bridge filtering with nftables

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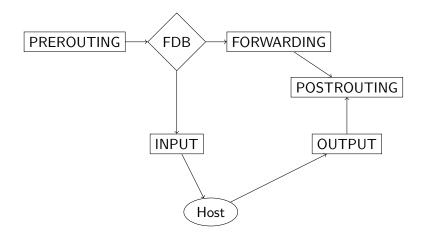
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Intro

- ▶ 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

- 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 I2 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 { $1:1,\,2:2\ldots$

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?