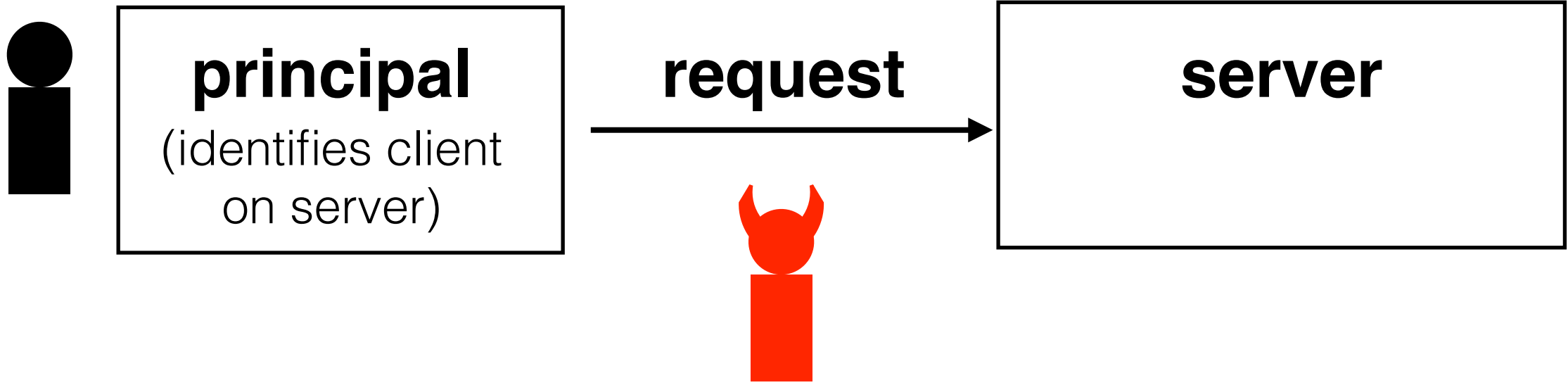


6.1800 Spring 2025

Lecture #25: Network-based attacks

preventing access — *denying service* — to online resources

**we've been dealing with
adversaries on the network for
two lectures**



adversary's goal: observe or tamper with
packets

today, our adversaries are still
on the network, but they have
new goals

the primary method they'll use to
achieve this goal is a **DDoS**
attack, made more effective with
a **botnet**



adversary's goal: prevent legitimate access
to an internet resource

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'Denial of service condition' disrupted US energy company operations

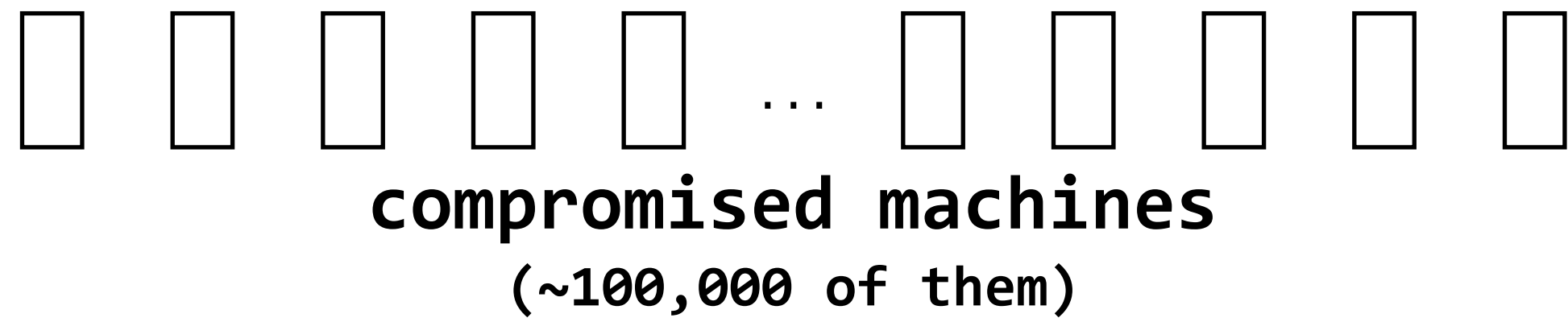
Zack Whittaker — 8:42 AM PDT · May 2, 2019



policy: maintain **availability** of the service

threat model: adversary controls a **botnet**, and is aiming to prevent access to a legitimate service via **DDoS attacks**

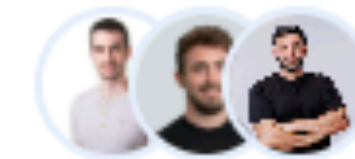
botnets: large collections of compromised machines controlled by an adversary



these machines can become compromised in a variety of ways. the mirai botnet, for example, works by attempting to log in to many machines using common username/password combinations. this has been effective for IoT devices that often have a common default password.

6.1800 in the news

Airborne: Wormable Zero-Click Remote Code Execution (RCE) in AirPlay Protocol Puts Apple & IoT Devices at Risk



Uri Katz, Avi Lumelsky, Gal Elbaz

April 29, 2025

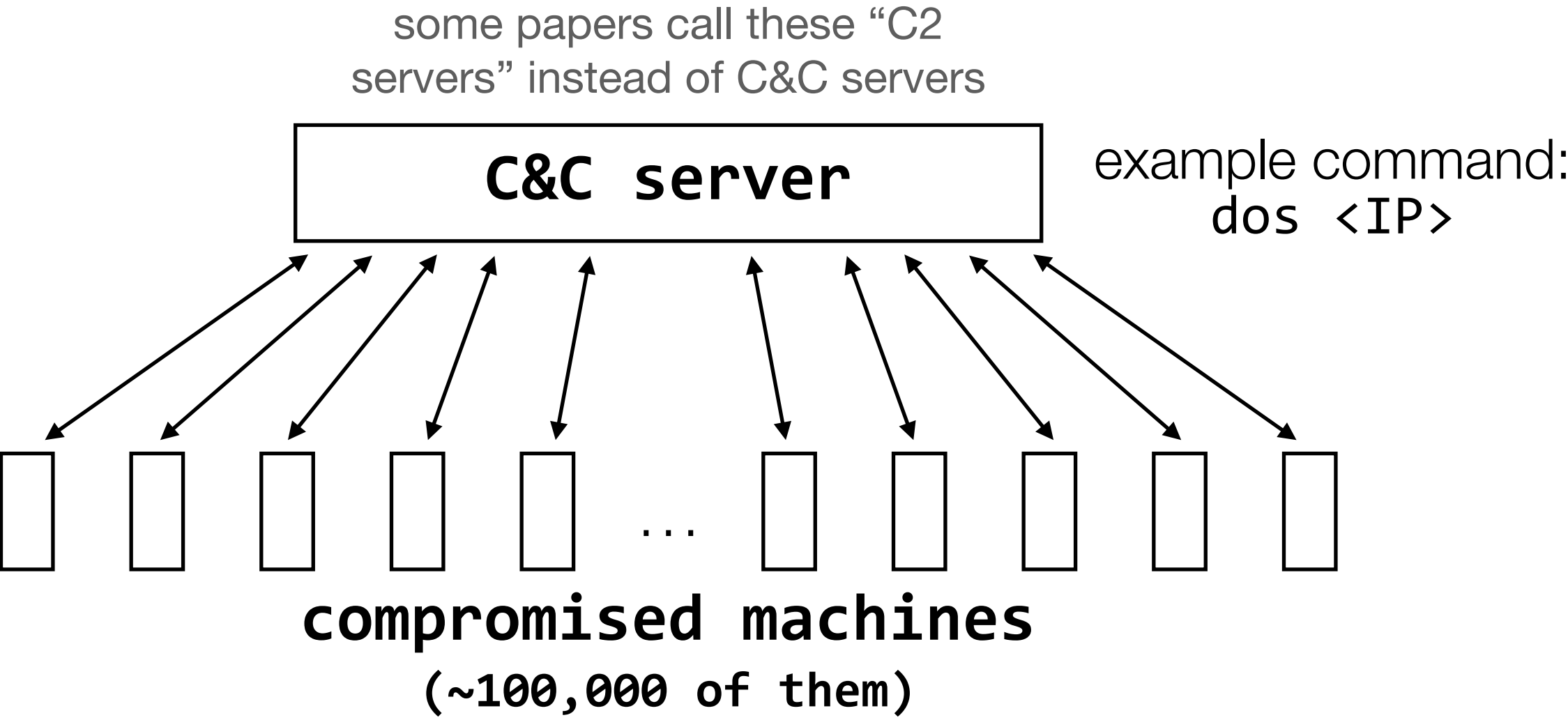
CVE-2025-24132 is a stack-based buffer overflow vulnerability. This vulnerability allows for a zero-click RCE on speakers and receivers that leverage the AirPlay SDK. These devices are vulnerable to zero-click RCE under all configurations. The vulnerability allows for wormable exploits under these circumstances, given it enables an attack path that can spread from one device to another with no human interaction.

Examples of successful attack outcomes include more playful actions like displaying an image on the device or playing music, to more serious actions like using the device's microphone to listen to nearby conversations, such as eavesdropping via a device in a high-profile conference room.

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network intrusion detection systems:

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;)
```

an example of a signature

signature-based NIDS match traffic
against known signatures

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signature-based NIDS match traffic
against known signatures

anomaly-based NIDS match traffic
against a model of “normal” traffic

for each packet:
search packet for “root”

problem: string might be split across packets

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

problem: packets might arrive out of order

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

problem: this is more involved than it looks on the
slide, and requires keeping a lot of state

it's certainly not impossible; after all, your computer
reconstructs TCP byte streams all the time

problem 2: it doesn't even work

policy: maintain **availability** of the service

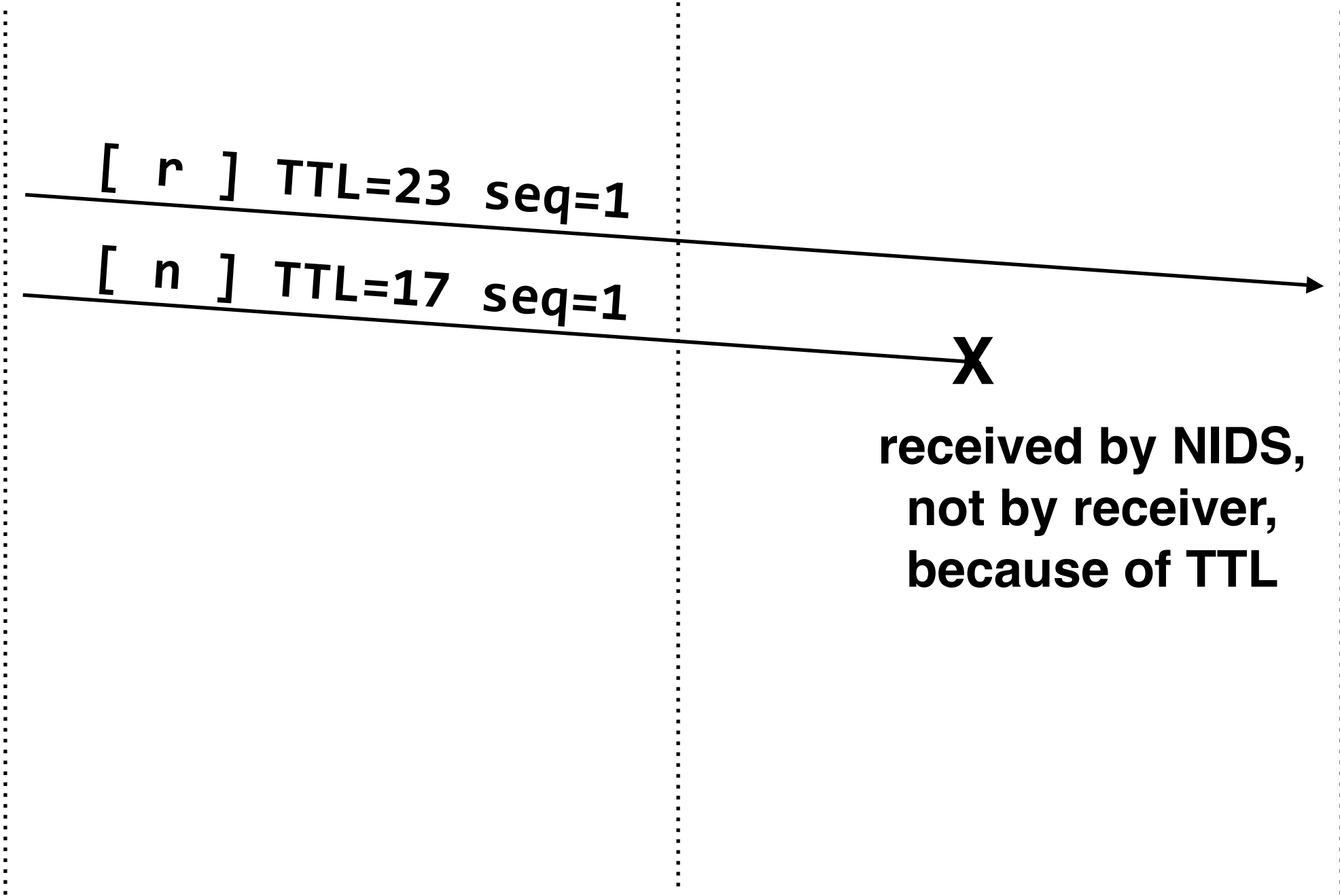
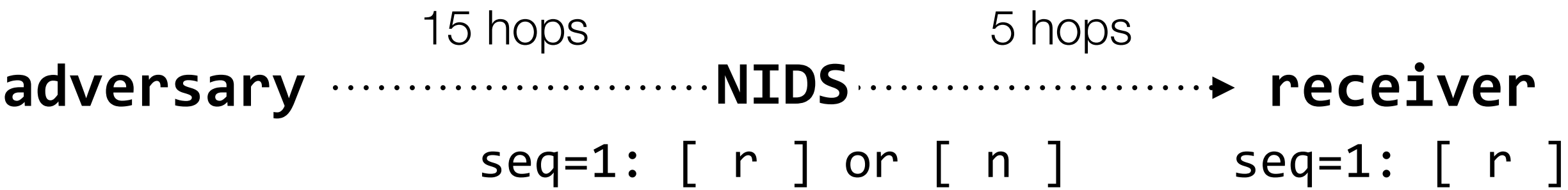
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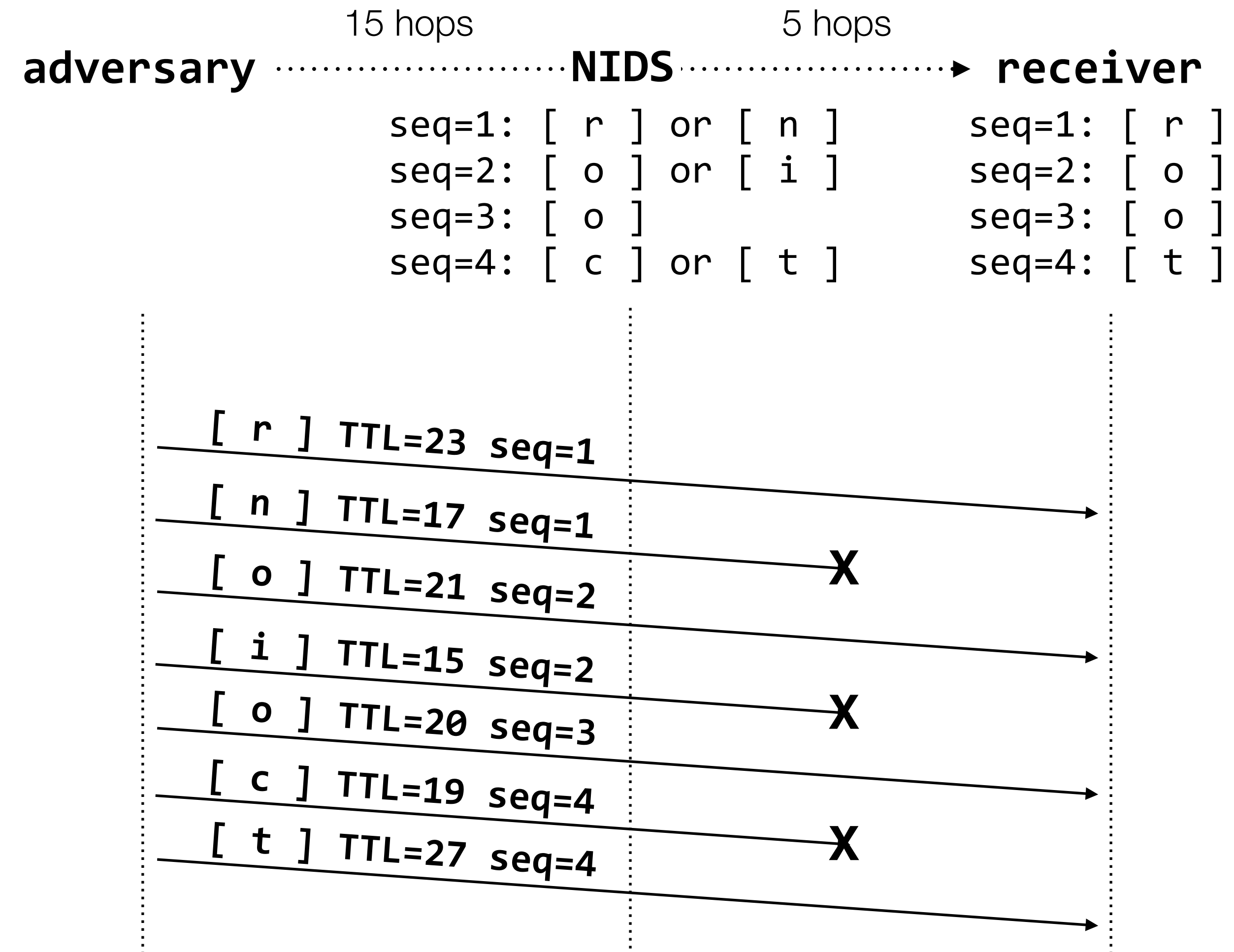
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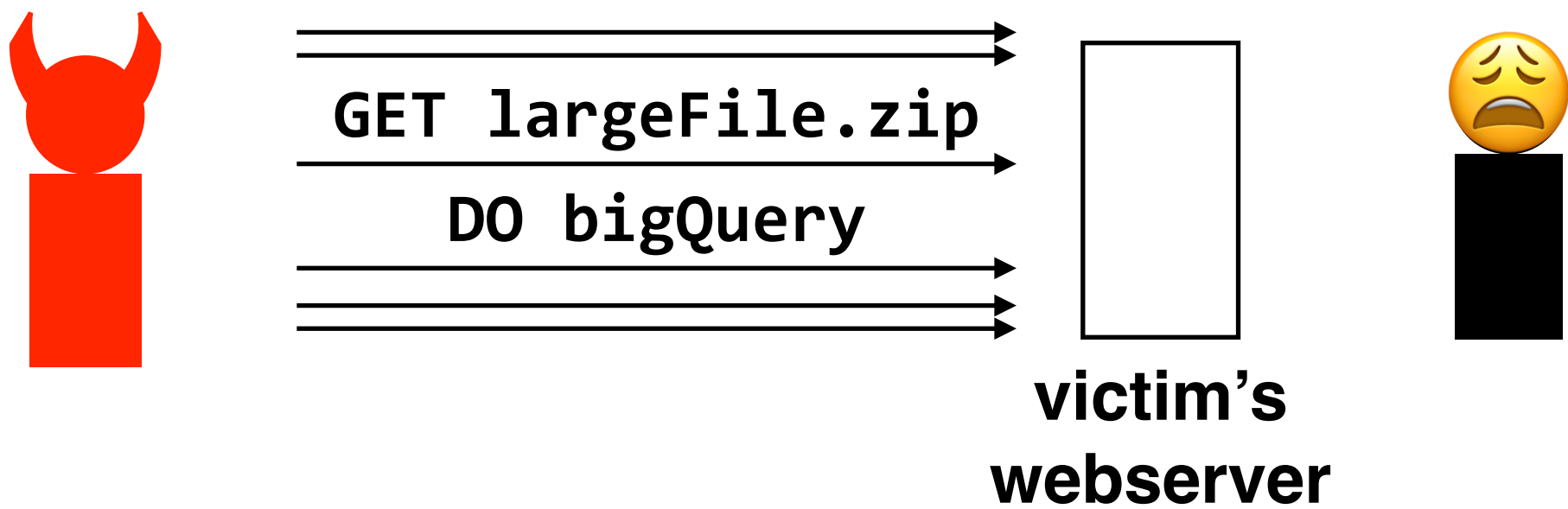


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additional challenge:

some DDoS attacks mimic legitimate traffic,
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server itself

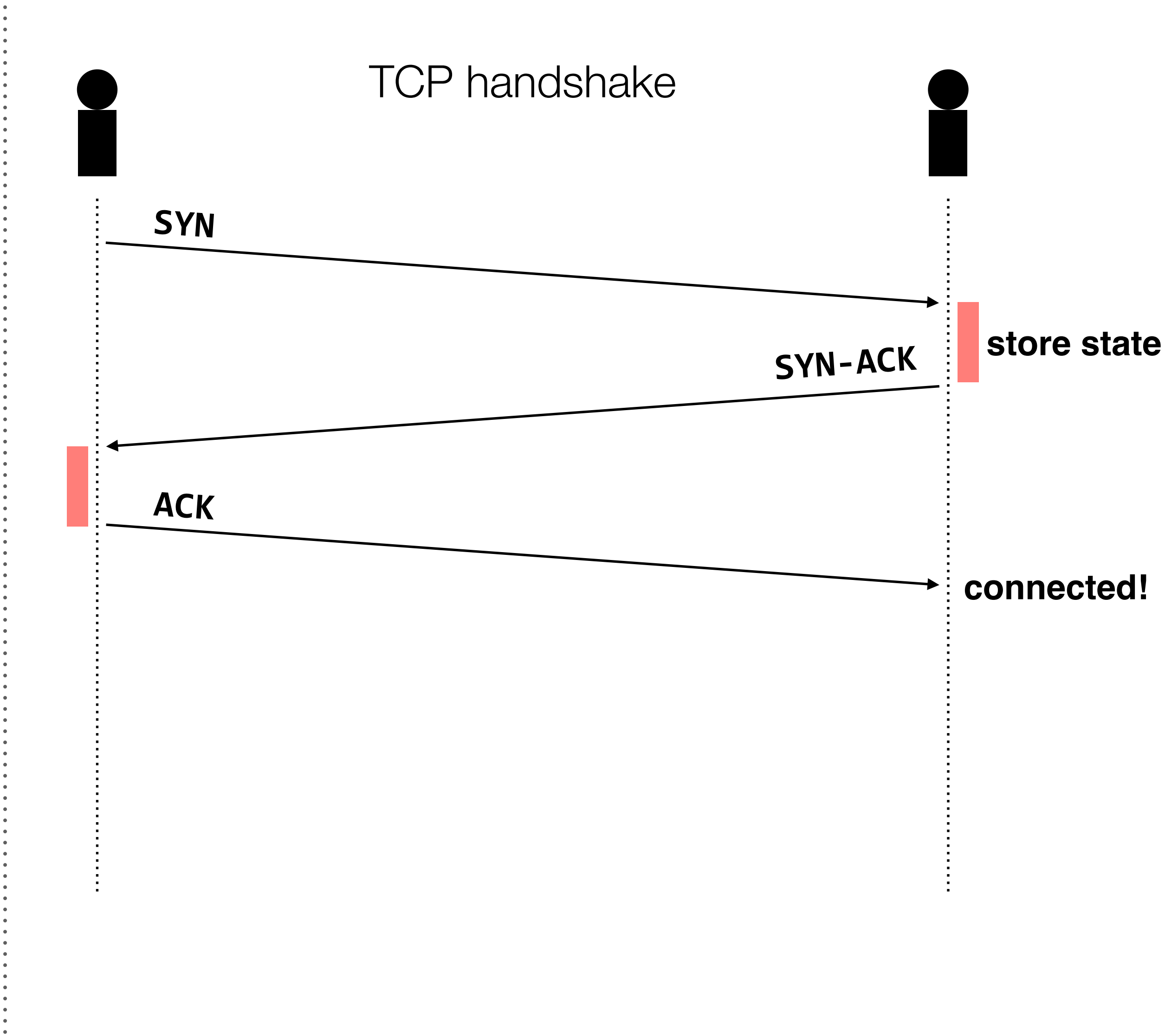


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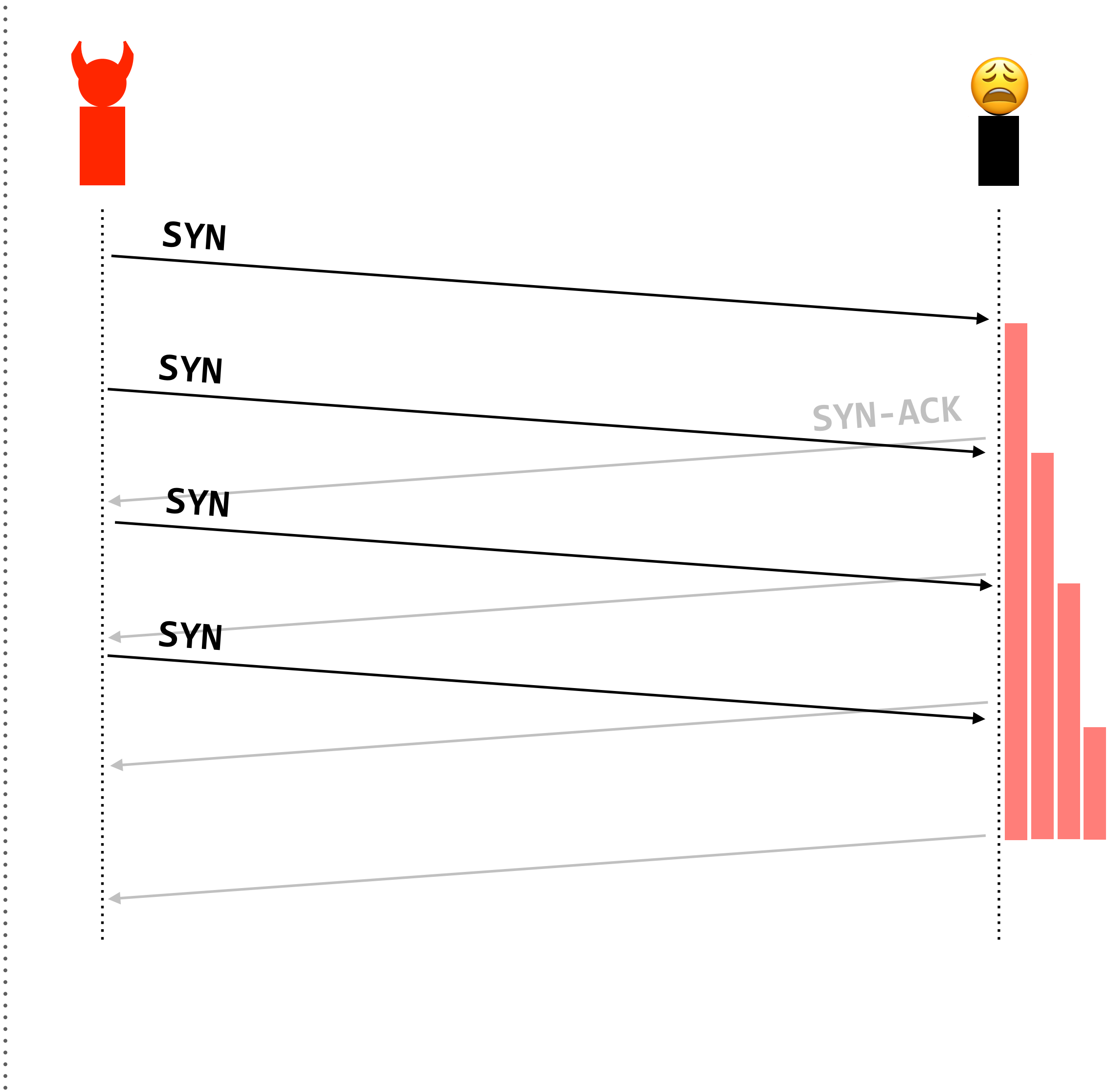


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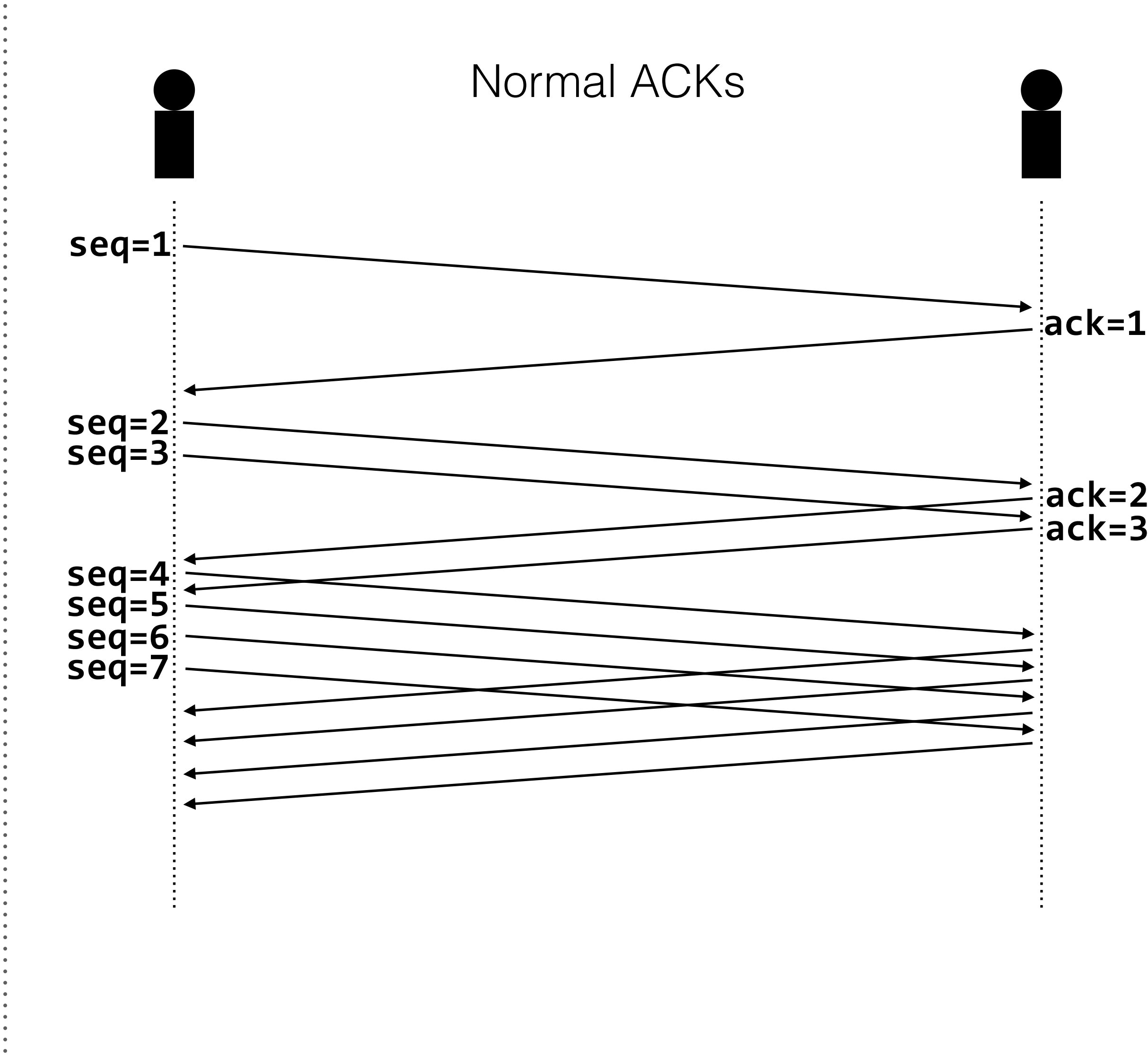


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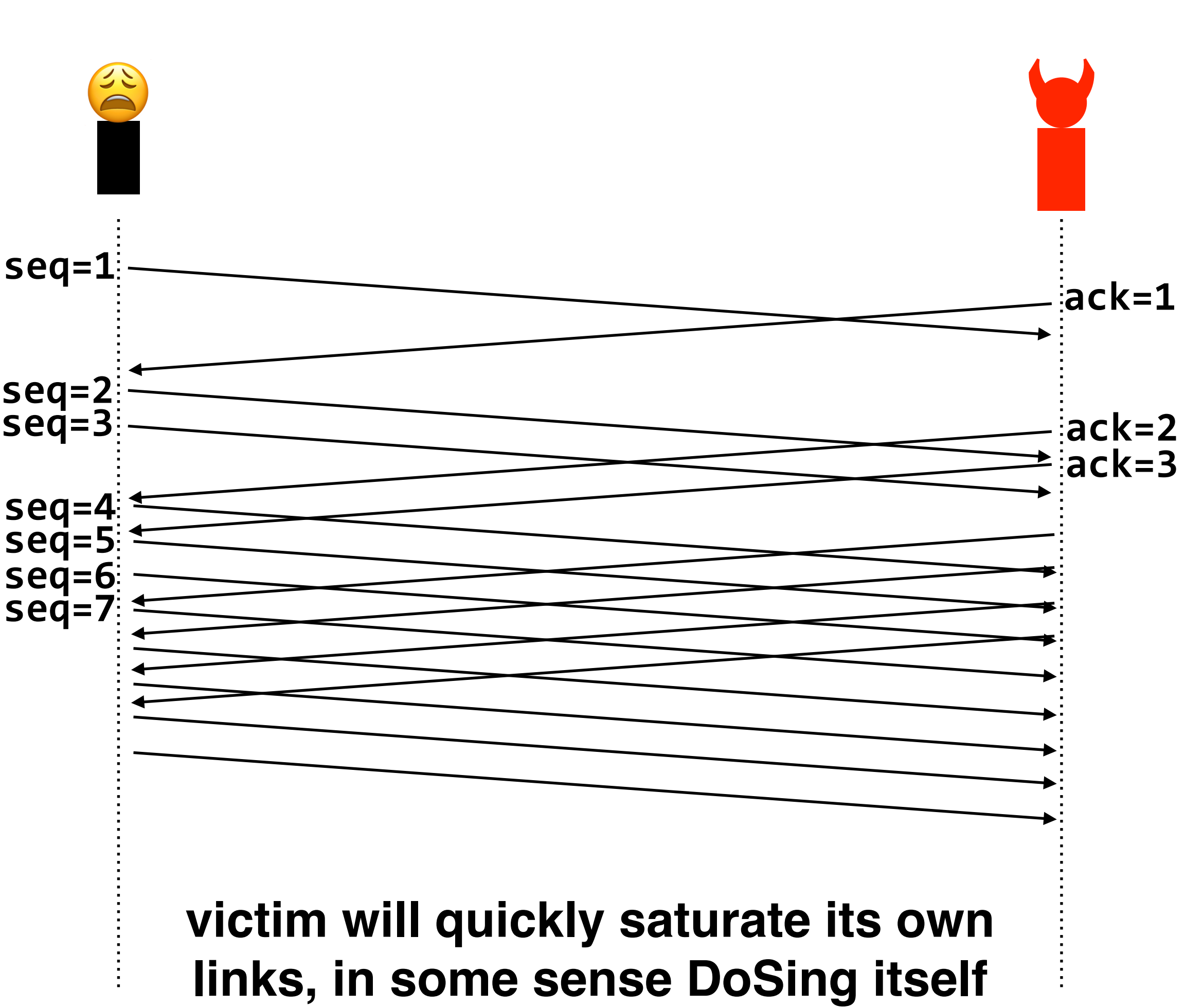


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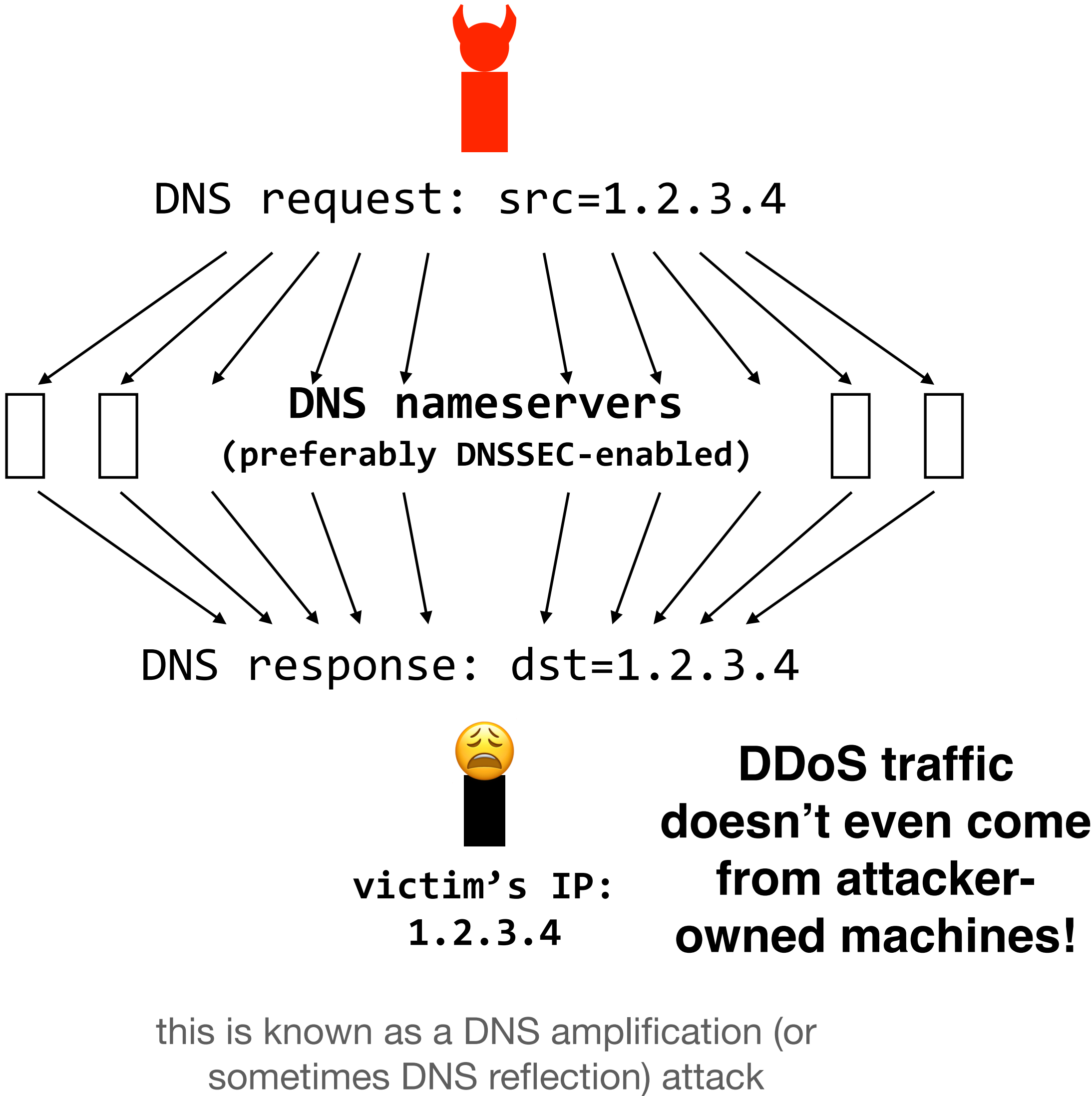


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DDoS attacks prevent legitimate access to internet services. secure channels won't help us here, and **botnets** make DDoS attacks relatively easy to mount

DDoS attacks are difficult to prevent because they are sophisticated and can mimic legitimate traffic; **network-intrusion detection systems** help, but they're not perfect

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

robust, distributed systems are a good defense against DDoS attacks

these attacks are possible in part because the internet was not designed with them in mind