Load Balancing with nftables II

by Laura García (Zen Load Balancer Team)
Netdev 1.2

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Development Evolution

Development Evolution

New expressions available

➔ **nft_numgen**: number generator with two modes.

- Incremental
- Random

Ability to scale the values and add an offset

➔ **nft_hash**: Hash any selector concatenation, one mode.

- Jenkins

nft_numgen expression (based on xt_statistics)

➔ Incremental counter for round robin scheduler.

ip daddr <vip> tcp dport <vport> dnat to **numgen inc mod 2** map { 0 : <ipaddr0>, 1 : <ipaddr1> }

meta mark set **numgen inc mod 3 offset 100**

(100, 101, 102, 100, ...)

➔ Random generation for weight scheduler.

ip daddr <vip> tcp dport <vport> dnat to **numgen random mod 2** \

map { 0 : <ipaddr0>, 1 : <ipaddr1> }

meta mark set **numgen random mod 3 offset 100**

(100-102)

nft_hash expression

➔ Hash function for persistence.

ip daddr <vip> tcp dport <vport> dnat to **jhash ip saddr mod 2** \
map { 0: <ipaddr0>, 1: <ipaddr1> }
meta mark set **jhash ip saddr mod 3 seed 0xabcd offset 100**
(100-102)

Requirements:

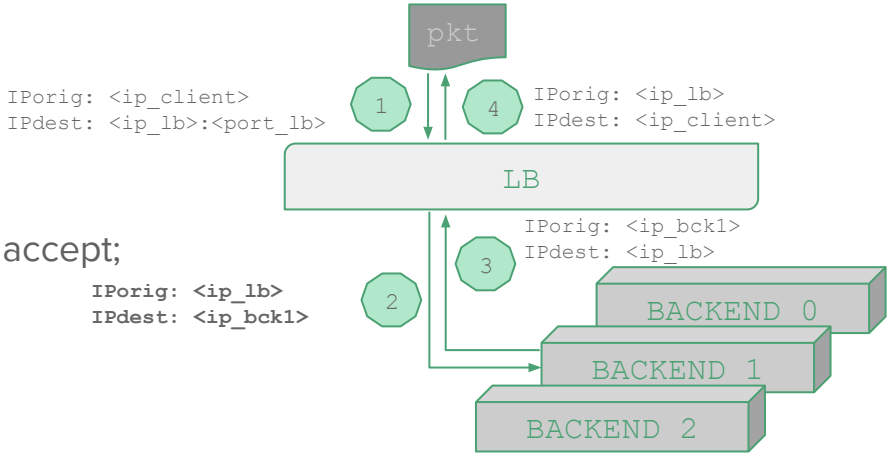
- ★ kernel >= 4.8.0-rc4+ (nf-next branch)
- ★ libnftnl > 1.0.6
- ★ nftables > 0.7 (not yet released)

Use Cases Review

(The definitive syntax)

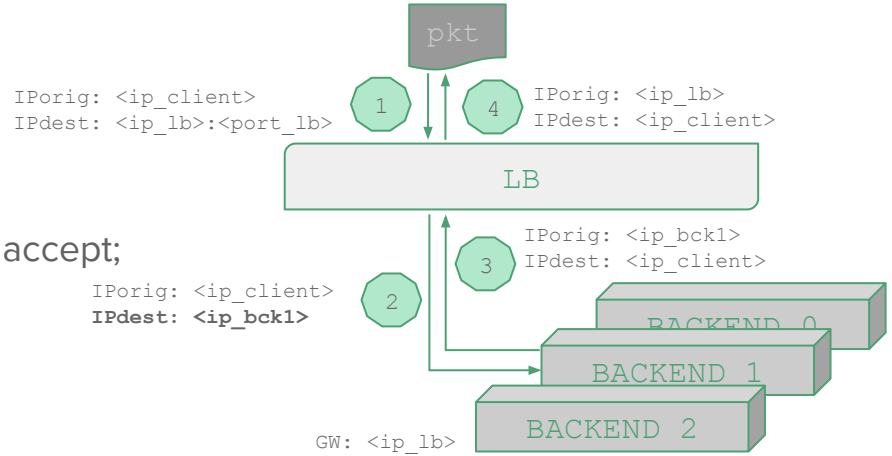
sNAT Topology

```
table ip nat {
        chain prerouting {
                type nat hook prerouting priority 0; policy accept;
                ip daddr <ip_lb> tcp dport <port_lb> dnat to numgen inc mod 3 map { \
                        0 : <ip_bck0>, \
                        1 : <ip_bck1>, \
                        2 : <ip_bck2> }
        }
        chain postrouting {
                type nat hook postrouting priority 100; policy accept;
                masquerade
        }
}
```



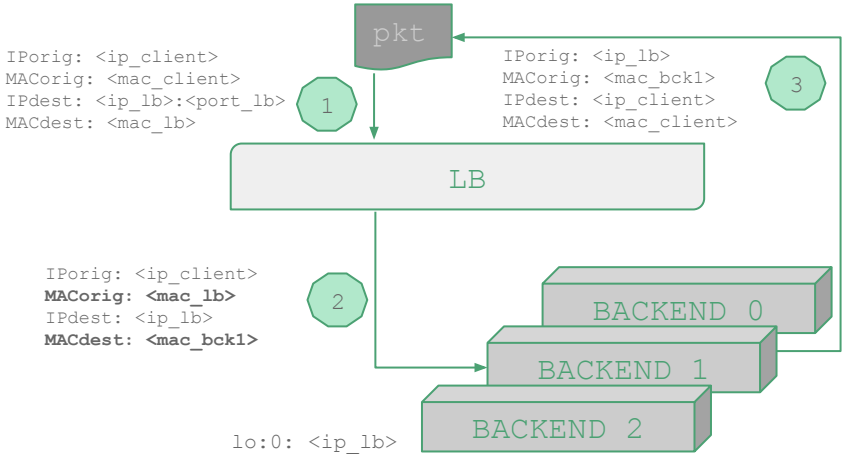
dNAT Topology

```
table ip nat {
        chain prerouting {
                type nat hook prerouting priority 0; policy accept;
                ip daddr <ip_lb> tcp dport <port_lb> dnat to numgen random mod 3 map { \
                        0 : <ip_bck0>, \
                        1 : <ip_bck1>, \
                        2 : <ip_bck2> }
        }
        chain postrouting {
                type nat hook postrouting priority 100; policy accept;
        }
}
```



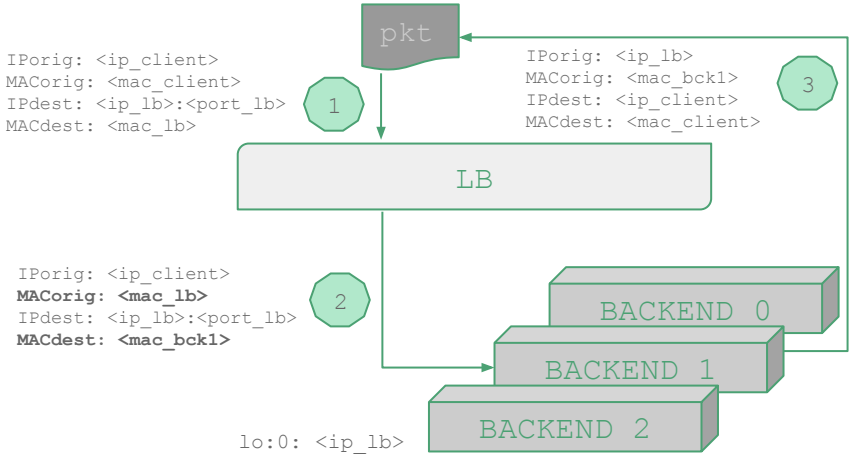
DSR Topology (non connection oriented)

```
table netdev filter {
        chain ingress {
                type filter hook ingress device <if_lb> priority 0; policy accept;
                ip daddr <ip_lb> udp dport <port_lb> ether saddr set <mac_lb> \
                        ether daddr set numgen inc mod 3 \
                        map { \
                                0: <mac_bck0>, \
                                1: <mac_bck1>, \
                                2: <mac_bck2> } \
                        fwd to <if_lb>
        }
}
```



DSR Topology (connection oriented)

```
table netdev filter {
        chain ingress {
                type filter hook ingress device <if_lb> priority 0; policy accept;
                ip daddr <ip_lb> tcp dport <port_lb> ether saddr set <mac_lb> \
                        ether daddr set jhash ip saddr . tcp sport mod 3 seed 0xabcd \
                        map { \
                                0: <mac_bck0>, \
                                1: <mac_bck1>, \
                                2: <mac_bck2> } \
                        fwd to <if_lb>
        }
}
```



Benchmarks

Lab Environment

Kernel version 4.8.0-rc4+ branch nf-next

2 clients, 3 backends & 1 LB

2 cores (3.33 GHz each) i5 660 with 2 threads/core, 4GB RAM @1333 MHz

2 Intel Gigabit Network 82578DM & 82574L per machine

System tuning considerations from József paper

HTTP protocol transferring 229 bytes per connection (client wrk/server nginx)

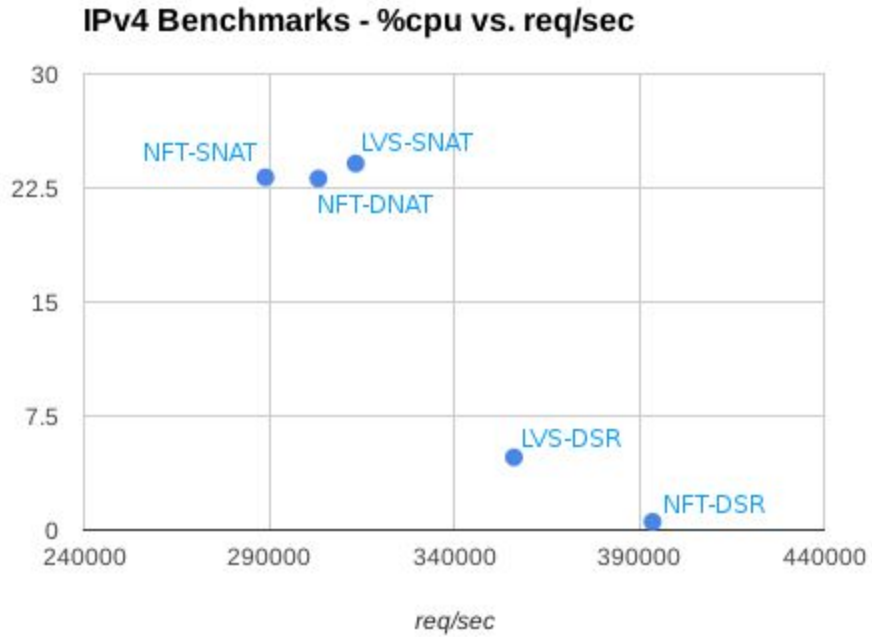
Both IPv4 & IPv6

LB was never saturated during a test of 30 seconds

LVS performance used as a reference

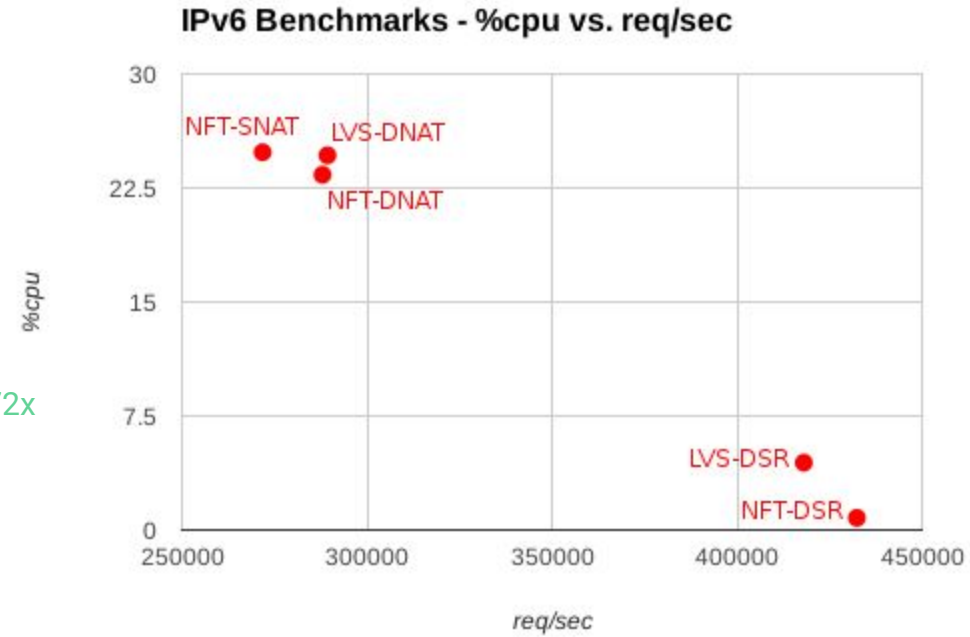
IPv4 Benchmarks

method	req/sec	%cpu	
LVS-SNAT	313427.91	24.11	
NFT-SNAT	289035.54	23.2	
NFT-DNAT	303356.59	23.12	
LVS-DSR	356212.05	4.78	
NFT-DSR	393672.35	0.54	+9.78x



IPv6 Benchmarks

method	req/sec	%cpu	
LVS-DNAT	289320.17	24.65	
NFT-SNAT	271790.98	24.85	
NFT-DNAT	287978.41	23.37	
LVS-DSR	418067.65	4.43	
NFT-DSR	432399.38	0.8	+5.72x



Work To Do

Work To Do

- ★ Lightweight NAT from hook ingress to improve NAT results
- ★ User space nft rules manager:
  - Set basic and complex algorithms
  - Manage different topologies easily
- ★ Health checks monitor
  - Layered support
  - Internal and external monitor

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