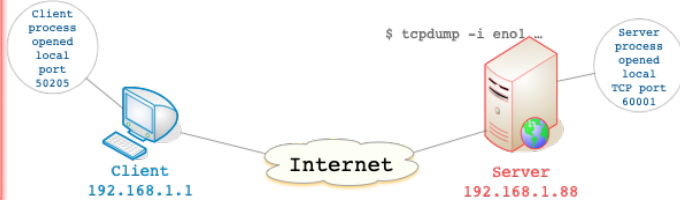
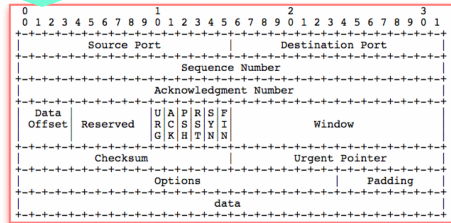


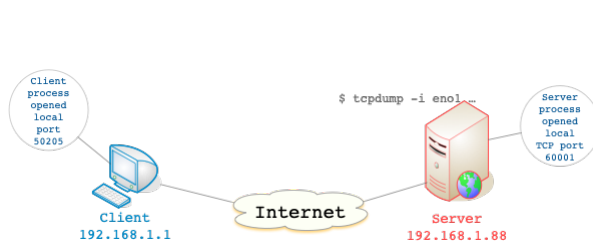
```
administrator@tunnel-ssh:~$ /usr/sbin/tcpdump -i eno1 -vvv -X tcp port 60001 -n
tcpdump: listening on eno1, link-type EN10MB (Ethernet), capture size 262144 bytes
```

From RFC 793 by Jon Postel, 1981

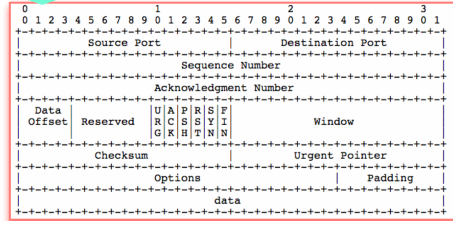


- Client sends a segment having the SYN flag set: The client requests a connection with the server
- Observe "Flags [SEW]" in the following trace
- Letter S means that the SYN flag is set. The other flags are not relevant to this introduction.
- The initial sequence number (seq) announced by this client is 2088096106. This ISN, will be used by the client to number the byte stream (The ordered sequence of bytes) sent by the client
- Later, when the server responds, it will send back an ack for 2088096107 which acknowledges the correct reception of this segment by the server
- Observe that the ACK flag is not set: no field contains the string "ack"

```
14:26:31.847912 IP (tos 0x0, ttl 63, id 0, offset 0, flags [DF], proto TCP (6),
length 64)
192.168.1.1.50205 > 192.168.1.88.60001: Flags [SEW], cksum 0x6d00 (correct),
seq 2088096106, win 65535, options [mss 1460,nop,wscale 6,nop,nop,TS val 4164899058
ecr 0,sackOK,eol], length 0
0x0000: 4500 0040 0000 4000 3f06 b80e c0a8 0101 E..@..@.?......
0x0010: c0a8 0158 c41d ea61 7c75 d16a 0000 0000 ...X...a|u.j....
0x0020: b0c2 ffff 6d00 0000 0204 05b4 0103 0306 ....m.....
0x0030: 0101 080a f83f 50f2 0000 0000 0402 0000 .....?P.....
```



From RFC 793 by Jon Postel, 1981

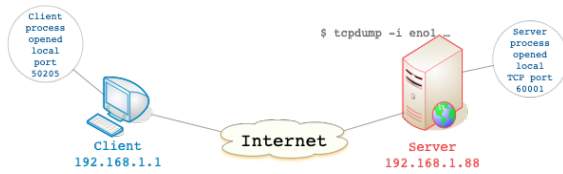


- Server responds to the Client with a segment which in turn has the SYN flag set
- The ISN (Initial Sequence Number) for the Server-to-Client channel is 800462370. It is sent within this segment (See "seq ...", below); when the client receives it, it will have to send back an ACK for 800462371
- This segment acknowledges data received from the Client up to and excluding byte 208809107 (See ack 208809107, below), i.e., the last byte correctly received was byte number 208809106. That byte number, in this case, was the initial sequence number sent by the client, so that, this segment means "I accept your connection request and do know that your ISN is 208809106).

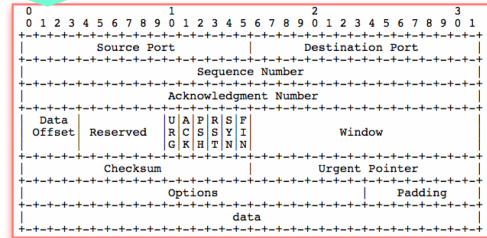
14:26:31.847975 IP (tos 0x0, ttl 64, id 0, offset 0, flags [DF], proto TCP (6), length 60)

192.168.1.88.60001 > 192.168.1.1.50205: Flags [S.E], cksum 0x83d8 (incorrect -> 0x3292), seq 800462370, ack 2088096107, win 65160, options [mss 1460,sackOK,TS val 2633263755 ecr 4164899058,nop,wscale 7], length 0

```
0x0000: 4500 003c 0000 4000 4006 b712 c0a8 0158  E.<..@.@.....X
0x0010: c0a8 0101 ea61 c41d 2fb6 1622 7c75 d16b  ....a../.."|u.k
0x0020: a052 fe88 83d8 0000 0204 05b4 0402 080a  .R.....
0x0030: 9cf4 6a8b f83f 50f2 0103 0307  ..j..?P.....
```

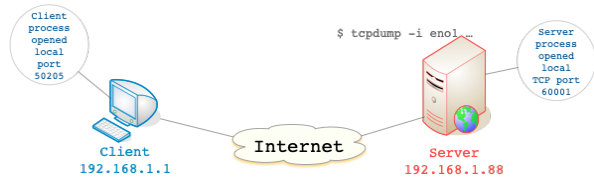



From RFC 793 by Jon Postel, 1981

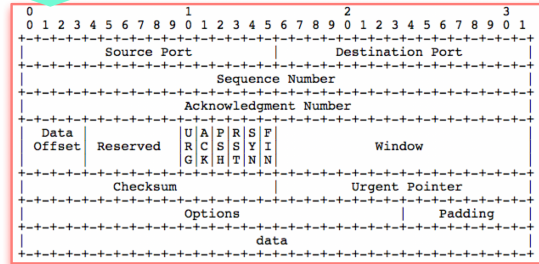


- The user of the nc command types "Hello" and includes a return key stroke: The bytes that actually get sent are the following:
 - [H] [e] [l] [l] [o] [ASCII enter key]
- Observe "Flags [SEW]" in the following trace

```
14:26:36.406787 IP (tos 0x2,ECT(0), ttl 63, id 0, offset 0, flags [DF], proto TCP (6), length 58)
192.168.1.1.50205 > 192.168.1.88.60001: Flags [P.], cksum 0x226a (correct), seq 1:7, ack 1, win
2058, options [nop,nop,TS val 4164903611 ecr 2633263755], length 6
0x0000: 4502 003a 0000 4000 3f06 b812 c0a8 0101 E...@.?.....
0x0010: c0a8 0158 c41d ea61 7c75 d16b 2fb6 1623 ..X...a|u.k/..#
0x0020: 8018 080a 226a 0000 0101 080a f83f 62bb ...."j.....?b.
0x0030: 9cf4 6a8b 4865 6c6c 6f0a                ..j.Hello.
```



From RFC 793 by Jon Postel, 1981



- Server responds by acknowledging the received data which was sent by the client
- See Ack 7 below. Ack 7 means that the sender of this segment acknowledges data bytes from logical sequence number 1 through 7 (excluded), all in all, sequence numbers 1, 2, 3, 4, 5 and 6.
- No data is sent by the server (Payload is empty) since length is 0 (See length 0 below)

14:26:36.406853 IP (tos 0x0, ttl 64, id 8400, offset 0, flags [DF], proto TCP (6), length 52)

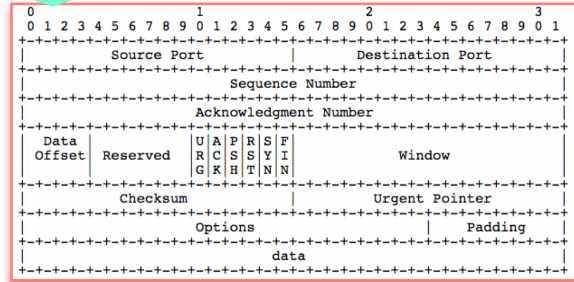
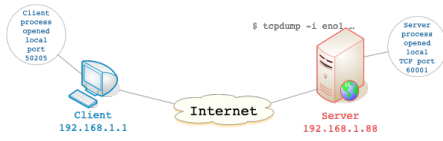
192.168.1.88.60001 > 192.168.1.1.50205: Flags [.], cksum 0x83d0 (incorrect -> 0x3a8b), seq 1, ack 7, win 510, options [nop,nop,TS val 2633268314 ecr 4164903611], length 0

```

0x0000: 4500 0034 20d0 4000 4006 964a c0a8 0158  E..4..@.@..J...X
0x0010: c0a8 0101 ea61 c41d 2fb6 1623 7c75 d171  ....a../#|u.q
0x0020: 8010 01fe 83d0 0000 0101 080a 9cf4 7c5a  ....|Z
0x0030: f83f 62bb .?b.

```


From RFC 793 by Jon Postel, 1981



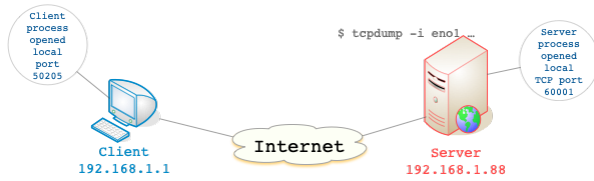
- Server, after receiving the F flag, sends a segment with that flag set. See Flags [F.] below.

14:26:40.355088 IP (tos 0x0, ttl 64, id 8401, offset 0, flags [DF], proto TCP (6), length 52)

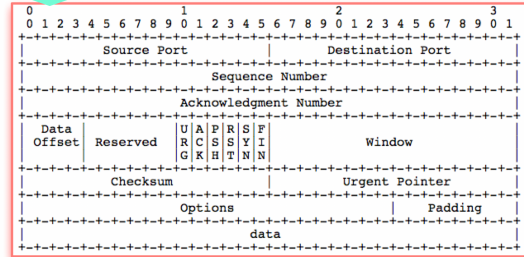
192.168.1.88.60001 > 192.168.1.1.50205: Flags [F.], cksum 0x83d0 (incorrect -> 0x1bb8), seq 1, ack 8, win 510, options [nop,nop,TS val 2633272262 ecr 4164907552], length 0

```

0x0000:  4500 0034 20d1 4000 4006 9649 c0a8 0158  E..4..@.@..I...X
0x0010:  c0a8 0101 ea61 c41d 2fb6 1623 7c75 d172  .....a../.#|u.r
0x0020:  8011 01fe 83d0 0000 0101 080a 9cf4 8bc6  .....
0x0030:  f83f 7220                                     .?r.
  
```



From RFC 793 by Jon Postel, 1981



- Client acknowledges the correct reception of the F flag. See ack 2 below.
- Both connections are closed

```
14:26:40.356782 IP (tos 0x0, ttl 63, id 0, offset 0, flags [DF], proto TCP (6),
length 52)
  192.168.1.1.50205 > 192.168.1.88.60001: Flags [.], cksum 0x15ab (correct), seq
8, ack 2, win 2058, options [nop,nop,TS val 4164907553 ecr 2633272262], length 0
  0x0000: 4500 0034 0000 4000 3f06 b81a c0a8 0101  E..4..@.?.....
  0x0010: c0a8 0158 c41d ea61 7c75 d172 2fb6 1624  ...X...a|u.r/..$
  0x0020: 8010 080a 15ab 0000 0101 080a f83f 7221  .....?r!
  0x0030: 9cf4 8bc6                                     ....
^C
8 packets captured
8 packets received by filter
0 packets dropped by kernel
```

```
administrator@tunnel-ssh:~$
paloalto.unileon.es/ds/lab/result2.txt
```