



OpenWRT

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August 2014



- What is OpenWRT?
- Why OpenWRT?
- Supported Hardware
- Installation and Initial Setup
- Packages
- Add-ons:
 - USB Storage
 - Syslog-NG
 - Traffic monitoring
 - Dynamic DNS





What is OpenWRT?

- A free and open Linux based firmware platform for embedded devices
- Named “WRT” after the first device that prompted porting Linux to them “Linksys WRT45G”
- First release: Jan 2004



Why?

- Free and Open Source
- Community driven (cf. DD-WRT)
- Large repository of packages



Similar Projects

- Linksys WRT45G firmware (the first Linux firmware for a consumer router)
- DD-WRT (Since 2005)
 - Buffalo routers ship a modified version
 - Hitron DOCSIS modem/router (Rogers!)
- Tomato
- Lesser known ones:
 - Gargoyle, Sveasoft Alchemy



- Architecture: MIPS, ARM, PowerPC, x86, ...etc
- Chipsets:
 - Atheros AR71xx/AR724x/913x
 - Broadcom BCM47xx/53xx
 - See <https://dev.openwrt.org/wiki/platforms>
- Check latest trunk
 - <http://downloads.openwrt.org/snapshots/trunk/>



- Versions are extremely important (check the box!)
 - Manufacturers change chipsets for same model, so **A1** and **C1** may be supported, but *not* **B1**!
- RAM size
 - Minimum 16MB since 12.09 (latest stable)
 - Dlink DIR-835: 128MB RAM
- Flash size
 - Dlink DIR-835: 16MB flash
- The definitive resource: <http://wiki.openwrt.org/toh/start>





Router Options

- Various features
 - RAM, CPU speed, USB ports, WiFi speeds)
- TP-Link WDR-4300 ~ \$70
- TP-Link TL-WDR3600 ~ \$55
- TP-Link TL-WR1043ND ~ \$50





Getting the software

- Find the correct binary
- SquashFS images recommended, if supported.
- Binary naming:

`openwrt-ar71xx-generic-dir-835-a1-squashfs-factory.bin`

- Architecture, version, model
 - *-factory.bin for initial install
 - *-sysupgrade.bin for upgrading a router that already has OpenWRT installed.



Flashing a router

- Ideally, done from the manufacturers web interface, but using the image you downloaded.
- Some routers cannot be done this way, and need alternative methods that can be more involved.
- See specific documentation on [OpenWRT Wiki](#).



- Connect Ethernet cable to PC (ports 1 to 4)
- Browse `http://192.168.0.1`, then cancel from wizard
- Tools -> Firmware -> Browse -> Upload, and wait the router to start (amber light not flashing)
- Disconnect Ethernet cable, and reconnect
- Login via command line: `telnet 192.168.1.1`
- Set the password, using the command: `passwd`





Initial Setup

- Default IP address 192.168.1.1, can be changed later
- Connect to the internet (WAN port)
- Install the web admin interface (LuCI) using opkg
- Add your SSH public key (optional)
- Setup WiFi WPA2 password
- Enable WiFi (it is off by default)
- <http://wiki.openwrt.org/doc/howto/firstlogin>



Additional Setup

- Map MAC addresses to IP addresses
 - So each device has the same IP every time
- Change the default DHCP range (if you want to reserve others)
- Enable NTP to keep the time correct
- Additional steps at:
 - <http://wiki.openwrt.org/doc/howto/basic.config>

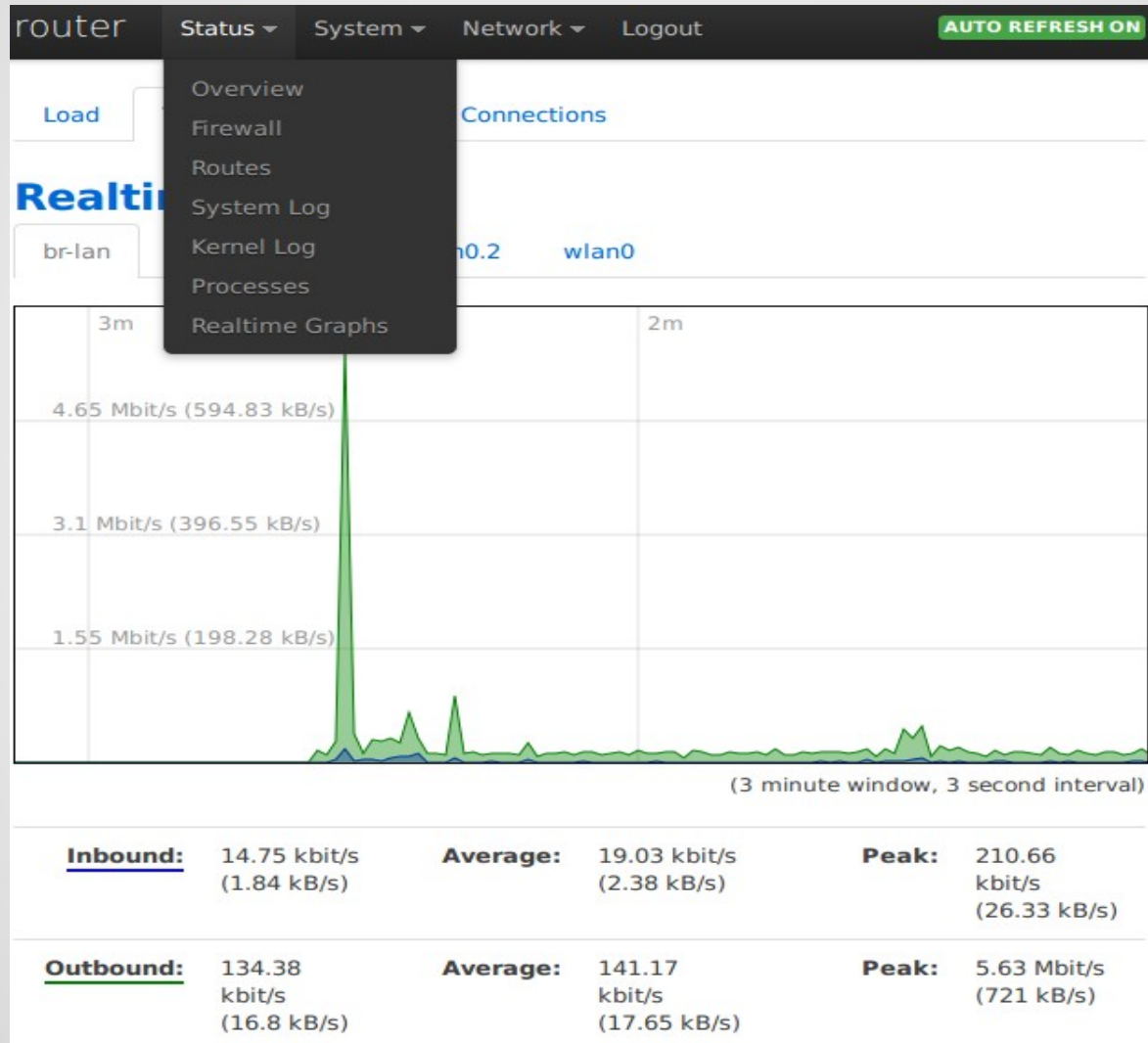


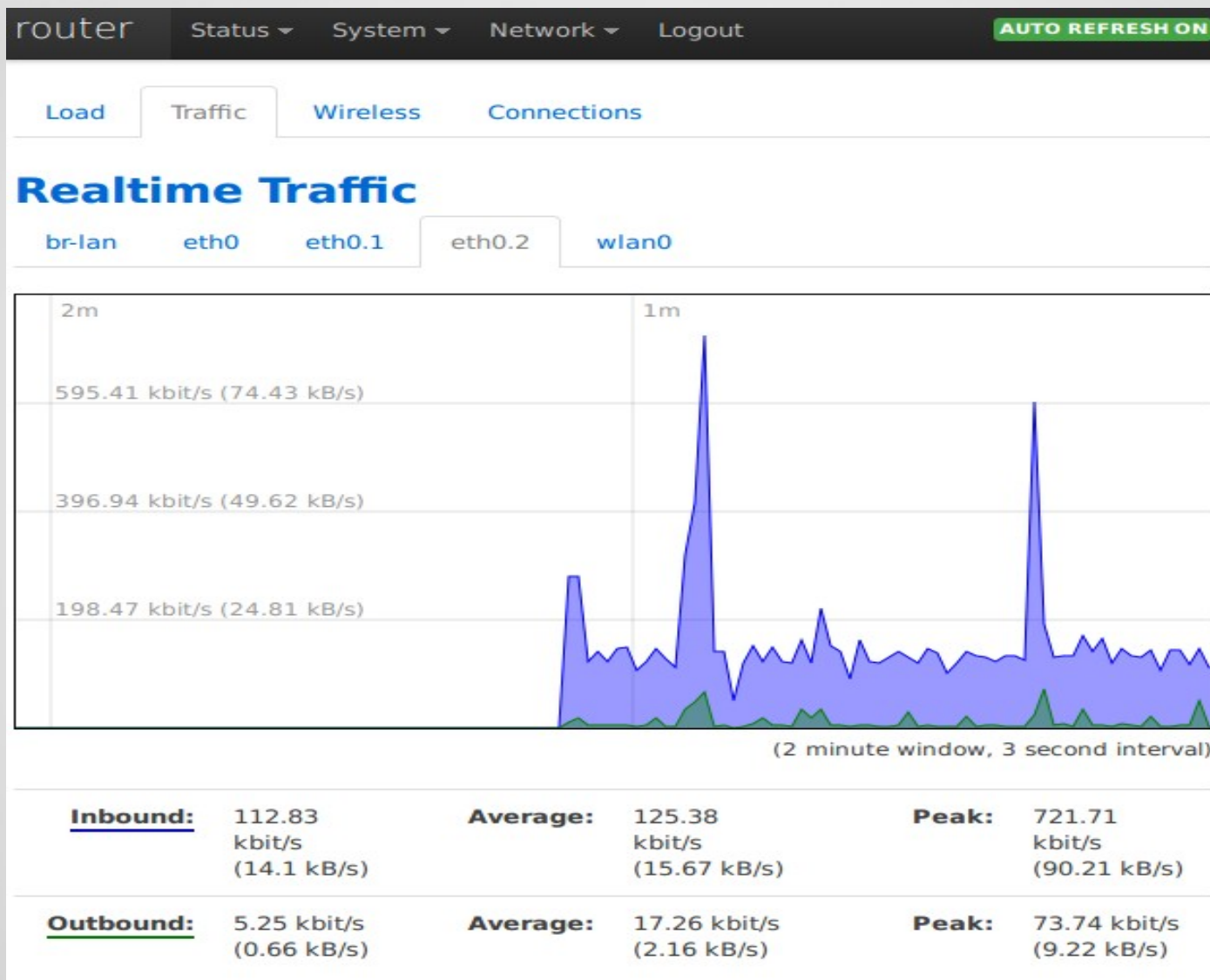
- Command line interface for configuration
- Useful for backing up your configuration
- Useful for scripting (query and modify config)
- Tedious if used alone from scratch for all config
- Web admin better for day to day tasks
- **Example:** `uci get network.wan.ifname`

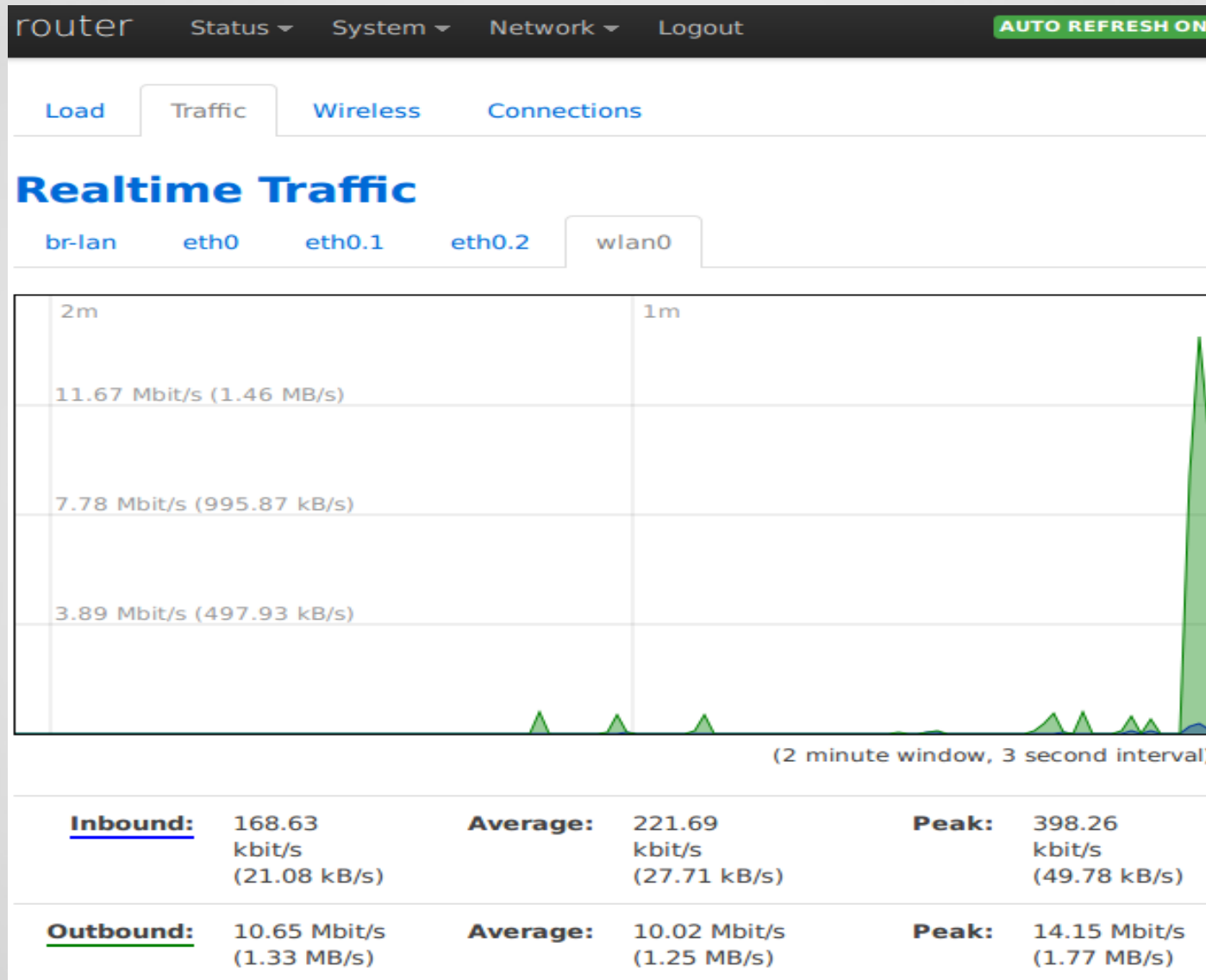


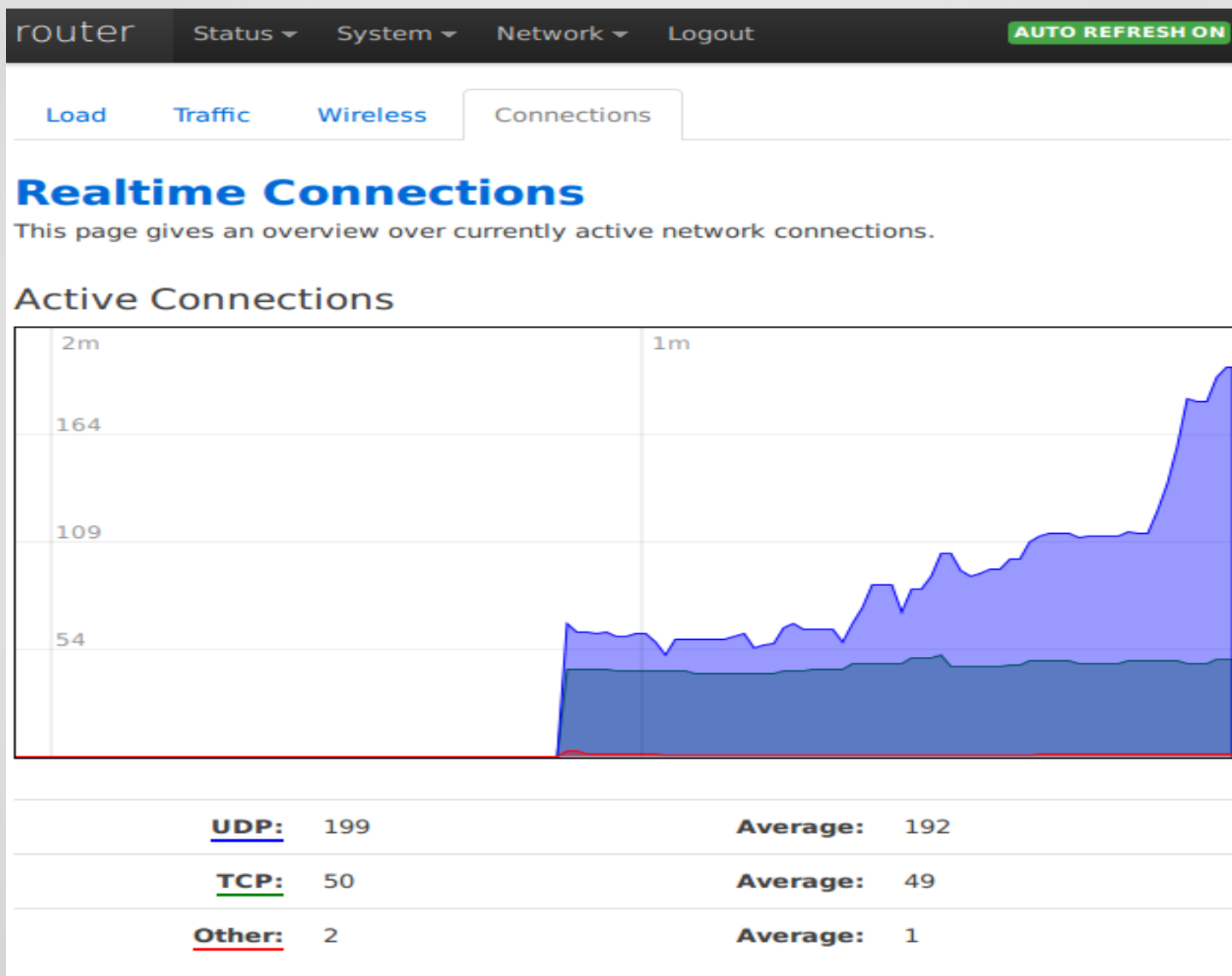
- A light weight web interface for OpenWRT
- Configuration, Administration, Status and monitoring
- Recommended, since doing the initial setup in UCI will be very tedious








































LuCI - Connections

Protocol	Source	Destination	Transfer
UDP	ooma.lan:39517	vpn16-eqix-sv4.ooma.com:1194	4.54 MB (57291 Pkts.)
TCP	receiver.lan:1285	stxts10103.swisstxt.ch:80	2.26 MB (59112 Pkts.)
TCP	[REDACTED]:36519	[REDACTED]:22	1.81 MB (22774 Pkts.)
TCP	[REDACTED].lan:41612	[REDACTED]:22	1.74 MB (21808 Pkts.)
TCP	[REDACTED].lan:35732	router.lan:22	1.65 MB (21204 Pkts.)
TCP	[REDACTED] laptop.lan:36025	yyz08s13-in-f22.1e100.net:443	964.63 KB (2107 Pkts.)
TCP	[REDACTED].lan:55787	[REDACTED]:22	604.01 KB (7868 Pkts.)
TCP	[REDACTED] laptop.lan:36000	channel-proxy-shv-06-frc1.facebook.com:443	602.79 KB (1766 Pkts.)
TCP	[REDACTED] ipad.lan:50768	17.110.226.139:5223	413.12 KB (2239 Pkts.)
TCP	[REDACTED] laptop.lan:48240	channel-proxy-shv-04-frc3.facebook.com:443	398.07 KB (536 Pkts.)
TCP	[REDACTED]:50068	[REDACTED]:2	347.67 KB (4212 Pkts.)
TCP	[REDACTED] laptop.lan:39413	157.55.[REDACTED]:10003	332.52 KB (2107 Pkts.)



Processes

This list gives an overview over currently running system processes and their status.

PID	Owner	Command	CPU usage (%)	Memory usage (%)	Hang Up	Terminate	Kill
1	root	/sbin/procd	0%	1%	 Hang Up	 Terminate	 Kill
2	root	[kthreadd]	0%	0%	 Hang Up	 Terminate	 Kill
3	root	[ksoftirqd/0]	0%	0%	 Hang Up	 Terminate	 Kill
4	root	[kworker/0:0]	0%	0%	 Hang Up	 Terminate	 Kill
5	root	[kworker/0:0H]	0%	0%	 Hang Up	 Terminate	 Kill
7	root	[khelper]	0%	0%	 Hang Up	 Terminate	 Kill
60	root	[writeback]	0%	0%	 Hang Up	 Terminate	 Kill
62	root	[bioset]	0%	0%	 Hang Up	 Terminate	 Kill
64	root	[kblockd]	0%	0%	 Hang Up	 Terminate	 Kill



Scheduled Tasks

This is the system crontab in which scheduled tasks can be defined.

```
# Check external IP address, and update Linode's DNS if changed
5,25,45 * * * * /etc/custom/linode-dyndns.sh
```

```
# OpenWRT Bandwidth monitor
```

```
*/3 * * * * /mnt/usb1/wrtbwmon/wrtbwmon scan
```

```
*/5 * * * * /mnt/usb1/wrtbwmon/wrtbwmon collect
```

```
*/15 * * * * /mnt/usb1/wrtbwmon/wrtbwmon devices
```



Active DHCP Leases

Hostname	IPv4-Address	MAC-Address	Leasetime remaining
████████ laptop	192.168.0.166	00:1e:4c:████████	11h 10m 51s
████████ laptop	192.168.0.151	00:1e:65:████████	7h 51m 37s
Ig-tv	192.168.0.103	cc:2d:8c:████████	11h 29m 53s
████████ phone	192.168.0.152	b4:52:7d:████████	11h 26m 37s
receiver	192.168.0.102	d8:d4:3c:████████	10h 13m 50s
████████ tablet	192.168.0.181	ec:89:f5:████████	4h 3m 43s
████████ iphone	192.168.0.165	20:c9:d0:████████	2h 59m 56s
████████ tablet	192.168.0.192	4c:aa:16:████████	11h 51m 44s
printer	192.168.0.105	98:4b:e1:████████	7h 24m 52s
ooma	192.168.0.101	00:18:61:████████	9h 9m 57s
████████ ipad	192.168.0.171	1c:ab:a7:████████	1h 42m 21s
████████ tablet	192.168.0.153	e0:b9:a5:████████	11h 50m 19s
████████ phone	192.168.0.184	00:eb:2d:a████████	1h 38m 15s
████████ ipad	192.168.0.161	64:20:0c:████████	6h 58m 19s



- Vary by device and hardware version
- Use LuCI to configure the ones available on your device
- Examples: Planet light flickers when there is traffic
 - “dlink:green:planet”
 - Trigger: netdev
 - Device: eth0.2 (i.e. WAN interface)
 - Select: transmit and receive



Repository

- Centralized repository for available packages.
- Same concept as Debian/Ubuntu, much simpler
- Dependencies pulled in automatically
- Apple/Google borrowed the concept for their mobile devices, while Windows still does not have such an ecosystem
- Counted 4,050 packages (Feb 2014, for ar71xx)



- Moving target, always changing
- sysupgrade from “factory” image can help, since it upgrades kernel
- Some packages can be missing, hopefully waiting a few days may solve this



What Packages?

- **Filesystems:** CIFS (Samba), NFS, sshfs, ...
- **Filesystem tools:** lvm2
- **Editors:** nano, joe, vim
- **IRC:** Bahamut IRC, Eggdrop IRC, lirc, irssi
- Torrent, Tor
- **Proxies:** dansguardian
- **Network authentication:** FreeRADIUS



What Packages?

- **Dynamic DNS:** ddns-scripts, ndyndns
- **VPN:** OpenVPN, StrongSWAN, Racoon
- **Webcams:** crtmpserver, ...
- **Email:** mini-sendmail, mutt
- **Monitoring:** Munin Lite, Nagios
- **Databases:** MySQL, PostgreSQL, SQLite
- **Web Servers:** uhttpd, apache, nginx, lighttpd



What Packages?

- **Languages:** Perl, PHP, Python, Ruby, LUA, Erlang
- **Printing:** CUPS
- **Audio:** ALSA, PulseAudio
- **Video:** ffmpeg
- **Multimedia:** minidlna
- **VoIP:** Asterisk, Freeswitch, kamailio



- Command line interface for querying the repository and installing packages
- Sub commands:
 - **update** :get a list of packages from repo
 - **install** :install one or more package, with dependencies
 - **remove** :uninstall a package
 - **list-installed** :list installed packages
 - **files** :list files for a package





opkg (cont'd)

- Package list has a very simple format
- <http://downloads.openwrt.org/snapshots/trunk/ar71xx/packages/Packages.gz>

Package: iftop

Version: 1.0pre2-1

Depends: libc, libpcap, libncurses, libpthread

Architecture: ar71xx

Installed-Size: 20002

Size: 20460

MD5Sum: ...

SHA256sum: ...

Description: iftop does for network usage what top(1) does for CPU usage. It listens to network traffic on a named interface and displays ...



Upgrading

- Did not try it yet, but plan to, once stable 14.xx is released
- Command Line
 - Saving config files (and other /etc/ stuff)
 - Using *sysupgrade* and a *-sysupgrade.bin* image
 - Reinstalling packages (so modules in packages match the new kernel from the image)
- LuCI
 - Edit /etc/sysupgrade.conf for exclusions.

- VPN
 - <http://wiki.openwrt.org/doc/howto/vpn.overview>
- Asterisk (VoIP PBX)
 - <http://wiki.openwrt.org/doc/howto/voip.asterisk>
- USB Video (Security/Surveillance)
 - <http://wiki.openwrt.org/doc/howto/usb.video>



USB Storage

- Useful for several things:
 - Persistence of larger stuff that does not fit in flash memory (binaries, and data)
 - Sharing disks over the network (multimedia)
- Variety of file systems supported
 - I use ext4 on a 2GB USB stick
- Options
 - `rw,noatime,nodiratime, sync`



- By default, logging is to an in-memory circular buffer, hence limited number of lines
- Viewable via `logread` command, or LuCI
- Syslog-NG provides more logging
- Had to change:
 - `/etc/rc.d/S50syslog-ng` to `S15` so it takes over logs earlier
 - destination messages
`{file("/mnt/usb1/logs/syslog");};`
 - Filtering of annoying repetitive messages



- DynamicDNS
 - Variety fo scripts for different services
- Linode-dyndns
 - Useful if you already have a domain with Linode
 - Setup the router as a subdomain
 - Curl command with parameters





Bandwidth Monitoring

- Bandwidthd
 - Comprehensive, by IP and by port
 - Extremely resource heavy, may slow the router
- Iftop (interface top)
 - Command line tool to see who is using what in real time (no history)
 - Command: `iftop -B Pi br-lan`



- Shell script that uses iptables
- Simple and resource efficient, yet feature rich
- Many variants floating around
- Modified it to:
 - Use USB storage instead of convoluted logic to move files from flash to ram disk
 - Separate install from scan for new MAC addresses
 - Simplified code



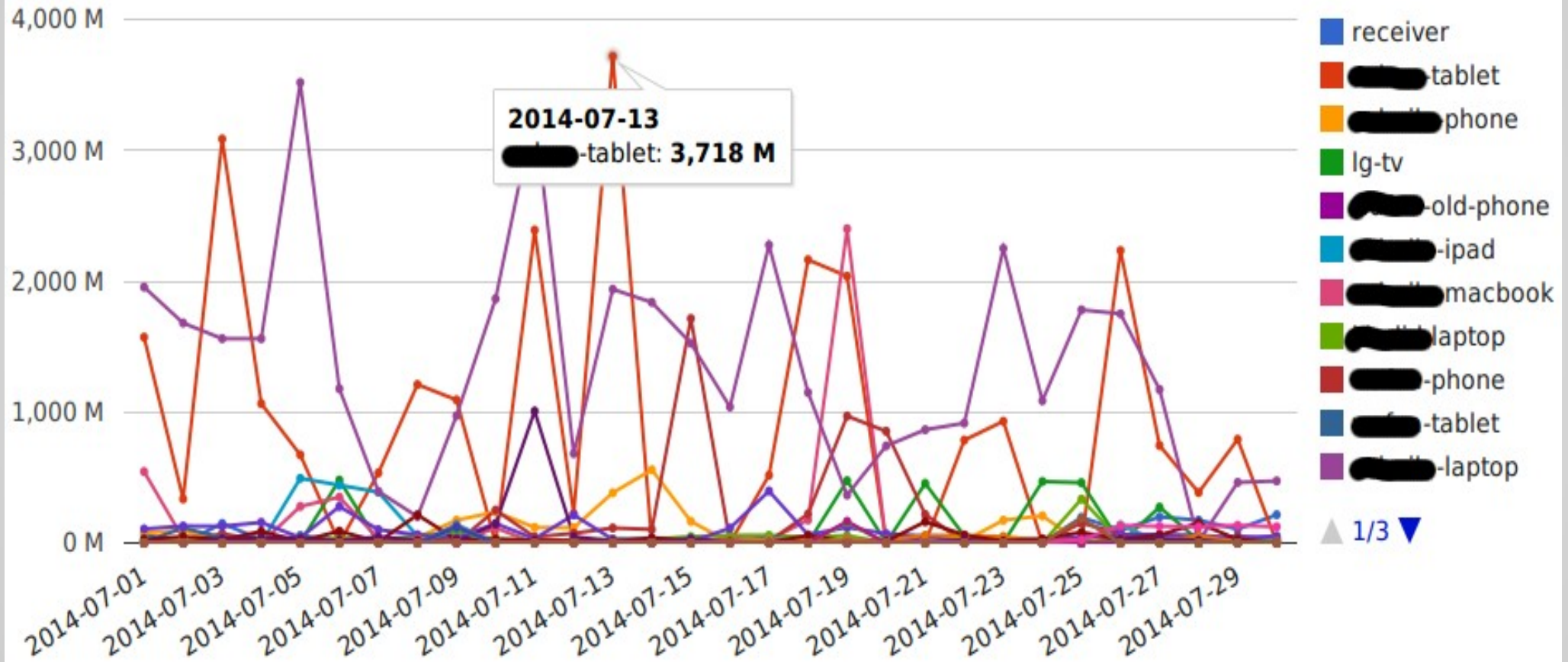


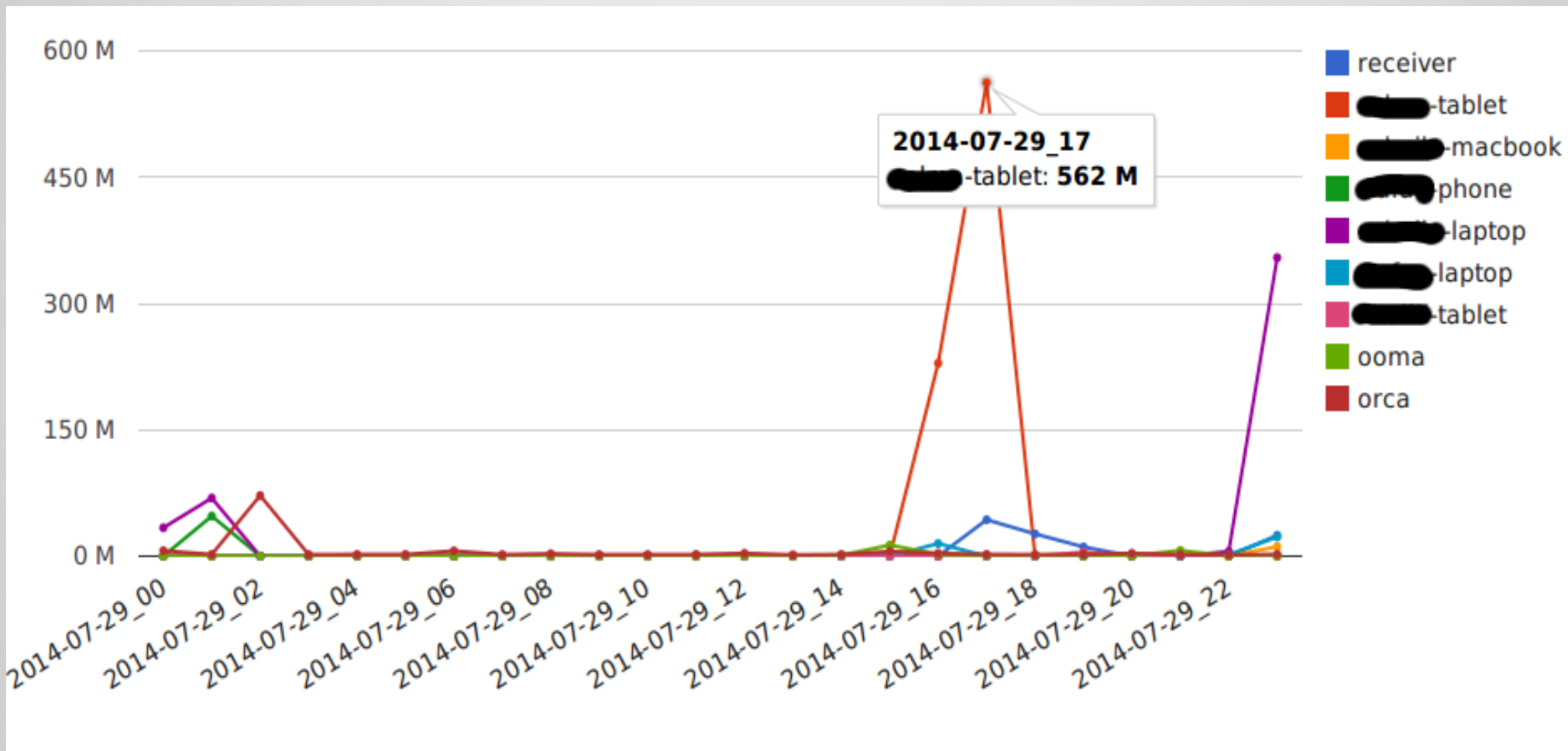
wrtbwmon - Monthly

Traffic 2014-07 Period: Date: << 07/30/2 >> Plc

Name	Extern Total ▲	Extern Down	Extern Up
08:00:27: [redacted]	34 M	34 M	1 M
[redacted]	104 M	102 M	2 M
[redacted]	121 M	119 M	2 M
[redacted]	142 M	139 M	3 M
vm2	157 M	155 M	2 M
vm1	165 M	163 M	3 M
[redacted]-ipad	187 M	172 M	15 M
[redacted]-old-phone	236 M	214 M	21 M
[redacted]-phone	237 M	203 M	34 M
[redacted]-tablet	298 M	276 M	22 M
[redacted]-iphone	605 M	536 M	69 M
[redacted]-tablet	645 M	572 M	73 M
[redacted]	669 M	636 M	33 M
[redacted]-laptop	1,122 M	264 M	858 M
receiver	1,230 M	1,192 M	38 M
ooma	1,397 M	654 M	743 M
[redacted]-ipad	1,434 M	1,348 M	85 M
[redacted]-phone	1,581 M	1,501 M	81 M
[redacted]-phone	2,367 M	2,233 M	134 M
[redacted]-laptop	2,708 M	2,420 M	288 M
lg-tv	2,730 M	2,688 M	42 M
[redacted]-macbook	4,056 M	3,754 M	302 M
[redacted]-phone	5,078 M	4,950 M	128 M
[redacted]-tablet	26,498 M	26,128 M	370 M
[redacted]-laptop	40,531 M	38,142 M	2,389 M
Total	94,335 M	88,597 M	5,738 M







- Download the tar archive from here:
 - <http://goo.gl/oPBydj>
- Make sure you follow the instructions in the README file!





Questions?

Any questions? Comments?

