

Building MESHdesk firmware using the LEDE Project

What is the LEDE Project?

The LEDE project is founded as a spin-off of the OpenWrt project and shares many of the same goals. We are building an embedded Linux distribution that makes it easy for developers, system administrators or other Linux enthusiasts to build and customize software for embedded devices, especially wireless routers. The name LEDE stands for Linux Embedded Development Environment.

Why are you advocating LEDE Project instead of OpenWrt?

- The LEDE project is endorsed by communities that share common interests to MESHdesk (eg Mesh networks)
- The LEDE project is active and dynamic.

Preparing the environment

- We assume you have a standard install of the Ubuntu 16.04 operating system.
- You need to install certain required packages which the LEDE build environment needs to function correct.

```
sudo apt-get update
sudo apt-get install build-essential subversion git-core libncurses5-dev
zlib1g-dev gawk flex quilt libssl-dev xsltproc libxml-parser-perl unzip
mercurial
```

Check out the code

- We will use the **17.0.1 release** of LEDE which is the first stable release of the LEDE Project.



- Please note that we use the **release 17.0.1** and not the **lede-17.01 branch**.
- Refer to this URL for the different releases and branches:
<https://github.com/lede-project/source/>

```
cd ~
mkdir lede
cd lede
git clone https://git.lede-project.org/source.git
#To see the tags (releases)
```

```
git fetch --tags
git tag -l
#Checkout the 17.0.1 release
git checkout v17.01.0
```

- This will create a folder called **source** where the build environment resides.



Please refrain from using the current development branch or even the lede-17.01 branch since something in that code breaks the Batman-adv mesh in the MESHdesk firmware making it useless.

Installing the packages

- Update the feeds:

```
./scripts/feeds update
```

- Install the following MESHdesk specific packages:

```
./scripts/feeds install coova-chilli
./scripts/feeds install luasocket
./scripts/feeds install libuci-lua
./scripts/feeds install curl
./scripts/feeds install -a -p routing
./scripts/feeds install iwinform
./scripts/feeds install alfred
```

- You might get some warnings when you install these packages.
 - They are non-critical except if you might want to include ssl support with CoovaChilli.
 - The other warning is if you might want to include GPS support with Alfred

```
Installing package 'coova-chilli' from packages
WARNING: No feed for package 'libmatrixssl' found, maybe it's already part
of the standard packages?
```

```
Installing package 'alfred' from routing
WARNING: No feed for package 'libgps' found, maybe it's already part of the
standard packages?
```

Adding the MESHdesk package

- MESHdesk is now very easy to add since it is simply an LEDE package which can be selected.
- Check out the current development MESHdesk code from SVN

svn checkout

```
svn://dvdwalt@svn.code.sf.net/p/radiusdesk/code/trunk/meshdesk/MESHdesk
./MESHdesk
```

- Make a tar file of the code:

```
tar -czvf MESHdesk.tar.gz ./MESHdesk
```

- Change directory to the LEDE **source** code:

```
cd ./source
```

- Create a directory called **zzz-MESHdesk** with a sub directory called **files** under the **package** directory.

```
mkdir -p ./package/zzz-MESHdesk/files
```

- Copy the MESHdesk.tar.gz file to the **./package/zzz-MESHdesk/files** directory.

```
cp [where ever you file is]/MESHdesk.tar.gz ./package/zzz-MESHdesk/files
```

- Change directory to the ./package/zzz-MESHdesk/files directory and extract the file.

```
cd ./package/zzz-MESHdesk/files
```

```
tar -xzvf MESHdesk.tar.gz
```

- Move the **Makefile** to be under the **zzz-MESHdesk** directory.

```
mv ./MESHdesk/Makefile ../
```

- The MESHdesk code also include a **password** and **shadow** file with a user **root** and password **admin**.
- To include that in the firmware you need to do the following:
 - Create a **files** directory under the **source** directory.
 - Create a directory structure similar to what you want on the firmware
 - Add the files in these directories
- Change directory to the LEDE **source** code:

```
cd ./source
```

```
mkdir -p files/etc
```

```
cp ./package/zzz-MESHdesk/files/MESHdesk/files/common/passwd ./files/etc
```

```
cp ./package/zzz-MESHdesk/files/MESHdesk/files/common/shadow ./files/etc
```

- Should you wish to get an existing build environment's MESHdesk package updated to the latest SVN:



```
cd ./source
```

```
cd ./package/zzz-MESHdesk/files/MESHdesk
```

```
svn update
```

```
#It will mention that it restored the Makefile
```

```
#Restored 'Makefile'
```

```
cd ../
```



```
mv ./MESHdesk/Makefile ../
```

Tweaking MESHdesk package

MediaTek or Atheros

- We now support both MediaTek and Atheros based devices.
- This enables MESHdesk firmware to run on a whole lot of additional devices.
- The MediaTek devices are typically cheaper when compared to the Atheros based devices.
- We even got the MediaTek devices to mesh on 802.11AC!

- When you compile for MediaTek, replace the **dhcp_network_one_eth** with **dhcp_network_one_eth_mediatek** and the **frmwr_network_one_eth** with **frmwr_network_one_eth_mediatek**.
- When you compile for Atheros, replace the **dhcp_network_one_eth** with **dhcp_network_one_eth_atheros** and the **frmwr_network_one_eth** with **frmwr_network_one_eth_atheros**.

```
#Compiling MediaTek
cd ./source
cp ./package/zzz-
MESHdesk/files/MESHdesk/configs/dhcp_network_one_eth_mediatek ./package/zzz-
MESHdesk/files/MESHdesk/configs/dhcp_network_one_eth
cp ./package/zzz-
MESHdesk/files/MESHdesk/configs/frmwr_network_one_eth_mediatek
./package/zzz-MESHdesk/files/MESHdesk/configs/frmwr_network_one_eth

#Compiling Atheros
cd ./source
cp ./package/zzz-
MESHdesk/files/MESHdesk/configs/dhcp_network_one_eth_atheros ./package/zzz-
MESHdesk/files/MESHdesk/configs/dhcp_network_one_eth
cp ./package/zzz-
MESHdesk/files/MESHdesk/configs/frmwr_network_one_eth_atheros ./package/zzz-
MESHdesk/files/MESHdesk/configs/frmwr_network_one_eth
```



- Please take care to do the steps above or else you could render your firmware **useless** if it is using the wrong file!

HTTP or HTTPS

- We also support both **HTTPS** and **HTTP** when the device fetch and report its settings to the back-end.

- To use HTTPS instead of the default **HTTP** edit the meshdesk config file

```
vi ./package/zzz-MESHdesk/files/MESHdesk/meshdesk
```

- Change the protocol to **https**.

```
config internet 'internet1'  
    option dns 'rd01.wificity.asia'  
    option url 'cake2/rd_cake/nodes/get_config_for_node.json'  
    option status_url 'cake2/rd_cake/mesh_reports/submit_report.json'  
    option actions_url 'cake2/rd_cake/node_actions/get_actions_for.json'  
    option ap_url 'cake2/rd_cake/aps/get_config_for_ap.json'  
    option ap_status_url 'cake2/rd_cake/ap_reports/submit_report.json'  
    option ap_actions_url  
'cake2/rd_cake/ap_actions/get_actions_for.json'  
    option protocol 'https'  
    option ip '192.168.99.1'
```

Identity interface

- The following step is only required on some TP Link devices. Notably those who has Gigabit Ethernet ports.
- On these devices the LAN is connected to **eth1** instead of the usual **eth0**.
- We know of the **TP-Link WR1043ND** and also the **Archer** models that have this issue.

```
vi ./package/zzz-MESHdesk/files/MESHdesk/meshdesk
```

- Edit the following and change:

```
option id_if 'eth0'
```

- To

```
option id_if 'eth1'
```

Default mode

- The MESHdesk firmware currently supports three modes.
- They are:
 - **off** → The MESHdesk package is not active
 - **mesh** → The device will contact the **MESHdesk** applet and are managed as a mesh node.
 - **ap** → The device will contact the **APdesk** applet and are managed as a member of one of the AP Profiles.

```
vi ./package/zzz-MESHdesk/files/MESHdesk/meshdesk
```

- These are specified as an option under the **settings** section.

```
option gw_auto_reboot_time '600'  
option mode 'mesh'
```

```
option id_if 'eth0'
```

Preset for a certain model and server

- Should you wish to already have the firmware setup when you flash it (As needed for Over The Air OTA upgrades) check the following additional items.
- Specify the server it is pointing to

```
vi ./package/zzz-MESHdesk/files/MESHdesk/meshdesk
```

- Under **internet1** the value of **ip**
- Under **settings** the value of **hardware** should specify the correct value of the model you use. Available options are in the same file.
- Then you need to specify a system config file to define the LED we will use to indicate the mesh traffic

```
vi ./files/etc/config/system
```

- Use this as a reference.

```
config system
    option ttylogin '0'
    option log_size '64'
    option urandom_seed '0'
    option timezone 'SAST-2'
    option hostname '505'

config timeserver 'ntp'
    option enabled '1'
    option enable_server '0'
    list server '0.lede.pool.ntp.org'
    list server '1.lede.pool.ntp.org'
    list server '2.lede.pool.ntp.org'
    list server '3.lede.pool.ntp.org'

config led 'wifi_led'
    option name 'wifi'
    option trigger 'netdev'
    option dev 'bat0'
    option mode 'link tx rx'
    option sysfs 'zbt-wa05:blue:air'
```

- Now the tweaks are completed we can select the packages to include.

Selecting the packages

- Enter the following command in the directory which you checked the code out:

make menuconfig

- This will open a cursors interface which allows you to specify certain selections to include with the firmware build.
- Along with this you also need to select the architecture and or board combination of the firmware you are planning to build.
- It seems the package selection get lost if you switch between architectures.
- Make sure that when you build for another architecture the packages are still selected.
- Some packages are actually optional, depending on how you user **MESHdesk** and **APdesk**. We recommend though that you include all of the packages in the list where possible. The optional packages which can be left out are the the following:
 - **Coova Chilli** - Not having this package will remove the captive portal functionality.
 - **OpenVPN** - Not having this package will remove the ability to set up OpenVPN tunnel exit points.
 - **wpad** - By using the default **wpad-mini** you will not have WPA2 Enterprise security available on the SSIDs.
- Select the following packages as build-in when preparing the firmware:



We recommend that you include all of the packages in the list where possible. 😊

Package	Detail
Languages → lua	Embedded lightweight scripting language
Languages → luasocket	We need this library for precision timing
libraries → libuci-lua	Interface library for lua scripting language to UCI system
Kernel modules → Network support → batman-adv	used for the mesh
Network → alfred	used to communicate over the mesh
Network → batctl	User space configuration tool
Network → Captive Portals → coova-chilli	Captive portal for the breakout points
Network → File Transfer → Curl	A Client side URL Transfer utility
Network → VPN → OpenVPN PolarsSSL	OpenVPN package for OpenVPN brige exit point - You can also use OpenVPN OpenSSL
Network → wpad	use this instead of wpad-mini to allow WPA Enterprise suport
Utilities → iwinfo	Handy utility to get Wifi info instead of iw
Base system → zzz-MESHdesk	The package we checked out and added manually from SVN

Support for 3G/4G dongles



- We are once again taking the lead with new features.
- Lets see **when and if** the commercial guys will follow with 3G/4G support since it requires additional hardware.

- If you want to add support for 3G/4G dongles as an alternative to Ethernet based Internet be

sure to include the following packages.

Package	Detail
Utilities → comgt	Used to create chat scripts to connect to mobile network
Kernel modules → USB support → kmod-usb-serial	Required for USB data transfer
Kernel modules → USB support → kmod-usb-serial-option	Required for USB data transfer
Kernel modules → USB support → kmod-usb-serial-wwan	Required for USB data transfer
Kernel modules → USB support → kmod-usb2	Required for USB support in device
Utilities → usb-modeswitch	Required to switch the mode of the USB stick from storage to modem

Atheros based 802.11AC

- If you build firmware for hardware that includes the **ATH10K** driver, be sure to also include the binary blob firmware package.
- The following table can be used as a reference

Hardware	Firmware Package
Yuncore XD3200	ath10k-firmware-qca988x

Support for WiFi Client Internet connection



- We are once again taking the lead with new features.
- This might take the others a bit quicker to catch up with us since it does not require additional hardware.

- If you want to add support for WiFi Client Internet connection as an alternative to Ethernet based Internet be sure to include the following package.

Package	Detail
Network → Routing and Redirection → relayd	Used to bridge the WiFi Station interface with the LAN

Removing unused packages

- Some devices that we flash the MESHdesk firmware on have limited space on the flash chip. These devices typically have only 4M flash.
- We then need to remove as much of the packages we do not need in order for our firmware to fit on the chip.

Package	Detail
Network → odhcp6c	No need for DHCP client v6
Network → odhcpd	No need for DHCP server v6
Network → ppp	No need for PPP

Package	Detail
Kernel modules → Network Support → kmod-ppp	No need for PPP
Network → wpad	Use wpad-mini instead (This forfeit WPA Enterprise suport)



The only way we could manage to fit everything on a 4M device was to replace **wpad** again with **wpad-mini** (This on Chaos Calmer)

Building the firmware

- You should now be able to build the firmware using the following command inside the build directory

```
make V=99
```

- The build process can take long especially if you have a slow machine with a slow Internet connection so put at least 12 hours aside for this.

What next?

- After the firmware has been build you can now flash it onto the device. Please see the specific pages related to the specific hardware.

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