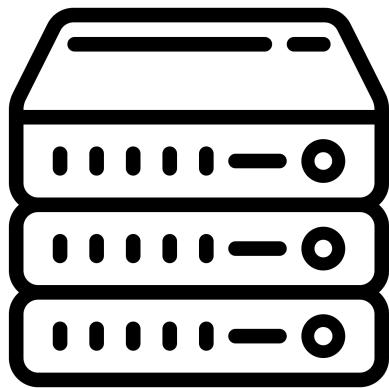
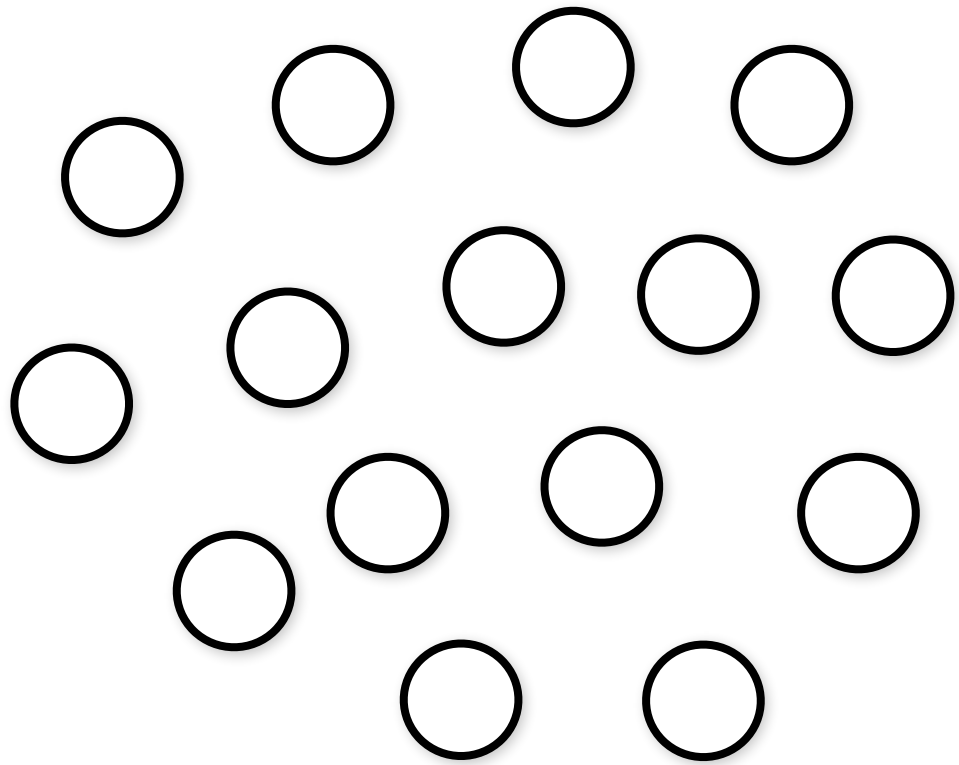


# Flow Relay System for UDP

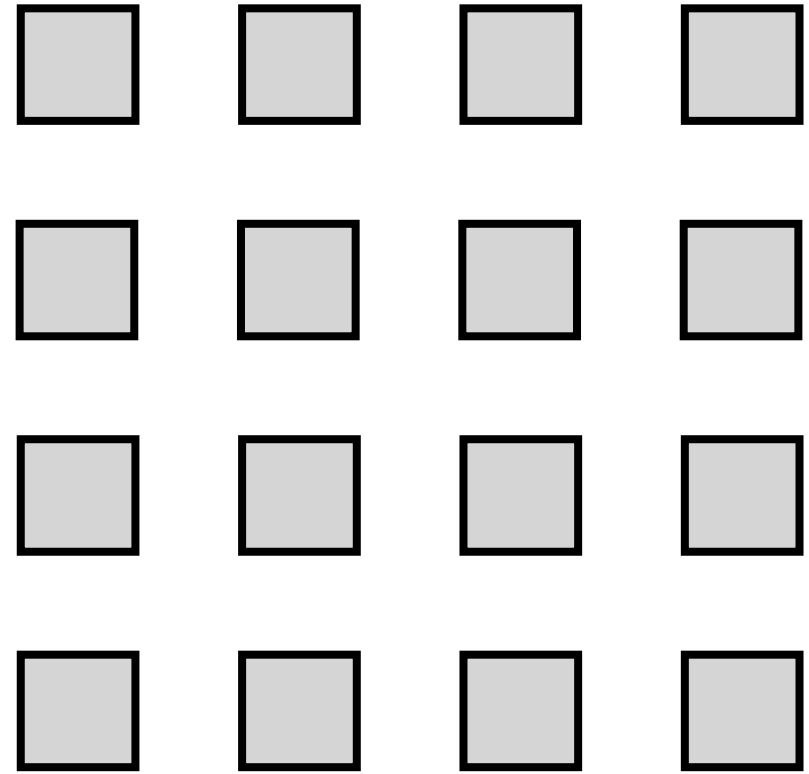
*Copyright © 2017, The Network Protocol Company, Inc. All rights reserved.*

## Relays



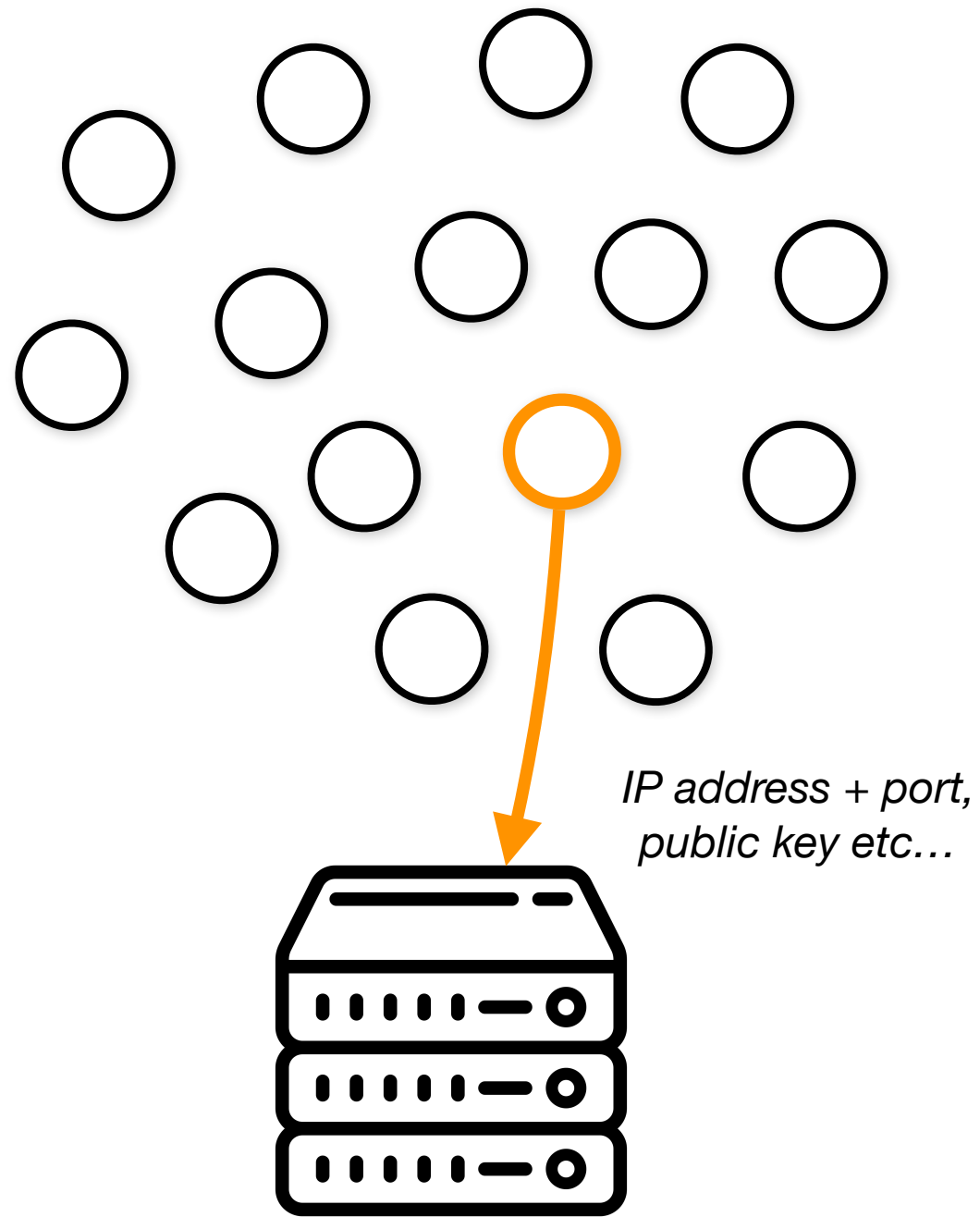
Master Server

## Servers



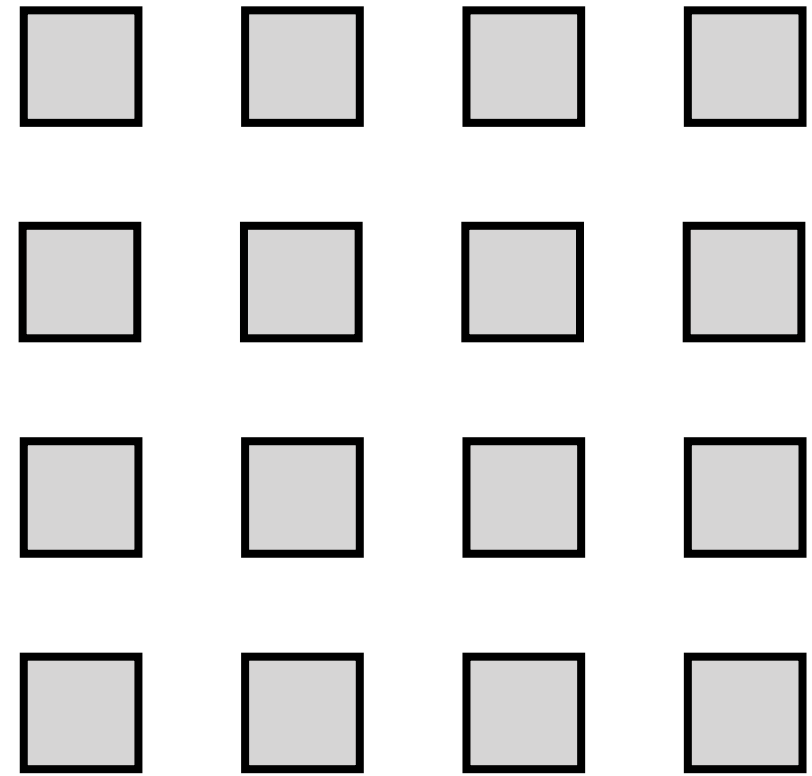
Matcher

## Relays



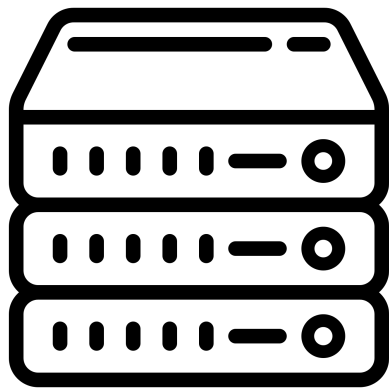
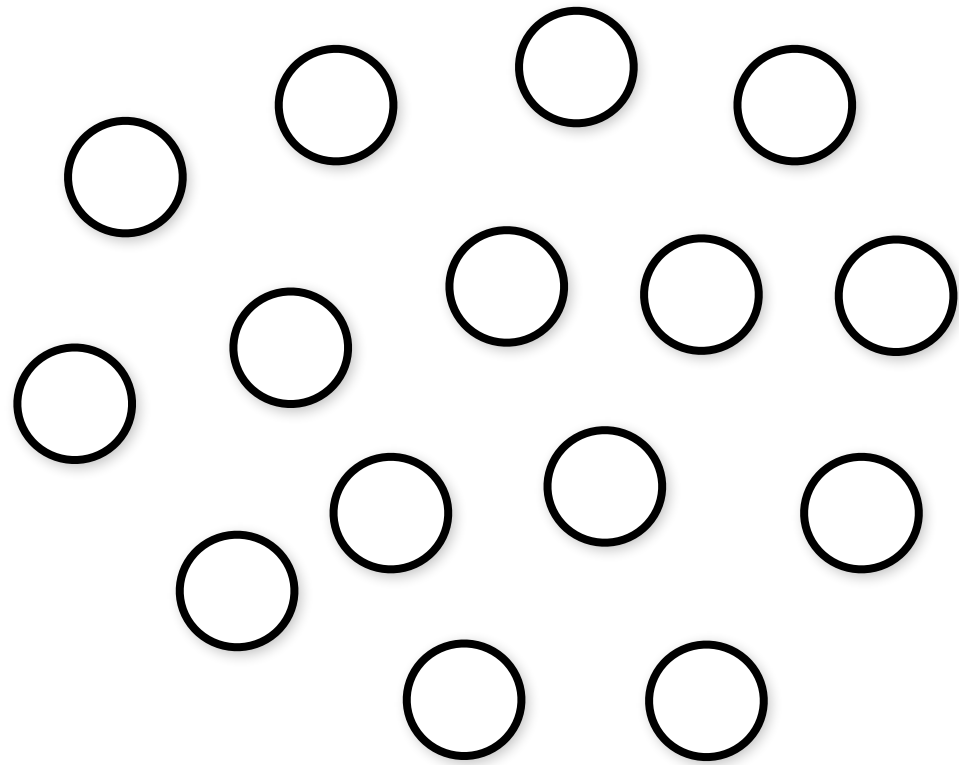
Master Server

## Servers



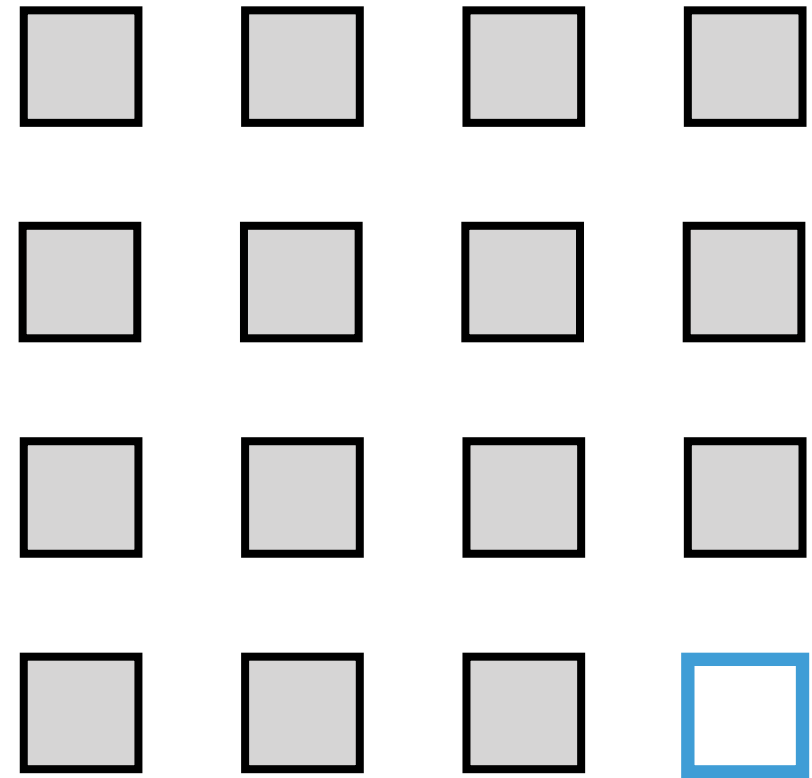
Matcher

## Relays



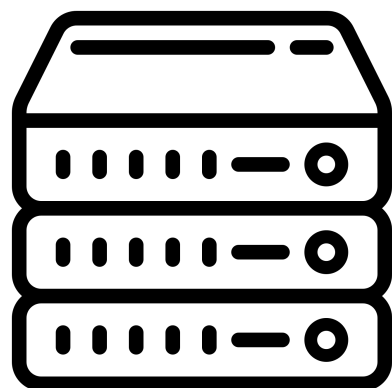
Master Server

## Servers

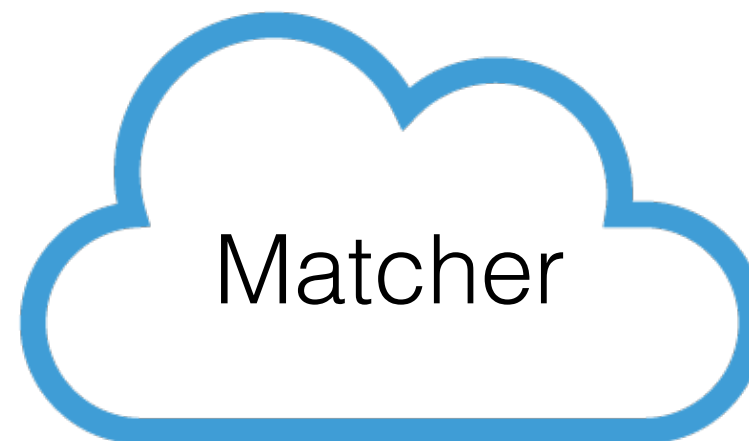


Matcher

*IP address + port,  
public key etc...*

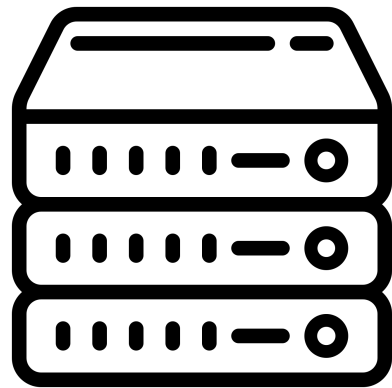


Master Server



Client

Request to play



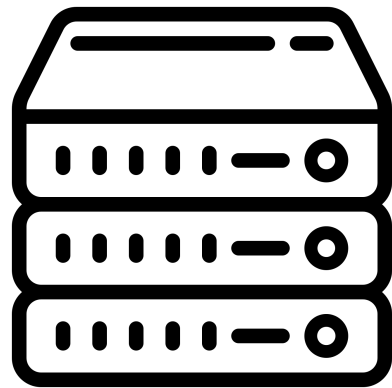
Master Server

**List of servers**

[  $S_0$ ,  $S_1$ ,  $S_2$  ...  $S_{n-1}$  ]



Client

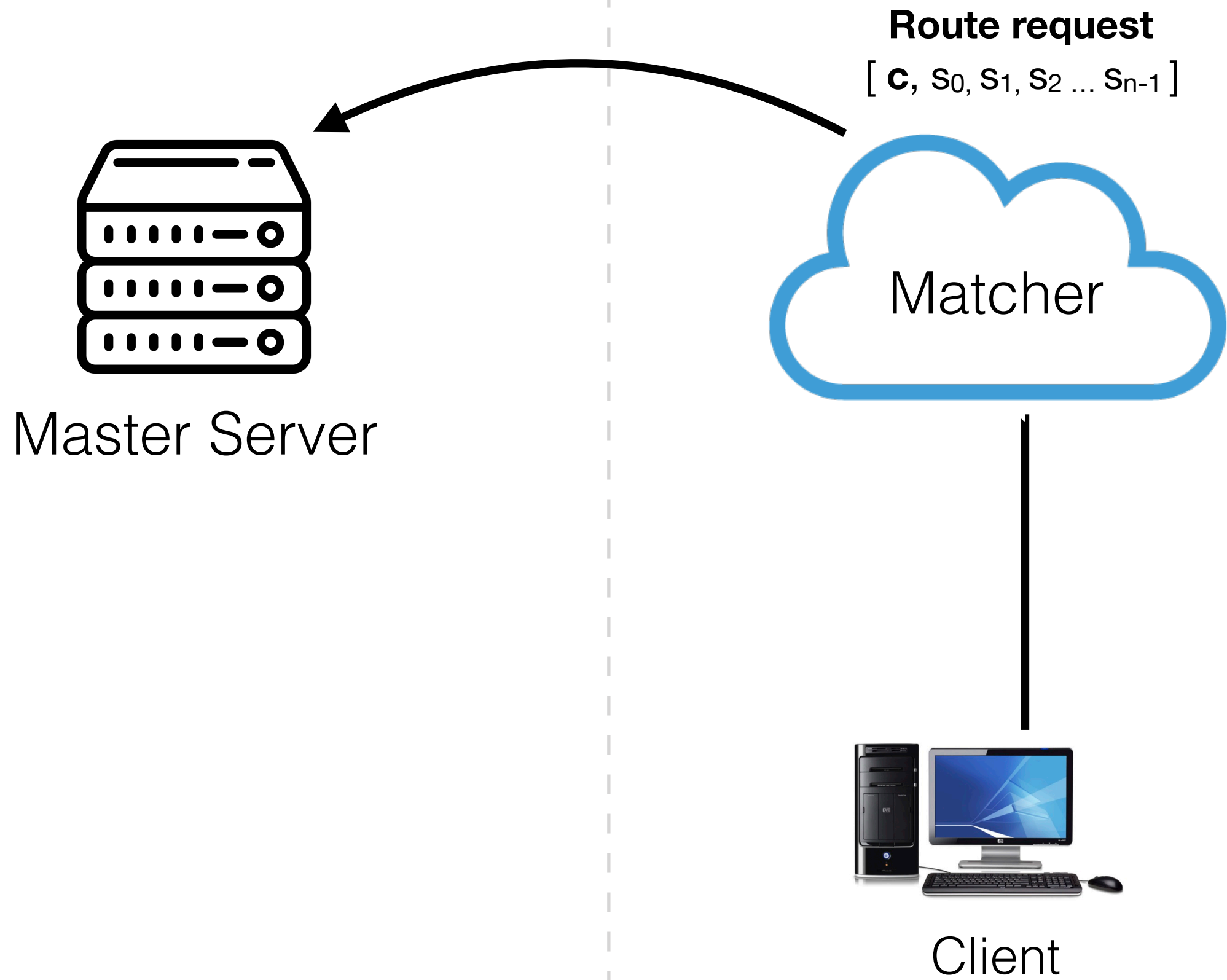


Master Server

**Route request**  
[ **c**,  $s_0$ ,  $s_1$ ,  $s_2$  ...  $s_{n-1}$  ]



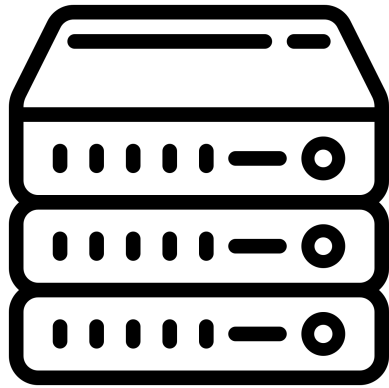
Client





**Routes to servers**

$[r_0, r_1, r_2 \dots r_{n-1}]$



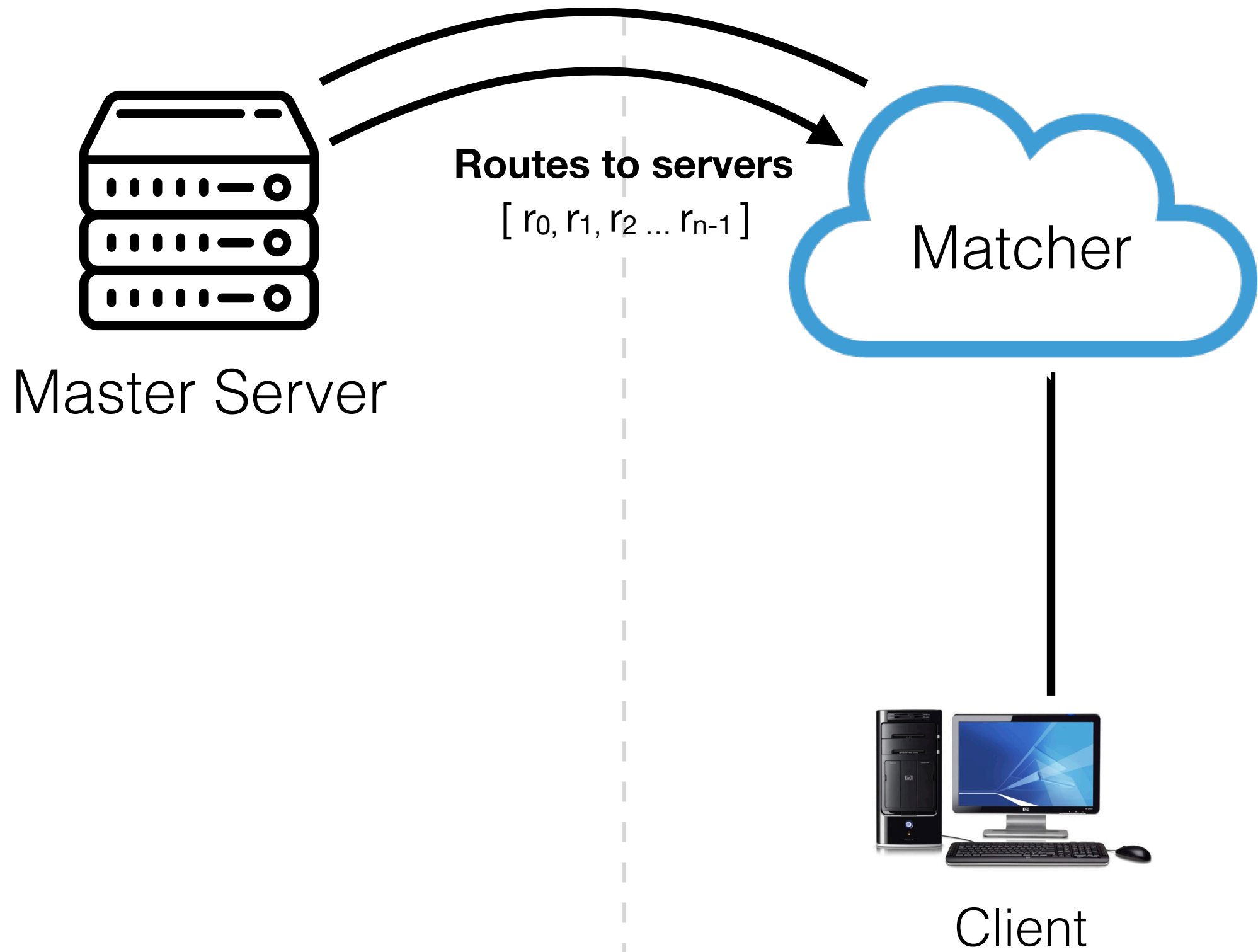
Master Server

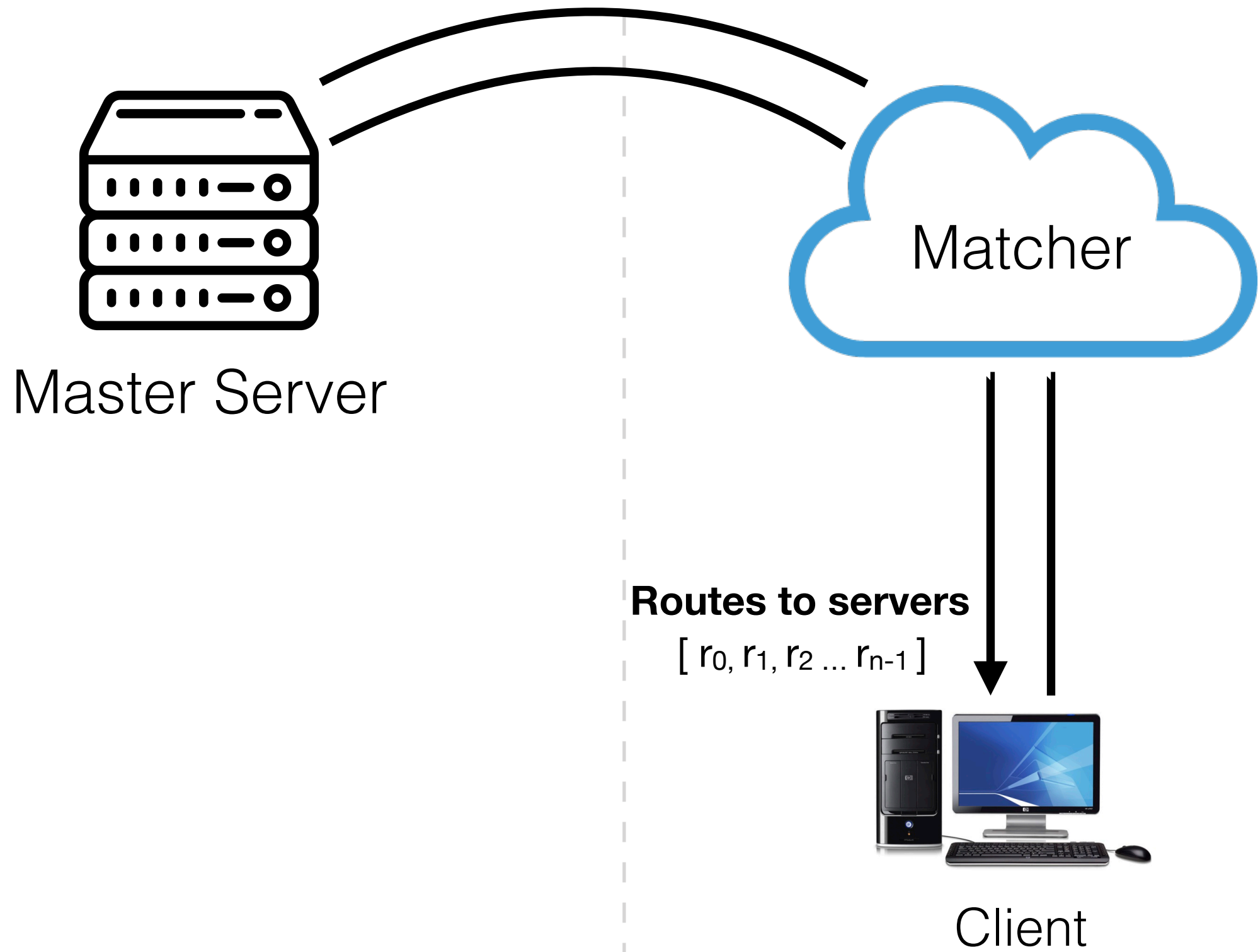
**Route request**

$[c, s_0, s_1, s_2 \dots s_{n-1}]$



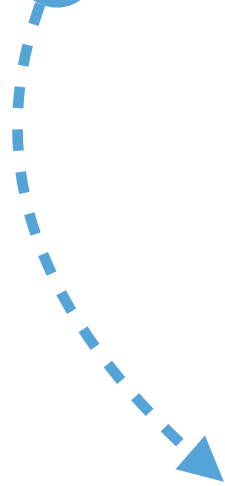
Client



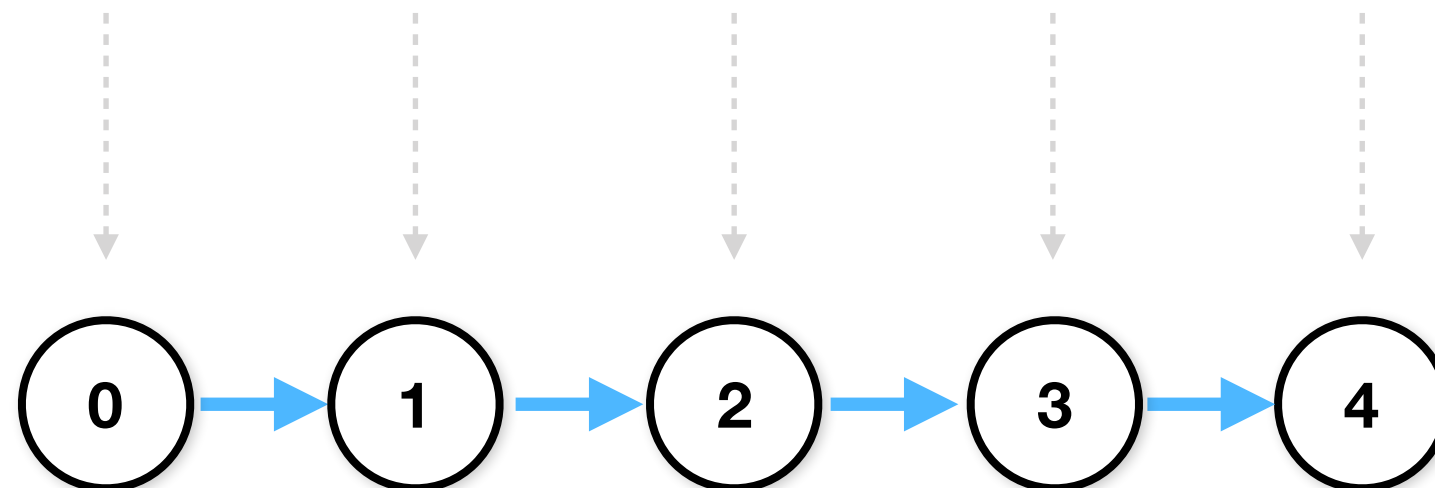


## Routes to servers

$[r_0, r_1, r_2 \dots r_{n-1}]$



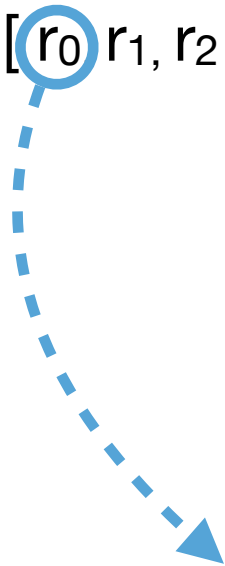
## Flow Route 0



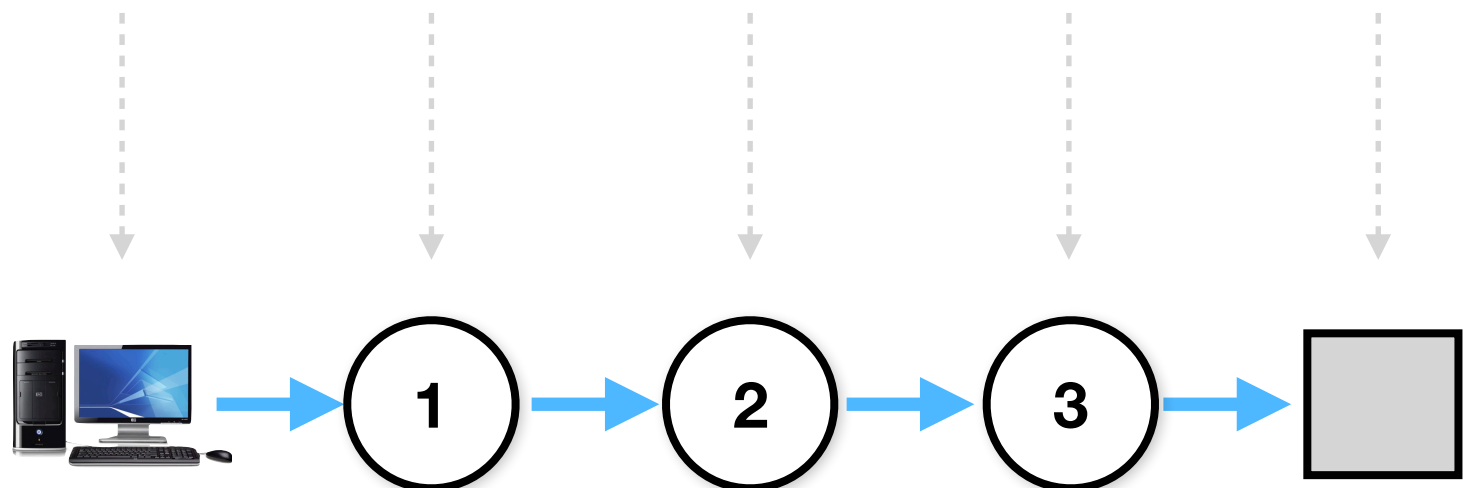
Nodes

## Routes to servers

$[r_0, r_1, r_2 \dots r_{n-1}]$



### Flow Route 0



**Client**

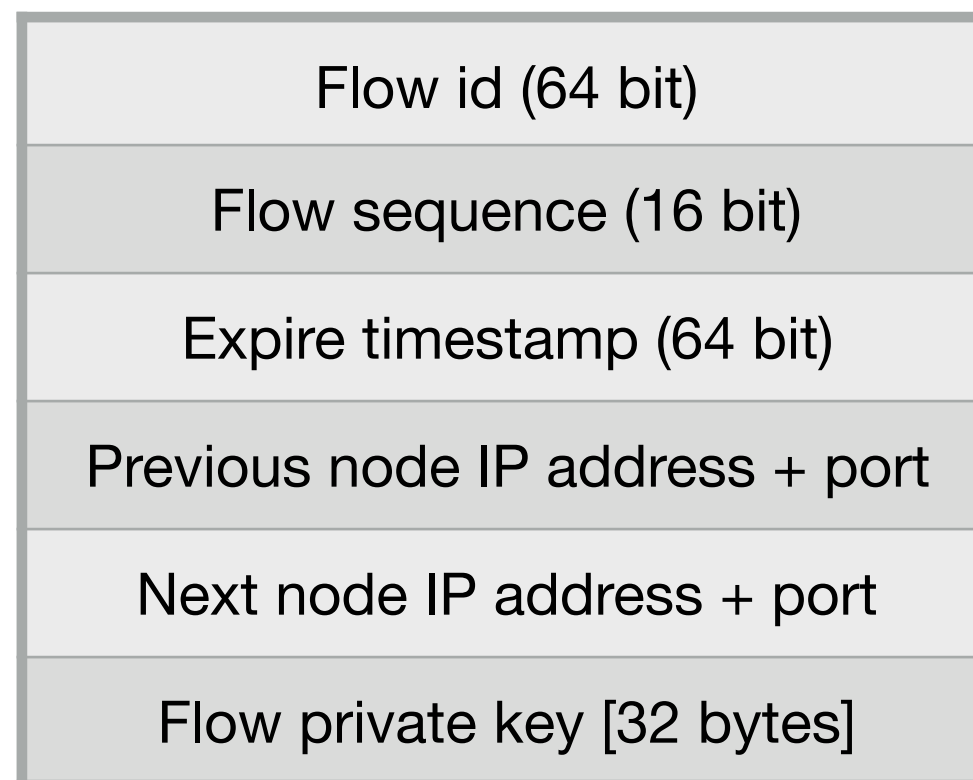
**Relays**

**Server**

## Flow Route 0

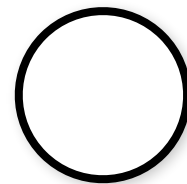
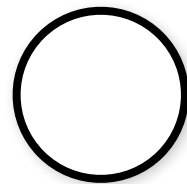
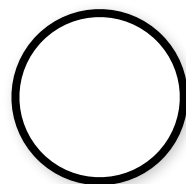


## Flow Token

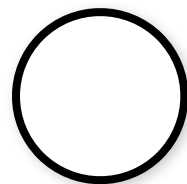
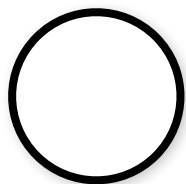




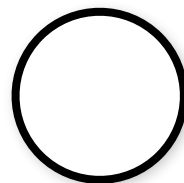
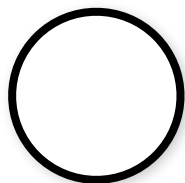
**Client**



**Server**



**Relays**



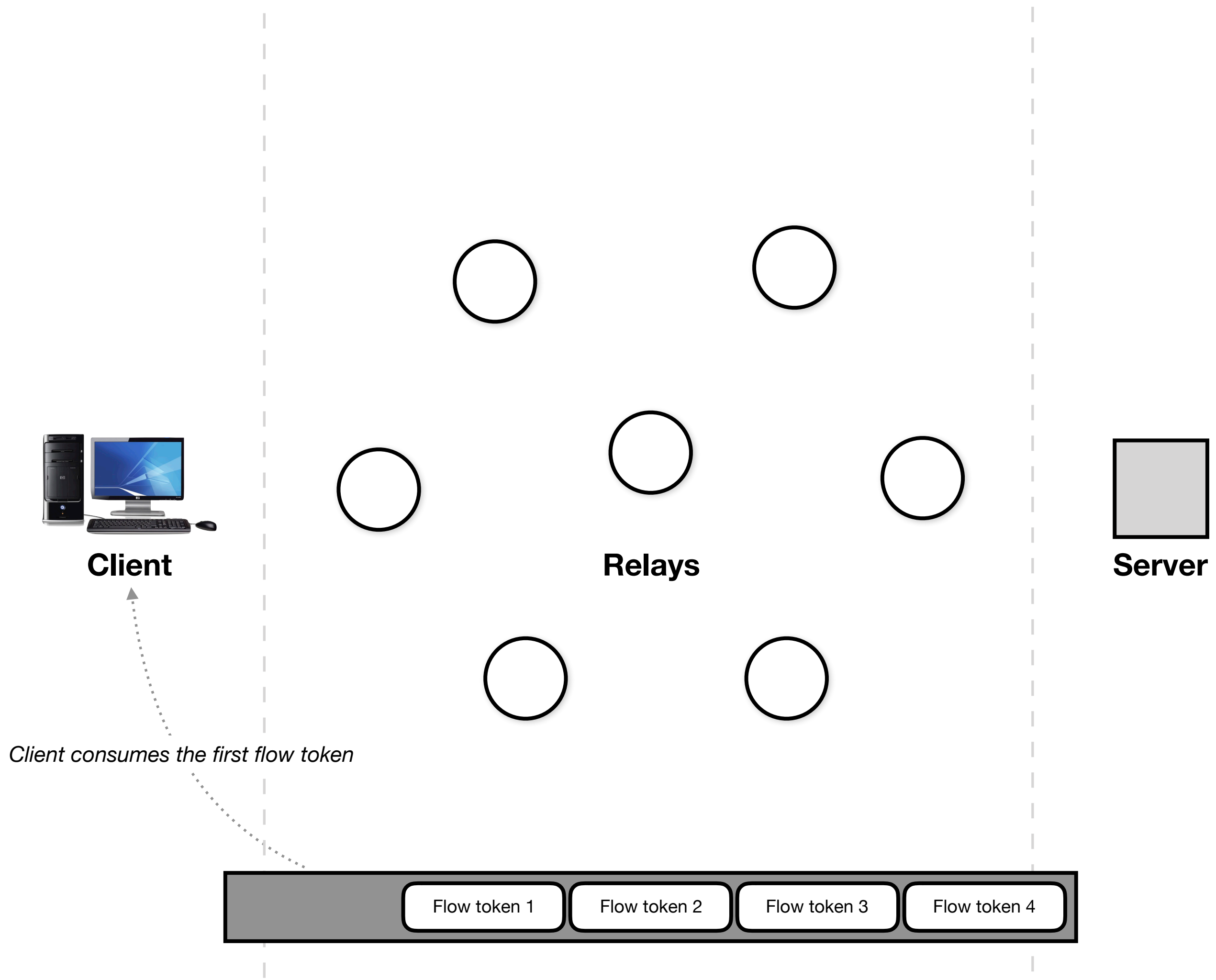
Flow token 0

Flow token 1

Flow token 2

Flow token 3

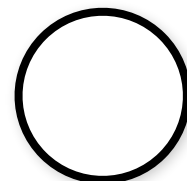
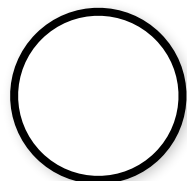
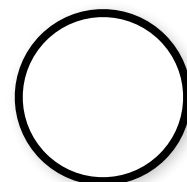
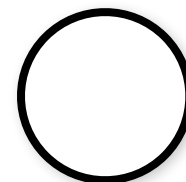
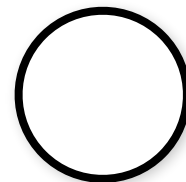
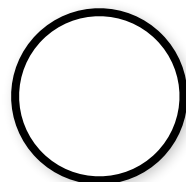
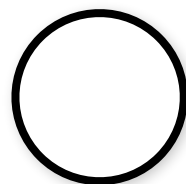
Flow token 4







**Client**



**Relays**



**Server**

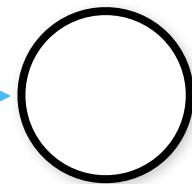
*Client prefixes remaining route with **0** byte, creating a **request packet***



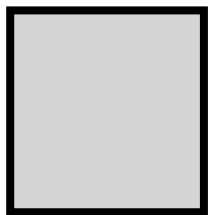
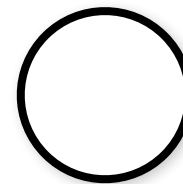
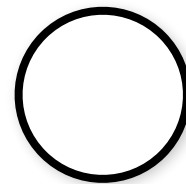
Client sends a series of **request packets** to the first relay



**Client**



**Relays**

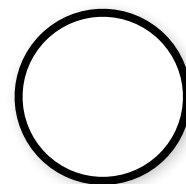
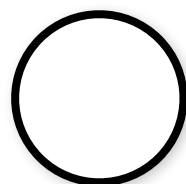
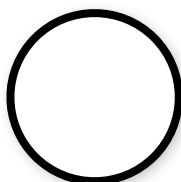


**Server**

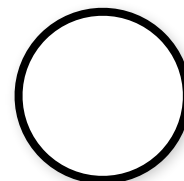
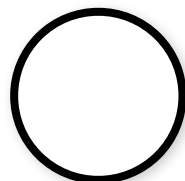
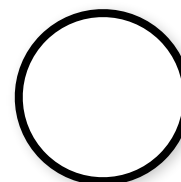
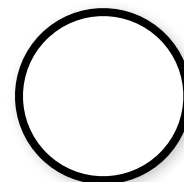




**Client**



**Relays**



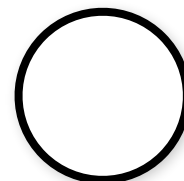
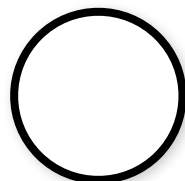
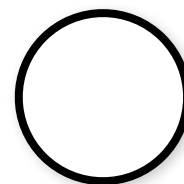
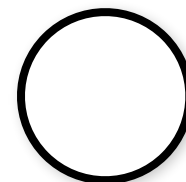
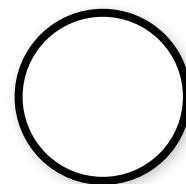
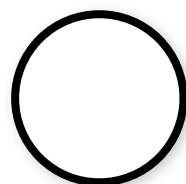
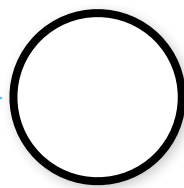
**Server**

*Relay consumes the first token*





**Client**



**Server**

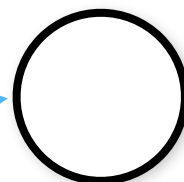
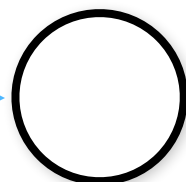
**Relays**

*Relay prefixes remainder of route with **0** byte, creating a **request packet***

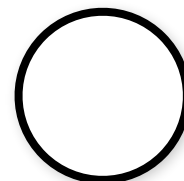
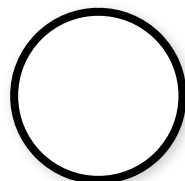
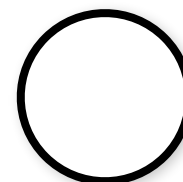
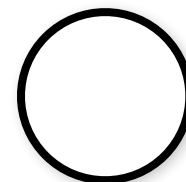
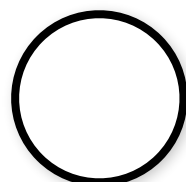




**Client**



**Relays**



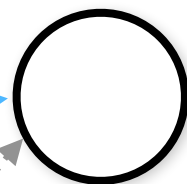
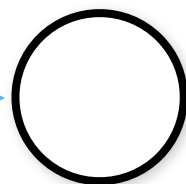
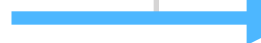
**Server**

*Relay forwards the modified **request packet** to the next relay*

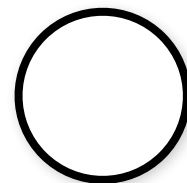
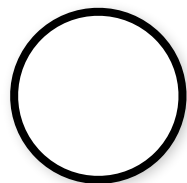
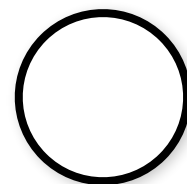
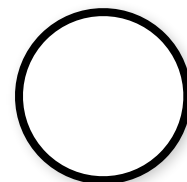
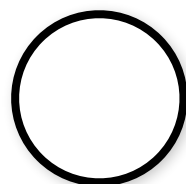




**Client**



**Relays**



**Server**

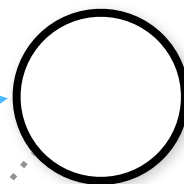
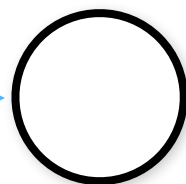


*Relay consumes the first token*

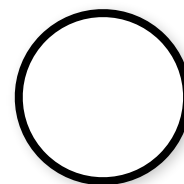




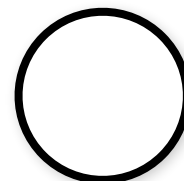
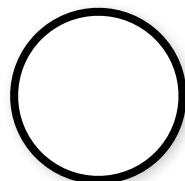
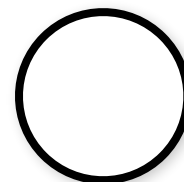
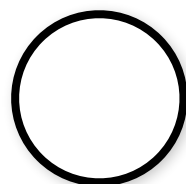
**Client**



**Relays**



**Server**

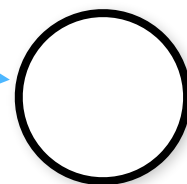
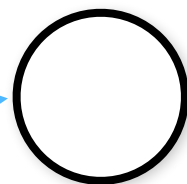
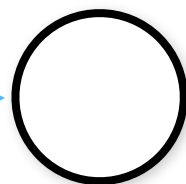


*Relay prefixes remainder of route with **0** byte, creating a **request packet***





**Client**



**Relays**



**Server**

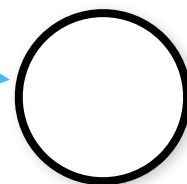
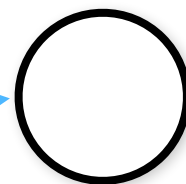
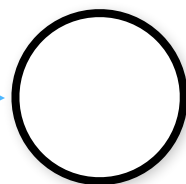
*Relay forwards the modified **request packet** to the next relay*







**Client**



**Relays**



**Server**

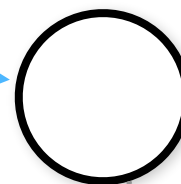
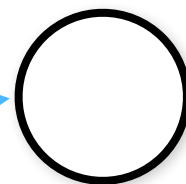
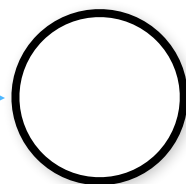


*Relay consumes the first token*





**Client**



**Relays**



**Server**

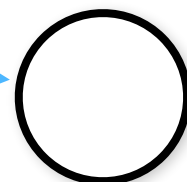
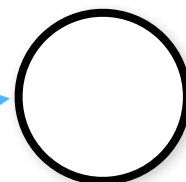
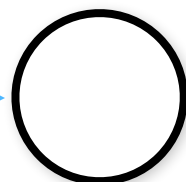


*Relay prefixes remainder of route with **0** byte, creating a **request packet***





**Client**



**Server**

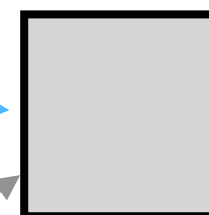
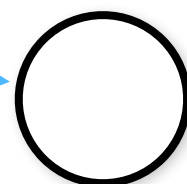
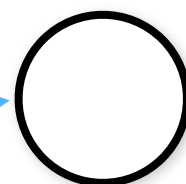
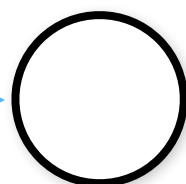
*Relay forwards the modified **request packet** to the server*

**Relays**



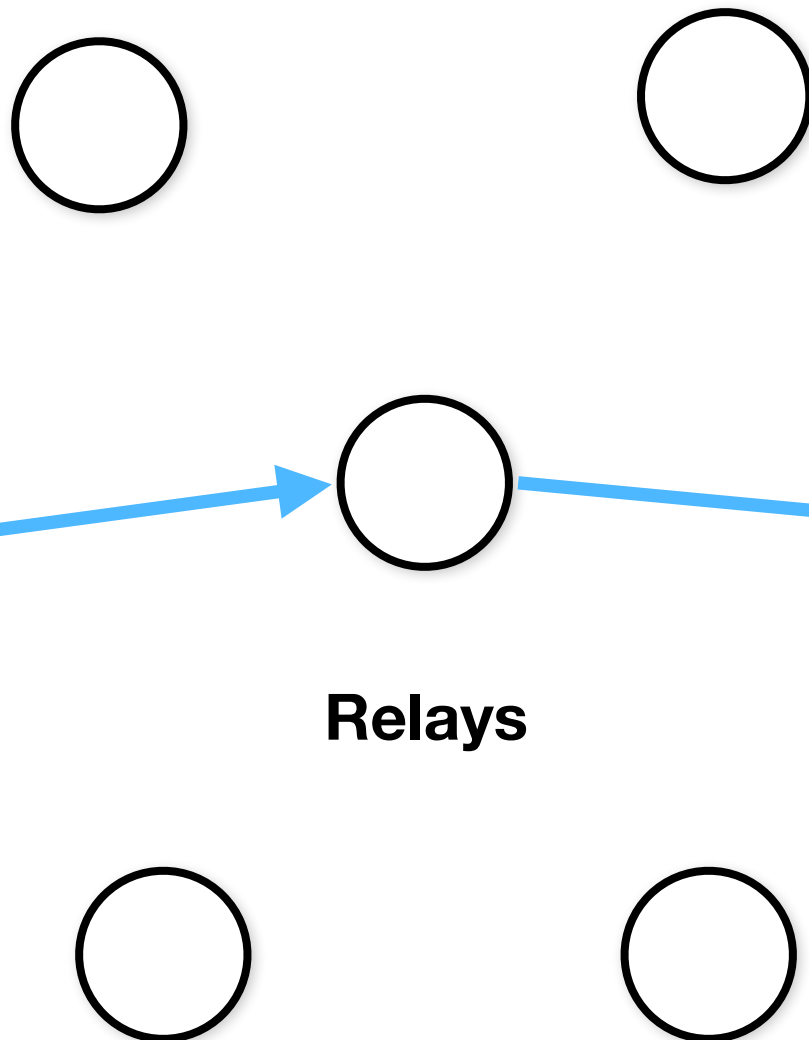


**Client**



**Server**

**Relays**

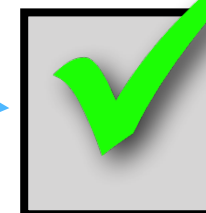
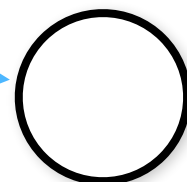
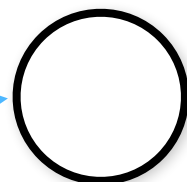
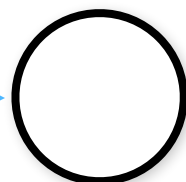


*Server consumes the first (and last) token*





**Client**

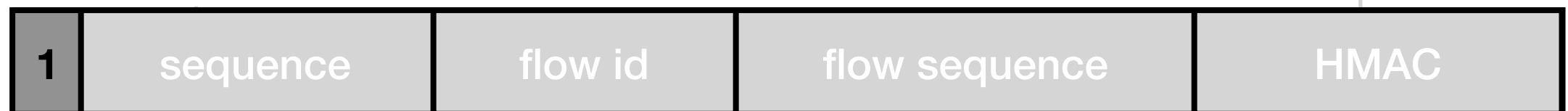
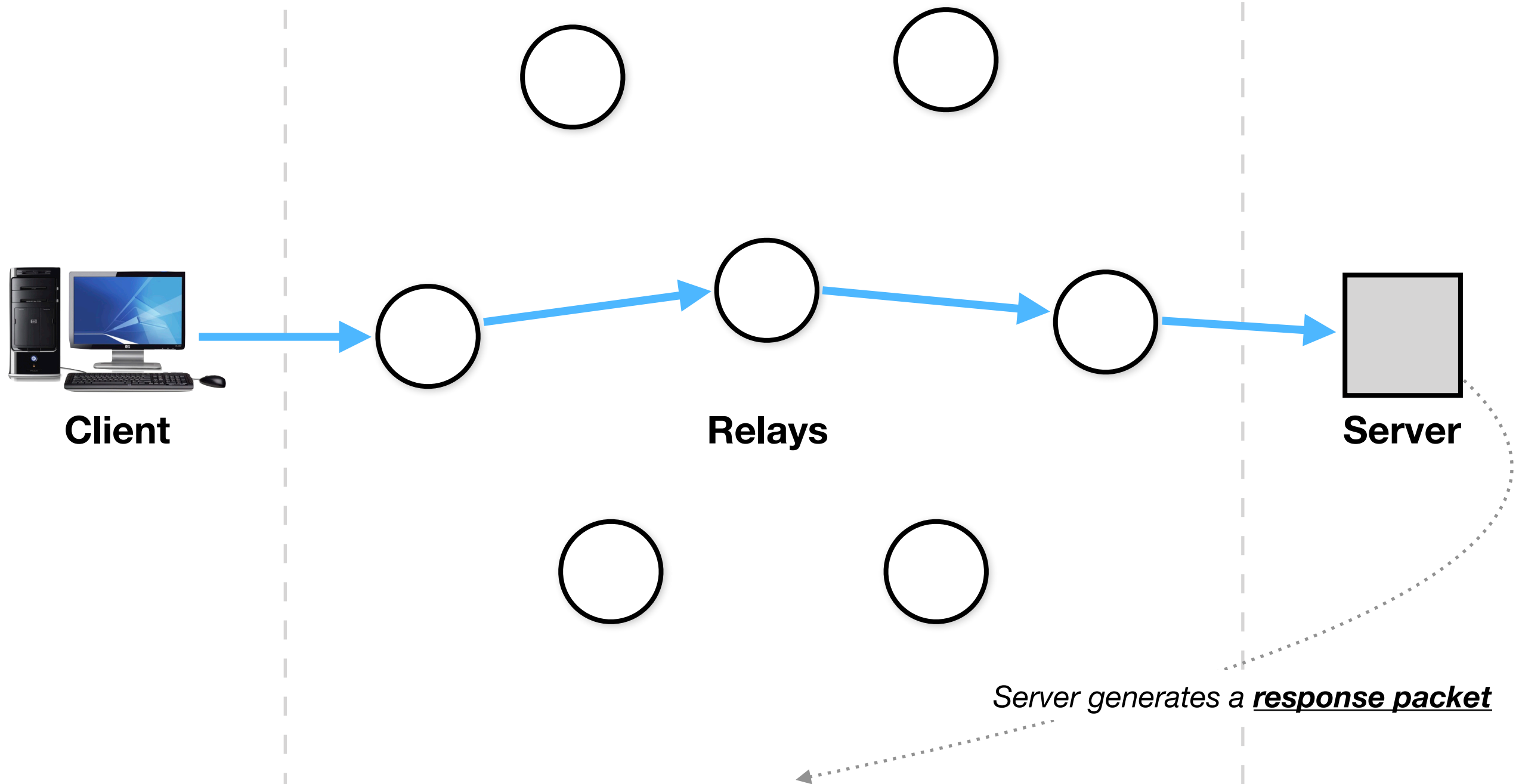


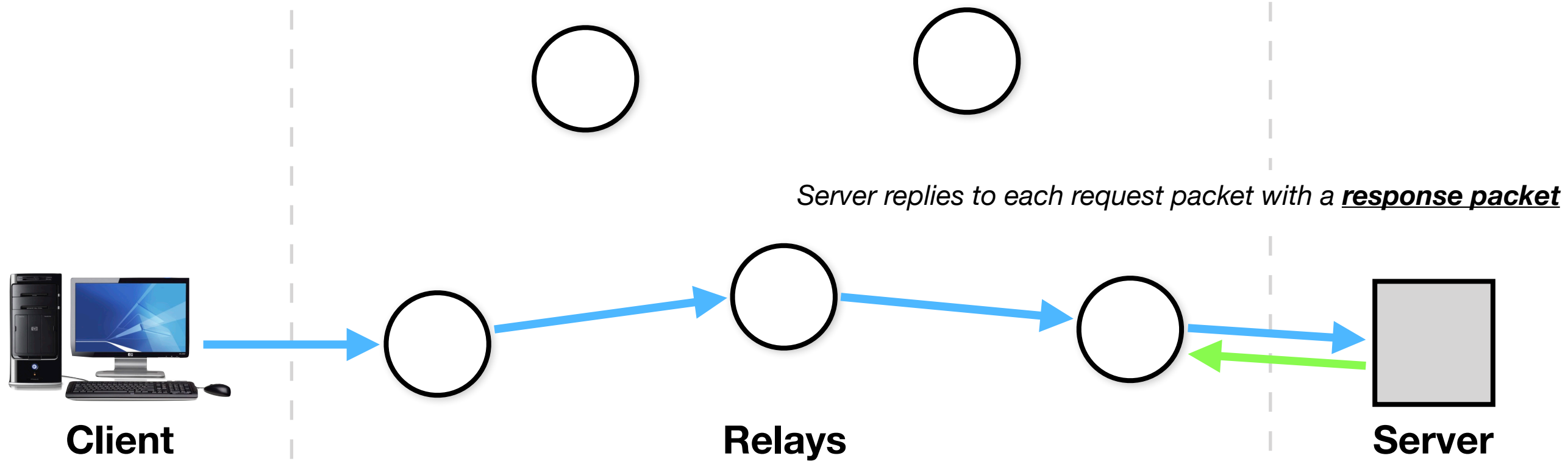
**Server**

**Relays**

*Server flow established*

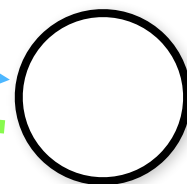
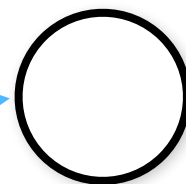
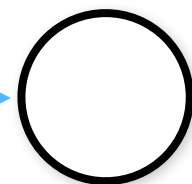








**Client**



**Server**

*Each relay forwards the **response packet** to the previous node*



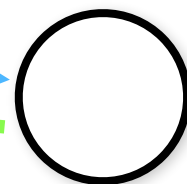
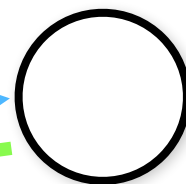
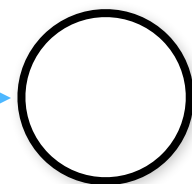
**Relays**







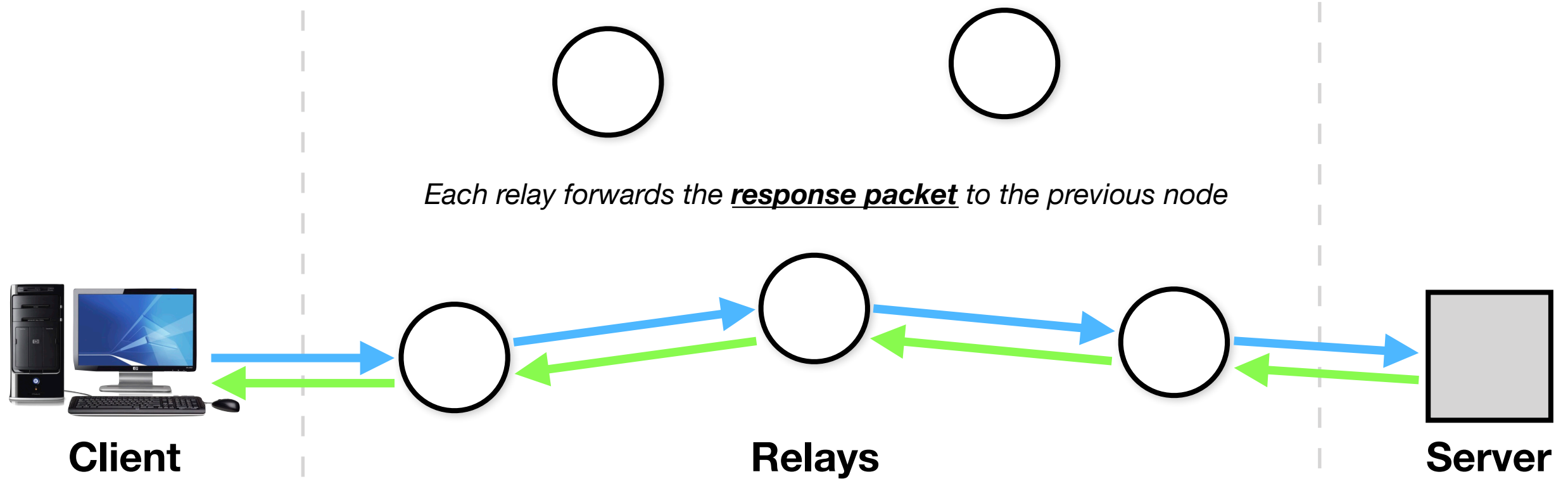
**Client**



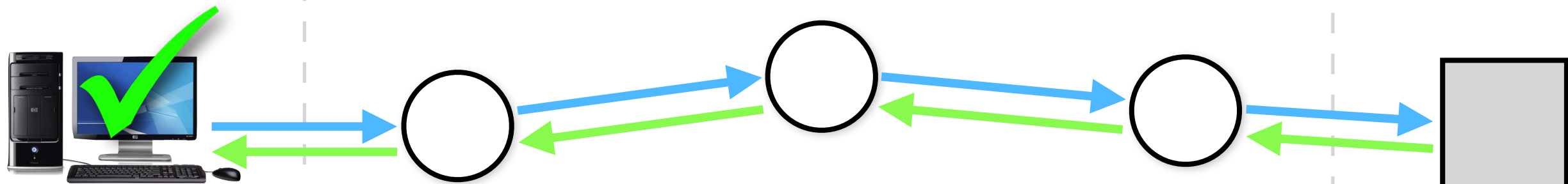
**Server**

*Each relay forwards the **response packet** to the previous node*





*Client flow established*



**Client**

**Relays**

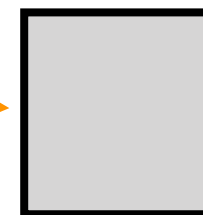
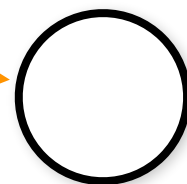
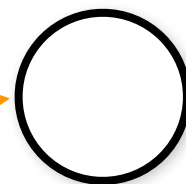
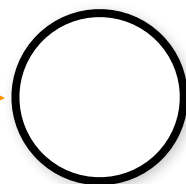
**Server**

1	sequence	flow id	flow sequence	HMAC
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**Client**

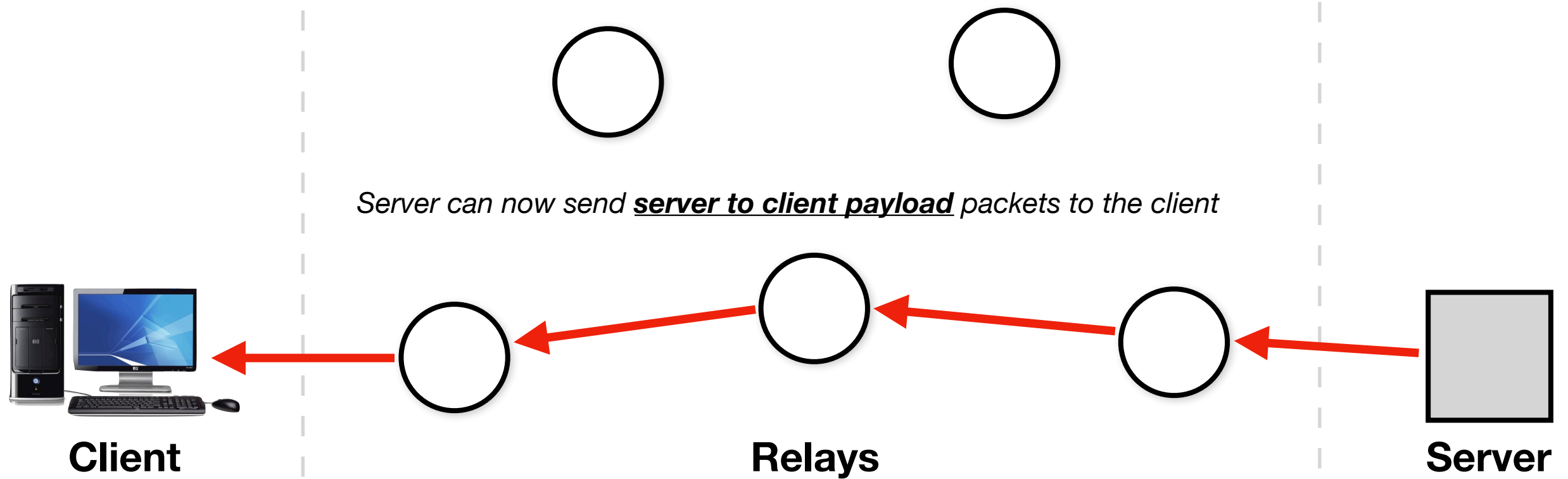
*Client can now send **client to server payload** packets to the server*

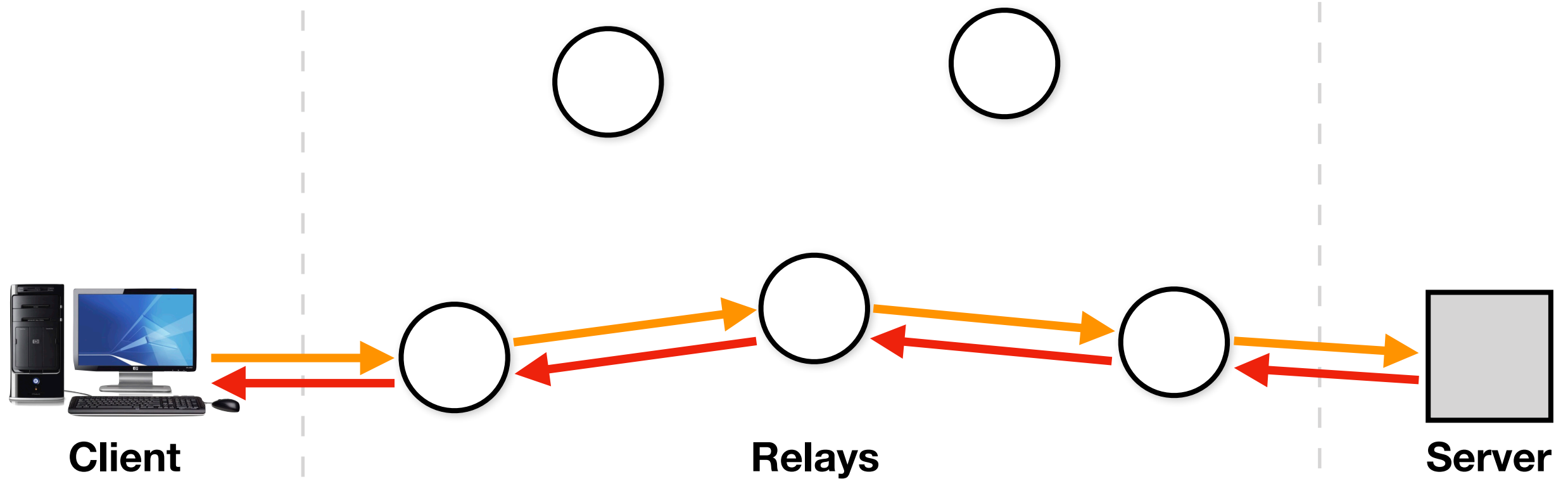


**Server**

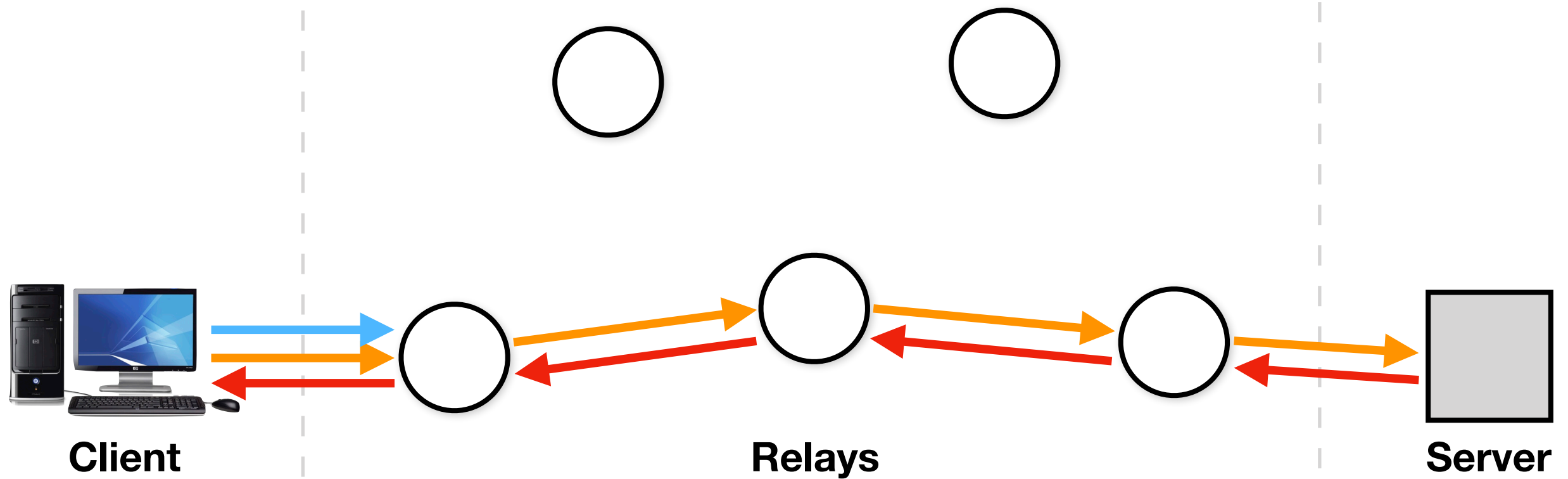
**Relays**



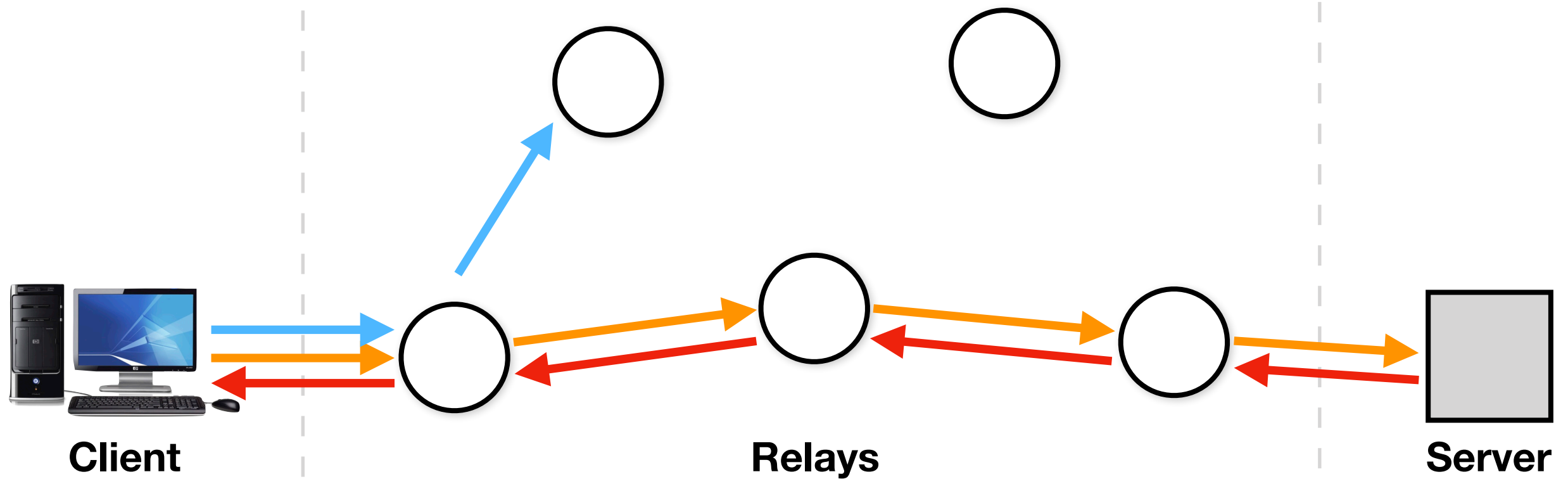




Steady state is a **bidirectional flow** of packets

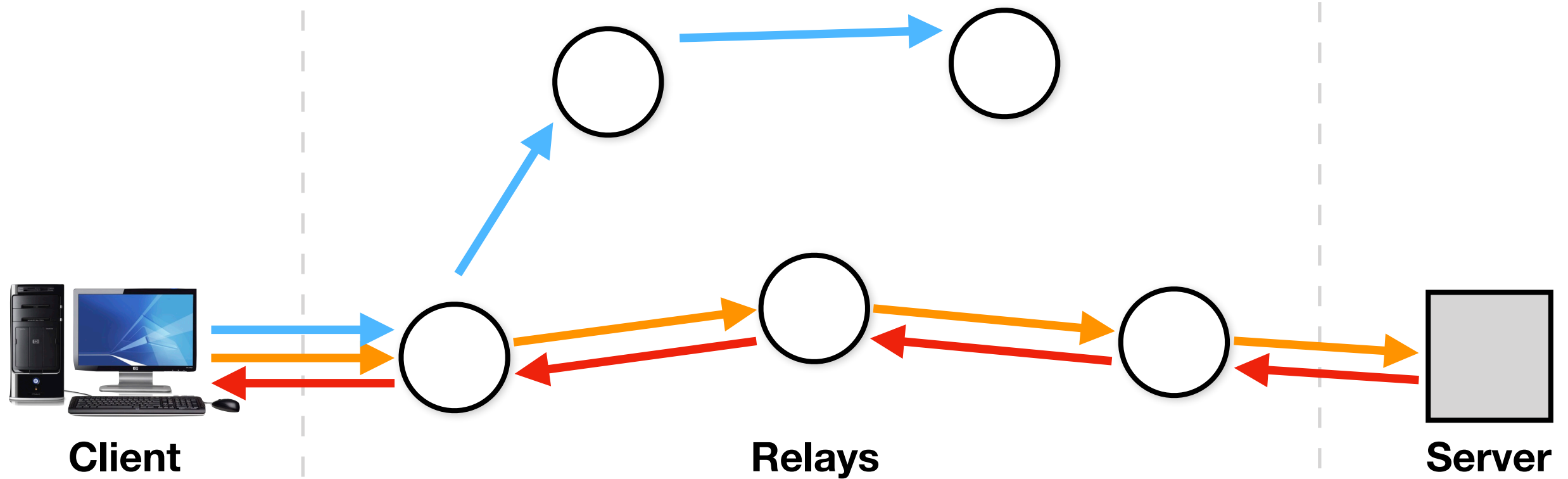


Route can be dynamically updated **without disrupting** the existing flow

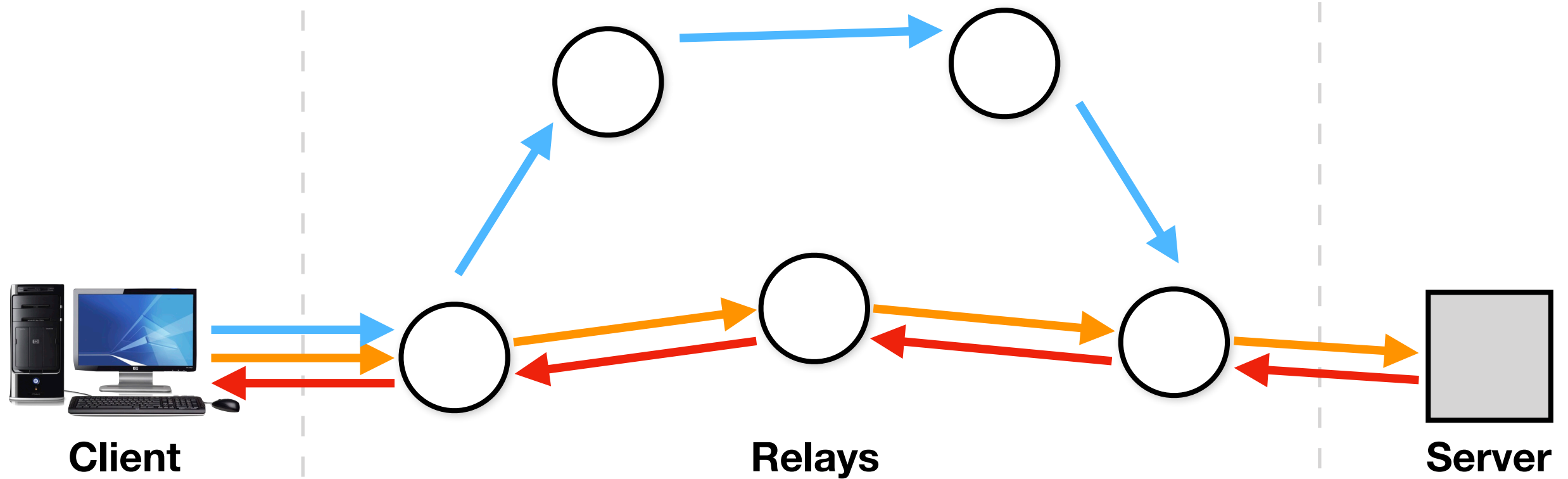


Route can be dynamically updated **without disrupting** the existing flow



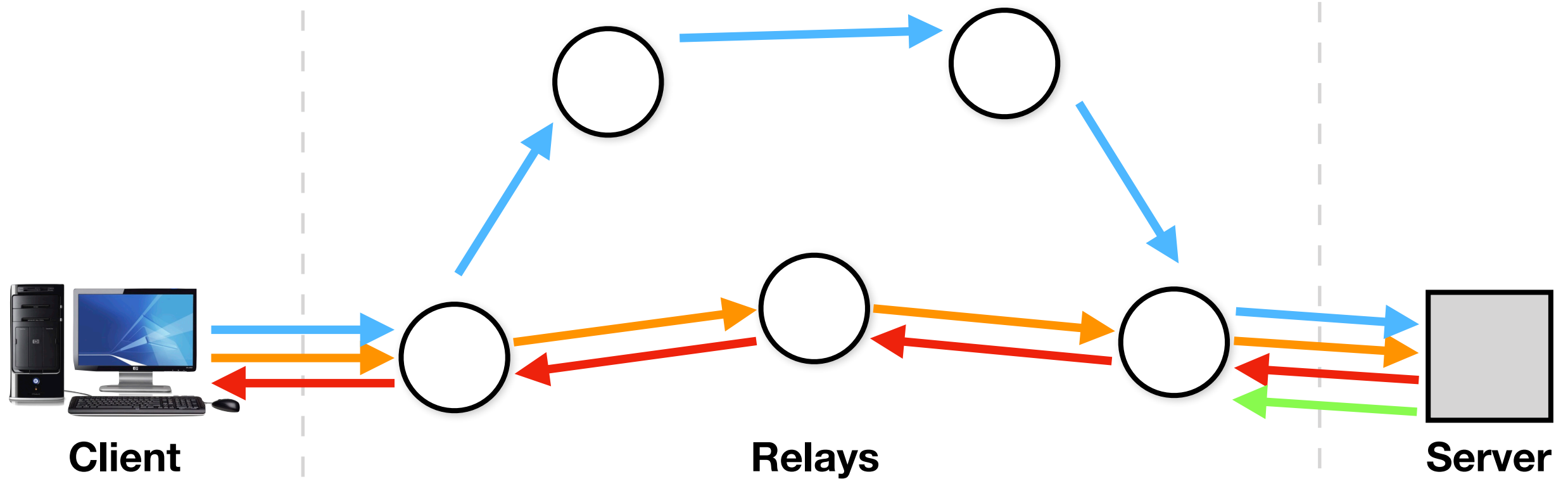


Route can be dynamically updated **without disrupting** the existing flow

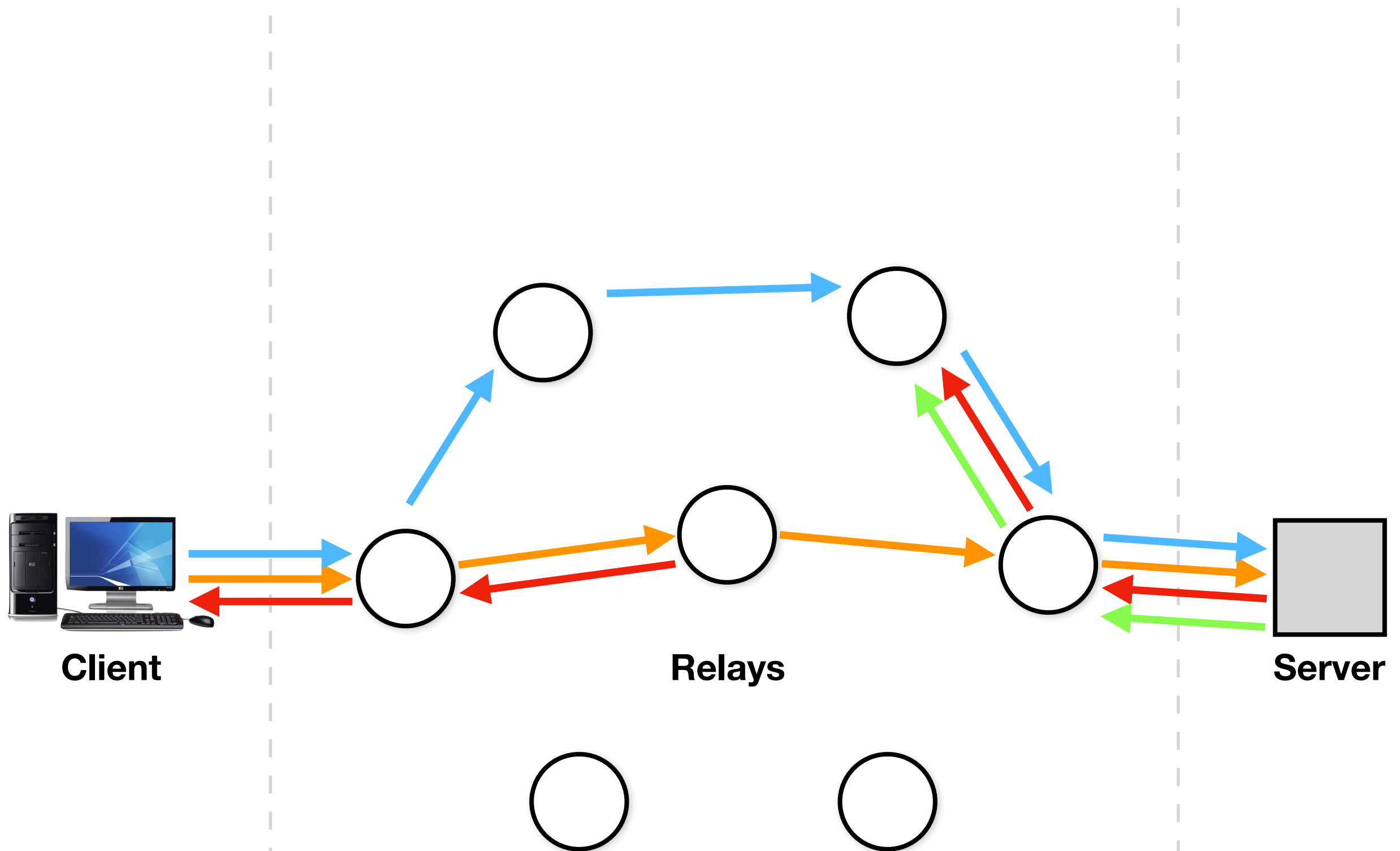


Route can be dynamically updated **without disrupting** the existing flow

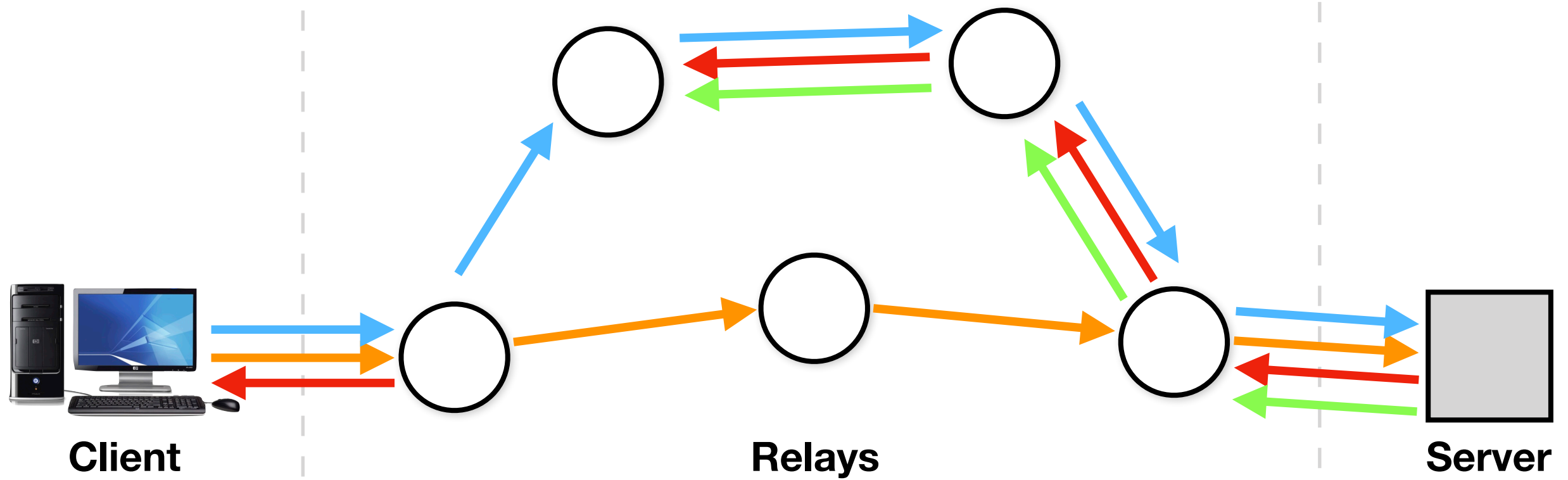




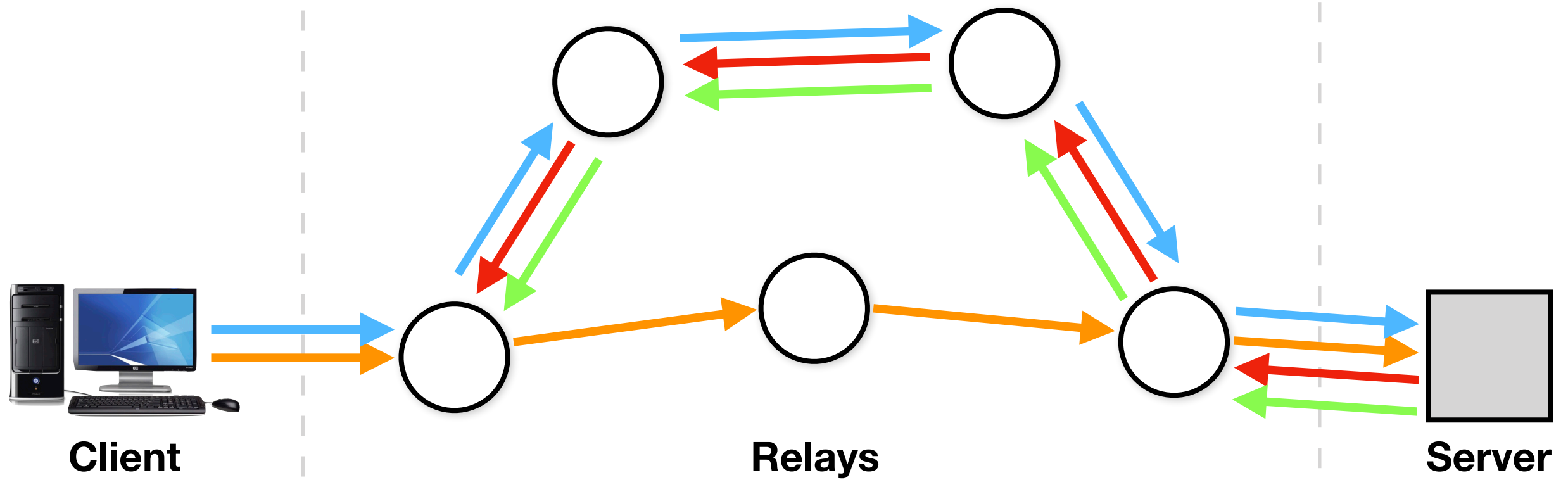
Route can be dynamically updated **without disrupting** the existing flow



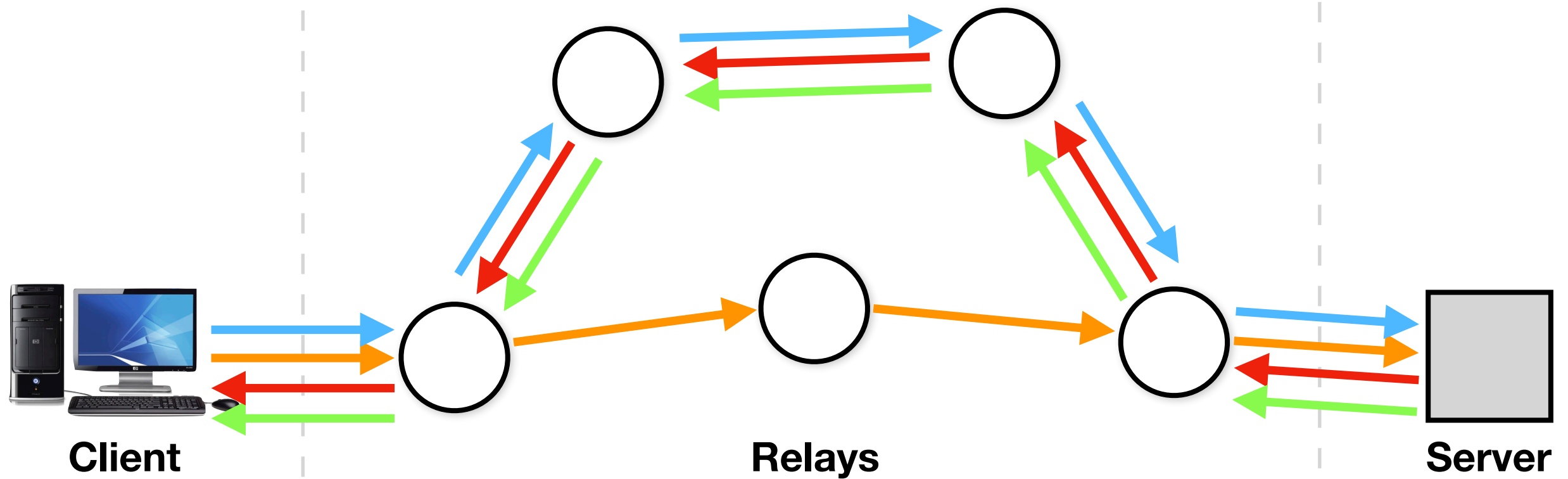
Route can be dynamically updated **without disrupting** the existing flow



Route can be dynamically updated **without disrupting** the existing flow

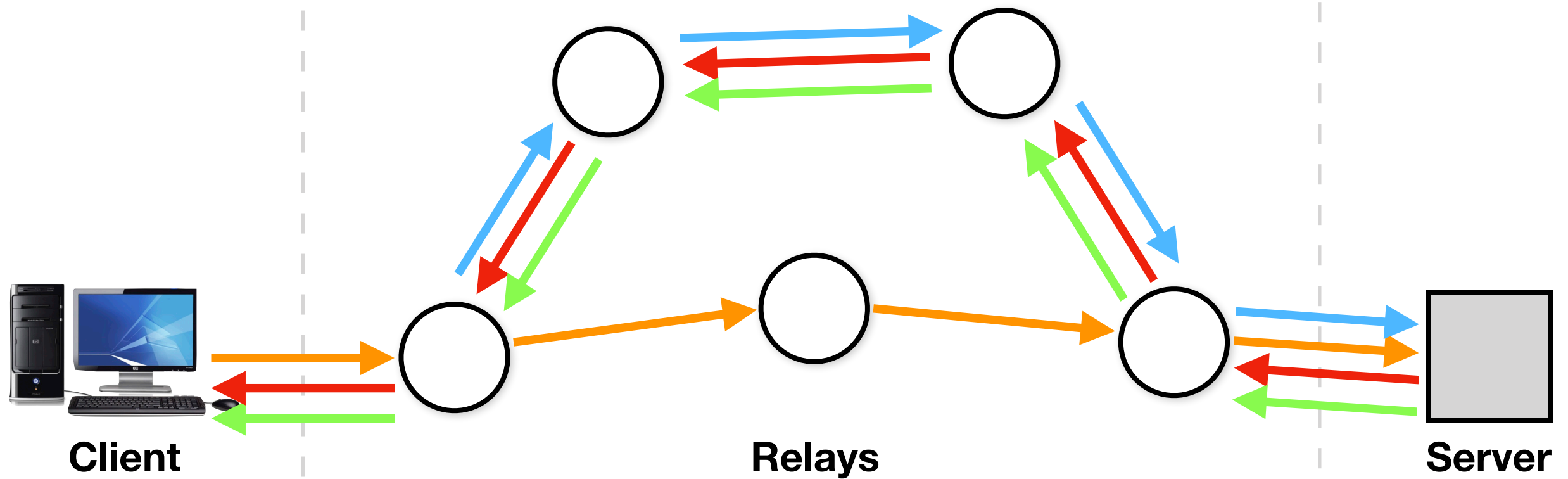


Route can be dynamically updated **without disrupting** the existing flow

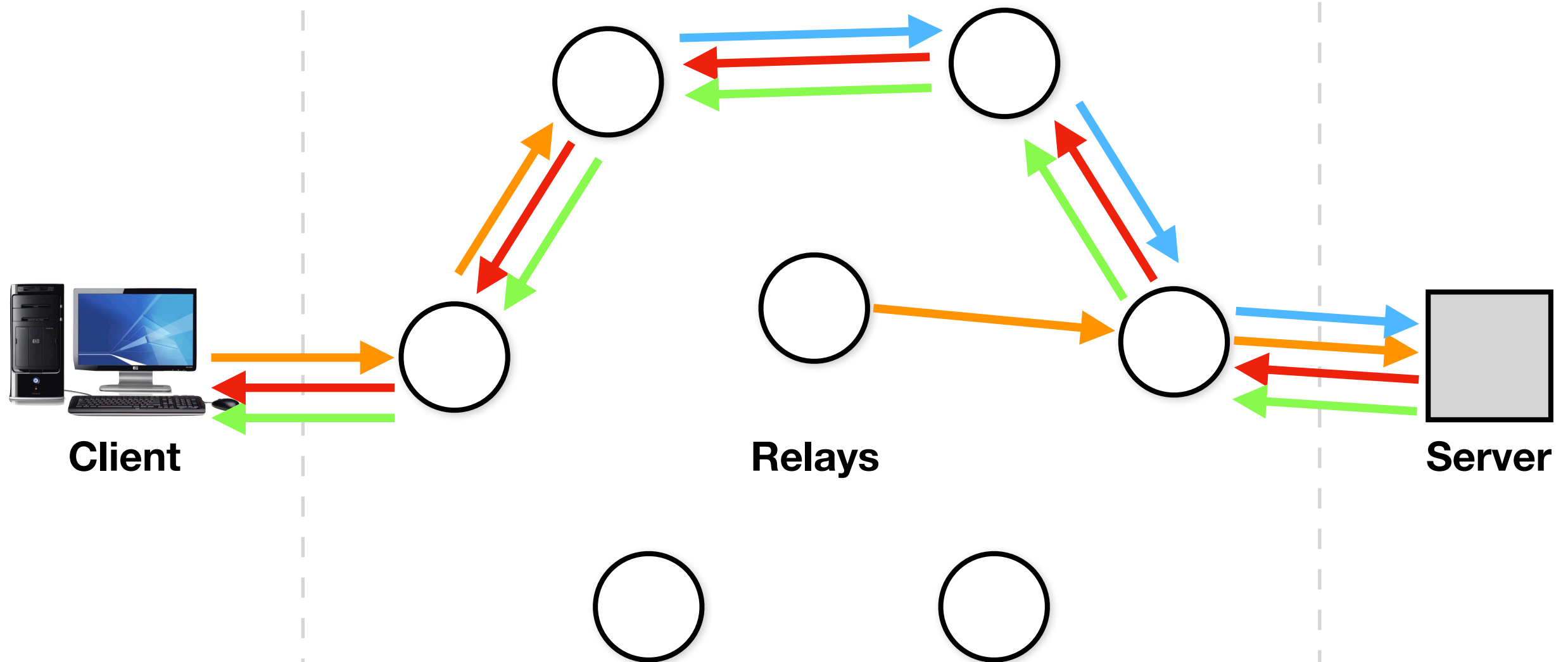


Route can be dynamically updated **without disrupting** the existing flow

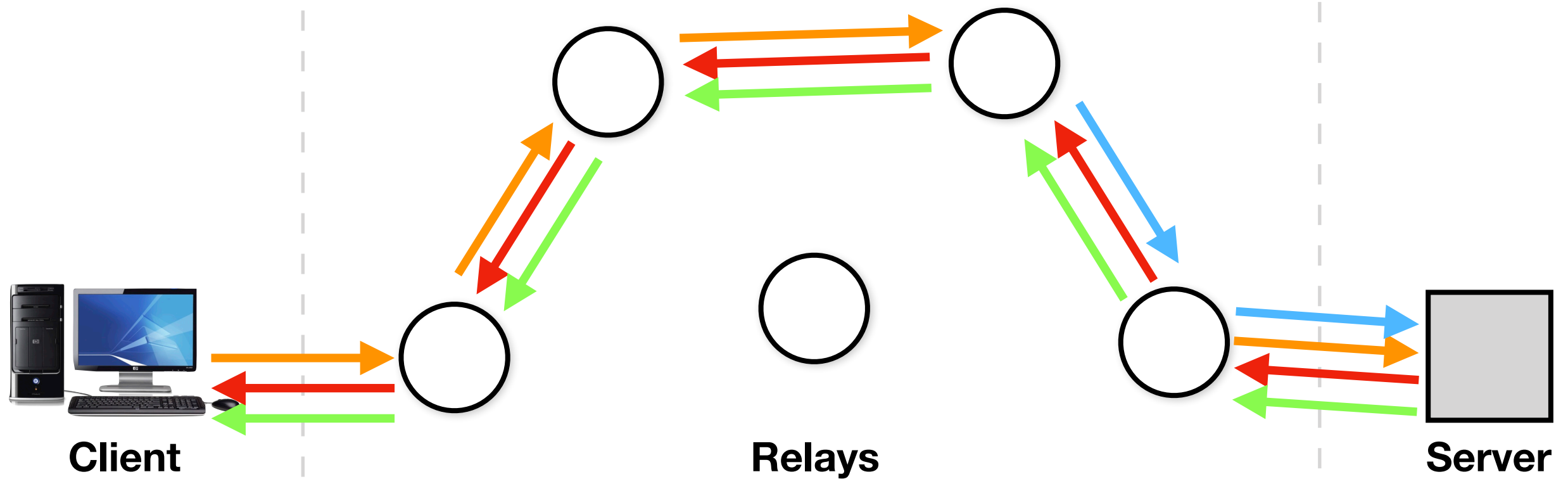




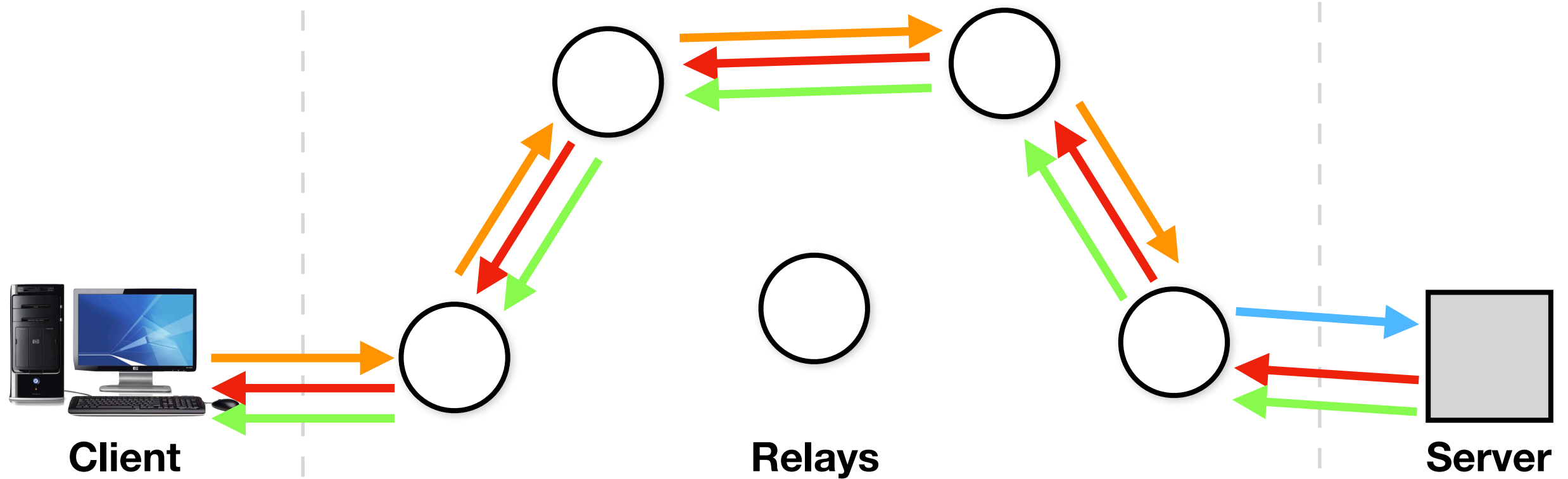
Route can be dynamically updated **without disrupting** the existing flow



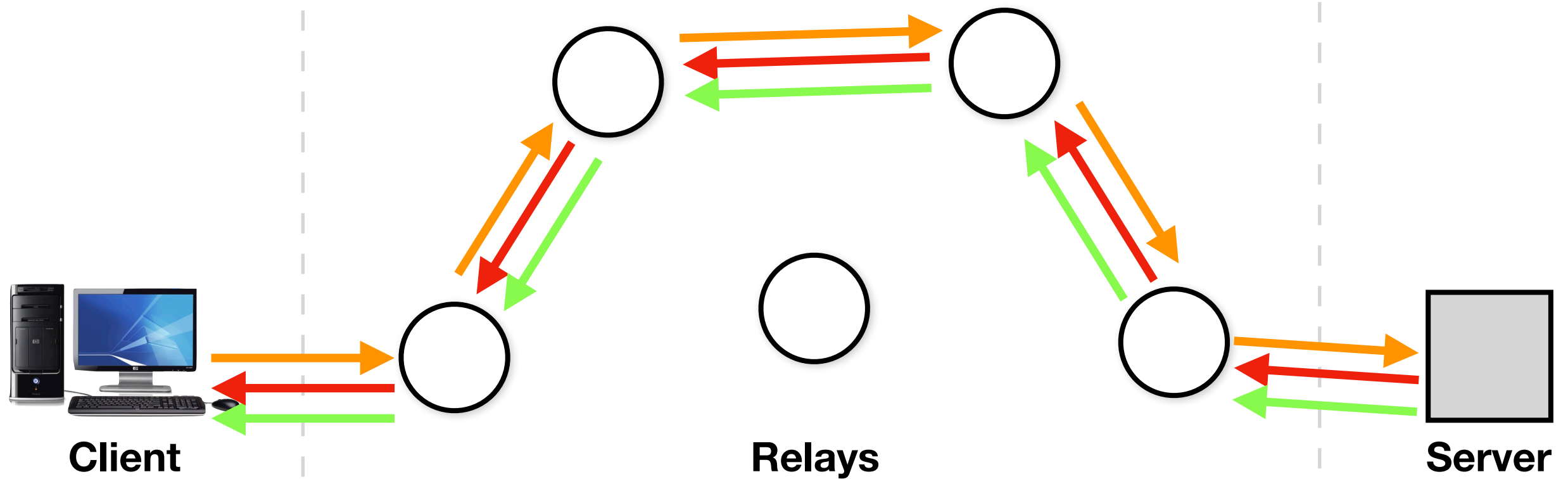
Route can be dynamically updated **without disrupting** the existing flow



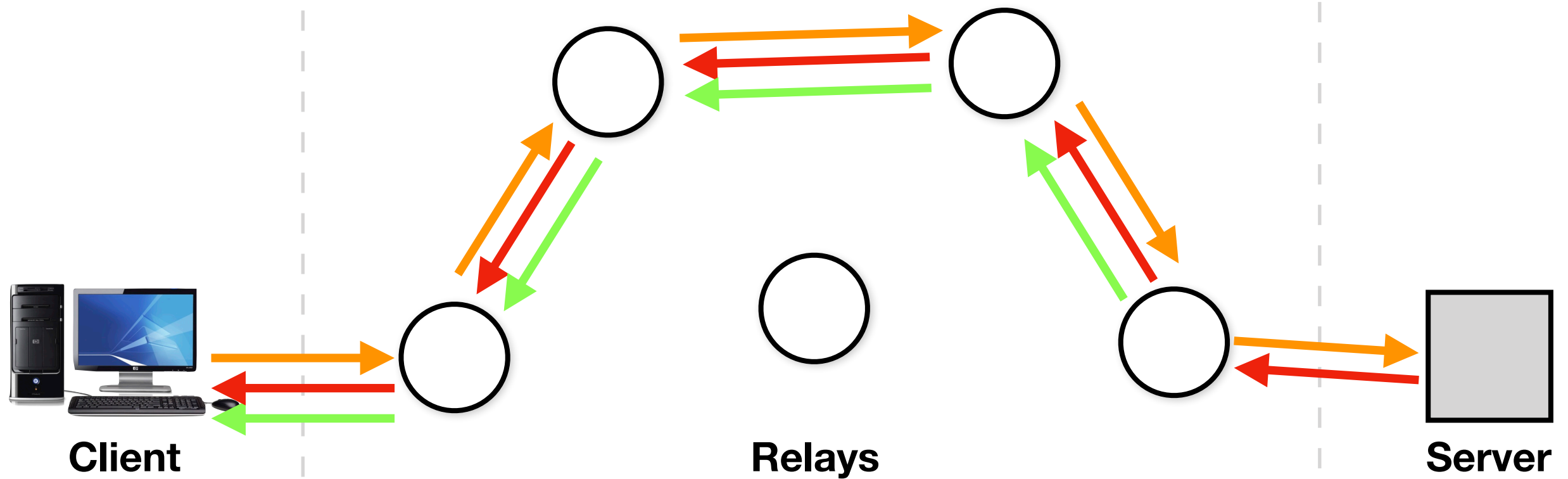
Route can be dynamically updated **without disrupting** the existing flow



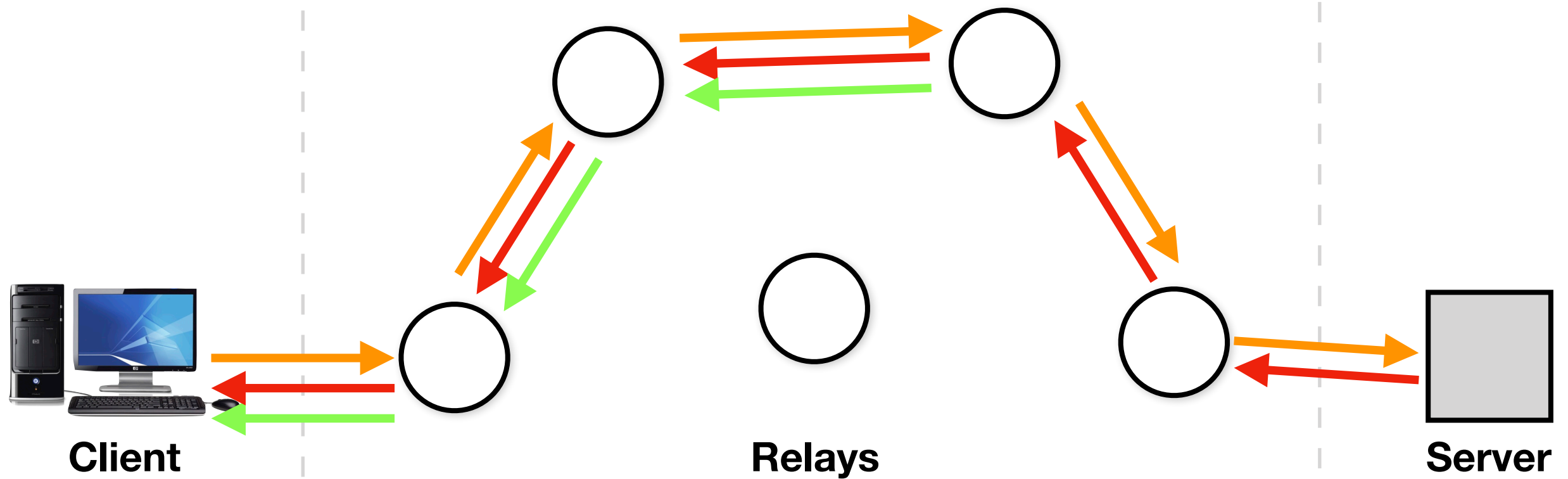
Route can be dynamically updated **without disrupting** the existing flow



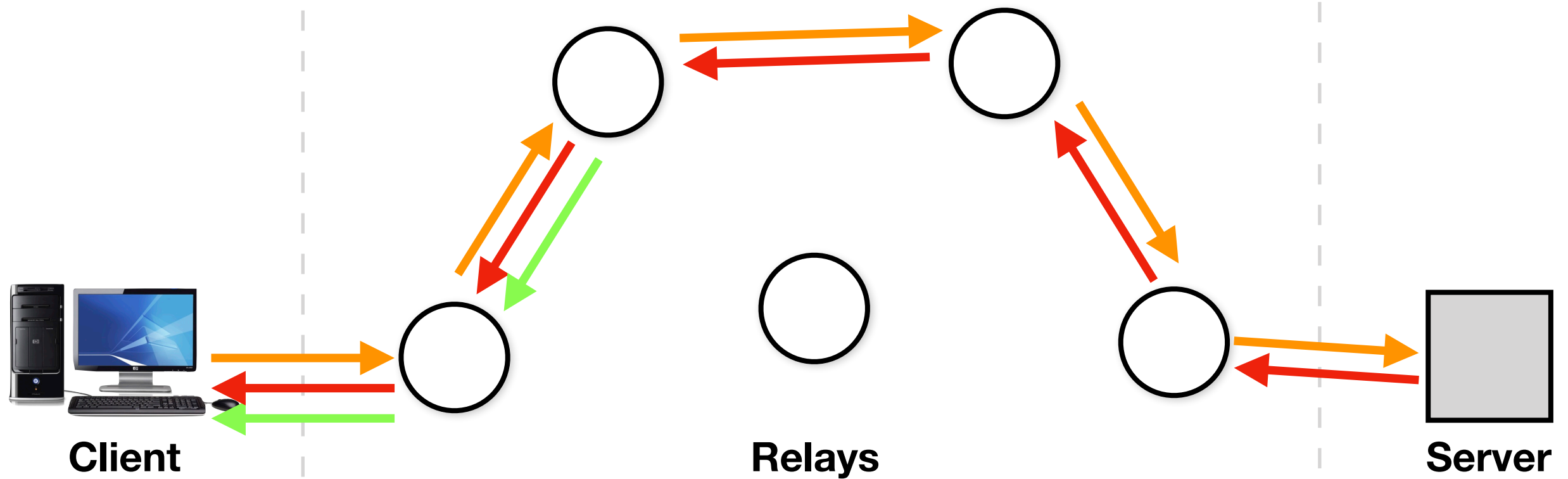
Route can be dynamically updated **without disrupting** the existing flow



Route can be dynamically updated **without disrupting** the existing flow

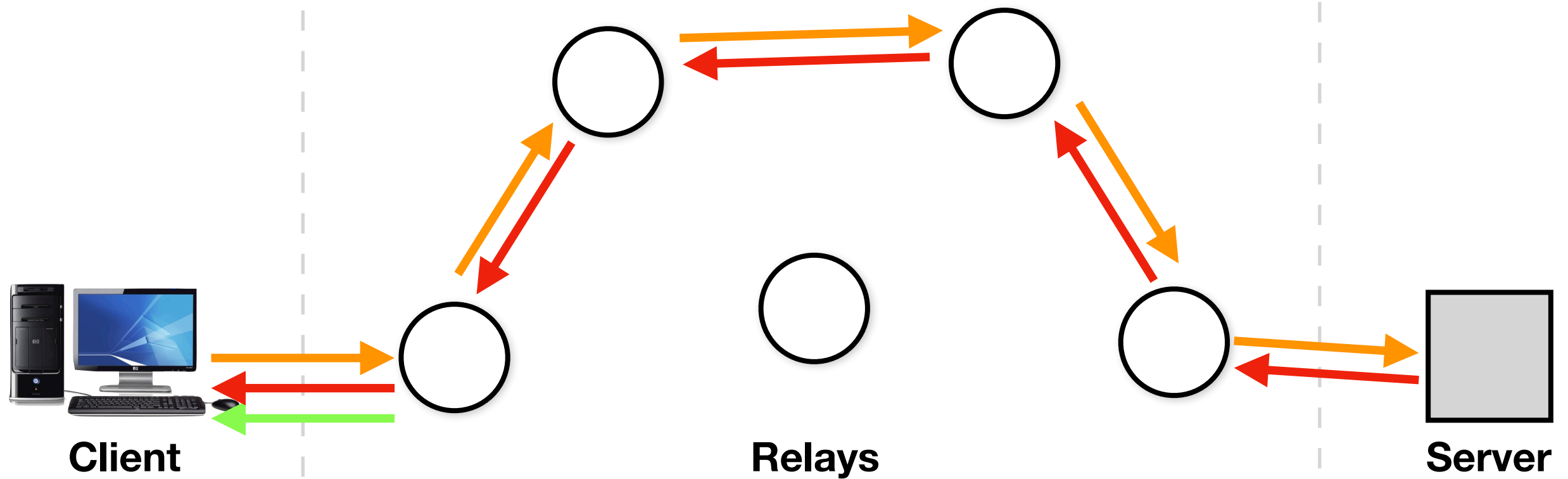


Route can be dynamically updated **without disrupting** the existing flow

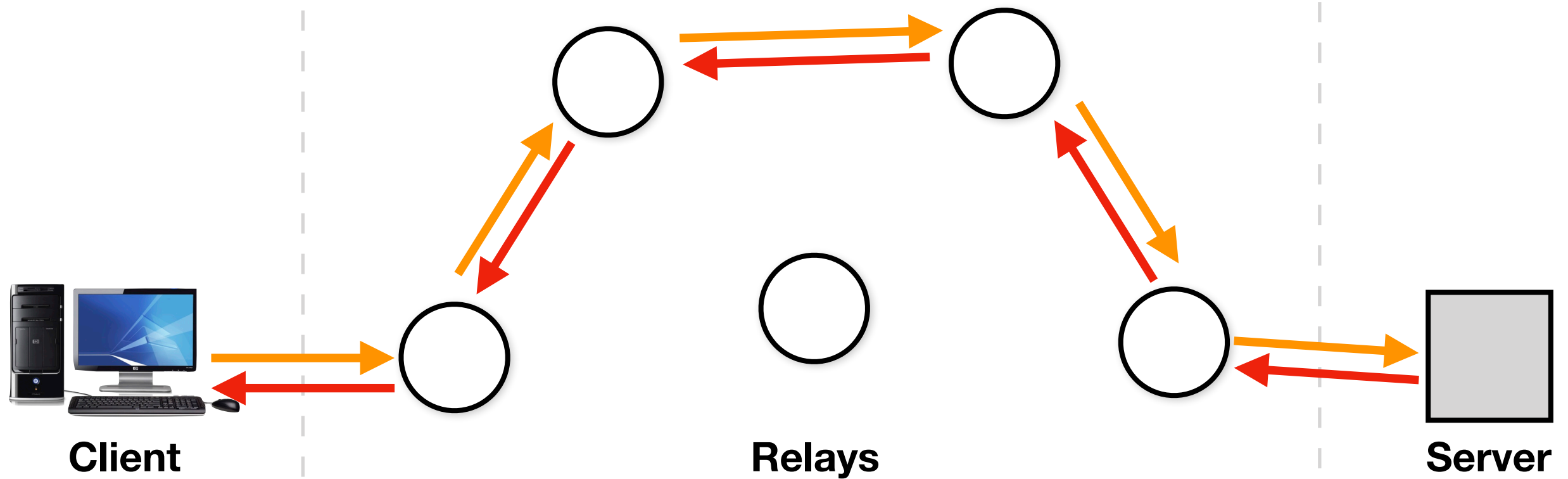


Route can be dynamically updated **without disrupting** the existing flow





Route can be dynamically updated **without disrupting** the existing flow



*Flow route is updated*