This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 688421.

tracebox: Topology Measurement and Impairement Discovery

RCM tutorial

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University of Liège

mami
measurement and architecture for a middleboxed internet

LIÈGE université

Launch the VM

$ git clone https://github.com/mami-project/vpp-mb **-b rcm**

Contains a **Vagrantfile**.

$ cd vagrant && vagrant up && vagrant ssh

Middlebox discovery ?

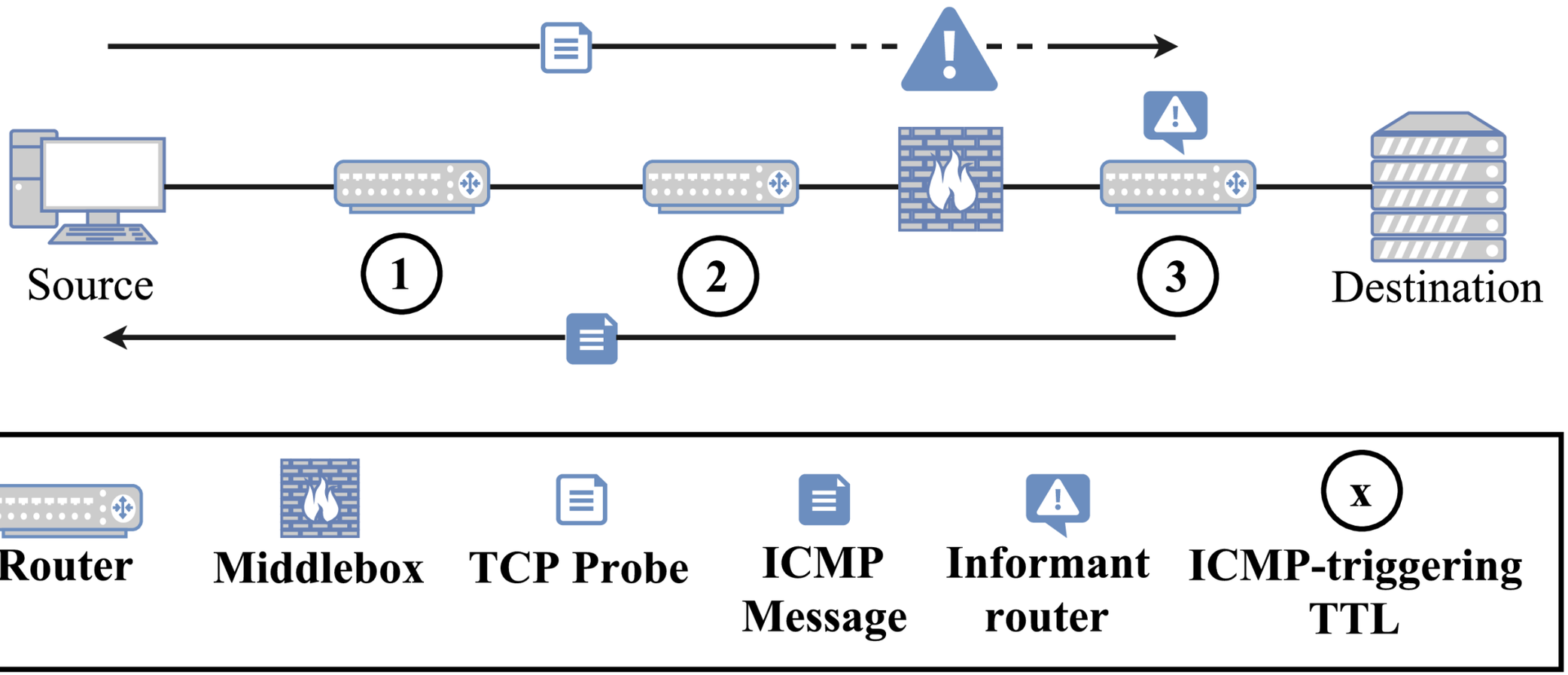
$ ./setup_topology **1**

$ ./setup_topology **2**

Destination is **10.0.0.10**

Middlebox discovery ?

- **Tracebox**



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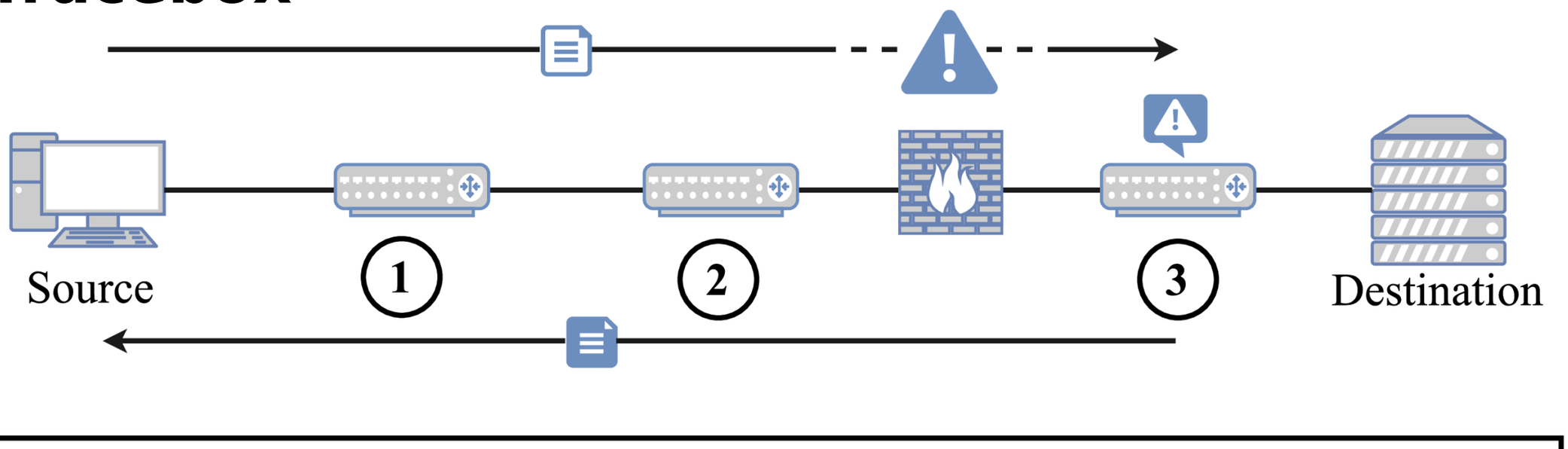
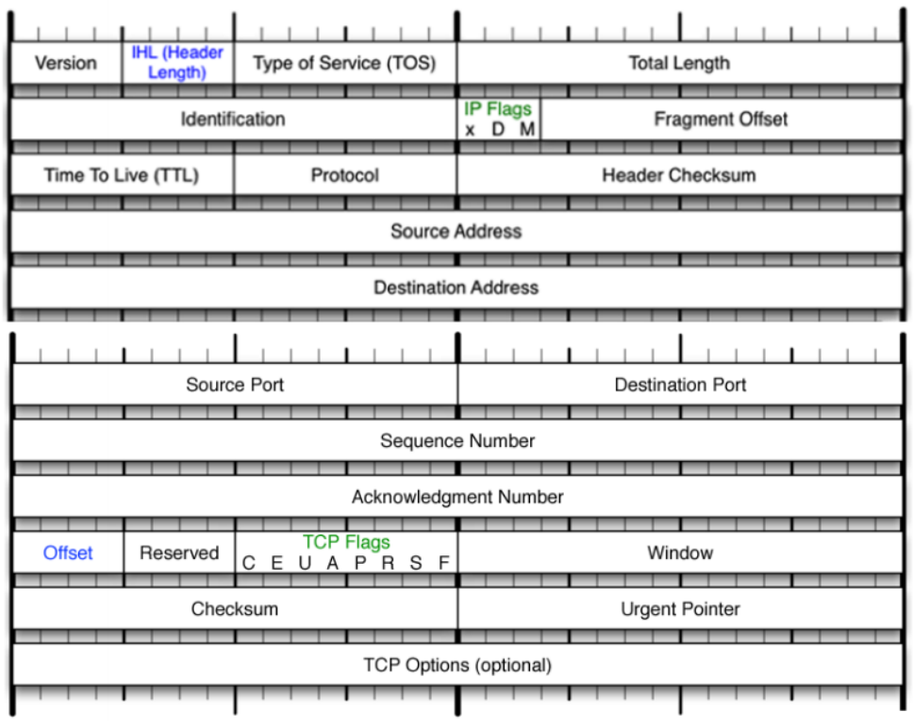


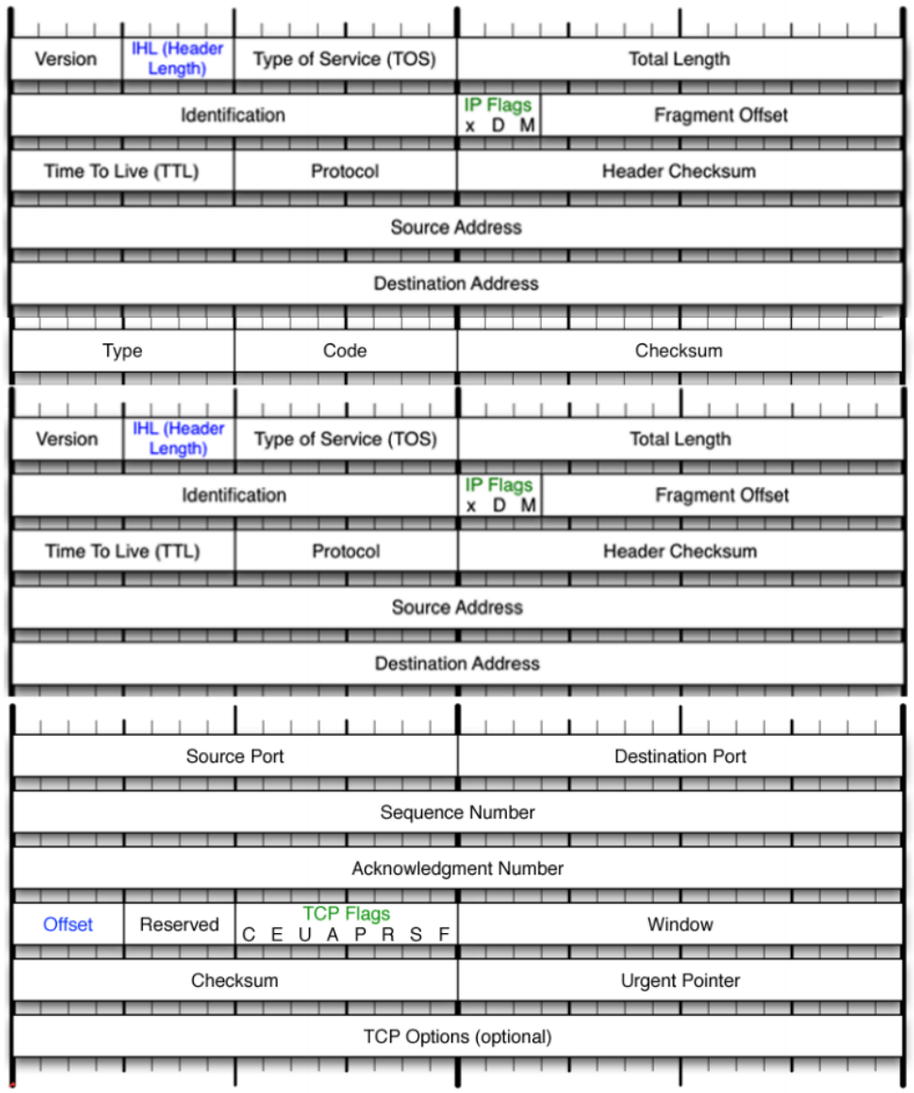
- Middlebox **Detection**

Middlebox discovery ?

Probe Sent



ICMP Received



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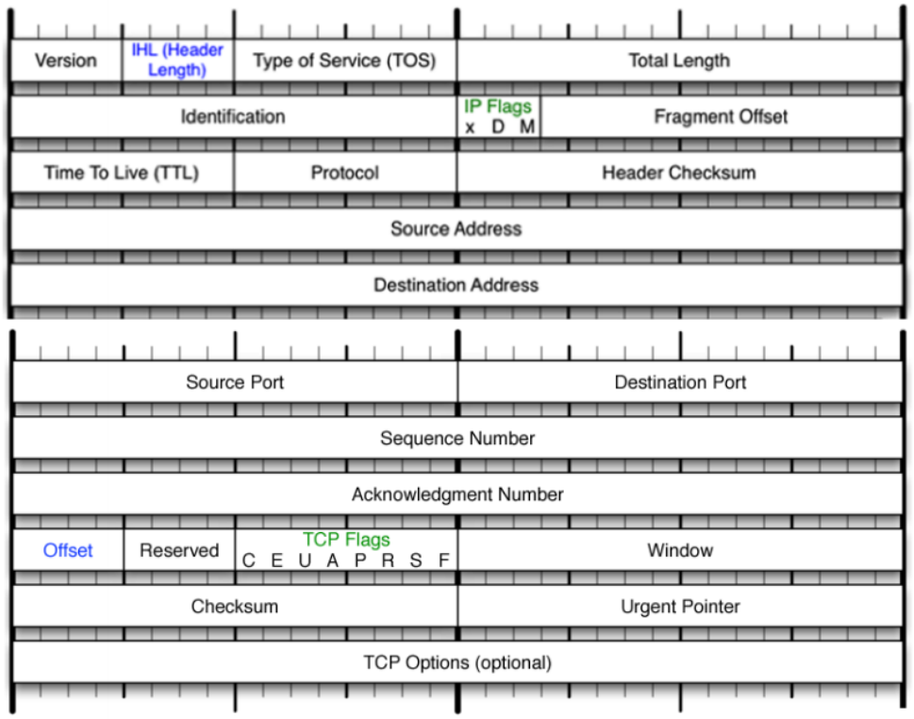

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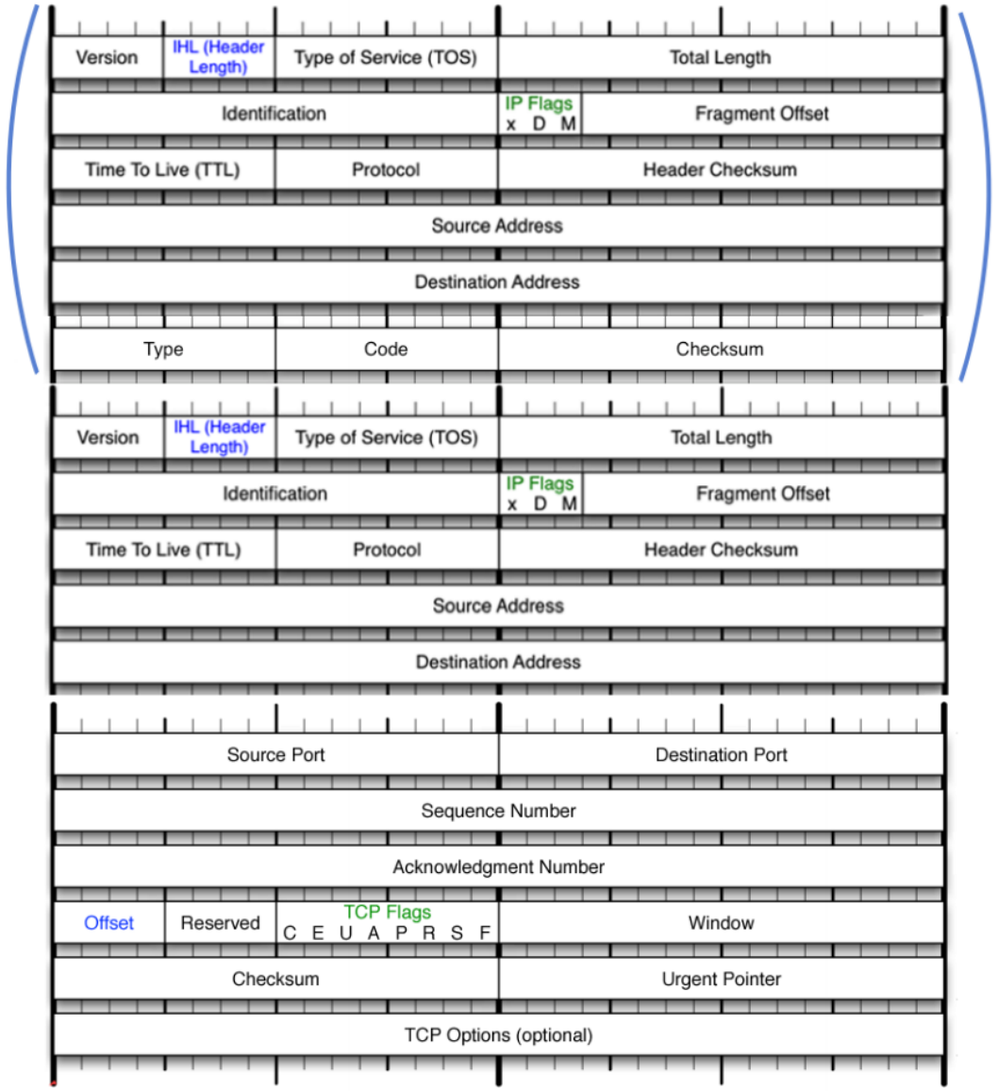
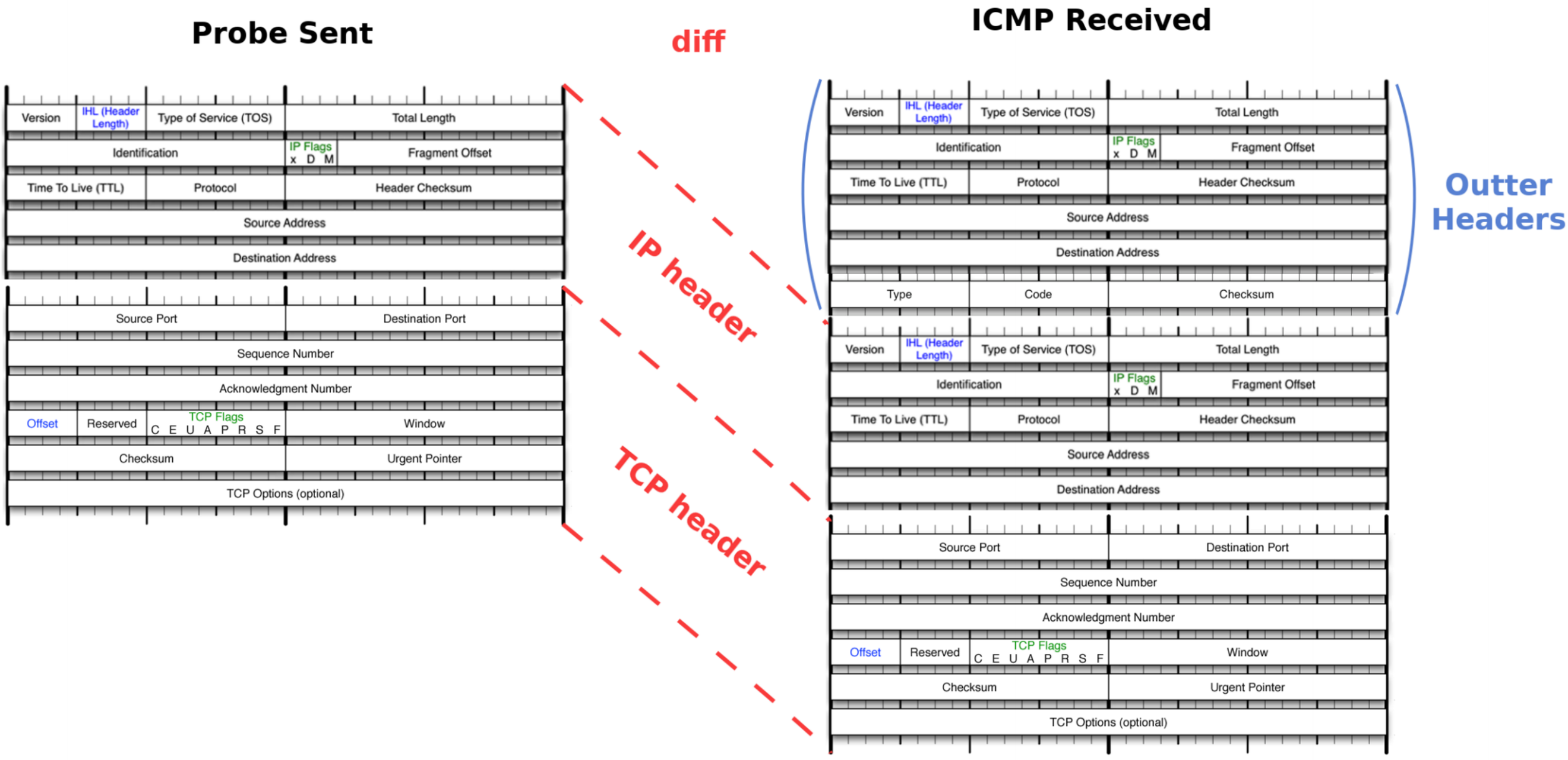


Outter Headers

Middlebox discovery ?



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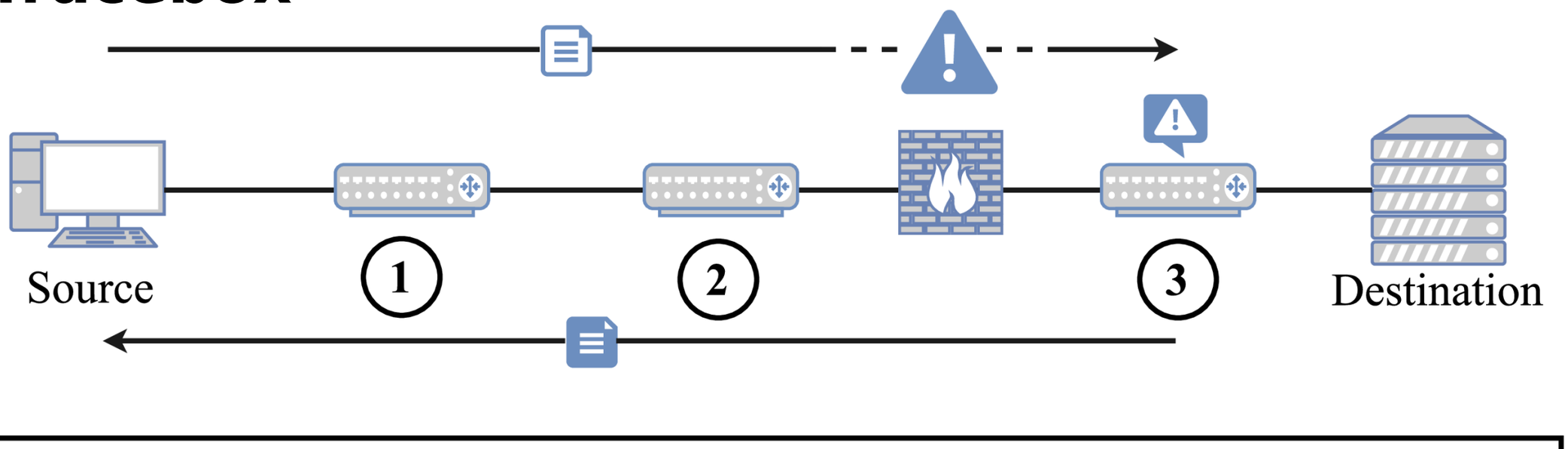

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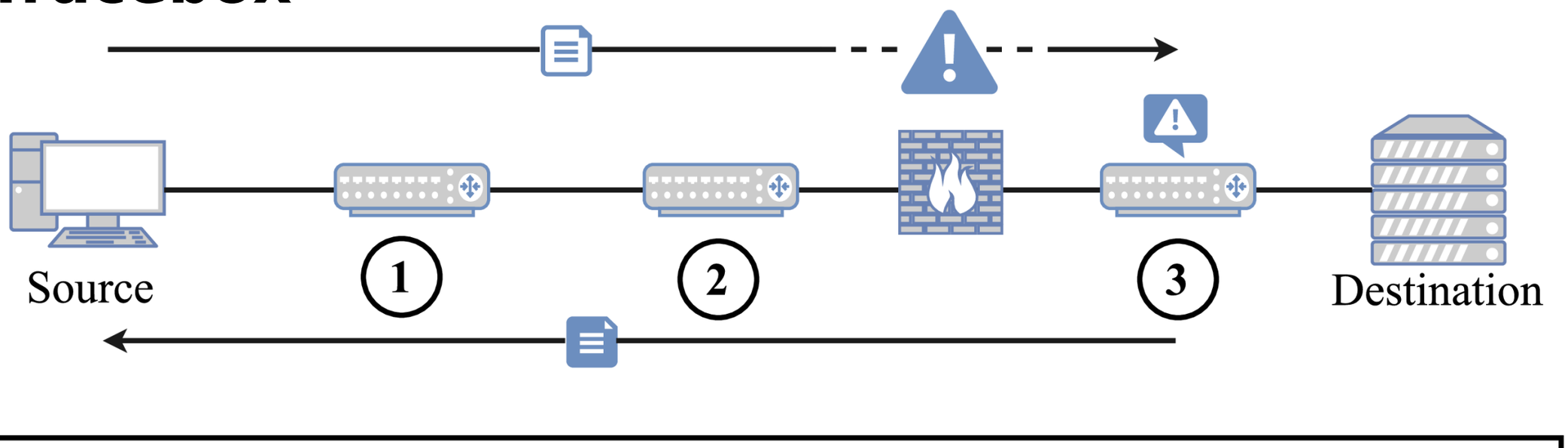

- Middlebox **Detection**
- Middlebox **Location**

Location precision

- **Quotation size:**
  - **RFC 792** : “The internet header plus the first 64 bits”
  - **RFC 1812** : “as much [...] as possible” (< 576 B)
    - Default on Linux, Cisco OSX, HP, Alcatel, ...

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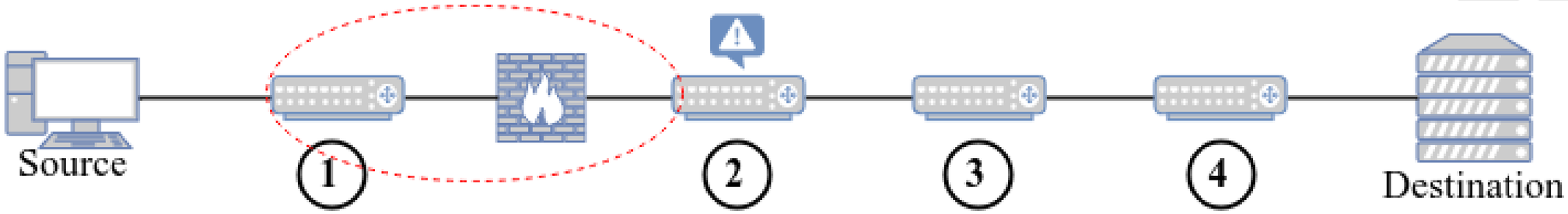
- 90% of all path at least contain one RFC1812 router
  - Edeline, K., & Donnet, B, “A First Look at the Prevalence and Persistence of Middleboxes in the Wild” In 29th International Teletraffic Congress (ITC 29), 2017.

Middlebox discovery ?



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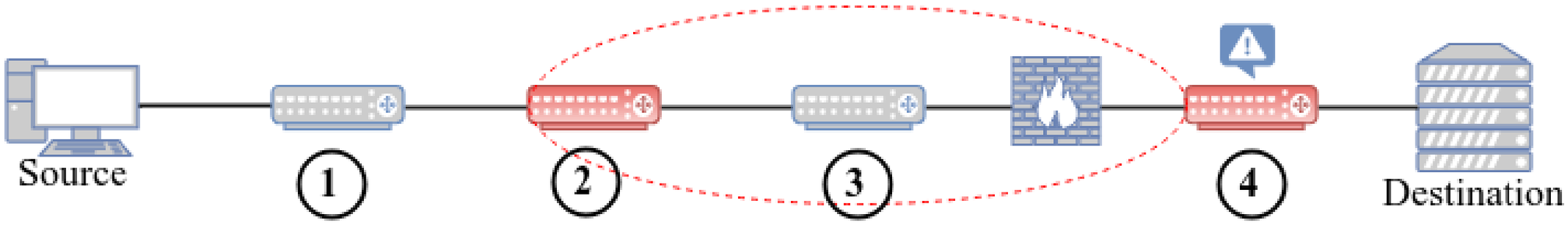

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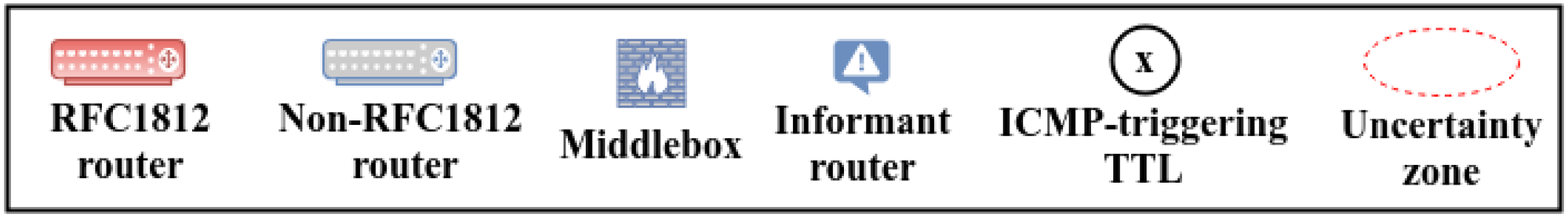
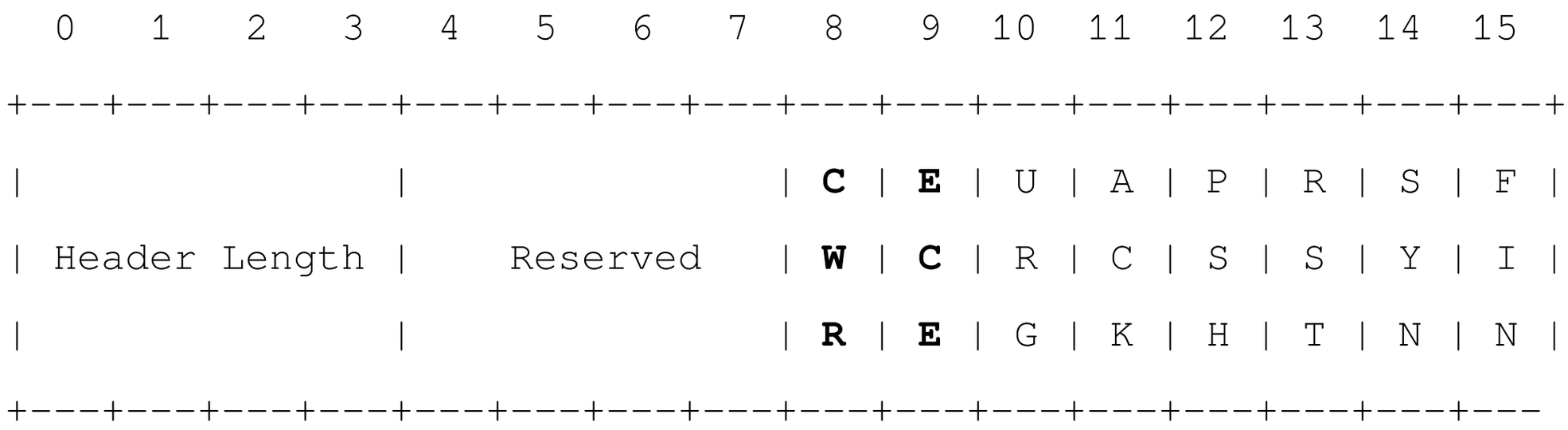


Explicit Congestion Notification (ECN)

- What is ECN ?
  - End-to-end notification of network congestion without dropping packets
  - ECN-aware router may **set a mark** in the IP header **instead of dropping** a packet in order to signal impending congestion.

ECN Negotiation

- ECN Negotiation with TCP



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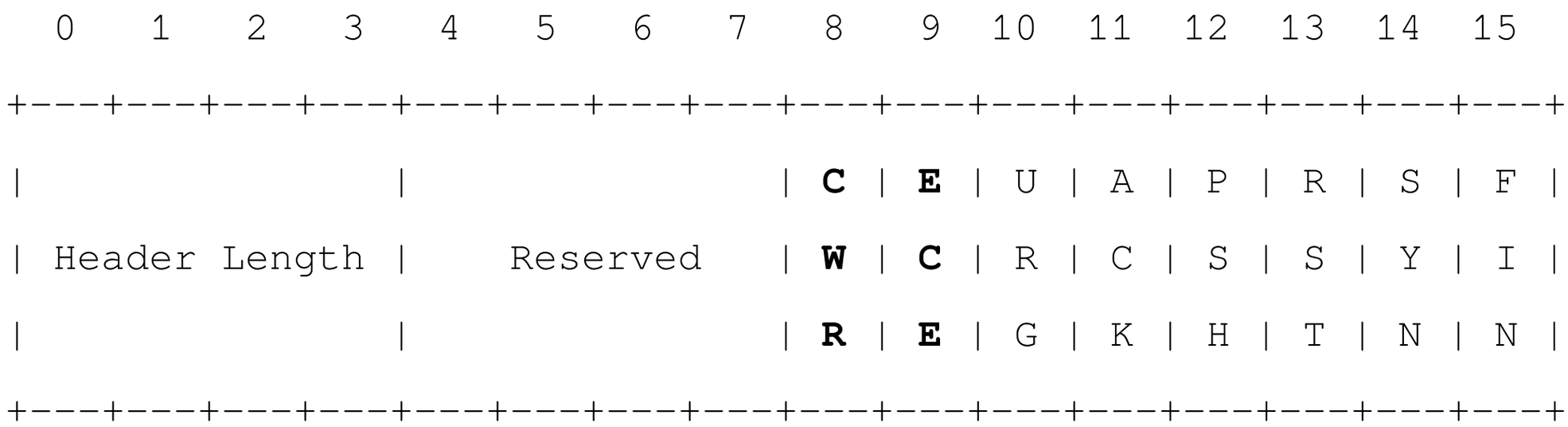
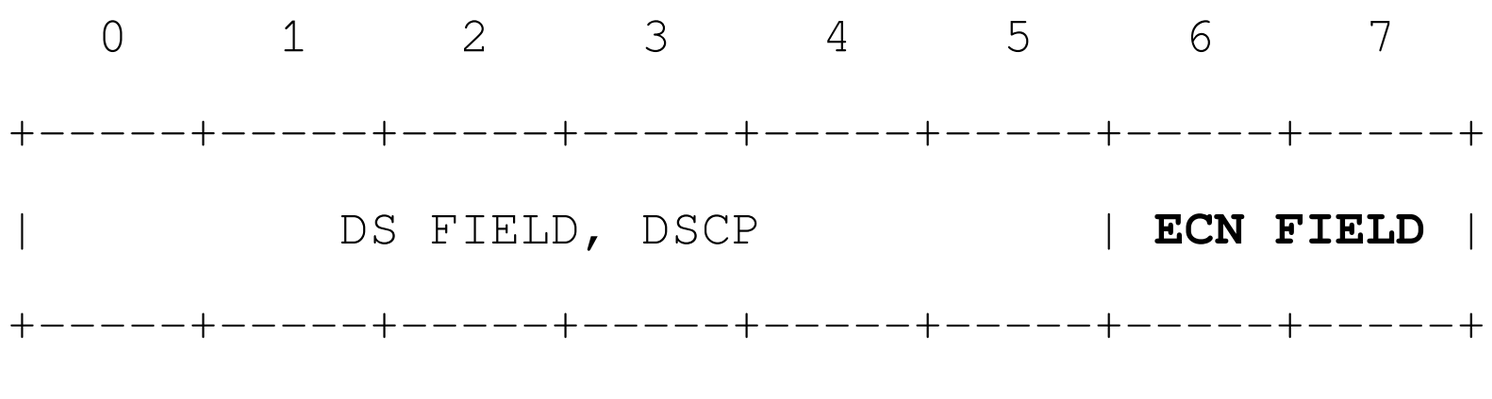


  - **ECE** & **CWR** set in SYN packet
  - **ECE** & **!CWR** set in SYN ACK packet

ECN Marking

- ECN in IP:



ECN Marking

- ECN in IP:

```
    0     1     2     3     4     5     6     7
+-----+-----+-----+-----+-----+-----+-----+-----+
|          DS FIELD, DSCP                 | ECN FIELD |
+-----+-----+-----+-----+-----+-----+-----+-----+
```

	ECT	**CE**	
	0	0	Not-ECT
ECN-Capable Transport	0	1	**ECT**(1)
ECN-Capable Transport	1	0	**ECT**(0)
Congestion Experienced	1	1	**CE**

IP Features: DSCP

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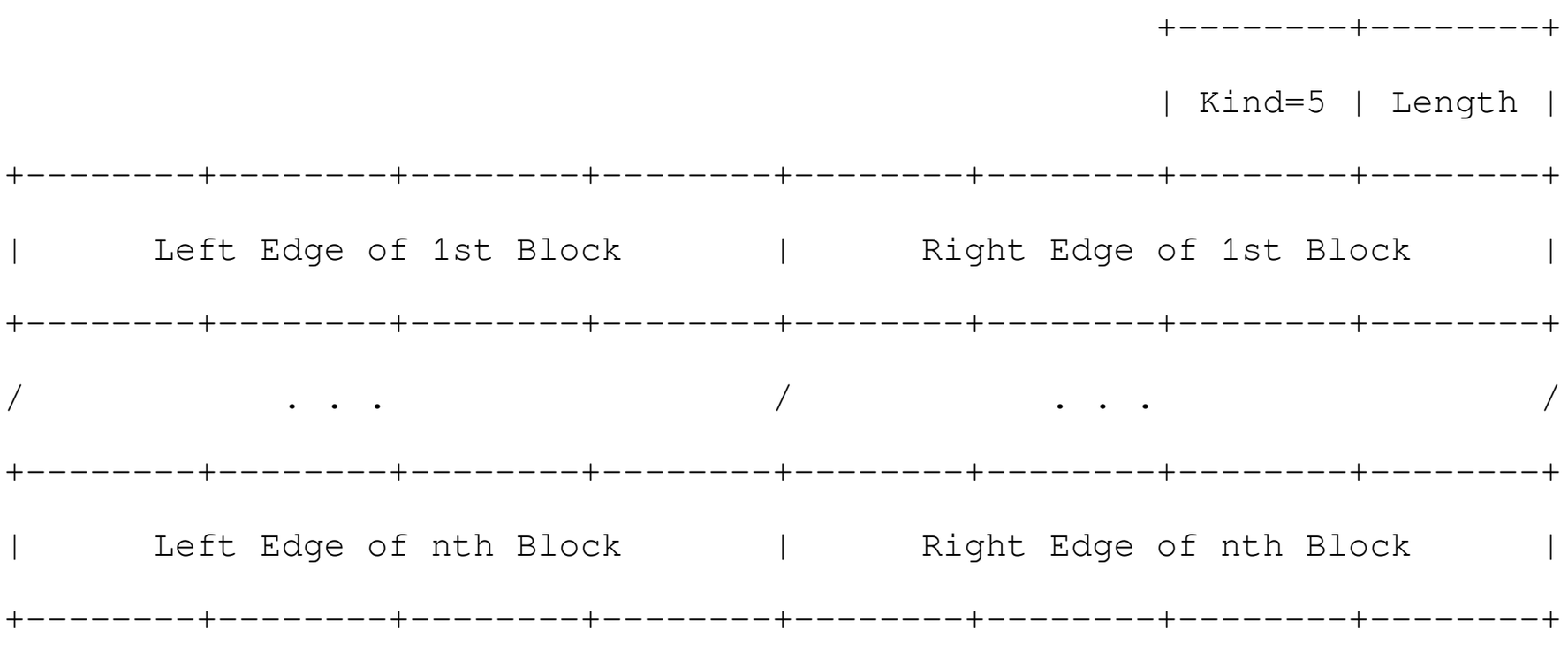

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tracebox

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- **$** … “tracebox -v -p ip/tcp/CWR/ECE/**MSS(1460)**” …
- **$** … “tracebox -v -p ip/tcp/**ECT**” …

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  - reseted when instanciating topologies
    - **$** `sudo sysctl -p`

Topology #1

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$ ./setup_topology 1
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Scenario: “Slow HTTP traffic from server”

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$ wget 10.0.0.10/big_buck_bunny_720p_10mb.mp4
```

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  - ECN use can be set by changing the kernel parameters at runtime
    - **$** sudo sysctl –w net.ipv4.**tcp_ecn**=**0**

Topology #1

$ ./setup_topology **1**

Scenario: “Slow HTTP traffic from server”

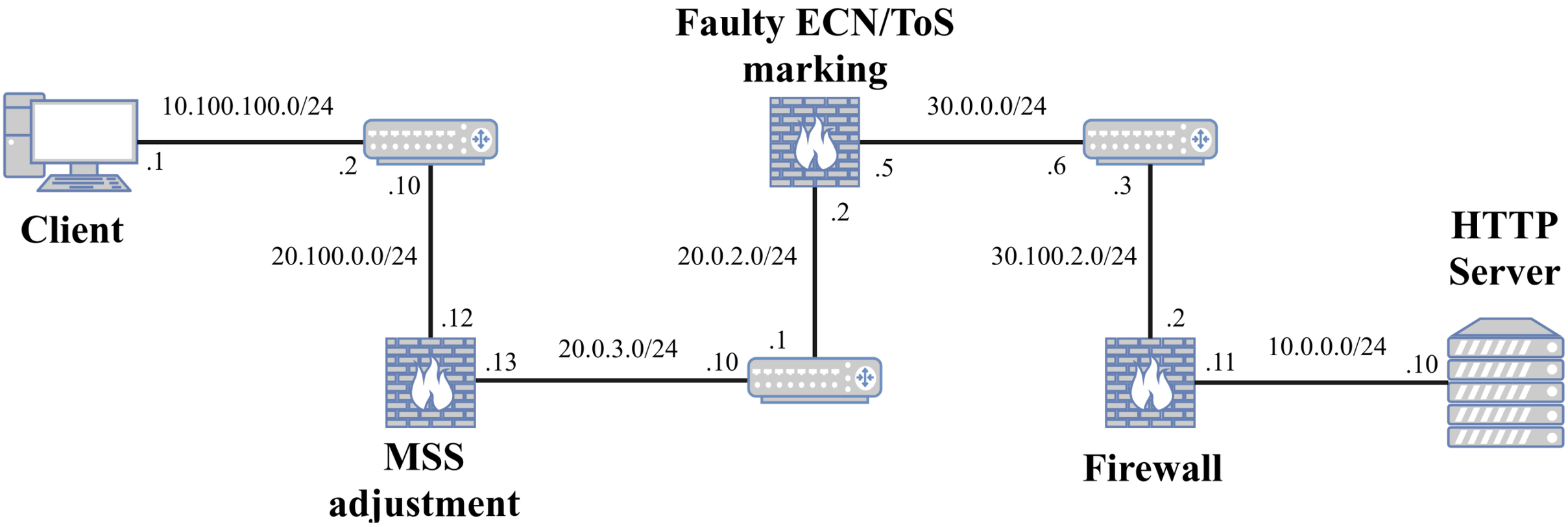
Problem:

- Middlebox reporting inexistant congestion

Solution:

- Disable ECN

Topology #1


Faulty ECN/ToS marking
10.100.100.0/24
.1
.2
.10
Client
20.100.0.0/24
20.0.2.0/24
30.0.0.0/24
.5
.6
.3
.2
30.100.2.0/24
HTTP Server
.12
.13
20.0.3.0/24
.10
.1
.2
.11
10.0.0.0/24
.10
MSS adjustment
Firewall

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Scenario: “No connectivity to HTTP server”

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  - TCP Window scale of 8 means that a constant factor of 2^8 must be applied to the receive window.
  - Receive window: $[0;2^{16}-1] * 2^8$

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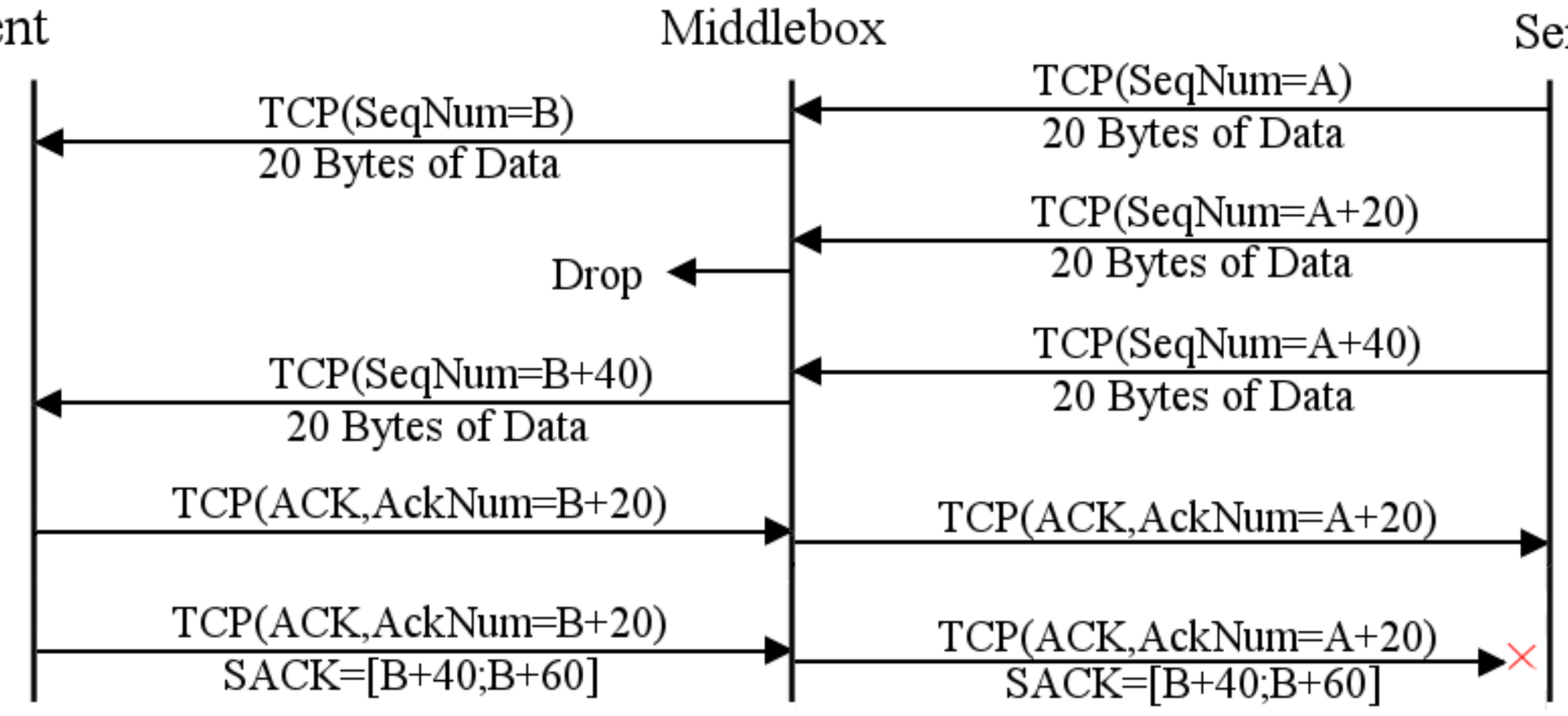

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Topology #2

$ ./setup_topology **2**

Scenario: “No connectivity to HTTP server”

Problem 1:

- ECN-setup blackhole

Solution 1:

- Enable ECN fallback

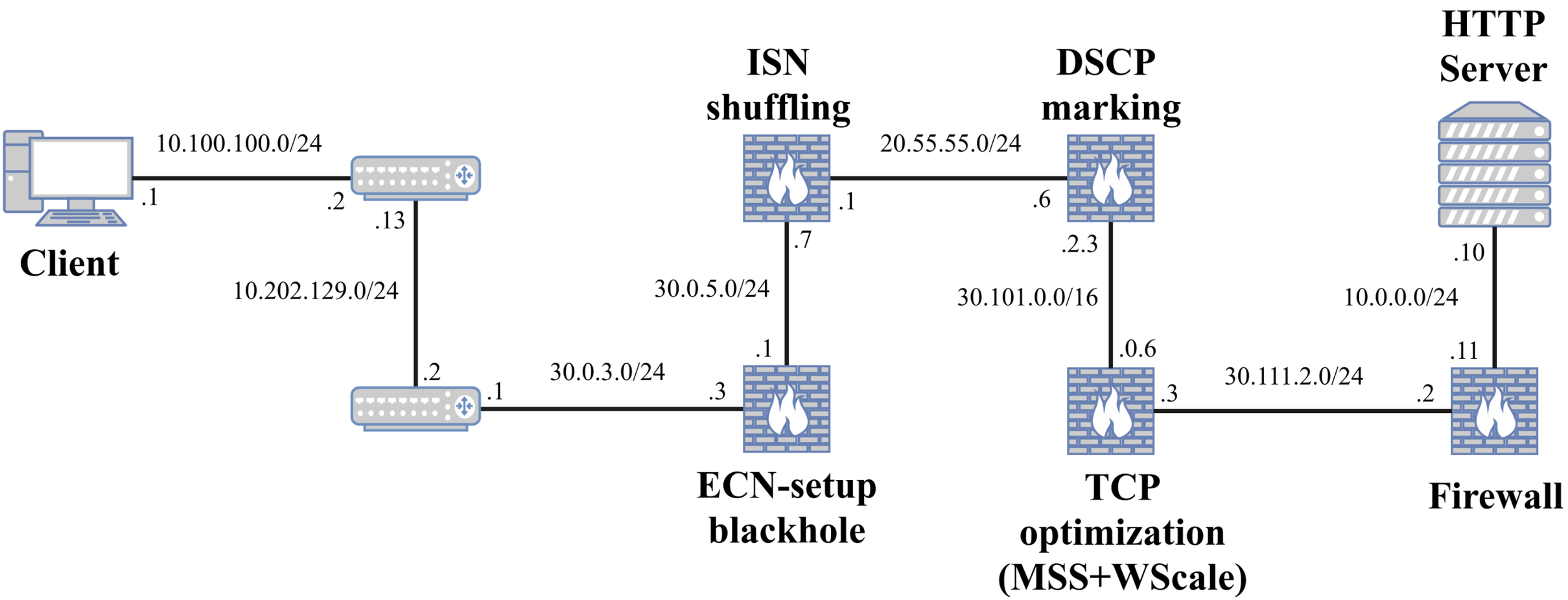
Problem 2:

- Invalid SACK blocks stall the connection

Solution 2:

- Disable SACK

Topology #2


10.100.100.0/24
.1
.2
.13
Client
10.202.129.0/24
.2
.1
30.0.3.0/24
.3
.1
30.0.5.0/24
.7
ECN-setup
blackhole
ISN
shuffling
20.55.55.0/24
.1
.6
.2.3
30.101.0.0/16
.0.6
.3
TCP
optimization
(MSS+WScale)
DSCP
marking
HTTP
Server
.10
10.0.0.0/24
.11
30.111.2.0/24
.2
Firewall

Thanks!

Tools used

- Testbed
  - fd.io
  - Configurable Middlebox plugin
    - https://github.com/mami-project/vpp-mb
- Tracebox
  - https://github.com/mami-project/tracebox