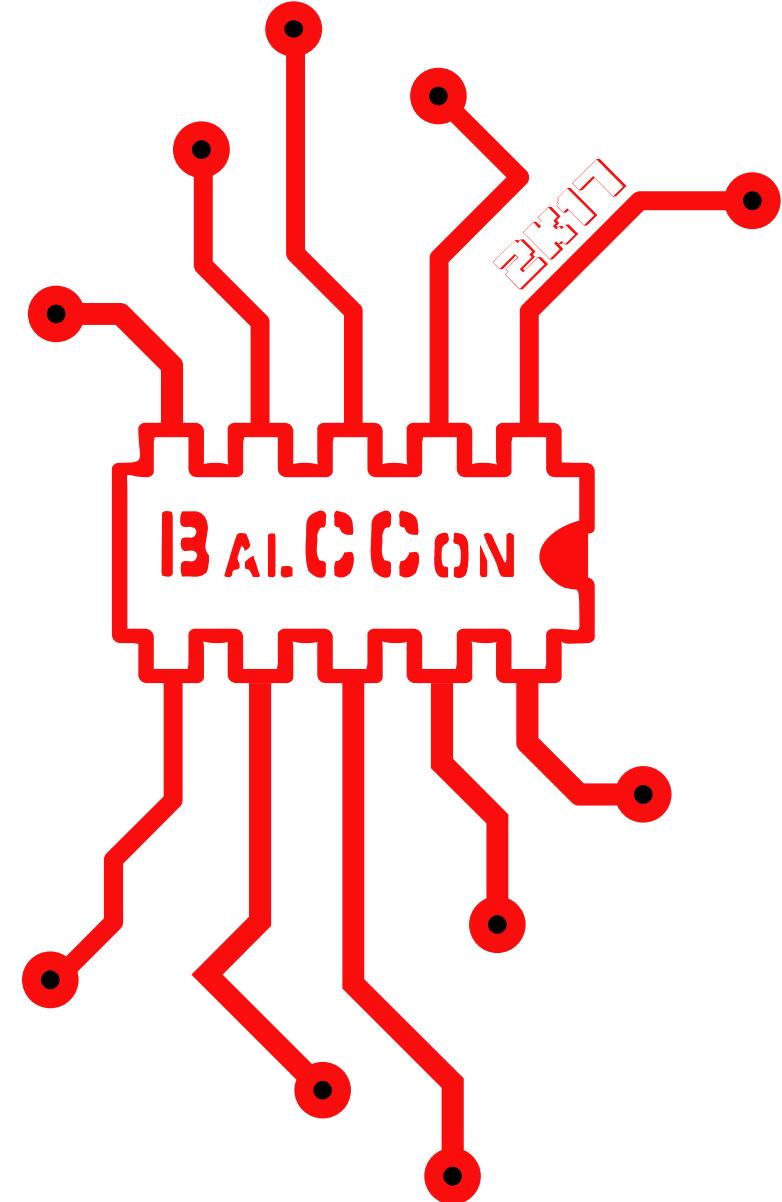


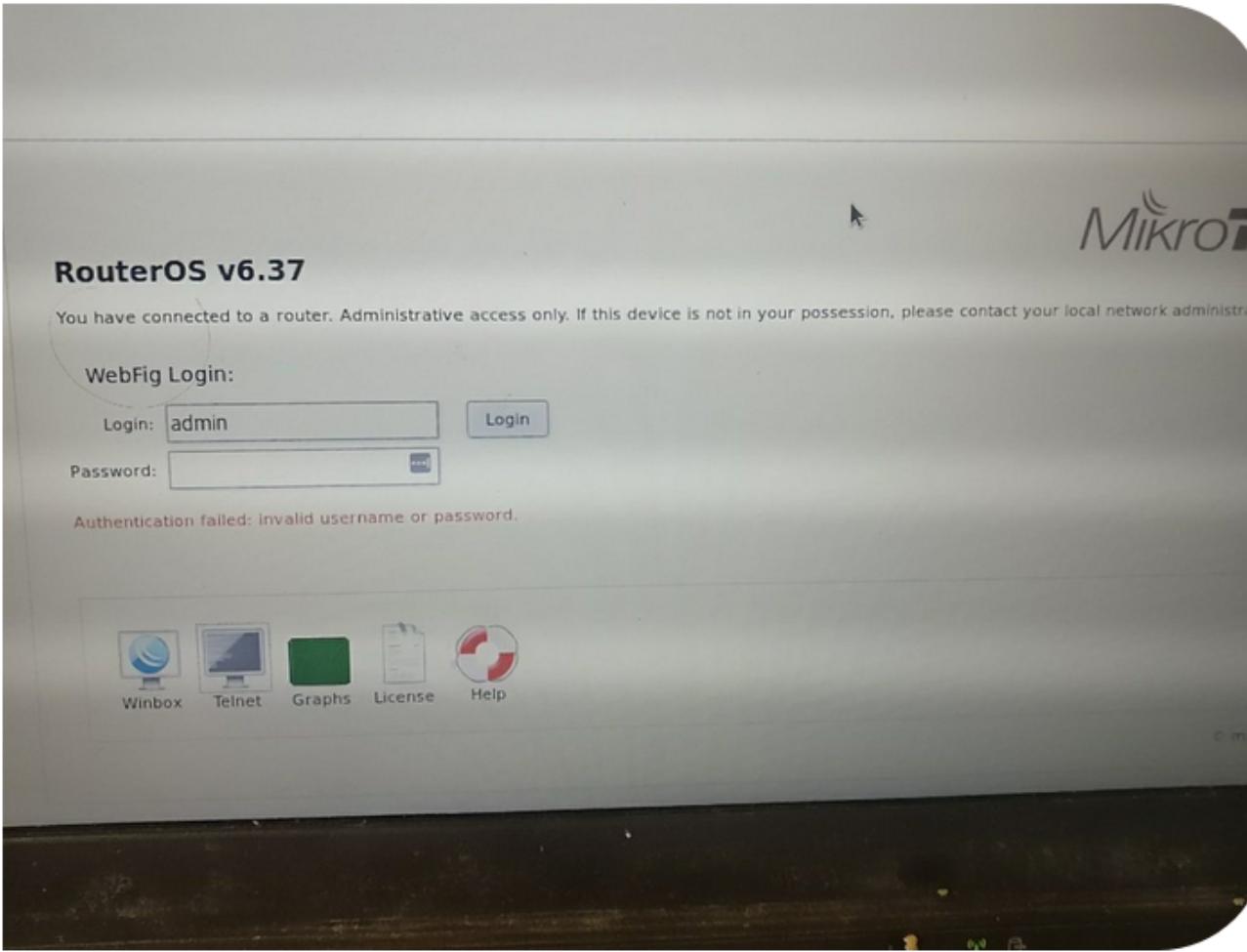
A deeper journey into MikroTik routers

v2









It's good that you are not in my hotel. Lol



– TANOY BOSE

Us

- **KIRILS – PASSIONATE ABOUT ... THINGS AND STUFF**
- **JĀNIS – MAKER ... WHO SOMETIMES BREAKS THINGS**

Legal disclaimer

**GOAL OF THIS RESEARCH IS TO ACHIEVE THE INTEROPERABILITY
OF COMPUTER PROGRAMS (I.E. SOFTWARE RUNNING ON
MIKROTIK ROUTERS) WITH OTHER COMPUTER PROGRAMS.**



ACK: Prior research

- “**ANTONY++**” FROM **AWMN.NET**
 - **INITIAL NPK ANALYSIS**
- “**DRUBICZA**”
 - **NPK FILE UNPACKING**
- **PAUL McCALL**
 - **INITIAL SUPOUT.RIF ANALYSIS**
- **OPENWRT TEAM**
 - **KERNEL CONFIG FILES**

ACK: The team

- **KIRILS SOLOVJOVS**
 - **DYNAMIC BINARY ANALYSIS, JAILBREAK SCRIPTS, INTERNAL FILE FORMAT ANALYSIS**
- **JĀNIS JANSONS**
 - **STATIC BINARY ANALYSIS, WEBFIG ANALYSIS, BOOTUP SEQUENCE, TESTING**
- **You?**
 - **INTERESTED IN MIKROTIK SW/HW**
 - **EXPERIENCE IN LINUX OR REVERSE ENGINEERING**



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@KirilsSolovjovs
@Janamaja

Content outline

- **ROUTEROS INTRO**
- **ROUTEROS BOOT PROCESS AND BINARIES**
- **PACKAGE FORMAT**
- **SUPOUT.RIF**
- **CONFIG FILES**
- **LOTS OF DEMOS, OF COURSE!**

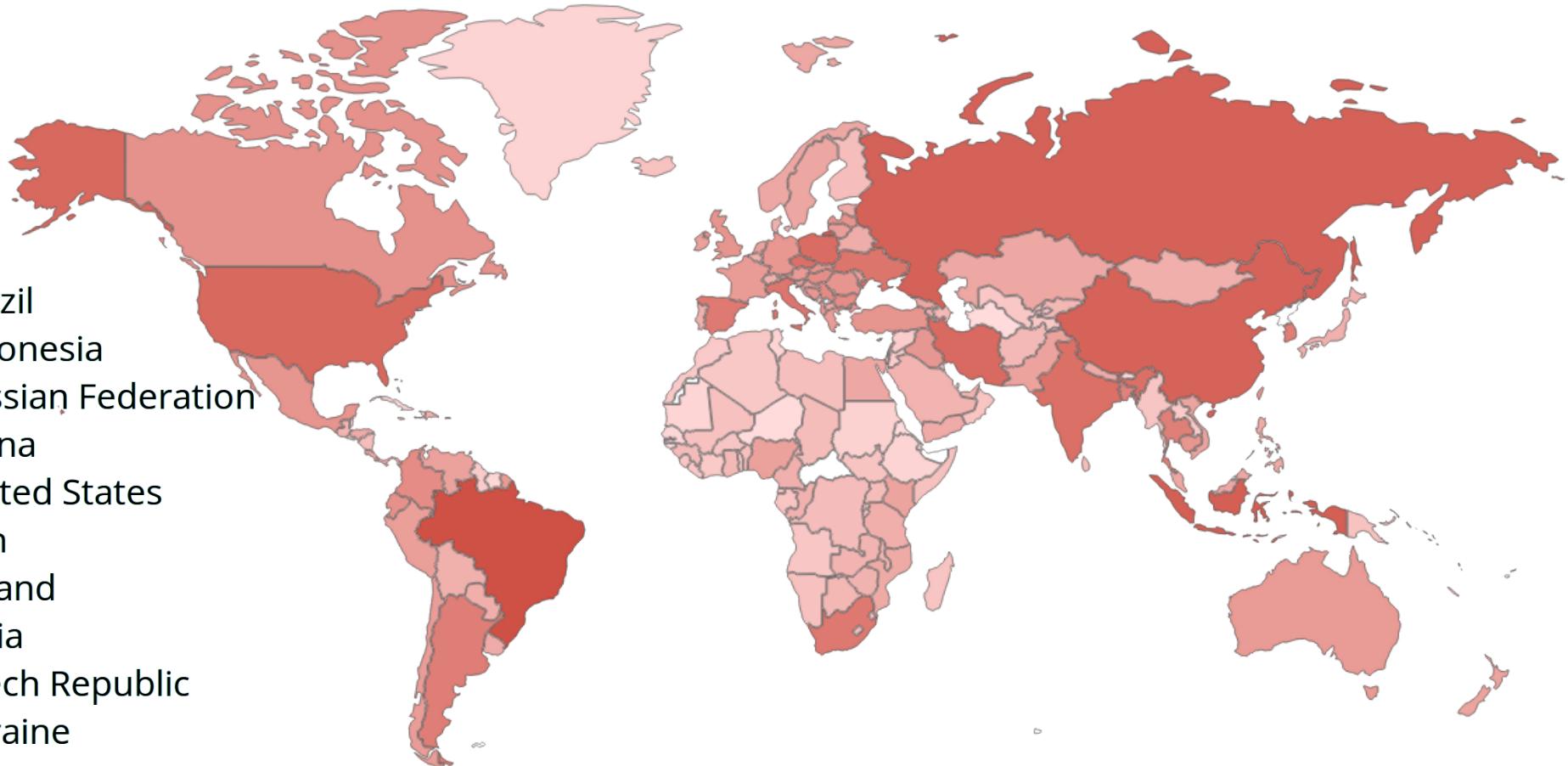


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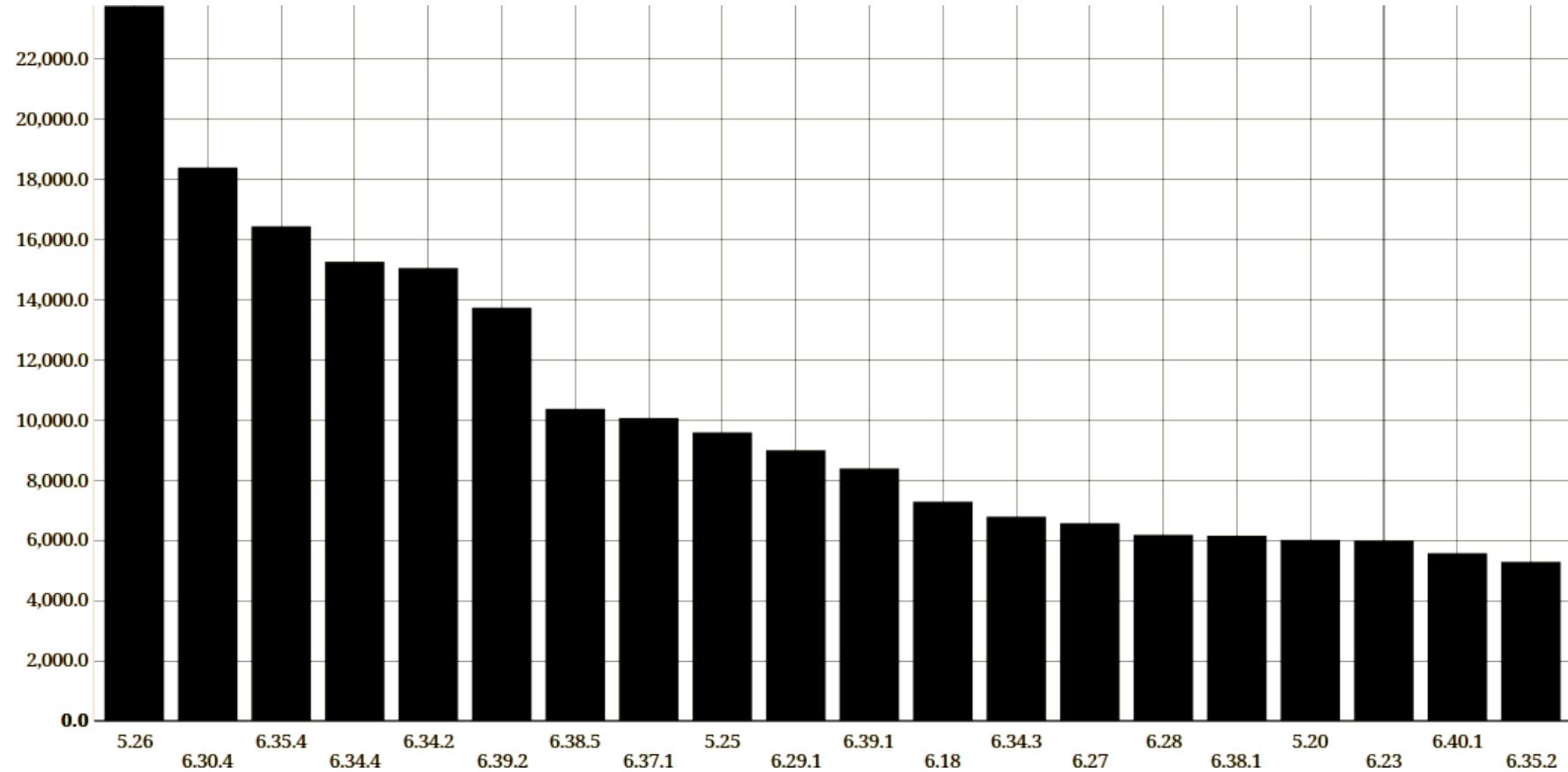
@KirilsSolovjovs
@Janamaja

Who uses MikroTik?

1. Brazil
2. Indonesia
3. Russian Federation
4. China
5. United States
6. Iran
7. Poland
8. India
9. Czech Republic
10. Ukraine



Do they update?

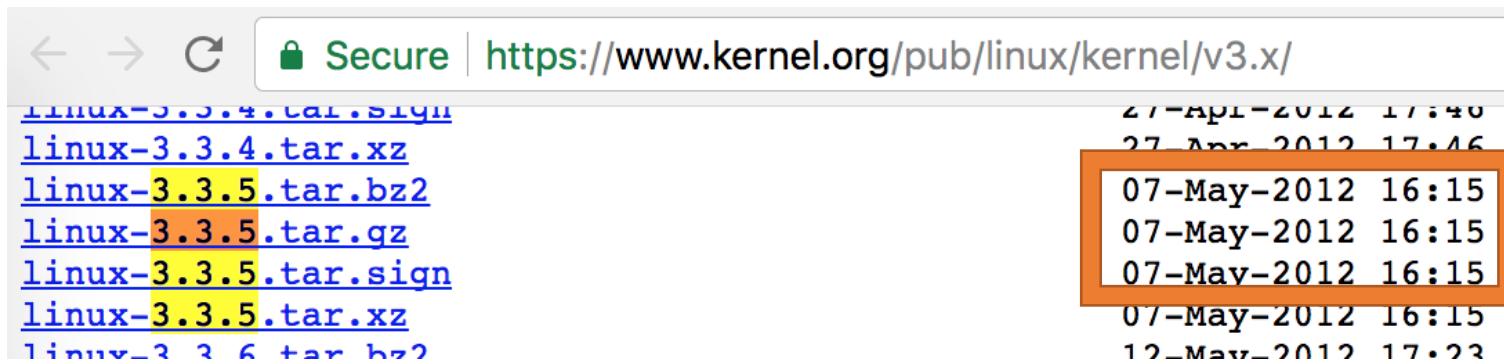


RouterOS externals

RouterOS is ...

- **LINUX (KERNEL) + STARTUP SCRIPTS + NOVÅ BINARIES + CONFIG**

```
[# uname -a
Linux MikroTik 3.3.5 #1 Thu Aug 24 10:36:14 UTC 2017 i686 GNU/Linux
```



GPL to the rescue?

The screenshot shows a GitHub repository page for 'wsxarcher / routeros-linux-patch'. The repository has a master branch and 3_2_2017 as the latest commit. The commit message is 'routeros-linux-patch / 3_2_2017 /'. The commit was made by 'wsxarcher' on March 13, 2017. The commit details show updates to 'configs' and 'linux-3.3.5.patch'. On the right side of the page, there is a sidebar listing various configuration files: config.440, config.arm, config.e500, config.e500-smp, config.i386, config.i386-smp, config.mips, config.mipsel, config.powerpc, config.tile, and config.x86_64. The 'config.arm' file has 2 forks.

wsxarcher / routeros-linux-patch

Code Issues 0 Pull requests 0 Projects 0 Insights

Branch: master ▾ routeros-linux-patch / 3_2_2017 /

wsxarcher updated

..

configs updated

linux-3.3.5.patch updated

config.440

config.arm Fork 2

config.e500

config.e500-smp

config.i386

config.i386-smp

config.mips

config.mipsel

config.powerpc

config.tile

config.x86_64

HTTPS://GITHUB.COM/WSXARCHER/ROUTEROS-LINUX-PATCH

History: the beginnings

- **1999**
 - **MIKROTIK™ V2.0 ROUTER SOFTWARE**
 - INITIAL RELEASE
 - WORKS ON 486
 - UPGRADES AVAILABLE AS PACKAGES
- **2001**
 - **MIKROTIK™ V2.3 ROUTER SOFTWARE**
 - NPK FIRST MENTIONED AS METHOD FOR EXTENDING FUNCTIONALITY

History: not just x86

- **12 FEB 2004**
 - **MIKROTIK ROUTEROS™ V2.8**
 - SOFTWARE KEY SYSTEM CHANGED
 - HAS NOT BEEN CHANGED SINCE!
- **1 AUG 2005**
 - **MIKROTIK ROUTEROS™ V2.9**
 - FIRST NEW ARCHITECTURE INTRODUCED
 - MIPSEL FOR RB500

History: “backdoor”

- **15 Nov 2005**
 - **2.9.8**
 - A WILD “/NOVA/ETC/DEVEL-LOGIN” APPEARS IN /NOVA/BIN/LOGIN
 - [-F /NOVA/ETC/DEVEL-LOGIN && USERNAME == DEVEL && PASSWORD == ADMIN.PASSWORD] && /BIN/ASH
 - FUN FACT: PREVIOUSLY USERNAME WAS “BASH”



History: the ghost & signing

- **8 FEB 2009**

- **3.21**

- WHAT'S UP WITH THIS VERSION?
 - WHY HAS IT VANISHED FROM THE INTERNET?

- **16 MAR 2009**

- **3.22**

- NPK VERIFICATION AND SIGNING ADDED
 - CHECKSUM AND SIGNATURE CHECKED BY /NOVA/BIN/INSTALLER
 - NO MORE FREE LUNCHES



History: SquashFS in NPK

- **7 MAY 2013**
 - **6.0 (SINCE BETA3)**
 - SQUASHFS EMPLOYED IN NPK FILES
 - ZEROFILL BLOCKS ADDED
 - SO THAT ACTUAL SQUASHFS START IS LOCATED AT ADDRESSES DIVISIBLE BY 4096
- **6 Nov 2015**
 - **6.33**
 - PACKAGES NOW INCLUDE DISTRIBUTION CHANNEL
 - BUGFIX | CURRENT | **DEVELOPMENT** | RELEASE-CANDIDATE

¿Development branch?

```
GET /routeros/LATEST.7 HTTP/1.1
Host: upgrade.mikrotik.com
User-Agent: RouterOS 6.40
```

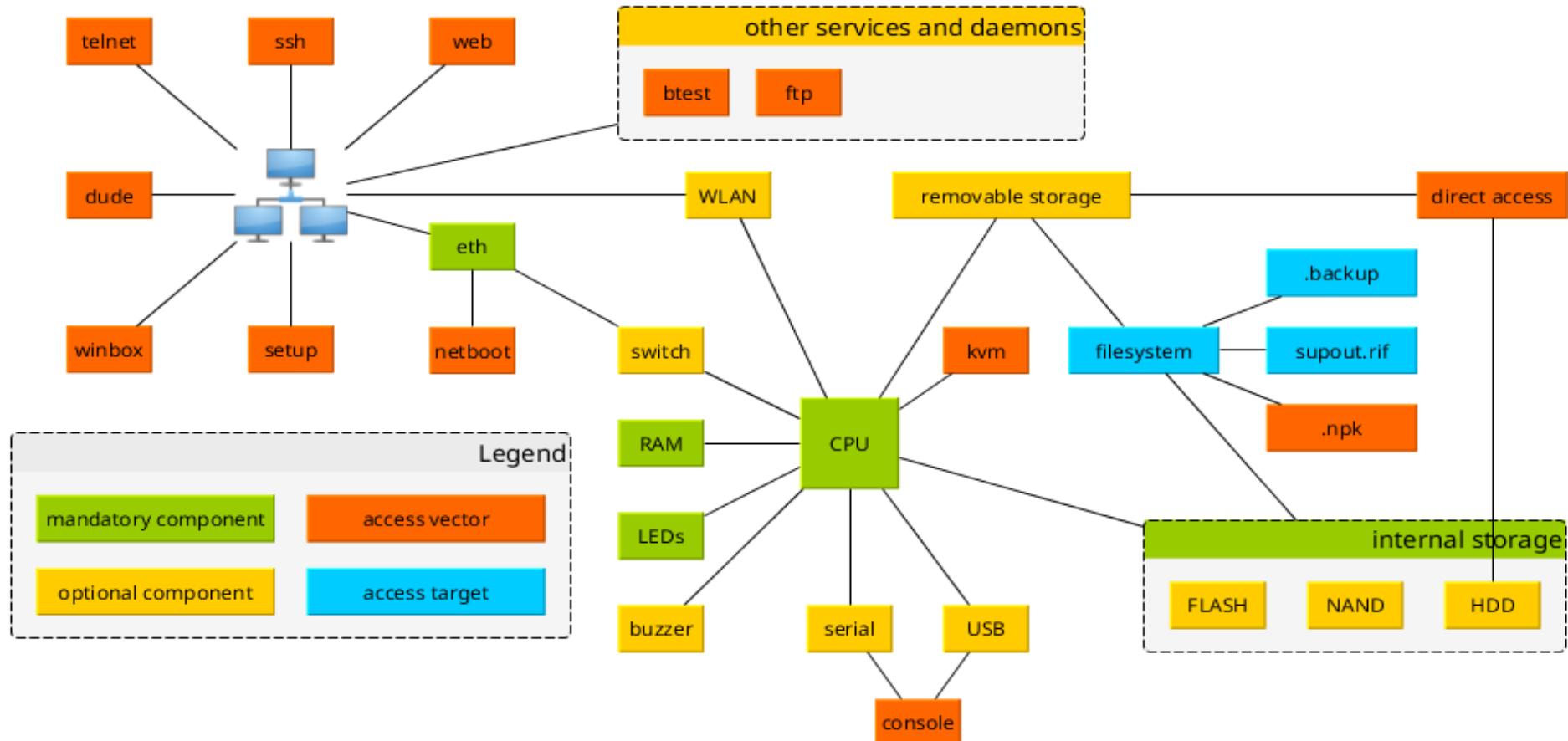
```
HTTP/1.1 403 Forbidden
Content-Type: application/xml
```

```
[admin@mikrotik] >system package update> print
    channel: current
    installed-version: 6.40
[admin@mikrotik] >system package update> set channel=development
[admin@mikrotik] >system package update> check-for-updates
    channel: development
    current-version: 6.40
    status: ERROR: file not found
```

loudFront)

```
<?xml version="1.0" encoding="UTF-8"?>
<Error><Code>AccessDenied</Code><Message>Access Denied</
Message><RequestId>20C70<RequestId><HostId>U+NhxKind+0jlzr52scm3d8o/
<HostId></Error>
```

RouterOS ecosystem revisited

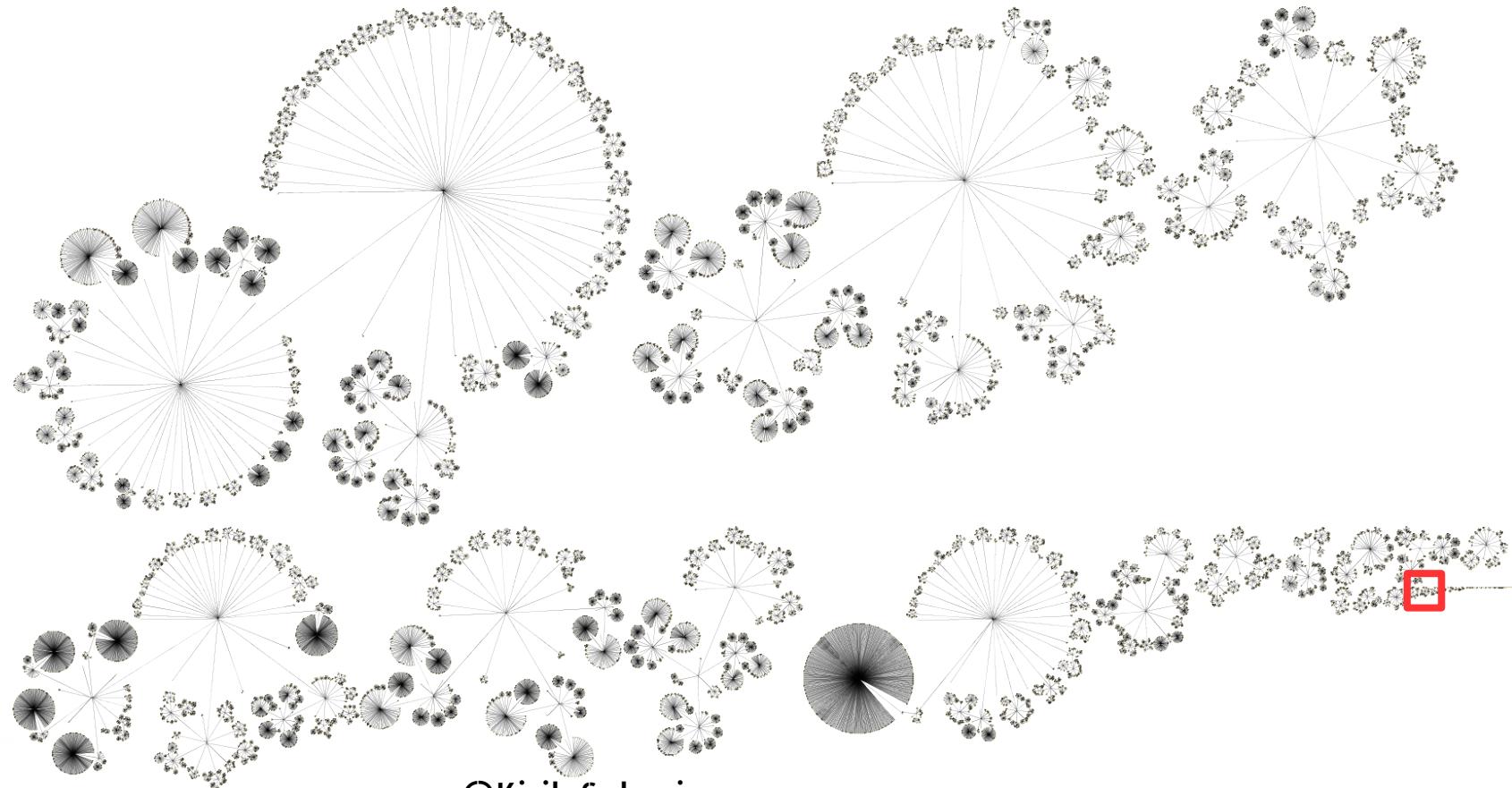


DEMO: RouterOS console

RouterOS command tree

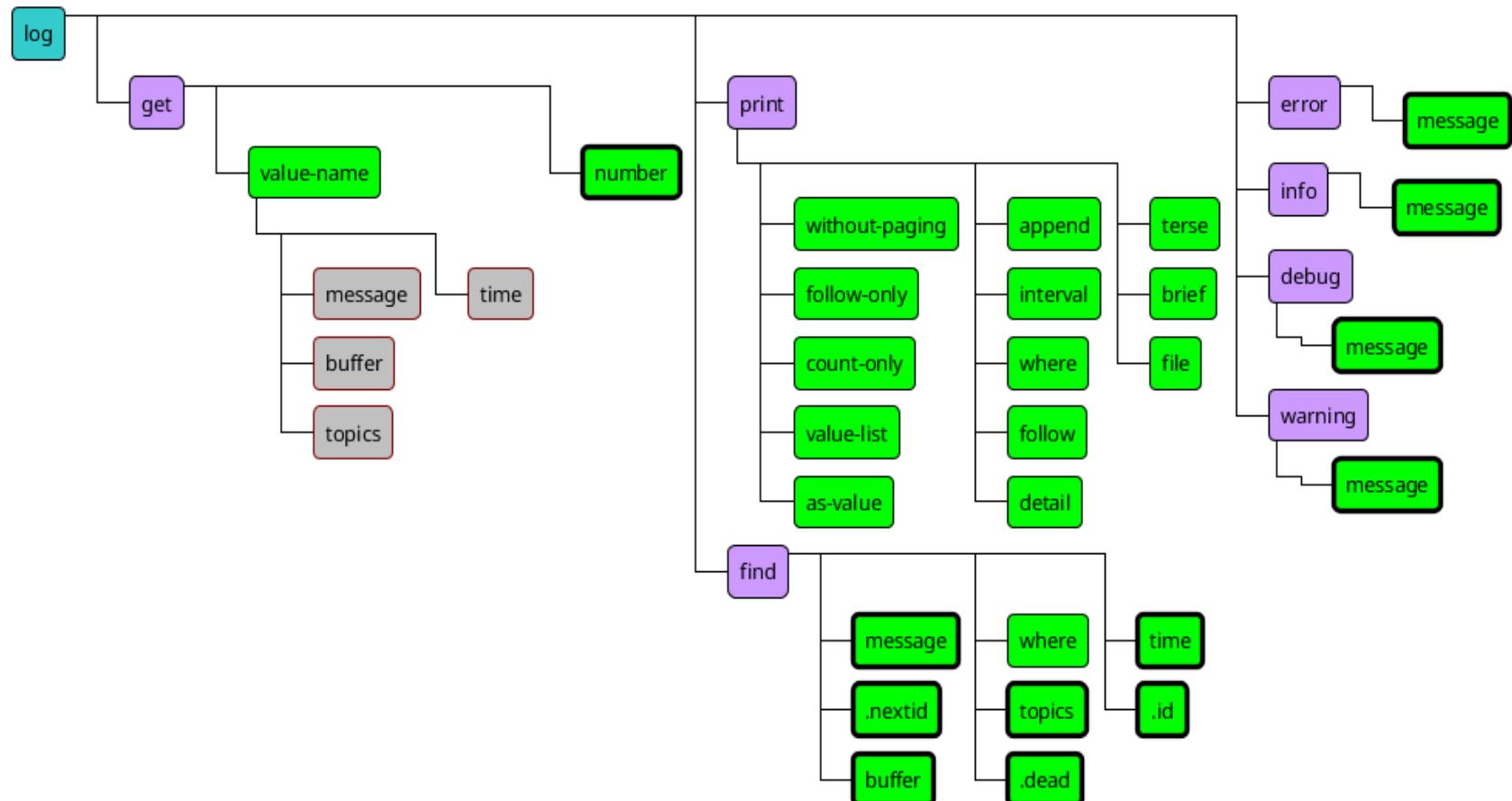
xviewer memory
requirements (.png)

/ip	3.7 GiB
/interface	3.5 GiB
/routing	2.1 GiB
/tool	1.9 GiB
/system	1.2 GiB
/caps-man	1.1 GiB
/ipv6	0.9 GiB



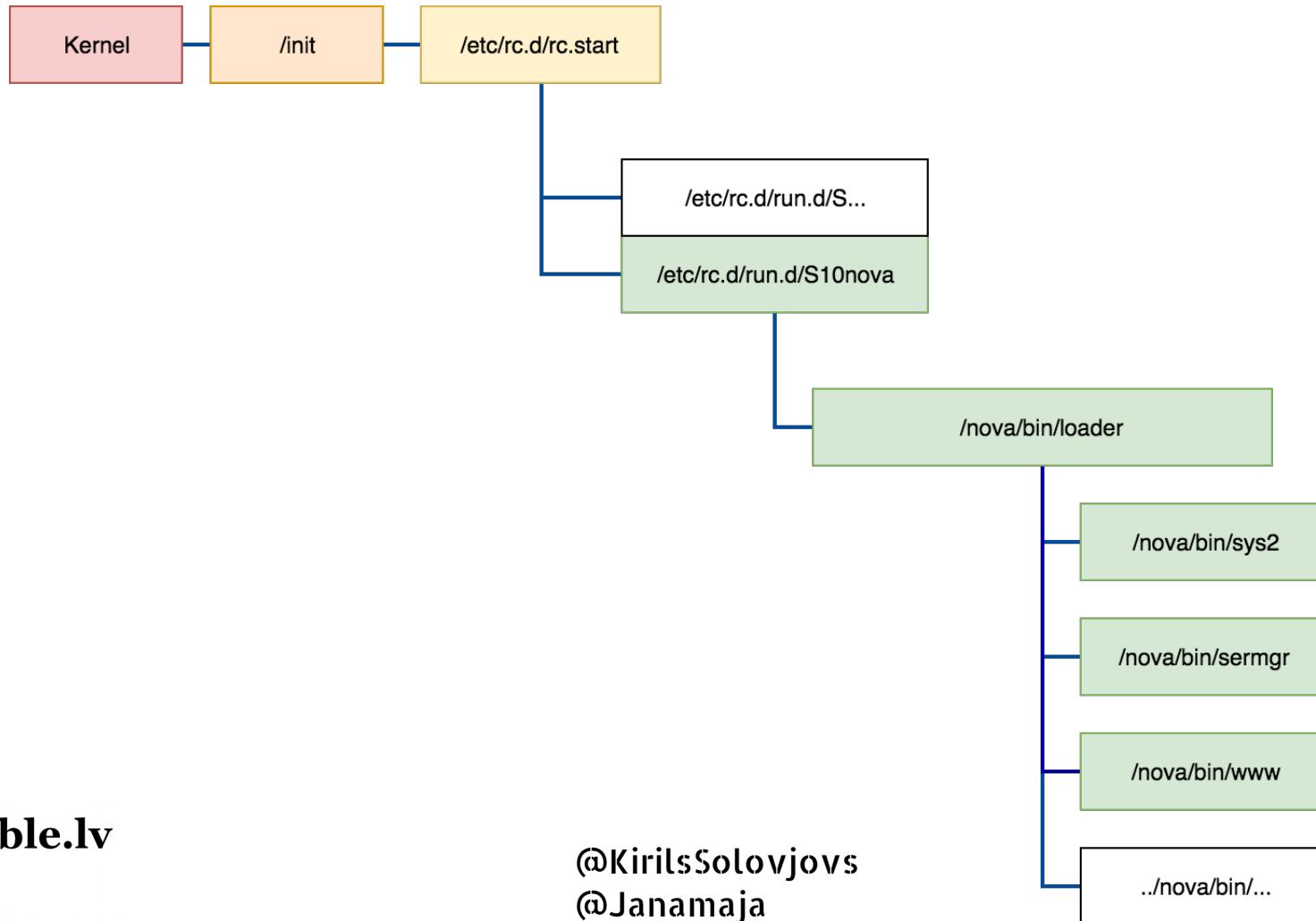
@KirilsSolovjovs
@Janamaja

Example: /log command



RouterOS internals

RouterOS boot process



A nice feature for jailbreakers...

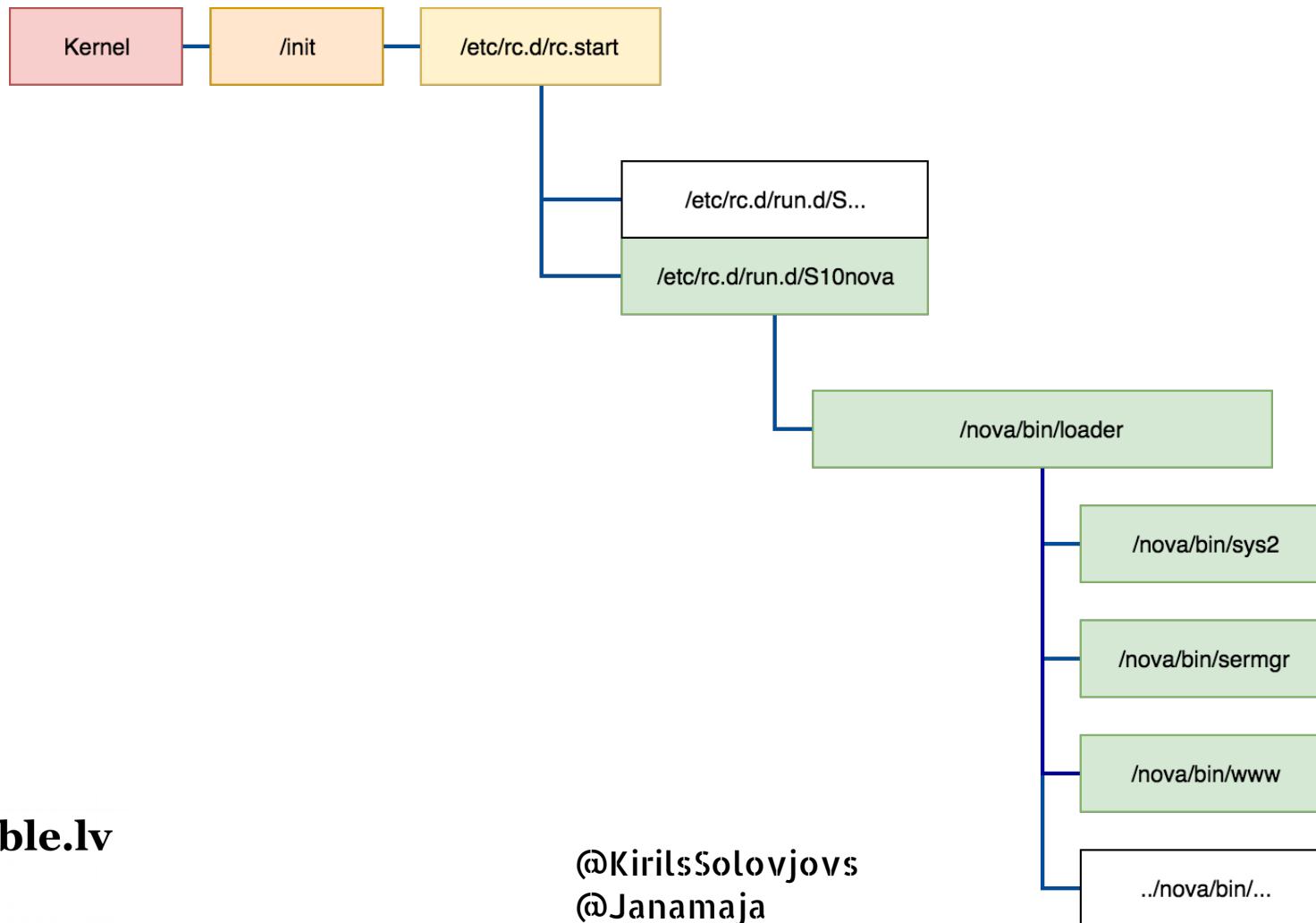
```
[#!/bin/bash  
  
[echo "Starting..."  
  
/etc/rc.d/rc.sysinit || exit 1  
  
export PATH=$(path --colon /sbin):$(path --colon /bin)  
[export LD_LIBRARY_PATH=/rw/lib:$(path --colon /lib)  
  
# disable core files  
ulimit -c 0  
  
[# set maximum opened files per process  
ulimit -n 500000  
  
# start syslog daemon  
for i in $(path --prefix S /etc/rc.d/run.d); do  
    if [ ! -f $i ]; then  
        [ $i || exit 1  
    fi  
done  
  
exit 0  
[  
/etc/rc.d/rc.start
```

A nice feature for jailbreakers...

- **“PATH” LOOKS FOR SPECIFIED PATH IN PREFIXED DIRECTORIES**
 - USED THROUGHOUT THEIR SCRIPTS
 - MAKES USING CUSTOM SCRIPTS EASIER

```
# path --colon /etc/rc.d/  
/pckg/dude/etc/rc.d/:/pckg/ntp/etc/rc.d/:/pckg/ups/etc/rc.d/:/pckg/ipv6/etc/rc.d/:/pckg/security/etc/rc.d/:/etc/rc.d/  
# path --colon /bin/  
/flash//bin/:/pckg/kvm/bin/:/bin/  
"
```

RouterOS boot process



nova binaries

- **LOADER**
 - SPAWNS PROCESSES AND MANAGES COMMUNICATION BETWEEN THEM
- **WATCHDOG**
 - RESTARTS THE DEVICE IF A CRITICAL PROCESS STOPS WORKING
- **SYS2**
 - MANAGES DEVICE SETTINGS AND PARSES RECEIVED COMMANDS
- **SERMGR**
 - SUPER-SERVER DAEMON THAT PROVIDES INTERNET SERVICES

sermgr ≈ inetd

```
# netstat -a -n -p
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp      0      0 ::1:21                   ::*:*
tcp      0      0 ::1:22                   ::*:*
tcp      0      0 ::1:23                   ::*:*
tcp      0      0 :::8728                 ::*:*
tcp      0      0 :::8729                 ::*:*
tcp      0      0 :::8291                 ::*:*
tcp      0      0 :::80                   ::*:*
tcp      0      0 :::2000                 ::*:*
tcp      0      0 ::ffff:10.0.2.15:23    ::ffff:10.0.2.2:51133 ESTABLISHED
tcp      0      0 ::ffff:10.0.2.15:22    ::ffff:10.0.2.2:51138 ESTABLISHED
udp      0      0 0.0.0.0:41778           0.0.0.0:*
udp      0      0 0.0.0.0:68             0.0.0.0:*
udp      0      0 :::546                  ::*:*
udp      0      0 :::5678                 ::*:*
raw     0      0 :::58                  ::*:*
                                         58

Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type      State         I-Node PID/Program name
unix    2      [ ]        DGRAM          821 268/console
unix    2      [ ACC ]     STREAM        LISTENING   591 189/log
unix    2      [ ACC ]     STREAM        LISTENING   469 175/loader
unix    2      [ ]        DGRAM          1276 309/login
```

```
# pstree
init--+--catlog
      `--loader--+--bridge2
                  |-btest
                  |-console
                  |-dhcpclient
                  |-diskd
                  |-dudes
                  |-gps
                  |-keyman
                  |-lcd
                  |-log
                  |-macping
                  |-mactel
                  |-manager
                  |-modprobed
                  |-moduler
                  |-mproxy
                  |-net
                  |-quickset
                  |-radvd
                  |-rbbios
                  |-route
                  |`-- sermgr---telnetd---bash---pstree
                  |`-- sshd---login
                  |`-- sssd---login
                  |-undo
                  |-ups
                  |-user
                  |-watchdog
                  |-wireless
                  `--www
```



nova binaries

- **NET**
 - DEALS WITH NETWORK CONFIGURATION, TUNNELS, AT COMMANDS
- **MODULER**
 - MANAGES LOADING OF FIRMWARE FOR EXTERNAL DEVICES
 - E.G. USB2SERIAL ADAPTERS, 3G MODEMS
- **MODPROBED**
 - SYMLINK TO MODULER, USED FOR LOADING KERNEL MODULES
- **MANAGER**
 - USER AND GROUP MANAGEMENT



nova binaries

- **LOG**
 - **LOG DAEMON**
- **MPROXY**
 - **WINBOX DAEMON**
- **QUICKSET**
 - **SEPARATE DAEMON FOR MANAGEMENT OF QUICKSET SETTINGS**
- **UNDO**
 - **SAFE MODE SUPPORT**
- **WWW**
 - **WEB INTERFACE DAEMON**



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@Janamaja

Package format

NPK format

- **NUMERIC VALUES ARE UNSIGNED LITTLE ENDIAN**
- **FILE CONSISTS OF HEADER, FILE SIZE, PARTS AND FOOTER.**
- **FILE SIZE IS 8B LESS**
- **EACH PART CONSIST OF:**
 - **PART TYPE (SHORT)**
 - **PAYLOAD SIZE (LONG)**
 - **PAYLOAD**

FB	0F	10	A1	1F	01	00	00	01	00	20	00	00	00	72	65	73	74	72	69
63	74	69	6F	6E	00	00	00	00	00	00	66	00	06	D9	B4	82	59	00	00
00	00	00	00	00	00	10	00	00	00	00	00	00	02	00	27	00	00	50	72
6F	76	69	64	65	73	20	72	65	73	74	72	69	63	74	65	64	20	76	65
72	73	69	6F	6E	20	6F	66	20	72	6F	75	74	65	72	6F	73	03	00	02
00	00	00	00	00	04	00	68	00	00	00	78	9C	7B	EB	CA	00	06	F7	FF
5B	07	33	A4	31	B0	DD	DC	D2	14	C9	00	05	2C	0C	79	F9	65	89	6F
A1	2A	5E	62	51	C1	01	56	A1	9F	93	99	04	53	B5	B2	0B	28	8B	A6
4A	10	AE	4A	BF	3C	B3	28	35	27	B5	B8	78	49	23	76	E5	8C	40	2C
85	A9	5C	3F	AD	28	B5	30	37	3F	25	D5	08	97	46	26	20	96	C4	A2
31	31	AF	24	3D	31	33	CF	D0	12	00	99	5D	3F	86	09	00	44	00	00
00	20	F1	64	5E	73	76	2A	A2	95	BF	93	84	F2	BA	BA	73	F0	2E	B8
44	EC	3A	17	29	BD	D8	BA	A3	94	49	1B	30	66	82	84	A6	8A	BC	06
24	A2	BD	E4	9A	C0	6D	EC	F9	25	80	C3	C9	B3	85	BD	3F	6E	E3	EB
CD	BB	AF	B2	FD	B3	51	16	0D	03	00	00	00	00	00	00	00	00	00	00

NPK format

- **AT LEAST TWO TYPES OF CURRENT NPKs:**

- **PACKAGE**

- 0..3 HEADER 1E F1 D0 BA
 - FOOTER 10 00 01 00 00 00 49
 - FOOTER SINCE 3.22

- **RESTRICTION (INVISIBLE PACKAGE)**

- 0..3 HEADER FB 0F 10 A1
 - FOOTER 03 00 00 00 00 00

```
[admin@MikroTik] > /system package
[admin@MikroTik] /system package> print
Flags: X - disabled
#      NAME                      VERSION
0      system                   6.38.4
1      X restriction           6.0
[admin@MikroTik] /system package> █
```

Part types

N	Type	Meaning	First seen	Last seen	Mandatory
1	01 00	Part info	forever	now	yes
2	02 00	Part description	forever	now	yes
3	03 00	Dependencies	forever	now	yes
4	04 00	File container	forever	now	no
5	05 00	Install script (libinstall)	forever	2.7.xx	no
6	06 00	? Uninstall script (libinstall)	never	never	no
7	07 00	Install script (bash)	forever	now	no
8	08 00	Uninstall script (bash)	forever	now	no
9	09 00	Signature	3.22	now	yes
10	0a 00	unused	never	never	no
11	0b 00	unused	never	never	no
12	0c 00	unused	never	never	no
13	0d 00	unused	never	never	no
14	0e 00	unused	never	never	no
15	0f 00	unused	never	never	no
16	10 00	Architecture	2.9	now	yes
17	11 00	Package conflicts	3.14	3.22	no
18	12 00	Package info	2.9	now	no
19	13 00	Part features	2.9	now	no
20	14 00	Package features	2.9	now	no
21	15 00	SquashFS block	6.0beta3	now	package only
22	16 00	Zero padding	6.0beta3	now	no
23	17 00	Digest	6.30	now	package only
24	18 00	Channel	6.33	now	package only

supout.rif

What is supout.rif?

- **SUPPORT OUTPUT**
 - **RIDICULOUSLY INTRICATE FORMAT**
 - **OR ROUTEROS INFORMATION FILE, MAYBE, IDK \(_\)(ツ)_/¯**

```
[admin@mikrotik] > /system sup-output
    created: 1%
-- [Q quit | D dump | C-z pause]
```

supout.rif from outside

```
--BEGIN ROUTEROS SUPOUT SECTION  
oVWYsRHaAgHnjXuAAAgJAgB=  
--END ROUTEROS SUPOUT SECTION  
--BEGIN ROUTEROS SUPOUT SECTION  
w9WZt8Wd0BAecukSMFFS0/czNx8SRh8SM3UVog8TVBNyJz8SVBjBKR0lmbeKYkxayFAAcc0D1D==  
--END ROUTEROS SUPOUT SECTION  
--BEGIN ROUTEROS SUPOUT SECTION  
sNGZ09WdjhGA4x58xZXUwdX9z1gc0HFC21QCxT/cPYe5KpETRhkzP3cTMvUIvEzNVFyJ5UUQjcy  
MvUVwEgSkTp5mnCmoJXAAsty1S0E=  
--END ROUTEROS SUPOUT SECTION
```

supout.rif section decoding

- **SWAP BITS AROUND**

- PER THREE BYTES



- **BASE64**

- **SECTION DECODES TO:**

- **NAME + '\0' +**

ZLIB_COMPRESSED_CONTENT



supout.rif section decoding

```
tribitmap=[10,11,0,1,2,3,4,5,14,15,16,17,6,7,8,9,18,19,20,21,22,23,12,13]

def tribit(content):
    result=""
    for i in xrange(0, len(content) - 1, 3):
        goodtribit=0
        badtribit=ord(content[i])*0x10000+ord(content[i+1])*0x100+ord(content[i+2])
        for mangle in tribitmap:
            goodtribit = (goodtribit<<1) + (1 if ((badtribit & (0x800000>>mangle))>0) else 0)

        for move in [16,8,0]:
            result=result+chr((goodtribit >> move)& 0xff)

    return result
```



supout.rif from inside

- **WHAT DOES IT CONTAIN?**

- **YOUR WHOLE CONFIGURATION**
- **/PROC/ FOLDER**
- **MEMORY ADDRESSES**
- **YOUR LOG**
- **AND MORE**

```
$ ls supout.rif_contents/
01_debug      16_arp          31_profile        46_wirelesselog
02_profile    17_ip           32_dhcp          47_bfd
03_proc       18_nexthop     33_neighbor      48_bgp
04_startup    19_route       34_dhcp6         49_mme
05_livetrace  20_user        35_license       50_mpls
06_resource   21_firewall    36_package       51_ntp-client
07_pci        22_firewall-stats 37_instchk     52_ospf
08_usb        23_bridge       38_oops          53_ppp
09_log         24_mesh         39_backtrace    54_ipsec
10_export     25_queue        40_store         55_health
11_interface  26_queue-packets 41_hotspot       56_poe-out
12_ethernet   27_queue-bytes  42_routerboard  57_lcdtouch
13_switch     28_queue-stats   43_webproxy     44_wireless
14_address    29_ippool        44_certificate  45_wirelessdump
15_port       30_certificate   $ 
```

mikrotik.com has a reader ...

≡ Toggle menu

ACCOUNT INFORMATION

- [Home](#)
- [Balance](#)
- [Edit account details](#)
- [MUM registration history](#)
- [Hardware orders](#)

WEB ORDERS

- [Your orders and invoices](#)

ROUTEROS KEYS

- [Search and view all keys](#)
- [Request key from another account](#)
- [Purchase a key](#)
- [Make a demo key](#)

CHR LICENCES

- [All CHR keys](#)
- [CHR orders and invoices](#)
- [Transfer CHR prepaid keys](#)

TRAINING

- [My training sessions](#)
- [My certificates](#)

SUPPORT

- [Support contact form](#)
- [Supout.rif viewer](#)

OTHER

- [Lockpack creator](#)

Supout.rif reader

New + New + New + New + New +

Upload your supout.rif file

Browse...

No file selected.

Upload

... but it won't show you everything

DEMO

DEMO: MIKROTIK.COM XSS

DEMO: DECODE_SUPOUT.PY

Config file format

Configuration

- **CONFIG IS STORED IN /RW/STORE AS PAIRS OF FILES**

- **IDX = INDEX**
- **DAT = DATA**



@KirilsSolovjovs
@Janamaja

IDX format

- **RECORD ID (LONG)**
 - IF ID IS 0xFFFFFFFF, FIELD HAS NO CONTENT
 - USED FOR OFFSETTING
- **LENGTH (LONG)**
- **SEPARATOR (LONG)**
 - USUALLY 0X05000000

DAT format

- **LENGTH (SHORT)**
- **M2 RECORD OF LENGTH**
 - **CONFIG ID (3 BYTES)**
 - **TYPE (1 BYTE)**
 - CONTENT DEPENDS ON TO TYPE

```
btype .....  
0000000, - boolean  
.1,1... - M2 block (len = short)  
.11,... - binary data block (len = short)  
.....,1 - one byte  
.....,1, - ???  
....,1,, - ???  
...,11... - 128bit int  
...,1... - int (four bytes)  
...,1..., - long (8 bytes)  
.,1,... - string  
,1,..... - ??? unused? or long array of?  
1,..... - short array of
```

```
types (MT notation)  
(CAPITAL X = list of x)
```

```
a,A, (0x18) IPv6 address (or duid)  
b,B, bool  
M, multi  
q,Q, (0x10) big number  
r,R, (0x31) mac address  
s,S, (0x21) string  
u,U, unsigned integer
```

Peculiarities / features

- **FIELD IDs SHARED WITH WEB**
- **WINBOX PROTOCOL DERIVED FROM DAT FORMAT**
 - **WORKING DIRECTLY WITH FILES?**
 - **DANGEROUS!**

Where to get field IDs?

```
function post(req, cb) {
    console.log(req);
    if (window.ArrayBuffer) {
        request('POST', '/jsproxy', session.encryptUint8Array(msg2buffer(req)), function(r) {
            session.decryptUint8Array(new Uint8Array(r), cb);
            session.dequeue();
            if (cb = receive) {
                post({}, receive);
            }
        }, null, true);
    } else {
        request('POST', '/jsproxy', session.encrypt(msg2json(req)), function(r) {
            session.decrypt(r, cb);
            session.dequeue();
            if (cb = receive) {
                post({}, receive);
            }
        });
    }
}
```



user.dat has your password?

- **YEP!**

283i4jfka13389



```
key = md5(username + "283i4jfka13389")  
password = password xor key
```

Rooting the router

Getting shell

1) CREATE /NOVA/ETC/DEVEL-LOGIN

2) TELNET TO 192.168.88.1 AS DEVEL

- **YAAAY! :)**

```
$ telnet 192.168.88.1
Trying 192.168.88.1...
Connected to 192.168.88.1.
Escape character is '^]'.
```

3) LS

- **FAIL :(**

```
MikroTik v6.39.2 (stable)
Login: devel
Password:
```

```
BusyBox v1.00 (2017.05.31-11:35+0000) Built-in shell (ash)
Enter 'help' for a list of built-in commands.
```

```
# ls
bash: ls: not found
# █
```



[TAB] to the rescue

- **No ls? No problem!**

- CAT, SPACE, TAB, TAB

```
# cat
bin/    boot/   etc/   home/   nova/   proc/   rw/   sys/   usr/
bndl/   dev/    flash/  lib/    pckg/   ram/    sbin/  tmp/   var/
# ls
bin     boot    dude   flash   lib     pckg   ram    sbin   tmp   var
bndl   dev     etc    home   nova   proc   rw    sys    usr
# █
```

- **Or, you know, do it properly, and upload BusyBox**

- **STATICALLY LINKED, FOR THE RIGHT ARCHITECTURE**

- uname -m

- **THIS MIGHT BE OF INTEREST:**

- <https://busybox.net/downloads/binaries/1.21.1/>

Can we speed this up?

- **OF COURSE.**
- **A VIRTUALBOX APPLIANCE!**
 - **DOES THE WORK FOR YOU**
- **THIS SHOULD WORK OUT NICELY***
 - **IF YOUR CPU IS AR9344 AND DEVICE HAS AT LEAST TWO ETHERNET PORTS**
 - RB951G-2HND, RB951Ui-2HND <== TESTED
 - CRS109-8G-1S-2HND-IN, CRS125-24G-1S-IN, CRS125-24G-1S-2HND-IN
 - RB2011L, RB2011LS, RB2011iLS-IN, RB2011iL-IN, RB2011UiAS-IN RB2011UiAS-RM, RB2011UiAS-2HND-IN
 - OMNIPIK 5, OMNIPIK 5 PoE



How to use the appliance

DEMO: MT_JB_0.89.0VA

- 1) IMPORT THE APPLIANCE**
- 2) MAKE SURE BRIDGED NETWORK CARD IS SET TO ETHERNET**
- 3) DISCONNECT ALL WIRES FROM THE ROUTER, POWER IT UP**
- 4) START THE VIRTUAL MACHINE AND FOLLOW INSTRUCTIONS**
- 5) BE READY TO SWIFTLY RE-PLUG THE CABLE WHEN PROMPTED**

So, what's new?

- **WHAT IF I'VE FORGOTTEN MY PASSWORD?
NOT A PROBLEM! ;)**

DEMO



Question time

- **TOOLS ARE AVAILABLE**

[HTTPS://GITHUB.COM/OKI/](https://github.com/oki/)

- **CURRENT APPLIANCE:**

[HTTP://O2.LV/F/2017/09/15/MT_JB_0.89.0VA](http://o2.lv/f/2017/09/15/MT_JB_0.89.0VA)

– GOOD LUCK GUESSING

WHICH LETTERS ARE CAPITAL ;P



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