        option device 'br-lan'

config interface 'wan'
        option proto 'dhcp'
        option device 'eth0.2'

config switch 'eth0'
        option enable '1'
        option reset '1'
        option enable_vlan '1'

config switch_vlan
        option device 'eth0'
        option vlan '1'
        option ports '0 1 2 5t'

config switch_vlan
        option device 'eth0'
        option vlan '2'
        option ports '3 5t'

config device
        option name 'br-lan'
        option type 'bridge'
        list ports 'eth0.1'
```



OpenWrt Package Manager - opkg

```
root@OpenWrt:~# opkg

Package Manipulation:
    update          Update list of available packages
    upgrade <pkgs>      Upgrade packages
    install <pkgs>      Install package(s)
    configure <pkgs>    Configure unpacked package(s)
    remove <pkgs|regexp>    Remove package(s)
    flag <flag> <pkgs>  Flag package(s)
     <flag>=hold|noprune|user|ok|installed|unpacked (one per invocation)

Informational Commands:
    list            List available packages
    list-installed      List installed packages
    list-upgradable     List installed and upgradable packages
    list-changed-conffiles  List user modified configuration files
    files <pkg>     List files belonging to <pkg>
    search <file|regexp>    List package providing <file>
    find <regexp>       List packages whose name or description matches <regexp>
    info [pkg|regexp]   Display all info for <pkg>
    status [pkg|regexp] Display all status for <pkg>
    download <pkg>      Download <pkg> to current directory
```

opkg update

```
root@OpenWrt:~# opkg update
Downloading
https://downloads.openwrt.org/releases/21.02.1/targets/bcm63xx/generic/packages/
Packages.gz
Updated list of available packages in /var/opkg-lists/openwrt_core
Downloading
https://downloads.openwrt.org/releases/21.02.1/targets/bcm63xx/generic/packages/
Packages.sig
Signature check passed.
Downloading https://downloads.openwrt.org/releases/21.02.1/packages/mips_mips32/
base/Packages.gz
Updated list of available packages in /var/opkg-lists/openwrt_base
Downloading https://downloads.openwrt.org/releases/21.02.1/packages/mips_mips32/
base/Packages.sig
Signature check passed.
Downloading https://downloads.openwrt.org/releases/21.02.1/packages/mips_mips32/
luci/Packages.gz
Updated list of available packages in /var/opkg-lists/openwrt_luci
Downloading https://downloads.openwrt.org/releases/21.02.1/packages/mips_mips32/
luci/Packages.sig
Signature check passed.
Downloading https://downloads.openwrt.org/releases/21.02.1/packages/mips_mips32/
```

opkg list-upgadable

```
root@OpenWrt:~# opkg list-upgradable
luci-app-opkg - git-21.079.58598-6639e31 - git-21.312.69848-4745991
iw - 5.9-8fab0c9e-1 - 5.9-8fab0c9e-3
libuci20130104 - 2020-10-06-52bbc99f-5 - 2021-04-14-4b3db117-5
rpcd - 2021-03-11-ccb75178-1 - 2022-02-19-8d26a1ba-1
busybox - 1.33.1-6 - 1.33.2-2
luci-mod-system - git-21.295.66903-8acd0d7 - git-22.019.40321-7a37d02
libustream-wolfssl20201210 - 2020-12-10-68d09243-1 - 2022-01-16-868fd881-1
luci-theme-bootstrap - git-21.298.68362-d24760e - git-22.052.81802-2dba71e
wpad-basic-wolfssl - 2020-06-08-5a8b3662-35 - 2020-06-08-5a8b3662-39
netifd - 2021-07-26-440eb064-1 - 2021-10-30-8f82742c-1
procd - 2021-02-23-37eed131-1 - 2021-03-08-2cfc26f8-1
luci-mod-status - git-21.295.66779-853a128 - git-22.046.85784-0ac2542
luci-app-firewall - git-21.295.66767-8eceb63 - git-22.046.85957-59c3392
uci - 2020-10-06-52bbc99f-5 - 2021-04-14-4b3db117-5
rpcd-mod-file - 2021-03-11-ccb75178-1 - 2022-02-19-8d26a1ba-1
luci-base - git-21.295.67054-13df80d - git-22.052.50801-31a27f3
rt2800-pci-firmware - 20201118-3 - 20211216-1
rpcd-mod-iwinfo - 2021-03-11-ccb75178-1 - 2022-02-19-8d26a1ba-1
luci-mod-network - git-21.295.67048-4d3de0e - git-22.046.85061-dd54dce
hostapd-common - 2020-06-08-5a8b3662-35 - 2020-06-08-5a8b3662-39
wireless-regdb - 2021.04.21-1 - 2021.08.28-1
```

opkg upgade

```
root@OpenWrt:~# opkg upgrade procd
Upgrading procd on root from 2021-02-23-37eed131-1 to 2021-03-08-2cfc26f8-1...
Downloading https://downloads.openwrt.org/releases/21.02.1/packages/mips_mips32/
base/procd_2021-03-08-2cfc26f8-1_mips_mips32.ipk
Configuring procd.

root@OpenWrt:~# opkg upgrade luci-mod-status
Upgrading luci-mod-status on root from git-21.295.66779-853a128 to git-
22.046.85784-0ac2542...
Downloading https://downloads.openwrt.org/releases/21.02.1/packages/mips_mips32/
luci/luci-mod-status_git-22.046.85784-0ac2542_mips_mips32.ipk
Configuring luci-mod-status.
```

LuCI Software – All packages

Software

Free space:

93% (9.4 MB)

Filter: Type to filter… Clear

Download and install package: Package name or URL… OK

Actions: Update lists… Upload Package… Configure opkg…

Available | Installed | Updates

9322 Packages

« Displaying 1-100 of 9322 »

Package name	Version	Size (.ipk)	Description	
464xlat	12	5.2 KB	464xlat provides support to deploy limited IPv4 access services to mobile…	Install…
6in4	26	2.5 KB	Provides support for 6in4 tunnels in /etc/config/network.…	Install…
6rd	10	3.9 KB	Provides support for 6rd tunnels in /etc/config/network.…	Install…
6to4	13	1.9 KB	Provides support for 6to4 tunnels in /etc/config/network.…	Install…
UDPspeeder	20210116.0-2	82.9 KB	A Tunnel which Improves your Network Quality on a High-latency Lossy Link by using Forward Error Correction.for All Traffics(TCP/UDP/ICMP)	Install…

LuCI Software - Updates

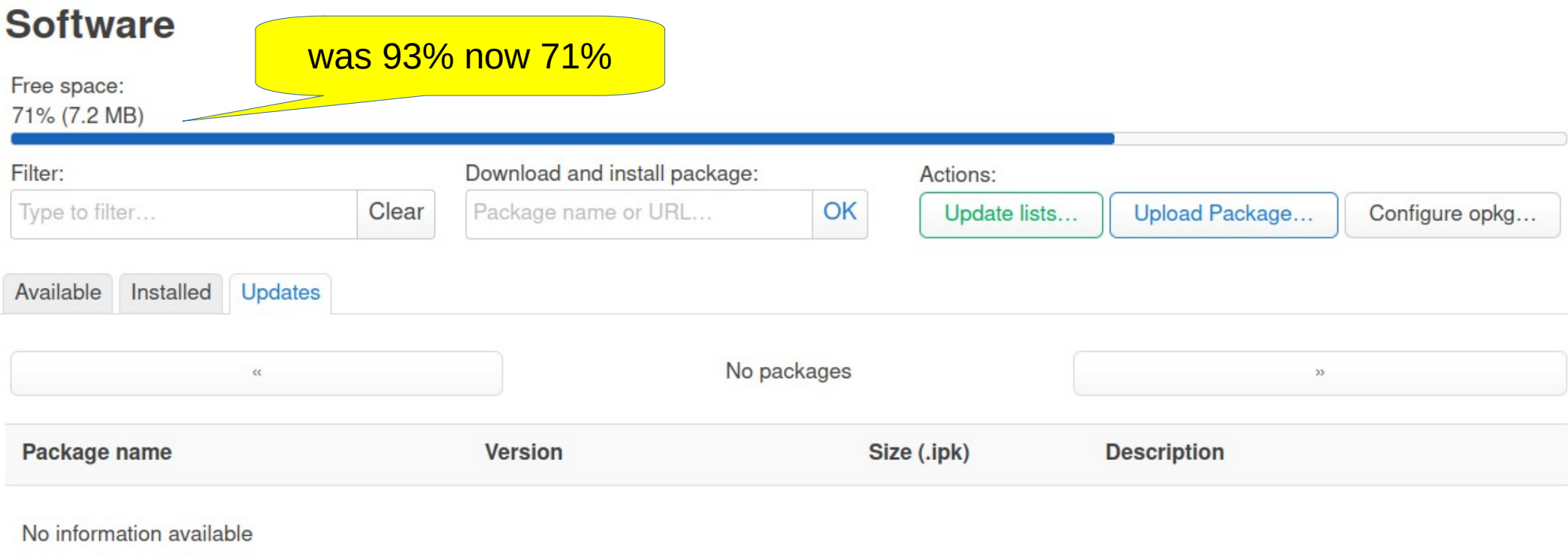
Available | Installed | Updates

21 Update Packages

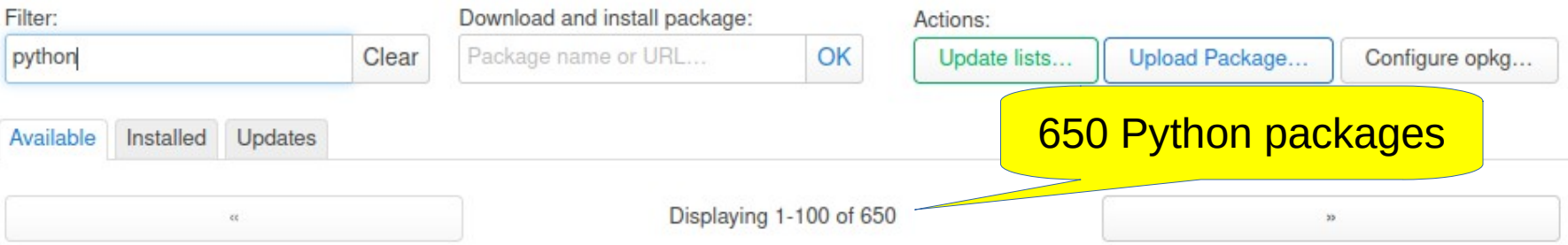
« Displaying 1-21 of 21 »

Package name	Version	Size (.ipk)	Description	
busybox	1.33.1-6 » 1.33.2-2	~249.0 KB	The Swiss Army Knife of embedded Linux....	Upgrade...
hostapd-common	2020-06-08-5a8b3662-35 » 2020-06-08-5a8b3662-39	~12.3 KB	hostapd/wpa_supplicant common support files	Upgrade...
iw	5.9-8fab0c9e-1 » 5.9-8fab0c9e-3	~45.2 KB	cfg80211 interface configuration utility	Upgrade...
libuci20130104	2020-10-06-52bbc99f-5 » 2021-04-14-4b3db117-5	~18.2 KB	C library for the Unified Configuration Interface (UCI)	Upgrade...
libustream-wolfssl20201210	2020-12-10-68d09243-1 » 2022-01-16-868fd881-1	~4.9 KB	ustream SSL Library (wolfssl)	Upgrade...
luci-app-firewall	git-21.295.66767-8eceb63 » git-22.046.85957-59c3392	~15.0 KB	Firewall and Portforwarding application	Upgrade...
luci-app-opkg	git-21.079.58598-6639e31 » git-21.312.69848-4745991	~9.3 KB	OPKG package management application	Upgrade...
luci-base	git-21.295.67054-13df80d » git-22.052.50801-31a27f3	~131.3 KB	LuCI core libraries	Upgrade...
luci-mod-network	git-21.295.67048-4d3de0e » git-22.046.85061-dd54dce	~47.1 KB	LuCI Network Administration	Upgrade...

LuCI Software – Updates complete



LuCI Software – Python



Package name	Version	Size (.ipk)	Description	
python-pip-conf	0.1-1	931 B	Configuration file for pip/pip3	Install…
python3	3.9.10-1	1.1 KB	This package contains the (almost) full Python install.…	Install…
python3-aiohttp	3.7.4-1	644.2 KB	Asynchronous HTTP client/server framework for asyncio and Python3.	Install…
python3-aiohttp-cors	0.7.0-2	18.1 KB	Implements Cross Origin Resource Sharing (CORS) support for aiohttp asyncio-powered asynchronous HTTP server.	Install…
python3-aiohttp-cors-src	0.7.0-2	10.0 KB	Implements Cross Origin Resource Sharing (CORS) support for aiohttp asyncio-powered asynchronous HTTP server.…	Install…
python3-aiohttp-src	3.7.4-1	138.2 KB	Asynchronous HTTP client/server framework for asyncio and Python3.…	Install…
python3-apipkg	1.5-2	6.3 KB	apipkg is used to control the exported namespace of a Python package and	Install…

opkg Python

```
root@OpenWrt:~# opkg list-installed | grep python
libpython3-3.9 - 3.9.10-1
python3-base - 3.9.10-1
python3-light - 3.9.10-1
python3-urllib - 3.9.10-1
root@OpenWrt:~#
root@OpenWrt:~# python
Python 3.9.10 (main, Feb 19 2022, 09:01:03)
[GCC 8.4.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> help("modules")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/usr/lib/python3.9/_sitebuiltins.py", line 102, in __call__
ModuleNotFoundError: No module named 'pydoc'
>>> import sys
>>> sys.version
'3.9.10 (main, Feb 19 2022, 09:01:03) \n[GCC 8.4.0]'
>>>
```

4 Python packages

Need to install python3-pydoc

OpenWrt - Demo

Demo

- SSH into OpenWrt
- Browser view of LuCI server.