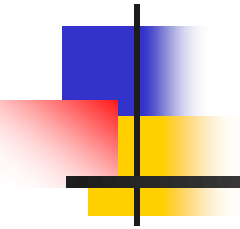
Packet Sniffing and Spoofing



Lecture 03

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Processing Captured Packet

- *got_packet*(…) is invoked once a packet is captured
  - in *demonstration*: *print out a simple msg*
  - in *real world*: ***process*** packet, or even ***react to*** packet
    - e.g., capturing a *DNS request packet* and sending out a ***spoofed reply*** based on the content of packet
- *got_packet*(…)

```
void got_packet(u_char *args, const struct pcap_pkthdr *header,
                              const u_char *packet)
```

  - *args:* a user-defined argument passed to the callback
    - NULL or point to some user data
  - *header*: a pointer to a *pcap_pkthdr* structure, which contains metadata about the captured packet
    - e.g., timestamp and length

Processing Captured Packet

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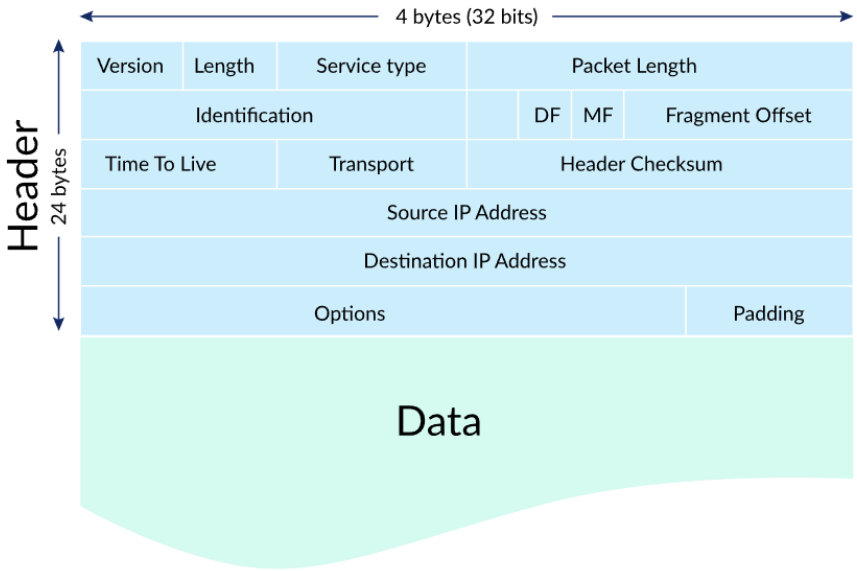
    - e.g., capturing a *DNS request packet* and sending out a ***spoofed reply*** based on the content of packet
- *got_packet*(…)

```
void got_packet(u_char *args, const struct pcap_pkthdr *header,
                              const u_char *packet)
```

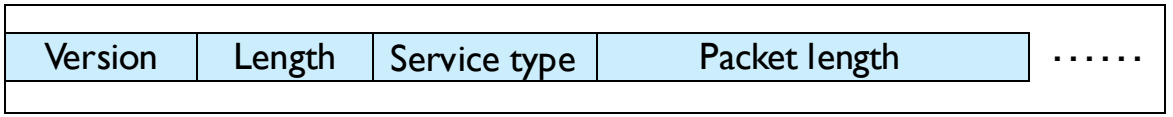
  - *u_char *packet*: a pointer points to the ***buffer*** that holds the ***packet***
    - *u_char* (*unsigned char*) indicates the contents of the buffer are a *sequence of characters* (have structures internally)
      - including an *ethernet frame* ethernet header placed at the beginning

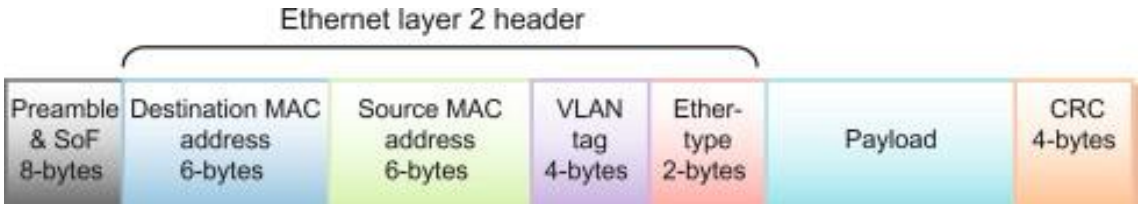
Processing Captured Packet

- How we visualize IP packet



- How computer stores packet





Processing Captured Packet (cont.)

inconvenient & not scalable

- Checking whether the type field (Ethertype) of ethernet header is IP or something: find the *offset* of type field and read its value
- Efficient idea: *struct:* a group of variables stored in contiguous memory
  1. case a buffer to a *struct* to treat the buffer as a *structure*;
  2. access its data using the *structure*'s field names

```
/* Ethernet header */
struct ethheader {
  u_char  ether_dhost[ETHER_ADDR_LEN]; /* destination host address */
  u_char  ether_shost[ETHER_ADDR_LEN]; /* source host address */
  u_short ether_type;                  /* IP? ARP? RARP? etc */
};

void got_packet(u_char *args, const struct pcap_pkthdr *header,
                              const u_char *packet)
{
  struct ethheader *eth = (struct ethheader *)packet;
  if (ntohs(eth->ether_type) == 0x0800) { ... } // IP packet
  ...
}
```

IPv4

packet argument contains a copy of the packet, including the Ethernet header

- typecast it to the Ethernet header structure

access the field of the structure

Processing Captured Packet (cont.)

- More to do…: print out some info. from the IP header

```
void got_packet(u_char *args, const struct pcap_pkthdr *header,
                              const u_char *packet)
{
  struct ethheader *eth = (struct ethheader *)packet;

  if (ntohs(eth->ether_type) == 0x0800) { // 0x0800 is IP type
    struct ipheader * ip = (struct ipheader *)
                           (packet + sizeof(struct ethheader)); ①
    printf("       From: %s\n", inet_ntoa(ip->iph_sourceip));   ②
    printf("         To: %s\n", inet_ntoa(ip->iph_destip));     ③

    /* determine protocol */
    switch(ip->iph_protocol) {                                  ④
        case IPPROTO_TCP:
            printf("   Protocol: TCP\n");
            return;
        case IPPROTO_UDP:
            printf("   Protocol: UDP\n");
            return;
```

typecast to IP header structure

IP header structure offset

access IP header structure

- src. IP addr.
- des. IP addr.

find *where* the *IP header* starts and typecast it to the IP header structure

* *distance*: the size of ethernet header

access the fields in the IP header

Processing Captured Packet (cont.)

- Compile the program

  $ gcc –o sniff_improved sniff_improved.c –lpcap

- Run the program

  $ sudo ./sniff_improved

Packet Spoofing

- Typical socket programming:
  - we have controls over a few selected fields in the header
    - des. IP addr. (not src. IP addr.)
      - when the packet is sent out, the OS will put corresponding IP addr. in the src. IP field
- In network attacks, packets are constructed with *bogus*, *unrealistic*, and *targeted info.* in the headers.
  - TCP SYN flooding attack: src. IP addr. is randomly generated
  - TCP session hijacking attack:
    - use other people's IP addr
    - set correct sequence and port #s
  - sending packets like those is called ***packet spoofing***
    - critical info. in the packet is ***forged***

Packet Spoofing (cont.)

- Writing your own packet spoofing tool in C language can give you an idea how these tools are built

- Tools for spoofing packets: Netwox Scapy
- Scapy
  - packet manipulation tool
  - forge or decode packets of a wide number of protocols
  - send packets on the wire, capture them, match requests and replies

Sending Normal Packet Using Socket

- Normally sending out packets requires three steps for UDP client program:
  1. create a socket
  2. provide des. info., e.g., des. IP addr. and des. UDP port #
  3. call *sendto()* to send out a UDP packet with payload
     - The OS will construct the actual UDP packet based on the info provided

Sending Normal Packet Using Socket (cont.)

- Normally sending out packets requires three steps:

```
void main()
{
    struct sockaddr_in dest_info;
    char *data = "UDP message\n";

    // Step 1: Create a network socket
    int sock = socket(AF_INET, SOCK_DGRAM, IPPROTO_UDP);

    // Step 2: Provide information about destination.
    memset((char *) &dest_info, 0, sizeof(dest_info));
    dest_info.sin_family = AF_INET;
    dest_info.sin_addr.s_addr = inet_addr("10.0.2.5");
    dest_info.sin_port = htons(9090);

    // Step 3: Send out the packet.
    sendto(sock, data, strlen(data), 0,
                (struct sockaddr *)&dest_info, sizeof(dest_info));
    close(sock);
}
```

Testing:

- Use the netcat (nc) command to run a UDP server on 10.0.2.5.
- Run the program on another machine.

Output:

- The message has been delivered to the server machine

(port #)

```
seed@Server(10.0.2.5):$ nc -luv 9090
Connection from 10.0.2.6 port 9090 [udp/*] accepted
UDP message
```