Project 2
Simple Router
[Part 2]

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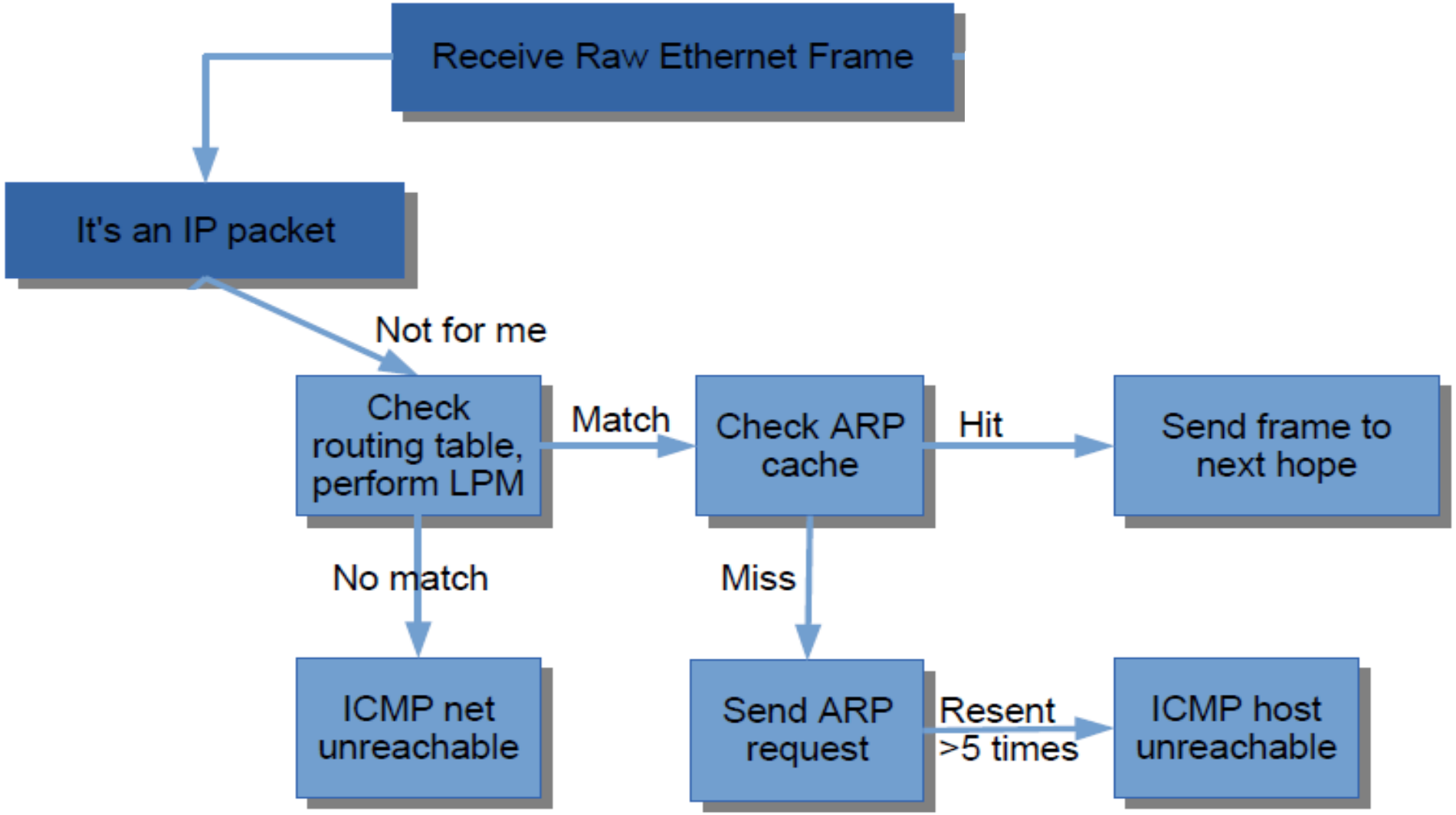
IP Flow Chart



ICMP Type 11

- See if the packet is not destined to the router interface. How?

Check if the dst ip address of the packet is equal or not equal to the ip address of the router interface.

- If not destined and ttl of the packet = 1, create ICMP type 11 (time exceeded) packet, with updated ethernet, ip and icmp header.

  Note: ICMP Type 11 structure already defined for you.

- Then, send the packet using sr_send_packet.

Time exceeded message[3]:5

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Type = 11								Code								Header checksum															
unused																															
IP header and first 8 bytes of original datagram's data																															

Where:

Type must be set to 11

Code specifies the reason for the time exceeded message, include the following:

Code	Description
0	Time-to-live exceeded in transit.

LPM

- If packet not destined to router and ttl of the packet != 1, check routing table to see if the entry exists (LPM). How?

You have the routing table (*sr->routing_table*) and destination ip address. The routing_table is a structure of type *sr_rt* (defined in sr_rt.h).

The routing table has *dest* and *mask* variables of type *in_addr*.

Do & (bitwise AND) between dest and mask. Also, between the

destination ip address and mask. Compare to see if they match.

If multiple matches, check to see which match has the longest mask.s_addr.

dest.s_addr

mask.s_addr

```
#include <netinet/in.h>
struct in_addr {
    unsigned long s_addr;
};
```

ICMP Type 3 Code 0

- If LPM returns empty, then create ICMP type 3 (network unreachable) packet, with updated ethernet, ip and icmp header.

  Note: ICMP Type 11 structure can be used for this as they are similar.

- Then, send the packet using sr_send_packet.

Destination unreachable message[3]:3

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Type = 3								Code								Header checksum															
unused																Next-hop MTU															
IP header and first 8 bytes of original datagram's data																															

Creating ARP Request

- If LPM entry (type sr_rt) is found, then reduce ttl and update checksum for the IP header.
- Do a ***sr_arpcache_lookup***. '*gw.s_addr*' one of the variables to be passed to the function.
- If returns NULL, use ***sr_arpcache_queuereq*** function to add the ARP request to the ARP request queue.

  Send the sr instance and the queue to ***handle_arpreq***. Function to be implemented. Pseudocode available in sr_arpcache.h.

  NOTE: Do a pthread_mutex_lock(pthread_mutex_t *mutex) for arp cache before and pthread_mutex_unlock after calling the function.

- If the lookup returned an arp entry, then modify the Ethernet source and destination values and use *sr_send_packet*.

To test your LPM logic

- To test your routing table lookup, you can change the entries in rtable file to have different subnet masks. For instance, to check your router's longest prefix match logic, you can have multiple entries in your rtable file that match a single destination IP. The following routing table has two matching entries for the packet destined to 192.168.2.2.

192.168.2.0	**192.168.2.2**	**255.255.255.0**	**eth2**
192.168.2.2	**192.168.2.2**	**255.255.255.255**	**eth1**
172.64.3.10	172.64.3.10	255.255.255.255	eth2
10.0.1.100	10.0.1.100	255.255.255.255	eth3

More testing

- With some changes to the routing table, you can trigger a Destination Host Unreachable ICMP (type 3, code 1) by making your router send ARP request to a host which is not present. To simulate that scenario, change the next hop gateway to a non-existing IP address.

Thank You