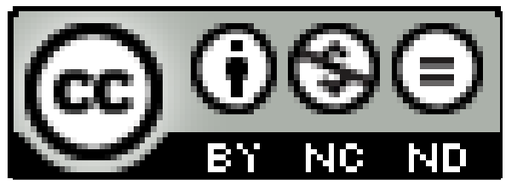
Мрежова сигурност I

http://training.iseca.org/

TCP 3/3 - Атаки



Boyan Krosnov

План на курса

- Увод в мрежовата сигурност
- Криптография
- Увод в мрежите
- Ethernet
- Wi-Fi
- IP
- UDP, DHCP, ARP, Атаки върху IP
- IP routing protocols, IPv6

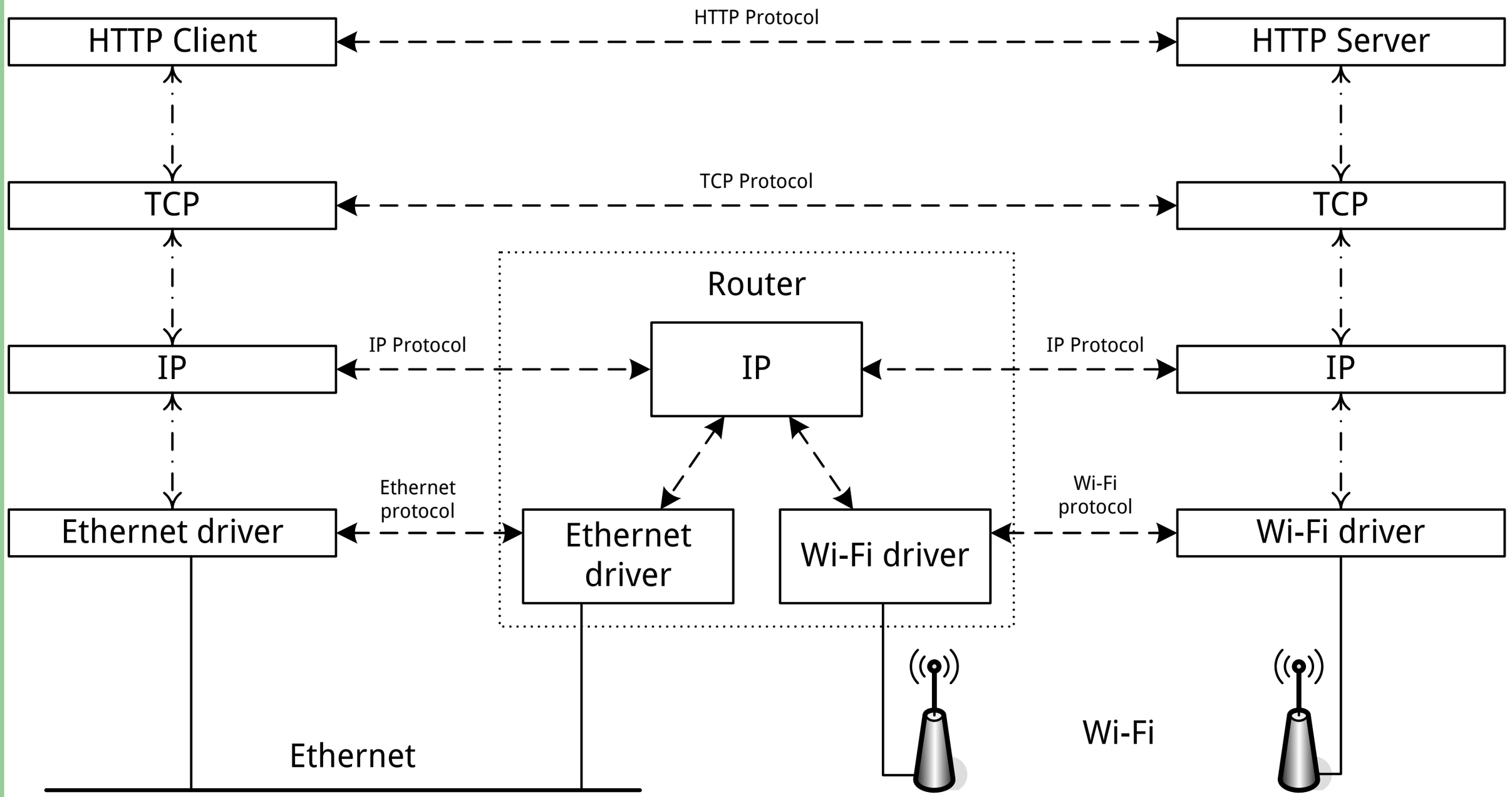
→ **TCP**

- Лекция преговор – 16-ти Ноември
- Тест – 18-ти Ноември
- Демо
- …

План

- История и Стандарт
- Предназначение и употреба
- Интерфейси
- Енкапсулация
- TCP Протокола
  - отваряне и затваряне на сесии
  - flow control
  - congestion avoidance & control
  - други
- Атаки върху TCP

Слоевете


HTTP Client
HTTP Protocol
HTTP Server
TCP
TCP Protocol
TCP
Router
IP
IP Protocol
IP
IP Protocol
IP
Ethernet driver
Ethernet protocol
Ethernet driver
Wi-Fi driver
Wi-Fi protocol
Wi-Fi driver
Ethernet
Wi-Fi

План

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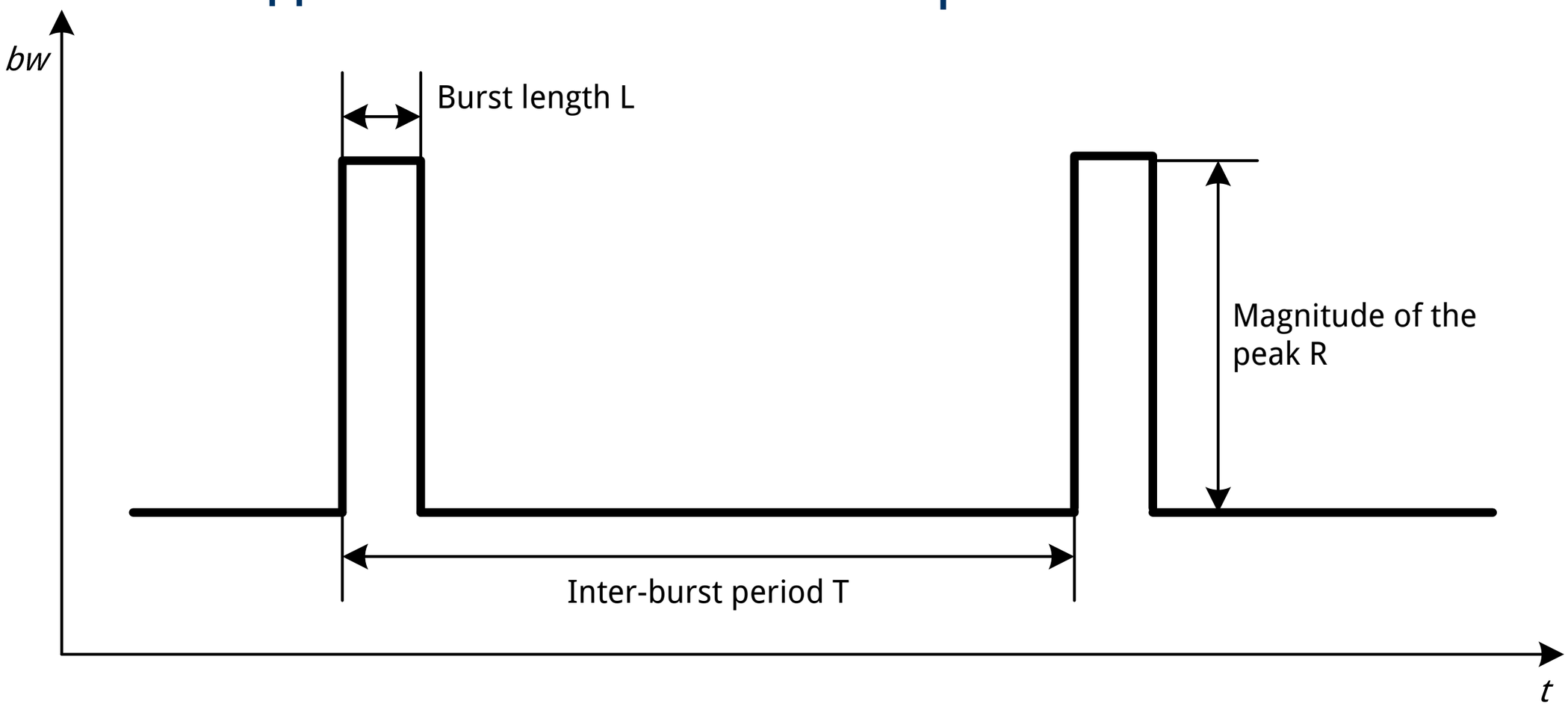
- Атаки върху TCP

Атаки върху TCP

- Resource exhaustion на буфери
- State machine attacks / tweaks
  - resource exhaustion на TCP state
  - scanning
- Бъгове в стековете
- Blind connection reset
- Blind performance degradation
- Blind TCP spoofing

Resource exhaustion на буфери

- Буферите в рутерите са краен ресурс
- Low-rate TCP атака
  - пращаме bursts, синхронизирани с TCP retransmissions
  - вижте допълнителните материали



Resource exhaustion на TCP state

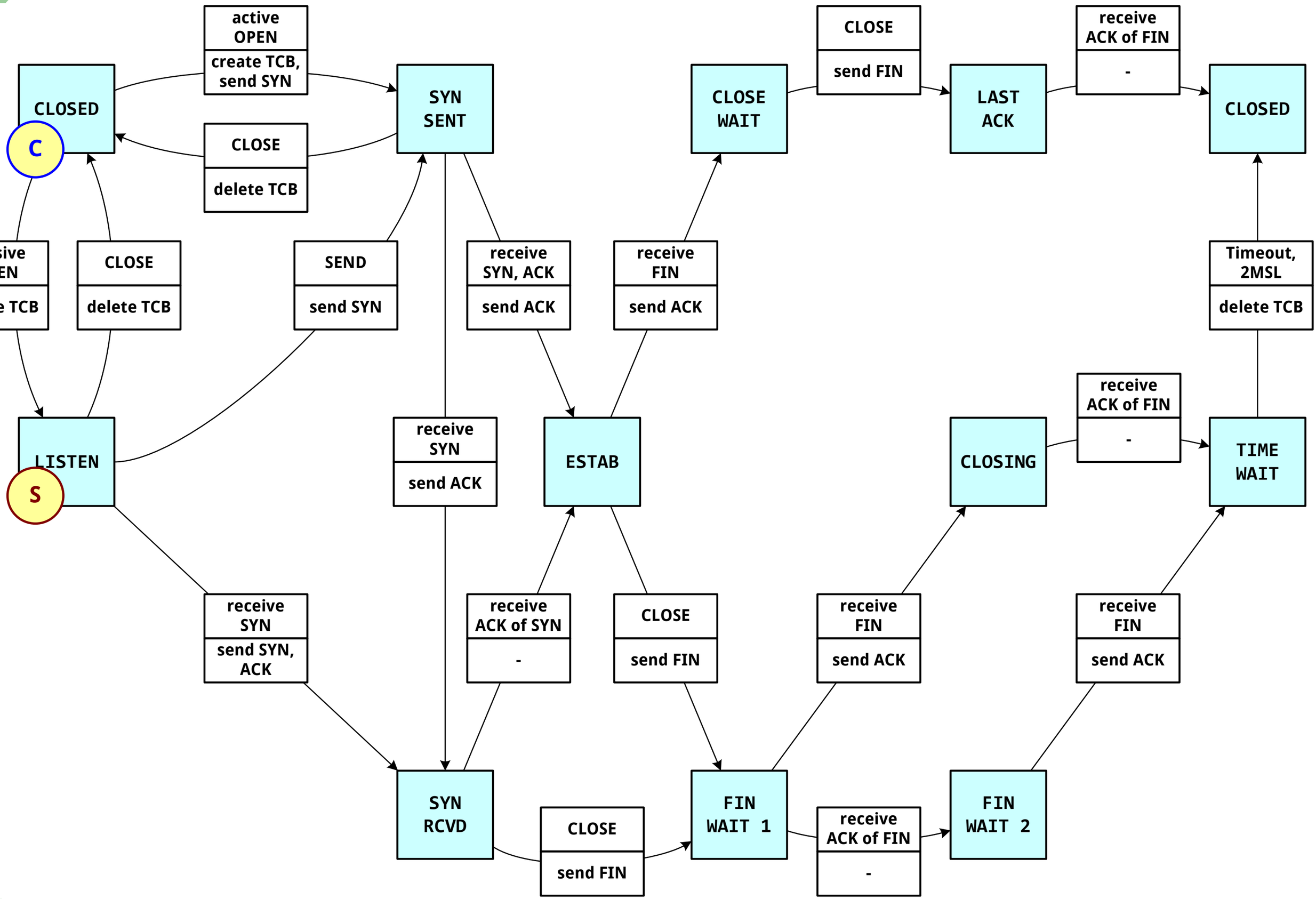
- SYN flood
  - по стандартния краен автомат при преход от LISTEN в SYN RCVD състояние се създава TCB
  - Хостовете могат да поддържат краен брой сесии
  - Оценка на скоростта: 1.5M нови сесии в секунда на GigE

SYN flood mitigations

- RFC4987 TCP SYN Flooding Attacks and Common Mitigations (2007)

- Filtering – URPF – защитава от IP spoofing*
- Увеличаване на таблиците
- Намаляване на таймерите
- Рециклиране на най-старото полуотворено TCB
- SYN cache
- SYN cookies*

- Firewalls*, etc. (внимателно)


CLOSED
active OPEN
create TCB, send SYN
CLOSE
delete TCB
SYN SENT
CLOSE WAIT
CLOSE
send FIN
LAST ACK
receive ACK of FIN
-
CLOSED
C
passive OPEN
create TCB
CLOSE
delete TCB
SEND
send SYN
receive SYN, ACK
send ACK
receive FIN
send ACK
Timeout, 2MSL
delete TCB
LISTEN
S
receive SYN
send ACK
ESTAB
CLOSING
receive ACK of FIN
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TIME WAIT
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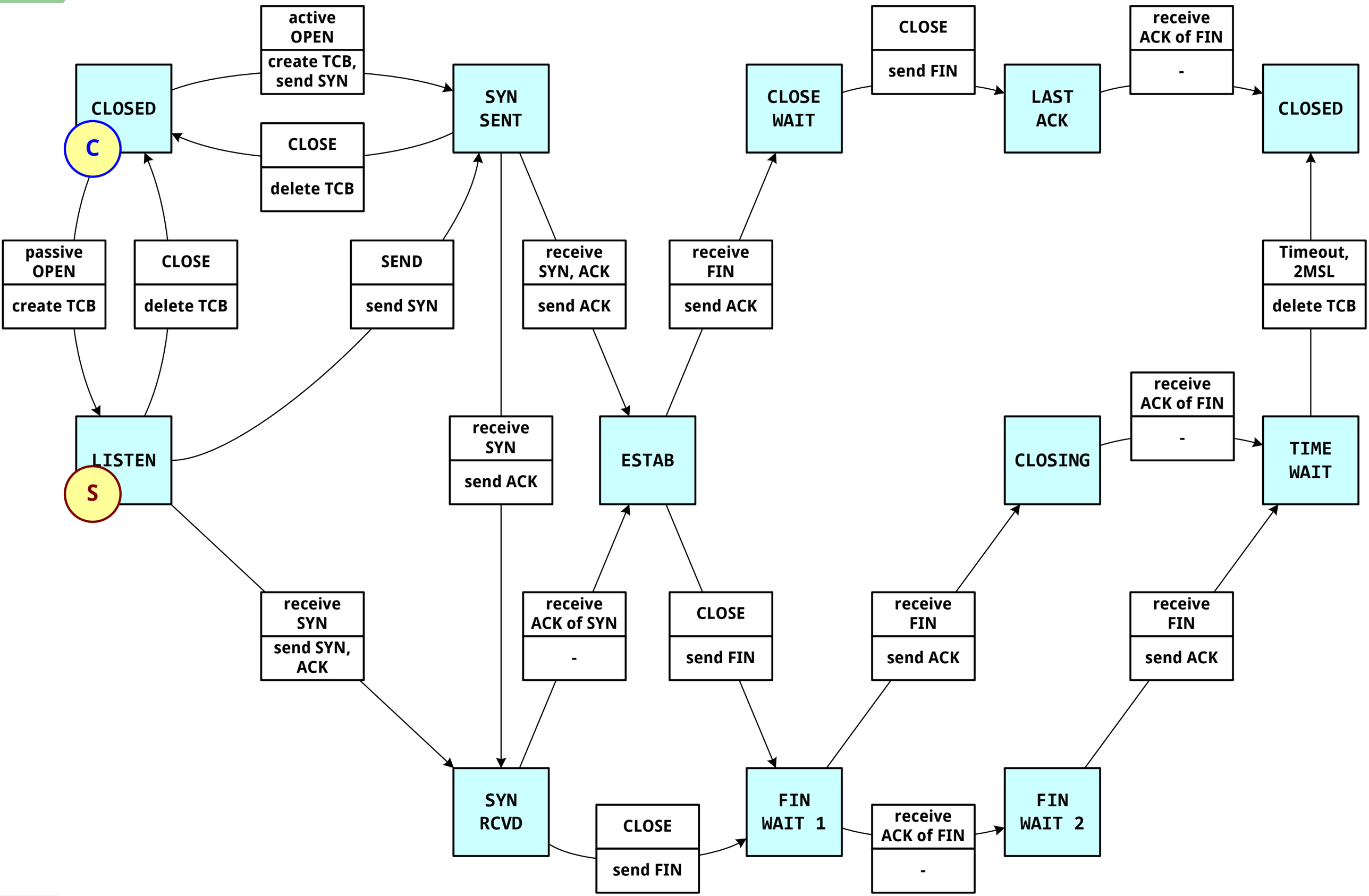
send SYN, ACK
receive ACK of SYN
-
CLOSE
send FIN
receive FIN
send ACK
receive FIN
send ACK
SYN RCVD
CLOSE
send FIN
FIN WAIT 1
receive ACK of FIN
-
FIN WAIT 2

SYN cookies

1. client
   - **create TCB**
   - send SYN, seq=c, ack=0
   - change state to SYN SENT
2. server
   - receive SYN
   - send SYN+ACK, ack=c+1, seq=s
   - **create TCB**; change state to SYN RECEIVED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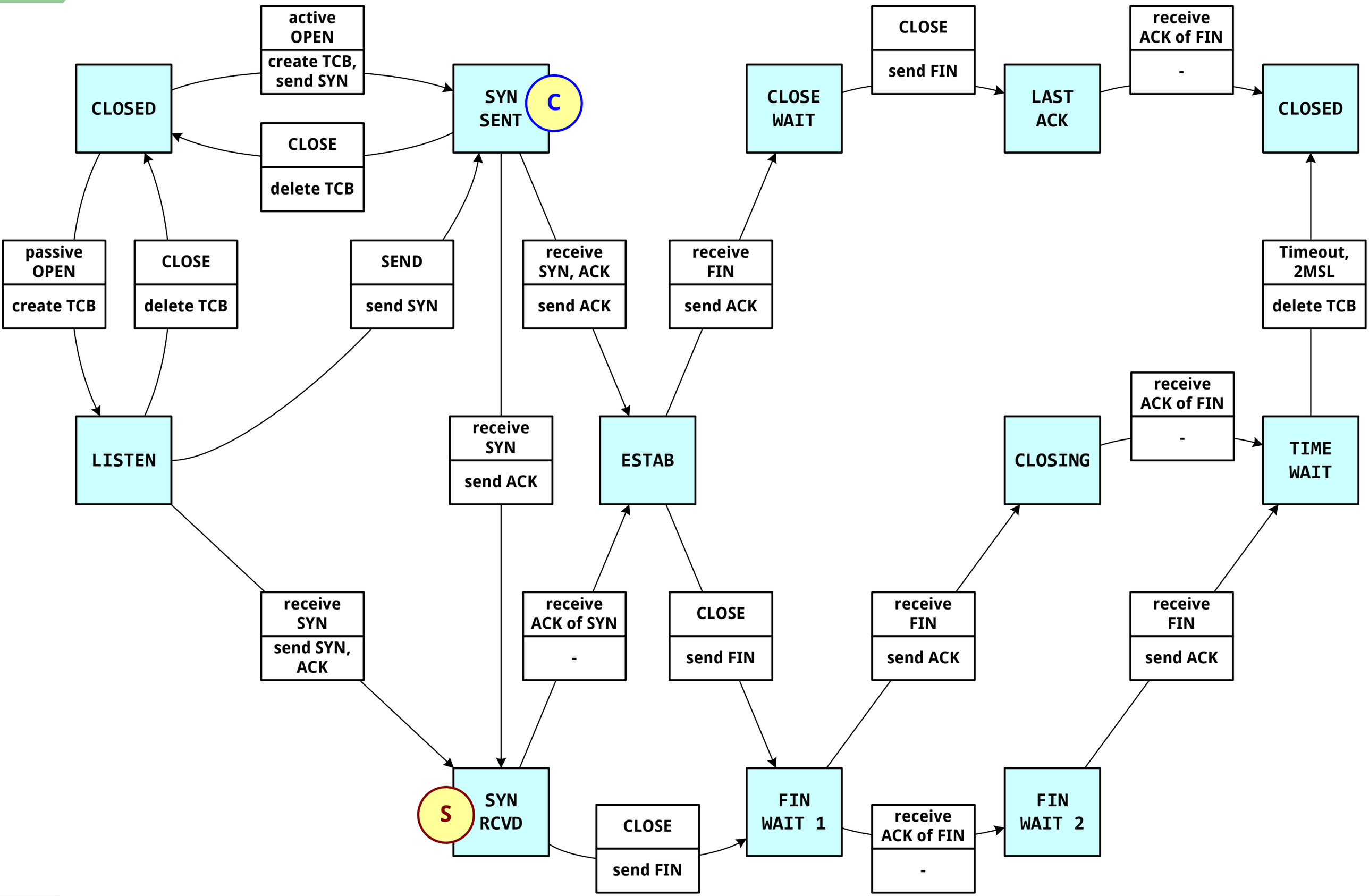
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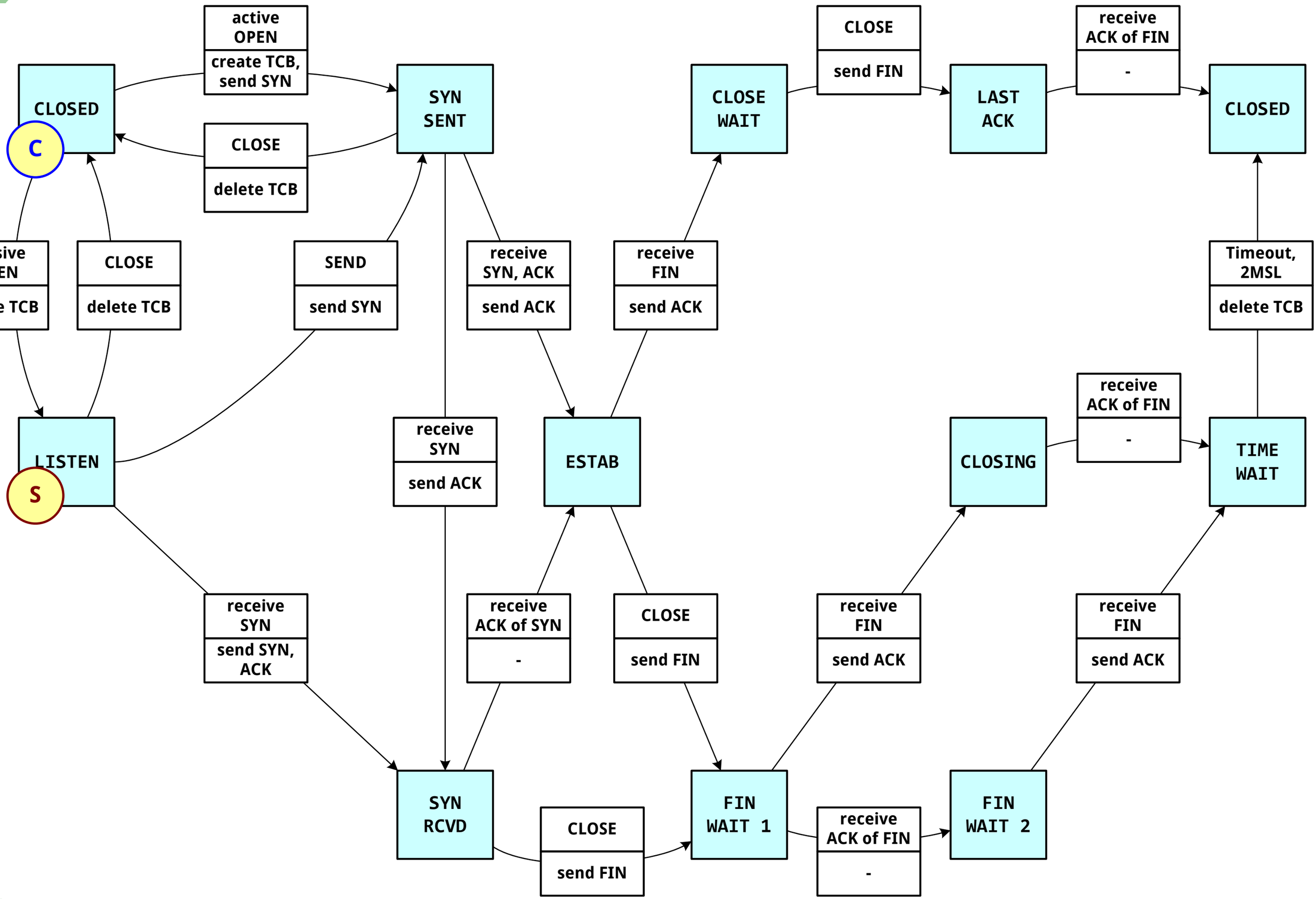
FIN WAIT 2

SYN cookies

1. client
   - **create TCB**
   - send SYN, seq=c, ack=0
   - change state to SYN SENT
2. server
   - receive SYN
   - compute cookie = hash (salt + client ip + client port + c)
   - send SYN+ACK, ack=c+1, **seq=cookie**
   - ~~create TCB; change state to SYN RECEIVED~~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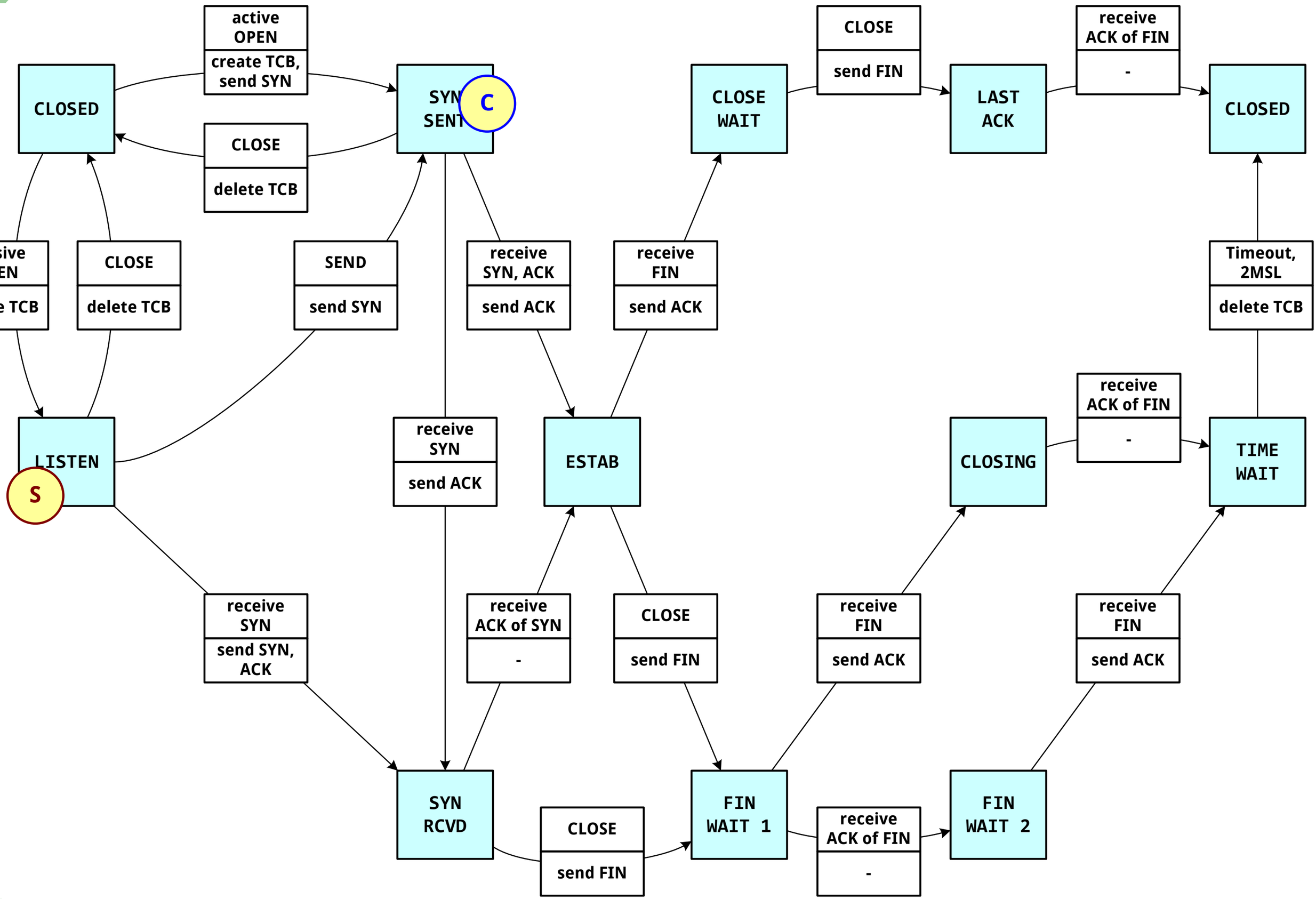
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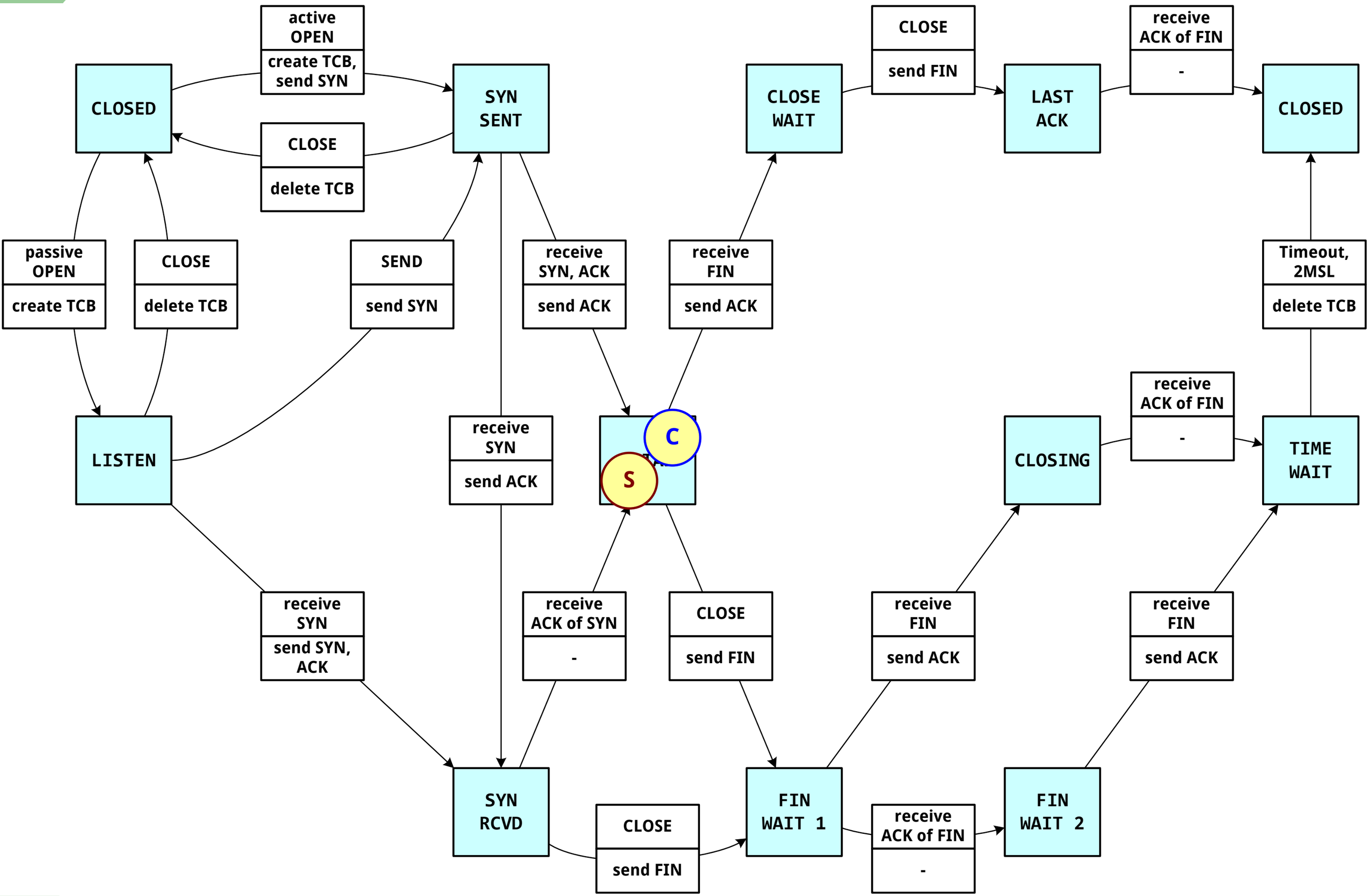
SYN cookies

3. client
   - receive SYN+ACK
   - send ACK, seq=s+1, **ack=cookie+1**
   - change state to ESTABLISHED
4. server
   - receive ACK
   - **cookie = ack-1**; check cookie or drop
   - recover state; **create TCB**
   - change state to ESTABLISHED

- особености с TCP опции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Resource exhaustion на TCP state

- SYN flood
  - по стандартния краен автомат при преход от LISTEN в SYN RCVD състояние се създава TCB
  - Хостовете могат да поддържат краен брой сесии
  - Оценка на скоростта: 1.5M нови сесии в секунда на GigE
  - Syncookies защитават от blind SYN flood

- connect() flood
  - без IP spoofing
  - изисква армия от зомбита

Въпроси

Директно сканиране

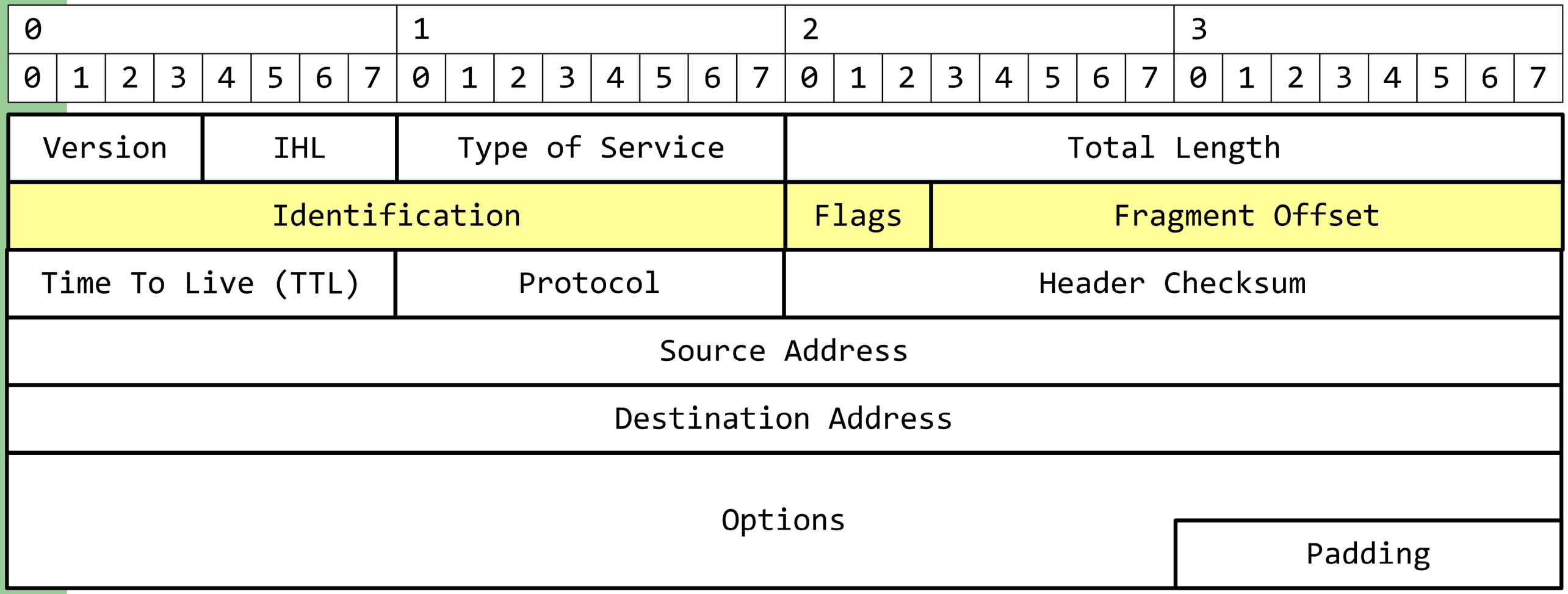
- SYN scan, connect() scan
- други директни начини за сканиране
  - NULL, FIN, Xmas
  - etc.

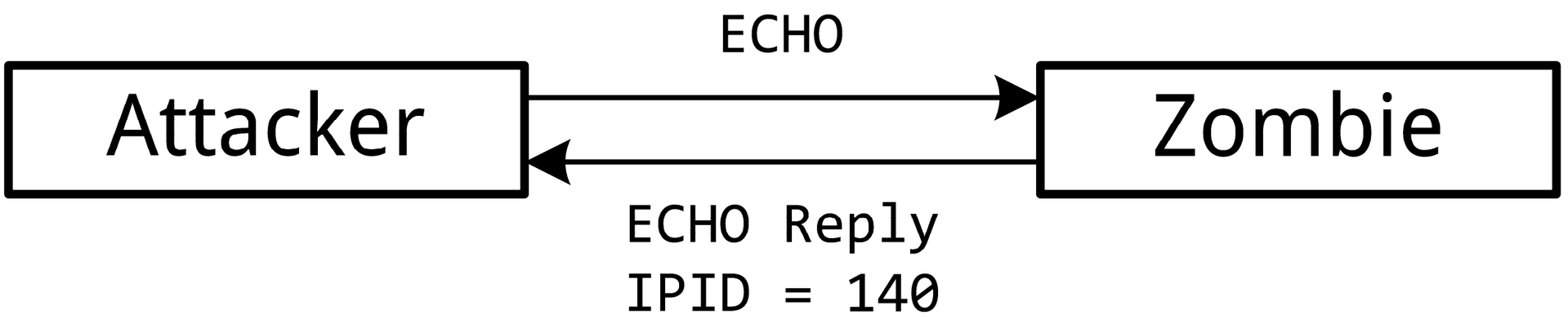
- nmap

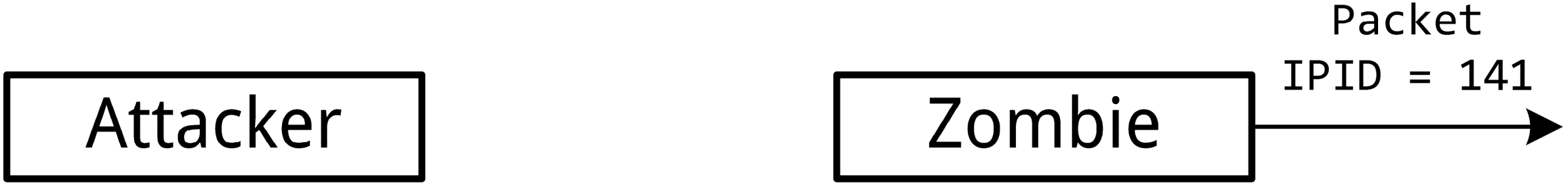
Idle scan

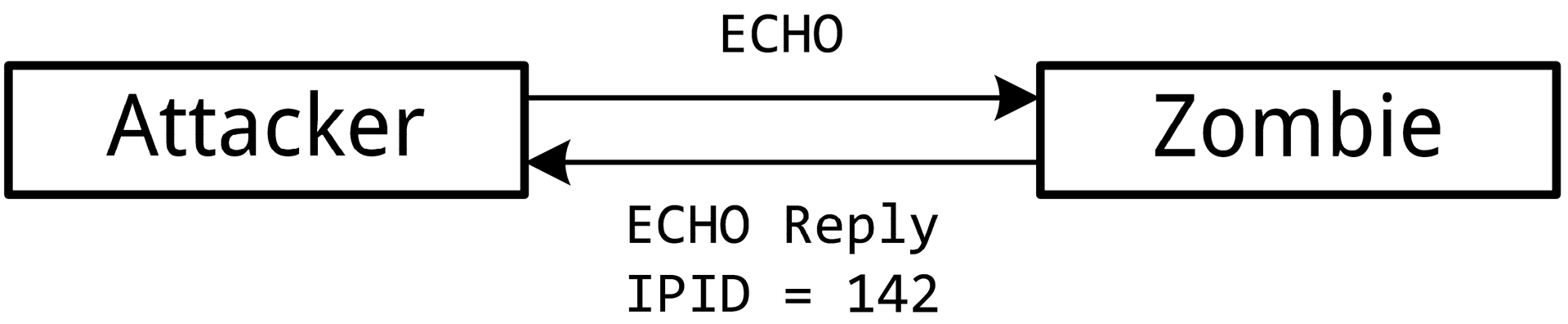
- IP ID полето
  - предвидимо ip id
  - наблюдение на ip id
    - всеки изпратен пакет се отбелязва с увеличение на ip id с 1

IP ID


0 1 2 3
0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7
Version
IHL
Type of Service
Total Length
Identification
Flags
Fragment Offset
Time To Live (TTL)
Protocol
Header Checksum
Source Address
Destination Address
Options
Padding


ECHO
Attacker
Zombie
ECHO Reply
IPID = 140


Packet
IPID = 141
Attacker
Zombie

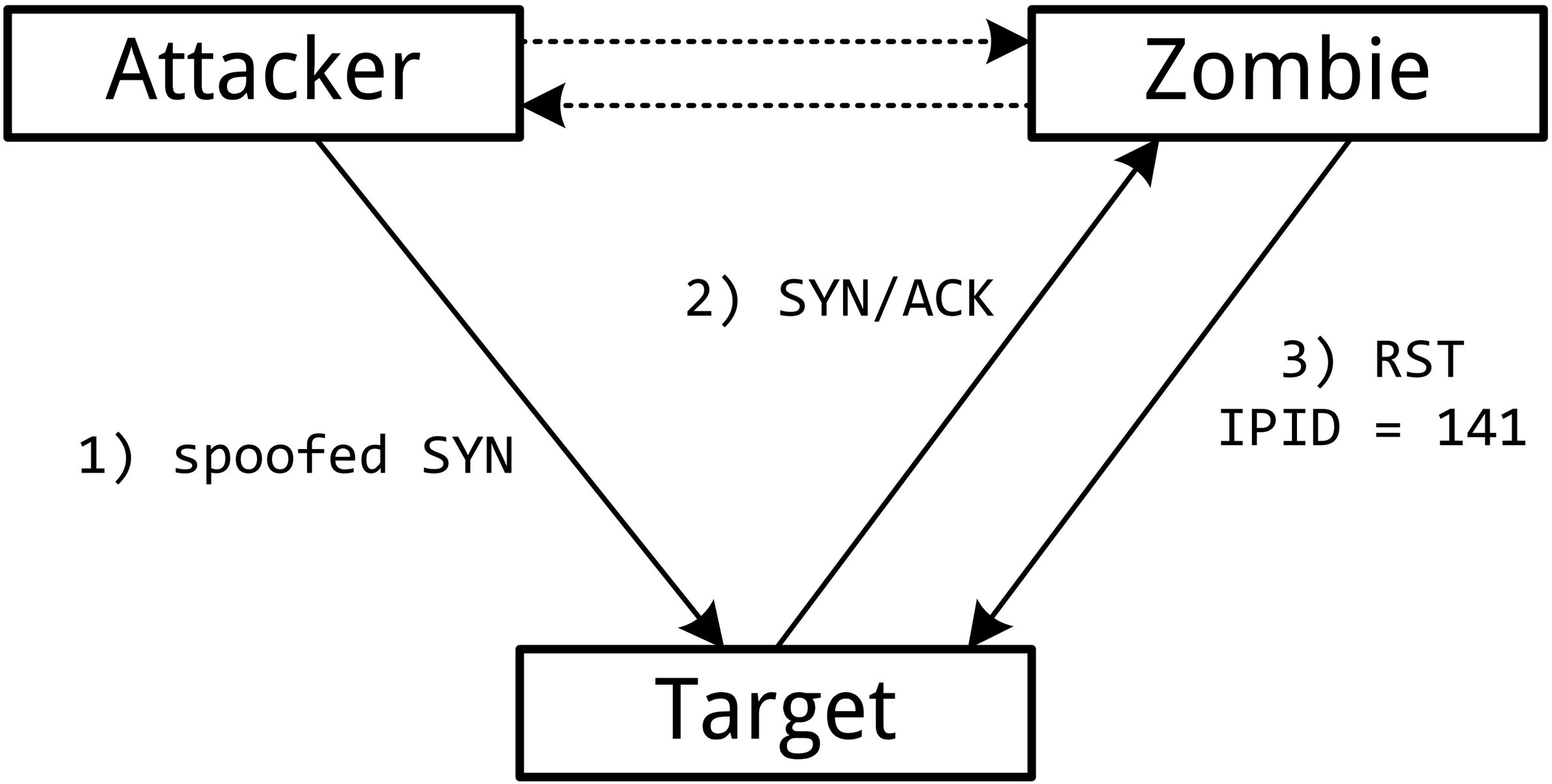

ECHO
Attacker
Zombie
ECHO Reply
IPID = 142

Idle scan

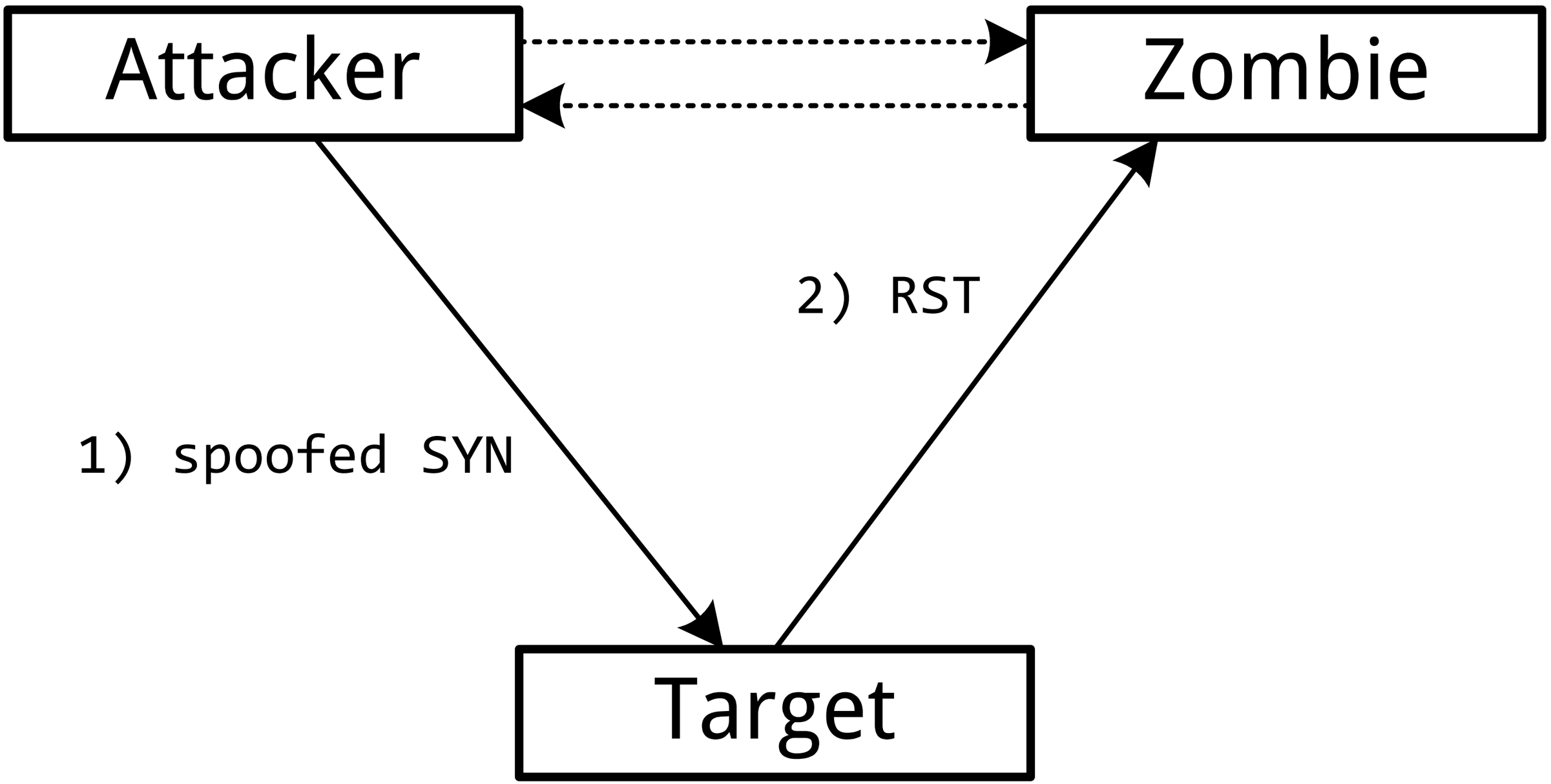
- IP ID полето
  - предвидимо ip id
  - наблюдение на ip id
    - всеки изпратен пакет се отбелязва с увеличение на ip id с 1

- плюс IP spoofing

Отворен(слушащ) порт



Затворен порт



Idle scan

- IP ID полето
  - предвидимо ip id
  - наблюдение на ip id, всеки пратен пакет се отбелязва с увеличение на ip id с 1

- плюс IP spoofing

- е равно на Idle scan

Въпроси

Бъгове в стековете

- Land
  - TCP SYN
  - sport=dport, source=destination
- Winnuke
  - URG
- etc.

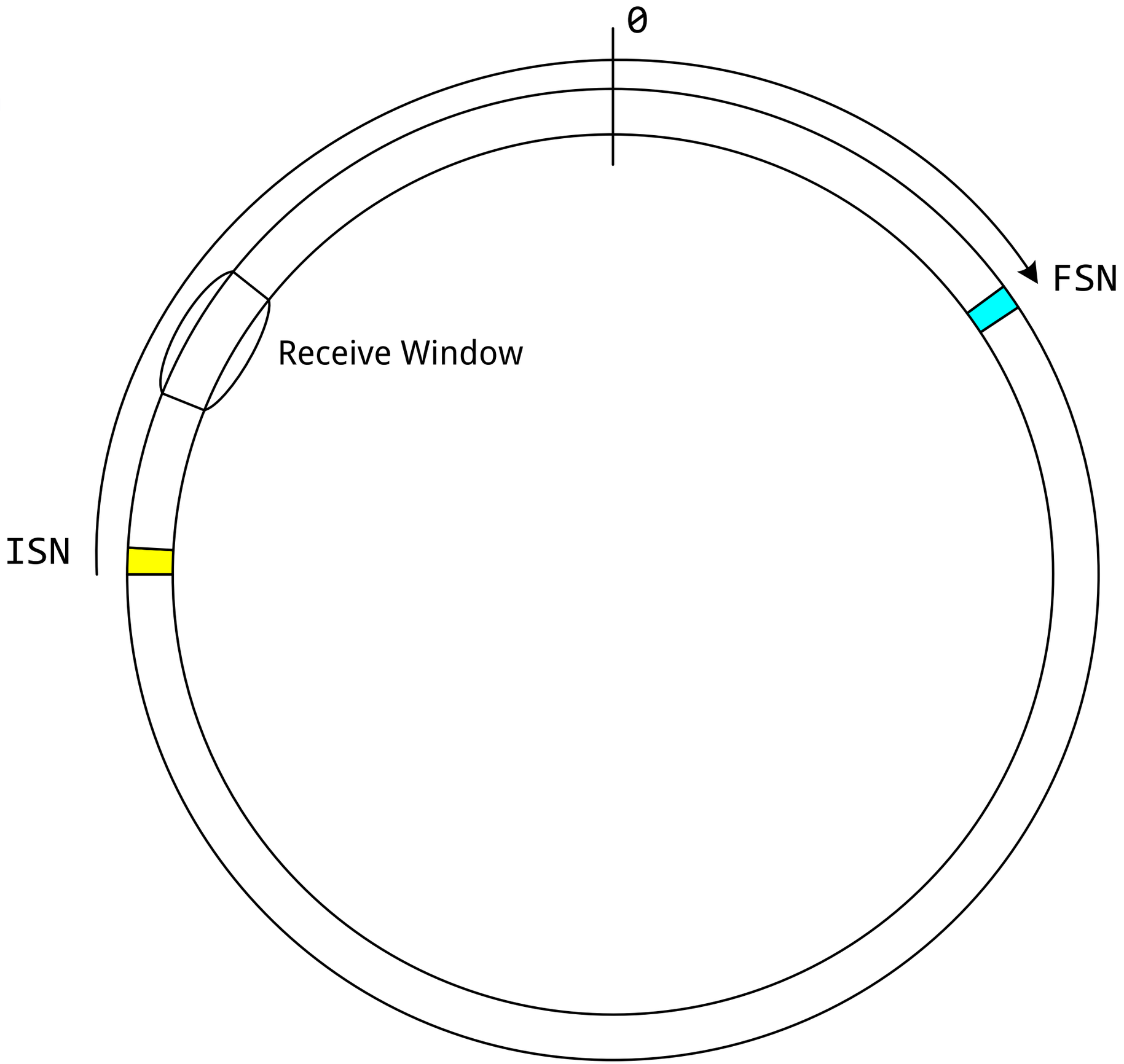
In-window и ICMP атаки

- TCP-прозорецът е голям
- Контролни съобщения в прозореца
- ICMP съобщения, които засягат TCP
  - Source Quench
  - Host/Net/Port Unreachable
  - PMTU-D – Fragmentation needed but DF set

Колко е голям прозореца?

- Receive Window >= bandwidth*RTT

- Пример 10 gigabit trans-atlantic
  - 1250 MB/s, 0.10 s RTT
  - 125 MB receive window (1/35 от sequence space)


0
FSN
Receive Window
ISN

Blind connection reset

- ICMP unreach
  - RFC5927 – ICMP Attacks against TCP (2010)
  - Някои стекове не проверяват sequence номера
- RST in window
  - RFC4953 – Defending TCP Against Spoofing Attacks (2007)
  - RFC5961 – Improving TCP’s Robustness to Blind In-Window Attacks (2010)
- SYN in window
  - SYN in window – предизвиква RST
  - RFC5961

Blind performance degradation

- tcpnice

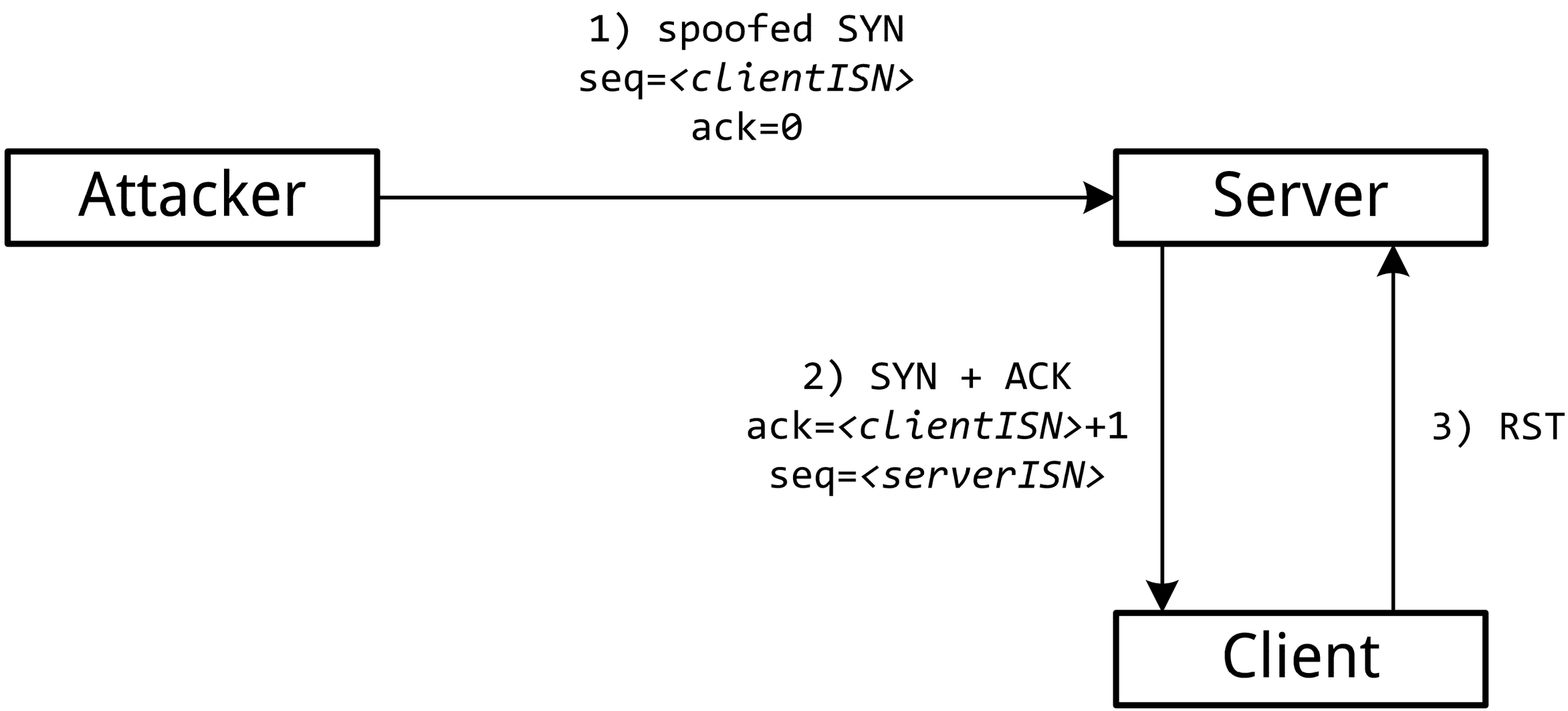
- ICMP Source Quench
- ICMP Fragmentation needed but DF set

- Със знание на точния последен ack номер
  - Малки прозорци
  - Повторени ACKs

Blind TCP spoofing

- Отваряне на сесия от името на друг хост
- атакуващ от името на клиента
  - SYN, seq=clientISN, ack=0
- сървър
  - SYN+ACK, ack=clientISN+1, seq=serverISN
- истинският клиент
  - RST

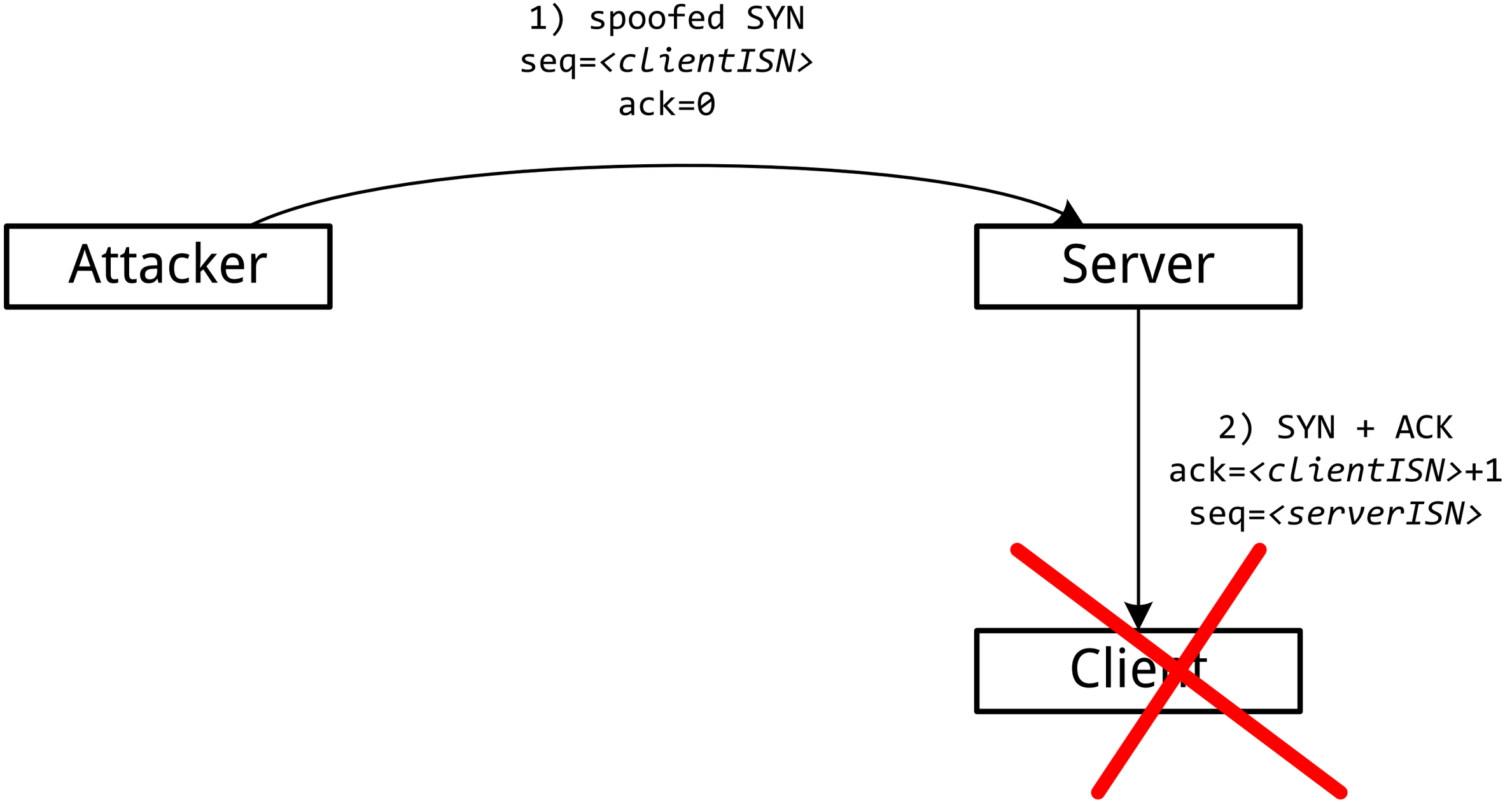
Blind TCP spoofing



Blind TCP spoofing

- Отваряне на сесия от името на друг хост
- атакуващ от името на клиента
  - SYN, seq=clientISN, ack=0
- сървър
  - SYN+ACK, ack=clientISN+1, seq=serverISN
- атакуващ от името на клиента
  - ACK, seq=clientISN+1, **ack=serverISN+1**
  - ACK+PSH, seq=clientISN+1, ack=serverISN+1
  - payload – каквото иска

Blind TCP spoofing



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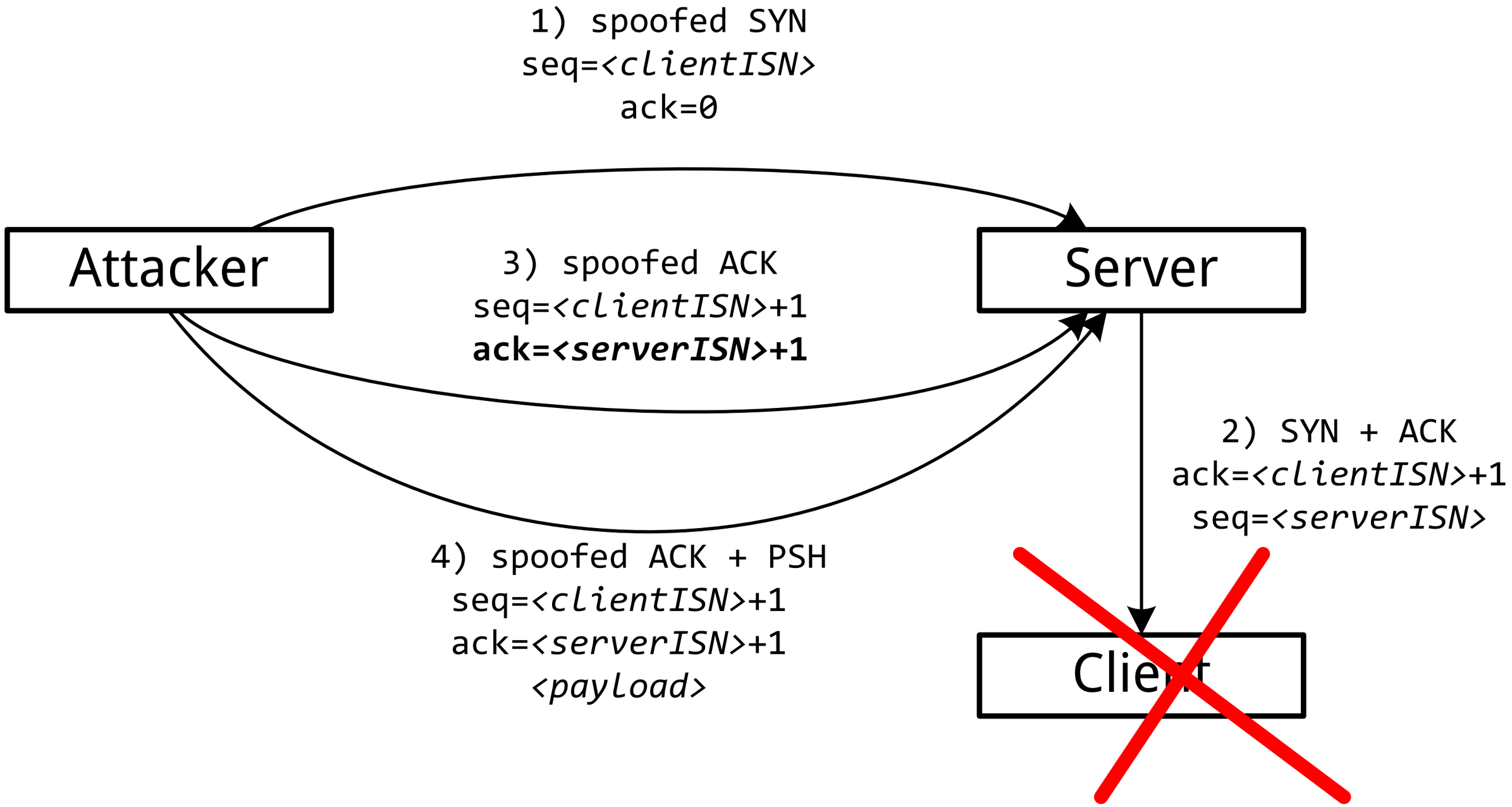

Blind data injection

- Вмъкване на данни в чужда сесия
- Трябва да познаем
  - source ip (фиксиран), destination ip (фиксиран)
  - source port, destination port (фиксиран)
  - прозореца (голям)
- RFC5961 – Improving TCP’s Robustness to Blind In-Window Attacks (2010) – точка 5
- Резултат - разсинхронизиране на прозореца или вмъкване на данни

Въпроси

Общи препоръки

- Непредвидим ISN
- Непредвидими портове
- Непредвидимо IP ID

Общи препоръки

- Sequence Validation
  - seq, ack трябва да са в прозореца
  - всички TCP пакети трябва да се валидират
  - всички ICMP-та също
- IP Spoofing
  - Защитата от IP spoofing предотвратява повечето TCP атаки
  - Няма напълно защитена от IP Spoofing мрежа

Въпроси