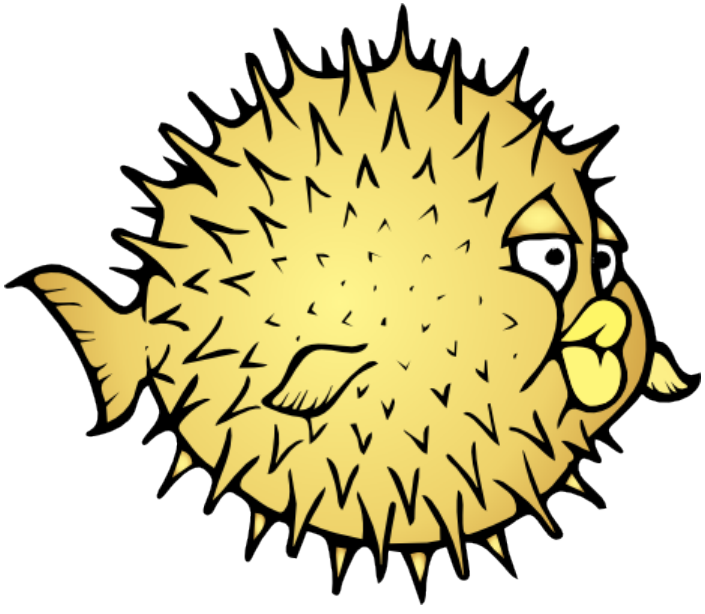
Taming OpenBSD Network Stack Dragons



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EuroBSDcon, Sofia

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Taming OpenBSD Network Stack Dragons

sys/net/radix_mpath.c

```
/*
 * Stolen from radix.c rn_addroute().
 * This is nasty code with a certain amount of magic and dragons.
 [...]
 */
```

Agenda

Motivation

Representing Addresses & Routes

Stack Metamorphosis

Where are we now?

Conclusion

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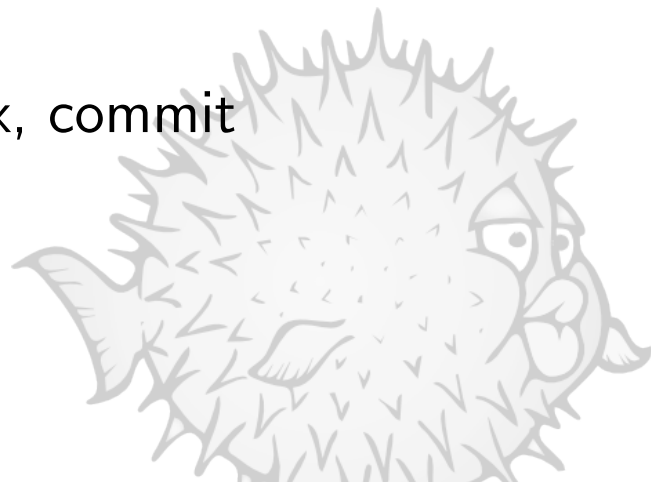
Motivation

1. Give a talk at EuroBSDCon
2. Enjoy code from the 80's
3. Make it easier to run it in parallel
   - Execute (some parts of) the forwarding path on > 1 CPUs
   - Cleaning from the "top": ioctl and ipforward paths
4. Adapt it to a Plug & Play world
5. Development process: commit early, revert, fix, commit



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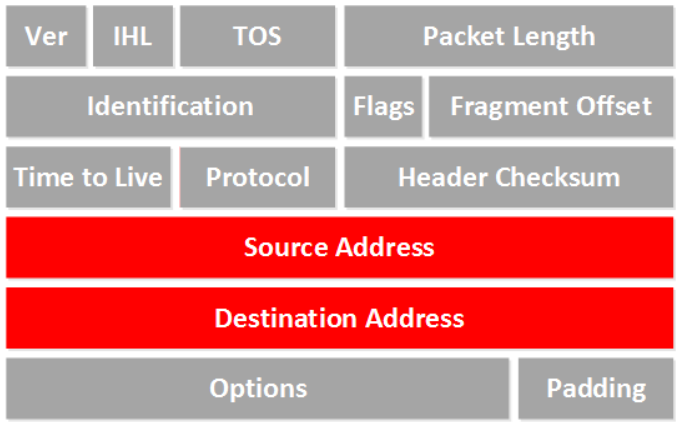
What do we use addresses for?

Identify peers

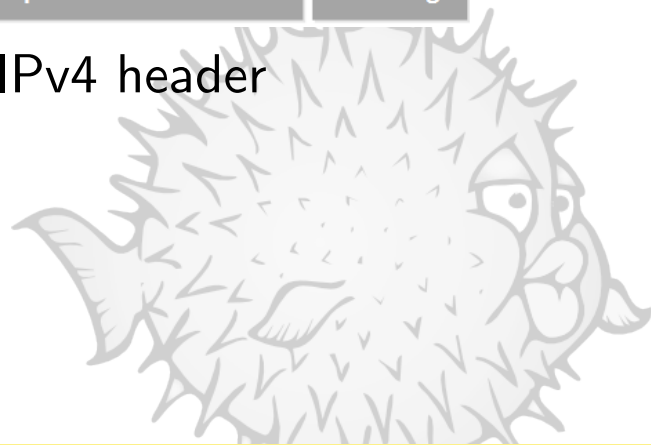
- Who is the receiver?
- Who is the sender?

Direct packets

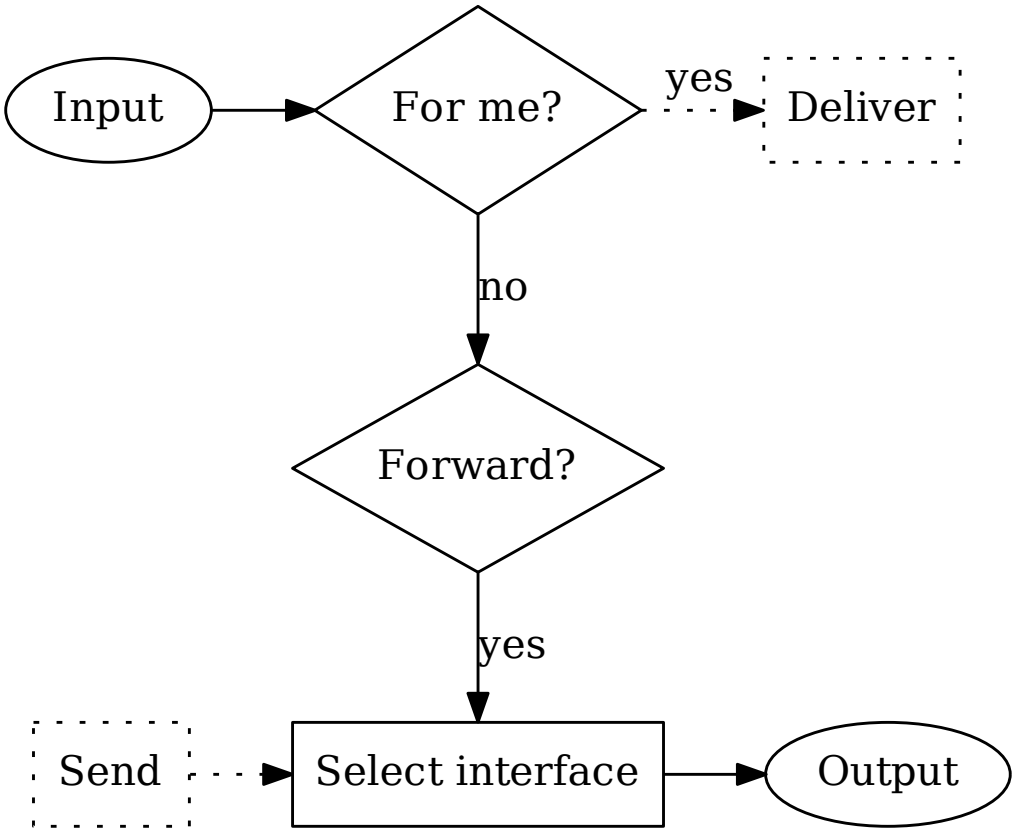
- Where is the destination?



IPv4 header

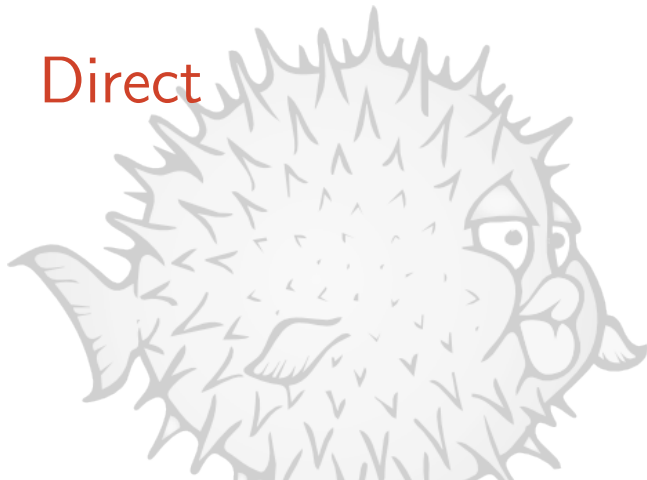


Journey of a packet



Identify

Direct



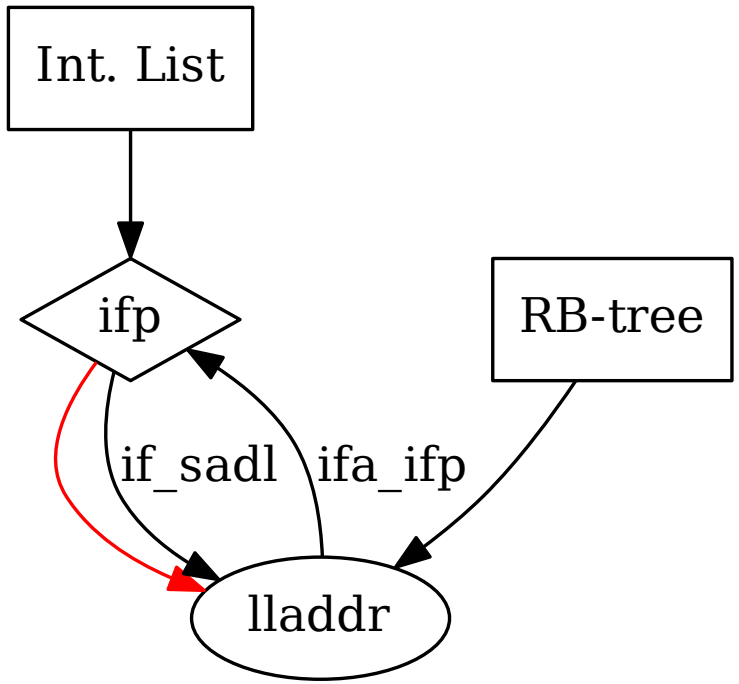
Representation of an address

Interface address (*ifa*)

```
struct ifaddr {
        struct  sockaddr *ifa_addr;     /* address of interface */
        struct  sockaddr *ifa_dstaddr; /* other end of p-to-p link */
#define ifa_broadaddr  ifa_dstaddr      /* broadcast address interface */
        struct  sockaddr *ifa_netmask; /* used to determine subnet */
        struct  ifnet *ifa_ifp;         /* back-pointer to interface */
        TAILQ_ENTRY(ifaddr) ifa_list;  /* list of addresses for interface */
        [...]
};
```

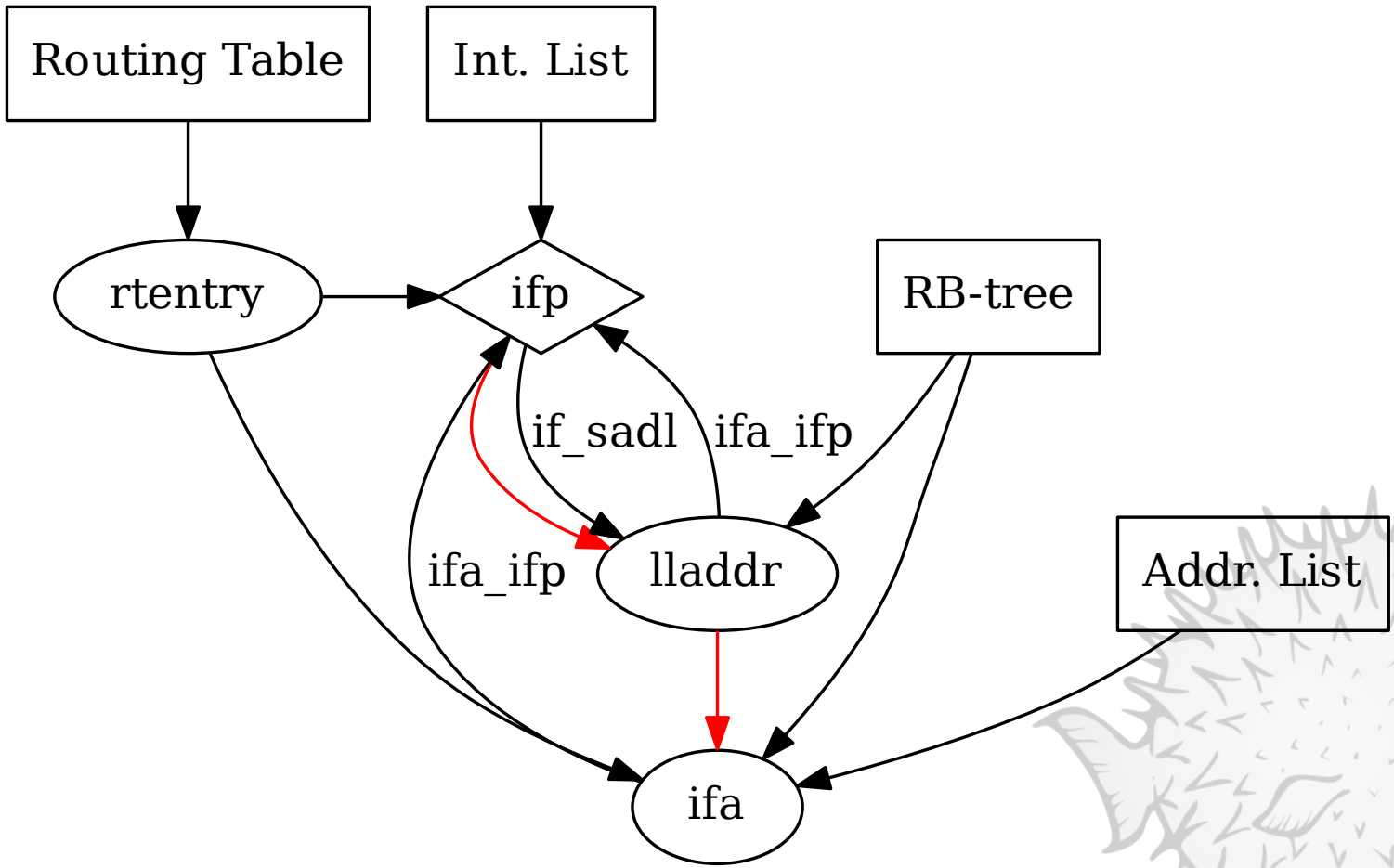
Global data structures

Interface without address

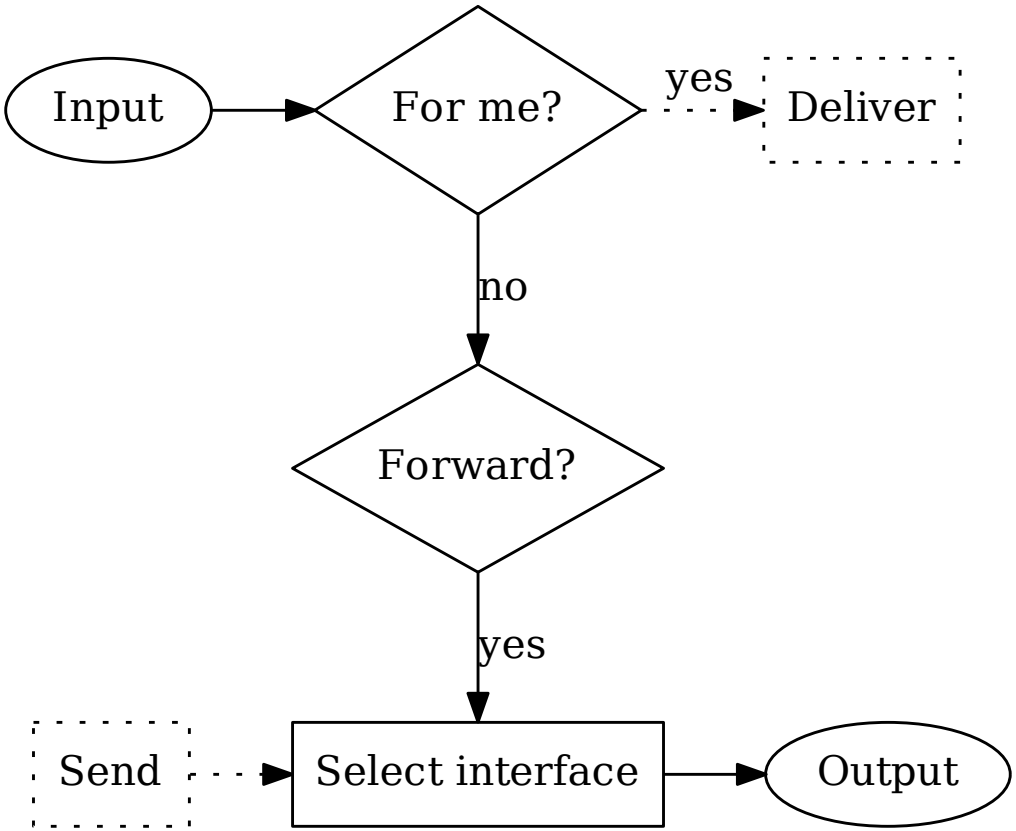


Global data structures

Interface with an address



When are they accessed?



ip_input

- RB-tree
- Addr. List
- Int. List

ip_forward

- Routing table*

ip_output

- Routing table*
- Addr. List
- Int. List

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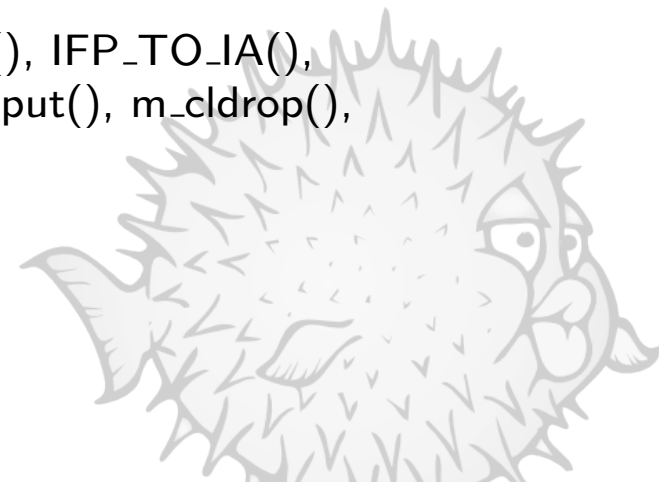
Global lists

1. Get rid of link-layer address lookups
2. Use local (per *ifp*) lists instead of global ones
3. Or simply rewrite the code without the lookup
4. Otherwise (in the process context) use the Interface List

Some modified functions

carp_set_addr(), ether_output(), ifa_ifwithnet(), ifa_ifwithroute(), IFP_TO_IA(), in_localaddr(), in_pcbbind(), in_selectsrc(), ipv4_input(), ip_output(), m_cldrop(), rip_usrreq(), rt_getifa()...



Interface list

ifa_ifwith**addr**(), ifa_ifwith**dst**addr() and ifa_ifwith**net**()

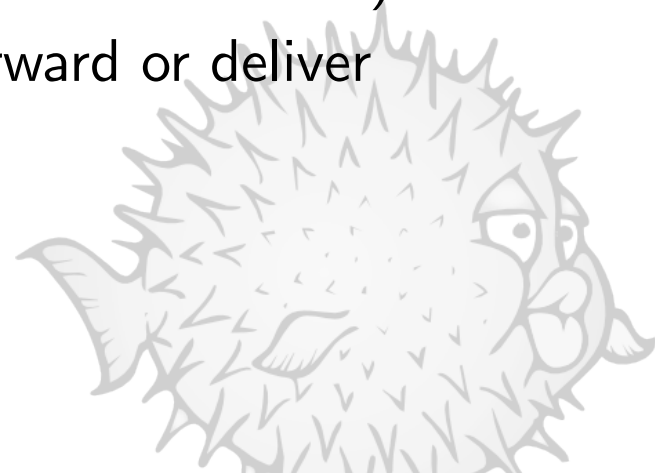
1981: One address per interface (struct *ifnet*)

1985: Per interface list of addresses (struct *ifaddr*)

2010: Global RB-Tree of addresses

1985: Global list of addresses per protocol (i.e. struct *in_ifaddr*)

1999: KAME uses the routing table to forward or deliver



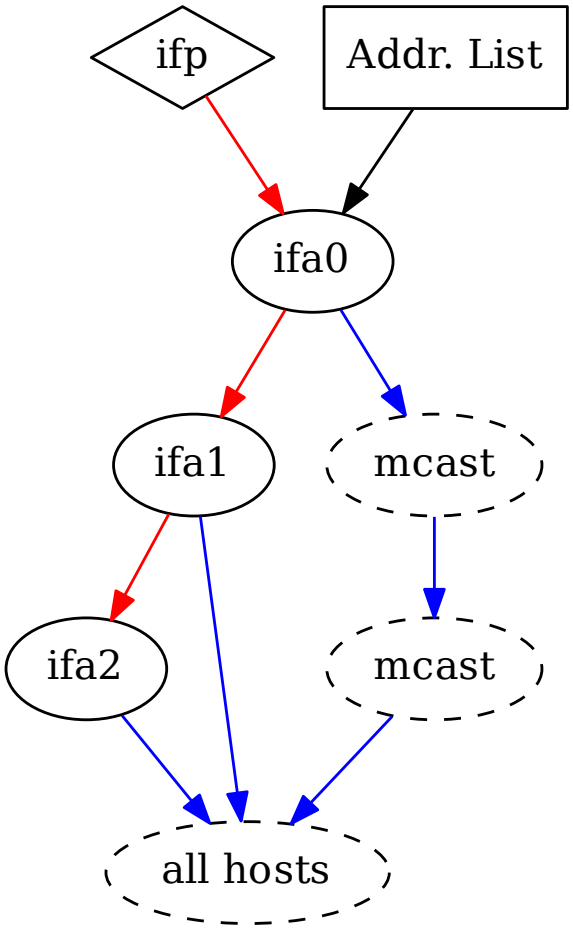
Routing table

- Use the routing table for address lookups
  - Consolidate KAME's "loobpack" hack

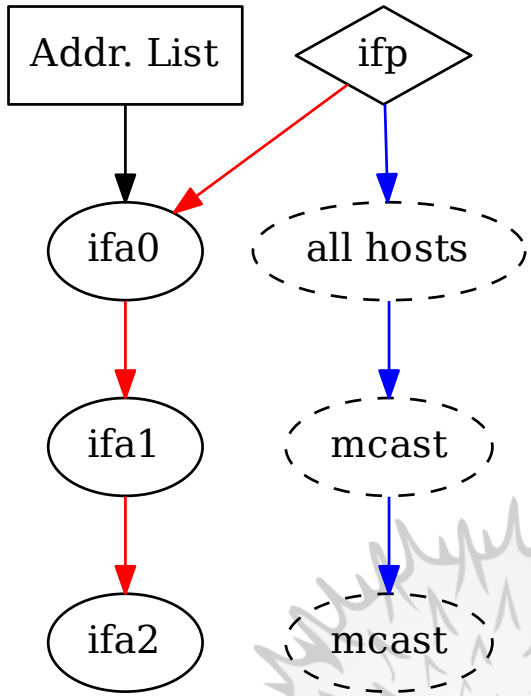
    RTF_LOCAL For each configured address

    RTF_BROADCAST For every IPv4 subnet
- Only one global structure
  - Easier than maintaining coherency between various structures
  - Needs some love to be accessed in parallel
- Not slower/faster than the actual RB-tree

Protocol multicast addresses



OpenBSD 5.4



OpenBSD 5.5

Related changes

- The link-layer address has been remove from all the lists
  - No need to move this information to the routing table
  - Many many dragons in this code
- SO_DONTROUTE is no longer supported
  - No option to bypass the routing table
- Interface indexes are now unique
  - Avoid dangling pointers
- inet_ntop() replaces inet_ntoa() in the kernel

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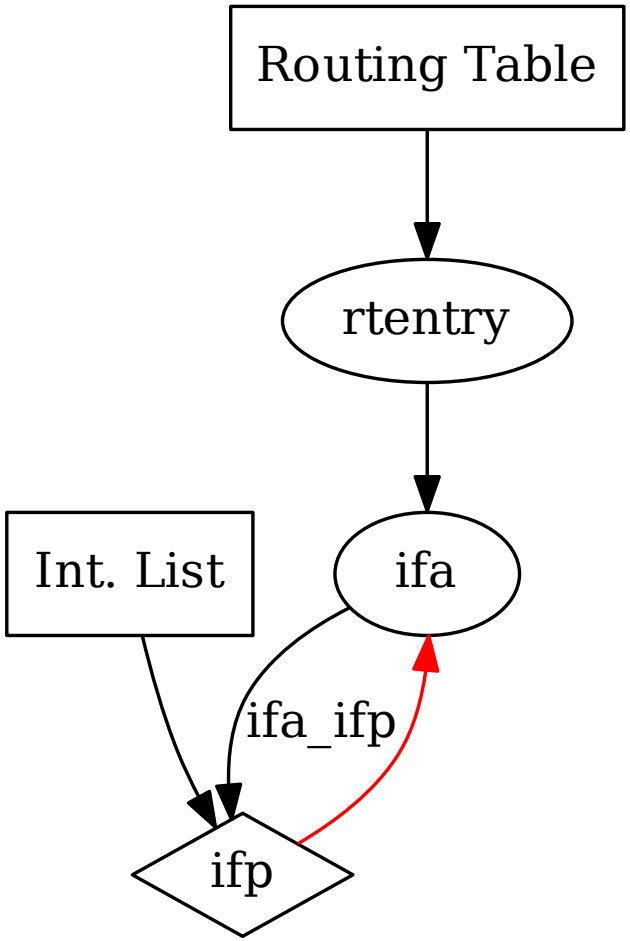
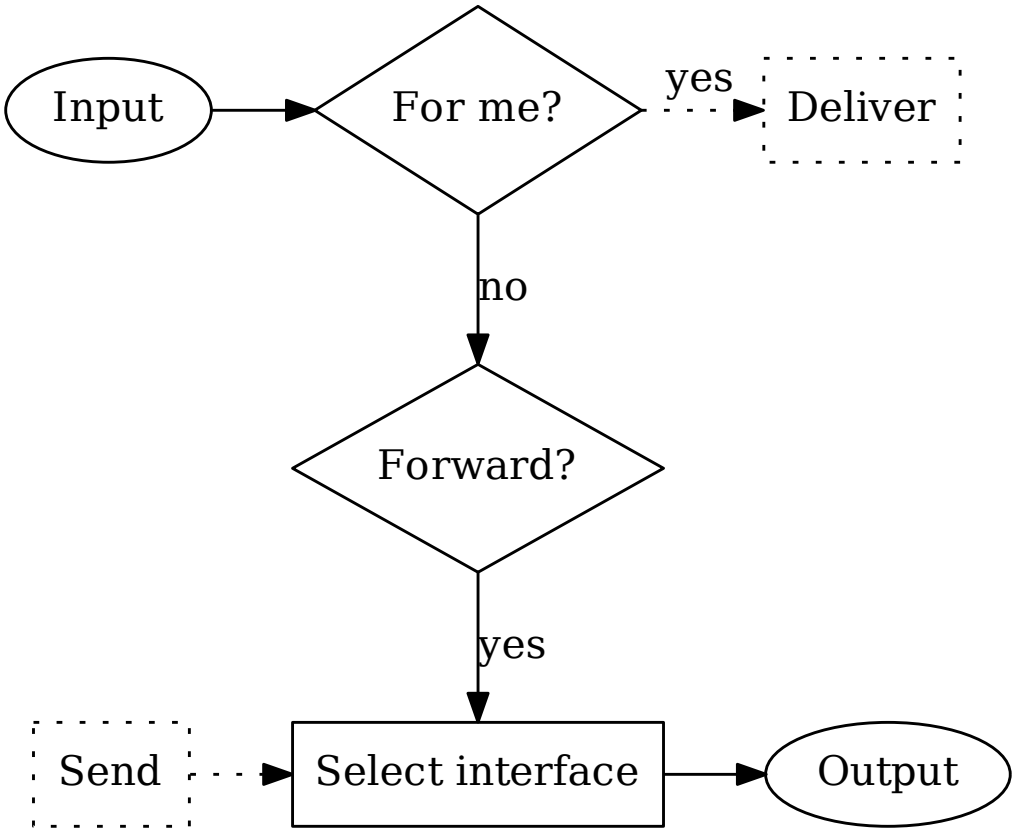


When are they accessed?



ip_input

- Routing table*

ip_forward

ip_output

- Routing table*

Well, we're almost there

- Diff to kill the RB-tree is on tech@
- RTF_LOCAL routes still points to lo0
- Still doing 2 lookups in the forwarding case

Hopefully integrated for OpenBSD 5.7

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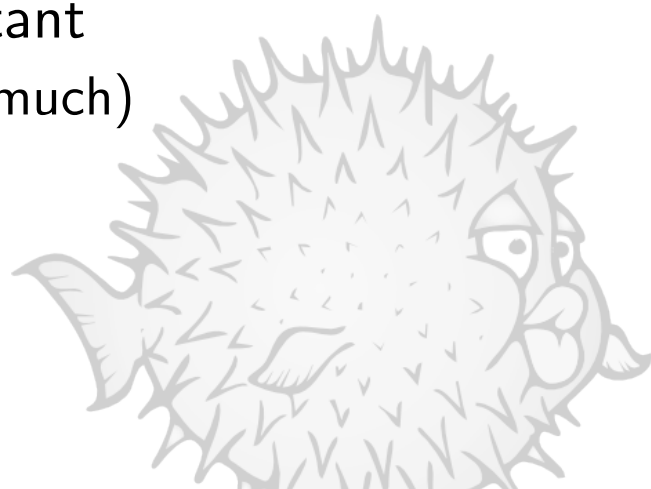
- Refactoring 30 years old code is hard
  - But we have a pretty good history
- Very few people care because
  - It's not a "feature"
  - There's no visible speed gain
  - Changes always find some dragons
- Understanding what you're changing is important
  - Future developers won't hate you (or not that much)
- Still plenty of dragons



Questions?

Slides on http://www.openbsd.org/papers/