IP Fragmentation Overlapping

ByPassing IDS

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Let's Go!

- Having Fun with RFCs
- IP Fragmentation
- Overlapping & Defragmentation
- ByPassing IDS
- Overlapping Defenses

Having Fun with RFC

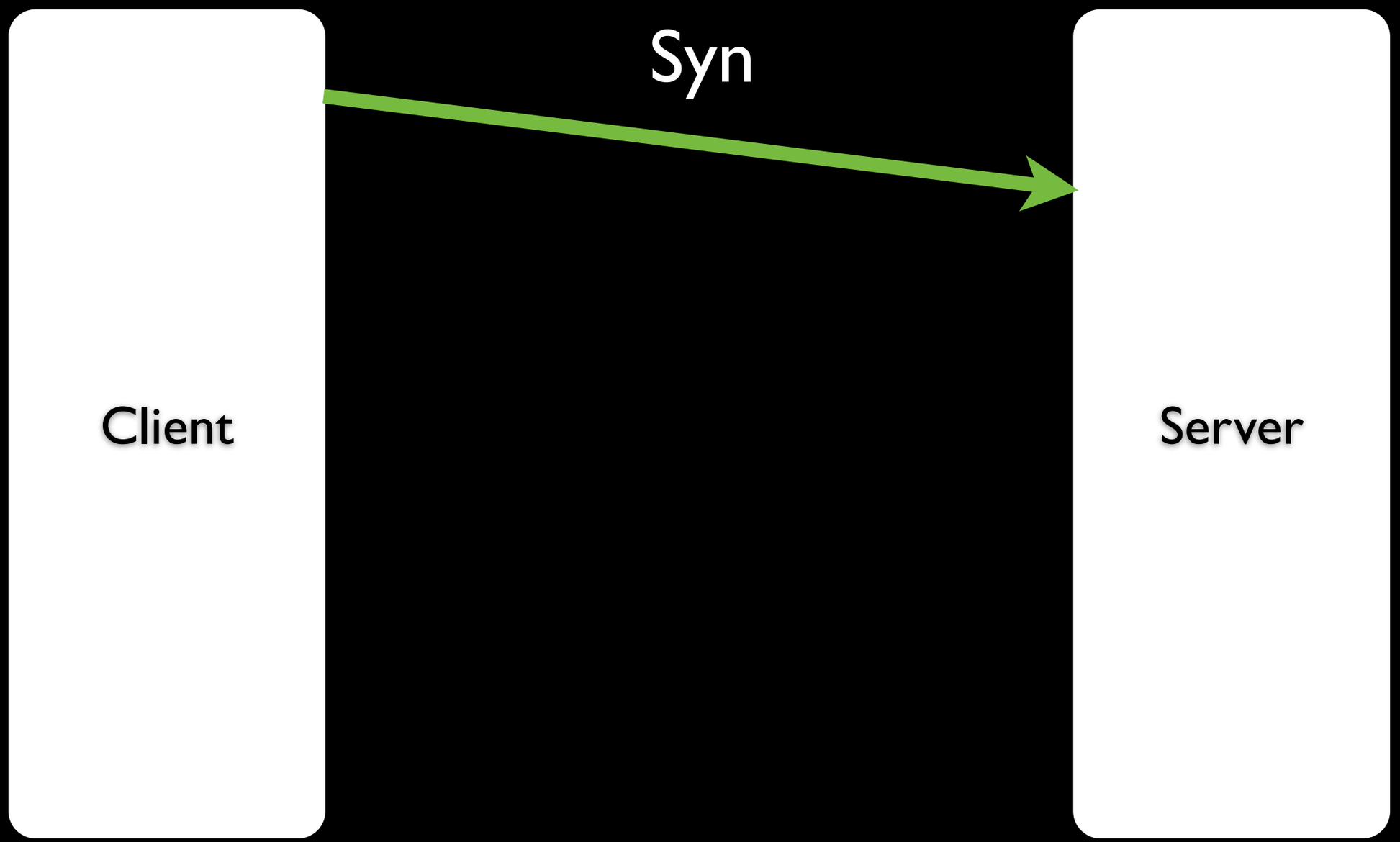
- RFC = Request for Comments (http://www.ietf.org/rfc.html)
- All Protocols are fully defined by RFCs
- Fully? No!!
- One small set of possible situations still holds out being undefined

3-Way HandShake

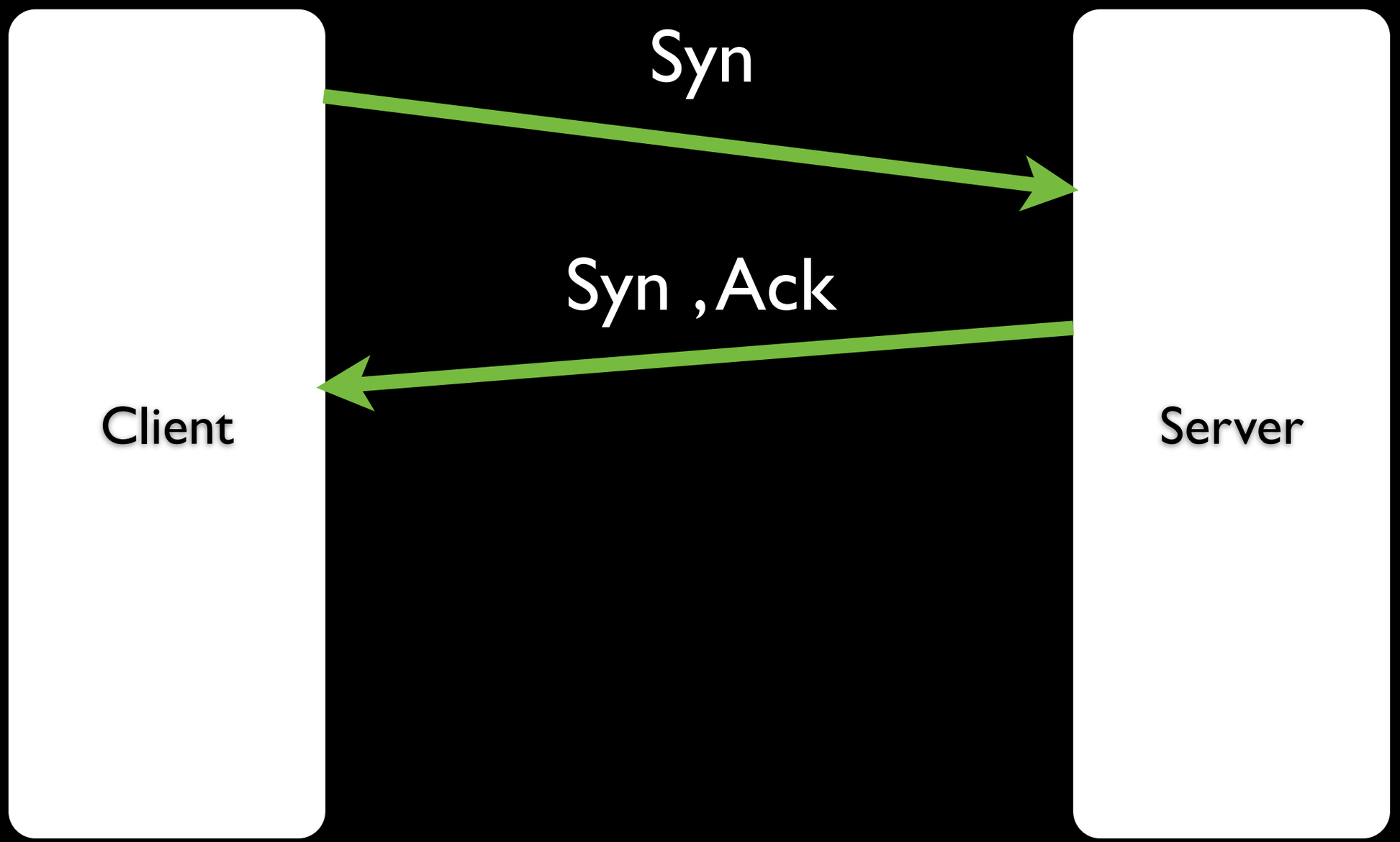
Client

Server

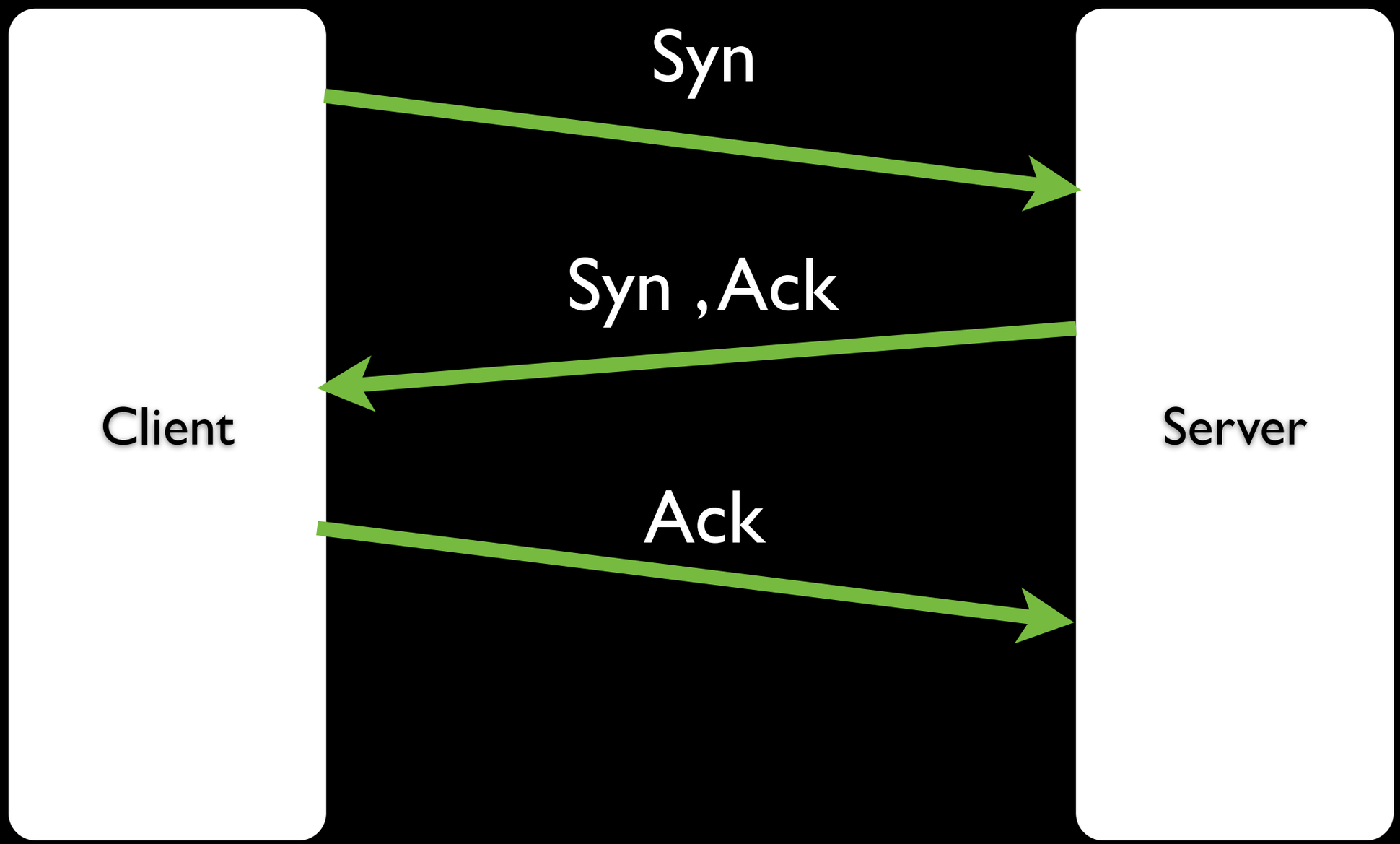
3-Way HandShake



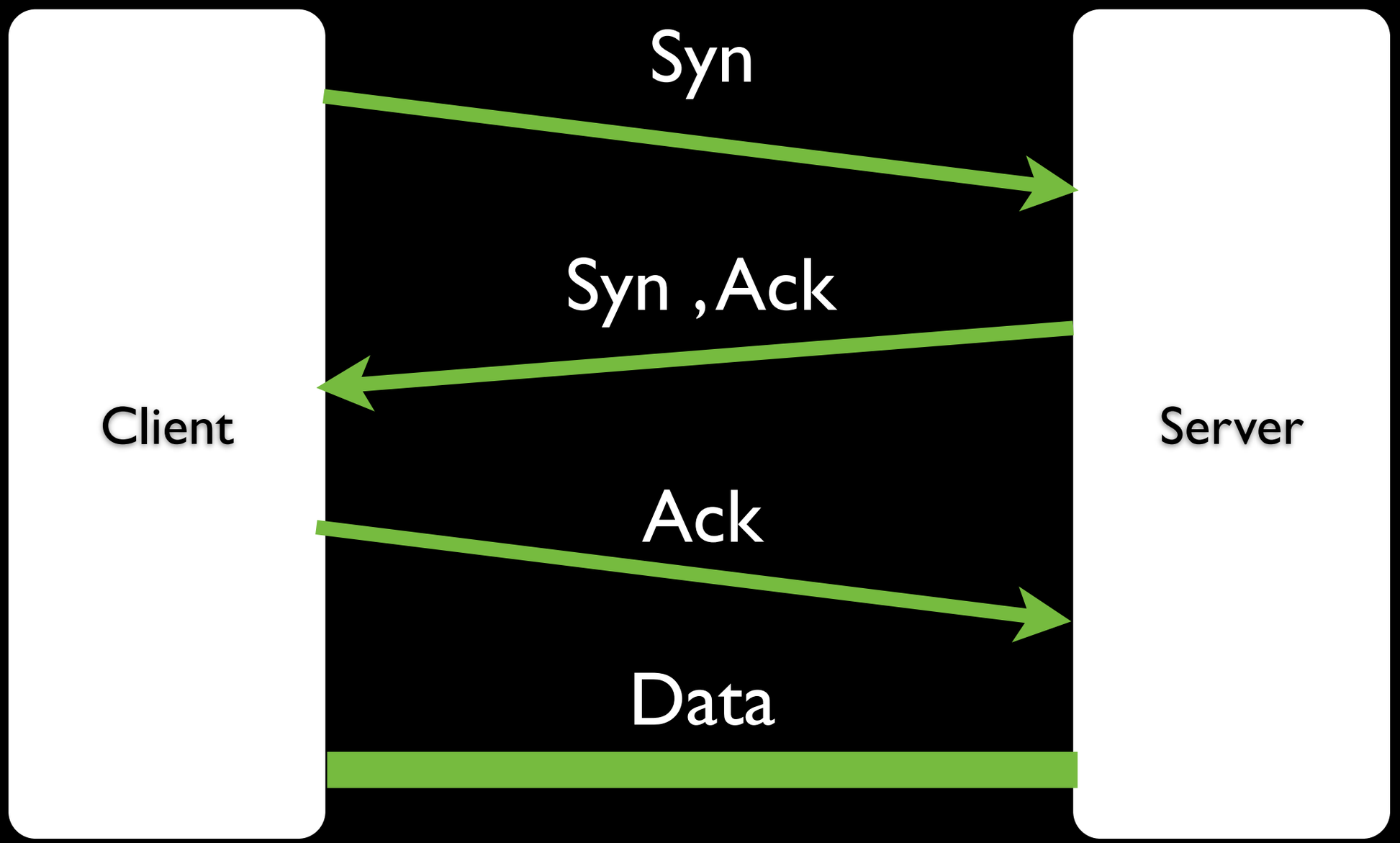
3-Way HandShake



3-Way HandShake



3-Way HandShake

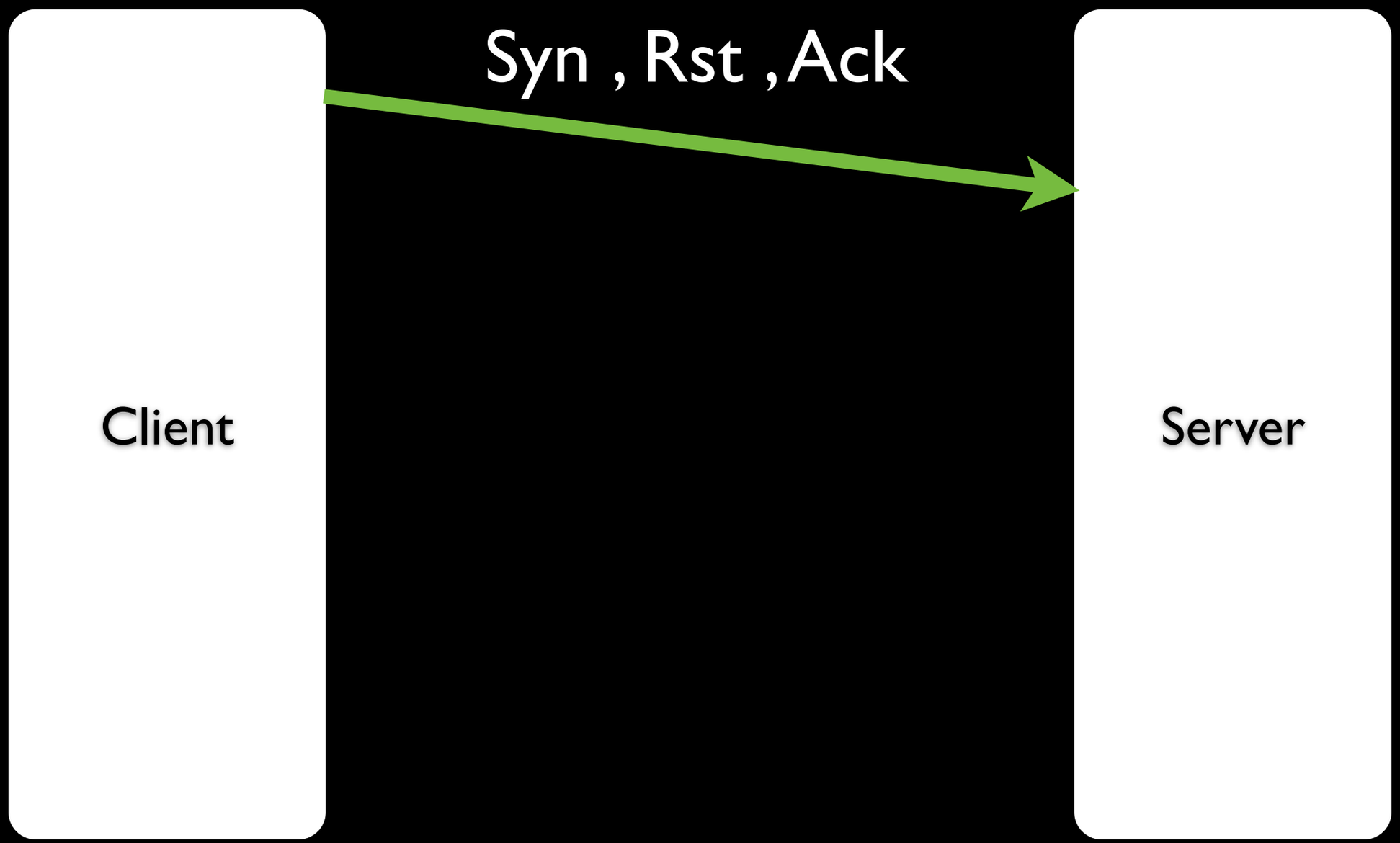


3-Way HandShake

Client

Server

3-Way HandShake



3-Way HandShake

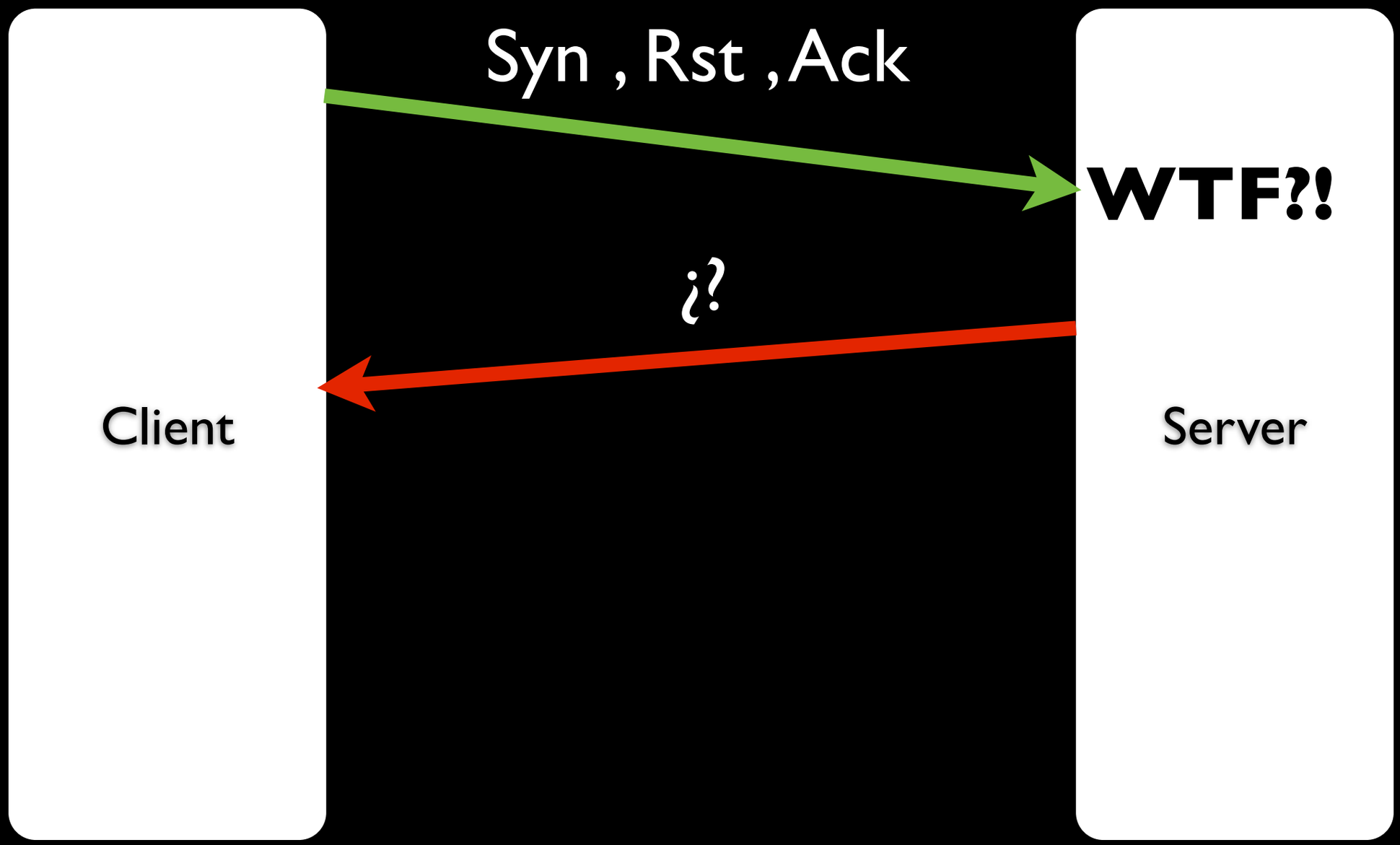
Syn , Rst , Ack

WTF?!

Client

Server

3-Way HandShake



Abuse: OS Fingerprinting

- Each coder solves it in a different way
- So... each different TCP/IP Stack response different
- Used for OS fingerprinting

- Different TCP/IP Stacks can work different? That's sounds evily interesting!

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To Fit or not to Fit

- MTU = Maximum Transfer Unit
- Depending on Layer 2 Network
  - Ethernet = 1500 bytes

- To Fit or not to Fit. That's the question.
- What if doesn't fit?
- IP FRAGMENTATION!

IP Fragmentation

Packet

Packet

Packet

IP Fragmentation

Packet

Packet

Packet

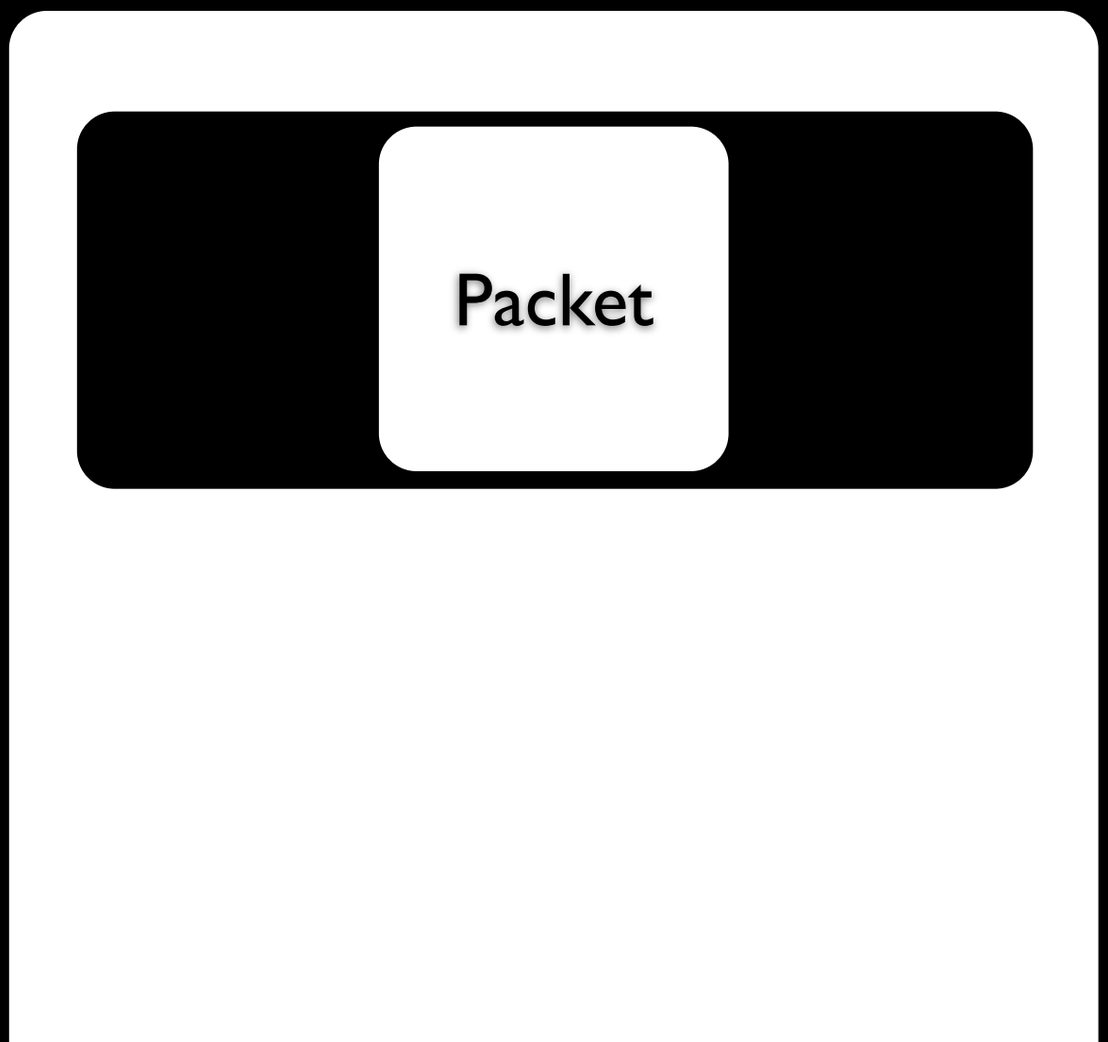
IP Fragmentation

Packet

Packet

IP Fragmentation

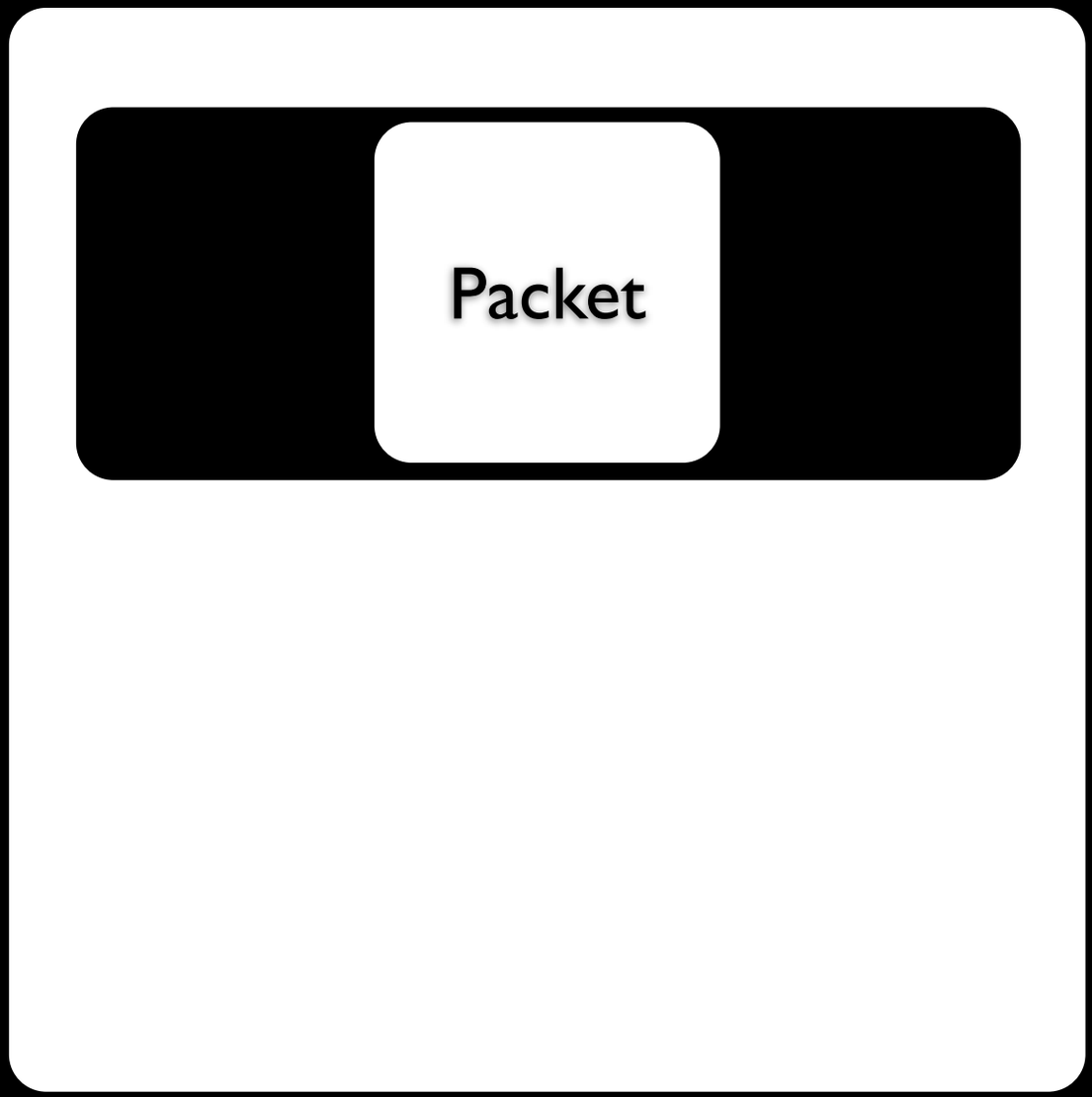
Packet



IP Fragmentation

Packet

IP Fragmentation



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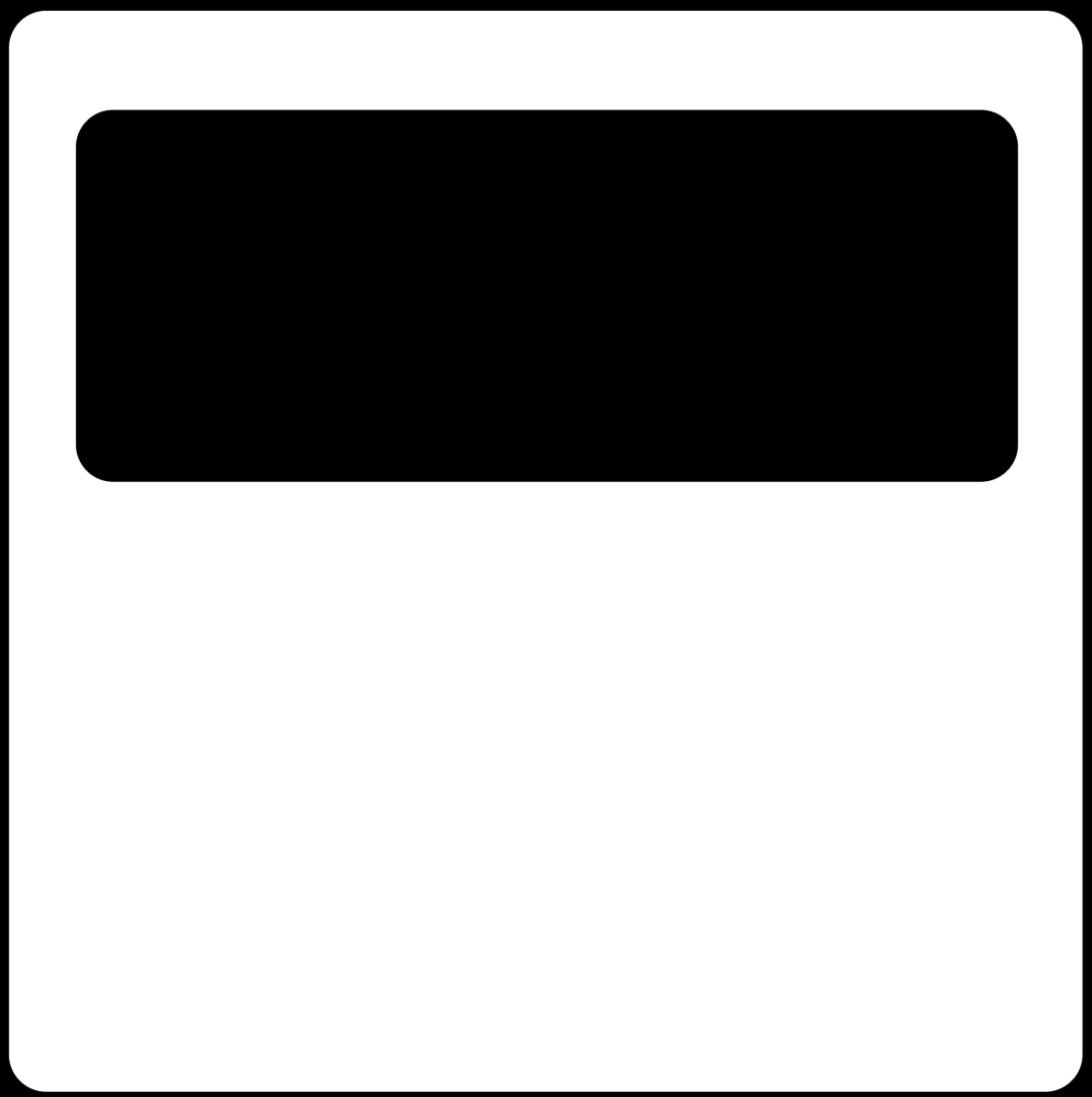


IP Fragmentation

Packet

IP Fragmentation

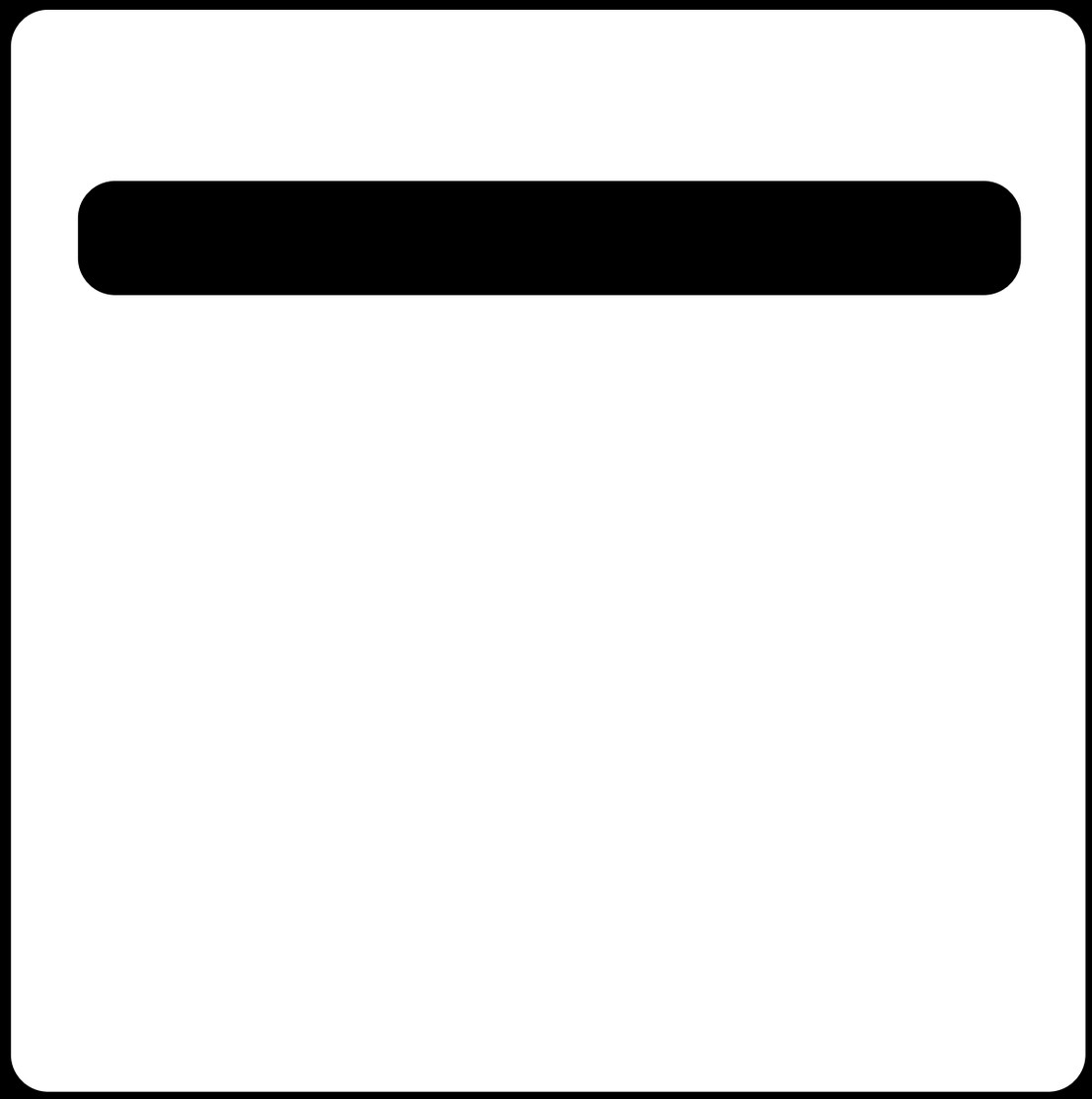
Packet

IP Fragmentation

Fragment

Fragment

Fragment

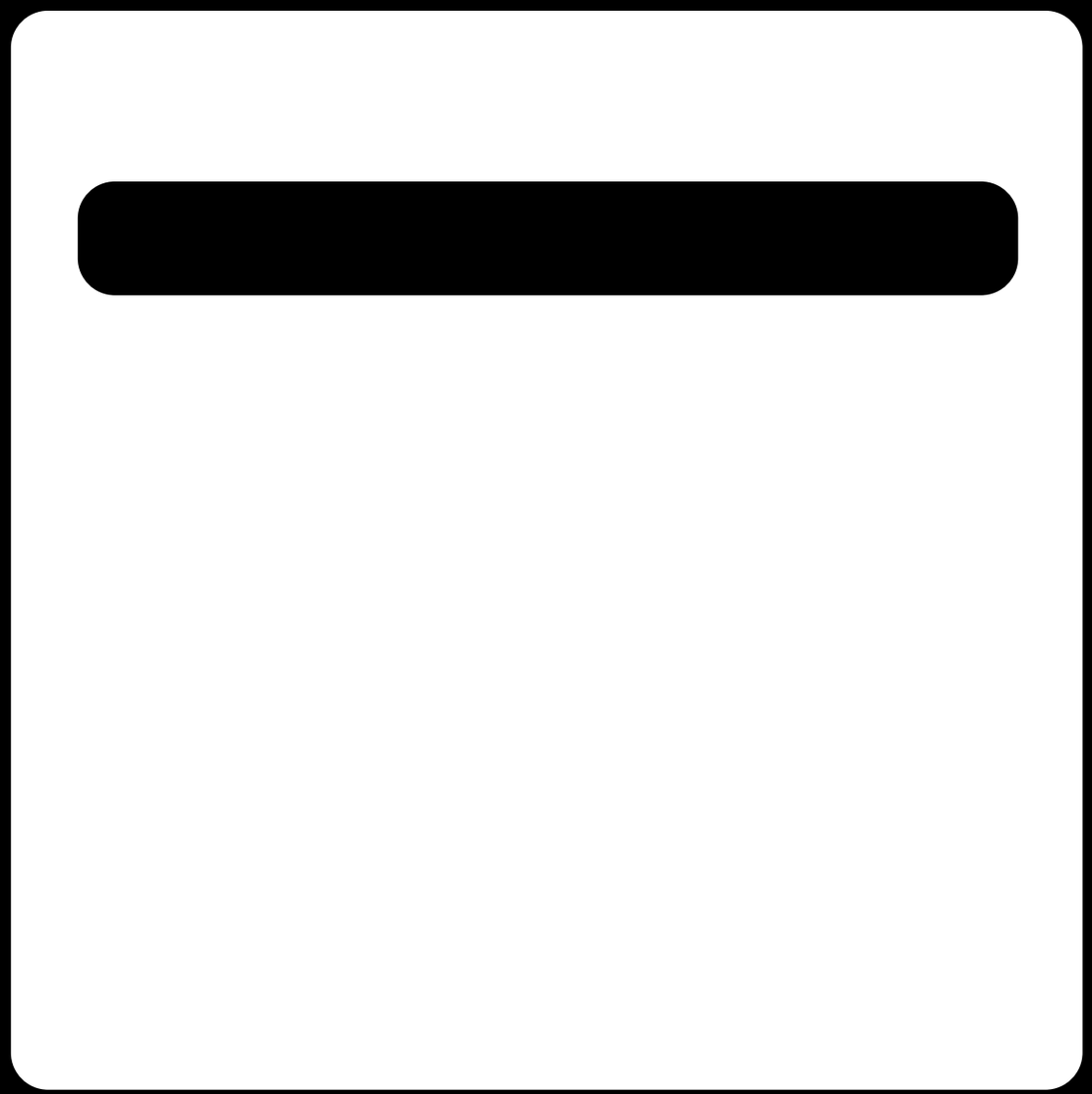


IP Fragmentation

Fragment

Fragment

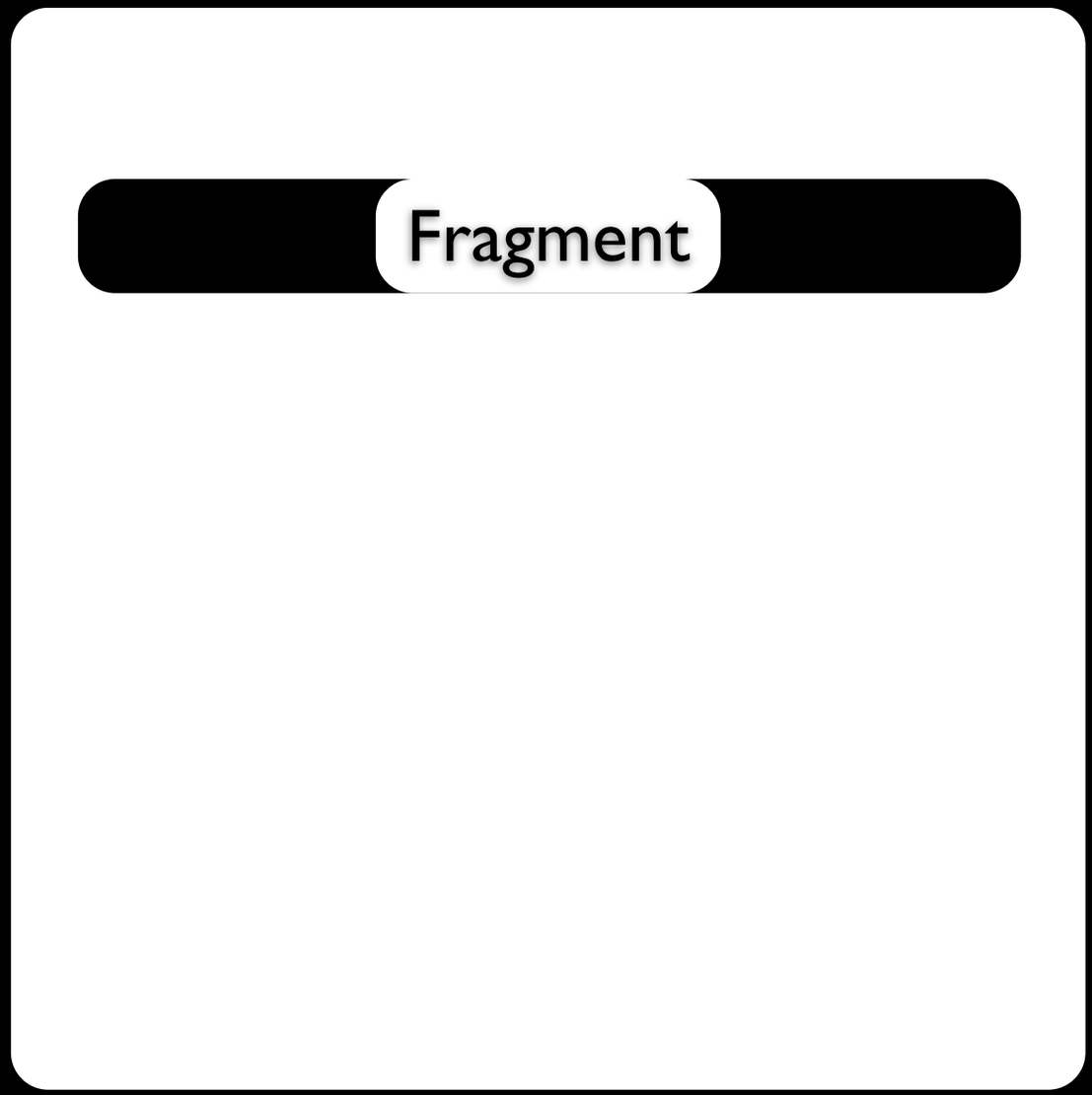
IP Fragmentation



Fragment

Fragment

IP Fragmentation



Fragment

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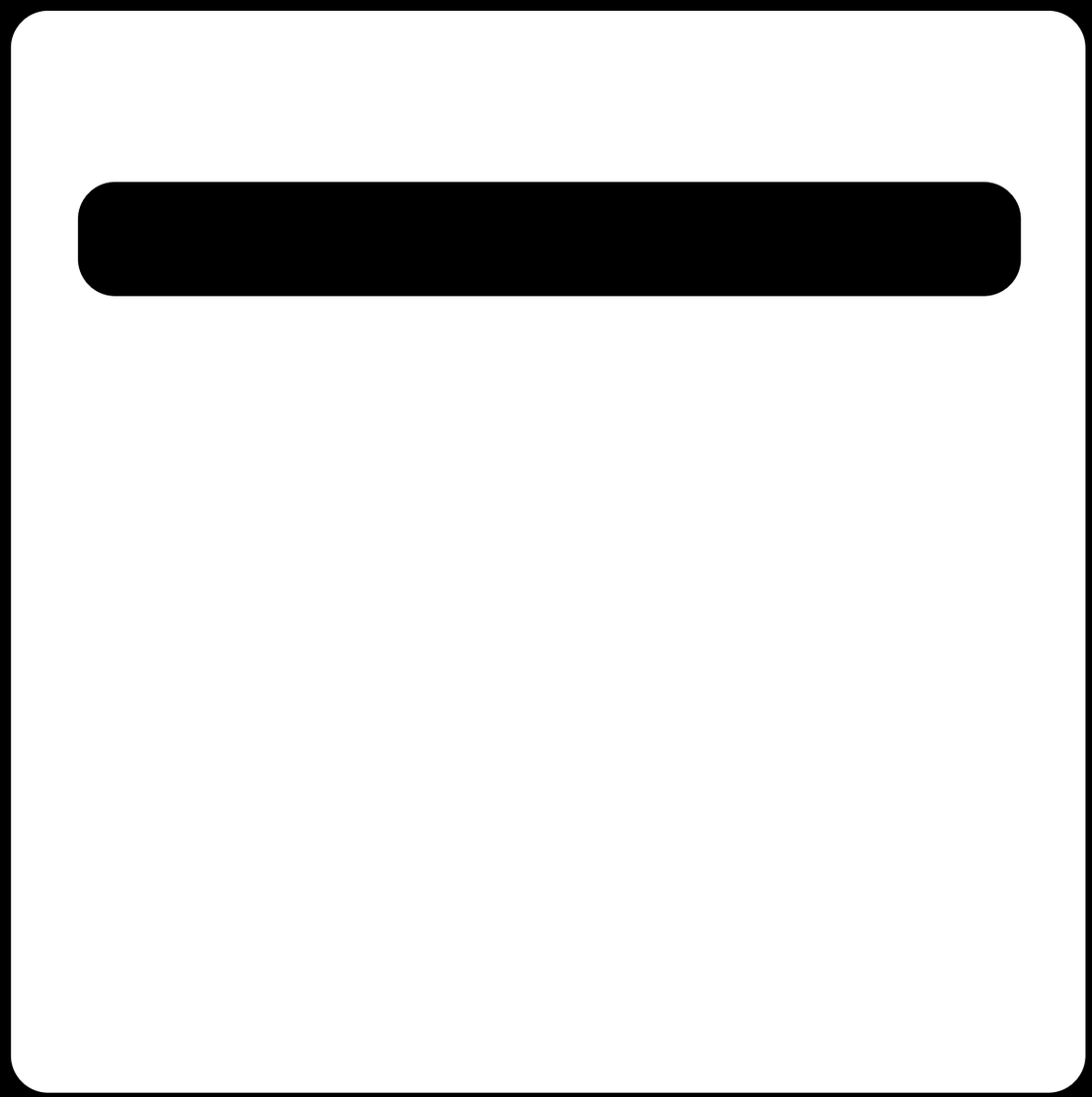
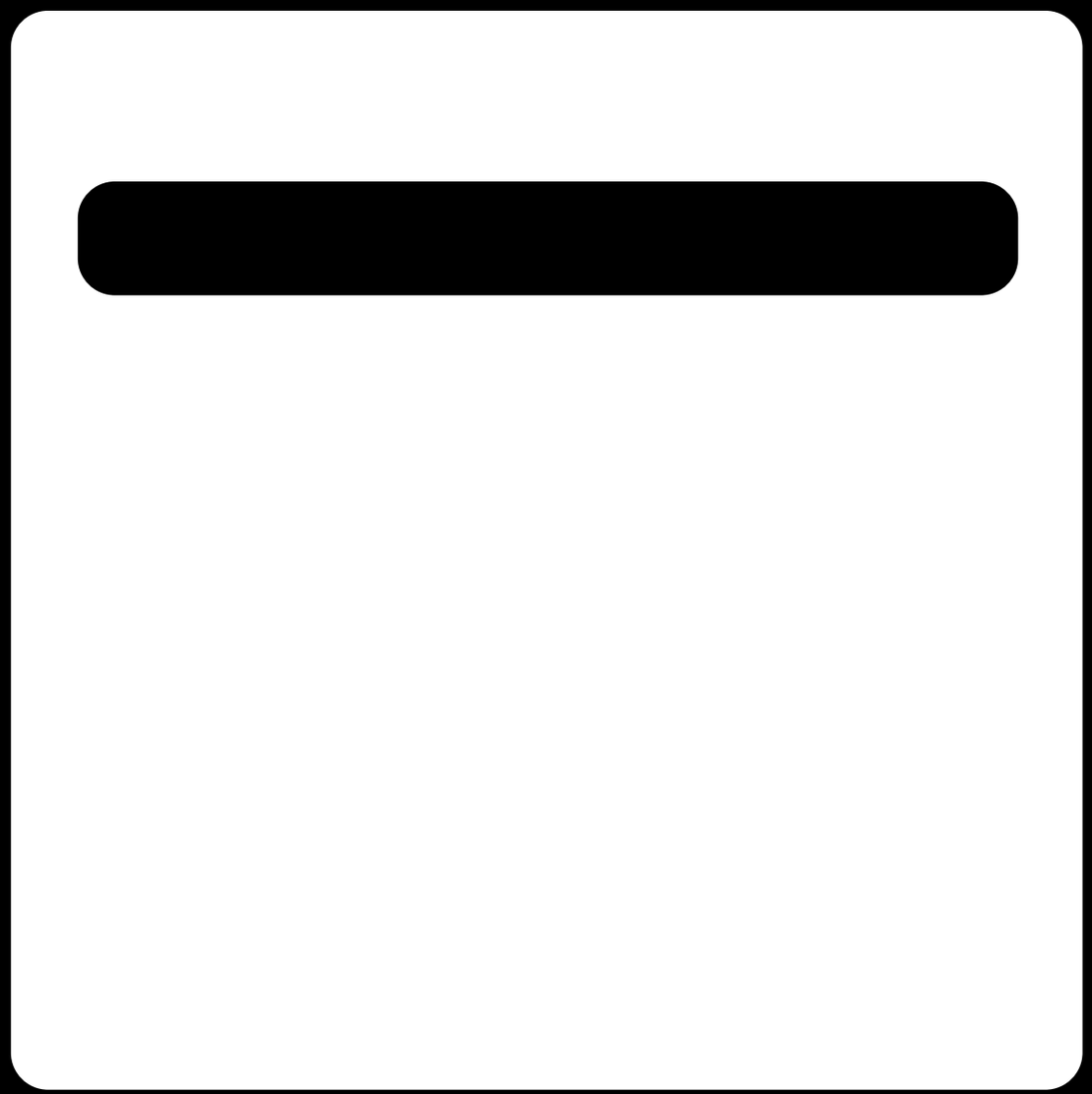


Fragment

IP Fragmentation

IP Fragmentation



IP Header

- IPID = IP Identifier
- MF Flag = More Fragments
- Fragment Offset

Howto Fragment

4000 bytes
MF = 0
Offset = 0

Howto Fragment

4000 bytes
MF = 0
Offset = 0

Howto Fragment

1500 bytes
MF = 1
Offset = 0

1500 bytes
MF = 1
Offset = 1500

1000 bytes
MF = 0
Offset = 3000

Howto Defragment

1000 bytes
MF = 0
Offset = 3000

1500 bytes
MF = 1
Offset = 1500

1500 bytes
MF = 1
Offset = 0

Howto Defragment

1500 bytes
MF = 1
Offset = 0

1000 bytes
MF = 0
Offset = 3000

1500 bytes
MF = 1
Offset = 1500

Howto Defragment

1500 bytes
MF = 1
Offset = 0

1500 bytes
MF = 1
Offset = 1500

1000 bytes
MF = 0
Offset = 3000

Howto Defragment

1500 bytes	1500 bytes	1000 bytes
MF = 1	MF = 1	MF = 0
Offset = 0	Offset = 1500	Offset = 3000

Howto Defragment

4000 bytes
MF = 0
Offset = 0

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Overlapping

200 bytes
MF = 1
Offset = 0

300 bytes
MF = 1
Offset = 100

100 bytes
MF = 0
Offset = 400

Overlapping

Overlapping

Overlapping

Defragmentation

- Blue or Green?
  - Not defined by RFC
- So... each OS do it by its own
- There are 7 different policies

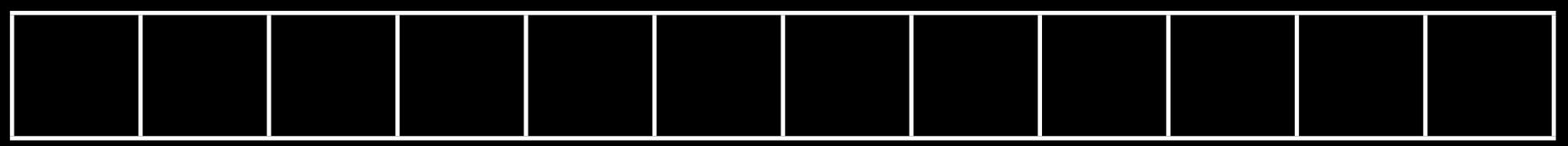
Policies & OS's

- First: HP-UX, MacOS, SunOS <5.8
- Last: Cisco
- BSD: AIX, FreeBSD, HP-UX 10.x, IRIX
- BSD-Right: HP Printers (some of them)
- Linux: OpenBSD, Linux
- Windows
- Solaris: Solaris 9 and 10

First Policy

Policy:

1) Always accept the first value received for each byte.



First Policy

Policy:

1) Always accept the first value received for each byte.

1	1	1		2	2	3	3	3			

First Policy

Policy:

1) Always accept the first value received for each byte.

1	1	1	4	2	2	3	3	3			

First Policy

Policy:

1) Always accept the first value received for each byte.

1	1	1	4	2	2	3	3	3			

First Policy

Policy:

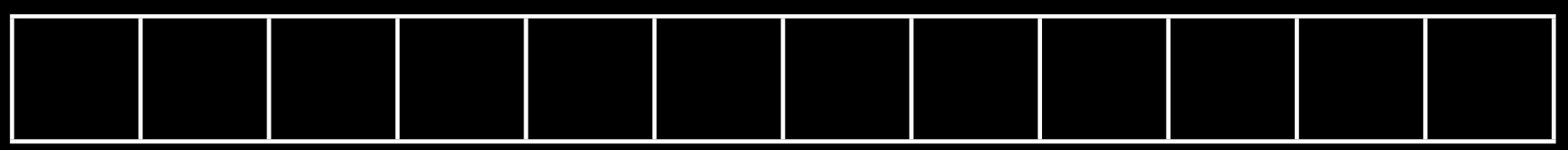
1) Always accept the first value received for each byte.

1	1	1	4	2	2	3	3	3	6	6	6

Linux Policy

Policy:

1) Accept lower offset packet bytes received
2) With same offset, accept last received bytes



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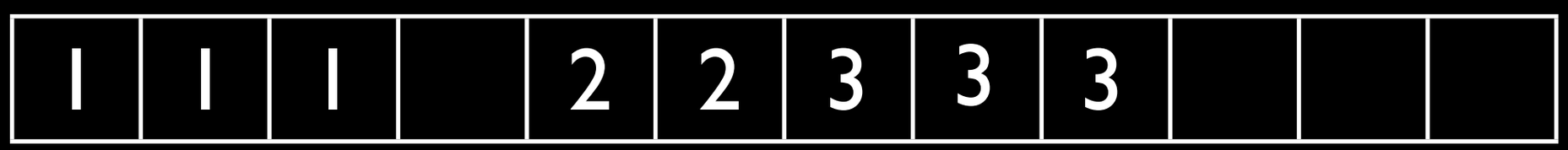

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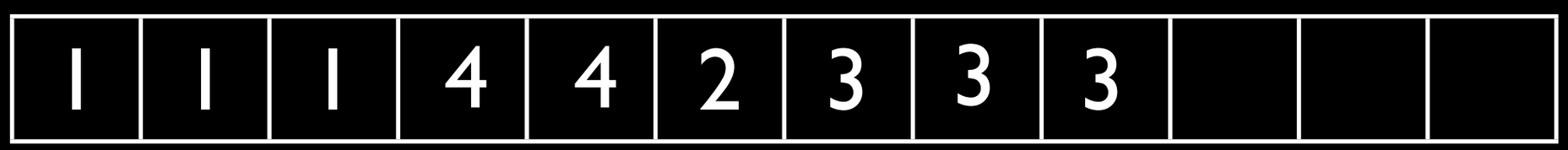

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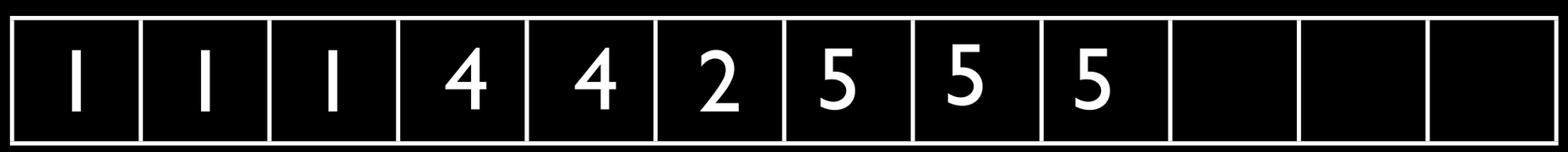

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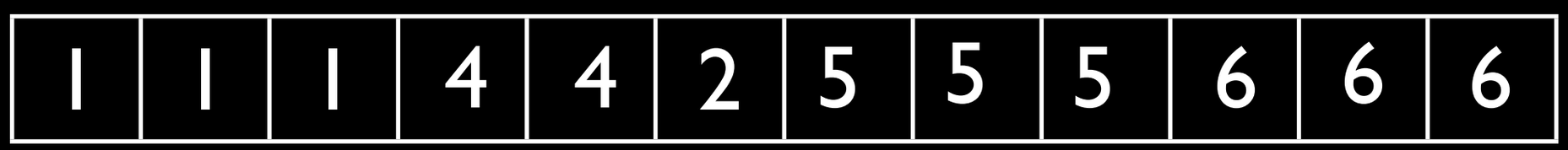

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IDS & Signatures

- Usually signature based IDSs
- Signature = string or regular expression
  - Does it match with packet? => ALERT!

- Evil at Target but not at IDS?
  - Target Policy != IDS Policy?
  - Possible with IP Fragmentation

Overlapping

GET /../../ETC/P

FOOFOO**ASSWOR**

D HTTP/1.1

Overlapping

Target => /../../ETC/PASSWD

IDS => /../..FOOFOOASSWD

FragRoute

- “Insertion, Evasion, and Denial of Service: Eluding Networking Intrusion Detection”, January 1998

ip_frag size [old|new]

Fragment each packet in the queue into size-byte IP fragments, preserving the complete transport header in the first fragment. *Optional fragment overlap may be specified as old or new*, to favor newer or older data.

Windows Frag

- Policy: Always accept the first value received for each byte.
- First value = Older value

```
ip_frag 40 old
order random
print
```

- fragroute -f ncn.conf 192.168.0.100

DEMO

ByPassing SNORT with IP Fragmentation (I)

Problems

- Attack String is still there!
- Why not detected?
  - Packet dropped for bad checksum
- What if packet inspected anyway?
  - Bypass doesn’t work!
- Can we improve it with FragRouter?

FragRoute

ip_chaff **dup**|opt|ttl

Interleave IP packets in the queue with duplicate IP packets containing different payloads, either scheduled for later delivery, carrying invalid IP options, or bearing short time-to-live values.

delay first|**last**|random ms

Delay the delivery of the first, last, or a randomly selected packet from the queue by ms milliseconds.

drop first|last|random prob-%

Drop the first, last, or a randomly selected packet from the queue with a probability of prob-% percent.

First/BSD Vs Linux

- Policy: With same offset:
  - First/BSD => First Fragment
  - Linux => Last Fragment
  - Bypass = First fragments OK, Last fragments garbage

```
ip_frag 40
delay last 1
ip_chaff dup
drop last 100
```

DEMO

ByPassing SNORT with IP Fragmentation (II)

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Defenses

- SNORT: Frag3 Preprocessor
  - Others should have something similar

- Makes Snort speak in OS language
- You have to configure for each one

DEMO

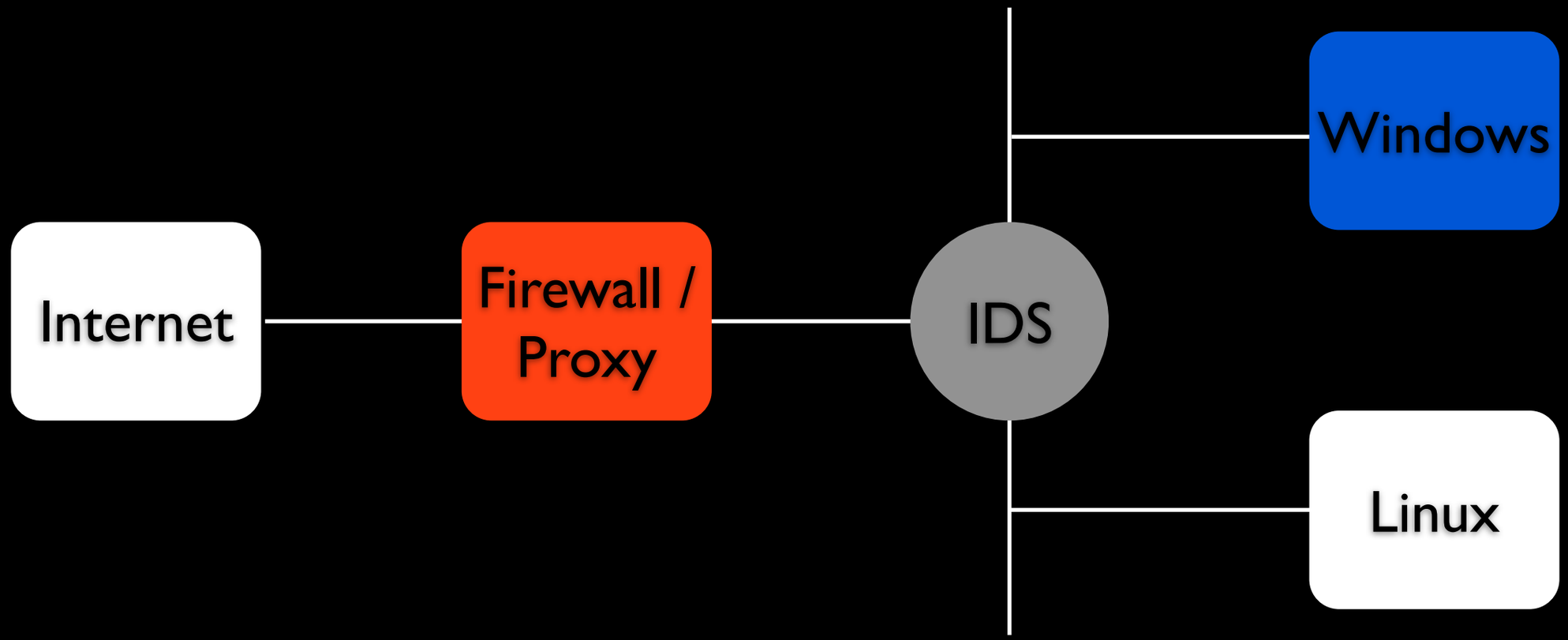
Frag3 against IP Fragmentation

Other Defenses

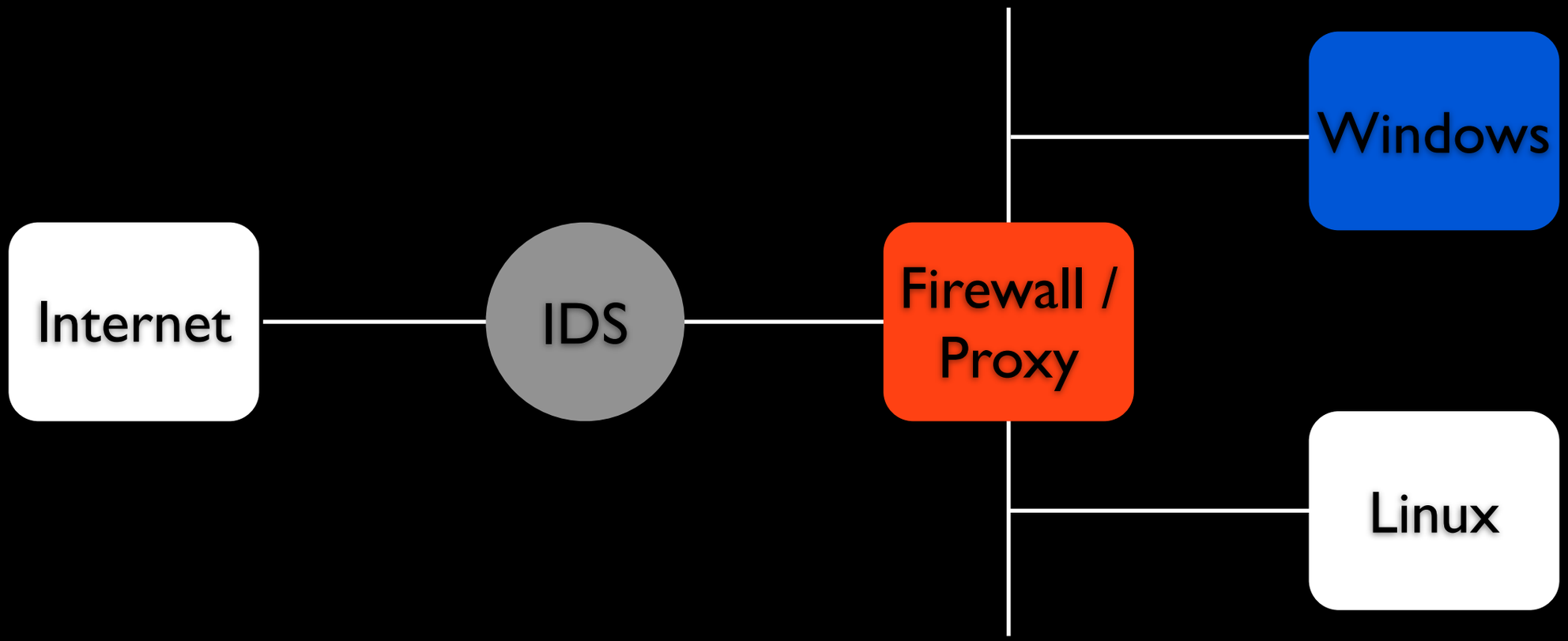
- Force Defragmentation at Perimeter
- Reject Fragmented Packets
- Proxys
- NAT

- Keep out with network design!

Network Design (I)



Network Design (II)



Other Threats

- Feel safe?
- TCP Overlapping
- TTL .....
- Bad Checksum
- ...

Proverb

MORE HUMAN

LESS MACHINE

THANKS!
QUESTIONS?

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