

计算机网络实验 6

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1. Capturing and analyzing Ethernet frames

The image shows a Wireshark packet capture analysis of an Ethernet II frame. The packet list shows Frame 19, 578 bytes on wire (4624 bits), 578 bytes captured (4624 bits) on interface enp0s20f0u1u4c2, id 1. The packet details pane shows Ethernet II, Src: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b), Dst: Hangzhou_91:72:e2 (5c:dd:70:91:72:e2). The packet bytes pane shows the raw data of the frame, including the destination MAC address (5c:dd:70:91:72:e2), source MAC address (08:26:ae:3a:5b:9b), and the IP header (0x0800).

Frame 19: 578 bytes on wire (4624 bits), 578 bytes captured (4624 bits) on interface enp0s20f0u1u4c2, id 1

Ethernet II, Src: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b), Dst: Hangzhou_91:72:e2 (5c:dd:70:91:72:e2)

Destination: Hangzhou_91:72:e2 (5c:dd:70:91:72:e2)

Address: Hangzhou_91:72:e2 (5c:dd:70:91:72:e2)

.....0. = LG bit: Globally unique address (factory default)

.....0. = IG bit: Individual address (unicast)

Source: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)

Address: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)

.....0. = LG bit: Globally unique address (factory default)

.....0. = IG bit: Individual address (unicast)

Type: IPv4 (0x0800)

0000 5c dd 70 91 72 e2 08 26 ae 3a 5b 9b 08 00 45 00 \.p.r.&.: [...E.
0010 02 34 d6 b7 40 00 40 06 cd 82 de c3 40 42 80 77 .4..@.@.@B.w
0020 f5 0c 98 80 00 50 cb 2f 9d 5c d4 c5 84 13 80 18P./ .\.....
0030 01 f6 0b f7 00 00 01 01 08 0a 20 e2 66 b8 ea 77f..w
0040 84 19 47 45 54 20 2f 77 69 72 65 73 68 61 72 6b ..GET /w ireshark
0050 2d 6c 61 62 73 2f 48 54 54 50 2d 65 74 68 65 72 -labs/HT TP-ether
0060 65 61 6c 2d 6c 61 62 2d 66 69 6c 65 33 2e 68 74 eal-lab- file3.ht
0070 6d 6c 20 48 54 54 50 2f 31 2e 31 0d 0a 48 6f 73 ml HTTP/ 1.1..Hos
0080 74 3a 20 67 61 69 61 2e 63 73 2e 75 6d 61 73 73 t: gaia. cs.umass
0090 2e 65 64 75 0d 0a 43 6f 6e 6e 65 63 74 69 6f 6e .edu..Co nnection
00a0 3a 20 6b 65 65 70 2d 61 6c 69 76 65 0d 0a 43 61 : keep-a live..Ca
00b0 63 68 65 2d 43 6f 6e 74 72 6f 6c 3a 20 6d 61 78 che-Cont rol: max

☒ Show packet bytes

关闭 帮助

1. 我的电脑的地址为 `08:26:ae:3a:5b:9b` .
2. 目的地址为 `5c:dd:70:91:72:e2` , 它不是 `gaia.cs.umass.edu` 的地址. 这个地址属于我的主机连接到的路由器的接口.
3. 类型字段为 `0x0800` , 它对应 IP 协议.
4. "GET" 中的 "G" 是报文中的第 67 字节.

Frame 23: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface enp0s20f0u1u4c2,

Ethernet II, Src: Hangzhou_91:72:e2 (5c:dd:70:91:72:e2), Dst: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)

Destination: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)

Address: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)

.... ..0. = LG bit: Globally unique address (factory default)

.... ..0. = IG bit: Individual address (unicast)

Source: Hangzhou_91:72:e2 (5c:dd:70:91:72:e2)

Address: Hangzhou_91:72:e2 (5c:dd:70:91:72:e2)

.... ..0. = LG bit: Globally unique address (factory default)

.... ..0. = IG bit: Individual address (unicast)

Type: IPv4 (0x0800)

0000	08	26	ae	3a	5b	9b	5c	dd	70	91	72	e2	08	00	45	68	..&.:[]\ p.r...Eh
0010	05	dc	00	fa	40	00	25	06	ba	30	80	77	f5	0c	de	c3	...@.%..0.w...
0020	40	42	00	50	98	80	d4	c5	84	13	cb	2f	9f	5c	80	10	@B.P...../.\...
0030	00	eb	af	6f	00	00	01	01	08	0a	ea	77	84	ea	20	e2	...o...w...
0040	66	b8	48	54	54	50	2f	31	2e	31	20	32	30	30	20	4f	f.HTTP/1.1 200 0
0050	4b	0d	0a	44	61	74	65	3a	20	53	75	6e	2c	20	30	34	K..Date: Sun, 04
0060	20	44	65	63	20	32	30	32	32	20	30	39	3a	34	39	3a	Dec 202 2 09:49:
0070	33	31	20	47	4d	54	0d	0a	53	65	72	76	65	72	3a	20	31 GMT.. Server:
0080	41	70	61	63	68	65	2f	32	2e	34	2e	36	20	28	43	65	Apache/2.4.6 (Ce
0090	6e	74	4f	53	29	20	4f	70	65	6e	53	53	4c	2f	31	2e	ntOS) Op enSSL/1.
00a0	30	2e	32	6b	2d	66	69	70	73	20	50	48	50	2f	37	2e	0.2k-fip s PHP/7.
00b0	34	2e	33	30	20	6d	6f	64	5f	70	65	72	6c	2f	32	2e	4.30 mod_perl/2.
00c0	30	2e	31	31	20	50	65	72	6c	2f	76	35	2e	31	36	2e	0.11 Per l/v5.16

☒ Show packet bytes

关闭 帮助

- 源地址为 `5c:dd:70:91:72:e2` , 它不是我的电脑地址或 `gaia.cs.umass.edu` 的地址. 这个地址属于我的主机连接到的路由器的接口.
- 目的地址为 `08:26:ae:3a:5b:9b` , 它是我的电脑地址.
- 类型字段为 `0x0800` , 它对应 IP 协议.
- "OK" 中的 "O" 是报文中的第 80 字节.

2. The Address Resolution Protocol

```

~ took 19ms
> arp
Address          HWtype  HWAddress      Flags Mask      Iface
222.195.67.127   ether   5c:dd:70:91:72:e2 C              enp0s20f0u1u4c2
gateway          ether   5c:dd:70:91:72:e2 C              enp0s20f0u1u4c2
222.195.64.46    ether   5c:dd:70:91:72:e2 C              enp0s20f0u1u4c2
222.195.65.29    ether   5c:dd:70:91:72:e2 C              enp0s20f0u1u4c2
222.195.64.31    ether   5c:dd:70:91:72:e2 C              enp0s20f0u1u4c2
~ took 6s
>

```

- ARP 缓存内容如上图. `Address` 栏为 IP 地址, `HWtype` 为硬件类型, `HWaddress` 为 MAC 地址, `Flags Mask` 指示表项的来源 (`C` : dynamically learned by arp protocol; `M` : manually entered/added in the memory; `P` : publish), `Iface` 为网络接口.

Frame 76: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface enp0s20f0u1u4c2, id 0

Ethernet II, Src: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

- Destination: Broadcast (ff:ff:ff:ff:ff:ff)
 - Address: Broadcast (ff:ff:ff:ff:ff:ff)
 - 1. = LG bit: Locally administered address (this is NOT the factory default)
 - 1 = IG bit: Group address (multicast/broadcast)
- Source: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)
 - Address: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)
 - 0. = LG bit: Globally unique address (factory default)
 - 0 = IG bit: Individual address (unicast)
- Type: ARP (0x0806)

Address Resolution Protocol (request)

```

0000  ff ff ff ff ff ff 08 26 ae 3a 5b 9b 08 06 00 01  .....&.: [...
0010  08 00 06 04 00 01 08 26 ae 3a 5b 9b de c3 40 42  .....&.: [...@B
0020  00 00 00 00 00 00 de c3 43 ad  .....C.
  
```

☒ Show packet bytes

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10. 源地址为 `08:26:ae:3a:5b:9b`, 目的地址为 `ff:ff:ff:ff:ff:ff`.
11. 类型字段为 `0x0806`, 它对应 ARP 协议.

Address Resolution Protocol (request)

- Hardware type: Ethernet (1)
- Protocol type: IPv4 (0x0800)
- Hardware size: 6
- Protocol size: 4
- Opcode: request (1)
- Sender MAC address: Shenzhen_0a:5b:9b (08:26:ae:3a:5b:9b)
- Sender IP address: 222.195.64.66
- Target MAC address: 00:00:00:00:00:00 (00:00:00:00:00:00)
- Target IP address: 222.195.67.173

```

0000  ff ff ff ff ff ff 08 26 ae 3a 5b 9b 08 06 00 01  .....&.: [...
0010  08 00 06 04 00 01 08 26 ae 3a 5b 9b de c3 40 42  .....&.: [...@B
0020  00 00 00 00 00 00 de c3 43 ad  .....C.
  
```

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12. a. opcode 开始于第 21 字节.
- b. opcode 字段的值为 `0x0001`.
- c. ARP 报文包含了发送方的 IP 地址.
- d. "问题" 出现在 Target MAC address, 它被设为了 `00:00:00:00:00:00`.


```
~ took 18ms
> cat /proc/sys/net/ipv4/neigh/enp0s20f0u1u4c2/base_reachable_time
30

~ took 30ms
> cat /proc/sys/net/ipv4/neigh/enp0s20f0u1u4c2/gc_stale_time
60

~ took 23ms
> cat /proc/sys/net/ipv4/neigh/default/gc_interval
30

~ took 22ms
> |
```

由上图可知, 表项会在 $(15 \sim 45) + 60 + 30$ 秒, 也就是 105 ~ 135 秒内被删除.