bridge filtering with nftables

Florian Westphal
4096R/AD5FF600 fw@strlen.de
80A9 20C5 B203 E069 F586
AE9F 7091 A8D9 AD5F F600

Red Hat

February 2016

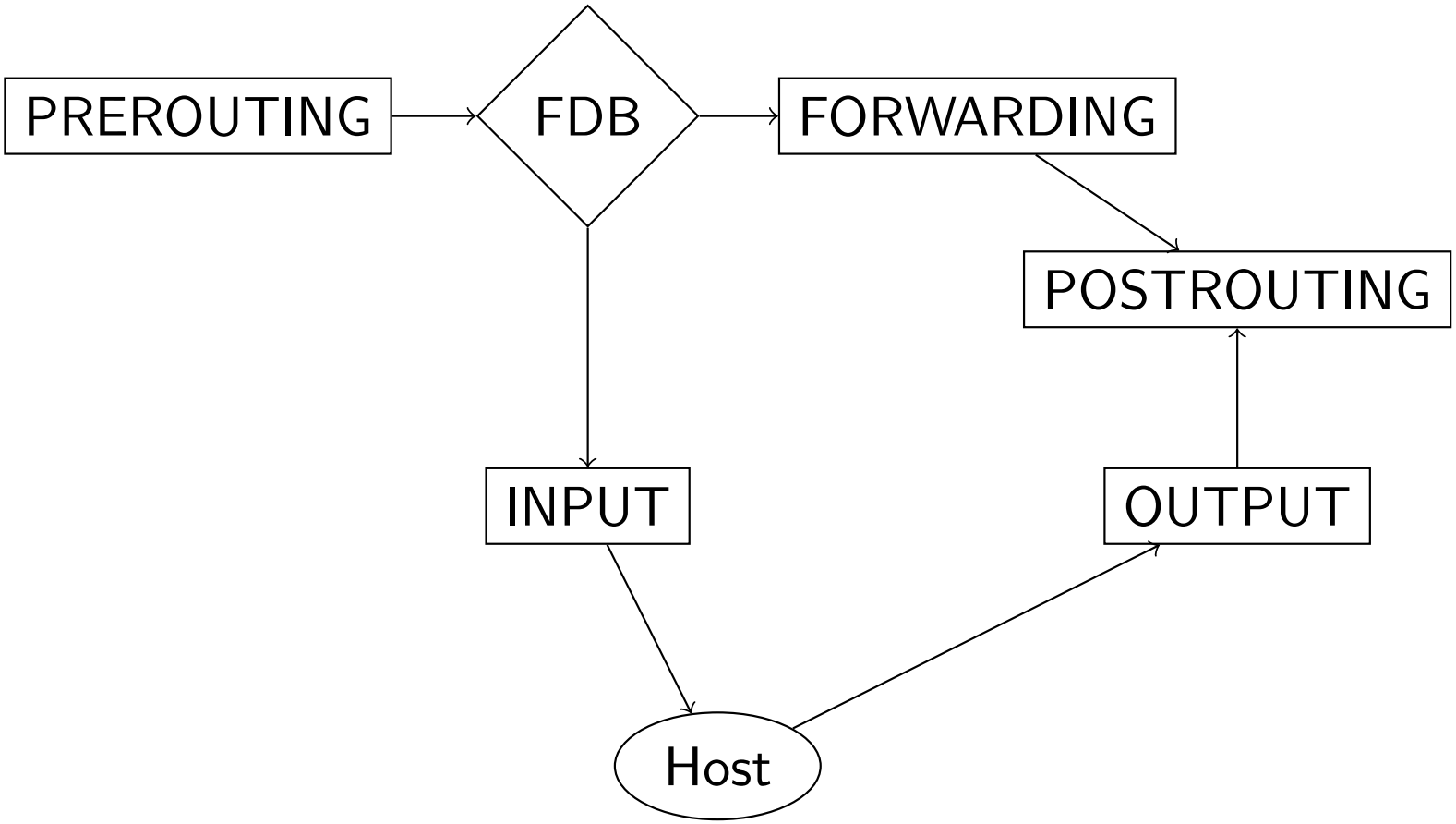
Intro

- same concept as netfilter ipv4/ipv6
- "hooks" are placed at various spots in the bridge module
- kernel modules can register functions to be called at these hook points

```
NF_HOOK(NFPROTO_BRIDGE, NF_BR_PRE_ROUTING, skb, skb->dev,
        NULL, br_handle_frame_finish);
```

- iterates over registered functions and calls them
- functions can decide fate of packet (continue, drop, . . .)

Kernel Bridge Hooks



current state: ebtables

- cloned off iptables more than a decade ago
- offers a few (stateless) matches and targets
  - ip/ip6 addresses, vlan id
  - packet type (i.e. multicast, broadcast, ...)
  - packet mark
  - src/dst MAC rewrite, redirect to local stack support (routing, proxies)
- bridge netfilter hooks placed in bridge code, similar to ip stack
- no stateful matches, no connection tracking
- ebtables cannot use xtables targets or modules

call-iptables (1)

- `br_netfilter.ko` – implements `call-iptables` mode:
- invoke ip/ipv6 nf hooks from the bridge path
- upside:
  - provides all xtables modules and targets (via iptables ruleset on the bridge)
  - conntrack support, L3/L4 NAT
- downside:
  - many subtle layering violations and problems
  - inet "owns" `skb->cb[]`: save/restore for each iptables trip
  - in iptables indev and outdev is bridge, i.e. `-i br0` instead of bridge port
  - VLAN mess: allows temporary removal of VLAN header
    - end host/router doesn't care, filtering via ifname ("`-i eth0.42`")
    - VLAN data only accessible from bridge hooks

call-iptables (2) – conntrack

- the good news: It'll work
- unless you have overlapping addresses (different bridges, VLANs)
- unless you need/use `NFQUEUE` to have packets inspected by userspace (e.g. suricata).
- bridge has to consult ipv4 FIB to cope with NAT
- also needs to cope with e.g. re-lookup of the destination MAC address
- `skb->nf_bridge` exists only because of the call-iptables mode

Summary

- bridge filtering is usually done with both ebtables and iptables rulesets
- ... because thats the only way you get conntrack + iptables features
- at least one long standing oops (call-iptables+conntrack+nfqueue) remaining
- another problem: netfilter hooks are per namespace, not per bridge
- ebtables == 'iptables from 2001' (e.g. rwlock in main traverser)

nfqueue

- pass packets to userspace via netlink
- userspace can drop or accept packet
- userspace can rewrite/replace payload
- backend is limited to ip and ipv6
- netlink attributes provided (incomplete list):
  - the family and hook that queued the packet
  - in and outgoing interface index
  - packet nfmark
  - packet payload (starts w. network header – `skb->data`)

nfqueue for bridge

- most simple solution: just push/pull eth header
- i.e. payload attribute starts with ethernet header
- several issues with this approach
  - VLAN untag or extra attribute?
  - how to allow l2 header rewriting?
    Doesn't really work since we might have to pull more data, e.g. added qinq
- seems preferable to add new netlink attributes
- bonus: can use this for netdev family too

nfqueue for bridge, plan

- add new attributes for L2 and VLAN header
- L2 – `skb_mac_header()`
  - can add L2 header expansion/shrinking since attr size is known
- VLAN – serialize skb vlan metadata
  - no need to untag queued skb
  - allows later addition of VLAN header removal

Handling overlapping addresses

- distinct VLANs might have duplicate addresses
- already a problem w. `call-iptables` and `bridge-nf-filter-vlan-tagged` enabled
- partial workaround for conntrack with `-j CT --zone x`, but not for defrag
- requires manual setup
- not very efficient with lots of vlan zone pairs due to xtables limitations

Handling overlapping addresses (2)

- could extract vlan id and use that as additional key
- would need kernel change when e.g. asking to conntrack ip inside PPPoE frames
- in light of this manual setup doesn't seem too bad

nft would not suffer from 'linear ruleset' xt problem, e.g. use map:

```
add rule bridge track pre ct zone set vlan id map {
                                        1 : 1, 2 : 2 ...
```

bridge conntrack

plan: add new bridge ct expression

- serves as ingress hook point and conntrack-enable switch
- native bridge hooks for confirmation, helpers and reply direction
- look at `skb->protocol`, then do upcall to ipv4 or ipv6 ct handler
- no tracking for outgoing connections – ip(6) conntrack already does it

bridge conntrack hook overview

add following bridge hooks:

- postrouting:
  - helper
  - confirmation
- prerouting:
  - reply traffic handling, i.e. no `NEW` ctstate also handle IP(v6) defragmentation here
- absent:
  - no input confirm (would be handled by ipv4/ipv6 hook)
  - prerouting input for new connections – only via explicit rule

no auto-defrag?

- ipv4/ipv6 conntrack forces defrag via module dependency
- "How can I disable `nf_defrag_ipv4` on ethX"?
  You can't
- How would one go about to allow this?
  Best idea so far: `defrag` expression:

  ```
  add rule bridge track pre meta iif not ethX defrag
  ```

- Need for manual config doesn't play nice with conntrack `RELATED` handling
- seems best to force-on once conntrack is used/activated

Future Work

- implement defrag+conntrack as outlined
- try to avoid dependencies – no ipv6 conntrack outload for example
- L3/L4 nat not planned at the moment
- can use `ether set daddr` plus `pkttype set unicast` to redirect packet to bridge for routing

Questions?