IN 3230 / IN 4230
Oracle Session – Week 3 – ARP Protocol

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Outline

1. ARP Protocol
    1. ARP Request
    2. ARP Response
2. Different Components needed
    1. Packet socket
    2. sockaddr_ll
    3. Ifaddrs
    4. iovec
    5. ether_frame
    6. msghdr

1 . ARP Protocol

- ARP – Address Resolution Protocol
- Maps **ip address** to

physical address (mac address)

- Used by the switches or o

ther layer 2 devices

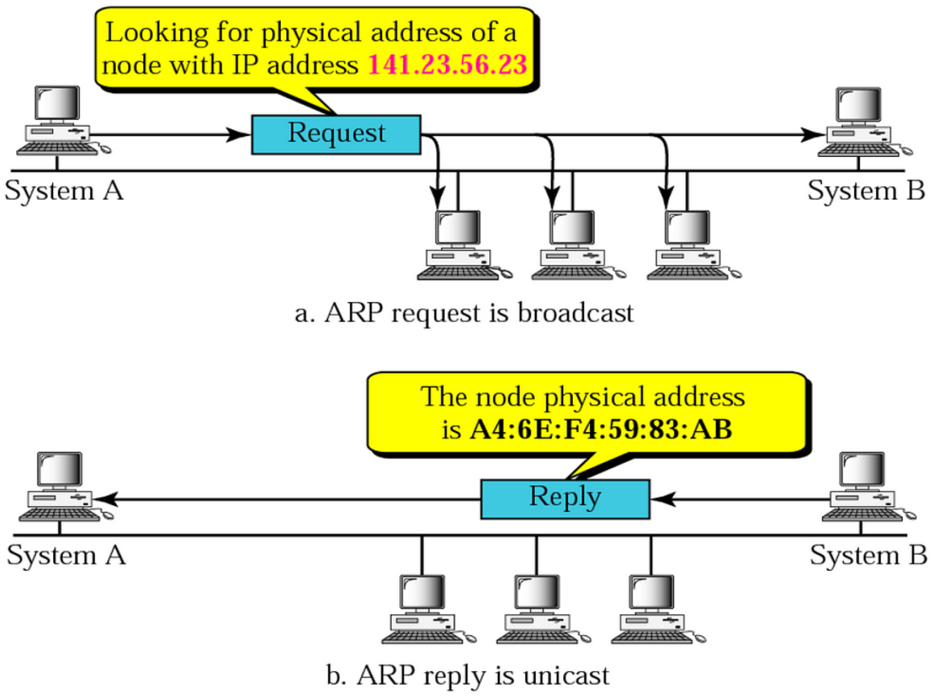

Looking for physical address of a node with IP address 141.23.56.23
Request
System A
System B
a. ARP request is broadcast
The node physical address is A4:6E:F4:59:83:AB
Reply
System A
System B
b. ARP reply is unicast

Fig: ARP Protocol [1]

[1] ARP Protocol image reference : link

ARP Request

Steps:

1. Construct frame header (source address, dest address (broadcast address), protocol)
2. Point msg vec to frame header (msg vec and msg vec len)
3. Construct msg header
    1. Point the msg name to the source sock address (sockaddr ll)
    2. Point the msg iovec to the msg vec
4. Send msg

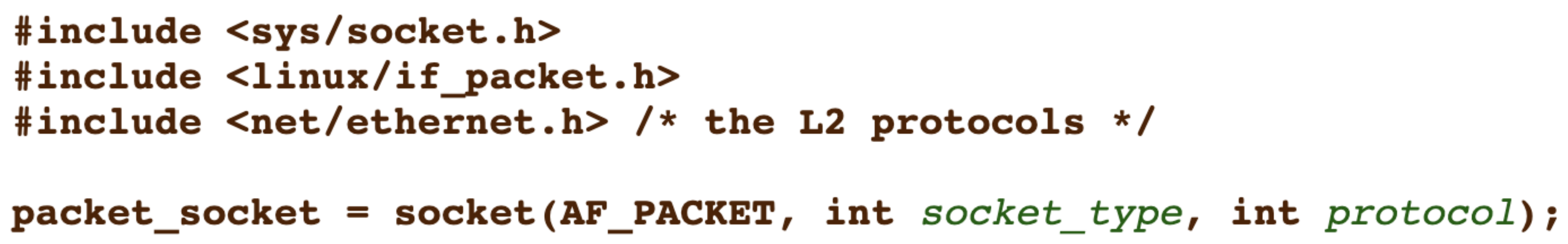
ARP Response

Steps:

1. Construct frame header (source address, dest address (unicast address), protocol)
2. Point msg vec to frame header (msg vec and msg vec len)
3. Construct msg header
   1. Point the msg name to the source sock address (sockaddr ll)
   2. Point the msg iovec to the msg vec
4. Send msg

The node which receives the ARP response can find out the other nodes mac address by checking the source address in frame header

2 . 1 Packet Socket (AF_PACKET)



```
#include <sys/socket.h>
#include <linux/if_packet.h>
#include <net/ethernet.h> /* the L2 protocols */

packet_socket = socket(AF_PACKET, int socket_type, int protocol);
```

1. **AF_PACKET:**
   - Also called as "packet socket".
   - used to receive or send raw packets at the device driver
2. **SOCK_RAW:**
   - for raw packets
3. 0xFFFF:
   - For broadcast (but other protocols also can be used other popular option is using ETH_P_ALL)

[1] https://man7.org/linux/man-pages/man7/packet.7.html

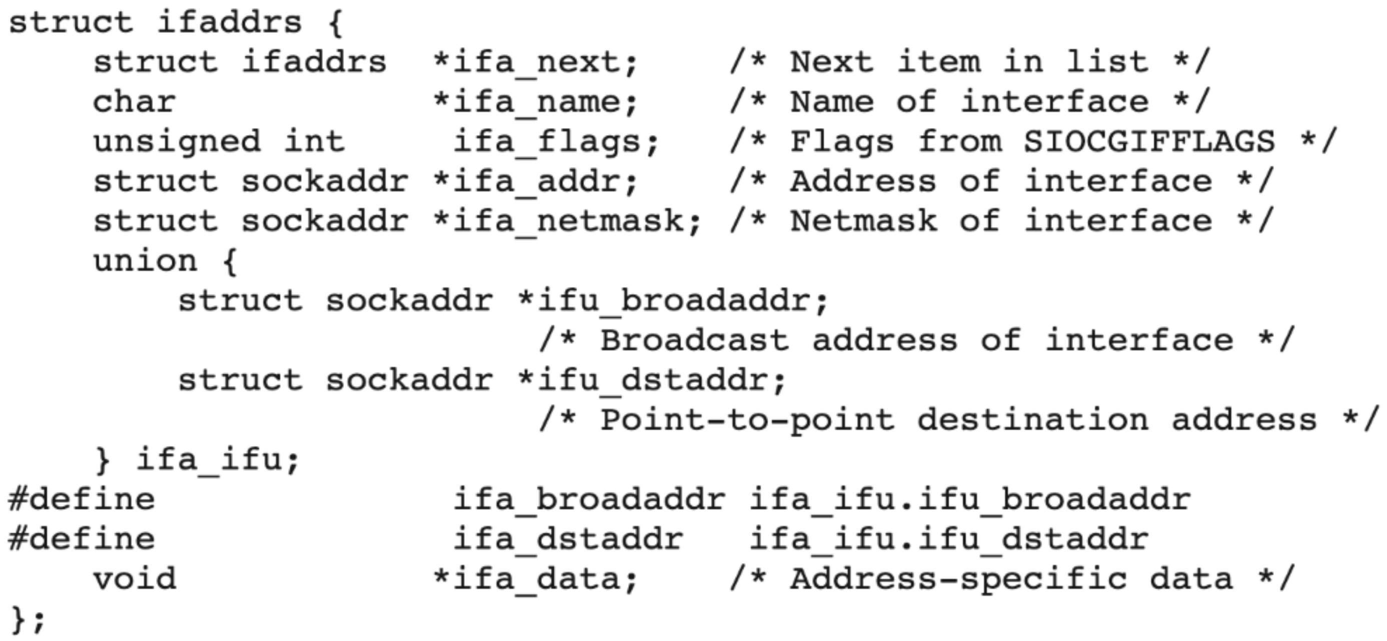
2 . 2 Sockaddr_ll

```
struct sockaddr_ll {
unsigned short sll_family;   /* Always AF_PACKET  */
unsigned short sll_protocol; /* Physical-layer protocol */
int  sll_ifindex;  /* Interface number */
unsigned short sll_hatype;   /* ARP hardware type */
unsigned char  sll_pkttype;  /* Packet type */
unsigned char  sll_halen;    /* Length of address */
unsigned char  sll_addr[8];  /* Physical-layer address */
};
```

[1] https://man7.org/linux/man-pages/man7/packet.7.html

[2] https://github.com/spotify/linux/blob/master/include/linux/if_ether.h

2 . 3 ifaddrs



```
struct ifaddrs {
    struct ifaddrs  *ifa_next;    /* Next item in list */
    char            *ifa_name;    /* Name of interface */
    unsigned int     ifa_flags;   /* Flags from SIOCGIFFLAGS */
    struct sockaddr *ifa_addr;    /* Address of interface */
    struct sockaddr *ifa_netmask; /* Netmask of interface */
    union {
        struct sockaddr *ifu_broadaddr;
                         /* Broadcast address of interface */
        struct sockaddr *ifu_dstaddr;
                         /* Point-to-point destination address */
    } ifa_ifu;
#define              ifa_broadaddr ifa_ifu.ifu_broadaddr
#define              ifa_dstaddr   ifa_ifu.ifu_dstaddr
    void            *ifa_data;    /* Address-specific data */
};
```

- creates a linked list of structures describing the network interfaces of the local system, and stores the address of the first item of the list in *ifap.
- Important fields: ifa_next, ifa_name and ifa_addr

[2] https://man7.org/linux/man-pages/man3/getifaddrs.3.html

2 . 4 iovec

-
  ```
  struct iovec {
     ptr_t iov_base; /* Starting address */
     size_t iov_len; /* Length in bytes */
  };
  ```

- iov_base – stores the starting address
- Iov_len – stores the length

Why it's needed ?

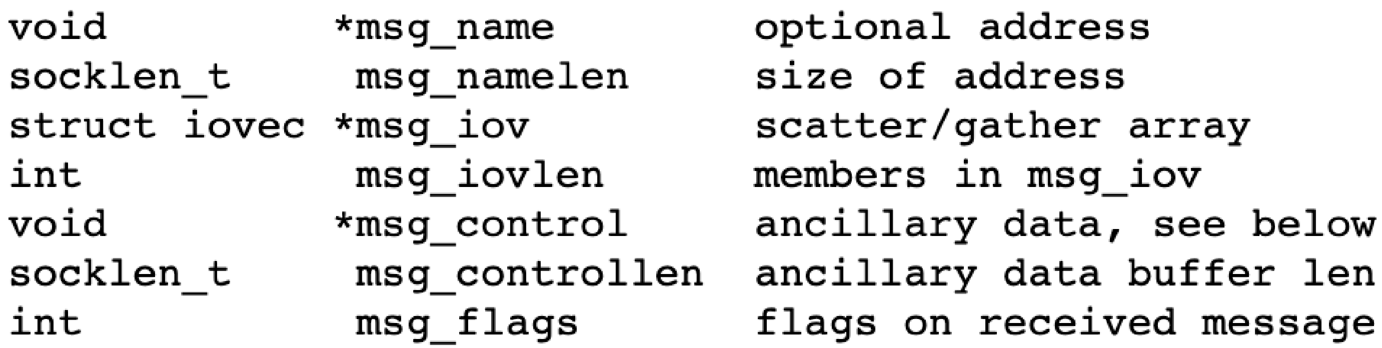
- It's used by the message header (msghdr)
- To point to ethernet frame header and the payload

2 . 5 ether_frame

```
struct ether_frame {
uint8_t dst_addr[6];
 uint8_t src_addr[6];
 uint8_t eth_proto[2];
 uint8_t contents[0]; } __attribute__((packed));
```

- It's frame header we use in the raw socket (it contains the mac address needed in the ARP request and response)
- **__attribute__ ((packed)):** it packs the ether_frame in such a way that it preserves memory (removes automatic padding between the structure members)

2 . 6 msghdr



```
void          *msg_name        optional address
socklen_t      msg_namelen     size of address
struct iovec  *msg_iov         scatter/gather array
int            msg_iovlen      members in msg_iov
void          *msg_control     ancillary data, see below
socklen_t      msg_controllen  ancillary data buffer len
int            msg_flags       flags on received message
```

- **Msg_name :** sockaddr pointer will be used here (struct sockaddr_ll *)
- **Msg_namelen:** size of sockaddr pointer
- **Msg_iov:** array of io vector structures (we use 1 arrays. It points to the frame header)
- **Msg_iovlen:** no of numbers in msg_iov (1 in our example)

References

1. https://man7.org/linux/man-pages/man7/packet.7.html
2. https://man7.org/linux/man-pages/man3/getifaddrs.3.html
3. http://www.ccplusplus.com/2012/02/struct-iovec-iov.html
4. msghdr : https://pubs.opengroup.org/onlinepubs/7908799/xns/syssocket.h.html

Thank You