Network packet forgery with xxd

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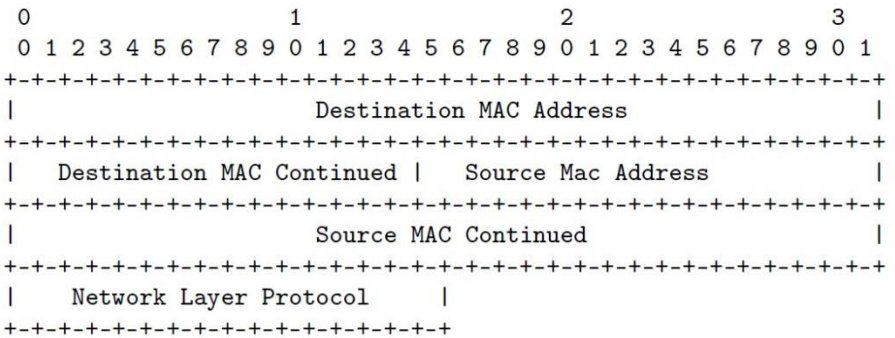
Why use xxd?

- Installed by default on every Linux distribution
- Low level method to build a packet
- Full control of the packet fields

The layers

- Data Link Layer

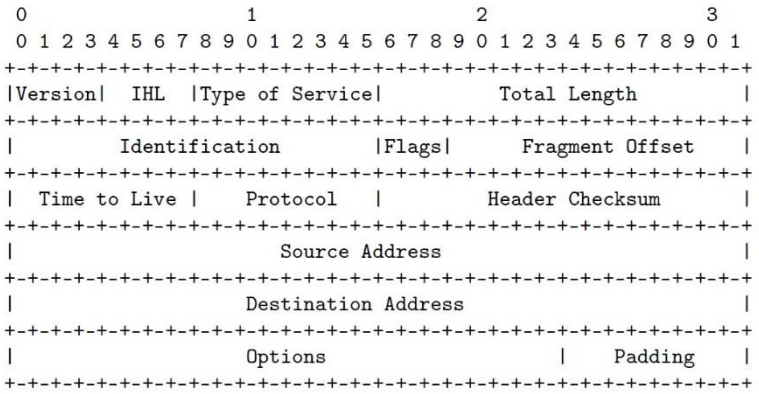
  Has the destination and source MAC addresses and 2 bytes referring to what the Network Layer should be (0x8000 for IPv4)



The layers

- Network Layer (RFC791)

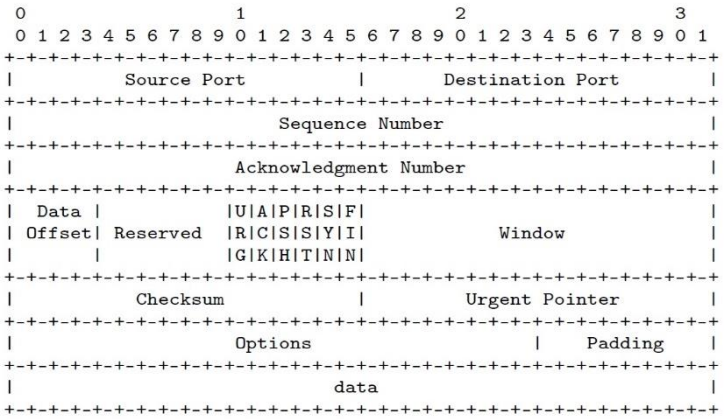
  IPv4 interesting fields: Version, Total length, TTL, Source and Destination IP addresses, Checksum and the Protocol byte (0x06 for TCP)



The layers

- Transport Layer (RFC793)

  Handles the transportation of data between two hosts. Simple UDP header but complex TCP headers.



Crafting a packet

◎ Link Layer

- Destination MAC address: b4:0c:25:67:5a:00
- Source MAC address: 00:0c:29:69:6f:c6
- Network-layer protocol of IPv4: 0x8000

Crafting a packet

◎ Network layer (IPv4) -> Header length 20 bytes and no IP options

- First nybble (version is 0x4): 0x4
- Second nibble (Header length in 32 bit words): 0x5
- Service byte (QoS): 0x00
- Total length (61 bytes IP+TCP+Payload): 0x003D
- IP identification field: 0x1337
- IP flags + Fragment offset: 0x4000
- TTL (140): 0x8C
- Higher protocol TCP: 0x06
- Checksum: 0x4500 + 0x003d + 0x1337 + 0x4000 + 0x8c06 + 0xC0A8 + 0x0101 + 0xC0A8 + 0x0102 = 0x2A7CD with 0x2 overflow -> add 0x2 back in -> 0xA7Cd + 0x2 = 0xA7CF. Final checksum: 0xFFFF – 0xA7CF = 0x5830
- Source IP: 192.168.1.1 (0xC0A80101) ; Destination IP: 192.168.1.2 (0xC0A80102)

Crafting a packet

◎ Transport layer (TCP)

- Source port: 0x1337
- Destination Port (HTTPS 443): 0x1BB
- SEQ and ACK number no specificity so both: 0x00000000
- Data offset (TCP header length) 32 bytes (20 header + 12 bytes TCP options) 8 32-bit words + PSH ACK: 0x8018
- Windows Size no specific size so: 0x0000
- URG flag: 0x0000
- TCP Options (Two NOPs and and timestamp): NOPs -> 0x0101; TSval -> 0xDEADBEEF; TSecr -> 0xFFFFFFFF
- Checksum: (0xC0A8 + 0x0101 + 0xC0A8 + 0x0102 + 0x0006 + 0x0029) + 0x1337 + 0x01BB + 0x0000 + 0x0000 + 0x000 + 0x0000 + 0x8018 + 0x0000 + 0x0000 + 0x0101 + 0x080A + 0xDEAD + 0xBEEF + 0xFFFF + 0xFFFF + 0xD796 + 0xC34F + 0x4FC7 + 0xE3C6 + 0xD600 = 0x963A3 with 0x9 overflow -> add 0x9 back in -> 0x63A3 + 0x9 = 0x63AC. Final checksum: 0xFFFF – 0x63AC = 0x9C53

Crafting a packet

◎PCAP Metadata

- Create pcap metadata to dissect or inject the crafted packet.
- First 6 PCAP 4 bytes fields : magic number (0xA1B2C3D4); PCAP version (0x00020004); timezone (GMT 0x00000000); sigfigs field (0x00000000); snaplen (0x0001000F); network data link type (Ethernet: 0x00000001)
- Per packet data: time to default day (0x4EBd02CF); microtime (0x00000000); packet length and capture length (0x0000004B)

Saving the Pcap: echoing hex data in order (Pcap metadata + packet)

```
echo  A1B2C3D4 00020004 00000000 00000000 0001000F 00000001  ¥
      4EBD02CF 00000000  0000004B 0000004B  ¥
      ¥
      000C2945   7E4A000C 29696FD0 0800  ¥
      ¥
      45 00 003d  1337 4 000 8C 06 5830 C0A80101 C0A80102  ¥
      ¥
      1337  01BB 00000000 00000000 8 0 18 0000 9C53 0000  ¥
       01 01 08 0A DEADBEEF FFFFFFFF ¥
       ¥
      D796C34F4FC7E3C6D6  | xxd -r –p > SEC.pcap
```

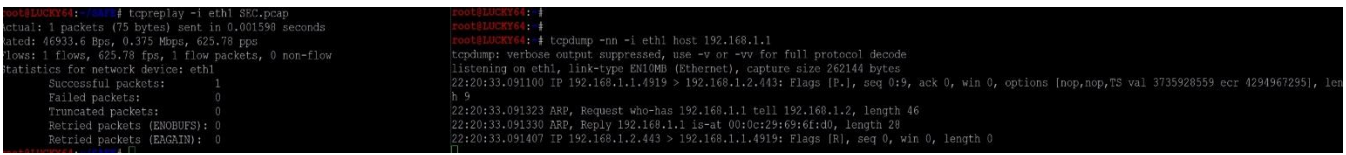
Crafting a packet

◎PCAP Metadata

- Bash script to create the packet.

```
# cat PACKET.sh
#!/bin/bash
echo A1B2C3D4 00020004 00000000 00000000 0001000F 00000001 4EBD02CF 00000000 0000004B 0000004B |
xxd -r -p > SEC.pcap
echo 000C2945 7E4A000C 29696FD0 0800 | xxd -r -p >> SEC.pcap
echo 45 00 003d  1337 4 000 8C 06 5830 C0A80101 C0A80102 | xxd -r -p >> SEC.pcap
echo 1337 01BB 00000000 00000000 8 0 18 0000 9C53 0000 01 01 08 0A DEADBEEF FFFFFFFF | xxd -r -p >>
SEC.pcap
echo D796C34F4FC7E3C6D6  | xxd -r -p >> SEC.pcap
```

- Sending the packet:



Conclusions

Powerful low level technique to craft custom packets for testing network, endpoint devices etc.

References

- Man xxd

  https://linux.die.net/man/1/xxd

- IPv4 Header calculator

  http://www.n-cg.net/hec.htm

- TCP checksum calculator

  http://www.netfor2.com/tcpsum.htm