nftables tutorial

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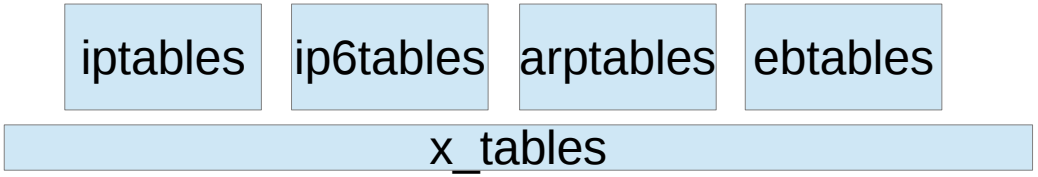
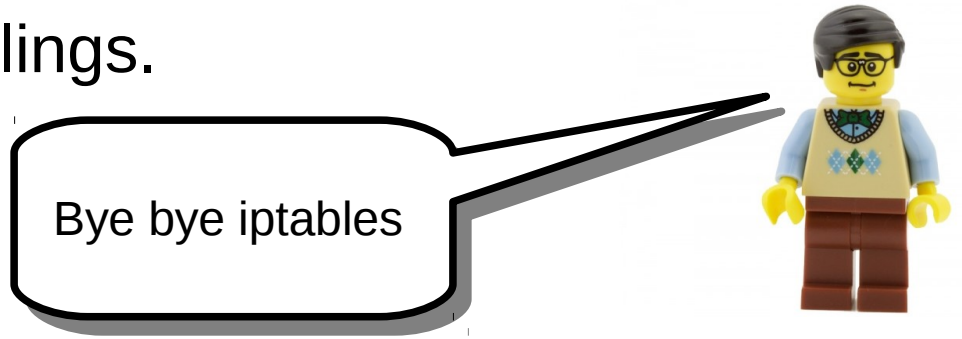
Userday Netfilter - June 2016
Netherlands

Why this?

- Abuse of copy and paste from iptables



- In the late 90s people were happy with shell scripts
- Avoid linear ruleset representations: Use concatenations and maps.
- Better incremental updates.
- Simplify dual stack IPv4/IPv6 administration and layer 2.
- No more dash dash spellings.

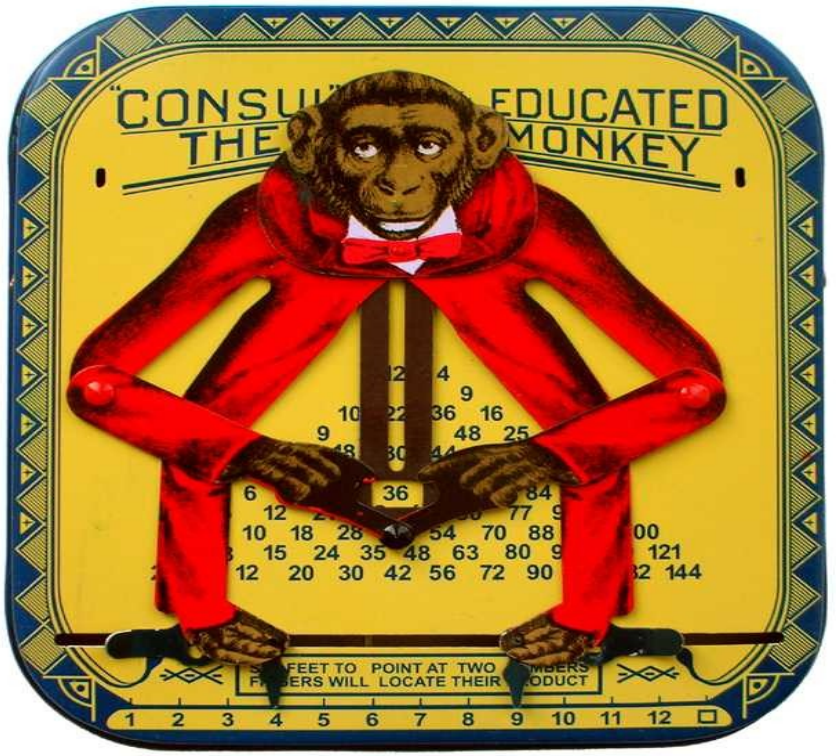


Let's look at internals...

- Simple like...

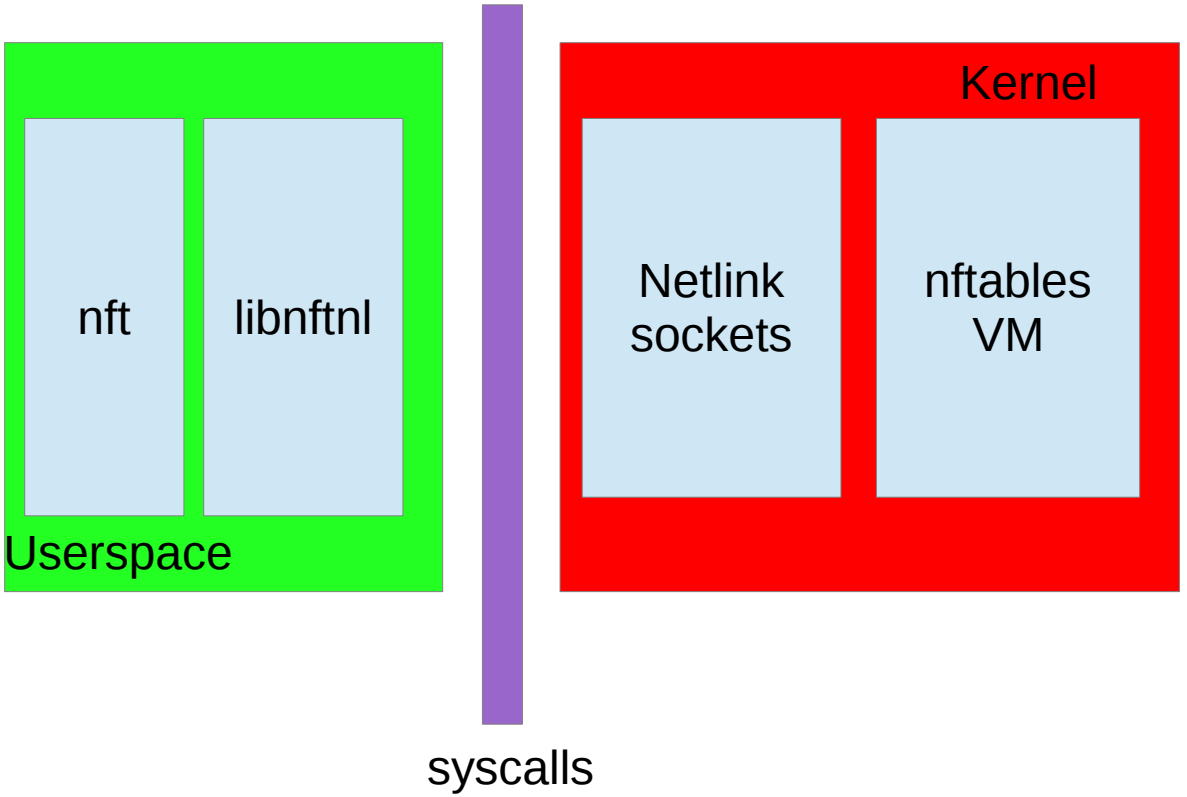
”Consul” The Educated Monkey.
“Computing Device” by
William H. Robertson (1823-1898)

  - Specific purpose VM
    - 22 instructions
    - 32/128 addressable regs
    - Very simple bytecode verifications



- Extensible like...
  - Netlink socket interface

Let's look at internals... (2)



nftables internals

- nft --debug=netlink add rule ip foo bar ct state new \
  ip saddr 192.168.0.0-192.168.0.13 tcp dport 22 accept

  ip foo bar

  [ct load state => reg 1]

  [bitwise reg 1 = (reg=1 & 0x00000008) ^ 0x00000000]

  [cmp neq reg 1 0x00000000]

  [payload load 4b @ network header + 12 => reg 1]

  [cmp gte reg 1 0x0000a8c0]

  [cmp lte reg 1 0x0d00a8c0]

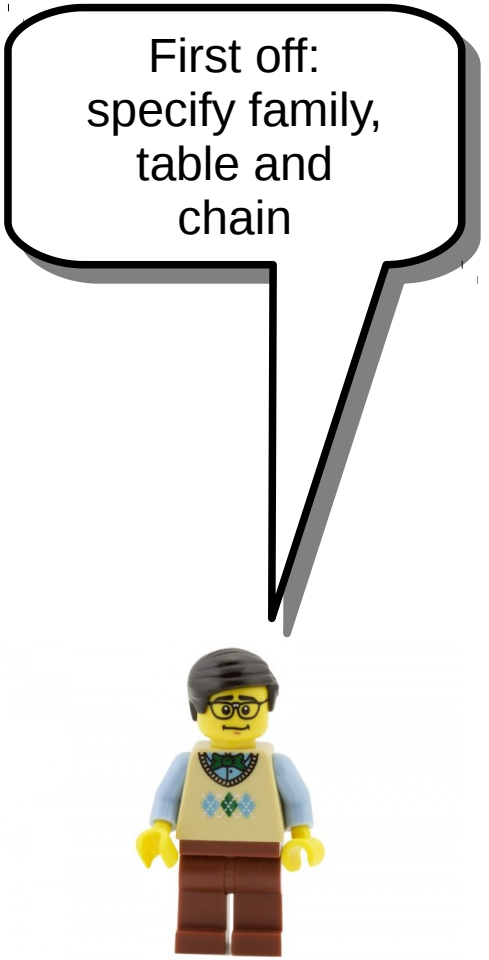
  [payload load 1b @ network header + 9 => reg 1]

  [cmp eq reg 1 0x00000006]

  [payload load 2b @ transport header + 2 => reg 1]

  [cmp eq reg 1 0x00001600]

  [immediate reg 0 accept]



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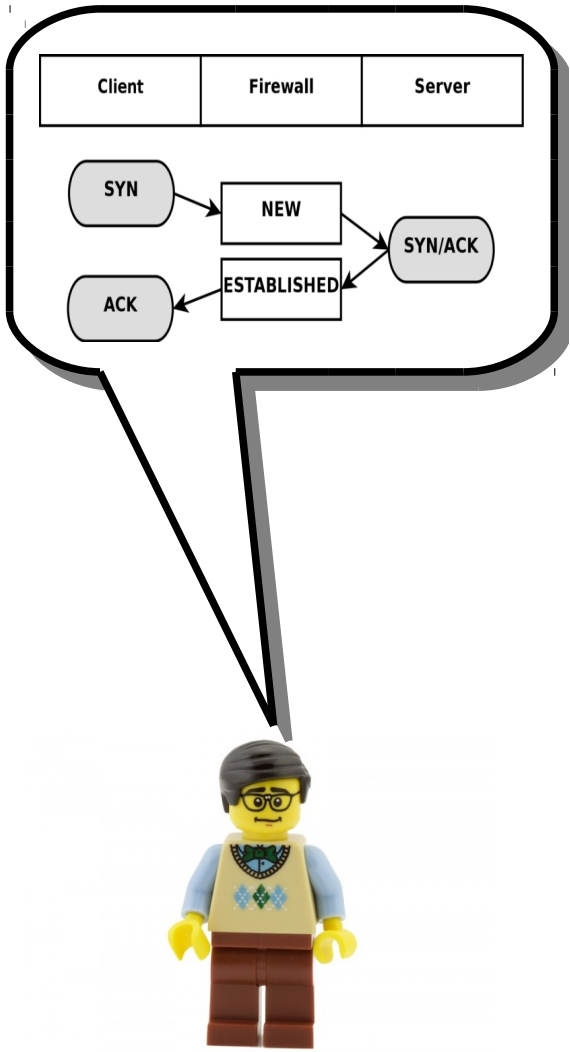

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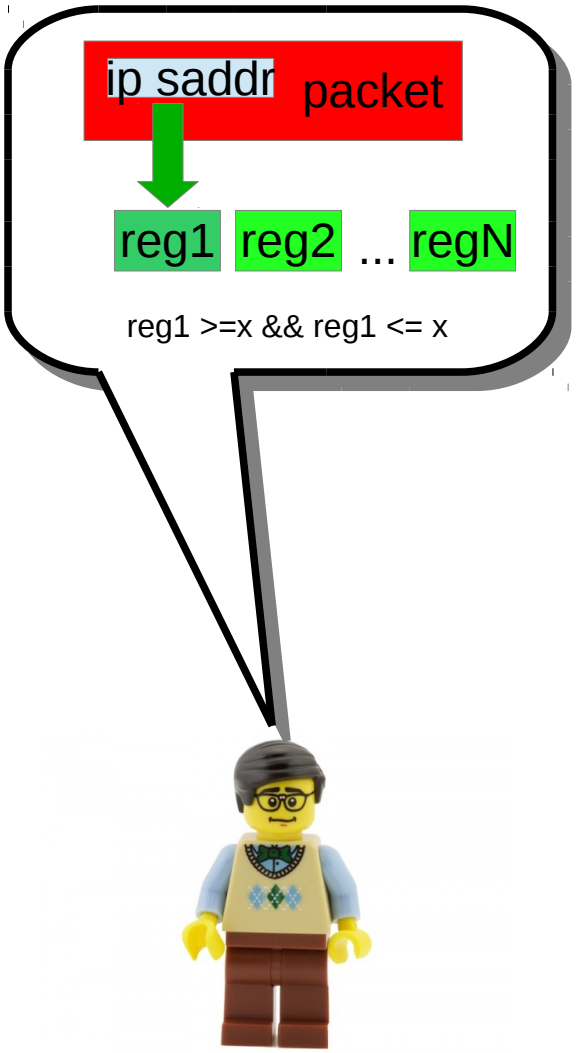

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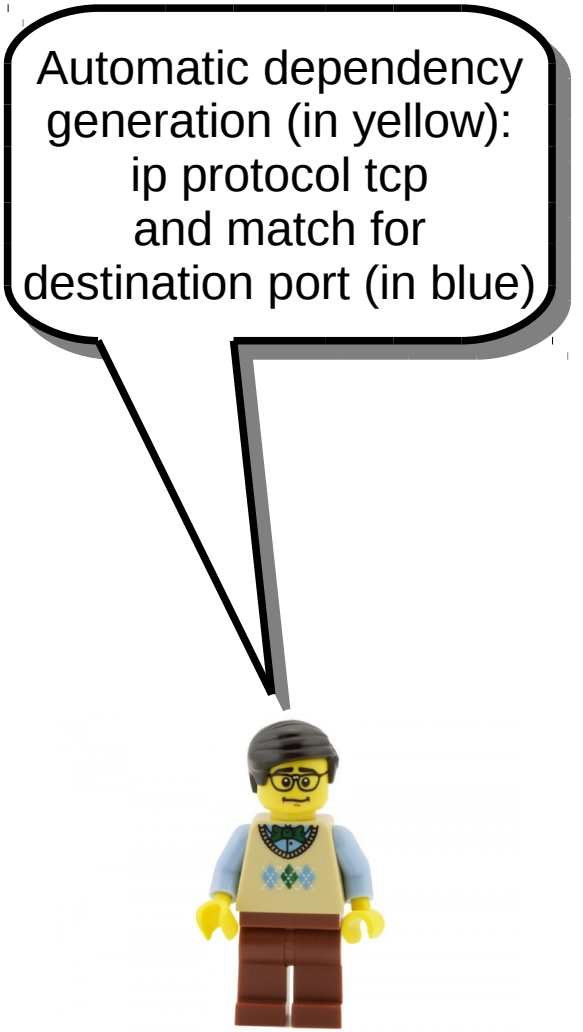

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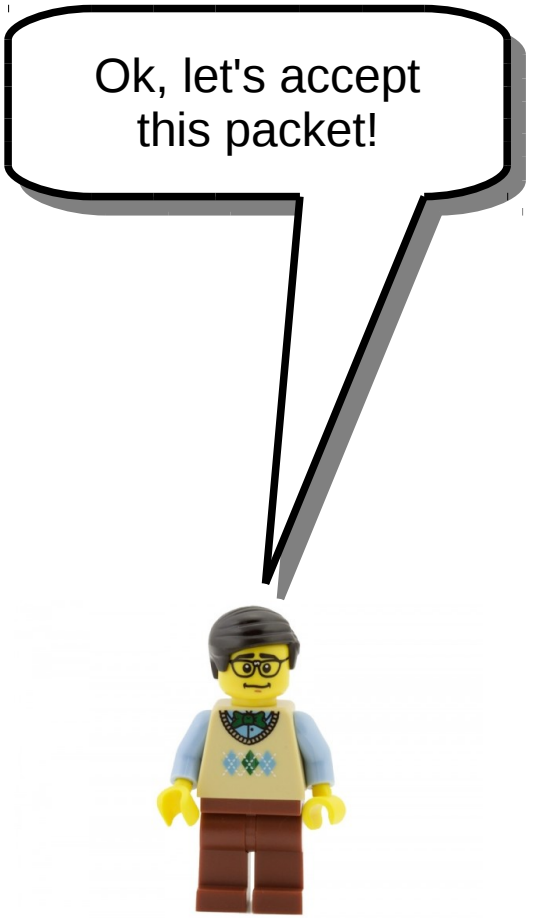
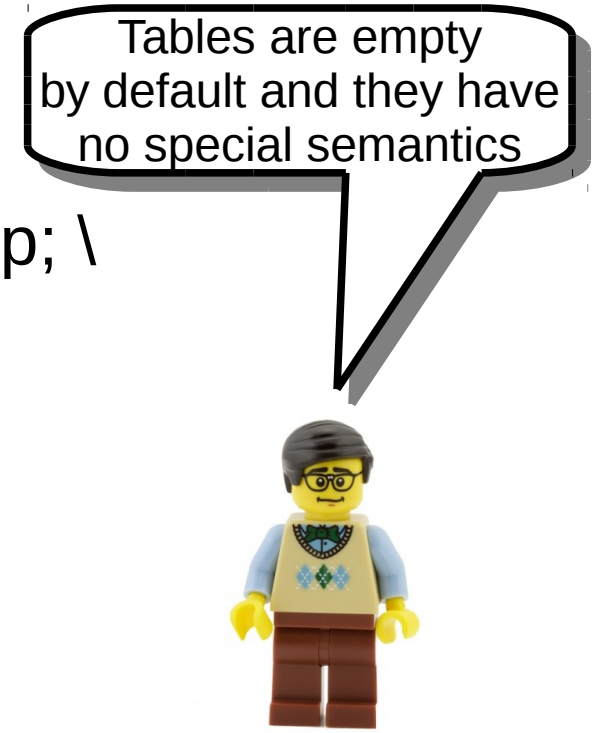


Tables, chains and rules

- nft add table ip foo
- nft add chain ip foo bar { \
  type filter hook input priority 0; policy drop; \
  }
- nft add rule ip foo bar \
  ct state established,related accept
  nft add rule ip foo bar \
  ct state new tcp dport 22 accept



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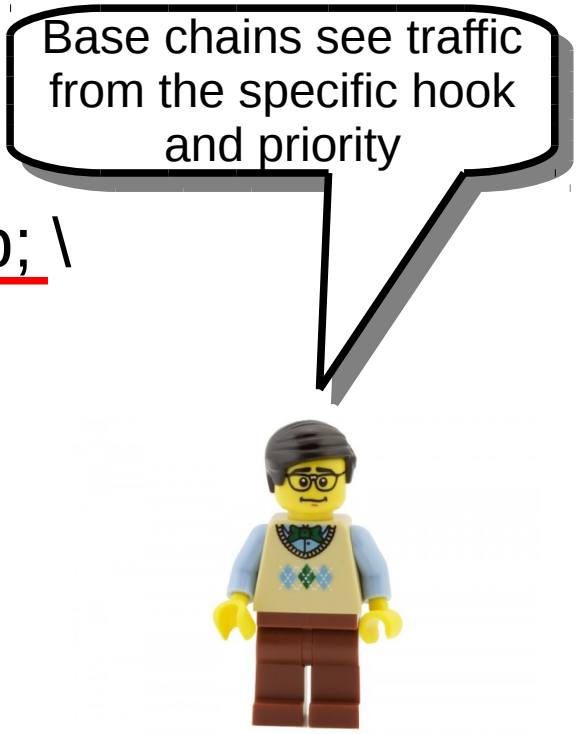

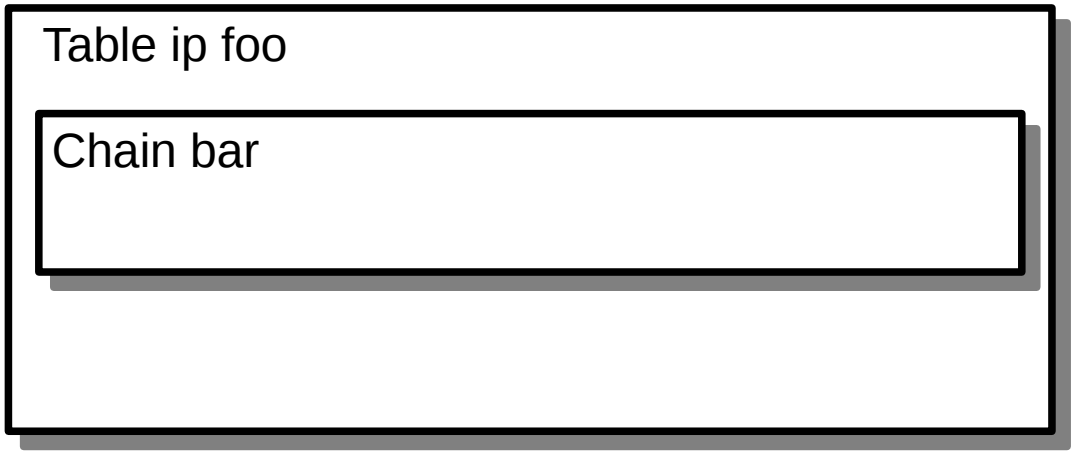

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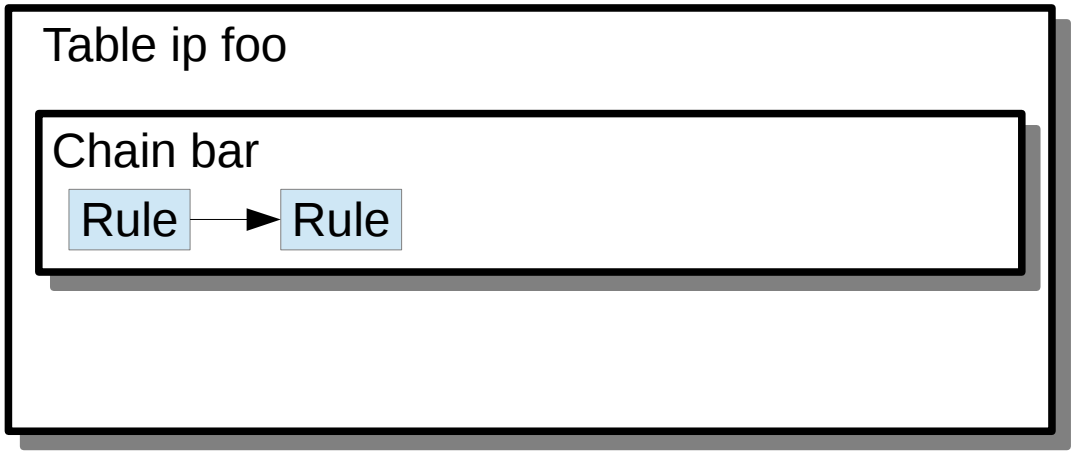

Expressions

- nft add rule ip foo bar tcp dport != 80
- nft add rule ip foo bar tcp dport 1-1024
- nft add rule ip foo bar meta skuid 1000-1100
- nft add rule ip foo bar ip daddr 192.168.10.0/24
- nft add rule ip foo bar meta mark 0xffffff00/24
- nft add rule ip foo bar ct state new,established
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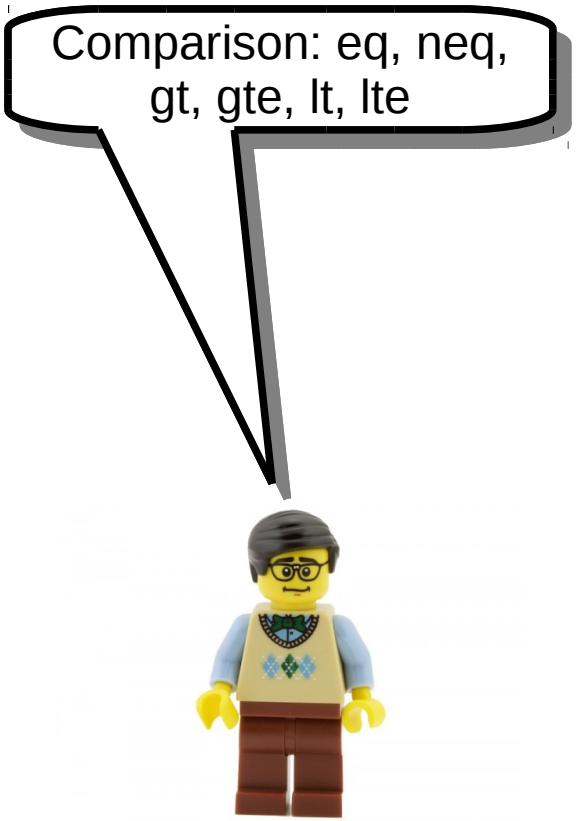

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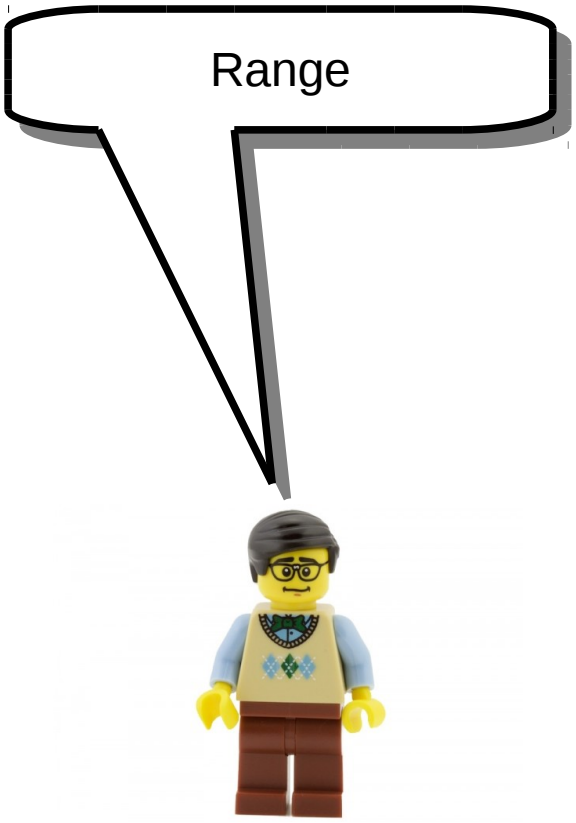

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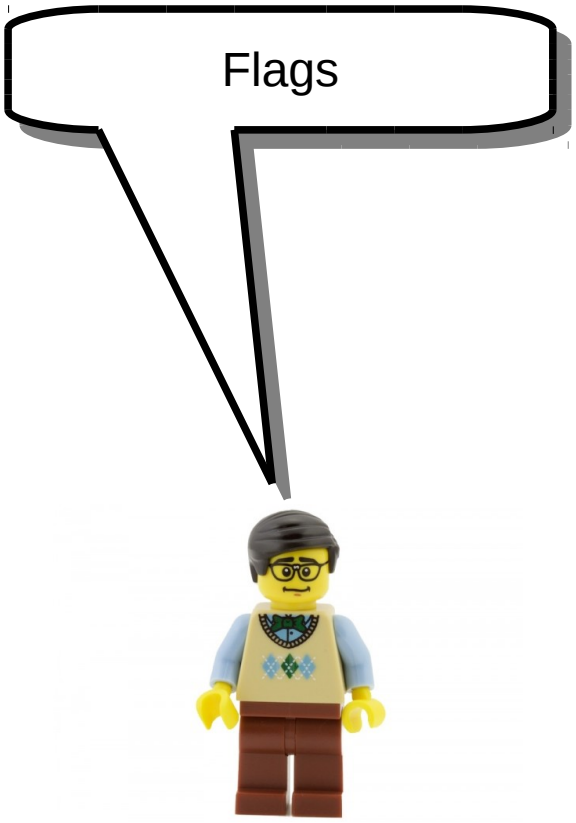

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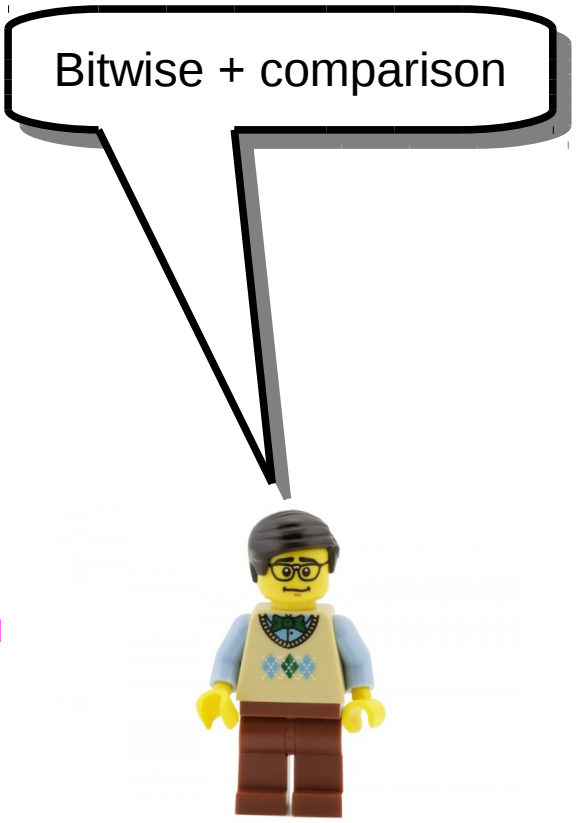

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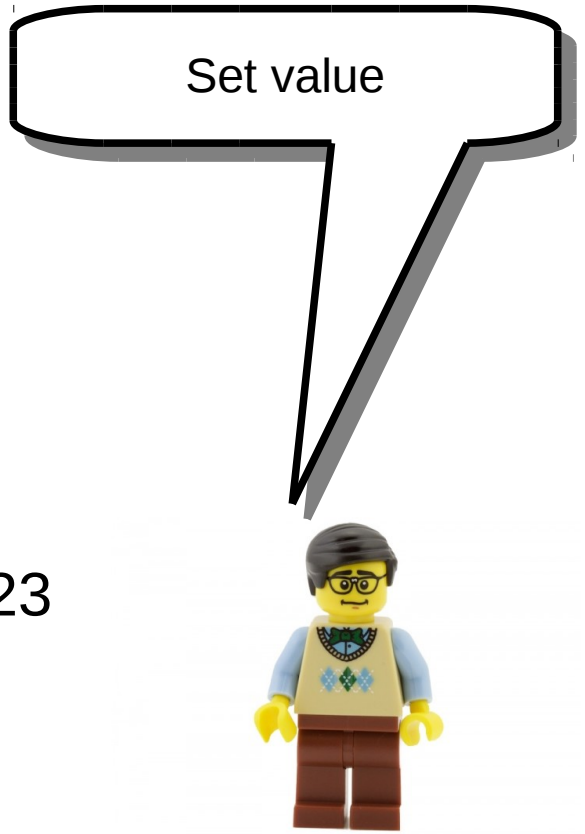
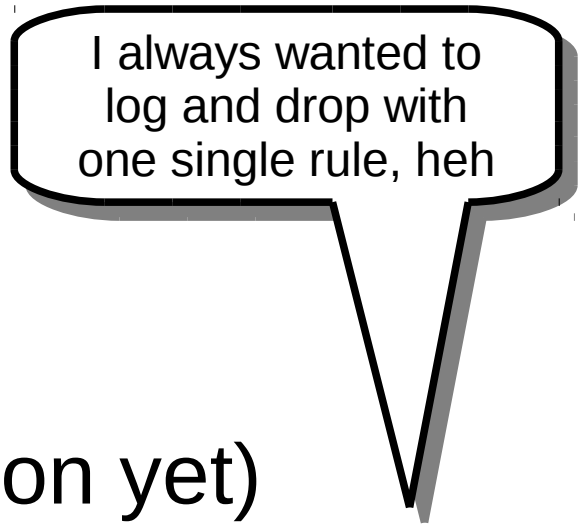


Rules

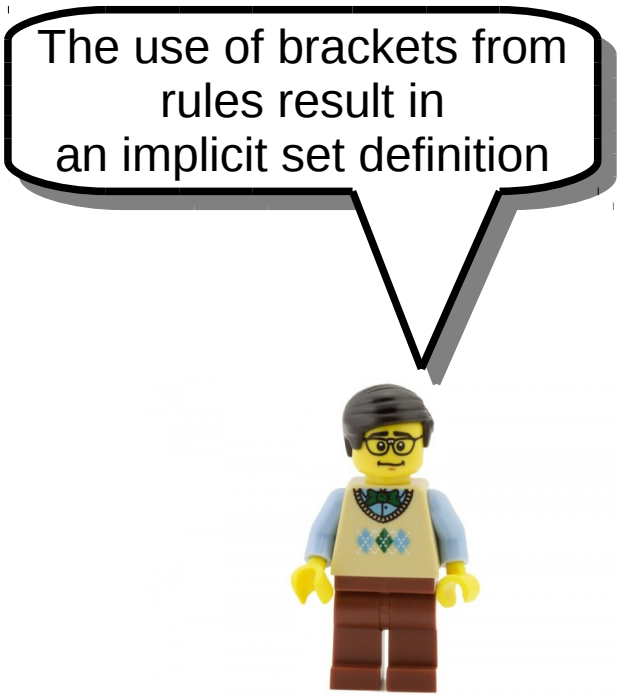
- Counters are optional (unlike iptables)
  - nft add rule ip foo bar counter
- Several actions in one rule
  - nft add rule ip foo bar ct state invalid \
    log prefix “invalid: “ drop
- Interactive mode (no autocompletion yet)
  - nft -i

    nft> add table foo



Sets and maps

- nft add rule ip foo bar tcp dport { 22, 80, 443 } counter
- nft add set ip foo whitelist { type ipv4_addr \; }
  nft add rule ip foo bar ip daddr @whitelist counter accept
  nft add element ip foo whitelist { \
  192.168.0.1, \
  192.168.0.10 \
  }
- nft add table ip nat
  nft add chain ip nat post { \
  type nat hook postrouting priority 0\; }
  nft add rule ip nat post snat ip saddr map { \
  1.1.1.0/24 : 192.168.3.11 , \
  2.2.2.0/24 : 192.168.3.12 \
  }



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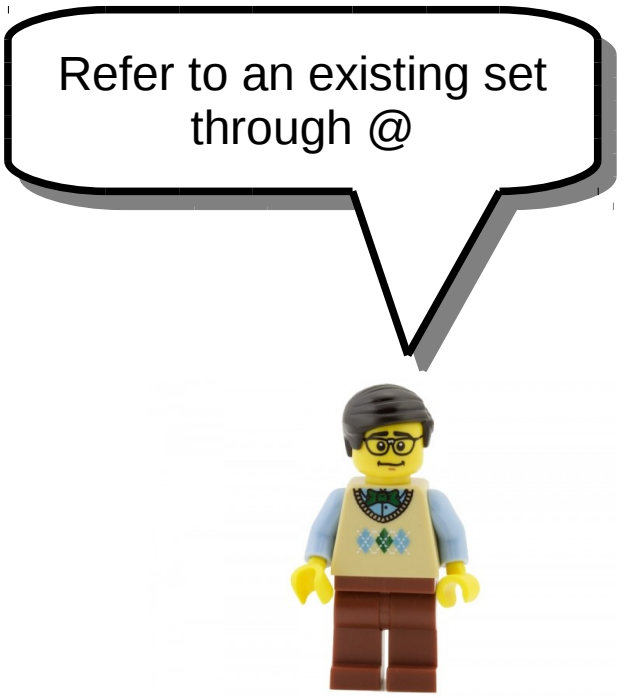

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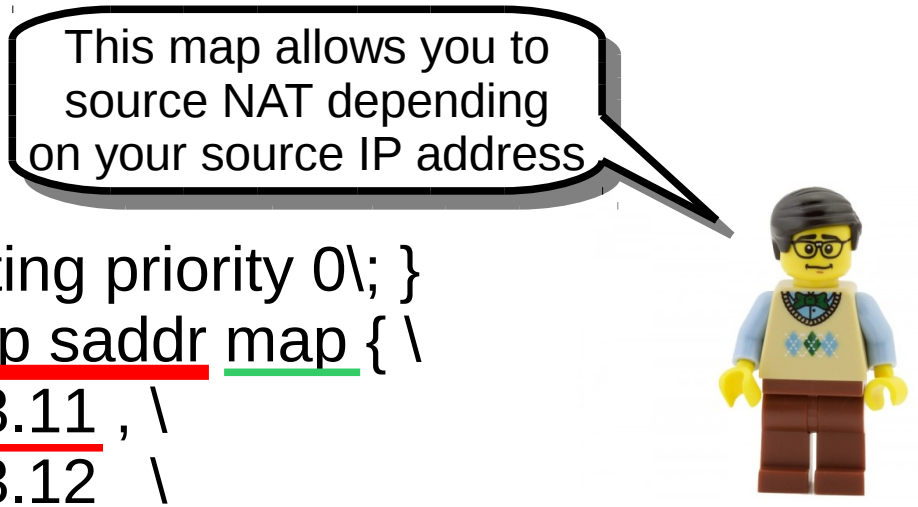


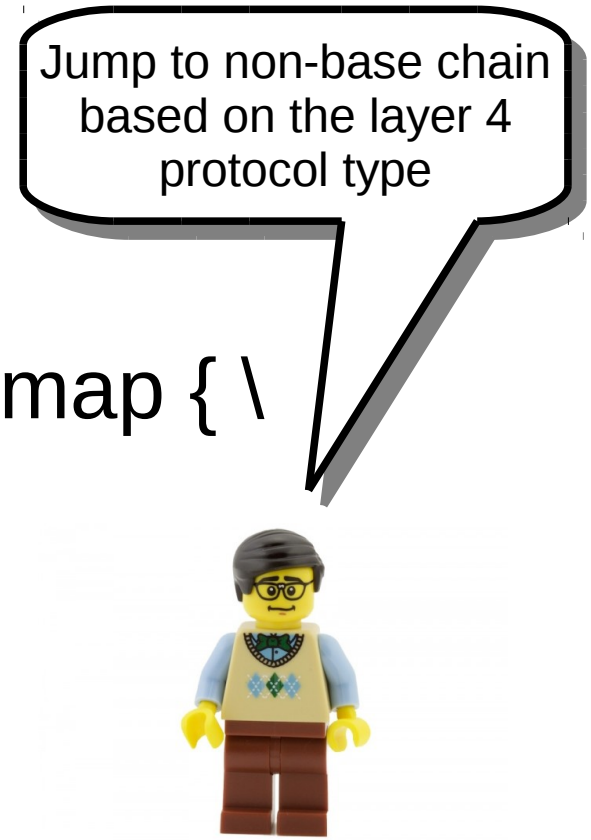
Set timeouts

- nft add set ip foo whitelist { \
  type ipv4_addr; \
  timeout 1h; \
  }
- nft add element ip foo whitelist { \
  192.168.2.123, \
  192.168.2.124, \
  }
- nft add set ip foo whitelist { \
  type ipv4_addr; flags timeout; \
  }
- nft add element ip foo whitelist { 192.168.2.123 timeout 10s }

Dictionaries

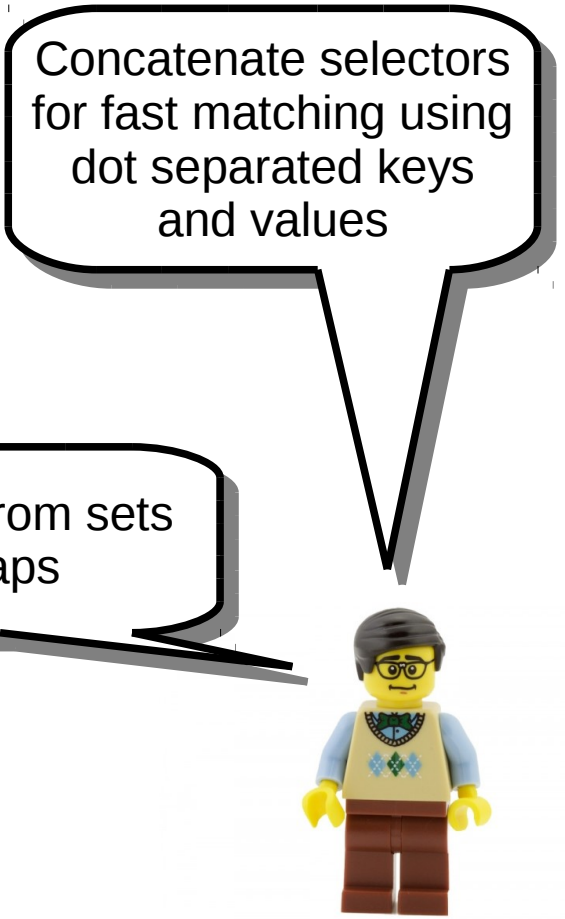
- nft add chain ip foo tcp-chain
  nft add chain ip foo udp-chain
  nft add chain ip foo icmp-chain

- nft add rule ip foo bar ip protocol vmap { \
  tcp : jump tcp-chain, \
  udp : jump udp-chain, \
  icmp : jump icmp-chain
  }



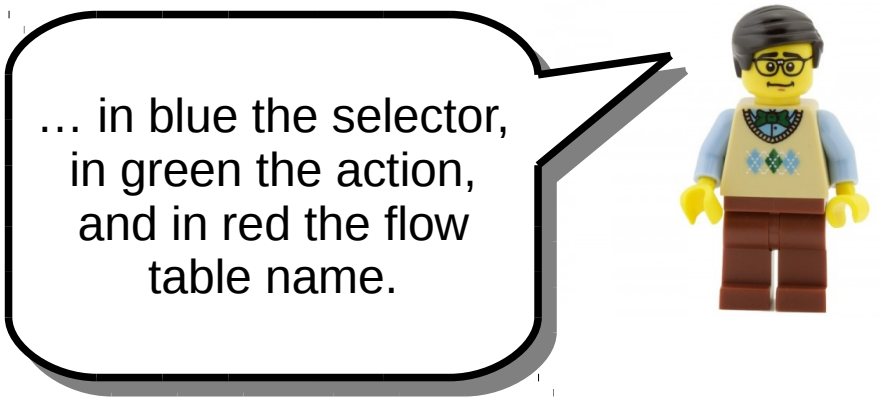
Contenations

- nft add rule netdev foo bar \
  ether saddr . ip saddr . tcp dport { \
  c0:fe:00:c0:fe:00 . 192.168.1.123 . 80, \
  be:ef:00:be:ef:00 . 192.168.1.120 . 22} \
  counter accept
- nft add rule netdev foo bar ip saddr . tcp dport vmap { \
  192.168.1.123 . 22 : jump whitelist, \
  192.168.1.123 . 80 : jump whitelist, \
  }
- nft add set netdev foo bar { \
  type ether_addr . ipv4_addr \; }
- nft add element netdev foo bar { \
  00:ca:fe:00:be:ef . 192.168.1.123, \
  00:ab:cd:ef:00:12 . 192.168.1.124 \
  }



Flow tables

- nft add rule ip foo bar ct state new tcp dport 22 \
  flow table ssh-spammer { \
  ip saddr limit rate over 3/second
  } log prefix \"New SSH connection: \" drop
- nft list flow table ssh-spammer



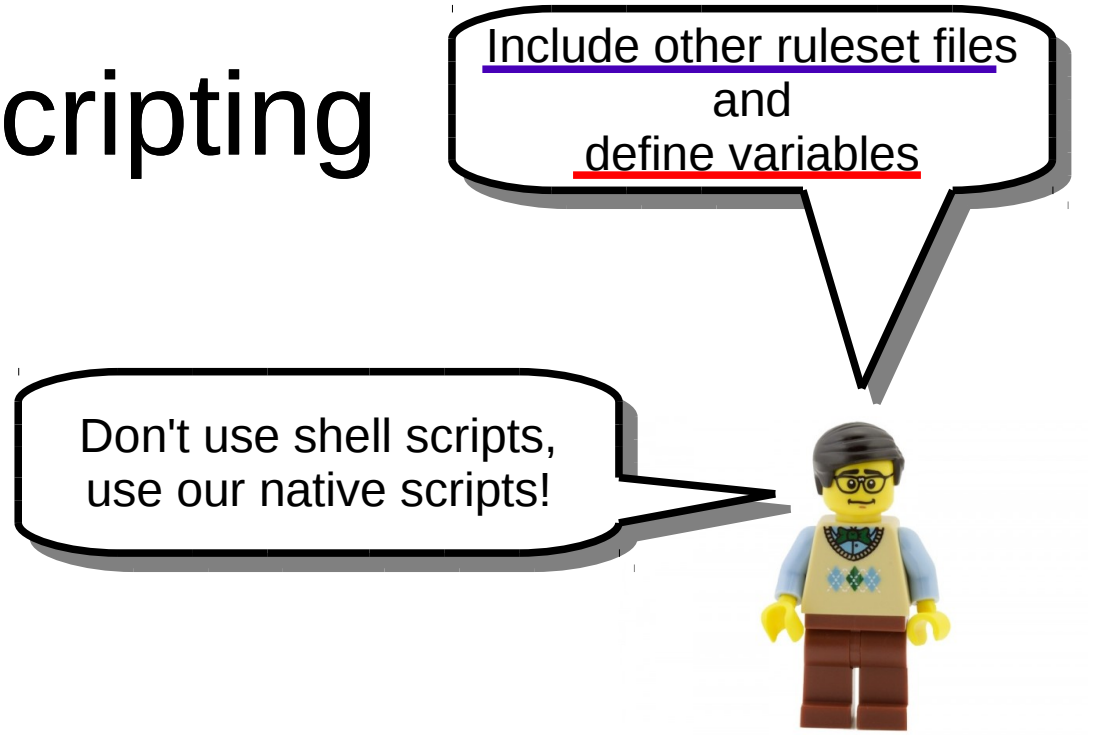
More actions

```
nft add rule foo bar reject with icmp type host-unreachable
nft add rule netdev foo ingress \
    limit rate 10 mbytes/second accept
nft add rule netdev foo prerouting queue num 3
nft add rule netdev foo ingress \
    ether daddr ab:cd:de:ff:00:01 fwd to vethXYZ
nft add rule netdev foo ingress ip daddr 1.2.3.4 dup to dummy0
nft add rule nat postrouting snat 1.2.3.4
nft add rule nat postrouting masquerade
nft add rule foo prerouting tcp dport 80 tcp dport set 8080
```

Comments

- nft add rule ip foo bar \
  ip daddr 8.8.8.8 counter accept\
  comment \“google dns\”
- nft add set ip foo dns-whitelist {\
  type ipv4_addr\;
  }
- nft add element ip foo dns-whitelist { \
  8.8.8.8 comment “google dns”, \
  192.203.230.10 comment “nasa dns”,
  }

Scripting

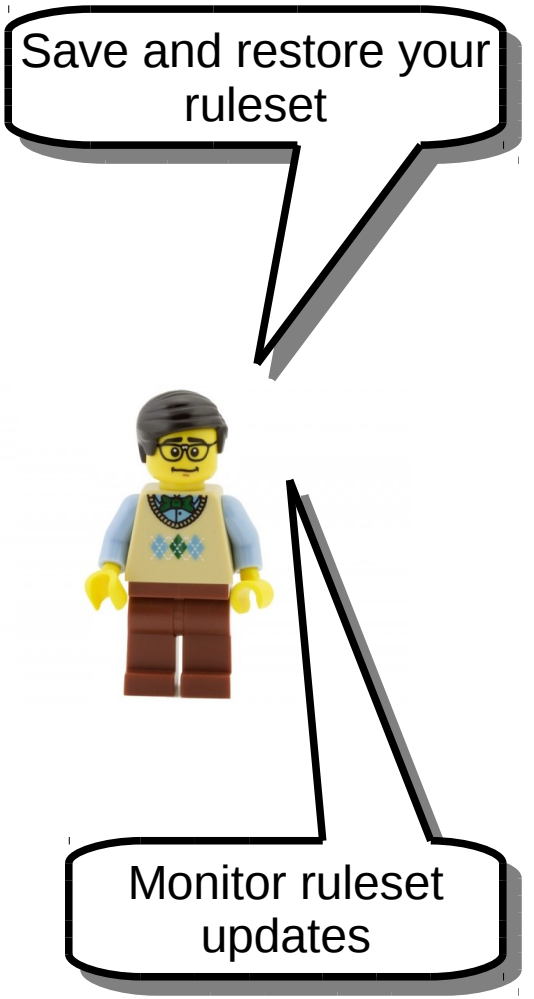



```
#!/usr/sbin/nft

include "another-ruleset.nft"


#
# Allowed NTP servers
#
define ntp_servers = { 84.77.40.132, 176.31.53.99, 81.19.96.148,
138.100.62.8 }

add rule netdev foo bar ip saddr $ntp_servers udp dport 123 counter
```

Restoring ruleset

- echo “flush ruleset” > ruleset.nft
- nft list ruleset >> ruleset.nft
- nft -f ruleset.nft

  nft export ruleset json > ruleset.json



Monitoring update

- nft monitor
- nft monitor new rules

Tracing

- nft add rule foo prerouting meta trace 1
- nft monitor trace

Learn more and help us

- Grab the code
  - Kernel: http://www.kernel.org
  - Library: git://git.netfilter.org/libnftnl
  - User-space: git://git.netfilter.org/nftables
- Documentation
  - http://wiki.nftables.org
  - man nft
- Report bugs:
  - https://bugzilla.netfilter.org
- Follows us @nftables

nftables tutorial

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