ICTP 2012
Mesh Networking Lab

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last updated: Feb 2012

Lab

- Flashing a wireless device
- OpenWRT based mesh nodes – on mixed hardware (Linksys WRT54G, Ubiquiti Pico, NanoStation & Bullet)
- Routing protocol: OLSR

- Optional: Trying B.A.T.M.A.N., 802.11s
- Optional: Running olsrd on a PC/laptop
- Optional: Running batmand on a PC/laptop
- Optional: Android phone mesh / servalproject.org

Flashing

- ***Flashing*** a wireless device means ***replacing its firmware with an alternative firmware***
- Methods for flashing:

  1) Through web GUI – often works for devices in default state.
  2) via tftp – when the web GUI does not work
  3) if all that fails – via serial ports, soldering etc
  4) if nothing works: you have a *brick :)*

Choosing firmware

- **Find out exactly what hardware model and hardware revision you have**
- **Find the right firmware accordingly and verify that it will run**

Examples of firmware:

OpenWRT – list of supported hardware:

http://wiki.openwrt.org/toh/start

We will use a variety of Ubiquiti devices, so check http://wiki.openwrt.org/toh/start#ubiquiti

- **Freifunk http://wiki.freifunk.net/Freifunk_Firmware_%28English%29**

Classical Freifunk firmware was targetted at Linksys WRT54G and similar devices

Newest Freifunk software comes as packages to be installed under OpenWRT. Kamikaze/Builder allows for creation of packages for all hardware platforms supported by OpenWRT Kamikaze

OpenWRT versions for Ubiquiti

- **Look at**

  http://wiki.openwrt.org/toh/start#ubiquiti

  to find

  Ubiquiti Nanostation2, Bullet2 -

  http://downloads.openwrt.org/kamikaze/8.09.2/atheros/openwrt-atheros-ubnt2-squashfs.bin

  Ubiquiti Picostation2 -

  http://downloads.openwrt.org/backfire/10.03.1/atheros/openwrt-atheros-ubnt2-pico2-squashfs.bin

Flashing a wireless device via Web interface

- **Have firmware ready on your computer**
- **Find out the device's default IP**
- **Set your own computers IP accordingly (same network, different IP)**
- **Connect to the device's original web interface (see: Access Point configuration) and find the "Firmware Update" button, or similar, if there is any**
- **Use this to upload and install new firmware**

- **NOW: REMEMBER TO WAIT!**
  DO NOT PRESS CONTINUE WHEN IT SHOWS!!! DONT!!!
  WAIT UNTIL THE LEDS STOP BLINKING!
  TYPICALLY 4-6 MINUTES!
- **MAKE SURE YOU HAVE STABLE POWER WHILE DOING THIS!**

  IF YOU DO NOT TRUST GRID POWER, USE A BATTERY!

Flashing a wireless device via tftp

- Connect the device to your computer via ethernet cable.
- Set your computer to be 192.168.1.x, but not 192.168.1.20 (which is the Ubiquiti default IP)
- Power down the device.
- Power it back up, while at the same time holding the reset button, for about 10 seconds.
- By now, the second LED should be flashing green, and the device be pingable on 192.168.1.20
- The device is now waiting for a tftp transfer. It might look like this:

```
sb@sb-laptop:~$ tftp
tftp> connect 192.168.1.20
tftp> binary
tftp> put <firmware-filename>.bin
Sent 2989541 bytes in 13.2 seconds
```

- Remember to be patient – Dont interrupt it.
- MAKE SURE YOU HAVE STABLE POWER WHILE DOING THIS!

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Working with OpenWRT

- **OpenWRT comes with the LuCi webGUI**
- **Go to webgui, default is http://192.168.1.1**
- **Set password!**

- **Alternative: instead of using the GUI, use ssh & command line**

  If not, set up a root password in the device:
  telnet 192.168.1.1
  passwd
- **ssh into the device using the root password you've just entered**

Adding software packages to OpenWRT

- **Note you will need to have your device connected to the internet, so you may need a switch, and good idea how to connect :)**

  Hint: you could set the device to receive a DHCP lease, or set a static IP – while you do this, you might wanna connect to the device wirelessly.
  Once you are done, you can use the newly configured ethernet connection to connect to it.

  But this also means, we need to start coordinating within our group:

  192.168.4.2-50
  is free for static addresses

  192.168.4.49 = Sebastian
  192.168.4.48 =
  192.168.4.47 =
  192.168.4.46 =
  192.168.4.45 =
  192.168.4.44 =
  192.168.4.43 =

Adding software packages to OpenWRT

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- **Add packages you need, e.g.**

  for OLSR:

  ```
  opkg install luci-app-olsr
  ```

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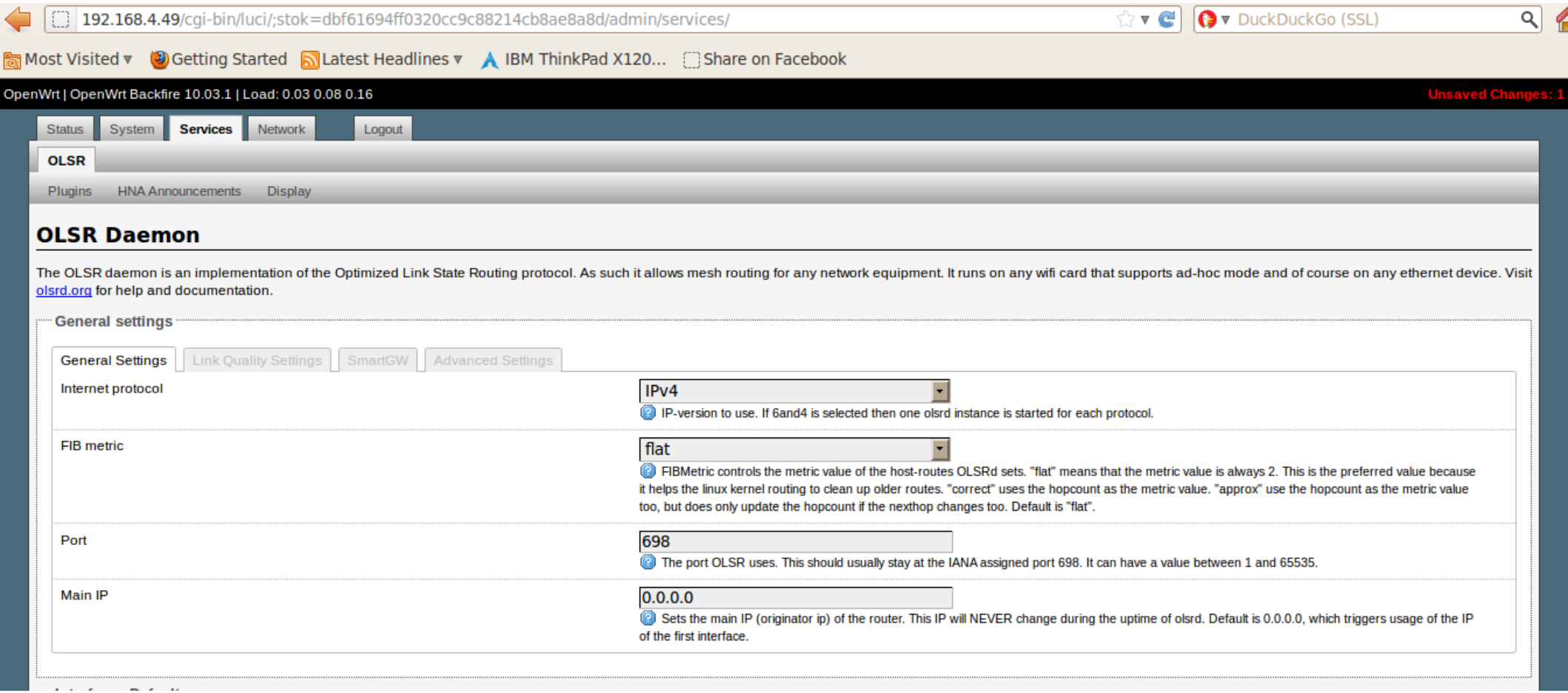
Configuring OLSR in OpenWRT

- **When olsr is installed,**
  in the web gui, go to Services, and configure OLSR



http://wiki.ubnt.com/OLSR_on_OpenWrt
http://wiki.openwrt.org/inbox/mesh.olsr

- **You can also do all this without the GUI! In /etc/olsrd.conf**

Configuring OLSR in OpenWRT - agreements

- **We need to agree on some settings:**

  IP settings: wired side: e.g.

  192.168.4.3x with x = number of group

  wireless side: e.g.

  10.0.0.x with x = number of group

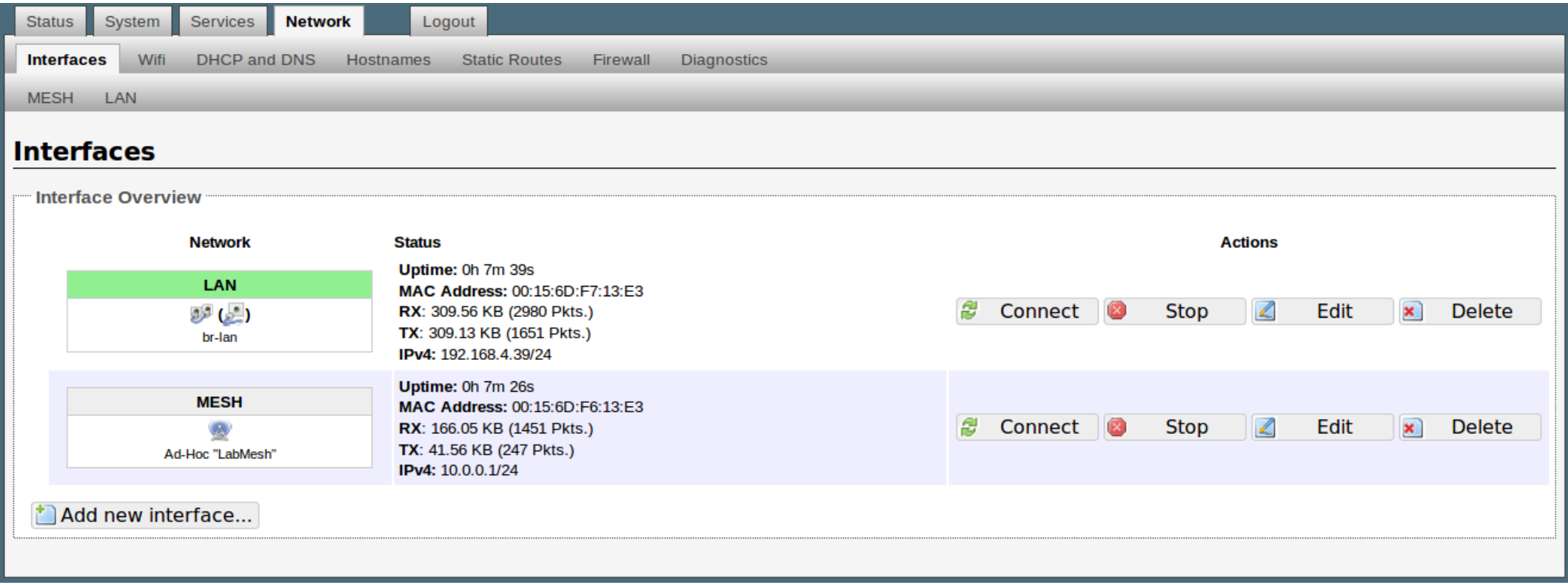
  SSID = LabMesh
  channel 1
  BSSID = 00:CA:FF:EE:BA:BE

  Remember to enable OLSR on the right interface!

Configuring OLSR in OpenWRT – step 1

- **> Network > Interfaces**

Create a logical interface, configure IP settings, name it as you like. Mine is called “MESH”.

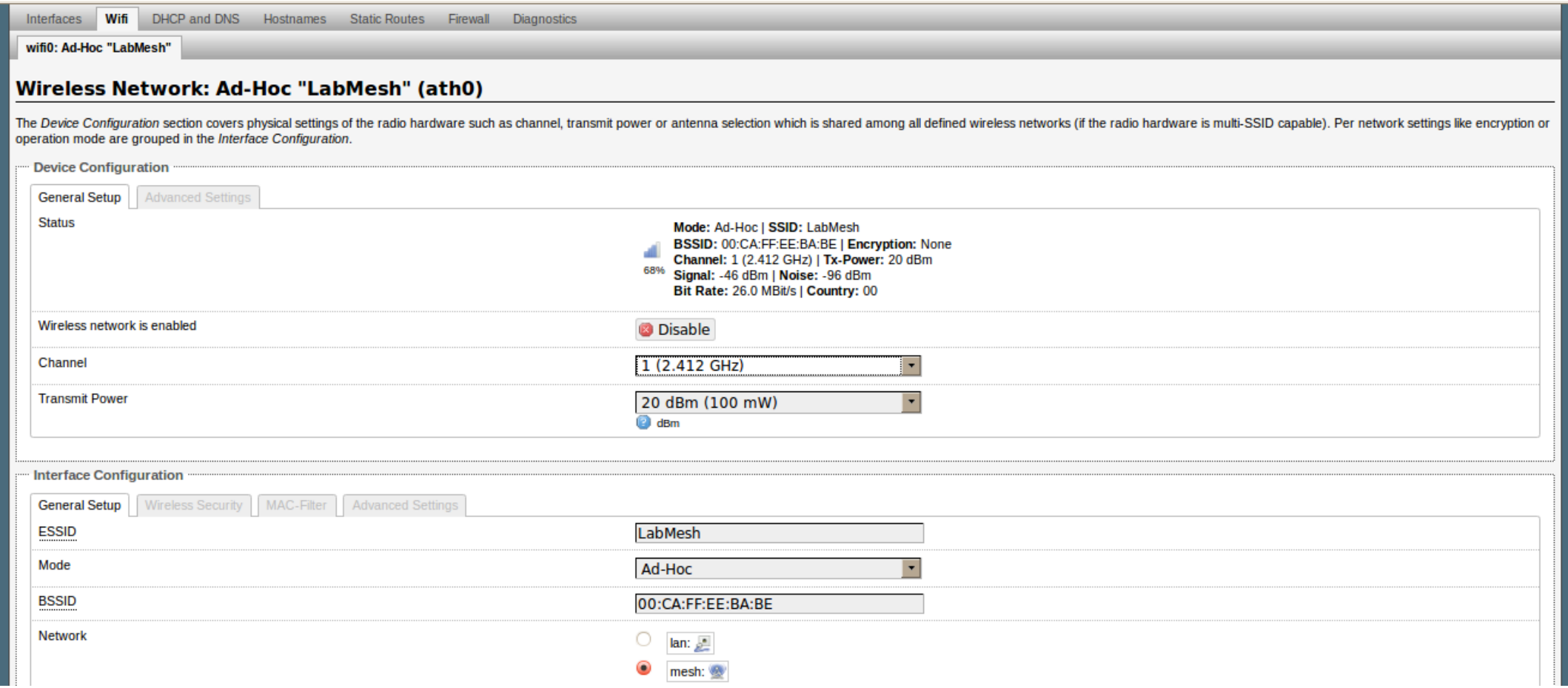


Configuring OLSR in OpenWRT – step 2

- **> Network > Wifi**

  Configure the wireless interface -
  in my case (Ubiquiti Picostation) it is a Atheros 802.11bg Wireless Controller (wifi0) -
  to use right SSID, Channel, Output power, etc

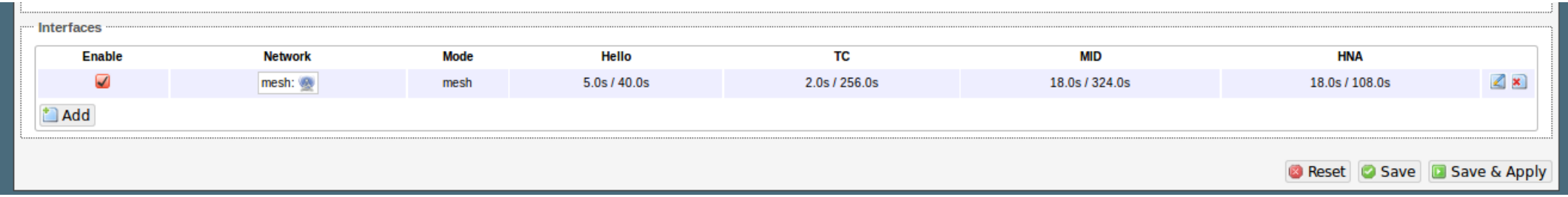
- **Dont forget to turn it on! It is off per default!**



Configuring OLSR in OpenWRT – step 3

- **> Services > OLSR**

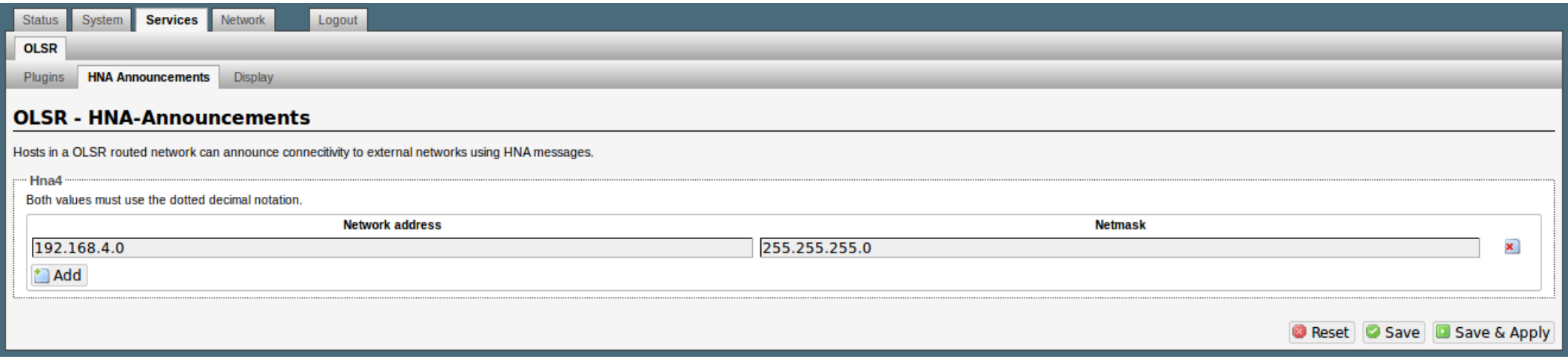
  Most importantly, activate OLSR on the right interface -
  in our case, the wireless mesh interface we have created above.



Configuring OLSR in OpenWRT – step 4

- **> Services > OLSR > HNA**

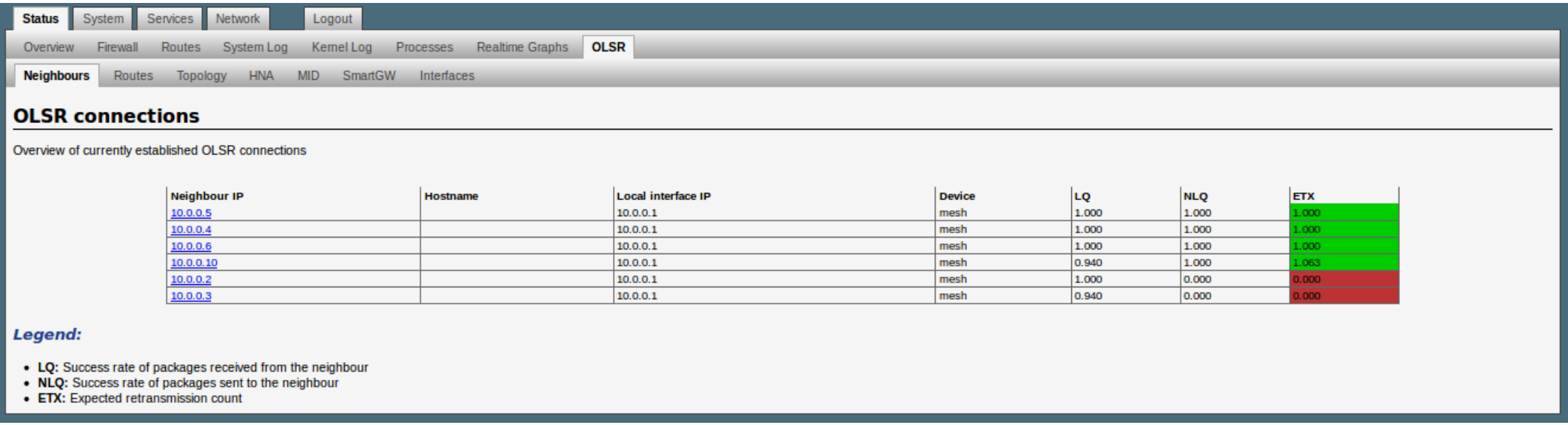
  If our node offers access to a network (e.g. an internet uplink), we need to announce that.



Configuring OLSR in OpenWRT – step 5

- **> Status > OLSR**

  Check our success … check neighbours, LQ, ETX ...



Old slides for reference:

Freifunk, debricking,
olsrd on linux laptop,
etc

Lab: Configuring a Freifunk Mesh

Mesh planning

- Planning is about people! Consider the social dynamics, ownership, support, ...
- Map / Site Survey
- Select network topology
- Channel allocation (mesh, backbone, local hotspots)
- IP address allocation
- Draw the network diagram

Lab: Configuring a Freifunk Mesh Guide

- **For the planning for each device: e.g. Meraka Mesh Guide Form**

Meraka Institute Mesh Guide
APPENDIX G: Planning Sheet

Device Details	Model number	
	Router serial number	
	MAC address	
Download appropriate software	Freifunk firmware version	
	DD-WRT firmware version	
Node type	Gateway node	X
	Backbone mesh node	X
	Mesh cluster node	X
	Wireless access point	X
System settings	Host Name	
Wireless settings	WLAN-IP address	. . .
	WLAN netmask	. . .
	ESSID	
	BSSID	
	Channel number (1,6,11)	
LAN settings	LAN IP	. . .
	LAN netmask	. . .
OLSR	HNA4	. . . . 0 / 2 4
WAN Settings	WAN IP	. . .
	WAN netmask	. . .
Setup – Basic Setup	AP LAN IP address	. . .
	Subnet mask	. . .
	DHCP Server IP address	. . .
Wireless – Basic Settings	SSID	

Device history	
Date (DD/MM/YYYY)	Description
/ /	Device build date (firmware upgrade, configuration, assembly)
/ /	Device installation date
	Location installed:

Lab: Freifunk Firmware on Linksys WRT54G

Debricking a WRT54G

- power down the WRT54GL
- Example of a tftp transmission:
  on a linux command line, do
  [root@samsarix /]# ifconfig eth1 192.168.1.99 up
  [root@samsarix /]# tftp -v -m binary 192.168.1.1
  mode set to octet
  Connected to 192.168.1.1 (192.168.1.1), port 69
  tftp> put openwrt-g-freifunk-1.6.25-en.bin
  <NOW POWER UP THE WRT54GL! and if you are lucky... it will say ....>
  putting openwrt-g-freifunk-1.6.25-en.bin to 192.168.1.1:openwrt-g-freifunk-1.6.25-en.bin [octet]
  Sent 1303552 bytes in 7.9 seconds [1326539 bit/s]
  tftp>
- If debricking via tftp fails, you will have to open the device and do some pin magic – read more here:

  http://www.notsecure.us/debrick_wrt54g_without_void_warrenty.html
  http://www.ranvik.net/prosjekter-privat/jtag_for_wrt54g_og_wrt54gs/HairyDairyMaid_WRT54G_v22.pdf
  http://www.freewebs.com/wrt54grevival/wrt54grevial.htm.html

Lab: Running olsrd / batmand on a laptop

- Olsr demons are available for Linux, Mac OS X, BSD, Windows: http://www.olsr.org/?q=download
- Also: Ubuntu plugins, .debs, Nokia, iPhone
- Linux: install via the normal make routine
  Do this in the lib directories too to activate libs!
- Windows: GUI OLSR-Switch might be out of date!
- Biggest obstacle in all of this: card and driver issues (ad-hoc mode often badly buggy)

Lab: Running olsrd / batmand on a laptop

olsrd on Linux

- **Download sources, build**

```
(in olsr dir)
# make
# make install
# cd lib
# make install
(...)
```

Lab: Running olsrd / batmand on a laptop

olsrd on Linux

- Prepare settings and start the demon

- example session:

```
# killall NetworkManager
# killall NetworkManagerDispatcher
# killall olsrd
# ifconfig ath0 172.31.1.19 netmask
255.255.255.0
# iwconfig ath0 essid roadshow-mesh mode ad-hoc
channel 1
# olsrd -i ath0 -d 5
# netstat -nr
```